

DRAFT BYCATCH ACTION PLAN
FOR THE
SHARK BAY PRAWN MANAGED FISHERY
(FULL REPORT)

By Jo Bunting

FISHERIES MANAGEMENT PAPER NO. 147

Department of Fisheries
3rd Floor, SGIO Atrium
168-170 St Georges Terrace
Perth WA 6000

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- Full Report -

AN INVITATION TO COMMENT

The Department of Fisheries invites people to make a submission on the issues and recommendations of this report - *Draft Bycatch Action Plan for the Shark Bay Prawn Managed Fishery*. This draft plan has been prepared by the Department of Fisheries' Fish and Fish Habitat Protection Program.

Two versions of the draft Bycatch Action Plan for the Shark Bay Prawn Managed Fishery have been released for public comment. The 'Full Report' (this document - Fisheries Management Paper No. 147) is a comprehensive version of the plan containing detailed rationale and justification for the objectives and actions proposed in the plan. The Full Report also provides detailed background information regarding issues such as the natural environment in Shark Bay, current management arrangements within the prawn fishery and existing information on bycatch.

A shorter 'Summary Report' is also available for comment. The Summary Report (Fisheries Management Paper No. 148) provides a brief summary of the background information used in the development of the draft Bycatch Action Plan and focuses on its objectives and actions.

Why Write a Submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action, including alternative proposals.

The Department of Fisheries will collate and summarise all public submissions received. Analysis of the submissions will be undertaken and recommended changes identified and documented.

Public submissions will be treated as public documents, unless specifically marked confidential, and may be quoted in full or in part in any further reports related to bycatch management in the Shark Bay Prawn Managed Fishery.

Developing a Submission

In your submission you may agree, disagree or comment on general issues or specific strategies listed.

It may help to reduce the workload on individuals and increase the pool of ideas and information if you join a group with similar interests and make a joint submission.

It is preferred that you use the Public Comment Form provided. A loose-leaf copy should have accompanied this document, but another copy is bound within the document, for you to photocopy and use (see Appendix C), should you require an extra one.

In the event that you do not wish to use the form provided, you should:

- refer each of your comments to the appropriate section or chapter heading in the report;
- clearly state your point of view;
- indicate your reasoning or source of information; and
- suggest alternate strategies, safeguards or information.

Please remember to include your name, address, the date and whether you want your submission to be confidential.

Closing Date

A public comment period has been provided. The closing date for submissions is 27 June 2002.

Contacts

Submissions should be addressed to:

Mr Colin Chalmers
Fish & Fish Habitat Protection Program
Department of Fisheries
Locked Bag No. 39, Cloister Square Post Office
PERTH WA 6850

If you wish to discuss the content of the document or require further information, please contact Mr Colin Chalmers (08) 9482 7318.

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SECTION 1 INTRODUCTION

1.1 General

Drawn from the national and international interest in the ecological sustainability of fisheries and concern about 'wastage', bycatch has become a major issue for fisheries managers, fishing industries, scientists and the public over the past decade. As concern has increased, further efforts have been devoted, globally, to the development of effective management measures to reduce the effects of bycatch.

The Department of Fisheries is committed to managing bycatch in Western Australian fisheries. Under the Western Australian Policy on Fisheries Bycatch (June 1999), the Department of Fisheries is embarking on a program to target bycatch issues in fisheries throughout the State.

Owing to differing fishing operations and environmental conditions, bycatch issues are quite specific for individual fisheries. The development of fishery-specific Bycatch Action Plans reflects this situation, as they are tailored to meet the unique requirements of each fishery.

This Bycatch Action Plan for the Shark Bay Prawn Managed Fishery is the first of its kind in Western Australia. The relatively unselective nature of trawl operations and the World Heritage Area in which the fishery operates have combined to make it the first priority for bycatch management within the State.

The Shark Bay Prawn Managed Fishery is located within the waters of Shark Bay in the Gascoyne Region of Western Australia (refer Figure 1). The waters of Shark Bay are highly valued, as they are within a World Heritage Property Area and part of a State-administered marine park. The fishery is also highly valued, being worth approximately \$30 million per year, and is a major contributor to the economy and employment in the region.

1.2 Objective of Plan

This draft Bycatch Action Plan for the Shark Bay Prawn Managed Fishery has been prepared to provide a policy framework for the management of bycatch in this fishery. The objective of the plan is to:

"Increase the understanding of the nature and degree of bycatch in the Shark Bay Prawn Managed Fishery in order to develop and implement appropriate and effective management strategies to reduce bycatch generated by the fishery."

This objective is detailed in Section 8.

1.3 What is Bycatch?

Fishing gear used to trawl for prawns often affects additional untargeted organisms. Some species of untargeted fish are caught in the nets, but a high proportion of these are generally not commercially valuable and subsequently discarded either dead or alive.

Some fish are discarded for other reasons, including legal prohibitions on their take. Other commercially valuable species are often retained. All these organisms are regarded as bycatch.

There are some species which are affected or disrupted by trawl gear, but may not be retained in the net. For example, sponges might be 'knocked over' or detached by a trawl foot-rope or ground-chain during demersal trawling. These are also regarded as bycatch.

A lack of consistency between the legal interpretation of bycatch and what is practical to manage has resulted in confusion about "what is bycatch?." This primarily stems from the uncertainty of the relationship between 'bycatch' and 'byproduct' and the absence of a descriptive reference or definition of these terms in the *Fish Resources Management Act (FRMA) 1994*.

For the purpose of this plan, the following definitions have been adopted. These are consistent with those contained within the Western Australian and National Policy on Fisheries Bycatch (refer to Section 1.4):

- Target Species - the highest value catch.
- Bycatch - includes discards and also that part of the catch that is not landed but is killed as a result of interactions with fishing gear.
- Byproduct - non-target catch, which is commercially valuable and retained by fishers.
- Discards - non-target species that are caught in fishing gear and landed on the deck of a vessel, but are subsequently discarded, either because they have no value (for example there is no market or they are toxic), or because regulations preclude them being retained.

1.4 Policy Framework

As the steward of the State's fish resources, the Department of Fisheries has a particular responsibility to lead and coordinate efforts to manage bycatch. In developing this draft Bycatch Action Plan, the Department of Fisheries has demonstrated its commitments to obligations under a number of State and Commonwealth agreements and policies. The relationship of this draft Bycatch Action Plan to these policies and agreements is summarised below.

- ***Fish Resources Management Act 1994*** - The draft Bycatch Action Plan is consistent with the objects of the *FRMA 1994*, which aim to conserve, develop and share the fish resources of the State for the benefit of present and future generations, and in particular to conserve fish and protect their environment and to ensure that the exploitation of fish resources is carried out in a sustainable manner.
- **Australia's Oceans Policy** - Environment Australia has released Australia's Oceans Policy, which commits the government to removing the blanket exemption of marine species from export controls. This would require that species targeted for export are harvested as part of a commercial fishery which is able to demonstrate that both its target and non-target catch are managed sustainably. The Bycatch Action Plan is a critical step towards meeting this requirement.
- **National Policy on Fisheries Bycatch and Western Australia Policy on Fisheries Bycatch** - The National Policy on Fisheries Bycatch, developed by the Commonwealth's Standing Committee on Fisheries & Agriculture, was finalised in December 1998. The policy was developed to provide a national framework for coordinating action to address bycatch issues.

In June 1999, the (then) Minister for Fisheries decided to adopt the National Policy as the basis for the Western Australian Policy on Fisheries Bycatch. The policy advocates the preparation of Bycatch Action Plans tailored to the specific requirements of various fisheries. This approach has been adopted by the Department of Fisheries in the preparation of this Draft Action Plan for the Shark Bay Prawn Managed Fishery.

- **Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*** - The management of bycatch issues is consistent with the objectives of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, which came into effect on 16 July 2000 and aims to promote ecologically sustainable development and the conservation of biodiversity.

It is anticipated the final version of the Bycatch Action Plan for the Shark Bay Prawn Managed Fishery will satisfy requirements for a Plan of Management to be approved by Environment Australia for the purpose of a defence against the incidental take of a listed species.

- **Draft Recovery Plan for Marine Turtles in Australia** - This Action Plan details the Department of Fisheries' obligation under the Draft Recovery Plan for Marine Turtles in Australia. Under this draft recovery plan, the Department of Fisheries is committed to gathering information on marine turtle bycatch and to develop bycatch 'reduction strategies' (the equivalent of this 'Action Plan') for the Shark Bay Trawl Fishery, which:
 - Incorporate marine turtle conservation;
 - Takes into account actions in other trawl fisheries; and

- Uses bycatch data to assess the effectiveness of adopted turtle bycatch mitigation measures.
- **National Strategy of Biological Diversity** - In June 1992 at the Rio Earth Summit, Australia signed the Convention on Biological Diversity. The Convention has been implemented in Australia through the National Strategy for the Conservation of Australia's Biological Diversity.

The goal of the National Strategy is to protect biodiversity and maintain ecological processes and systems. The following components are directly relevant to this plan:

- *Objective 2.3* - Achieve the conservation of biological diversity through the adoption of ecologically sustainable fisheries management practices.
- *Action 2.3.1* - Improving knowledge base:
 - (a) Priority should be given to increasing data and research on the impact of commercial fishery practices on non-target and bycatch species and ecosystems; on the viability of populations; and on genetic diversity.
 - (b) The development of fishing techniques that are species-specific; have the least impact on non-target species; and have minimum waste of the resources, with particular emphasis on trawling and shellfish dredging.
- **Gascoyne Recreational Fishing Review** - The Gascoyne Recreational Fishing Working Group has undertaken a review of recreational fishing in the Gascoyne, producing a final report paper entitled: *'A Five-Year Management Strategy for Recreational Fishing in the Gascoyne Region of Western Australia'* (Fisheries Management Paper No. 154).

The Minister for Forestry and Fisheries is currently considering the final report. Strategy 24 of the paper recommends that Bycatch Action Plans should be introduced for all commercial fisheries in the Gascoyne.

- **Gascoyne Fisheries Environmental Management Review** - This review was released in May 2001 (Fisheries WA, 2001) and is the first in a series of Fisheries Environmental Management Reviews (FEMRs) to be published by the Department of Fisheries. The objectives of the FEMRs are to outline the status of fisheries and aquaculture in a particular region; identify environmental effects associated with fishing and aquaculture activities and develop recommendations for their management; identify potential threats to fish and their habitats; and identify areas in need of fish and fish habitat protection.
- **Shark Bay Fish Habitat Protection Area Planning** - The Department of Fisheries will be seeking funding to develop a Plan of Management for a proposed Fish Habitat Protection Area within Shark Bay. The area is proposed to be the portion of the World Heritage Area that is not part of the current or proposed extension to the Shark Bay Marine Park.

SECTION 2 CONSULTATIVE METHODOLOGY

The Department of Fisheries has prepared this draft Bycatch Action Plan through a consultative process with all stakeholders of the Shark Bay Prawn Managed Fishery, and other groups with an interest or who will be affected by this plan.

Consulted parties included licensees of the fishery, representatives from the recreational and commercial fishing and aquaculture industry, government agencies and authorities, conservation and community groups and other non-government organisations. A full list of stakeholders, who were contacted during the development of this plan, is provided in Appendix A.

Stakeholders were involved in key stages of the plan's development as depicted in 'Table 1 - Consultation Process'. All groups were invited to provide comment on bycatch issues in the Shark Bay Prawn Managed Fishery at the commencement of the preparation of the plan (Phase I of the process). The issues identified through this process were a critical input to the determination of this Draft Bycatch Action Plan.

Ongoing consultation was undertaken during the preparation of the draft document, in particular with the licensees of the fishery and the Bycatch Liaison Group (consisting of representatives of the Western Australian Fishing Industry Council (WAFIC), Recfishwest, Marine & Coastal Community Network and Conservation Council of WA) (Phase II of the process).

A disclosure draft of the Bycatch Action Plan has been forwarded to, and reviewed by, the Shark Bay Prawn Managed Fishery licensees (Phase III). This draft report has been released for broader public comment and has been advertised in the local Shark Bay newspaper and the *West Australian* (Phase IV).

Table 1 Consultation Process

STAGE	STAKEHOLDER GROUP	MEDIUM	PURPOSE
Phase I - Concept Plan	All stakeholders (refer Appendix A)	Letter and Phone	<ul style="list-style-type: none"> Gain input into planning process Receive information from stakeholders Determine concerns and priorities of stakeholder groups
Phase II - Draft Planning Phase	Bycatch Liaison Group	Meeting	<ul style="list-style-type: none"> To reach agreement on format and general framework for Action Plans
	Industry - Shark Bay Prawn Fishery Licensees and Association	Meeting	<ul style="list-style-type: none"> To reach agreement on format and general framework for Shark Bay Action Plan
Phase III - Preparation and Referral of Disclosure Draft Action Plan	<ul style="list-style-type: none"> Shark Bay Prawn Managed Fishery licensees Shark Bay Prawn Management Advisory Committee and Association Bycatch Liaison Group 	Draft plan forwarded to all relevant stakeholders Comments referred to the Department of Fisheries in writing	<ul style="list-style-type: none"> To allow for comments and consideration prior to release to broader public
Phase IV - Draft Release - Current Stage	All stakeholders (refer Appendix A) + Western Australian Community	Mail-out plus notice of release of draft in newspaper	<ul style="list-style-type: none"> Comments on Draft Action Plan

The Department of Fisheries will collate and summarise all public submissions received on this draft plan. Analysis of the submissions will be undertaken and recommended changes identified and documented. The content of submissions and recommended amendments will be discussed with stakeholders where necessary.

An amended plan will then be prepared together with a summary of submissions and a clear justification of the response to each submission. This summary of submissions will be published either as part of the final plan or as a separate document.

