GASCOYNE COAST BIOREGION

ABOUT THE BIOREGION

The marine environment of the Gascoyne Coast Bioregion (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.

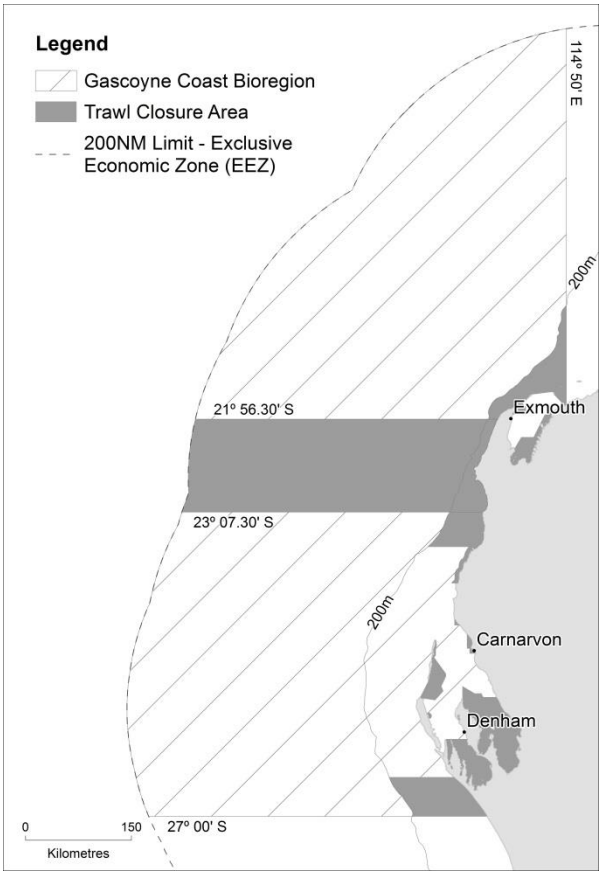
The coastline is characterised by high cliffs in the southern half changing to fringing coral reefs in the north. Coastal waters are generally high-energy in terms of wave action due to the strong trade wind system. The Exmouth Gulf section of the Gascoyne Coast Bioregion is seasonally influenced by 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 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 and areas closed to trawling. The areas permanently closed to trawling are consistent with IUCN marine protected area category IV.

SUMMARY OF ACTIVITIES POTENTIALLY IMPACTING THE BIOREGION

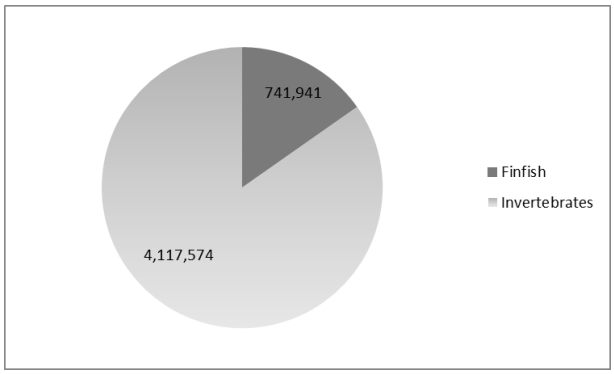
Commercial fishing

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 OVERVIEW FIGURE 2

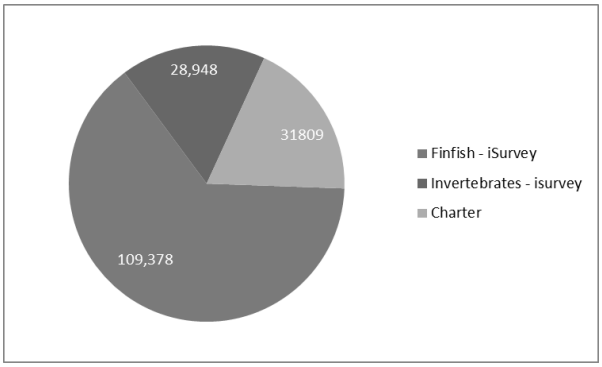
Relative contribution of finfish and invertebrates to the total commercial wild fishery catch originating from the Gascoyne Bioregion. Numbers represent total catch (in kg) based on all major assessed fisheries identified in the Overview section of this report (Gascoyne Overview Table 1).

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, trevallies and other game fish. Some temperate species at the northern end of their ranges, such as (pink) snapper, tailor and whiting, provide significant catches, particularly in Shark Bay.

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 OVERVIEW FIGURE 3

The Gascoyne Bioregion recreational catch as assessed in the integrated survey of boat-based recreational fishing in WA 2011/12, and the charter boat catch for the same 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.

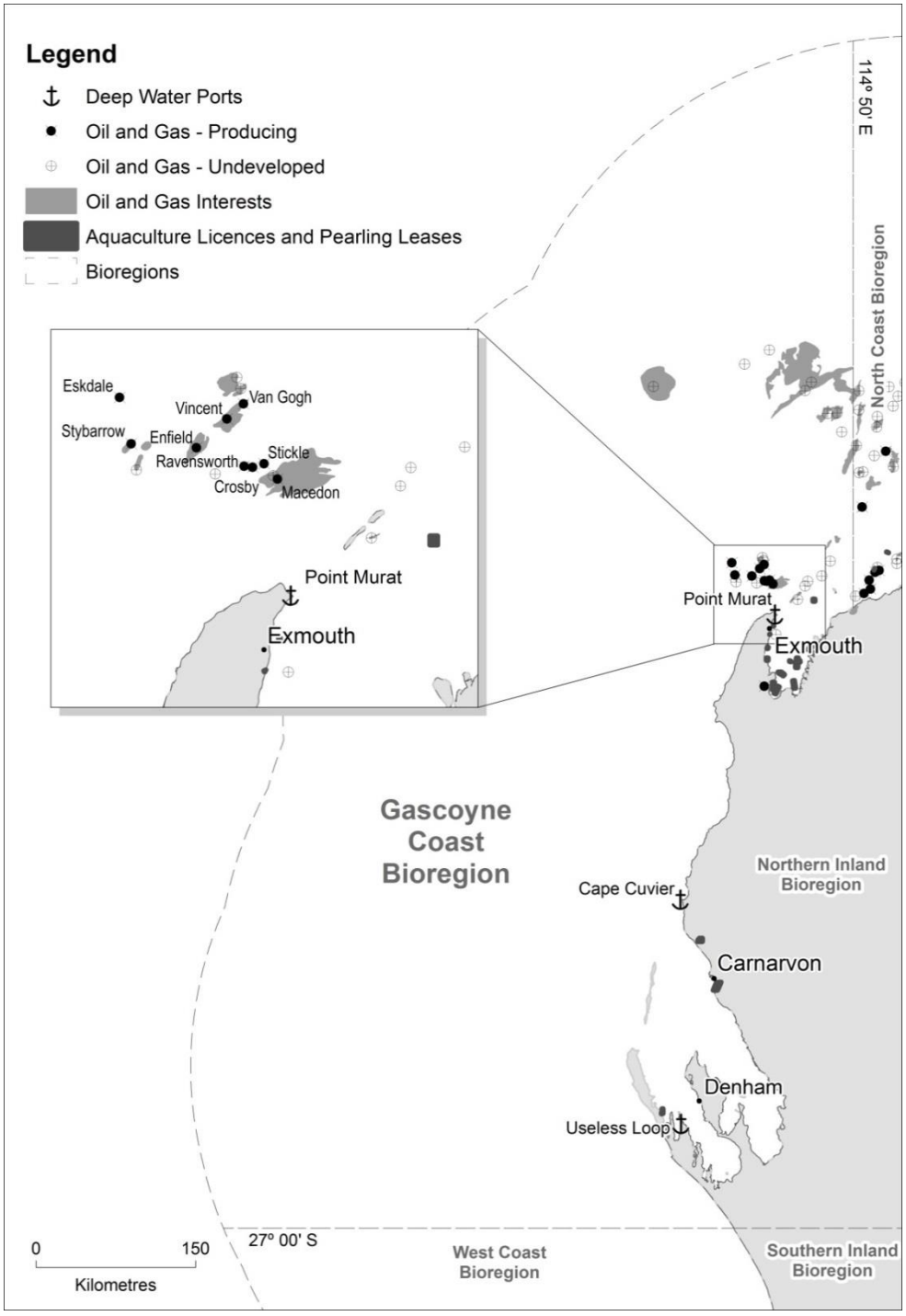
Tourism

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.



GASCOYNE OVERVIEW FIGURE 4

Exmouth Sub-basin offshore oil and gas production sites and Aquaculture Licences and Pearling Leases (Source G DC 2010a).

Shipping and Maritime Activity

There are three deepwater port facilities currently operating in the Gascoyne Coast Bioregion: Useless Loop and 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.

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:

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 Ecosystem Management Figure 1). The extent of these areas means that 35% of the entire shelf region (< 200 m) of the Gascoyne Coast Bioregion could be classified as a marine protected area with an IUCN category of IV (as per Dudley, 2008[1]; Gascoyne Ecosystem Management Table 1). The effective area that is not trawled is, however, much greater such that over 90% of the waters less than 200 m depth are not trawled (Gascoyne Ecosystem Management Table 1).

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 Ecosystem Management Figure 2). 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's Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) is also undertaking a process of identifying additional protected areas for Commonwealth waters between Shark Bay and the Northern Territory border. The federal minister for the environment has recently announced the final reserve network proposed for the north-west which spans the Gascoyne and North Coast Bioregions.

Management of Commercial Fisheries

There is a high degree of ecosystem management and protection for the ecological assests 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 protected 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

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

- Monitoring of fishing activities using the Vessel Monitoring System (VMS).

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 state-wide recreational 'fishing from boat' license was also introduced.

A number of recreational fishing surveys have been undertaken in the region, including a recent state-wide 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

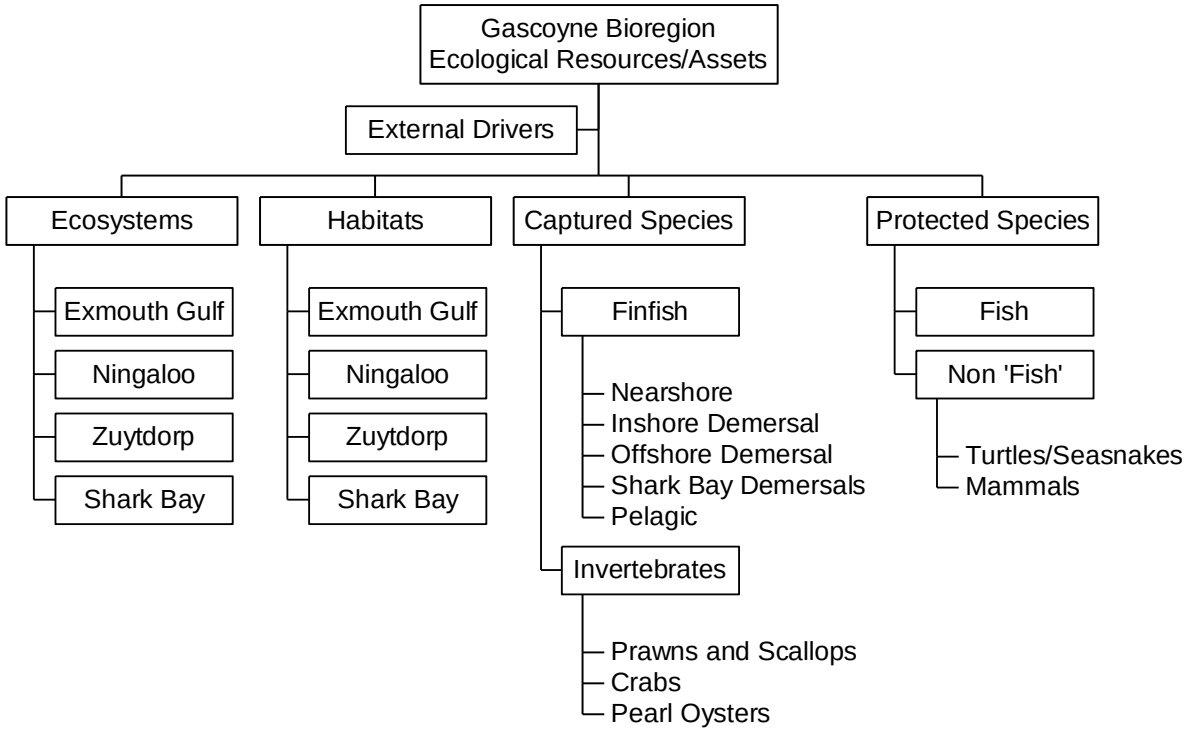
The main focus of the Department of Fisheries in the Gascoyne continues to be on the regulation of the regional pearling industry, including the blacklip oyster *Pinctada margaritifera*, which now complements the major State industry sector built on the silver lip pearl oyster (*Pinctada maxima*). A 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)[1] (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 Figure 3 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 5

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 (MBI). 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 continues 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 is 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 will 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. Ongoing Departmental research includes an assessment of the likelihood of a marine pest being introduced into ports and quantification of the risk associated with recreational vessels for the introduction and translocation of marine pests into this Bioregion. Further detail may be found in the Appendix section entitled "Activities of the Marine Biosecurity Research Unit during 2012/13".

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 state-wide benthic habitats out to the 200 m depth contour are, in practical terms, fully protected and may never have been trawled (Table x). 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 protected 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 Fig. 1).

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 Fig. 1).

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.

GASCOYNE ECOSYSTEM MANAGEMENT TABLE 1

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

Total Area of shelf	Area of shelf equivalent to IUCN marine protected area <= IV	Maximum area of trawl activity	Total area of habitat effectively protected from direct damage
15,800 sq nm	5,600 sq nm (35%)	1,100sq nm	14,700sq nm (93 %)

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 nm^2) 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 nm^2 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 northwestern 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 a 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 km^2 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 DEC, 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

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.

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 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

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

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

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.

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 (Shaw 2000). 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. DoF 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.

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 km^2 waters contained within the fishery boundary, 1100 km^2 is closed to trawling but a further 900 km^2 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

Protected Species

A variety of endangered, threatened and protected[1] (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

Protected Species	Risk
Fish	LOW

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

Non-Fish

Protected Species	Ecological Risk
Turtles/seasnakes	LOW
Mammals	LOW

While protected 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 protected species list does not automatically indicate that a species is either threatened or endangered.

FISHERIES

Shark Bay Prawn and Scallop Managed Fisheries Status Report

E. Sporer, M. Kangas S. Brown and L. Pickles

Main Features

Status		Current Landings	
Stock level		King Prawns	1075 t
Prawn	Adequate	Tiger Prawns	494 t
Scallop	Inadequate (non-fishing)	Endeavour Prawns	23 t
Fishing level		Scallops	Nil
Prawn	Acceptable		
Scallop	Acceptable		

Fishery Description

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

The Shark Bay Scallop Managed Fishery catches the saucer scallop (*Amusium balloti*), and is usually WA's most productive scallop fishery. These two managed fisheries are limited entry and both use low opening, otter trawls as the fishing method and incorporate 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 entitled to retain scallops.