SECTION 3 SHARK BAY PRAWN TRAWL FISHERY

3.1 Overview of Operation

3.1.1 Location of Fishery

As defined by the Shark Bay Prawn Managed Fishery Management Plan, the fishery exists within the waters of the Indian Ocean between 23° 24' and 26° 30' south latitude and adjacent to Western Australia landwards of the 200 metre isobath, together with those waters of Shark Bay south of 26° 30' south latitude (refer to Figure 2).

Although the existing licence area gives the impression of an extensive trawl fishery (extending out to 200m isobath), only a small portion of the licence area forms the functional fishery. This is due to fishers targeting the favourable, high yield fishing grounds, and also the exclusion of various areas due to permanent and temporary nursery grounds (under the management plan - refer to Figure 3). Also, trawling is excluded from the sanctuary and recreational zones of the Shark Bay Marine Park and from certain special purpose zones (see Figure 2).

It should be noted that although the Shark Bay area is a World Heritage-listed marine park, the environment of this area reflected 30 years of trawling in the bay at the time of listing. Furthermore, most of what became the marine park was already closed to trawling, to protect nursery areas and other important habitats, at the time the park was declared.

3.1.2 Value of the Fishery

The value of the prawn trawl industry contributes significantly to the regional economy of Western Australia. The Shark Bay Prawn Managed Fishery is the most productive prawn-fishery in the State, valued at approximately \$30m annually, and is an important contributor to employment opportunities within the Gascoyne region.

3.1.3 Operators, Catch Rates and Species

Prawn trawling in Shark Bay began in 1962, with four boats landing 152 tonnes of king and tiger prawns.

King prawns are still the dominant species, making up about 65 per cent of the catch, while tiger prawns and a small portion of Endeavour prawns make up the rest. This region now has 27 licensed boats operating in the area and is the largest prawn fishery in Western Australia. These boats are also licensed to trawl for scallops and take between 20 and 30 per cent of the annual scallop catch in Shark Bay.

3.1.4 Operational Aspects

The prawn trawlers in Shark Bay tow twin eight-fathom head-rope otter trawl nets. The trawl speed is approximately three and half to four knots. Based on a combination of head-rope length and trawl speed, the average swept area of the fleet has been estimated at 7,300 km². Trawling generally occurs in water deeper than 12 metres.

Trawl effort tends to be concentrated in certain areas of Shark Bay and it must be emphasised that due to the amount of overlapping of swept ground, the actual area of the bay subjected to trawling would be much smaller than the estimated 7,300km².

It is estimated that this effort, in terms of swept area, is concentrated into an area of approximately 2,150km² of seabed within the bay, which represents about 15 to 20 per cent of the waters in Shark Bay (A Review of Bycatch Issues relevant to the Shark Bay Demersal Trawl Fisheries, Department of Fisheries, in prep. b). Trawl shot duration in Shark Bay is generally about 60 minutes.

The nets of the Shark Bay prawn trawlers are spread by otter boards, which weigh in the vicinity of 270kg each. It should be noted the boards would not exert this amount of pressure on the sea bottom. These otter boards are comparatively light compared to those used in other fisheries, which can weigh up to several tonnes - for example, the otter boards used in commercial trawlers fishing the Grand Banks off Newfoundland weigh in excess of 1,000kg each.

Many operators attach a double-ended cod end to their trawl net to separate crabs from prawns during trawling. This minimises the damage caused to prawns by crabs while being held in the cod end.

3.2 Management Regime

There are a variety of management measures currently in use within the Shark Bay Prawn Managed Fishery, which already contribute to the management of bycatch. These management measures are detailed below.

3.2.1 Gear Controls

A series of gear controls exist within the Shark Bay Prawn Managed Fishery and include restrictions on the:

- mesh size of nets;
- number of nets;
- length of trawl net head rope;
- characteristics of the ground chains; and
- size of otter boards.

Mesh size should not be greater than 60 mm (although in practice, prawn vessels use a net with 50 mm mesh in the body of the net and 45 mm in the cod end). More detail on the gear controls can be found in the Shark Bay Prawn Managed Fishery Management Plan.

3.2.2 Seasonal Closure

The Shark Bay Prawn Managed Fishery is generally closed between November and March, which limits the fishing mortality on older prawns and allows a stock of large prawns to accumulate in deeper waters in the north of the bay. Large prawns from the previous year's recruitment are fished in deeper waters at the start of the following season, prior to fishing the new season's recruits.

New recruits enter the Shark Bay prawn population over this period, but, because of different habitat requirements of the juveniles, they are located within the permanently closed waters of the nursery area and are thus protected from fishing until they mature and move into the adult stock.

3.2.3 Temporary Area Closures

In addition to areas of permanent closure, there are other areas that are closed to fishing for part of the year. The closures have a number of purposes, including the protection of important nursery areas and of prawns under market size.

The current regime of temporal and spatial openings/closures within the Shark Bay Prawn Managed Fishery is the result of over 20 years of development and is described below. Note that the opening/closing dates alter marginally each year depending on environmental conditions, moon phase and the results of surveys that predict recruitment dynamics.

From the start of the season (mid-March) to the estimated start of recruitment of juveniles into the fishery (mid-April), fishers are restricted to the northern area of Shark Bay and the western gulf (refer to Figure 4). During this period, prawns left over from the previous year's recruitment are fished, while restrictions on fishing further south prevent fishing of juvenile prawns below the market size.

The recruitment pattern of prawns in Shark Bay is in a generally northwardly direction, from the shallow hypersaline areas to deeper oceanic waters.

From around mid-April, or when recruitment of marketable-sized prawns has been predicted to take place (confirmed by survey), until mid-May, fishers are permitted to trawl in the area within the Carnarvon Line and the extended nursery area north of the Eastern Gulf, in addition to the northern grounds (refer to Figure 4). The western gulf of Shark Bay is closed to trawling during this period.

From mid-April until the beginning of August, Denham Sound is closed as new recruits enter that section of the fishery. It re-opens in August to permit the capture of these prawns at a time when they have reached a marketable size (refer to Figure 4).

A closure north of the extended nursery area, designed to protect a portion of the tiger prawn breeding stock during spawning, is closed from mid-July (see also Figure 4). This closure

period is now determined through catch rate monitoring and surveying spawning areas in June and July.

From the beginning of August until the end of the season (around late October), trawling is permitted in all areas of the fishery except the permanent and extended nursery areas and the tiger prawn closure area.

From the start of the 2000 fishing season, the arc that formed part of the western and southern boundary of the extended nursery area was re-aligned and straightened and the boundary of the permanent nursery moved one mile north. This realignment facilitates navigation using GPS technology, thus reducing the risk of boats transgressing into non-trawl areas south of the new nursery line. It also provides the opportunity for a more sophisticated fishery closure that better achieves the aims of protecting breeding stocks of tiger prawns.

3.2.4 Time Closures

Prawns are predominantly nocturnal and trawling is only permitted between 1700 hours (local time) and 0800 hours in the majority of the fishing areas. North of 24°45'18" south latitude, trawling is permitted 24 hours a day for a limited time in the season. Trawling for prawns during the day is often unproductive, as prawns burrow in sediment in daylight and are hard to catch.

During full moon periods, prawns often moult and become more difficult to catch. A three to five day fishing closure around the full moon has been in place for several years to increase economic efficiency (by allowing a period for prawns to harden and thus be less prone to damage whilst being trawled) and avoid the capture of moulting soft-shelled prawns, therefore increasing product quality. Industry requested a seven-day closure around the full moon from July onwards for the 2000 season.

3.2.5 Crew Restrictions

The crew on a prawn trawler is limited to six unless the Executive Director of the Department of Fisheries grants an exemption.

SECTION 4 EXISTING ENVIRONMENT IN SHARK BAY

Bycatch is a consequence of interactions between trawl gear and the physical and biological environment. Therefore, in order to understand the impacts of bycatch within the Shark Bay Prawn Fishery, it is first necessary to understand the environment in which the fishery operates.

This section provides background on the environment in Shark Bay in terms of the natural (physical and biological) environment. More information on the current environmental state of Shark Bay can be found in the Gascoyne Fisheries Environmental Management Review (Department of Fisheries, December 2000). Specific information on the world heritage values of Shark Bay is provided in Appendix B.

The commercial trawling operations in Shark Bay commenced in the early 1960s. There is only limited information on the environmental conditions in the bay prior to this, making it difficult to determine if there are any long-term impacts of trawling.

There is considerably more information available on the existing natural environment in Shark Bay than that of the past. This section therefore details the existing resources in Shark Bay and their current condition. In the context of this Bycatch Action Plan, it is those natural resources that are currently harvested or have the potential to be otherwise affected by the prawn trawling activities, which will be highlighted.

4.1 Climate and Oceanography

Shark Bay has a semi-arid to arid climate with hot, generally dry summers and mild winters. The waters of Shark Bay cover an area of about 13,000 km². It is for the most part a shallow embayment, with an average depth of 9 metres and a maximum depth of 29 m.

The large seagrass beds in the bay influence the hydrology of the area, slowing water currents as they pass over the beds and allowing increased deposition of suspended sediments. This has led to the development of large sedimentary banks (e.g. Faure Sill).

The restrictions on water flow imposed by these seagrass banks have resulted in the unusual hydrological structure in Shark Bay, characterised by salinoclines and three major water types, namely oceanic (salinity 35 - 40ppt), metahaline (40 - 56ppt) and hypersaline (56 - 70ppt). This distinct salinity pattern influences the distribution of marine flora and fauna within the bay, leading to three biotic zones.

4.2 Seagrass

Shark Bay contains the world's largest reported seagrass meadow, as well as some of the most diverse seagrass assemblages (Walker, 1989). The most common and abundant species in the bay is *Amphibolis antarctica* which occupies over 90 per cent of the total seagrass area.

Being the dominant marine organism in Shark Bay, seagrass has a major role in the structure and function of the bay's communities. Seagrasses have a number of important values including high primary productivity, providing a food source, shelter and habitat, and nursery areas for fish and invertebrates (Kirkham *et al.* 1991).

The seagrass areas (Figure 5a) serve as prawn nursery areas with the majority of them protected from trawling by means of permanent and temporary nursery areas within the Management Plan for the Shark Bay Prawn Managed Fishery (Figure 3) and by reservation within the Shark Bay Marine Park (Figure 2).

Although there are some areas of seagrass within the areas where trawlers can operate, these areas are generally actively avoided as the seagrass would clog the nets, reducing the number of prawns caught, increasing sorting times and generally making fishing very inefficient.

4.3 Finfish Fauna

The recreationally and commercially important finfish within Shark Bay are pink snapper, trevally, sea perch, north-west snapper, queen fish, spangled emperor, mulloway, coral trout, dhufish, longtail tuna and amberjack.

Studies of the finfish fauna of Shark Bay were undertaken in the late 1960s (McKay, 1970; McKay, unfinished manuscript), while comprehensive surveys at Monkey Mia and South Passage have been undertaken since the 1960s.

The South Passage survey determined that this site is possibly the most southern location in Western Australia supporting predominantly tropical fish species. The survey at Monkey Mia recorded a comparatively high diversity of finfish in the inter-tidal seagrass areas and adjacent sand flats, compared to similar habitats elsewhere in the State.

4.4 Coral Communities

In Shark Bay, soft coral and sponge habitats occur in the relatively oceanic areas inside the 20-metre depth contour from Carnarvon to Quobba in the northern embayment, and did occur in the area west of Elbow Shoals prior to 1969.

The Department of Conservation and Land Management (CALM) has recorded the presence (and absence) of coral at survey sites within Shark Bay. This information is illustrated in Figure 5b.

The eastern shores of Bernier, Dorre and Dirk Hartog Island provide the most favourable habitats for coral growth. Some of these waters support prolific coral growth in both sheltered leeward and exposed areas. A large proportion of these areas are protected by a fishing closure, due to being located in a permanent fish nursery area.

Corals are prolific in the Sandy Point, Bar Flats and Egg Island area. The most popular recreational coral sites in the World Heritage Property Area occur in the more sheltered waters

of Dirk Hartog Island and at isolated coral outcrops, such as those at Broadhurst Bight and Bar Flats. Much of this area is subject to permanent closures under the trawl Management Plan.

4.5 Other Invertebrates

The shallows of Shark Bay support a diverse and abundant invertebrate community. This has been attributed to the spatial isolation, high organic productivity and extensive seagrass beds and carbonate sand flats.

4.6 Reptiles

Green and loggerhead turtles are common in Shark Bay. Two other species, the hawksbill and leatherback have been sighted in the bay, but are not common.

Although investigations have shown that green turtles occur commonly as residents in Shark Bay, there are no major breeding sites for this species located within Shark Bay.

The green turtle and hawksbill are 'priority fauna' – that is, Category 4 species under the *Wildlife Conservation Act 1980*. Priority 4 species are "taxa in need of monitoring" indicating that these are taxa considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change.

Sea snakes are very common in Shark Bay. Six of the 22 species known to occur in Western Australia have been recorded in Shark Bay, including *Aipysurus pooleorum*, which is endemic to the region.

4.7 Marine Mammals

Shark Bay is an internationally significant dugong habitat supporting large numbers of dugongs. Surveys carried out in 1989 and 1994 have estimated the population of dugongs in the bay to be stable at 10,000 individuals (Marsh *et al* 1994; Prince pers. comm.).

Dugongs migrate seasonally within Shark Bay, with large numbers of dugongs and their young found on the Faure Sill and Wooramel Seagrass Bank, and between Faure Island and Gladstone Bay during summer. All these areas are contained within the permanent nursery closure and are not trawled.

Dugongs are reported to move into the trawled area of the western gulf during winter (Marsh, 1994; Department of Fisheries, in prep.).

A large dolphin population is present in Shark Bay. Dolphins visit the beach in Monkey Mia, which is a popular tourist attraction. It is believed that they were originally attracted to Monkey Mia when it was an off-loading and mooring point for prawn trawlers.