Governing legislation/fishing authority

Shark Bay Prawn Management Plan 1993

Shark Bay Prawn Managed Fishery Licence

Shark Bay Scallop Management Plan 1994

Shark Bay Scallop Managed Fishery Licence

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

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 General Meetings are convened by the West Australian Fishing Industry Council

Boundaries

The boundaries of the Shark Bay Prawn Managed Fishery and the Shark Bay Scallop managed Fishery 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 2012 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 boat units no greater than 375, but the scallop fleet also operates under an exemption from the 375- hull unit rule. The total net headrope capacity for the scallop fleet was 358.4 metres (196 fathoms).

Within the Shark Bay Scallop Managed Fishery in 2011 the Minister adopted a formal catch share management objective for the annual scallop catch between A Class (scallop only) and B Class (scallop and prawn) boats of 70% and 30% respectively.

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 1994 (FRMA) is the overarching legislation for the Shark Bay Prawn Managed Fishery (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 environment impacts of the fishery.

The key strategy for these fisheries is 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 threshold catch rates. The Vessel Monitoring System (VMS) monitors the location of all activities by licensed fishing boats in these fisheries.

The Commonwealth Government's Department of Sustainability Environment Water Populations and Communities (SEWPaC), has assessed the fisheries under the provisions of the EPBC Act 1999 and has accredited these fisheries for a period of five years (re-assessment in 2013), allowing product from the fisheries to be exported from Australia. The comprehensive ESD 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, protected 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 2012 prawn season, the fishing arrangements included an opening date of 14 March and closing date of 23 October, providing a total of 175 nights fishing. During this season the fishing strategy involved flexible arrangements and voluntary rolling area openings, based on assessments of the sizes of king and tiger prawns obtained through fishery-independent surveys. The tiger prawn spawning area (TPSA) was closed on 29 June.

The 2012 scallop season did not open because of environmentally induced low scallop abundance.

Research summary

Research and monitoring activities in the Shark Bay region is separated into two regions - Northern Shark Bay and Denham Sound. Research activities continue to focus on stock assessment and annual monitoring of the target stocks, 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 seasons. 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 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 2012, the moon closures ranged from five to nine days 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. In addition, 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.

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 in ensuring that the prawns are targeted at an optimal market size.

Scallops

The opening date of the scallop fishing season is determined 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 minimum estimated scallop catch availability level for Denham Sound and northern Shark Bay has also been set to determine if commercial fishing can commence each season. Based on the catch prediction from the annual pre-season survey in November 2011 which indicated very low landings would be generated, the fishery remained closed for the 2012 season.

Retained Species

Commercial production (season 2012)

Prawns	**1592 tonnes**
Scallops	**Nil**

Landings

Prawns

The total landings (whole weight) of major prawn species for this fishery was 1592 tonnes, comprising 1075 tonnes of king prawns, 494 tonnes of tiger prawns and 23 tonnes of endeavour prawns (Shark Bay Prawn and Scallop Figure 3). In addition, 200 t of coral prawns (various species, but mainly *Metapenaeopsis crassissima*) were landed. The total landings of major prawn species were within the interim target catch range set in 2009 (1350 – 2150 t) and the historical target catch range (1501 to 2330 t). The interim catch range reflects the change in the expected level king prawn landings (950 to 1350 t) which are being reviewed to reflect current fishing/targeting strategies and effort levels under normal environmental conditions.

King prawn landings (1075 t) were within their interim catch range but slightly below their historical target catch range (1100 to 1600 tonnes). Tiger prawn landings (494 tonnes) were also within the historical target catch range (400-700 tonnes).

Scallops **Nil**

Byproduct

Byproduct landings from the prawn fleet included 12.5 t of blue swimmer crab (*Portunus armatus*), 5.1 t of squid, 22.6 t of cuttlefish, 2.5 t of bugs (*Thenus australiensis* and *T. parindicus*), < 1 t of octopus and 3 t mixed finfish species.

The blue swimmer crabs total season landings by the prawn boats were low as retention of crabs was voluntarily ceased in April due to low stock abundance of crabs in Shark Bay (see Gascoyne Coast Blue Swimmer Crab report for more details).

Fishing effort/access level

Eighteen prawn boats operated in 2012. 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 2012 adjusted effort being 33,198 hours (twin-gear equivalent). This adjusted effort is 8% lower than 2011 and the lowest seen since 1967 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 reduced effort. The 2012 prawn season arrangements provided 175 nights fishing, however, a maximum of 162 nights were fished, and only by some boats. Ten boats ceased fishing at the August moon closure (27 August to 5 September) for a total of 126 nights, with one additional boat ceasing fishing in late September with the remaining 7 boats fishing 16 of the 23 days left available to fish in that period.

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 is 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.

Catch rate assessment

The overall king prawn catch rate of 32.4 kg/hr (for adjusted effort equivalent to twin gear units) in 2012 was lower than in 2011 (36.2 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 14.9 kg/hr was also lower than 2011 but again higher that the previous 10 years mean catch rate (11.3 kg/hr). These catch rates show that the fishing fleet is fishing efficiently.

Survey assessment and breeding stock levels

For 2012, the king and tiger prawn mean survey catch rates (index) during the combined recruitment surveys (March and April) were 64.6 kg/hr and 43.7 kg/hr respectively and the catch predictions for king and tiger prawns were 950 t (760 to 1140 tonnes) and 485 t (390 to 580 tonnes) respectively. The actual landed catches of both species were within 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). For 2012, the daily catch rate in the TPSA was difficult to assess due to the sporadic fishing effort by boats in this area once the CPL was opened. Two standard spawning stock surveys were undertaken around the third moon phase in July and August 2012 and the catch rates for tiger prawns were 6.6 kg/hr in July and 5.9 kg/hr in August with a mean catch rate of 6.2 kg/hr, well below the target level. The mean catch rate was also below the proposed limit level.

Analysis of the spatial catch and catch rates of tiger prawns in 2012 using daily logbooks showed that most of the tiger prawn stock was caught well south of the TPSA in 2012 and only a very low abundance was present in the TPSA. Therefore the survey catch rates within this area during 2012 may not have been fully indicative of the overall spawning stock level. The effect of this apparent low level of spawning stock within the TPSA on recruitment for the 2013 season (as measured by the survey in March-April 2013) was closely monitored and found to have generated an acceptable level.

If the migration pattern in 2013 results in a similar low spatial distribution of tiger prawns within the TPSA this would suggest that the use of the TPSA closure may no longer be the appropriate strategy for the protection of spawning stock. Such an outcome would generate the need to review he strategy including identifying additional or different areas in order to protect a sufficient proportion of the tiger prawn spawning stock.

The king prawn catch rates during the spawning stock survey were 20.5 kg/hr and 12.9 kg/hr respectively with a mean catch rate of 16.7 kg/hr, which is within the historical range for this species (16-29 kg/hr). 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 minimal.

Projected prawn catch range next season (2013):

King prawns 700-1050 tonnes

Tiger prawns 400-600 tonnes

The main performance measures for the prawn fishery relate to maintenance of breeding stocks for each of the major target prawn species. In 2012, the breeding stock indicator for tiger prawns was well below the target level of 25 kg/hr. However, the 2013 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 2012. Examination of the 2012 logbook data for the spatial distribution and abundance of tiger prawn spawning stock indicates the stock was concentrated well south of the TPSA. This shift in their distribution pattern may have been related to the previous year's flood and heatwave events. The king and tiger prawn annual landings were within the historical 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 seasons recruits.

The 2012 catch predictions included was 42 t meat weight for northern Shark Bay and 11 t for Denham Sound. These low overall catch predictions for the fishery meant that all the available stock needed to remain as spawning stock and the fishery remained closed. This low recruitment appears due to the extreme environmental conditions in late 2010/early 2011 in Shark Bay due to the very strong La Niña, strong Leeuwin Current and higher than average sea water temperatures.

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 2012 season to allow all scallops to contribute to the spawning stock.

Projected scallop catch next season (2013):

Nil tonnes (whole weight)

The catch projection for the 2013 season was based on the 2012 annual survey results. In northern Shark Bay, observed recruitment was very low. The catch prediction for this area was 20 t meat weight but this was predominantly comprised of recruits with few residual scallops. In Denham Sound, both recruitment and residual levels were low and provided a low overall index giving a predicted catch of 10 t meat weight. Therefore the catch prediction for the fishery was at very low levels such that all the available stock should again remain for spawning with no scallops to be taken. These two consecutive years of low recruitment also means that the spawning stock in 2013 will be well below average. 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.

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 n 2012.

Protected species interaction: **Low**

Although protected 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 protected 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.

One performance measure for the fishery is for 90% of turtles from non-BRD nets to be returned alive. These fisheries have BRDs (grids) in all nets so this performance measure is no longer valid. For the 2012 season 6 turtles were recorded as caught in nets in the prawn fishery and were recorded as being returned to the sea alive. With improved reporting of protected species interactions, 431 seasnakes were reported as caught with 90% returned to the sea alive, 9 syngnathids and 1 dolphin were reported with status unknown.

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 nm^2 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 nm^2 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 2012 the performance measure was met as the total area trawled within inner Shark Bay by the prawn fleet was approximately 746 square nautical miles or 16% of inner Shark Bay.

Social Effects

These industries are a major contributor to regional employment. During 2012, approximately 100 skippers and other crew were employed in the prawn fishery. There are also approximately 100 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 2012:

Prawns **Level 5 - > $20 million ($20.9 million)**

Scallops **Level 0 - Nil**

The value of the fishery including crabs, coral prawns, scallops, squid and bugs to the prawn fleet is $21.12 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	$12.60/kg
Tiger prawns	$13.40/kg
Coral prawns	$3.50/kg
Scallops	$0.00/kg
Crabs	$5.50/kg

Fishery Governance

Target catch range:

Prawns (Historical range) **1501 – 2330 tonnes**

Prawns (New interim 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 which has resulted in a shift in effort shift 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. Because of the change to the king prawn catch range, aninterim overall range has been calculated as 1350 -2150 tonnes. This interim range will be reviewed over the next three years (2012 to 2015) 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 excludes 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 2013 (150 t) whole weight, based on a pre-season survey, is below the target catch range and the fishery remains closed.

New management initiatives (2013)

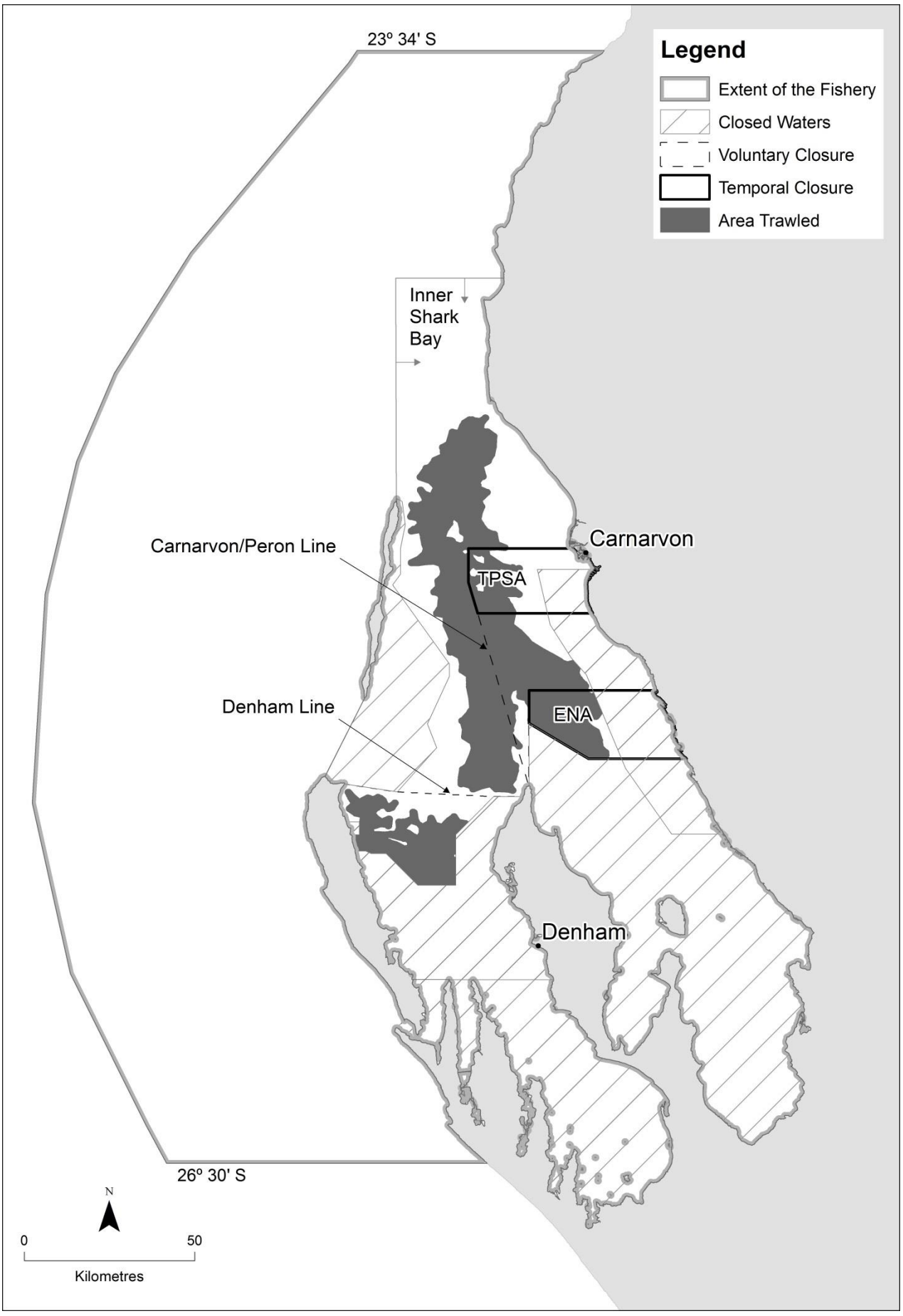
Pre-assessment phase for the Marine Stewardship Council approval system has been initiated for these two fisheries.

External Factors

Increasing costs of fishing and lower returns due to the global economic climate and competition from imported and locally aquaculture 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 lead the prawn industry maximise the return from all species taken in the fishery where possible particularly scallops and blue swimmer crabs.