In recent years, humpback whales have been sighted off the western shore of Dirk Hartog Island on their annual migration along the WA coastline. Killer whales have also been reported in South Passage and on the eastern coast of Dirk Hartog Island. It appears that they may occasionally enter Shark Bay in winter months to prey on dugongs.

4.8 Seabirds

Seabirds are a significant component of the fauna of the Shark Bay. Sea and shore bird nesting and feeding locations occur extensively throughout the Shark Bay area.

SECTION 5 OTHER FISHING ACTIVITIES IN SHARK BAY

Bycatch becomes a resource sharing issue when the species involved are the target of other commercial or recreational fishing operations.

This section documents the other recreational and commercial fishing operations that occur in Shark Bay. This information is a summary and does not attempt to provide a high degree of detail.

For more information, readers are referred to the Gascoyne Region Fisheries Environmental Management Review (Fisheries WA, December 2001) and the Gascoyne Regional Recreational Fishing Review discussion paper: *'A Quality Future for Recreational Fishing in the Gascoyne'* (Gascoyne Recreational Fishing Working Group, 1999) and *'A Five-Year Management Strategy for Recreational Fishing in the Gascoyne Region of Western Australia'* (Gascoyne Recreational Fishing Working Group, 2001).

5.1 Commercial Fisheries

There are numerous commercial fisheries operating within Shark Bay. This assessment focuses on those actively operating in the bay and, particular, the ones likely to interact in some way with the Shark Bay Prawn Managed Fishery.

5.1.1 Shark Bay Scallop Managed Fishery

The Shark Bay Scallop Managed Fishery is closely associated with the Shark Bay Prawn Managed Fishery. The scallop fleet is divided into two groups - dedicated scallop boats (Class A) and prawn trawlers who also have a licence to catch scallops (Class B).

Class A vessels use a trawl net with a minimum mesh size of 100 mm to limit the catch to larger scallops and prevent the capture of prawns, while Class B vessels use 50 mm mesh nets. Dedicated scallop trawlers can trawl 24 hours a day, whereas Class B vessels can only trawl from 1700 to 0800 hours.

All vessels are permitted to retain one tonne of snapper (or 10 snapper units) under the Shark Bay Snapper Management Plan.

5.1.2 Shark Bay Beach Seine and Mesh Net Managed Fishery

The Shark Bay Beach Seine and Mesh Net Managed Fishery operates within the waters of the bay south of the northern point of Dirk Hartog Island, with the exception of the Hamelin Pool Marine Nature Reserve.

Target species are predominately whiting and seasonal mullet, tailor and yellowfin bream. Although whiting are trawled, these are different species of whiting to the one caught by the Shark Bay Beach Seine and Mesh Net Managed Fishery.

Yellowfin bream, mullet and tailor are generally not caught in high numbers by trawlers. Species of whiting are becoming important to recreational fishers in Shark Bay.

5.1.3 Shark Bay Snapper Managed Fishery

Shark Bay snapper licensees target pink snapper and other finfish using mechanised hand-lines. Juvenile pink snapper are caught as bycatch in the Shark Bay Prawn Managed Fishery and subsequently discarded.

5.1.4 Wetline Fishery

A 'wetline licence' or 'WA Fishing Boat Licence' (WAFBL) without endorsement or access to any of the managed fisheries may be used to catch fish by a variety of methods, including hand-lines, drop-lines and hand-hauled nets. 'State-wide' target species for so-called wetline fishers include Spanish mackerel, pink snapper, north-west snapper, sea mullet, spangled emperor and sweetlip emperor.

The Shark Bay Prawn Managed Fishery fleet generally catches most of the 'State-wide' species, but the more localised wetlining target species are not known. Pink snapper are not permitted to be retained by wetliners in Shark Bay as they are the subject of the Shark Bay Snapper Managed Fishery.

5.1.5 Crabbing

There are five commercial fishers who are permitted to catch crabs in pots in Shark Bay - three by exemption in the Experimental Carnarvon Crab Pot Fishery and two other commercial fishers. Crabs can also be caught in wetline fishery by hand-hauled nets and drop nets. Note that crabs are retained as incidental catch in the Shark Bay prawn and scallop fisheries.

5.2 Recreational Fishing

Recreational fishing is an important activity and industry in Shark Bay. Key recreational fishing pursuits include angling, netting, spear fishing, rock lobster fishing, crabbing and collecting shellfish.

The degree to which trawler bycatch species overlap with important recreational fishing species is complicated by limited knowledge of both trawl bycatch and key recreational species. Information on the species important to recreational fisher in Shark Bay was gained from creel surveys and advice from the Regional Recreational Fishing Advisory Committee (RRFAC).

Creel surveys involve collection of data on recreational fishing effort, target species and catches. Surveys are conducted at boat ramps, shore-based fishing localities and other fishing sites. Interpretation of this data, to determine key target species, must be done with caution as records of high numbers caught of a particular species may not necessarily indicate it is a 'prized' one.

The Denham RRFAC advised that the key species important to recreational fishers, which need to be addressed by this Bycatch Action Plan, are squid, blue swimmer crabs and pink snapper.

SECTION 6 EXISTING INFORMATION ON BYCATCH

There is limited existing information on the level and nature of bycatch in the Shark Bay Prawn Managed Fishery. Although this, in turn, limits the perspective of the Bycatch Action Plan, its development has been based on the 'best data available' approach, recognising the need for further research.

The extent of the existing information is contained in the following sources:

- Department of Fisheries' Catch and Effort Statistics System (CAESS), which contains data on declared non-target catch in the fishery (as part of what is known as 'Monthly Returns', which is provided by fishers and details their catches).
- WA Museum Trawl Survey 1997.
- Shark Bay Bycatch Reduction Trials Observer Data.

For detailed information on these sources, the reader is referred to 'A Review of Bycatch Issues Relevant to the Shark Bay Demersal Trawl Fisheries' (Department of Fisheries, in prep. b). Summaries are provided below.

6.1 CAESS Data Information

Data was obtained from the CAESS relating to the Shark Bay Prawn Managed Fishery from 1992/93 to 1996/97. This indicated that the dominant by-products in the fishery, in terms of weight and value, are crabs, cuttlefish, samson fish, shark, squid and, to a lesser extent, mullocky.

It should be noted that some of this 'by-product' is unlikely to have been caught by trawling, but rather by other methods under the vessels' WAFBL. For instance, samson fish and shark are more likely to have been caught by wetlining.

6.2 WA Museum Trawl Survey 1997

During November 1997, in conjunction with the annual scallop stock survey, bycatch taken using nets with standard prawn mesh was sampled from 73 trawl shots of 20-minutes duration between the northern end of Bernier Island and Freycinet Estuary. This information was collected and identified by staff of the WA Museum working aboard the Department of Fisheries' *RV Flinders*.

The gear consisted of twin 8-fathom head-rope otter trawls fitted with 45mm stretched mesh cod ends, and trawling was conducted at night. From catch records and observation by Department of Fisheries staff, the catch was consistent with that taken by commercial prawn trawlers in Shark Bay.

The data recorded as part of the survey distinguished between species that were caught “frequently” (i.e. greater than three individuals per tow), and species that were caught “irregularly” (i.e. less than three individuals per tow).

6.3 Shark Bay Bycatch Reduction Trials Observer Data

Bycatch Reduction Devices (BRDs) is the term given to those devices fitted to existing fishing gear in order to reduce the amount - or change the nature - of bycatch collected during fishing. There have been several types of BRDs designed for trawl gear and these are discussed in detail in the document 'A Review of Bycatch Issues relevant to the Shark Bay Demersal Trawl Fisheries' (Department of Fisheries, in prep. b).

Depending on what type of bycatch is to be reduced (e.g. large animals, small animals, benthic organisms or habitat) and the environment in which the gear is to operate, different types of BRDs will have different levels of effectiveness. Therefore, it is important for BRDs to be specifically designed to meet the bycatch reduction requirements of individual fisheries, so they can function at optimal levels.

Also, in order for a BRD to be acceptable to fishers, the device needs to be able to eliminate the desired amount or type of bycatch without reducing the catch by an unacceptable level.

Trials of BRDs in the Shark Bay Prawn Managed Fishery commenced in 1998, funded through the Commonwealth's Natural Heritage Trust, State Development and Better Interests funds, and in-kind support from industry. The aim of the project was to test the two main types of BRDs used in prawn fisheries - grids (which exclude large organisms such as turtles, sharks and rays) and fish exclusion devices (which allow actively swimming fish to escape).

The overall objectives of the bycatch gear trials were to determine the most effective combination of BRDs in reducing bycatch without damaging the prawn catch and lowering its commercial value.

The formal trials were completed in August 1999, and the details of the results will be contained within a report to the Natural Heritage Trust (Department of Fisheries, in prep. a). The outcomes of the trials are summarised below:

- No turtles were caught in the BRD net in any of the trials.
- Two BRD configurations performed well at reducing bycatch and minimising the loss of king and tiger prawns. These were the Pyramid BRD, a peaked grid with a radial escapement device, and the Olsen BRD, which is essentially an angled grid with ‘fish-eye’ openings on either side of the grid.
- Fish exclusion devices appear to be successful at reducing bycatch of some fish species.
- Across all trials and devices tested, it appears that less sea snakes were caught in the net fitted with BRDs than in the standard net.
- Grids do occasionally clog with weed.

An observer program ran concurrently with the BRD trials to record information on the level of bycatch from both the standard net and the BRD net being trialled. Based on this observer program, the ratio of discards to target to target and byproduct weight has been estimated to be approximately 4 - 8:1 (note there is a very high variability of the amounts of bycatch caught).

Further trials have occurred since the formal ones described above, aimed at refining the design and operation of the BRDs.

The occasional occurrence of floating weed in Shark Bay has caused an operational constraint with some BRDs, which needs to be overcome. The weed becomes caught in - and clogs - BRD grids, and work will continue to resolve this issue.

SECTION 7 PRIORITISATION OF BYCATCH ISSUES

A list of issues relevant to bycatch management in the Shark Bay Prawn Managed Fishery was developed during the planning phase of this plan. This list was based on:

- Consideration of operational aspects of the fishery within the known physical and biological environment of Shark Bay (see Section 3 and 4 of this document).
- A review of existing information on bycatch data and management techniques within Shark Bay, nationally and internationally (see Section 6 and the document ‘A Review of Bycatch Issues relevant to the Shark Bay Demersal Trawl Fisheries’, Department of Fisheries, in prep. b).
- Input from a vast range of stakeholders regarding, among other things, environmental values, social values and expectations, and resource sharing issues (see Section 2).

The issues identified will be discussed in terms of the following categories:

- Environmental Impact Issues;
- Resource Sharing Issues;
- Level of Bycatch Information; and
- Industry Benefits.

This section provides a discussion and assessment of bycatch issues, with each issue being examined in order to determine its priority for management. Where appropriate, the range of management options available is also discussed and the preferred option documented.

The aim is to determine priority bycatch issues within the Shark Bay Prawn Managed Fishery and determine appropriate management options.

7.1 Environmental Impact Issues

7.1.1 Effects on Biodiversity

There is public concern that bycatch generated from the Shark Bay Prawn Managed Fishery may affect the ‘biodiversity’ and World Heritage value of the area. Biodiversity is defined as the variety of life forms, consisting of three levels - genetic diversity, species diversity and ecosystem diversity (Commonwealth of Australia, 1996).

The elements of genetic diversity are covered in Section 7.1.7, in the discussion regarding localised depletion of resources. The elements of ecosystem diversity are covered by discussions of damage to benthic habitats and ecosystem effects in Sections 7.1.3 and 7.1.8 respectively. Species diversity is addressed here.

Species diversity is only likely to be threatened if prawn trawling practices remove a species that is endemic to Shark Bay. Currently, the catch composition of prawn trawlers is not understood well enough to know whether this situation is occurring. Priority should be given to gathering this information by looking at the distribution of bycatch species and the proportion of their range inside and outside of the trawl grounds.

Conclusion: It is unknown whether prawn trawling poses a threat to the species diversity of Shark Bay. Priority should be given to determining whether any endemic species are threatened by this practice (elements of genetic diversity and ecological diversity are covered in Sections 7.1.3 and 7.1.8 respectively).

Action: Seek funding to determine the distribution of fish species inside and outside of the trawl grounds and the impact of trawling on endemic species.

7.1.2 Interaction with Seagrass Habitats

An issue that has been of high concern in Shark Bay is the destruction of benthic habitats, in particular seagrass beds.

The trawl gear used interacts with the seabed in two ways:

- The otter boards make significant contact with the seabed.
- The trawl ground chain makes minimal contact with the bottom and tends to pass over flexible plants such as seagrasses. However, it may dislodge objects such as sponges and corals if they extend more than a few centimetres above the seabed.

Fishing for prawns and scallops in Shark Bay occurs predominantly over sand, in the deeper waters where there is limited seagrass (Refer to Figure 5a). Although seagrass is seasonally picked up in trawl nets, this material has already detached from the bottom naturally and is moved around with the currents.

The seagrass present in Shark Bay is most often *Amphibolous antartica*, commonly described as 'wire weed'. Sloughing off of weed is a well-known occurrence and there is no evidence of trawl nets uprooting the seagrass.

Conclusion: The destruction of seagrass habitats, under current fishing operational conditions, is a misconception, possibly born from the amount of naturally-uprooted seagrass present in the water and the mistaken belief this has been caused by trawling. This issue is therefore not a management priority.

Management Options: No management required.

Action: No action required.

7.1.3 Disturbance of Benthic Communities

Although prawn trawling in Shark Bay occurs predominantly over sand and not seagrass, sand still represents a habitat within the bay as it harbours other benthic and epibenthic communities.

Under current conditions, a large proportion of the known areas of coral growth in Shark Bay are protected, as a result of permanently closed areas. As reported in Section 4.4, corals are prolific in the Sandy Point, Bar Flats and Egg Island area.