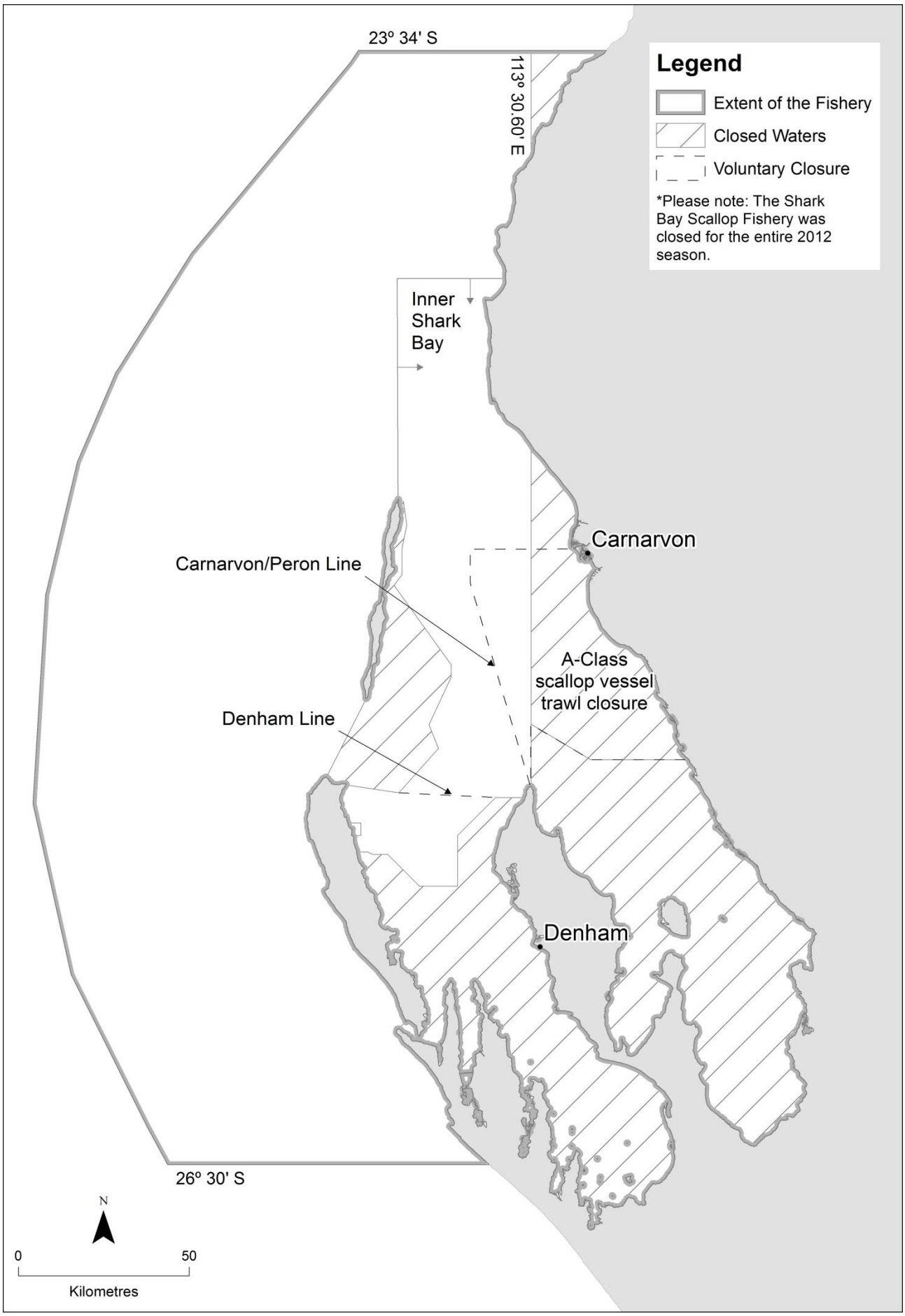
The major environmental factor influencing these stocks appears to be the flow of the Leeuwin Current along the outside of the embayment. A relationship between current strength (as measured by Fremantle sea level) and king prawn catches has been identified and may be used to indicate broad catch trends. The theory is that 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 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.



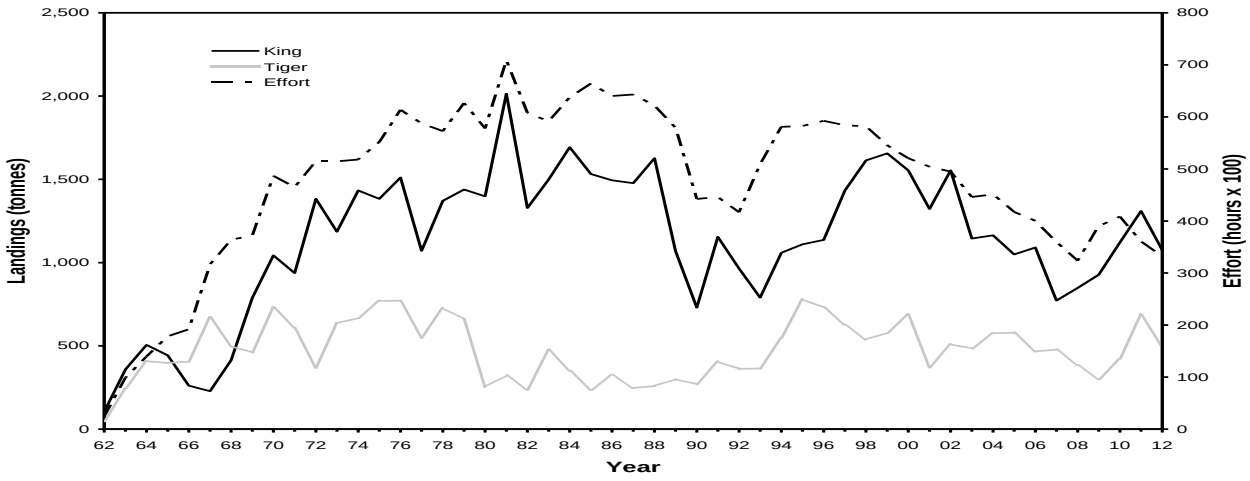
SHARK BAY PRAWN AND SCALLOP FIGURE 1

The main boundaries of the Shark Bay Prawn Fishery, Inner Shark Bay, TPSA, ENA, trawl closures, permitted trawl area (extends out to the 200m isobath) and area trawled in 2012.



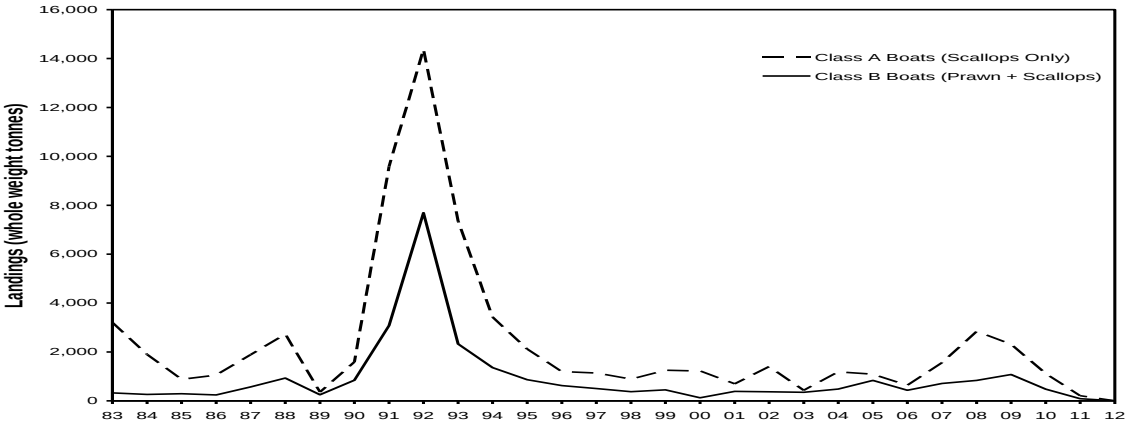
SHARK BAY PRAWN AND SCALLOP FIGURE 2

The main boundaries of the Shark Bay Scallop 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 twin gear units) 1962 – 2012.



SHARK BAY PRAWN AND SCALLOP FIGURE 4

Shark Bay Scallop Managed Fishery annual landings 1983 – 2012.

Exmouth Gulf Prawn Managed Fishery Status Report

E. Sporer, M. Kangas, S. Brown

Main Features

Status		Current prawn Landings	
Stock level	Adequate	Tiger	46 t
		Kings	157 t
Fishing level	Acceptable	Endeavours	51 t
		Banana	33 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 merguiensis*).

Governing legislation/fishing authority

Exmouth Gulf Prawn 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. 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. For statutory management plan processes, the Director General consults with licensees.

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 2012, 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.

The primary control on the fishery effort is through the maximum headrope units in the fishery and the duration of the season. The maximum headrope allocation for the fleet is set at 394.8 m (or 216 fathoms of headrope), which is a 10% reduction of the original headrope when 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 is continuing with the aim of maximizing economic efficiency, whilst maintaining overall catches in this fishery as well as stock sustainability.

For the 2012 season the boat numbers were reduced from 9 to 6 and all the boats were fitted with freezer storage capacity for processing at sea. Prior to 2012 all the boats were wet boats and landed retained product ashore for processing at the Learmonth processing factory.

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 2012 season, official opening and closing dates were set at 2 April and 28 November respectively, providing a maximum of 200 nights (allowing five nights closure each full moon) for fishing. The season actually commenced on 11 June, based on results from pre-season surveys and it closed at 0800 hrs on 28 October. Although the season commenced later than normal (usually April or May) there were also some spatio-temporal closures in June and July to avoid fishing on small size prawns prior to the closure of the key tiger prawn spawning area to maximise the value of the limited tiger prawn stock available in 2012.

Stringent measures are in place to ensure that spawning stock levels for tiger prawns are maintained at adequate levels and that 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, with a review of the conditions, of its BRD-compliancy, for reducing the potential for turtle captures. Because of the increase in the size of the net headrope and the body of the net to accommodate the reduction of boat numbers the grids actual size and the grid escape opening were also required to be increased in line with the U.S standards. This certification allows licensees to export product to the US market. 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 Sustainability Environment Water Populations and Communities (SEWPaC), assessed the fishery in 2008 as being sustainable under the provisions of the EPBC Act 1999. This has provided the export accreditation for the fishery for a period of five years and re-assessed in 2013. The comprehensive ESD assessment of this fishery identified the only risks that required specific management actions to ensure adequate performance were the breeding stock levels of target prawn species, bycatch species impacts, habitat and provisioning effects. 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 survey of king prawn sizes to assist with harvesting strategies (these are detailed above in the management arrangements). An annual catch prediction for both tiger and king prawns is also provided using an index derived from the recruitment survey data. Monitoring of fishing activity is undertaken in real time and using threshold 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. Pre-season surveys for king prawns have been established since 2002 to provide an index of recruitment into the fishery and as of provide a catch prediction and understanding of prawn movement in this fishery. In 2012 two pre-season recruitment surveys were undertaken and a catch prediction provided for the season.

Retained Species

Commercial production (season 2012):

288 tonnes

Landings

The total landings of major penaeids for the 2012 season were 288 t, comprising 46 t of tiger prawns, 157 t of king prawns, 51 t of endeavour prawns and 33 t of banana prawns. The tiger prawn landings were well below the normal catch range (250-550 t) and the lowest recorded since 1965. The king prawn landings were also well below the target catch range (350-500 t). The king prawn landings remain low, a trend that is consistent with other prawn fisheries in the northern bio-region. Endeavour prawn landings were below the normal catch range of 120-300 t. Banana prawn catches were the highest since 2000.

Recorded landings of byproduct were; 2 t of blue swimmer crab *(Portunus armatus)*, 3 t of squid, <1 t of bugs (*Thenus australiensis*), 12 t of coral prawns and <1 t of octopus.

Recorded landings of blue swimmer crabs were extremely low this season and the lowest since 2002 and below the historical range (8 to 58 t). The low effort and spatial distribution of fishing where crabs are abundant, were reflected in the low catches. 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). The larger minimum size was introduced on a voluntary basis into this fishery in 2007. Because of the low trawl effort this season all retained recorded annual landings of by product was the lowest recorded since 2002 (recorded byproduct).

Fishing effort/access level

In 2012 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 of the six boats cannot tow the larger 14.63 m nets.

Total nominal effort for the 2012 season was 7042 hours. The adjusted effort (to twin gear) was 12,592 hours, which is 39% lower than last year and the lowest since 1967. Fishing effort (in adjusted hours) in 2012 was extremely low but at the expected level because of the low prawn abundance. Generally the effort on king prawns is targeted at the latter part of the season when their abundance peaks during August and September. Fishing effort normally continues into November, however, because of low catch rates of king prawns this year fishing ceased on 28 October with 117 days actually fished.

Stock Assessment

Assessment complete: **Yes**

Assessment level and method:

Level 4 - Direct survey/catch rate

Breeding stock levels: **Adequate**

Projected catch next season (2013):

210 (170-250) tonnes tiger prawns

315 (250-380) 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 may need to be reviewed in the future and adjusted for the fishing harvesting strategy, if required. The tiger and king prawns stocks are also assessed each year using standardised recruitment and breeding stock surveys.

Catch assessment

The adjusted catch rate of 3.7 kg/hr for tiger prawn is below the reference catch rate of 10 kg/hr. This significant decline in the annual landings has not been previously observed since the early 1980's except after cyclone Vance when severe environmental conditions destroyed inshore habitats that caused the decline in the landings. The higher than normal water temperature spike in 2010/11 may have caused a decline in inshore structured habitat causing recruitment failure for the tiger prawn and possibly the endeavour prawns as this species is also associated with the same type of juvenile habitat. In addition, the low effort in those areas where endeavour prawns are primarily found (due to low abundance of tiger prawns) also contributed to poor landings. Fishing ceased according to the target catch rate level for tiger prawns.

The adjusted catch rate of 12.5 per kg/hr, for king prawns is slightly above the reference catch rate level of 11.7 kg/hr. The king prawn total landings were below the acceptable catch range and there is some concern for the king prawn stock, however, fishing effort does not appear to be the cause of the decline in annual landings at current effort levels. Fishery-independent surveys are undertaken to measure the recruitment strength and logbook spatial and catch and effort information is used during the spawning phase to review the stock status and to understand the distribution of king prawns in the gulf.

The season commenced on 11 June, which was later than previous seasons and king prawns were fished conservatively because fishing in the northern area (key king prawn fishing grounds) was limited. In the early part of the season total effort was reduced because of the later opening date and areas of small prawns were closed to fishing to ensure that size and quality were maintained. Overall, fishing ceased in 2012 because of 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 a very low abundance and predicted tiger prawn catch range for 2012 was 140 to 210 tonnes. For the 2012 season the annual total landings were below the prediction range which is probably due to the very low effort. 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).

During 2012, tiger prawn catch rates were monitored during July and the central Tiger Prawn Spawning Area (TPSA) and Eastern Area closed on 21 July. For the 2012 season it was difficult 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 a number of boat breakdowns. The low number of boats in the fishery now does not provide a full coverage of all the fishing areas with only hot spots primarily being fished. When boats shift effort between areas, monitoring tiger prawn catch rates on a daily basis is difficult. For this reason a survey was undertaken on 19 July to obtain tiger prawn catch rate information in the spawning area. As a result the southern part of tiger prawn area was closed to fishing on 21 July because the tiger prawn catch rates were below the target level. The northern part of the tiger prawn area remained open so that boats could fish the available banana prawns in the northern area. The risk of leaving this part of the fishery open until the mandatory cease fishing date of 2 August to the tiger prawn stock was considered low to negligible because catch rates of tiger prawns were highest inside the closed area and with low tiger prawn catch rates in the northern part precluding any targeting of tiger prawns.

Three standardised tiger prawn breeding stock surveys are carried out from August to October each year. The 2012 survey results showed an average quad gear CPUE of 10.7 kg/hr and 23.9 kg/hr in the spawning areas (Q1 and Q2 respectively). The August, September and October Q1 area surveys showed a quad gear CPUE of 12.0 kg/hr, 11.4 kg/hr and 8.8 kg/hr respectively. The spawning stock survey extends to the central Gulf (Q2 area) and the mean spawning indices for the three surveys were slightly below the target level of 25 kg/hr at 23.9 kg/hr. The overall mean (combined Q1 and Q2) spawning stock catch rate was 17.3 kg/hr, below the target level but above the limit (15 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 catch abundance information. The time series for king prawns is limited and 2012 is the first season for a catch prediction to be provided. The April pre-season survey provided a catch prediction of 190 t with a range between 150 and 225 t. The annual landing of 157 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 tiger prawn spawning stock catch rate of 17.3 above this limit. Stocks of king prawns are monitored using catch levels which were below the target catch range, however, there is a conservative harvesting strategy in place for this species and the annual landings were within the catch prediction. 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 2012 was the 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 and implementation of BRDs in the fleet. Both actions have reduced the rate of discards relative to the pre-BRD period.