Sandy Point is protected from trawling by a sanctuary zone of the Shark Bay Marine Park. The area around Egg Island is open to trawling at the end of the season (from around August to October) and trawling is permitted in parts of Bar Flats, but is excluded from around mid-April to around 1 August. However, both of these areas are not part of the actively trawled area (refer to Figure 3).

Although it appears that a large proportion of the coral habitat in Shark Bay is within an area where trawling is not carried out, the degree to which the current environments reflect the situation prior to the introduction of trawling in the bay is unknown.

Recollections of Department of Fisheries staff, (Penn pers. comm.) with a long association with the Shark Bay prawn trawl fishery suggests that a small area of sponge and coral was present south-west of Elbow Shoal. Trawling has evidently gradually removed the sponge and coral that used to exist in this area. Similar soft coral and sponge habitats were located in research surveys along the eastern border of Shark Bay, north of Carnarvon (Penn, pers. comm.)

There have been several studies looking at the effects of demersal trawls on benthic habitats. *'A Review of Bycatch Issues relevant to the Shark Bay Demersal Trawl Fisheries'* (Department of Fisheries, in prep. b) discusses these studies in depth. There have been varying results, as summarised by the following:

- Gilkinson *et al.* (1988). This study found that bivalves in the scour paths of trawl otter boards were displaced into sediment berms. Of 42 specimens in the scouring zones, only two showed major damage.
- Poiner *et al.* (1999). Recent work on the effects of trawling in the northern sections of the Great Barrier Reef suggests a removal rate for sessile benthos of approximately 10 per cent a tow. However, 'Before and After Control Impact' (BACI) experiments could not detect the impact of a single tow.
- Sainsbury (1991). This study showed that by modifying the benthic habitat in areas through the removal of large epibenthic organisms, trawling affected the abundance and kinds of fish species that occupied those habitats.
- Gibbs *et al.* (1980). Compared epibenthic assemblages in areas before and after trawling in Botany Bay and concluded that otter trawling caused no detectable alterations to the macrobenthic fauna, but the large variability inherent in their data may account for the non-significant positive results.

- Laurenson *et al.* (1993). Compared trawled and untrawled areas of south-western Australia using underwater video and concluded that physical impacts on trawling on the substratum were short-lived.

It is important to recognise that each of these studies has been undertaken in fisheries that are quite different from each other and from the Shark Bay Prawn Managed Fishery, in terms of gear types, operations and environment. Therefore, care must be taken in extrapolating the results of these studies to the Shark Bay Prawn Managed Fishery.

Having said this, based on the variety of studies and a knowledge of Shark Bay, it is reasonable to conclude that trawling has modified the habitat of heavily targeted areas within the bay, particularly given that trawling has been undertaken for around 30 years. However, it is expected that whatever modification occurred, it took place quite early in the history of the Shark Bay prawn fishery and that the environment has now reached a new level of dynamic equilibrium.

Although there is limited scientific survey data (CALM, 1997), anecdotal evidence suggests there are several valuable areas of coral and sponge still potentially susceptible to trawling in Shark Bay. What proportion of these are contained within the licence area and the functional trawl ground cannot be determined, due to limited knowledge of the location of the corals.

Prevention of further damage to valuable or sensitive benthic environments in Shark Bay is an issue.

Conclusion: Although it is likely that Shark Bay's environment has been modified over the period that trawling has been carried out in the area, it appears that current short-term changes are minimal and that Shark Bay may have reached a new equilibrium. The current issue is therefore the prevention of further damage to - and preservation of - existing valuable and/or sensitive benthic communities in Shark Bay.

Management Options: There are three management options available to reduce benthic disturbance:

- Modifying gear design or operation to reduce physical interaction of the gear with the sea floor; or
- Where practical, amending the area available to trawl to prohibit trawling in valuable or sensitive areas; and /or
- Reducing the annual season time to reduce the overall time spent trawling the area.

A full description of the options is as follows:

- *Option 1 - Modifying Gear Design or Operation* - Disturbance of the benthic environment is a consequence of the interaction between otter boards and ground chains used in trawling, and the benthos and sediments. As the use of otter boards/ground chains is an integral process in prawn trawling (they 'lift' prawns into the path of the trawl), it would be difficult to reduce the nature of this disturbance, in terms of gear modifications, and still maintain the present level of fishing efficiency.

- *Option 2 - Prohibiting Trawling in Sensitive or Valuable Areas* - It may be more practical to prohibit trawling in areas which are known to be valuable or sensitive. The impact this would have on the catch or efficiency of the Shark Bay prawn fishery would, of course, need to be carefully considered.

However, this option would seem achievable, as a large proportion of the area currently available for prawn trawling is not within the functional fishing area. Also, the remaining valuable and/or sensitive benthic communities are likely to be outside the current functional fishing area of the Shark Bay prawn fishery.

Habitat mapping would be required to determine the location of important benthic habitats in the bay, in order to develop a strategy to prevent damage to these areas.

This process would be aided by the introduction of the Department of Fisheries' Vessel Monitoring System (VMS) into this fishery during 2000, allowing the major trawl grounds and the distribution of trawl effort to be electronically determined within the bay. Based on this information and distribution of habitats, the Department of Fisheries will be able to re-assess the trawl boundaries.

This process should also allow areas to be closed to trawling to allow for rehabilitation, if there is any damage or disturbance to benthos. An appropriate medium for this work would be through the preparation of a Fish Habitat Protection Area for Shark Bay (see Section 1.4).

- *Option 3 - Reducing Trawling Time Each Year* - To further reduce the impact of the Shark Bay prawn fishery on the associated habitat, a third option would be to reduce the annual season length in terms of number of trawling days. This amendment has previously been suggested by the licensees and should be given consideration. However, it should be noted that this option would be intended to complement and not replace Option 2.

Action: Investigations should be undertaken to determine the location of areas of sensitive or valuable benthic habitats. Based on investigations of sensitive/valuable habitats, revise trawl boundaries to protect the former and, where possible, allow for the rehabilitation of areas modified by trawling. The possibility of reducing the length of the Shark Bay Prawn season should be investigated.

7.1.4 Mortality of Protected Species

'Protected species' is a broad term, which can be used to mean a number of different things. There are several jurisdictions and pieces of legislation, which 'protect' endangered, threatened and rare species and this (as well as many other factors) affects what organisms may be retained as by-product in the fishery.

The impact of the Shark Bay prawn fishery on protected species caught as bycatch is dealt with here in two sections - 'Endangered Megafauna' and 'Undersize Fish'.

Endangered Megafauna

Concern has been expressed about incidental catches of dolphins, turtles, sea snakes and even dugongs in trawl nets. Information from research vessels in Shark Bay indicates:

- dolphins and dugongs are not caught in trawl nets; and
- catches of turtles are infrequent, although those of sea snakes are more common.

CALM is carrying out a tagged recapture program involving turtles, which so far has indicated that mortality does not result from the capture of the latter by trawlers. Note that both turtles and sea snakes are caught by trawlers.

The document 'A Review of Bycatch Issues relevant to the Shark Bay Demersal Trawl Fisheries' (Department of Fisheries, in prep. b) reported that with respect to turtles, the impact of trawling seems to be minimal due to:

- moderate incidence of capture; and
- high rate of survival due to short shot duration of trawls.

Anecdotal evidence suggests that turtles can fall from hauled trawl nets onto a trawler's sorting tray, which may result in shell fractures. It has been reported that turtles have been seen with 'cracks' in their shells.

Although there is considerable evidence to show that the impact on turtles from trawling is minimal, the threatened status of these organisms places them as a high priority. Under the Draft Recovery Plan for Marine Turtles in Australia, the Department of Fisheries is committed to collecting data on the occurrence of turtles caught in trawl nets.

It is accepted that sea snakes are caught by trawl nets, but evidence suggests that minimal injuries occur as a result. Overall, in the shots conducted in the Department of Fisheries/Industry/Natural Heritage Trust trials, 60 per cent less sea snakes were caught in the net fitted with a BRD than in the standard net. Although the results of these trials includes data from several different BRD types, they are promising in terms of the ability to reduce sea snake bycatch.

Conclusions:

- There have been no reports of dugongs or dolphins being caught. This is not an issue.
- Turtles are known to be caught in trawl nets in moderate numbers, but probably have very high survival rates. They are considered a priority issue for management due to their threatened status, although in practice it appears that trawling has little impact on turtle populations in Shark Bay.
- Although sea snakes are caught moderately often, it appears that the impact is minimal. The incidence of sea snake capture should be monitored.

Management Options:

- *Option 1 - Installation of BRD Grid to Exclude Turtles* - It is considered that grids can be used in prawn trawl nets in Shark Bay to prevent turtle capture.
- *Option 2 - Develop Codes of Conduct to Increase Turtle Survival* - There are procedures that can be undertaken for a trawl-caught turtle that can increase its chance of survival. These procedures (such as resuscitation techniques) are considered to be rarely required in the Shark Bay Prawn Managed Fishery since very few are caught and, of those that are collected, drowning is rare due to the short duration of trawl shots. However, crew members should be aware and be able to carry out the procedure should the event arise.

The development of procedures to lessen the fall of turtles from the net to the sorting tray, to prevent shell fractures, should be considered. However, it should be noted that this would not be necessary if devices to exclude turtles from the nets were introduced (refer Option 1).

- *Option 3 - Collection of Data on Turtle Capture* - The Department of Fisheries is committed to collecting data on turtle capture in trawl nets through the Marine Turtle Recovery Plan (Environment Australia, 1998), although it is expected that once BRDs have been implemented, turtles are not likely to be caught. This data collection would be effectively achieved if vessels were required to log defined information once a turtle is captured.

Both the scallop and prawn fleets should collect this information, which could then be collated and analysed every six months. The information should be used to assess the effectiveness of a BRD installation on reducing turtle catch.

In order for this option to be effective, crew members will need to be able to identify turtle species. This could be achieved by providing a training program for them and placing identification cards on all fleet vessels.

- *Option 4 - Collection of Data on Sea Snakes* - Although it is thought that the mortality of sea snakes due to trawling is minimal, there is very limited information of both the occurrence and survival rates. This information should be collected through the same procedures outlined for turtle data collection. This would also require crew members to be familiar with the identification of snake species, and therefore would require training and identification cards. Identification may require close inspection, which could raise a safety issue that will need to be thoroughly addressed.

Actions:

- Dugongs - No actions required.
- Turtles - Develop and implement BRDs capable of excluding turtles from trawl net; continue to collect data on and monitor incidents of turtles being caught and their condition; establish a code of conduct for skippers and crews to ensure the survival of turtles caught in trawl nets; and skippers and crew should be trained in the identification of turtle species.

- Sea snakes - Record any incidents of sea snake catch in trawl nets; and skippers and crew should be trained in the identification of sea snake species. No other actions are required.

Undersized Fish

There are a number of other species protected under various legislation. The 1997 WA Museum Survey data did not reveal that any species protected under the *Wildlife Conservation Act 1950* (administered by CALM) were caught.

The *Fish Resources Management Act 1994* protects fish under specified legal size limits, to ensure that an adequate number reach reproductive maturity before being vulnerable to fishing. Trawlers are known to catch undersized fish. Anecdotal evidence suggests that many individual undersized fish are caught dead or die on the sorting table.

Conclusion: Reducing the mortality of species (undersized fish) is a high priority.

Management Options:

- *Option 1 - Prevent the Capture of Undersized Fish* - Efforts should be made to reduce the initial capture of undersized fish through the design and implementation of fish-excluding BRDs. The BRD trials undertaken to date have investigated the ability of various fish exclusion devices to reduce bycatch.

Although the juveniles of some fish species have limited swimming ability, and are therefore difficult to exclude through this means, it appears that the gear may be partially successful in this area. The use of double-ended cod ends, which are already used by many vessels in fleet, may also act as a protective measure by separating the fish while trawling.

- *Option 2 - Increase the Survival of Undersized Fish* - A significant proportion of bycatch species may perish on the sorting tray due to the length of time out of water. Minimising the time lapse between hauling nets and releasing protected species may increase the latter's chance of survival. This may be accomplished by carrying out a 'rough' sort for undersized species, prior to the more thorough sort that separates the target catch from bycatch species. It is anticipated that this option could be implemented in the form of an industry-wide code of conduct.

Although there is no scientific evidence at this stage to conclusively confirm that this will be effective at increasing survival of bycatch species, this is a practical option that should be encouraged, pending further assessment of the issue.

In order for this option to be effective, it is necessary for all crews and skippers to be able to identify the undersized individuals of the species requiring protection. The identification of juvenile fish species can be very difficult. To overcome this problem and ensure that meaningful results are obtained, data should be limited to fish groups (rather than species). Also, guidance should be provided through a brief training session

on identifying undersized fish for the skippers and crews of vessels operating in the Shark Bay Prawn Managed Fishery and the provision of identification charts that can be held on-board each vessel.

Survival of bycatch fish may also increase if the trawl catch is sprayed with seawater while it is on the sorting table.

- *Option 3 - Collect Data on the Incidence of Catch of Protected Species* - Data should be collected on the incidence of collecting protected species in trawl nets. This data can be used to develop more effective management strategies.

Actions:

- Design and implement a BRD capable of reducing the capture of undersized fish.
- Develop and implement codes of conduct, including measures such as spraying of the catch during sorting; introduce 'rough' sorts to ensure that undersized fish are returned to the sea as quickly as possible; and encourage the use of double-ended cod ends in trawls.
- Develop and implement education programs to train crews in the identification of undersized fish.
- Collect data on the incidence of the catch of undersized fish.

7.1.5 Wastage /Collection of Large Numbers of Small Fish

A high degree of wastage is generated where a large amount of dead or damaged organisms are brought onto the vessel's deck and then returned to the sea as discards. By the nature of the operation, trawl fisheries often have a large target species-to-wastage ratio.