Protected species interaction: **Low**

While protected 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 reporting of interaction with protected species by fishers. Six turtles (5 green and 1 unidentified) were reported as captured in nets and returned to the sea alive. Seventy sea snakes (unidentified) were reported as captured and reported as returned to the sea alive. Three sawfish were reported as captured but their status was unknown and no syngnathids were 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.

Performance measures for habitat impact relate to the spatial extent of trawling within the licensed area of the Exmouth Gulf fishery. In 2012 the performance measure was met as the total area trawled, at approximately 273 square nautical miles (24%) per cent of Exmouth Gulf, was below the 40% level.

Social Effects

The estimated employment in the fishery for the year 2012 was 18 including skippers and other crew. Additional support staff are also based in Exmouth Gulf and Fremantle. 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 2012: Level 2 - $1 - 5 million

($3.2 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 ($3.2 million). This reflects an extremely low return from the fishery a decline of approximately $8 million compared with the 2011 fishing season. Estimated prices for prawns were as follows:

King prawns	$12.00/kg
Tiger prawns	$12.50/kg
Banana prawns	$ 9.50/kg
Endeavour prawns	$6.00/kg
Coral prawns	$3.00/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 288 t is well 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 were well below the target catch range, however, the low catch prediction (140-210 t) indicated that the season landings could be below the target range and as such the low landings were not unexpected when you take into account the low effort because the target level triggered the cessation of fishing on tiger prawns. The king prawn survey catch rates were indicating low abundance, however, the annual landings (157 t) were within the predicted range (150 to 225 tonnes).

New management initiatives (2013)

The Department is still progressing a management plan amendment in consultation with the licensee to incorporate changes to gear arrangements in this fishery. The fishery will be undergoing Marine Stewardship Council pre-assessment during mid-2013.

External Factors

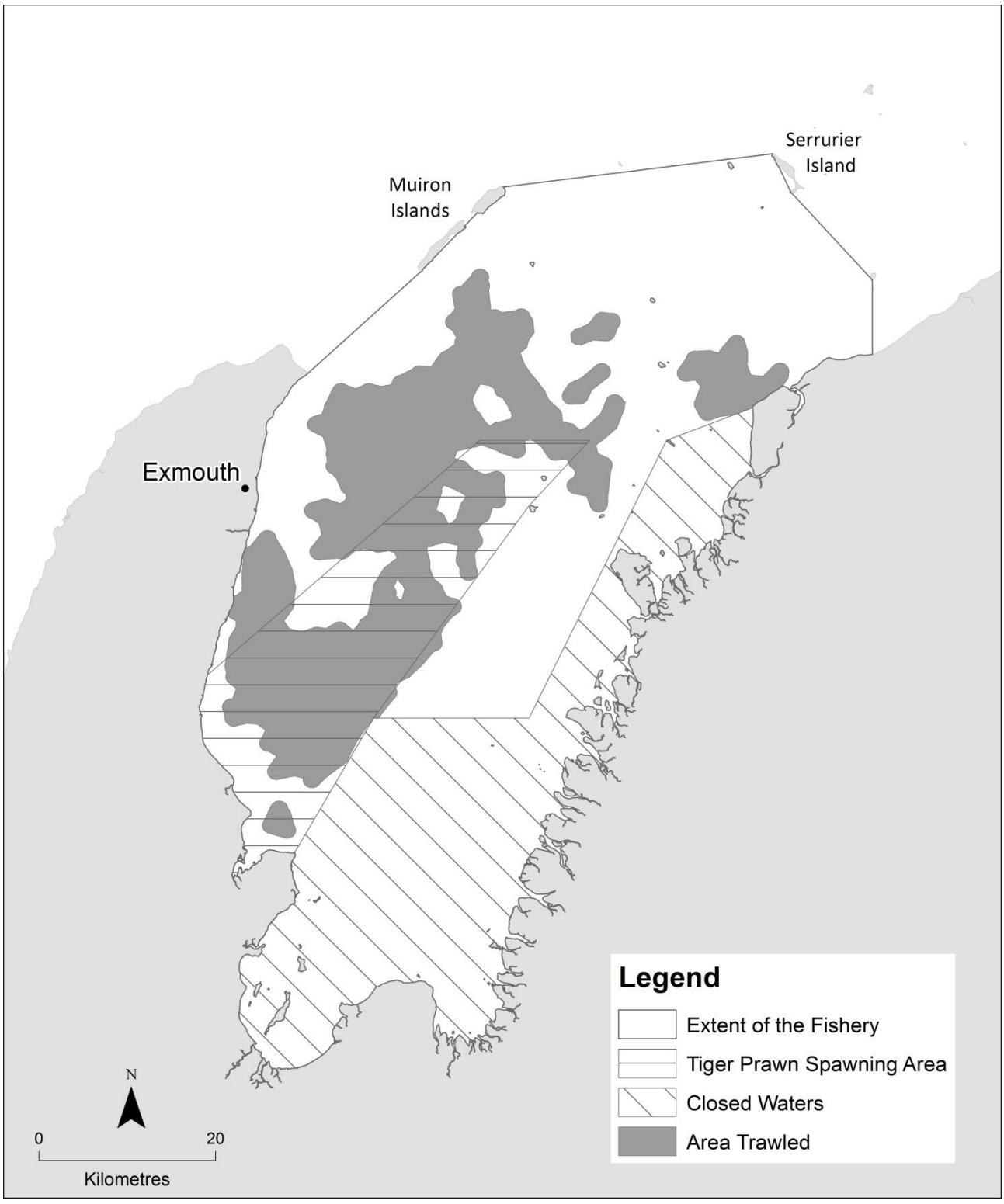
Increasing costs of fishing and lower returns due to the global economic climate, high value of the Australian dollar and competition from imported and Australian aquacultured small prawns, has focussed fishing harvesting strategies about targeting larger prawns during efficient catch rate periods and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

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.

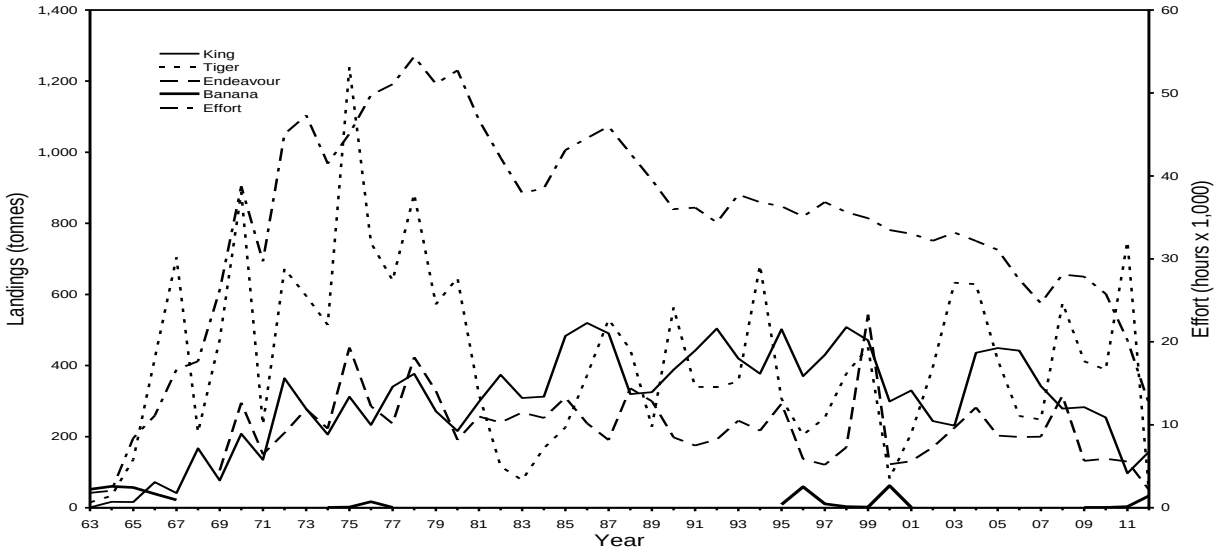
The hypotheses under investigation are that:

- The 2010/11 warmer summer temperatures may have been beneficial for recruitment in 2011.
- The warmer summer temperatures (which also occurred in the summer of 2012/13) may have had a direct negative effect on the spawning (timing/success) or transport/survival of larvae in the spring of 2011 leading to poor recruitment in 2012. This may be a short-term (1 year) effect as the spawning stock is not significantly affected.
- The warmer temperatures may have led to the loss of structured habitat (seagrass and/or algae) in the nursery areas that may have contributed to the poor recruitment. This may be a long-term (3-4 year) effect based on previous experience with loss of structured habitat.
- There was some other undetected perturbation in the region.



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 2012.



EXMOUTH GULF PRAWN FIGURE 2

Exmouth Gulf Prawn Managed Fishery annual landings and adjusted effort (twin-gear), 1963 – 2012.

West Coast[1] Deep Sea Crustacean Managed Fishery Status Report

J. How and K. Nardi

Main Features

Status		Current Landings	
Stock level	Adequate	Crystal Crabs	139 t
Fishing Level	Acceptable	Giant Crabs	0.8 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.

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 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 were 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.

Current research has focused on obtaining greater information on commercial catch through industry based sampling (FRDC TRF project, PI R. Melville-Smith), and remote video. Both projects are aimed at gaining a better understanding of the catches, particularly undersize and berried females which are currently only estimates by fishers recorded through the volunteer logbook program.

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

Retained Species

Commercial landings (season 2012):

Crystal crab	**138.7 tonnes**
Giant crab	**0.8 tonnes**
Champagne crab	**0.01 tonnes**

The catch of 138.7 tonnes of Crystal crab in 2012 was similar to all years since the introduction of quota in 2008 (Deep Sea Crab Figure 1). There was a very small catch of Champagne crab (13 kg) taken in 2012, compared to between 5-6 t in the previous three seasons which is likely due to low market demand. Minimal Giant crab has been landed since 2010 due to minimal targeted fishing. 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 2012) **Nil**

Fishing effort/access level

Nominal commercial effort decreased by 8 % from an estimated 59,249 pot lifts in the 2011 season to 54,301 pot lifts in the 2012 season. 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.

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 138.7 t, which is within the target catch range (100-140 t). The standardised catch rate of legal crabs increased by 4% in 2012 to 1.96 kg/pot compared with 1.86 kg/pot in 2011 (Deep Sea Crab Figure 2). The 2012 standardised catch rate represents the highest standardised catch rate in a decade (Deep Sea Crab Figure 2), and is well above the current notional threshold reference point with a large degree of certainty.

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. 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).

Non-Retained Species

Bycatch species impact **Low**

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

Protected species interaction **Negligible**

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

Ecosystem Effects

Food chain effects **Negligible**

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 km^2. 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 2012.

Economic Effects

Estimated annual value (to fishers) for 2012

Level 2 - $1 - 5 million ($2.8 million)

The beach value of the fishery was about $2.8 million in 2012 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**

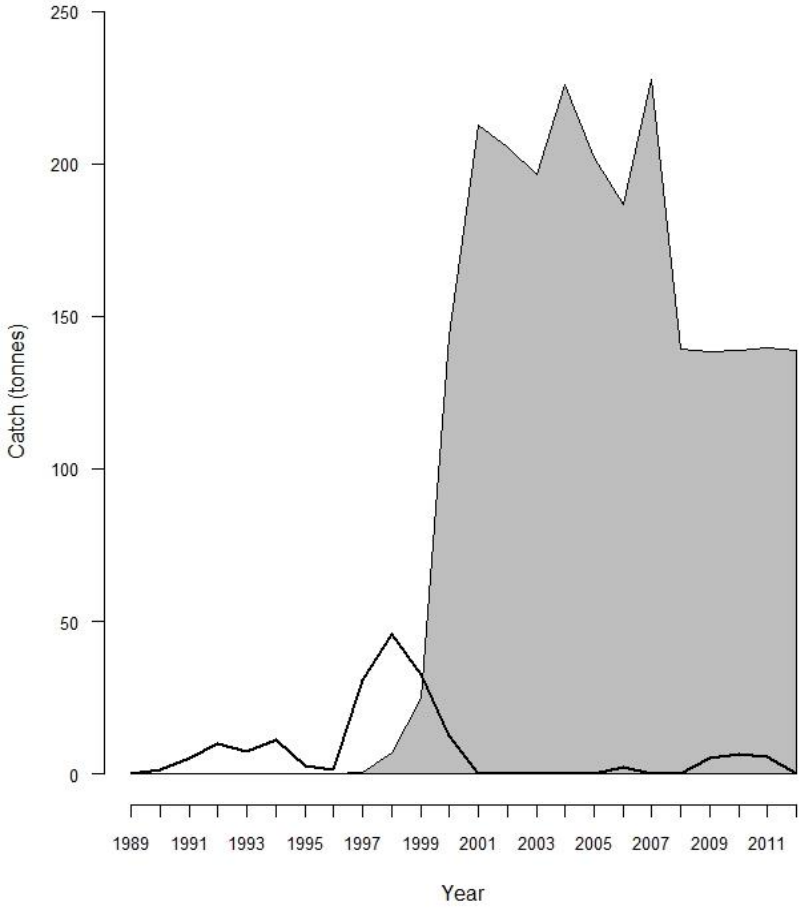
The TAC for the fishery has been set well below landings of which occurred in the early and mid 2000's and is at the lower end of the target catch range for the WTO assessments. A preliminary effort range to achieve the TAC had been generated as 70,000–100,000 pot lifts but with the current nominal effort (2009-12) of 76,370- 54,230 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 for 2013

There are no new management initiatives planned for 2013 noting the new management plan for the fishery was introduced on 1 January 2013.

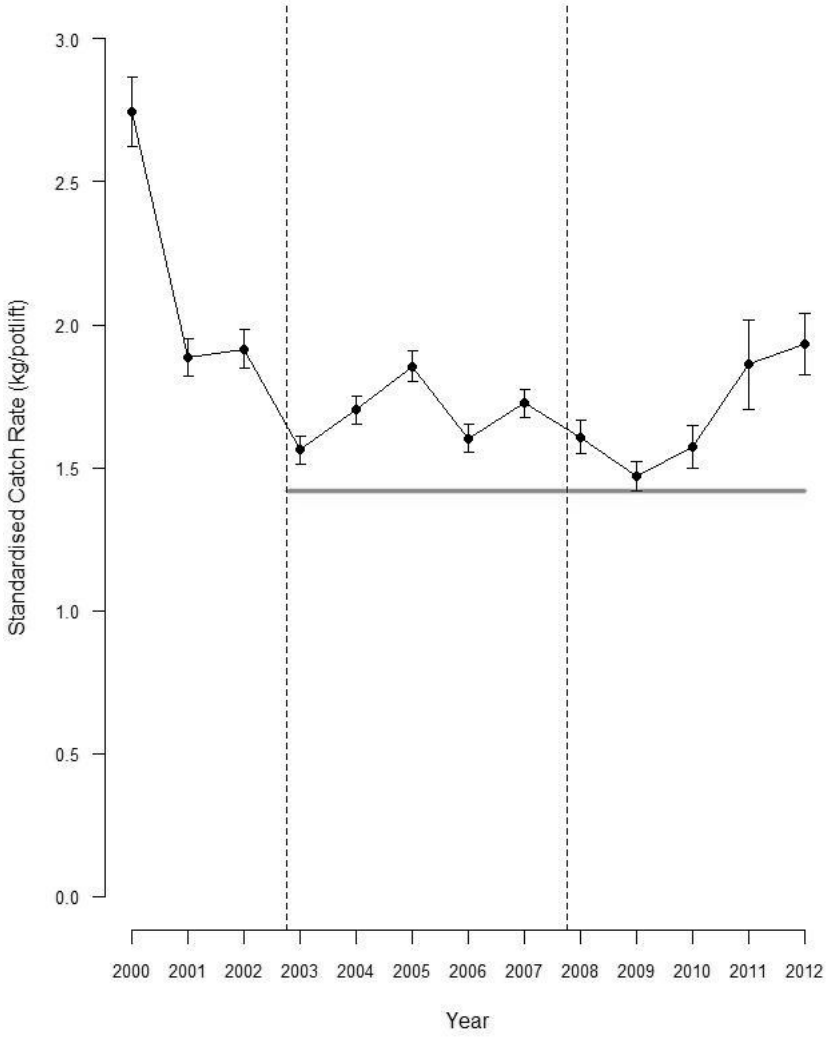
External Factors

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 (heavy line) crabs since 1989. Annual giant crab catches have always been small, and they have therefore been excluded.



WEST COAST DEEP SEA CRUSTACEAN FIGURE 2

Standardised catch per unit effort (±95CI) since 2000 for crystal crabs. Area between vertical dashed lines indicate period when management required fishing in all zones. Horizontal line represents the current notional threshold reference point for crystal crabs in the fishery.

Gascoyne Demersal Scalefish Fishery Status Report

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

Main Features

Status		Current Landings	
Stock level		Pink snapper:	
Pink snapper	Adequate	Commercial	235 t
Goldband snapper	Adequate	Recreational	30 t
Spangled emperor	Adequate	Charter	11 t
Fishing Level		Goldband snapper:	
Pink snapper	Acceptable	Commercial	64 t
Goldband snapper	Acceptable	Recreational	7 t
Spangled emperor	Acceptable	Charter	11 t
		Spangled emperor:	
		Commercial	4 t
		Recreational	35 t
		Charter	5 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 (*Pagrus 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 multidens*), 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 (Serranidae, 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 (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). GSDF 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

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 5,102 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 previous *Shark Bay Snapper Management Plan*.

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 to be in 2014).

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

Recreational

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. 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 2011-12 licensing period for the GDSF, i.e. 1 September 2011 – 31 August 2012 (referred to as 'season 2012'). 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 state-wide 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 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, these indicators were selected to represent the inshore (waters of 20-250 m depth) and offshore (greater than 250 m depth) demersal scalefish suites using a risk-based approach based on the relative vulnerability of the species/stock to fishing activities. In the Gascoyne Coast Bioregion, pink snapper, goldband snapper and spangled emperor are the indicator species for the inshore suite with ruby snapper and eightbar grouper (*Epinephelus octofasciatus*) the indicator species for the offshore suite (DoF 2011[3]).

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 2012).

Goldband snapper: Comprehensive research on goldband snapper commenced in 2007 as part of a Gascoyne Integrated Fisheries Management (IFM) project. Goldband snapper in the Gascoyne Coast Bioregion are managed as a single stock. A 'weight of evidence' based assessment has been completed and externally reviewed. Results from this work have been independently reviewed and published (Marriott *et al*. 2012). Monitoring of commercial catches and age structure is on-going and further research is planned to refine estimates of

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 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. A 'weight of evidence' based assessment has been completed and externally reviewed. Results from this work have been independently reviewed and published (Marriott *et al*. 2012). Limited monitoring of recreational catches landed at fishing tournaments is on-going.

Retained Species

Commercial landings (season 2012):

Total	**389 tonnes**
Pink snapper	**235 tonnes**
Goldband snapper	**64 tonnes**
Spangled emperor	**4 tonnes**
Other species	**86 tonnes**

The total commercial catch taken by the GDSF in the 2012 season was 389 t which is similar to the catch level in 2011 (Gascoyne Demersal Scalefish Fishery Figure 2). The catch comprised 235 t of pink snapper (oceanic stock, TACC = 277 t), plus 153 t of other species including 64 t of goldband snapper, 4 t of spangled emperor and 85 t of other scalefish species (Gascoyne Demersal Scalefish Table 1).

Recreational catch estimate (includes charter sector):

Pink snapper	**ca. 40 tonnes**
Goldband snapper	**ca. 18 tonnes**
Spangled emperor	**ca. 40 tonnes**

In 2012 the recreational catch of pink snapper (oceanic stock) reported by licensed charter boats was 11 t (12 t in 2011). 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 2012 increased to 11 t (6 t in 2011). 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 18 tonnes.

The recreational catch of spangled emperor reported by charter boats in 2012 was 5 t (6 t in 2011). 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 2012 season with 18 vessels actively fishing (17 in 2011). 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 875 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 223 boat days during June-July in 2012 (280 in 2011).

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 (2011)
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 2012) indicated that the spawning biomass in 2011 was above the threshold level (30% of the unexploited spawning biomass). The model estimated that at 2011 harvest levels (total annual catch ca. 300 t) the target level (40% of the unexploited spawning biomass) would be reached by 2014-2015. The next assessment is scheduled to be completed in 2014.

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 2012 season, the pink snapper catch rate reached 650 kg pink snapper/standard boat day, its highest level since significant TACC reductions in 2004 (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 2012, the catch rate was 650 kg pink snapper/standard boat day well above the threshold and the highest level since 2000.

Goldband snapper: Historical 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 '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 2012 was well below the maximum sustainable commercial catch limit recommended for this species in the Gascoyne Coast Bioregion (100-120 t, see Fisheries Research Report 228 for details). Breeding stock levels and fishing level are currently assessed as adequate.

Spangled emperor: Commercial catch rate data for spangled emperor were found to be uninformative as an index of abundance. A '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, given the available evidence, that the current level of fishing on the spangled emperor population in the North Gascoyne exceeded sustainable levels. 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 Fisheries Research Report 228 for 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.

Protected species interaction — Negligible

As line fishing is highly selective, interactions with protected species by commercial, charter and recreational fishers in the GDSF are low. Commercial GDSF and charter fishers are required to record all protected species interactions in their logbooks. During 2012, commercial fishers in the GDSF reported no interactions with protected species. No interactions were reported in 2012 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 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 2012 was similar to previous years and reflects the focus on pink snapper during the peak season and fishing further offshore in deeper water for other species at other times of the year.

In 2012, 18 vessels fished during the entire season of which 8 vessels 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 2012): **Acceptable**

Current catch level Goldband (season 2012): **Acceptable**

Target catch (and effort) range:

Pink snapper **277 tonnes/380-540 days**

Goldband snapper **50-120 tonnes (preliminary)**

In 2012, GDSF vessels with pink snapper quota required 362 boat days to catch 235 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 650 kg pink snapper/boat day during the peak season for the 2012 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 2012 was well within the preliminary acceptable commercial catch range.

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 is occurring north of Point Maud outside of the sanctuary zones.

New management initiatives (2012/13)

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 other demersal scalefish (e.g. goldband snapper). The development of an entitlement framework with the capacity to regulate catches of other scalefish, in particular goldband snapper, that can work in combination with the existing ITQ system for pink snapper is currently underway.

All commercial fisheries in the Gascoyne Coast Bioregion, including the GDSF, underwent Marine Stewardship Council (MSC) pre-assessment in the first half of 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 2010/11 season, total effort in this fishery was 258 trawl hours (628 in 2009/10), with 0.6 t of ruby snapper (the main component of the scalefish catch taken in this fishery) caught (15.6 t in 2009/10) (Woodhams *et al*. 2012)[2]. Recent information on catches of pink snapper taken by WDWTF

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.

2 Woodhams, J., Vieira, S., Stobutzki, I. (eds) (2012). Fishery status reports 2011, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra.

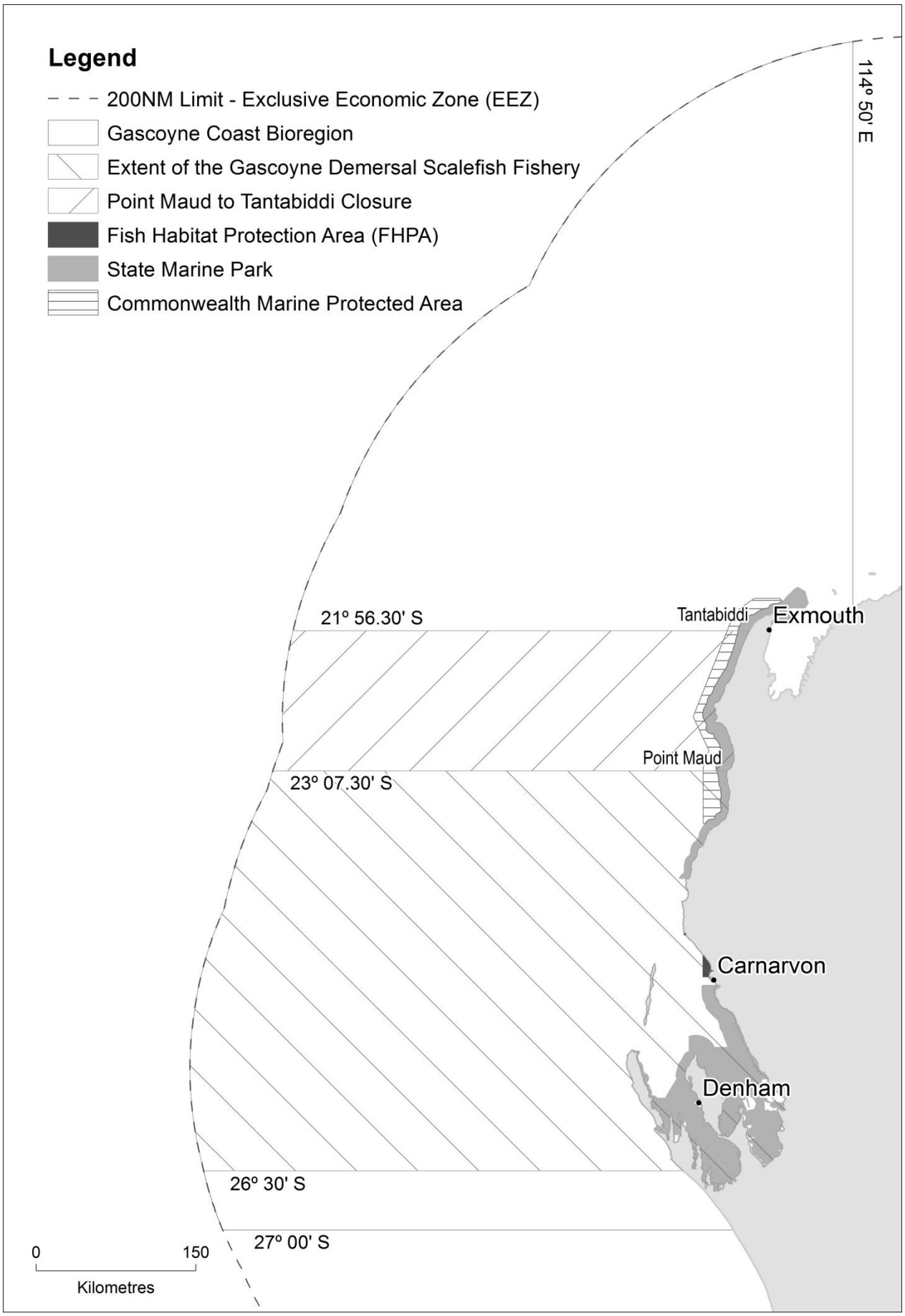
vessels fishing in waters off the Gascoyne coast is not available (last reported catch of snapper was <0.5 t in 2006).

Climate change has the potential to impact fish stocks in range of ways including, with temperate species such as pink snapper , affecting spawning patterns and influencing their geographic distribution (latitude shift). A review of the impacts and responses to marine climate change in Australia has been undertaken by CSIRO (see www.oceanclimatechange.org.au). In addition, a 3-year FRDC-funded project is currently assessing the effects of climate change on key fisheries in Western Australia. The key species that will be considered in relation to the consequences of climate change as part of this project include pink snapper, goldband snapper and spangled emperor. A recent collaborative study with CSIRO used modelling to investigate the potential influence of long-term increases in water temperatures and cyclone activity on spangled emperor in the Ningaloo Marine Park.

Species	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Goldband snapper	310.7	250.4	239.8	105.8	107.2	121.1	143.8	104.6	53.2	64.2
Red emperor	18.6	21.3	18.5	19.4	17.0	12.8	11.7	9.8	8.2	13.1
Spangled emperor	20.4	15.2	13.5	18.1	7.0	7.0	3.3	3.8	3.7	4.3
other emperors	25.8	37.4	31.8	29.2	34.3	26.8	13.8	9.2	10.4	11.6
Cods	38.0	39.2	27.9	21.9	21.5	15.0	9.5	13.4	11.4	21.1
Other	90.5	95.4	82.0	78.1	77.1	65.8	64.8	72.9	50.7	38.9
Total	504.0	458.9	413.5	272.5	264.1	248.5	246.9	213.7	137.5	153.0

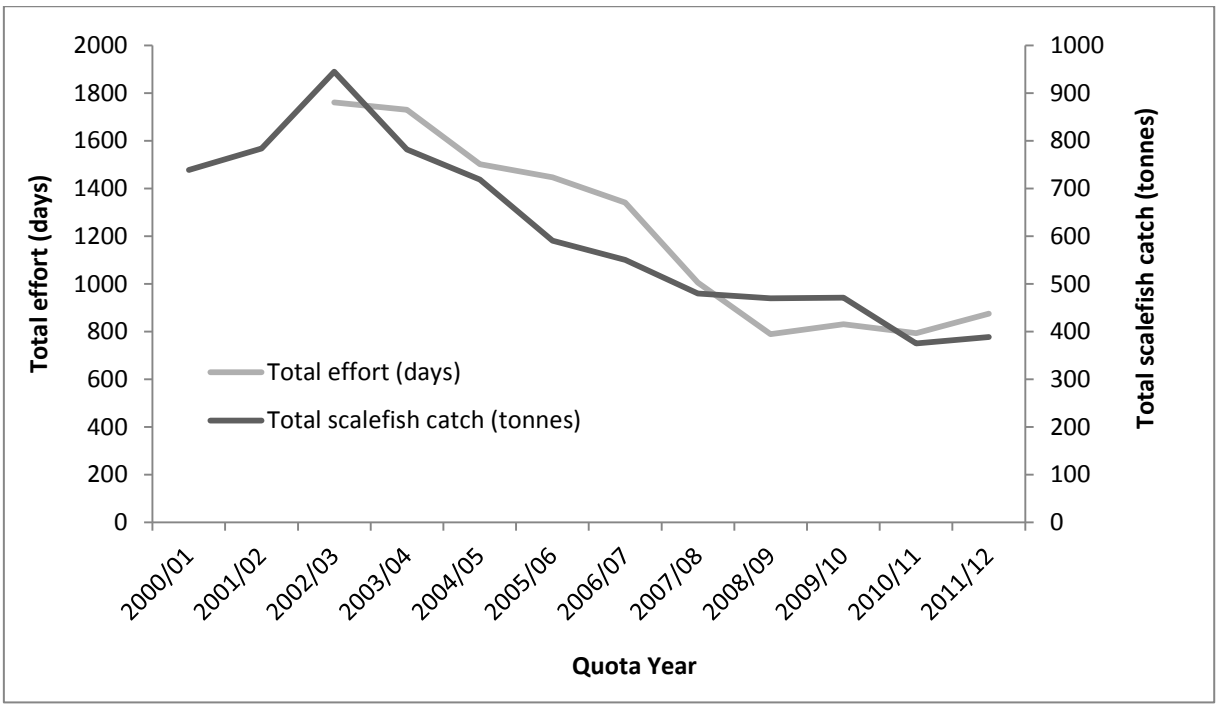
GASCOYNE DEMERSAL SCALEFISH FISHERY TABLE 1

Total commercial catch of demersal scalefish species other than pink snapper taken in Gascoyne waters between 2002/03 and 2011/12 (excludes mackerels, sharks and tunas). Units are tonnes.