During BRD trials, gross estimates were taken of the amount of bycatch compared to prawn catch in the Shark Bay Prawn Managed Fishery. Based on a coarse assessment of volumes, this has been determined to vary between approximately 4 - 8:1 (note the variation in amount of bycatch).

Based on anecdotal evidence, a large portion of discarded bycatch in the Shark Bay Prawn Managed Fishery is small fish that are not considered commercially valuable. These bycatch species generally have low survival rates and most are dead before they are returned to the sea.

The recreational fishing sector has concerns that the removal of large amounts of small fish and other organisms through trawl-induced mortality reduces the food source of their key target species, such as pink snapper. The likelihood of this is considered to be low, since snapper are opportunistic benthic predators, eating a variety of molluscs, crustaceans, worms and fish.

Conclusions: Wastage is regarded as a priority issue in the management of bycatch for the Shark Bay Prawn Managed Fishery.

Management Options: Wastage can be reduced through the following fundamental methods:

- Develop methods to increase the survival of incidental catch.
- Prevent the initial collection of discard species.

These are discussed in detail below.

- *Option 1 - Increase survival of incidental catch* - Practices adopted once the catch is brought to the deck may increase the survival of discarded species. As mentioned under Section 7.1.4, these include a ‘rough’ sort to return priority species at the commencement of the sort, and spraying of the catch during sorting.
- *Option 2 - Prevent the initial collection of discard species* - There are several strategies which could be used to prevent the capture of large amounts of untargeted species:
 - (i) Prevent and/or avoid fishing in areas and at times when there are large bycatch volumes.

Such mechanisms have been successfully implemented in foreign fisheries, including the Eastern Bering Sea Groundfish Fishery, where areas of relatively high bycatch rates of Pacific herring were identified from data collected by observer programs. From this information, three time/area closures were established, taking into account herring migration patterns (Nitherell & Pautzke, 1997). This measure was particularly effective for this fishery, as herring behaviour is very predictable.

Variations of this method, more suited to the marine organisms in Shark Bay, should be considered. Already in the Shark Bay Prawn Managed Fishery, vessels generally move away from areas where large amounts of bycatch are being caught. However, there is currently no information to indicate where or when the amount of bycatch is greatest within Shark Bay, or to suggest that there is a consistent variation that would allow the creation of closures around those areas.

For this option to be viable, data would need to be collected on the distribution and abundance, both spatially and temporally, of bycatch volumes.

- (ii) Sort the catch using BRDs while fishing.

Active BRDs (such as those with net flaps, slits and different mesh types) have been used to reduce the catch of large numbers of small fish able to swim actively through these devices. This is perhaps the most efficient and promising option of reducing wastage. As discussed in Section 6, trials are currently underway to develop BRDs capable of reducing the catch of large volumes of small fish.

Actions:

- Implement a fish exclusion device capable of reducing the capture of large volumes of small fish.
- Collect data on the spatial and temporal variations of bycatch volumes.
- Formalise, in a code of conduct, the practice of vessels avoiding areas where high levels of bycatch could result from fishing, if considered appropriate following the collection of spatial and temporal data.

7.1.6 *Pink Snapper Decline in Shark Bay*

Research has indicated that there are three separate stocks of snapper within the World Heritage Property of Shark Bay. These consist of one oceanic stock, occurring in waters outside the gulfs, and two inshore stocks centred on either side of Peron Peninsula (known as the Eastern and Western Gulf stocks) (Fisheries WA, 1996).

In recent times, the status of inner gulf snapper has been of some concern as there has been significant decline in stock levels. While fishing effort has not been increased in the commercial trawl fishery, the decline in biomass of inner gulf stock has coincided with increased recreational fishing in the region, which principally occurs within the inner gulfs.

Small quantities of pink snapper are also taken by the fishers operating in the Shark Bay Beach Seine and Mesh Net Managed Fishery, from the inshore waters of the bay.

Trawlers are unlikely to have contributed to the decline of the threatened Eastern Gulf stock, since trawlers operate north of this stock in the area of the oceanic stock. Trawlers do enter the Western Gulf for short periods during the second half of the season.

Juvenile pink snapper represent a minor component of the prawn trawl bycatch and although these are likely to be juveniles of oceanic stock (G. Jackson, pers. comm.), this still creates a degree of conflict, due to incorrect perceptions.

Also recreational fishing groups in Shark Bay are concerned that trawlers may have indirectly influenced the level of the pink snapper population by reducing this species' food source. This issue is addressed under the section on wastage.

Conclusion: Although juvenile pink snapper are caught in relatively low numbers and are not inner Eastern Gulf stock, the catch of pink snapper is an issue within this fishery due to the real or perceived conflict with other fishing sectors in the bay.

Management Option: As juvenile pink snapper are comparatively good swimmers, there may be an opportunity to exclude this species, and other species with similar hydrodynamic characteristics, from the catch through appropriately designed fish exclusion devices. The incidence of catches of pink snapper catch has been recorded during the BRD trials in the Shark Bay Prawn Managed Fishery, and this practice will continue as attempts are made to incorporate a fish exclusion device that reduces bycatch of pink snapper.

Actions:

- Consider and implement mechanisms to exclude juvenile pink snapper in the design of fish exclusion devices.
- Collect data on the incidence of pink snapper bycatch.

7.1.7 Local Depletion of Resources

Trawling does not occur throughout the entire Shark Bay Prawn Managed Fishery licence area - there are areas which are not trawled, and others that are fished at high levels of effort.

As trawling tends to occur in discrete areas within the fishery, it would be logical to expect that operators are targeting the known high yield areas. There is concern these high yield areas may occur in a particular habitat type, distinct from the other areas of Shark Bay. If this were the case, then it could lead to local depletion in these particular areas and habitat types in Shark Bay, if these are not adequately represented in un-trawled grounds.

More extensive and comprehensive habitat information on the trawl grounds and their 'representativeness' would be required in order to determine if local depletion is an issue.

Conclusions: Based on the current information, it cannot be determined whether localised depletion is a priority issue. However, it is considered that this potential threat will be reduced as a consequence of reducing wastage within the fishery and through re-assessing trawl boundaries based on knowledge of benthic habitat types.

Management Options: If this situation was found to be the case, then management options could include managing the level of effort applied in particular areas. However, careful consideration should be given to such moves, as there are several potentially damaging repercussions, including diversion of effort into other areas which may have unknown effects, and reducing the efficiency of the fishery.

Actions:

- Reduce wastage through mechanisms as identified in Section 7.1.5.
- Undertake studies to determine the extent of habitats within - and external to - the functional trawl grounds.

7.1.8 Effects of Bycatch on the Ecological Processes of Shark Bay

The taking of target and bycatch species from a fishery has an impact on both those categories of species in the way they interact through predation, competition and other ecosystem processes. Consequently, there are several potential ecosystem effects that can result from trawling.

Firstly, changes to the food web can occur when particular trophic groups are reduced. For example, removal of a large proportion of whiting may reduce the food supply of a higher trophic order species that feeds on whiting. Another example is where the removal of competitors increases the survival of remaining fish, through mortality from predation.

This can cause flow-on effects that are difficult to predict without an understanding of the natural dynamics of the associated ecosystem. A second ecosystem effect may be caused by the influx of dead fish returned to the sea after each trawl shot, which can change the trophic structure of the community.

These effects could have some very interesting consequences. Dolphins, sharks and seabirds are notoriously known to follow trawlers in anticipation of a ‘free feed’ of discards. Research on the Great Barrier Reef Marine Park indicates that some seabird populations benefit by feeding on trawl discards. Therefore, it is possible that these seabird populations are inflated by trawl discards, and that reducing bycatch may result in lower dolphin, shark and seabird numbers in Shark Bay through a reduction in their food supply.

Similarly, although there is concern that trawling has reduced crab populations within Shark Bay, it is more likely that the fish discards dropped to the sea floor of the bay are actually supporting these populations. This was suggested to be occurring in Moreton Bay, where it is thought that the success of the Sand Crab (*Portunus pelagicus*) Fishery may be due to the supply of large quantities of discarded trawl bycatch to these benthic scavengers (Wassenberg, 1989). Similarly, Blaber and Wassenberg (1989) note that the three major species of seabirds in Moreton Bay primarily depend on food from trawler discards.

Conclusion: Bycatch may affect dependent species within Shark Bay. Therefore, the reduction of bycatch may cause changes in populations, which will presumably be shifted back towards the ‘natural state’. There are large stakeholder interests in the current level of some of these populations in Shark Bay, including dolphins at Monkey Mia and crabs. This issue would not be a priority for management unless it is predicted that the results of this management will be a rapid reduction in bycatch.

Management Options: Where possible, the effects of bycatch reduction should be monitored. However, due to the low priority of this issue and the amount of resources that would be required to achieve meaningful results, the most appropriate option would be to develop strategic links with other researchers in Shark Bay to help gather data on bycatch reduction.

Actions:

- Monitor ecosystem effects of reduced bycatch in coordination with other research organisations.

7.2 Resource Sharing Issues

Where trawlers collect large amounts of recreationally or commercially important species, problems can arise regarding the ‘right’ to that stock if it is retained, and the wastage if it is not. The issue of wastage is targeted discussed under Section 7.1.5.

The issue of right of the various fishing groups to take particular species is a resource sharing issue and needs to be addressed in that light.

Based on the findings detailed in the document ‘A Review of Bycatch Issues relevant to the Shark Bay Demersal Fisheries’ (Department of Fisheries, in prep. b), the important species over which resource sharing issues occur between the commercial trawling and recreational fishing sectors are pink snapper, blue swimmer (manna) crabs, squid and cuttlefish. However, the whiting caught in the trawl nets in Shark Bay is not the same species as that targeted by recreational fishers - which is yellow-finned whiting (*Sillago schomburgkii*).

On the other hand, most of the data on recreational catch of whiting collected from creel surveys are not species-specific, and more detailed data would be required to clearly define any overlapping exploitation between the recreational and trawl fishing sectors for this species type.

In any event, the species caught in trawl nets are likely to change significantly with the implementation of BRDs within them.

7.3 Level of Bycatch Information

As has been outlined in Section 6 of this document, there is limited data on bycatch within the Shark Bay Prawn Managed Fishery, limiting the basis on which strategic management decisions can be made.

It will be necessary to collect data to monitor the implementation of this plan, the effects of BRDs on the efficiency of the trawl fishery and any long-term effects of fishing on the environment of Shark Bay.

In particular, the discussion above has indicated a variety of requirements for data collection, which are to:

- Determine the effectiveness of BRDs at reducing bycatch once implemented into the Shark Bay Prawn Managed Fishery.
- Determine the impact of BRDs on the prawn catch and catch rates, which are a key element in assessing the status of the fishery;
- Determine the distribution and abundance of bycatch components in order to:
 - investigate possible spatial controls to reduce bycatch; and
 - determine the threat of localised depletion of habitats and develop management strategies.
- Honour the Department of Fisheries' commitment to recording turtle capture incidence under the Turtle Recovery Plan.
- Determine areas in need of protection in order to preserve sensitive and/or valuable habitats.

Conclusion: Collection of information on bycatch is a priority issue for bycatch management in the Shark Bay Prawn Managed Fishery.

Management Options:

There are three main ways to obtain the information required on bycatch:

- Commercial Observer Surveys.
- Fisheries Independent Surveys.
- Data collected by Vessel Skippers.

- *Option 1 - Commercial Observer Surveys* - The most obvious and valid way to determine the quantity and diversity of bycatch is through surveys in which scientific observers sort, identify, count, measure and weigh the bycatch obtained during normal commercial fisheries operations.

The advantage of this method is that the information obtained is from representative commercial fishing operations. However, it must be recognised that some alterations to normal fishing behaviour may occur when scientific observers are on-board a vessel.

There are numerous examples of where fisheries' observer programs have been successfully used in the development of bycatch management programs, including Demersal Fish Trawling in the north-eastern United States of America (Kennelly *et al*, 1997); Spencer Gulf Prawn Fishery (Carrick, 1997); and Northern Prawn Fishery (Pender *et al*, 1992).

- *Option 2 - Fisheries Independent Surveys* - The most common form of data collection is through research vessels or chartered commercial vessels doing fisheries-independent surveys. The disadvantage of this method is that the data generated does not necessarily represent normal fleet operations and it is relatively expensive. There are ways to overcome the 'representative' problems, in particular by allowing the fishing forming the basis of the fisheries-independent survey to be carried out by hired skippers and crews who have previously operated in the fishery.
- *Option 3 - Data Collected by Fleet Vessels* - Another way of obtaining bycatch information is by instructing each vessel skipper to collect defined information about bycatch in a similar fashion to that of keeping a logbook. In this case, the most appropriate mechanism would be to develop a discrete 'Bycatch Journal', so as not to jeopardise the current voluntary logbook process. This Bycatch Journal would be linked to the logbook, kept by many vessels operating in the fishery.

Limitations of this method are that the information obtained can be somewhat subjective and, in some cases, unreliable. Also, since this information needs to be collected during catch sorting, journal completion can be very time-consuming, particularly in times of high yields, making crews and skippers very reluctant to complete entries. However, the method is cost effective and valuable, within its limitations.

Option 3 also has the disadvantage that the data is collected by interested parties (i.e. participants in the fishery itself) and is therefore likely to be criticised by other interest groups as potentially being compromised.

Actions:

- Design and implement a Scientific Observer Program to commence with the implementation of BRDs into the Shark Bay Prawn managed Fishery.
- Develop and implement a Bycatch Journal as a means of collecting bycatch information from each vessel.

7.4 Industry Benefit Issues

Reducing bycatch may have direct benefits to the Shark Bay Prawn Managed Fishery, although these may not be fully realised until skippers have become familiar with and ‘tuned’ the BRDs in their nets.