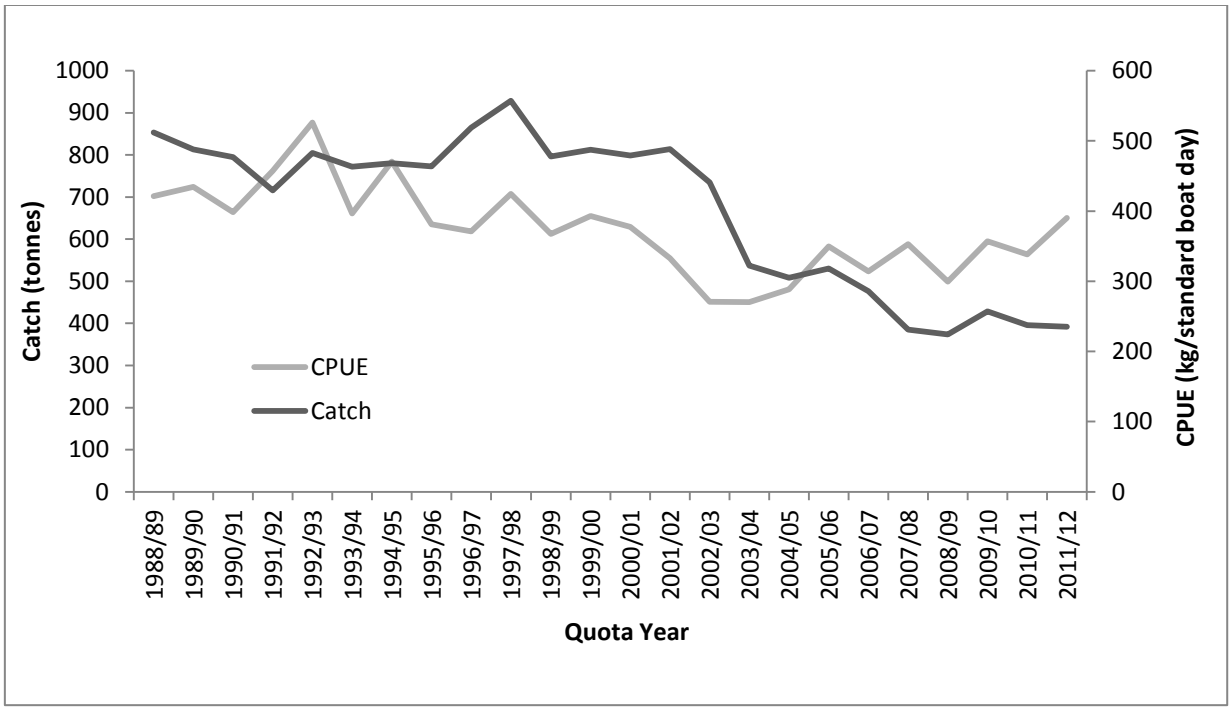
GASCOYNE DEMERSAL SCALEFISH FISHERY FIGURE 1

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 2011/12.



GASCOYNE DEMERSAL SCALEFISH FISHERY FIGURE 3

Gascoyne pink snapper catch and catch per unit effort by quota year from 1988/89 to 2011/12. 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. Norriss and H. Zilles

Main Features

Status

Stock level:	
Whiting	Adequate
Sea mullet	Adequate
Tailor	Adequate
Western yellowfin bream	Adequate
Pink snapper	Eastern Gulf - Adequate
	Denham Sound – Adequate
	Freycinet Estuary – Recovering
Fishing Level:	
Whiting	Acceptable
Sea mullet	Acceptable
Tailor	Acceptable
Western yellowfin bream	Acceptable
Pink snapper	Eastern Gulf – Acceptable
	Denham Sound – Acceptable
	Freycinet Estuary – Acceptable

Current Landings

Commercial (2012)	
Whiting	116 t
Sea mullet	40 t
Tailor	16 t
Western yellowfin bream	9 t
Pink snapper	1.5 t
Recreational (Pink snapper only)	
Eastern Gulf	4 t (2010)
Charter	0.1 t (2012)
Denham Sound	6 t (2010)
Charter	1.0 t (2012)
Freycinet	1.5 t (2010)
Charter	nil (2012)

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 is boat-based using rod & line or handline with some netting for bait and sea mullet. The key recreational species are pink snapper *(Pagrus 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, 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 and for boat-based fishing, by a Statewide recreational marine boat fishing licence, and for net fishing, by a Statewide recreational net fishing licence. For pink snapper more complex arrangements apply within the Eastern Gulf, Denham Sound and Freycinet Estuary (Inner Shark Bay Fishery Figure 1). These stocks are managed separately with explicit Total Allowable Catch (TAC) targets. In 2012, 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 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 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.

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)[1]. An integrated survey of boat-based recreational fishing in WA was conducted during 2011/12 (Ryan *et al.* 2013)[2]. This survey was developed to provide state-wide 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.

Research on pink snapper in the inner gulfs is now limited to a monitoring level and involves using daily egg production method (DEPM) surveys to estimate spawning biomass every 3 years. At the most recent meeting of the Shark Bay Inner Gulf Pink Snapper Working Group (September 2011), the Department committed to completing a DEPM survey in each of the three areas to enable the stock assessments to be updated prior to the next scheduled meeting (2014).

Retained Species

Commercial landings (season 2012):

Whiting	**116 tonnes**
Sea mullet	**40 tonnes**
Tailor	**16 tonnes**
Western yellowfin bream	**9 tonnes**
Pink snapper	**1.5 tonnes**

The total catch taken by SBBSMNF licensed vessels in 2012 was 188 t which represents an approximate 28% decrease on the total catch taken in 2011 (see Stock Assessment for explanation). This total catch comprised 116 t of whiting, 40 t of sea mullet, 16 t of tailor, 9 t of western yellowfin bream and 6 t of other mixed scalefish species that included 1.5 t of pink snapper (taken as bycatch in net fishing gears).

Recreational catch estimates

	(including charter, 2012)
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, including the introduction of TAC-based management in 2003, recreational catches of pink snapper in Shark Bay are much lower than were taken in the 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).

1 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

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

In 2012, approximately 1 t of pink snapper was taken in Denham Sound and approximately 100 kg in the Eastern Gulf by licensed charter vessels; 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 2012.

Fishing effort/access level

Commercial

In 2012, of the 12 SBBSMNF licenses, only six vessels were routinely involved in fishing. Total fishing effort declined significantly in 2012 (664 boat days) compared with 2011 (1,002 boat days) and 2010 (1,081 boat days). This approximate 34% decrease in overall effort can be mostly attributed to one particular vessel that had been highly active historically, that did not fish at all in 2012.

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). No more recent estimates of recreational effort are available from the first state-wide 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 (2012)**
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 fishery overall and for each target species (Inner Shark Bay Fishery Table 1).

In 2012, while the total catch (all species) at 188 tonnes was below the lower limit of the target catch range (235–335 tonnes)(Inner Shark Bay Scalefish Fishery Figure 2), the overall CPUE at 283 kg/boat day (all species) was maintained above the average since 1990 (230 kg/boat day). The large decrease in total catch can be attributed to a decrease in overall effort and the large decrease in the sea mullet catch in particular (see below).

In 2012, the catch of whiting (116 tonnes) was within the target catch range and CPUE (175 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 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. The catch and CPUE of western yellowfin bream (9 tonnes, 14 kg/boat day) were also within the respective target catch range and above the threshold catch rate, respectively. Although the catch of sea mullet (40 tonnes) was the lowest on record (previous lowest catch was 57 tonnes in 1976), and well below the target range, the CPUE (61 kg/boat day) was maintained around the threshold level. The decrease in the sea mullet catch is explained by the non-participation in 2012 of a single vessel that had landed 24% of the total mullet catch in 2011 and contributed 22% of the total effort (see comment for whiting above).

While the tailor catch (16 tonnes) was again below the target range, the CPUE (25 kg/boat day) increased to above the threshold level. The low landings of tailor that have become a feature of the fishery in recent years are mostly attributed to local processing restrictions.

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 2010. 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 information from 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.

Protected species interaction **Negligible**

As nets are actively set and hauled, if any protected species such as dugongs, dolphins or marine turtles are caught (rarely) they are immediately released.

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 20 fishers are employed in the SBBSMNF based on six 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 2012 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 (2012): **Acceptable**

Target catch range (2012):

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 declined to 664 boat days in 2012. This represents an approximate 34% reduction on effort in 2011 (1,002 boat days) and 38% reduction on 2010 (1,081 boat days). The large decrease between these two years is mostly explained by non-participation of one particular vessel in 2012 that historically had been a major operator in the fishery.

The total commercial catch (ex. pink snapper) in 2012 at 188 t was well below the lower limit of the target catch range (235–335 tonnes). 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 2011 were either nil or significantly below their allocation within the respective pink snapper TACs (1.5 tonnes in Denham Sound, nil catch in Eastern Gulf and Freycinet Estuary).

Recreational

Target catch range (2012):

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 or 2012) and therefore within the respective TACs in each area.

In 2012, a total of 561 applications (first and second rounds) were received for Freycinet Estuary management quota tags with a total of 914 tags (total available 1,050) allocated to recreational fishers.

New management initiatives (2012/13)

As an outcome of the ‘Wetline Review’ (see Fisheries Management Paper No. 224 for details), a management plan is being developed 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, underwent Marine Stewardship Council (MSC) pre-assessment in the first half of 2013.

External Factors

While the inner Shark Bay system has been considered relatively stable as a result of its typically low-rainfall, 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, scallops) (see Fisheries Research Report 222)[1]. 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 including, with temperate species such as pink snapper, affecting spawning patterns and influencing their geographic distribution (latitude shift). A review of the impacts and responses to marine climate change in Australia has been undertaken by CSIRO (see www.oceanclimatechange.org.au). A 3-year FRDC-funded project has recently commenced that will assess the effects of climate change on key fisheries in Western Australia. The key fishery species that will be considered in relation to the consequences of climate change as part of this project include pink snapper and tailor.

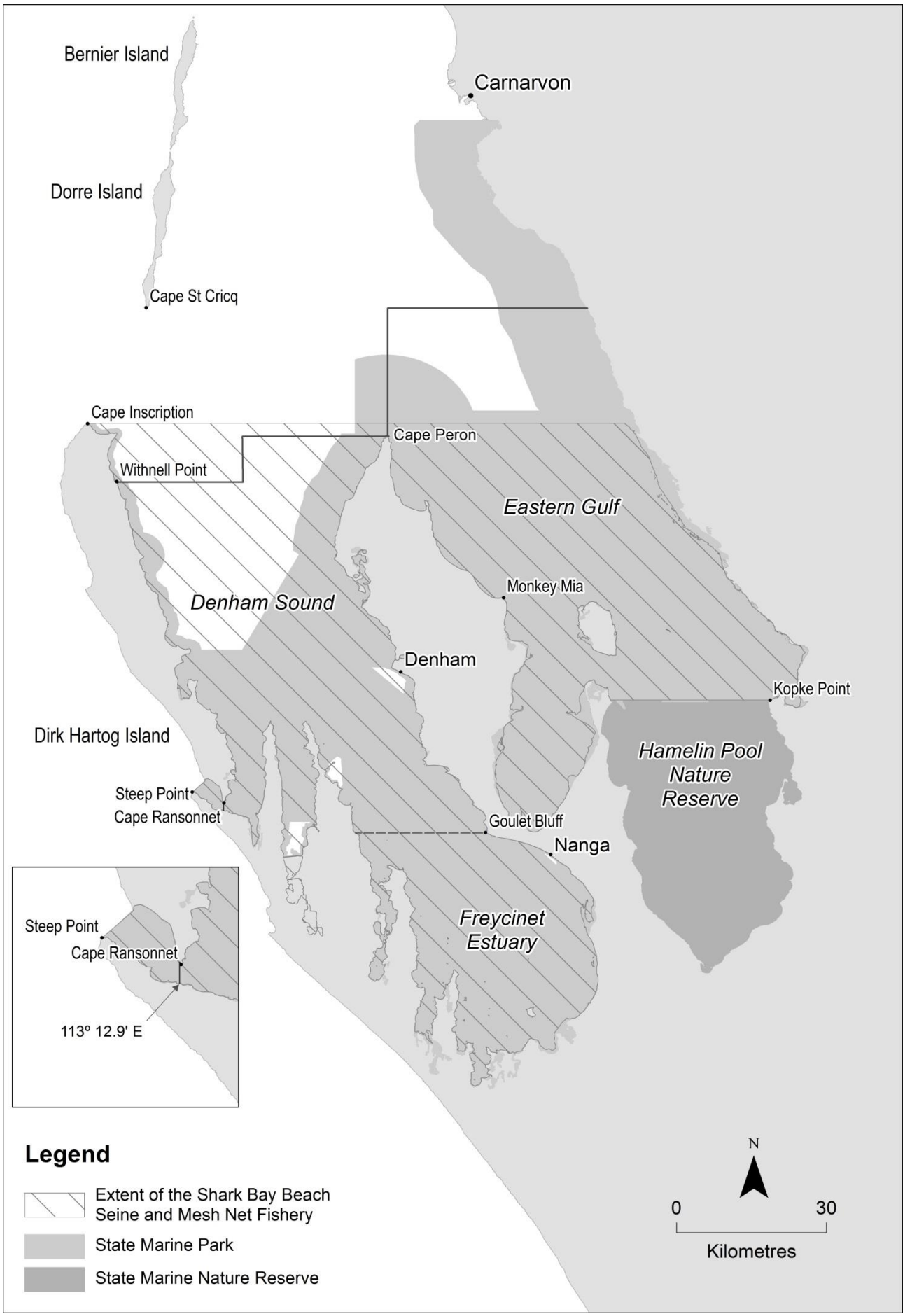
INNER SHARK BAY SCALEFISH FISHERY TABLE 1

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 2003-2012.

Species	Acceptable catch range	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Whiting	93-127	107	119	116	113	102	117	115	118	105	116
Mullet	77-144	149	143	85	62	91	107	124	117	116	40
Tailor	25-40	28	24	19	21	23	23	19	19	17	16
Bream	7-15	24	27	27	23	14	8	8	10	9	9

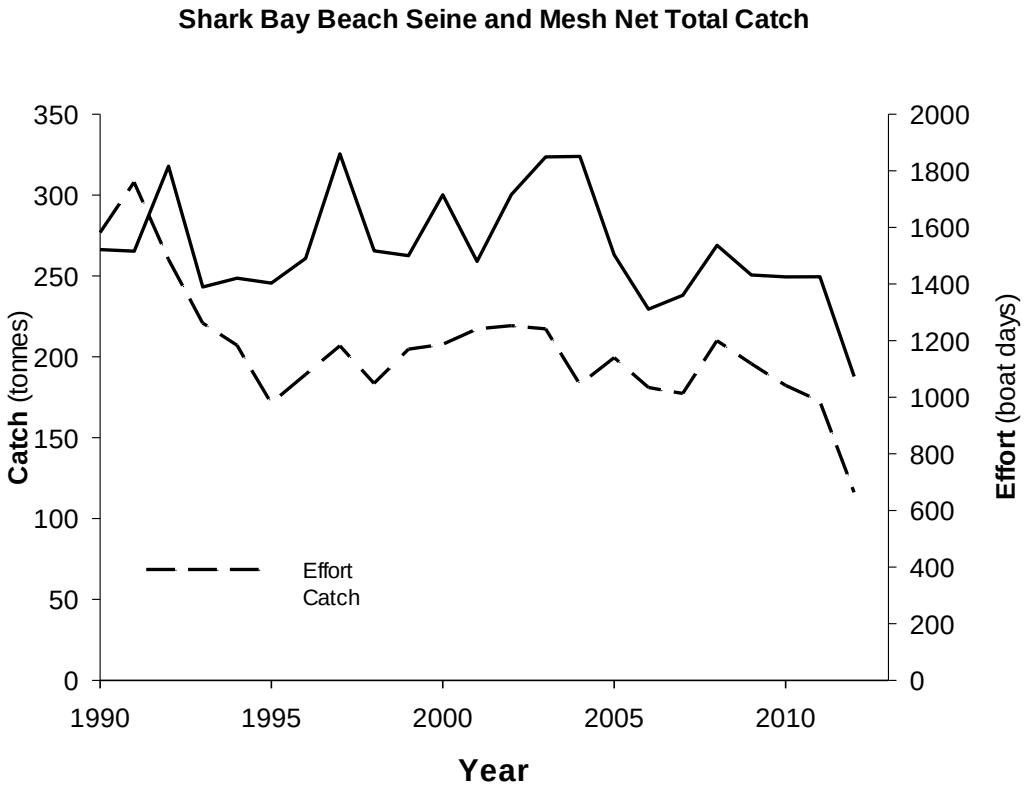
Species	Trigger level	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Whiting	75	86	114	102	110	100	98	100	112	105	175
Mullet	62	120	137	74	60	90	89	106	107	116	61
Tailor	21	22	23	17	20	22	19	16	17	17	25
Bream	5	19	26	23	22	14	6	7	10	9	14

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.



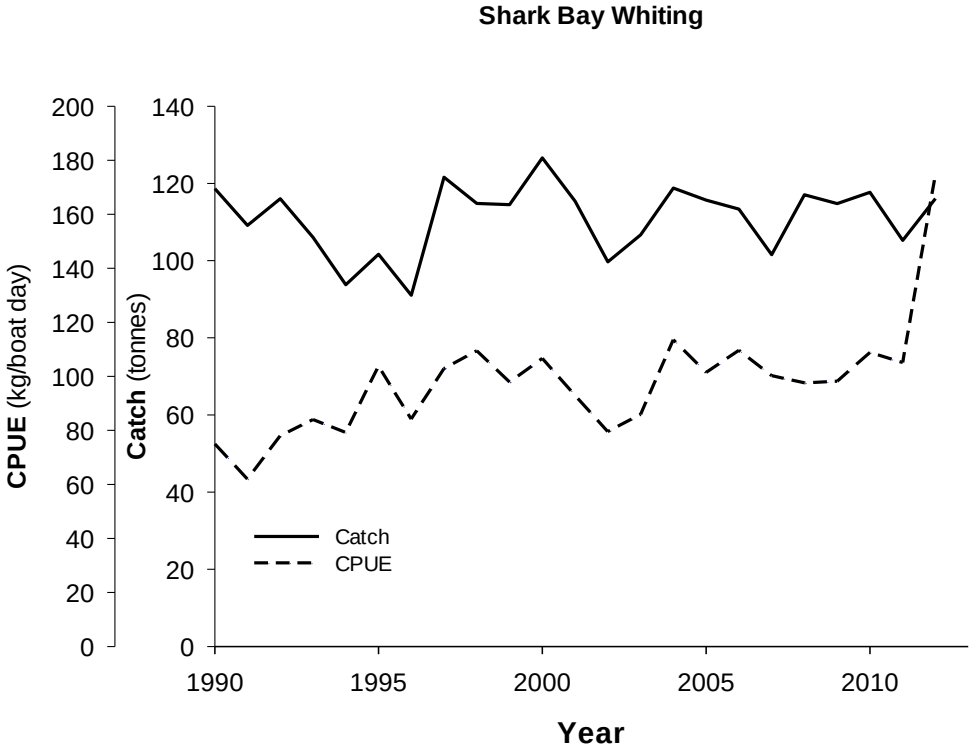
INNER SHARK BAY SCALEFISH FISHERY FIGURE 1

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 1990–2012.



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 1990–2012.

Shark Bay Blue Swimmer Crab Fishery Status Report

A. Chandrapavan, D. Johnston, E, Sporer, S. O'Donoghue and C. Syers

Main Features

Status		Current Landings	
Stock level	Inadequate (non –fishing)	Commercial catch	113 t
		Shark Bay trap fleet	59 t
Fishing level:		Shark Bay trawl fleet	54 t
Voluntary commercial closure since April 2012		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 negligible 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 multiple flooding events during the summer of 2010/11. Commercial fishing for blue swimmer crabs in Shark Bay was voluntarily halted by industry in April 2012 to facilitate stock rebuilding.

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 General 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 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 is designed to ensure adequate egg production for associated blue swimmer crab stocks under typical environmental conditions.

There are five crab trap licences each with 300 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 licences 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) licenses authorized 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 Sustainability, Environment, Water, Population and Communities (SEWPaC) 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

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. In addition, Department of Fisheries' research staff conduct quarterly catch monitoring aboard commercial crab trap vessels in Shark Bay. A fishery-independent trawl survey, which covers the deeper water habitat, is conducted annually during late November/early December. Some base-line information on the biology and ecology of blue swimmer crabs has been generated by a number of FRDC funded projects conducted over the past decade both by the Department of Fisheries and Murdoch University. An FRDC project completed in early 2005 produced a preliminary stock assessment of the Shark Bay blue swimmer crab fishery.

An external scientific review (May 2011) of the blue swimmer crab stock in Shark Bay highlighted the need for rigorous fishery-independent data collection to address knowledge gaps in some of the biological parameters, discard information from trawling and models to determine sustainable harvest levels. An additional FRDC project (2012/015) to determine how to more accurately assess the stock status of crabs in Shark Bay commenced in July 2012. This will include completing a program of fishery-independent surveys to provide an understanding of the annual life cycle.

Retained Species

Commercial landings (season 2011/12):

113 tonnes (total)

Shark Bay trap fleet	**59 tonnes**
Shark Bay trawl fleet	**54 tonnes**

The total commercial crab catch from Shark Bay during 2011/12 was 113 t, representing a significant decrease (87%) compared to the 20010/11 catch of 860 t (Shark Bay Blue Swimmer Crab Figure 2). This catch only accounted for 33% of the state commercial blue swimmer crab catch of 347 t for 2011/12.

The annual catch from the Shark Bay crab trap fishery for 2011/12 was 59 t, an 88% decrease on the 2010/11 catch of 496 t (Shark Bay Blue Swimmer Crab Figure 2, 3). Landings from the Shark Bay trawl fleet were 54 t in 2011/12, an 85% decrease on the 2010/11 catch of 364 t. These low catches resulted from low stock abundance that appears to be caused by extreme environmental conditions in the summer of 2010/11 and the voluntary no take of crabs from April 2012.

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. A more recent state-wide recreational survey found only 4% of the state's blue swimmer recreational catches came from the Gascoyne region.

Fishing effort/access level

Trap fishers reported a total of 76,940 traplifts for 2011/12 (Shark Bay Blue Swimmer Crab Figure 3) – a 73% decrease on the 284,400 traplifts reported for the previous year. This was driven by the extremely low catch rates of crabs by the end of 2011 and trap fishing ceasing in February 2012.

Effort in the Shark Bay Prawn fishery is described in the relevant status reports elsewhere within this document and is primarily directed at catching prawns not at crabs. The Shark Bay Scallop Managed Fishery was closed during 2011/12.

Stock Assessment

Assessment complete:

Shark Bay:	**Yes**

Assessment level and method:

Level 3 - Catch rate/Size Distributions

Breeding stock levels:

Shark Bay:	**Inadequate (non-fishing)**

The Shark Bay Crab Fishery (trap and trawl sectors) developed rapidly between 2000 and 2011 and was Australia's highest producing blue swimmer crab fishery. During the developmental phase of the commercial trap fishery, catches grew steadily in line with increases in fisher knowledge, gear development and fishing effort, from 87 t (1998) to 564 t (2005). In 2005, the trap fishery transitioned to interim managed status and trap catches have stabilized at around 500 t. The annual mean commercial trap catch rate was stable around 1.6 kg/traplift between 2000/01 and 2010/11, which was well above the performance measure of 1.0 kg/traplift. The Shark Bay trawl fisheries have retained crabs as a byproduct since the inception of this fishery. Their level of retained catch was relatively low (<100 t) up until 2001/02, but increased steadily to 364 t in 2010/11. An independent review of the status of the blue swimmer crab stocks in Shark Bay was completed in May 2011 which supported the conclusions on the risks to the stock and priorities for future research. Discussions were therefore being initiated to potentially cap overall catch levels until a better understanding of stock dynamics and knowledge gaps on the factors influencing recruitment, spawning, and other life-history traits were addressed.

The total crab landings in 2011 were approximately 690 t, which is similar to the catch levels taken over the past 6 years, however the monthly trend in crab trap landings was significantly different to that observed during the rest of this period. During 2011, crab catches during the early part of 2011 (peaking in April 2011) were higher than in previous years when catches usually peaked later in May-June and sometimes even in August. The early peak in catch rates may have been influenced by the large flooding events in the summer of 2010/11 that may have flushed the crabs from the inshore grounds of the Eastern Gulf region. For the trawl sector, catches declined rapidly from June 2011 (43 t), to 9 t in August 2011, to very low catch of 9 kg in October 2011. The trap sector experienced a similar trend with the catch rate falling from 1.75 kg/traplift in July 2011 to 0.5 kg/traplift by December 2011. The standard annual scallop survey, which also provides data on crab abundance, undertaken in November 2011 confirmed the collapse of the Shark Bay crab stock. Catches of legal biomass (>135mm) were 0.22 kg/nm compared to the previous years' average of 5.6 kg/nm and sublegal biomass (sexually mature) of 0.15 kg/nm compared to 3.9 kg/nm from previous years.

An exemption to fish was granted to one trap fisher in January and February 2012 to fish beyond the existing boundary of the fishery to determine if crabs had moved into areas that had previously not been fished. The results confirmed low stock abundance across all size classes. The trawl sector commenced fishing in March 2012 and a small amount of crabs (< 5 t) were retained in March and April 2012 until a voluntary no take of crabs was negotiated with trawl and trap sectors by the Fisheries Department in April 2012. Since this time the fishery has been in a rebuilding phase.

The reasons for this substantial decline while not fully understood are likely to be linked to several adverse extreme environmental events. Firstly, this part of the WA coast experienced an extreme "marine heat wave" event where sea surface temperatures were at record high levels, reaching 3-5°C higher than historical levels for December 2010 to March 2011 The increases in 2010/11 were part of the record water temperatures that occurred in the Gascoyne and mid-west region and were associated with a very strong La Niña and Leeuwin Current. These conditions are known to have contributed to the mortality of a number of invertebrate and fish species (Pearce *et al*., 2001)[1]. Secondly, there were two major flood events over the 2010/11 summer months as a result of cyclone activity. Large amount of freshwater outflow into Shark Bay may have redistributed crab inshore stocks and/or caused some mortality in the following months.

It is suspected the extremely high water temperatures (and possibly combined with the flood events) may have also been responsible for high mortality of adult legal and sub-legal crabs due to thermal stress and possibly through increased susceptibility to predation &/or disease. This may explain the low residual spawning stock during the second half of 2011. The lack of small recruits during the November trawl survey suggests recruitment failure poor larval survival and settlement as the spawning stock had been within historic ranges. The flooding events over the summer of 2010/11 could also have affected the larval movement (flushing out of Shark Bay) and the salinity regime may have also affected mortality further reducing the level of juveniles now present in Shark Bay.

The water temperature during the winter 2010 was well below average and this may be a contributing factor as the winter period has been identified as the potential peak spawning period and there appears to be a positive correlation between winter SST and subsequent commercial catches. In addition, water temperatures have been above average in the summers of 2011/12 and 2012/13 and these may also be contributing to the continued low recruitment.

The performance measure for the Shark Bay crab fishery requires legal crab abundance be maintained above a performance measure of 1.0 kg/traplift. While the 2010/11 catch rate was well above at 1.74 kg/traplift, for 2011/12 the catch rate declined to 0.76 kg/traplift due to significant decline in overall stock abundance across Shark Bay. There are currently trap and trawl based research surveys programs in place to monitor the recovery of the Shark Bay crab stock.

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 (eg. Snapper

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

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.

Protected species interaction **Negligible**

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

Ecosystem Effects

Food chain effects **Low**

As the commercial take of crabs represents a relatively small portion of the biomass, which is effectively renewed annually, 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 has 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 and additional employment for some 30-35 workers through the development of post-harvest processing of the crab catch, are all currently inactive.

Economic Effects

Estimated annual value (to fishers) for 2011/12

Level 1 - < $1 million ($565 000)

The beach price for uncooked crabs in the Gascoyne fisheries for the year varied between $4-5.50/kg.

Based on an average of $5/kg the blue swimmer crab landings from Shark Bay during 2011/12 were worth $565 000, a significant decrease on the estimated $5 million generated during 2010/11 (for the Gascoyne Coast Bioregion). While the majority of the product was sold through local and inter-state markets, several Shark Bay fishers have been developing markets in Asia.

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.