The collection of bycatch in trawl nets is an operational constraint. For example, bycatch increases sorting times and can reduce the quality of the prawn catch. Reducing bycatch has been demonstrated to have a number of positive impacts on the fishery through the following:

Increase catch value through the elimination of large animals (e.g. sharks and rays) - Large animals will crush or break prawns in the cod end of a trawl net and on the sorting tray. Recent research has shown that approximately 5 to 10 per cent more tiger prawns are damaged when large animals are caught at the same time, as compared to catches without large animals (unpublished data). These ‘broken’ prawns have a lower market value. A small increase in the quality of undamaged prawns could translate into a significant increase in annual turnover for Shark Bay Prawn Managed Fishery fishers.

Increase in prawn catch - The use of effective BRDs in trawl nets can increase the catches of prawns by reducing the mass in the cod end, which reduces drag and assists in maintaining the spread of the trawl net.

Reduced sorting time - In fisheries such as the Shark Bay Prawn Managed Fishery, a considerable amount of time is spent sorting bycatch from target catch by hand. Reducing the amount of bycatch can save considerable time and effort. It may be possible to increase the duration of trawl shots if bycatch is reduced, which should increase the effectiveness of fishing.

Increase safety by reducing the handling of dangerous organisms - Bycatch often consists of a number of potentially harmful organisms, including spined fish, sea snakes, sharks and rays. These animals need to be handled in order to return them to the sea, which can pose a danger to fishing crews. The handling of heavy animals, such as turtles, is also considered a danger. Reducing the frequency of catching these organisms increases the safety of the crew.

SECTION 8 AIMS AND OBJECTIVES OF THE ACTION PLAN

8.1 Vision Statement

“To increase understanding of bycatch in the Shark Bay Prawn Managed Fishery and develop appropriate reduction devices, operational procedures, codes of conduct and other management strategies, to reduce the bycatch generated in the fishery and protect the World Heritage Values of Shark Bay.”

8.2 Objectives

Based on options discussed in Section 7, a management strategy has been prepared based on a suite of objectives. The action plan comprises of the following key components:

- **RESEARCH**

Objective 1 - Gain a better understanding of the quantity, diversity and impact of bycatch in Shark Bay Prawn Managed Fishery, in order to refine management strategies.

- **MANAGEMENT**

Objective 2 - Reduce bycatch of large animals and snakes.

Objective 3 - Reduce collection and mortality of undersized fish.

Objective 4 - Reduce wastage in the fishery resulting from the mortality of non-target catch.

Objective 5 - Minimise the effects of trawling on species diversity and habitat diversity.

Objective 6 - Assist skippers and crew in the implementation of the Bycatch Action Plan.

- **MONITORING AND REPORTING**

Objective 7 - Monitor the effectiveness of BRDs and other management initiatives.

Objective 8 - Report on progress and review the Bycatch Action Plan.

- **PUBLIC AWARENESS AND EDUCATION**

Objective 9 - Inform Western Australians and Australians of the management arrangement for bycatch in the Shark Bay Prawn Managed Fishery.

This section documents the actions proposed to meet these objectives. A table summarising all objectives and actions can be found at the end of this section.

8.2.1 Research Objectives

Objective 1 - Gain a better understanding of the quantity, diversity and impact of bycatch in the Shark Bay Prawn Managed Fishery, in order to refine management strategies.

Rationale: The lack of comprehensive scientific data on bycatch in the Shark Bay Prawn Managed Fishery is the limiting factor to the management of bycatch within the fishery.

Quantitative data is necessary to more accurately determine the extent and diversity of bycatch in the fishery, and the relative importance of the different forms of bycatch. It is also important that information be obtained on the effect of any modified gear on the fishing effort of the fleet.

- *Action 1a - Design and Implement a Scientific Observer Program to gather information about bycatch in the fishery (Department of Fisheries).*

Bycatch information will be gathered through an observer program in which observers on board commercial vessels collect data *in situ* by quantifying (sorting, identifying, measuring, counting and weighing) retained and discarded catches. While such observer programs assume that fishers do not change their normal operations in the presence of observers, they nevertheless constitute the most accurate form of bycatch information that can be gathered.

During each trip, the catch and bycatch from selected trawl tows should be sorted and recorded by the crew and the scientific observer. The design of the observer program is to determine which species would be counted, measured or weighed, and recorded along with the location, starting point, time duration and basic gear configuration of each tow.

An observer program commenced in the year 2000 and has continued into the 2001 season, coinciding with the implementation of one BRD on each vessel in the Shark Bay Prawn Managed Fishery. The program involved placing observers on randomly selected vessels and trips throughout the duration of the prawn fishing season.

This program can also be used to collect length frequency data for the key prawn species.

Information from the observer program will provide the basis for a more rigorous assessment of bycatch issues within the fishery and further development of management arrangements.

- *Action 1b - Establish a Bycatch Journal system to be used across all fleet vessels (Department of Fisheries).*

To enable continued collection of data across the entire Shark Bay Prawn Managed Fishery fleet, all skippers will be required to record information on the bycatch components of their catch. The information should be collected and recorded in the form of a Bycatch Journal which should remain separate, but linked, to the voluntary log book system.

The Bycatch Journal should incorporate the current data collection of turtle catches, which is managed through the Department of Conservation and Land Management (CALM). The journal needs to be designed to at least collect data on incidents of catches of turtles, sea snakes, corals, sponges, weed, total bycatch and total target catch.

Bycatch Journal data will be compared to the more rigorous data collected through the Observer Program to detect any inconsistencies in the findings. Also, a key tool to reducing inaccuracies in journal data is educating the crews and skippers in both how to complete the journal correctly and the importance of accurate data to the management and ultimate benefit of the fishery.

- *Action 1c - Seek funding to undertake research into the distribution of valuable or sensitive habitats, and the distribution of fish species within the trawl grounds of Shark Bay (Department of Fisheries).*

Although it is recognised that modification of the benthic environment may have occurred in some parts of Shark Bay due to trawling, and that the World Heritage Property was declared after about 30 years of trawling, the preservation of remaining sensitive or valuable habitats (and, if possible, allowing rehabilitation of some areas) is a priority issue.

Lack of information on the distribution of sensitive or valuable environments in Shark Bay limits the ability to provide this protection. Funding is required to design and undertake a habitat survey within Shark Bay to identify these areas, which may be considered for protection.

Funding is also required to determine the distribution of fish species inside and outside of the Shark Bay prawn trawl grounds, to identify any species not well represented outside the trawl grounds.

8.2.2 Management Objectives

Objective 2 - Reduce bycatch of large animals and snakes

Rationale: Large mammals, reptiles and other large fish species contribute to the values of Shark Bay and are highly valued by the Western Australian community. If these animals are excluded from Shark Bay Prawn Managed Fishery trawl nets, the quality of the catch will improve and the biodiversity values of the area will be protected.

- *Action 2a - Develop appropriate BRDs to exclude large objects from trawl nets (Department of Fisheries/Industry).*

The Department of Fisheries and industry are determining an appropriate BRD for use in the fishery. During the Natural Heritage Trust (NHT) trials, it was determined the most appropriate method of introducing a grid to the fishery was in combination with a fish exclusion device.

Based on this decision, the trials progressed to seek to determine the best combination of grid and fish exclusion device. From this, several devices preferred by industry have been determined.

In the 2000 season, all vessels in the Shark Bay Prawn Managed Fishery fleet were required to fish with one BRD and one standard net. With an observer program running concurrently, collecting data from both nets, this allows information on the influence of the BRD on fishing effort to be collected.

It was hoped that enough data would be gathered by the observer program during the 2000 season of trials, to enable the introduction of 100 per cent BRDs in 2001. Due to the high proportion of weed in 2000 season, it was operationally difficult to fish with the BRD and hence only a limited amount of data was acquired. Trials with only one BRD have continued in the 2001 season. During the 2000 season, all vessels were required to fish with one BRD net and one standard net.

- *Action 2b - Ensure that a BRD containing a grid capable of excluding large objects from trawl nets is implemented into the Shark Bay Prawn Managed Fishery (note: this action relates to the combination of grid and fish exclusion devices) (Department of Fisheries/Industry).*

The development of an appropriate implementation process for the optimum BRD (grid plus fish excluding device) is a key issue for the future management of the fishery and also for the acceptance of the new gear by operators within it.

The implementation process must reflect the following two important criteria:

Criteria 1 - the implementation of the bycatch strategy occurs in a manner that does not affect the integrity of the Department of Fisheries' catch and effort database, on which the fishery is managed.

Criteria 2 - the bycatch strategy implementation process occurs in a manner that enables skippers to 'tune' the new gear (i.e. the net with a BRD) in order to maximise its performance.

Based on these criteria the following implementation program was determined:

Phase 1: 2000/2001 - From the beginning of the 2000 season, all vessels in the fishery are to tow one BRD and one standard net. This will occur in coordination with the Scientific Observer Program and the introduction of a Bycatch Journal (refer to **Action 1a** and **1b**), in order to collect information of the change in catch rate (so as to to maintain the Department of Fisheries' fishery's catch and effort database entries for the fishery and the performance of the BRDs in reducing bycatch).

The management plan will be modified to allow for the Executive Director to direct the allowed gear, or to allow the use of 'approved gear' that would subsequently be defined. The Shark Bay Prawn Managed Fishery management plan would need to set minimum design construction standards for the BRDs.

Phase 2: Once the Department of Fisheries' Research Division has determined that sufficient data has been gathered on the change in catch rate due to the BRD, all vessels in the fishery will be required to have BRDs fitted to both nets. The Observer Program and Bycatch Journal system will continue over this period (in accordance with Actions 1a and 1b respectively).

This will again require an amendment to the Shark Bay Prawn Managed Fishery management plan to reflect the requirement to have a BRD fitted to any or all trawl nets.

If a new BRD net is developed it may need to be compared to the standard net.

- *Action 2c - Continue to improve the BRD design used by the Shark Bay Prawn Managed Fishery fleet in light of new data (Department of Fisheries/Industry).*

BRDs are to be used as an adaptive management tool within the Shark Bay Prawn Managed Fishery. Therefore, the management of the fishery should allow for continued improvement of the BRD, based on data gathered from the data collection program and innovation by industry and/or Department of Fisheries.

- *Action 2d - Develop Codes of Conduct to reduce impacts to marine animals (Industry).*

Evidence suggests that the catch of turtles in trawl nets in Shark Bay is minimal and should be reduced to nil, following the introduction of BRDs in both net rigs.

In the period from the 2000 season to the full introduction of grids, industry will commence the development and adoption of codes of conduct to maximise the chance of survival of any turtles brought on to the deck of fishing vessels. The following codes of conduct and/or criteria should be used as a guide/developed.

- The “Handling of Trawled Sea Turtles” procedure as used in the Northern Prawn Fishery (already being used within the fleet).
- All sea snakes, when landed in trawl nets, are to be returned immediately in good condition.
- A code of conduct should be developed to reduce the damage to turtles from dropping onto the sorting tray.

- *Action 2e - Develop a decision-making process and protocol for use of BRDs in high-density weed (Department of Fisheries/Industry).*

In the 2000 season when vessels were required to fish with one BRD net, very high-density drift weed caused the grids to clog and severely constrain the operation of the gear. Local knowledge suggests that weed of this density occurs in Shark Bay every four to five years and coincides with cyclone events.

Industry and the Department of Fisheries are to jointly develop, through the Management Advisory Committee (MAC) process, a decision-making process for determining the response of the trawl fleet, and the use of grids during these periods of high-density weed.

Objective 3 - Reduce collection and mortality of undersized fish

Rationale: The mortality of undersized fish is an issue. Management of this issue is to focus on the prevention of initial capture of undersized fish and increase the survival of individuals that are still alive when trawl nets are hauled.

- *Action 3a - Ensure that a BRD incorporating a fish exclusion device to exclude undersized fish from trawl nets is implemented into the fishery (Department of Fisheries).*

Refer to Action 2b.

- *Action 3b - Develop and implement codes of conduct to increase the survival of undersized fish (Department of Fisheries/Industry).*

Once brought to the deck, attempts to increase the survival of organisms should be undertaken through codes of conduct, possibly containing the following elements:

- rough sorts of catch to ensure protected species are returned to sea as soon as possible; and
- spraying of catch during sorting.

Objective 4 - Reduce wastage in the fishery resulting from the mortality of incidental catch

Rationale: Anecdotal evidence suggests that the discarded portion of bycatch consists largely of small fish. Discards are generally returned to the sea dead and this results in a high degree of wastage. This component of the catch will be reduced in order to reduce the wastage generated by the fishery.

- *Action 4a - Implement a BRD incorporating an optimal fish exclusion device capable of excluding small fish from trawl nets (Department of Fisheries/Industry).*

Refer to Action 2b.

- *Action 4b - Continue to improve the BRDs used by the fleet in light of new data (Department of Fisheries/Industry).*

BRDs are to be used as an adaptive management tool within the Shark Bay Prawn Managed Fishery. Therefore, the management of the fishery should allow for continued improvement of BRDs, based on data gathered from the data collection program.

- *Action 4c - Formalise, in a code of conduct, the practice of vessels avoiding areas of high bycatch (Industry).*

In order to reduce collection of bycatch, industry should cooperate to ensure that the Shark Bay Prawn Managed Fishery fleet actively avoids areas where high levels of bycatch are known to occur. This should be implemented through an industry-developed code of conduct.

To further reduce the impact on the habitat, a third option would be to reduce the annual season length in terms of number of trawling days. This amendment has previously been suggested by the licensees and should be given consideration. However, it should be noted that this option would be intended to complement and not replace other actions under this objective.

Objective 5 - Minimise the effect of trawling on species diversity and habitat diversity

Rationale: The impact of trawling on species diversity and habitat diversity within Shark Bay is unknown, due to a lack of information on the distribution of species and the composition of the Shark Bay Prawn Managed Fishery trawl catch. A potential threat would arise if it were determined that trawlers were catching high proportions of a species (other than prawns) which had a distribution restricted to Shark Bay, or if trawling was targeting habitats not well represented outside the trawl grounds.