Current fishing (or effort) level:

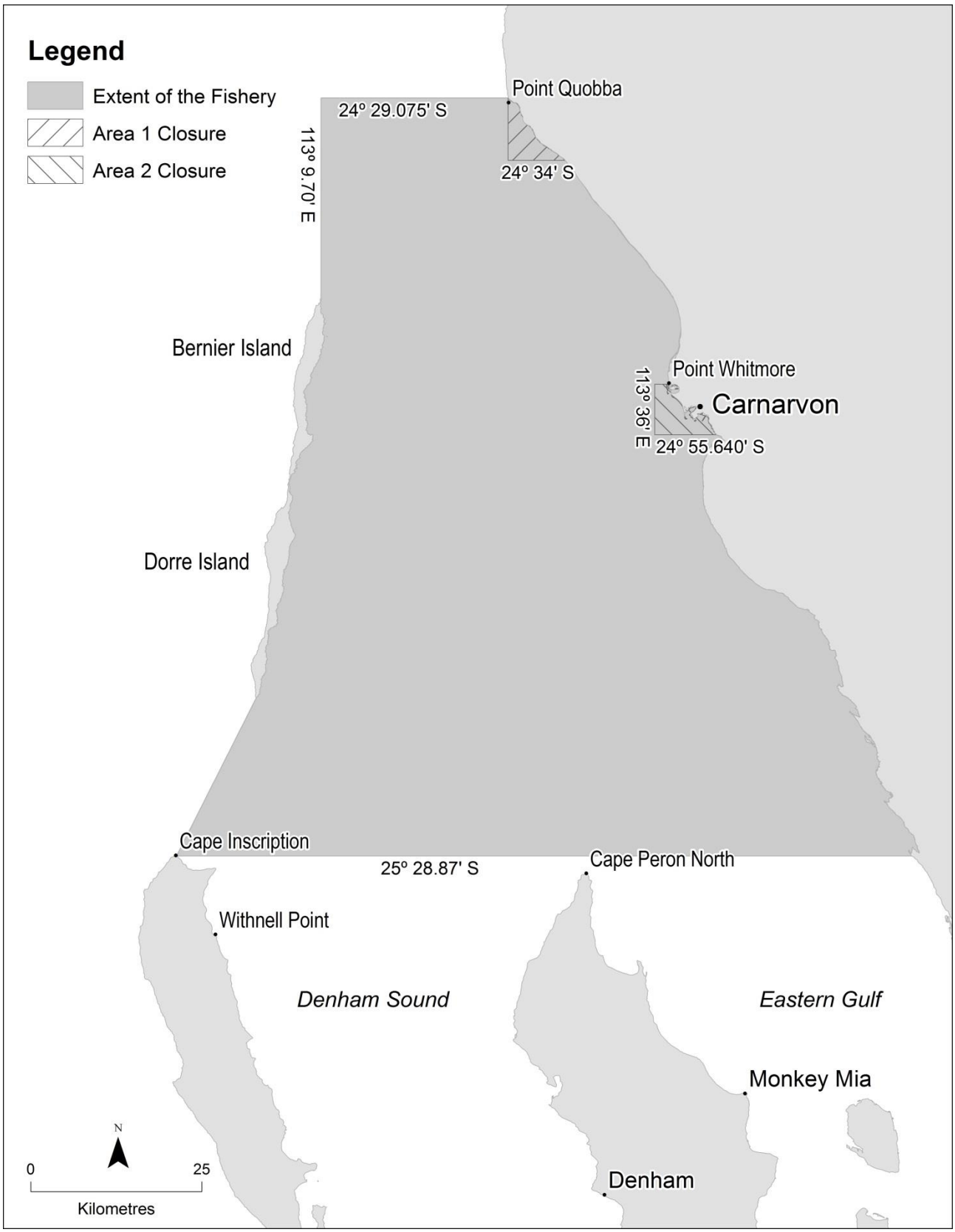
Not Applicable as fishery closed

New management initiatives (2012/13)

A ministerial decision on allocating catch shares within the commercial sectors was made in June 2012 (trap – 66%, prawn trawl 33.8%, scallop trawl sector 0.2%). Approval was also given by the 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 is extended to 31 August 2013.

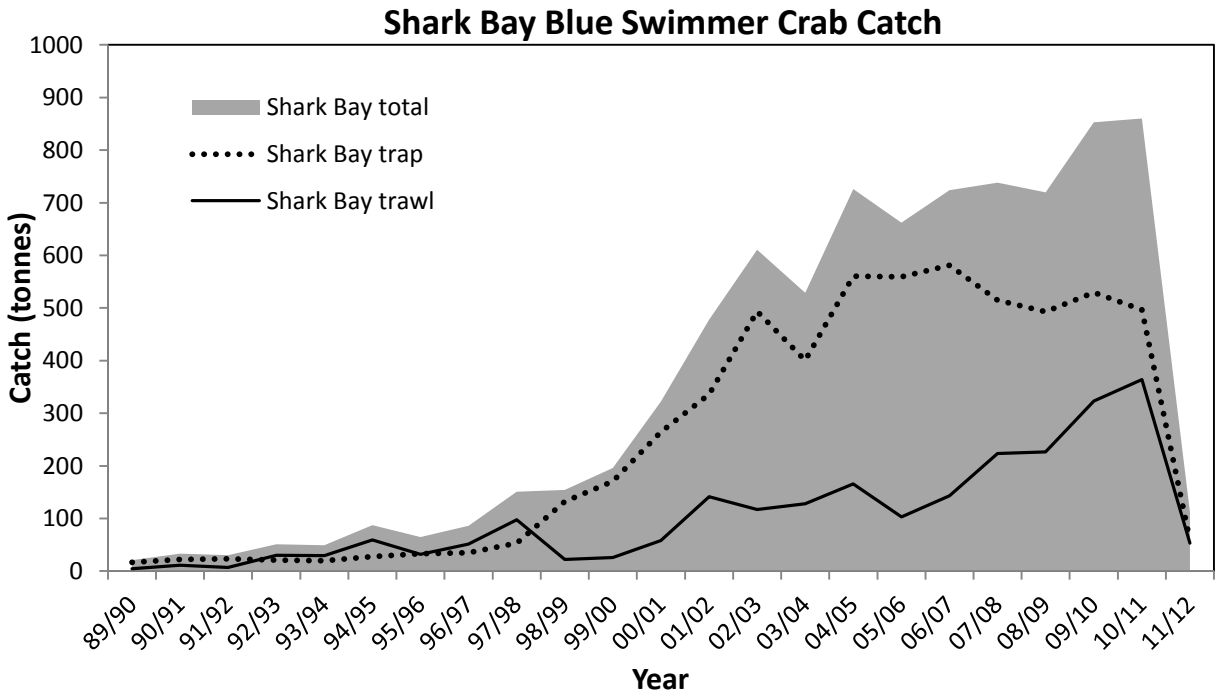
External Factors

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.



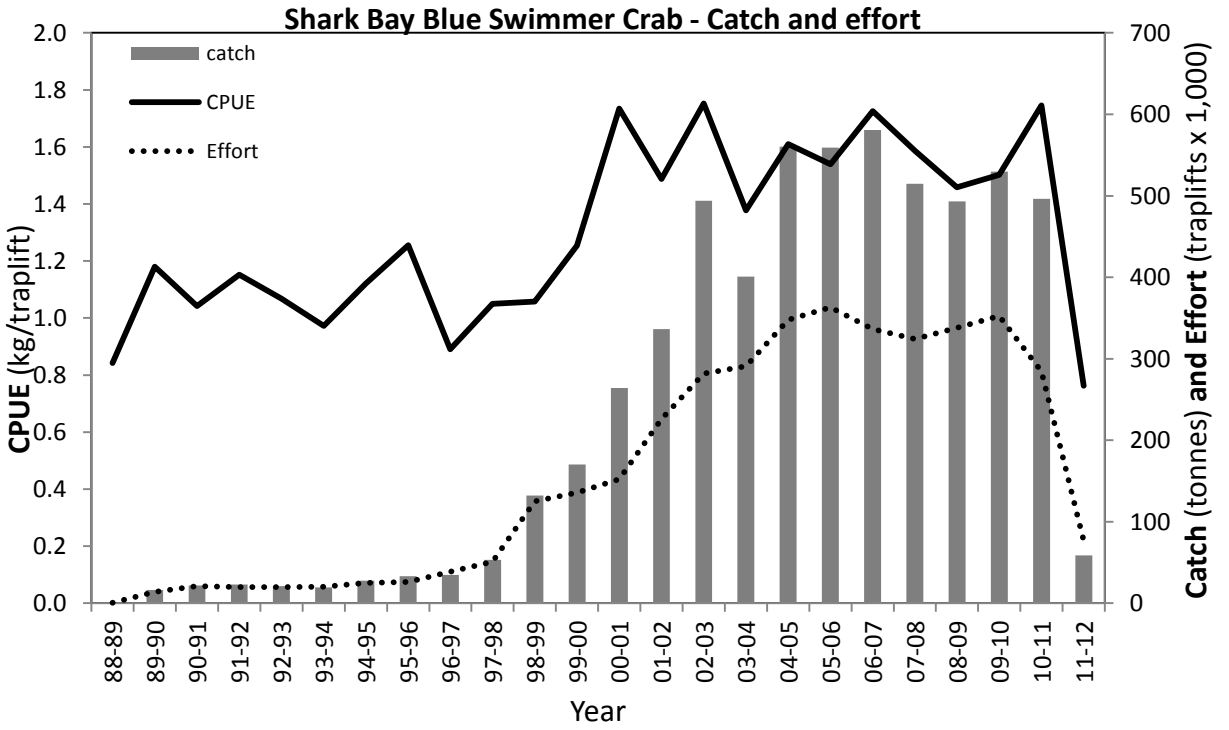
SHARK BAY BLUE SWIMMER CRAB FIGURE 1

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.



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.

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 imbricate.* , 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 start-up project is investigating the production of artemia (brine shrimp) and a small-scale project is growing limited quantities of diadromous and marine species for local markets.

COMPLIANCE AND COMMUNITY EDUCATION

Compliance and community education services in the Gascoyne Coast Bioregion are delivered by Fisheries and Marine Officers (FMOs), Community Education Officers (CEOs) and associated management and administrative support staff based at District Offices in Denham, Carnarvon and Exmouth. During 2011/12 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 100 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 and Scallop Fisheries. In 2011/12 this process was changed and tactical operations were developed incorporating the large PV's and the days were increased to 22 at-sea patrols in 2011/12. This allowed FMOs to conduct patrols the length of the Gascoyne and target offenders in all of the recreational and commercial fisheries based on intelligence gathered by FMO's 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.

In mid-2011, commercial blue swimmer crab trap catches dropped to below economically viable levels. Investigation of research data, including commercial trawl and trap catch data, showed that the stock was severely depleted. It appears that a recruitment failure was caused as a result of major environmental factors, including severe flood events in late 2010 and early 2011, plus a marine heat wave event in early 2011 resulting in very high water temperatures in Shark Bay.

As a result of all these factors, the trap industry was provided access to waters north of the current fishery under exemption in late 2011/early 2012, so as to allow the commercial fishers to explore the possibility of crabs in other areas.

Unfortunately low numbers of crabs were found following surveys conducted by the DoF in February and March 2012. Research results included:

- Small size and low estimated standing stock of blue swimmer crabs
- Few crabs in traditional areas
- Majority of crabs were females with 50% being berried.
- Recent trends in trawl landings and survey data showed numbers rapidly declining between May and August 2011
- Research surveys aboard the departmental research vessel "Naturaliste" recorded very low numbers (4 crabs/nm trawled) that produced the lowest crab density on record

As a result the Department of Fisheries asked for industry to adopt a no take approach of crabs on a voluntary basis as of the 2nd of April, 2012. This method allowed for real time adaptive management throughout the season based on the outcomes of the scheduled surveys, whereas the legislative approach was unlikely to afford the same level of flexibility. A voluntary approach also demonstrated industry's continued responsibility and stewardship over the resource.

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 2011/12 year using this model. Several other OCPs were completed, including the Commonwealth Ningaloo Marine Park. 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 OCP's 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 using 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.

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 number of infringement warnings (81) was similar to 2010/11, however infringement notices issued (186) increased marginally. The real difference was the detection of offences that required the instigation of prosecutions (10) over 2011/12. This was achieved from a total of 14,092 recreational fishing field contacts, which reflects the increased importance placed on recreational fishing and marine parks in general across the Gascoyne. Recreational fisher contacts were approximately 20% higher than in 2010/11.

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 2011/12. "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 2012/13

For the 2012/13-year a number of initiatives across the Gascoyne Bioregion have been planned. These include: -

- Continue to monitor the management and compliance aspects associated with the Shark Bay Crab Fishery;
- Continue to focus on a more intelligence based and tactical approach to compliance delivery, especially in marine parks and recreational fishing;
- Provide information to the Marine Stewardship Council (MSC) for the pre-assessment of the Gascoyne Bioregion's commercial and recreational fisheries;
- Increase effort in terms of education and enforcement in the Coral Bay and Gnarraloo area
- Improve recruitment and retention practises to attract and retain staff in the Gascoyne;

GASCOYNE COAST COMPLIANCE TABLE 1

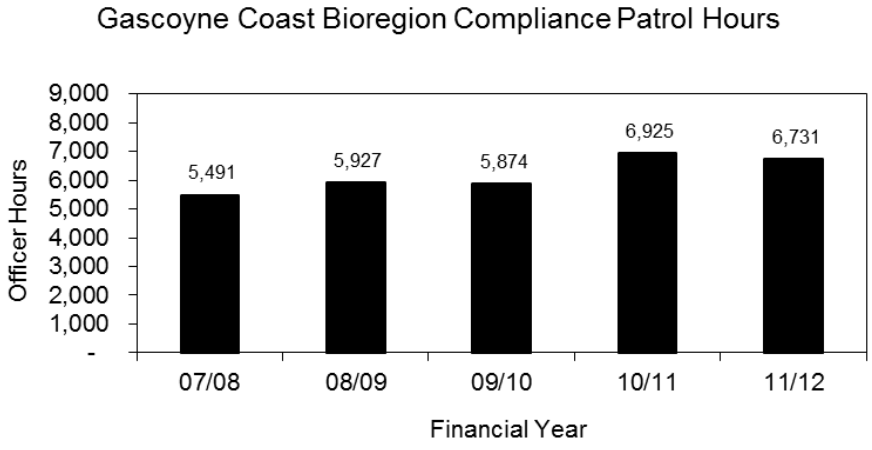
Summary of compliance and educative contacts and detected offences within the Gascoyne Coast Bioregion during the 2011/12 financial year.

PATROL HOURS DELIVERED TO THE BIOREGION	6,731 Officer Hours
CONTACT WITH THE COMMERCIAL FISHING COMMUNITY	
Field Contacts by Fisheries & Marine Officers	157
Infringement warnings	18
Infringement notices	0
Prosecutions	13
Fishwatch reports**	1
VMS (Vessel Days)***	7,091
CONTACT WITH THE RECREATIONAL FISHING COMMUNITY	
Field Contacts by Fisheries & Marine Officers	14,092
Infringement warnings	81
Infringement notices	186
Prosecutions	10
Fishwatch reports	13
OTHER FISHING-RELATED CONTACTS WITH THE COMMUNITY*	
Field Contacts by Fisheries & Marine Officers	786
Fishwatch reports	3

*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 11/12 total gives the patrol hours in the bioregion that resulted in the contacts detailed in Table 1. (The totals exclude time spent on other compliance related tasks e.g. travel time between patrol areas, preparation and planning time etc.).