- *Action 5a - In coordination with Action 5b, re-assess the Shark Bay Prawn Managed Fishery trawl ground boundaries based on an analysis of trawling effort and investigations into the distribution of fish species inside and outside of the trawl boundaries within Shark Bay (Department of Fisheries).*

Information gathered in accordance with Objective 1 is to be used to determine the distribution of fish species both inside and outside of areas susceptible to trawling.

Based on this information and Vessel Monitoring System (VMS) fishing effort data, trawl boundaries are to be re-assessed to ensure that there are no habitats or fish species being impacted that are inadequately represented outside of the trawl grounds.

- *Action 5b - In coordination with Action 5a, re-assess the Shark Bay Prawn Managed Fishery trawl ground boundaries based on an analysis of trawling effort and investigations into the distribution of benthic habitats in Shark Bay (Action 1c) (Department of Fisheries).*

Information gathered in accordance with Objective 1 is to be used to determine the:

- distribution and proportion of habitat types both inside and outside of areas susceptible to trawling; and
- location of any valuable and/or sensitive habitats within the trawl grounds.

Based on this information and VMS fishing effort data, trawl boundaries are to be re-assessed to ensure that all habitats are adequately represented in areas not susceptible to trawling and that any valuable and/or sensitive habitats are protected.

- *Action 5c - Reduce the trawl-induced mortality of small fish caught in trawl nets (refer to Objective 3) (Department of Fisheries).*

Refer to Objective 4.

- *Action 5d - Investigate the possibility of reducing the length of the Shark Bay Prawn Managed Fishery season. (Department of Fisheries/Industry).*

Reducing the length of the Shark Bay Prawn Managed Fishery fishing season would act to reduce the amount of fishing activity taking place in the area and thus reduce pressure on its fish habitats. This option has been tabled by licensees in the past and should be considered.

Objective 6 - To assist skippers and crews in the implementation of the Bycatch Action Plan

Rationale: The implementation of the plan will require the full understanding and support of skippers and crews.

- *Action 6a - Assist skippers and crews in the installation and operation of BRDs (Department of Fisheries).*

While the results of experiments to test modifications to trawling gear are widely published, there is sometimes a lack of detailed descriptions of how to actually install and operate them on a commercial trawler.

Correct installation and operation of gear modified for bycatch reduction will be critically important. When incorrectly used, this gear may be either ineffective at reducing bycatch, or allow high numbers of the target prawns to escape. While the installation and tuning of gear is the responsibility of the skippers and crews, the Department of Fisheries will provide information to assist in this process.

- *Action 6b - Provide information to skippers and crew in the identification of protected species (Department of Fisheries).*

Crews and skippers in the Shark Bay Prawn Managed Fishery should be able to recognise endangered and protected species that are prohibited to be retained in catches, or others that require special treatment. Training courses in the identification of these species should be developed, implemented and all crews and skippers invited to attend them.

Identification cards should be held on-board to aid in identification of endangered and protected species. Skippers should also be responsible for inducting all new crew in bycatch

management procedures, including identification of protected species and codes of conduct. The Department of Fisheries will make copies of this Bycatch Action Plan available to all vessels.

- *Action 6c - Ensure that new crews and skippers are aware of the obligations under the Bycatch Action Plan for the Shark Bay Prawn Managed Fishery (Industry/Department of Fisheries).*

This can be achieved by ensuring that a copy of this Bycatch Action Plan is made available to all new crew members working in the fishery and that a copy is kept on board all vessels working in the fishery at all times.

8.2.3 Monitoring and Reporting Objectives

Objective 7 - Monitor the effectiveness of BRDs and other management initiatives

Rationale: There are two main performance indicators of the proposed management arrangements. The first is the effectiveness of the plan in reducing bycatch. The second is the level of satisfaction and acceptance of the plan by the licensees and peak representative bodies.

- *Action 7a - Review data from Bycatch Journal and Observer Programs to determine bycatch information (Department of Fisheries).*

Data collected from the Observer Program is to be collected and used to prepare reports relating to the implementation of the plan. The findings of the program are to incorporate the following:

- Composition of total bycatch in the fishery (species by frequency).
- Composition of discarded and retained portion of bycatch.
- Spatial distribution of total bycatch.
- Spatial distribution of components of the bycatch.
- Temporal distribution of total bycatch.
- Temporal distribution of components of the bycatch.
- Temporal incidence of turtles and other protected species catch.

- *Action 7b - Form strategic links with other research programs in Shark Bay to provide mechanisms to assess flow-on effects of bycatch reduction (Department of Fisheries).*

The reduction of bycatch in the Shark Prawn Managed Fishery may induce other ecosystem changes. In effect, the ability to detect changes in ecosystem structure and function, as a result of reduced bycatch, would be highly difficult and require very resource-intensive investigations.

There are existing research programs which gather information that could provide suitable data to monitor the situation. The Department of Fisheries should develop links with other

agencies and universities undertaking research in Shark Bay, with the aim of investigating ecosystem effects of reducing bycatch.

- *Action 7c - Consult with licensees, skippers and the Management Advisory Committee to discuss the management arrangements (Department of Fisheries).*

The effectiveness of the BRDs, the Bycatch Journal and codes of conduct should be discussed with the licensees, particularly to determine:

- practical implications;
- suggested modifications; and
- other consequences.

The Department of Fisheries and licensees are to convene to discuss these matters four months after commencement of the Bycatch Action Plan, then again at the end of the season. Following this, these groups are to determine the need and forum for future discussions.

- *Action 7d - Consult with peak representative bodies (Department of Fisheries).*

The Department of Fisheries will liaise with peak bodies regarding the implementation and progress of this Bycatch Action Plan. Liaisons are to be conducted through the already established Bycatch Liaison Group with representatives from Recfishwest, Western Australian Fishing Industry Council, Conservation Council of WA and the Marine and Coastal Community Network.

Objective 8 - Report on the progress and review the Bycatch Action Plan

Rationale: Progress and outcomes of this Bycatch Action Plan are to be reported under the following arrangements.

- *Action 8a - Ensure that the progress and outcomes of the Bycatch Action Plan are reported (Department of Fisheries).*

The progress and achievement of each Objective and Action are to be reported within the Department of Fisheries' *State of the Fisheries* report, on an annual basis.

- *Action 8b - Review Bycatch Action Plan after two years (Department of Fisheries).*

Following two years, the outcomes and achievements of this plan are to be reviewed by the Department of Fisheries and amended to produce a revised version with a lifetime of at least two years.

8.2.4 Public Awareness and Education Objectives

Objective 9 - To inform Western Australians and Australians of the management arrangements for bycatch in the Shark Bay Prawn Trawl Managed Fishery

Rationale: Due to a lack of understanding and awareness of the issues, the public is often unaware of the positive steps that the Department of Fisheries and Industry have taken in reducing bycatch and other environmental effects of fishing.

- *Action 9a - Publicise and promote the management of bycatch in the Shark Bay Prawn Managed Fishery (Department of Fisheries/Industry).*

The Department of Fisheries' Community Relations Branch, in coordination with the Shark Bay Prawn Management Advisory Committee and Shark Bay Prawn Trawl Operators Association, will develop a Communications Plan to promote and publicise the management of bycatch within the Shark Bay Prawn Managed Fishery. This plan should be completed by June 2002.

Table 2 Summary of Bycatch Action Plan for the Shark Bay Prawn Managed Fishery

OBJECTIVE	ACTION	RESPONSIBLE	TIME FRAME
RESEARCH OBJECTIVES			
<p>Objective 1. To gain a better understanding of the quantity, diversity and impact of bycatch in the Shark Bay Prawn Managed Fishery in order to refine management strategies.</p>	<p>Action 1a. Design and implement a scientific observer program to gather information about bycatch in the fishery.</p>	<p>Department of Fisheries</p>	<p>Commenced at beginning of 2000 season. Ongoing.</p>
	<p>Action 1b. Establish a Bycatch Journal system to be used across all fleet vessels.</p>	<p>Department of Fisheries</p>	<p>Commenced at beginning of 2000 season.</p>
	<p>Action 1c. Seek funding to undertake research into the distribution of valuable or sensitive habitats, and the distribution of fish species within the trawl grounds of Shark Bay.</p>	<p>Department of Fisheries</p>	<p>Ongoing.</p>
MANAGEMENT OBJECTIVES			
<p>Objective 2. Reduce bycatch of large animals and snakes.</p>	<p>Action 2a. Develop appropriate BRDs to exclude large objects from trawl nets.</p>	<p>Department of Fisheries/Industry</p>	<p>Commenced in 1998. Developments and improvements are continuing.</p>
	<p>Action 2b. Ensure that a BRD containing a grid capable of excluding large objects from trawl nets is implemented into the Shark Bay Prawn Managed Fishery (note: this action relates to the combination of a grid and a fish exclusion device).</p>	<p>Department of Fisheries/Industry</p>	<p>Implementation of BRD to commence at beginning of 2000 season with one BRD. Two BRDs to be introduced following instruction from Department of Fisheries' Research Division.</p>
	<p>Action 2c. Continue to improve the BRD design used by the Shark Bay Prawn Managed Fishery fleet in light of new data.</p>	<p>Department of Fisheries/Industry</p>	<p>Ongoing</p>
	<p>Action 2d. Develop and adopt codes of conduct to reduce impacts to marine animals.</p>	<p>Industry</p>	<p>Development of protocol and process to be determined by the end of the 2002 season.</p>
	<p>Action 2e. Develop a decision-making process and protocol for use of BRDs in high-density weed.</p>	<p>Department of Fisheries/Industry</p>	<p>Development of protocol process commenced in 2001; to be finalised by the end of the 2002 season.</p>

OBJECTIVE	ACTION	RESPONSIBLE	TIME FRAME
Objective 3. Reduce collection and mortality of undersized fish.	Action 3a. Ensure that a BRD incorporating a fish exclusion device to exclude undersized fish from trawl nets is implemented into the fishery (note: this action relates to the combination of a grid and a fish exclusion device).	Department of Fisheries	Implementation of BRD commenced at beginning of 2000 season. Full implementation to occur by commencement of 2002 season.
	Action 3b. Develop and implement codes of conduct to increase the survival of undersized fish.	Department of Fisheries/Industry	Code of conduct developed by end of 2002.
Objective 4. Reduce wastage in the fishery resulting from the mortality of incidental catch.	Action 4a. Implement a BRD incorporating an optimal fish exclusion device capable of excluding small fish from trawl nets.	Department of Fisheries/Industry	Implementation of BRD to commence at beginning of 2000 season. Further research still required.
	Action 4b. Continue to improve the BRDs used by the fleet in light of new data.	Department of Fisheries/Industry	Ongoing
	Action 4c. Formalise, in a code of conduct, the practice of vessels avoiding areas of high bycatch.	Industry	To be complete within 12 months of obtaining information on high bycatch density areas.
Objective 5. Minimise the effects of trawling on species diversity and habitat diversity.	Action 5a. In coordination with Action 5b, re-assess the trawl ground boundaries, based on an analysis of trawling effort and investigations into the distribution of fish species inside and outside of the trawl boundaries within Shark Bay.	Department of Fisheries	Within 12 months of gathering appropriate data (under Action 1c).
	Action 5b. In coordination with Action 5a, re-assess the trawl ground boundaries based on an analysis of trawling effort and investigations into the distribution of benthic habitats and fish species in Shark Bay (refer Action 1c).	Department of Fisheries	Within twelve months of gathering appropriate data (under Action 1c).
	Action 5c. Reduce the trawl-induced mortality of small fish caught in trawl nets (refer to Objective 3).	Department of Fisheries	Refer Objective 4.
	Action 5d. Investigate the possibility of reducing the length of the Shark Bay Prawn Managed Fishery season.	Department of Fisheries/Industry	Within twelve months of gathering appropriate data (under Action 1c).

Table 2 Summary of Bycatch Action Plan for the Shark Bay Prawn Managed Fishery

OBJECTIVE	ACTION	RESPONSIBLE	TIME FRAME
Objective 6. To assist skippers and crew in the implementation of the Bycatch Action Plan.	Action 6a. Assist skippers and crews in the installation and operation of BRDs.	Department of Fisheries	Ongoing
	Action 6b. Provide information to skippers and crew in the identification of protected species.	Department of Fisheries	Ongoing
	Action 6c. Ensure that new crews and skippers are aware of their obligations under this plan.	Industry/Department of Fisheries	Ongoing
Objective 7. Monitor the effectiveness of BRDs and other management initiatives.	Action 7a. Review data from Bycatch Journal and Observer Programs to determine bycatch information.	Department of Fisheries	Ongoing and as necessary
	Action 7b. Form strategic links with other research programs in Shark Bay to provide mechanisms to assess flow-on effects of bycatch reduction.	Department of Fisheries	Ongoing
	Action 7c. Consult with licensees, skippers and the Management Advisory Committee to discuss the management arrangements.	Department of Fisheries	First meeting four months after implementation of the plan; then at the end of that season; then as necessary.
	Action 7d. Consult with peak representative bodies.	Department of Fisheries	Ongoing.
MONITORING AND REPORTING OBJECTIVES			
Objective 8. Report on the progress and review the Bycatch Action Plan.	Action 8a. Ensure that the progress and outcomes of the Bycatch Action Plan are reported.	Department of Fisheries	Annually within State of Fisheries Report.
	Action 8b. Review Bycatch Action Plan after two years.	Department of Fisheries	Two years from introduction of final Bycatch Action Plan.

Table 2 Summary of Bycatch Action Plan for the Shark Bay Prawn Managed Fishery

OBJECTIVE	ACTION	RESPONSIBLE	TIME FRAME
PUBLIC AWARENESS AND EDUCATION OBJECTIVES			
<p>Objective 9. To inform Western Australians and Australians of the management arrangements for bycatch in the Shark Bay Prawn Managed Fishery.</p>	<p>Action 9a. Publicise and promote the management of bycatch in the Shark Bay Prawn Managed Fishery.</p>	<p>Department of Fisheries</p>	<p>Ongoing</p>

SECTION 9 FIGURES

Figure 1 Locality Map

Figure 2 World Heritage Property and Marine Park Zones

Figure 3 Shark Bay Prawn Managed Fishery: Major Features

Figure 4a - 4c Shark Bay Prawn Managed Fishery: Seasonal Closures

Figure 5a Seagrass Distribution

Figure 5b Natural Environment (excluding Seagrass)

SECTION 10 REFERENCES

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APPENDIX A LIST OF STAKEHOLDERS

Shark Bay Prawn Managed Fishery Licensees
Shark Bay Prawn Trawl Operators' Association
Shark Bay Prawn Management Advisory Committee
Shark Bay Scallop Management Advisory Committee
Shark Bay Scallop Association
Shark Bay Snapper Association
Shark Bay Beach Seine Association
Denham Recreational Fishing Advisory Committee
Carnarvon Recreational Fishing Advisory Committee
Exmouth Recreational Fishing Advisory Committee
Western Australian Fishing Industry Council (WAFIC)
Recfishwest
Australian Marine Conservation Society
Conservation Council of Western Australia
Marine Parks and Reserves Authority
Gascoyne Regional Development Commission
Aquaculture Council of WA
Department of Conservation and Land Management
Department of Environmental Protection
Shark Bay World Heritage Property Consultative Committee
Shark Bay World Heritage Property Scientific Advisory Committee
Shire of Shark Bay
Shire of Carnarvon

APPENDIX B WORLD HERITAGE VALUES OF SHARK BAY

1. Outstanding examples representing the major stages of the earth's evolutionary history.

- Stromatolites and microbial mats of Hamelin Pool
- Hamelin Pool and Lharidon Bight
- Holocene deposits adjacent to Hamelin Pool and Lharidon Bight

2. Outstanding examples representing significant ongoing geological process, biological evolution and human interaction with the natural environment.

Marine Environment

- Unique hydrological structure, banks and sills, steep salinity gradients, three biotic zones
- Faure sill
- Hypersaline environment of Hamelin Pool
- Microbial communities
- *Fragum eragatum* shell deposits
- High genetic diversity due to steep environmental gradients (eg. snapper, venerid clams, bivalves)
- Seagrass meadows and their role in the evolution of marine environment
- Expanse of meadows and diversity of seagrass species
- Wooramel seagrass bank
- Carbonate deposits and sediments
- Northern limit of transition region between temperate and tropical marine environments, resulting in high species diversity (eg. 323 fish species, 218 bivalve species, and 80 coral species)

Terrestrial Environment

- Botanical province transition zone, most pronounced in the southern parts of Nanga and Tamala Stations
- Range limits (145 plant species at northern limit, 39 species at southern limit, and 28 vascular plant species endemic)
- Isolation of fauna habitats on islands and peninsulas - five threatened mammals on Beniers and Dorre Islands
- Range limits and fauna species richness (100 species of herpetofauna - nine endemic, 230 species of birds representing 35 per cent of Australia's total species)
- Species evolution illustrated in rufous hare-wallaby and banded hare-wallaby)

3. Superlative natural phenomena, formation or features - for instance, outstanding examples of the most important ecosystems, areas of exceptional natural beauty or exceptional combinations of natural and cultural elements.

- Stromatolites
- Hypersaline environment of Hamelin Pool
- Faure Sill
- Wooramel seagrass bank
- Coastal scenery of Zuytdorp cliffs, Dirk Hartog Island, Peron Peninsula and Heirisson and Bellefin Prong
- Fragam beaches and Lharidon Bight
- Inundated birridas and Lagoons, such as Big Lagoon
- Strongly contrasting colours of the dunes/cliffs, beaches and adjacent sea of Peron Peninsula
- Abundance of marine fauna (dugongs, dolphins, sharks, rays, turtles and fish)
- Annual wildflower season display

4. The most important and significant natural habitats where threatened species of animals or plants of outstanding universal value still survive

- Five out of Australia's 26 endangered mammals (Shark Bay mouse, banded hare-wallaby, rufous hare-wallaby, western barred bandicoot and burrowing bettong)
- Bernier Island subspecies of ash-grey mouse
- Twelve threatened reptiles (e.g. Baudin Island skink and woma)
- Endemic Soundhill frog
- Thirty five migratory bird species
- Threatened thick-billed grasswren
- Endemic Dirk Hartog subspecies of the southern emu-wren
- Dirk Hartog subspecies of southern emu-wren
- Dugong (approx. one eighth of the world's population)
- Humpback whale
- Loggerhead and green turtles
- Some threatened flora species

APPENDIX C PUBLIC COMMENT FORM

PUBLIC COMMENT FORM DRAFT BYCATCH ACTION PLAN FOR THE SHARK BAY PRAWN MANAGED FISHERY

- Full Report -

Send to: Colin Chalmers
Fish & Fish Habitat Protection Program
Department of Fisheries
Locked Bag No. 39, Cloister Square Post Office
PERTH WA 6850

Name: _____

Organisation
(if applicable): _____

Address: _____

HOW TO FILL OUT THE PUBLIC COMMENT FORM

SECTION 1 - SPECIFIC COMMENTS

Section 1 of the Public Comment Form is in a table format and is designed for you to provide comment on specific aspects of the Action Plan. Column One of the table summarises each of the objectives and actions of the Action Plan.

In Column Two of the table you should indicate whether you think that the relevant Objective/Action is appropriate. You can do this by circling whether you agree, strongly agree, disagree or strongly disagree with that Objective/Action (1 = strongly agree; 2 = agree; 3 = disagree; 4 = strongly disagree).

In Column Three you should provide any comments you may have about that Objective/Action. If you disagree or strongly disagree with that Objective/Action should state your reason.

SECTION 2 - GENERAL COMMENTS

Section 2 of the Public Comment Form provides space for you to provide your comment about any other aspects of the Bycatch Action Plan, e.g. the appropriateness of the methodology, any aspects you think are missing from the plan, etc.

PUBLIC COMMENT FORM

DRAFT BYCATCH ACTION PLAN FOR THE SHARK BAY PRAWN MANAGED FISHERY

Full Report

SECTION 1 - SPECIFIC COMMENTS

1 = strongly agree; 2 = agree; 3 = disagree; 4 = strongly disagree

COLUMN ONE OBJECTIVE/ACTION	COLUMN TWO What do you think of this Objective/Action?				COLUMN THREE Comments/Reasons for Disagreeing/Reasons for Agreement
RESEARCH OBJECTIVES					
OBJECTIVE 1. TO GAIN A BETTER UNDERSTANDING OF THE QUANTITY, DIVERSITY AND IMPACT OF BYCATCH IN THE SHARK BAY PRAWN MANAGED FISHERY, IN ORDER TO REFINE MANAGEMENT STRATEGIES.	1	2	3	4	
Action 1a. Design and implement a scientific observer program to gather information about bycatch in the fishery.	1	2	3	4	
Action 1b. Establish a Bycatch Journal System to be used across all fleet vessels.	1	2	3	4	
Action 1c. Seek funding to undertake research into the distribution of valuable or sensitive habitats, and distribution of fish species, within the trawl grounds of Shark Bay.	1	2	3	4	

COLUMN ONE OBJECTIVE/ACTION	COLUMN TWO What do you think of this Objective/Action ?				COLUMN THREE Comments/Reasons for Disagreeing/Reasons for Agreement
MANAGEMENT OBJECTIVES					
OBJECTIVE 2. REDUCE THE THREAT TO LARGE ANIMALS AND SNAKES.	1	2	3	4	
Action 2a. Develop appropriate BRDs to exclude large objects from trawl nets.	1	2	3	4	
Action 2b. Ensure that a BRD containing a grid capable of excluding large objects from trawl nets is implemented into the fishery (note that this action relates to the combination of a grid and a fish exclusion device).	1	2	3	4	
Action 2c. Continue to improve the BRD design used by the fleet in the light of new data.	1	2	3	4	
Action 2d. Develop and adopt a code of conduct to reduce impacts to marine animals.	1	2	3	4	
Action 2e. Develop a decision-making process and protocol for use of BRDs in high-density weed (Department of Fisheries/Industry).	1	2	3	4	
OBJECTIVE 3. REDUCE COLLECTION AND MORTALITY OF UNDERSIZED FISH	1	2	3	4	
Action 3a. Ensure that a BRD incorporating a fish exclusion device to exclude undersized fish from the trawl net is implemented into the fishery (note that this action relates to the combination of a grid and a fish exclusion device).	1	2	3	4	
Action 3b. Develop and implement codes of conduct to increase the survivorship of undersized fish.	1	2	3	4	

COLUMN ONE OBJECTIVE/ACTION	COLUMN TWO What do you think of this Objective/Action ?				COLUMN THREE Comments/Reasons for Disagreeing/Reasons for Agreement
OBJECTIVE 4. REDUCE WASTAGE IN THE FISHERY RESULTING FROM MORTALITY OF INCIDENTAL CATCH.	1	2	3	4	
Action 4a. Implement a BRD incorporating an optimal fish exclusion device capable of excluding small fish from trawl nets.	1	2	3	4	
Action 4b. Continue to improve the BRDs used by the fleet in light of new data.	1	2	3	4	
Action 4c. Formalise, in a code-of-conduct, the practice of vessels avoiding areas of high bycatch.	1	2	3	4	
OBJECTIVE 5. MINIMISE THE EFFECTS OF TRAWLING ON SPECIES DIVERSITY AND HABITAT DIVERSITY.	1	2	3	4	
Action 5a. In coordination with Action 5b, re-assess the trawl ground boundaries based on an analysis of trawling effort and investigations into the distribution of fish species within and outside the trawl boundaries of Shark Bay).	1	2	3	4	
Action 5b. In coordination with Action 5a, re-assess the trawl ground boundaries based on an analysis of trawling effort and investigations into the distribution of benthic habitats and fish species in Shark Bay (refer Action 1c).	1	2	3	4	
Action 5c. Reduce the trawl-induced mortality of small fish caught in trawl nets (refer Objective 3).	1	2	3	4	
Action 5d. Investigate the possibility of reducing the length of the Shark Bay Prawn Managed Fishery season.	1	2	3	4	

COLUMN ONE OBJECTIVE/ACTION	COLUMN TWO What do you think of this Objective/Action ?				COLUMN THREE Comments/Reasons for Disagreeing/Reasons for Agreement
OBJECTIVE 6. TO ASSIST SKIPPERS AND CREW IN THE IMPLEMENTATION OF THE PLAN	1	2	3	4	
Action 6a. Assist skippers and crews in the installation and operation of BRDs.	1	2	3	4	
Action 6b. Provide information to skippers and crew to aid in the identification of protected species.	1	2	3	4	
Action 6c. Ensure that all new crew and skippers are aware of the obligations under this plan.	1	2	3	4	
OBJECTIVE 7. MONITOR THE EFFECTIVENESS OF BRDS AND OTHER MANAGEMENT INITIATIVES	1	2	3	4	
Action 7a. Review data from Bycatch Journal and Observer Program to determine bycatch information.	1	2	3	4	
Action 7b. Form strategic links with other research programs in Shark Bay to provide mechanisms to assess flow-on effects of bycatch reduction.	1	2	3	4	
Action 7c. Consult with licensees, skippers and the Management Advisory Committee to discuss the management arrangements.	1	2	3	4	
Action 7d. Consult with peak representative bodies.	1	2	3	4	

COLUMN ONE OBJECTIVE/ACTION	COLUMN TWO What do you think of this Objective/Action ?				COLUMN THREE Comments/Reasons for Disagreeing/Reasons for Agreement
MONITORING AND REPORTING OBJECTIVES					
OBJECTIVE 8. REPORT ON THE PROGRESS AND REVIEW OF THE BYCATCH ACTION PLAN.	1	2	3	4	
Action 8a. Ensure that the progress and outcomes of the Bycatch Action Plan are reported.	1	2	3	4	
Action 8b. Review Bycatch Action Plan after two years.	1	2	3	4	
PUBLIC AWARENESS AND EDUCATION OBJECTIVES					
OBJECTIVE 9. TO INFORM THE COMMUNITY OF WESTERN AUSTRALIA AND AUSTRALIA OF THE MANAGEMENT ARRANGEMENTS FOR BYCATCH IN THE SHARK BAY TRAWL MANAGED FISHERY.	1	2	3	4	
Action 9a. Publicise and promote the management of bycatch in Shark Bay Prawn Managed Fishery.	1	2	3	4	

SECTION 2 - GENERAL COMMENTS

Please provide any general comments you have on the plan here.

A series of horizontal dotted lines for writing comments.

FISHERIES MANAGEMENT PAPERS

- No. 1** The Report of the Southern Western Australian Shark Working Group. Chairman P. Millington (1986).
- No. 2** The report of the Fish Farming Legislative Review Committee. Chairman P. Rogers (1986).
- No. 3** Management Measures for the Shark Bay Snapper 1987 Season. P. Millington (1986).
- No. 4** The Esperance Rock Lobster Working Group. Chairman A. Pallot (1986).
- No. 5** The Windy Harbour - Augusta Rock Lobster Working Group. Interim Report by the Chairman A. Pallot (1986).
- No. 6** The King George Sound Purse Seine Fishery Working Group. Chairman R. Brown (1986).
- No. 7** Management Measures for the Cockburn Sound Mussel Fishery. H. Brayford (1986).
- No. 8** Report of the Rock Lobster Industry Advisory meeting of 27 January 1987. Chairman B. Bowen (1987).
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