

**A BYCATCH ACTION PLAN
FOR THE
PILBARA FISH TRAWL
INTERIM MANAGED FISHERY**

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1.0 FOREWORD

Drawn from national and international interest in the ecological sustainability of fisheries, 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 effect of commercial fishing on bycatch species and the marine ecosystem generally, has emerged as a significant national and international issue. Environmental issues associated with bycatch – including impacts on the ecology of non-target species of fish and wildlife – are important issues to address in reducing the impacts, or potential impacts, of commercial fisheries.

In 1998, the National Standing Committee on Fisheries and Aquaculture developed a national policy on fisheries bycatch. In 1999, the (then) State Minister for Fisheries adopted the national policy as his position on bycatch for Western Australia. The main objective of the policy is to ensure that populations of bycatch species are maintained through reducing bycatch, improving protection of vulnerable species and minimising adverse impacts of fishing on the aquatic environment.

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. The development of Bycatch Action Plans for the State's commercial fisheries is considered important to progress the reduction of bycatch in a transparent way, which also sets out specific objectives for monitoring and evaluation.

2.0 INTRODUCTION

2.1 ESD Application

The Department of Fisheries applied to the (then) Department of Environment and Heritage to assess the Pilbara Fish Trawl Interim Managed Fishery (PFTIMF) against the *Australian Government Guidelines For The Ecologically Sustainable Management Of Fisheries*. The submission of a successful application meeting these guidelines is required under Part 13 (protected species) and 13A (wildlife trade provisions (export)) of the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999)*, to enable fish species caught in the Fishery to remain on the list of species exempt from export regulations.

Following assessment of the PFTIMF against the *Australian Government Guidelines For The Ecologically Sustainable Management Of Fisheries*, the PFTIMF was declared a Wildlife Trade Operation (WTO) for the six months to June 2005. In June 2005, the declaration was extended until 1 August 2006. The WTO was subsequently extended on three further occasions with the most recent assessment occurring in September 2009 (extending the WTO to the full allowable three year term until 1 June 2010). One of the conditions of this approval is that the Department maintains the Bycatch Action Plan for the PFTIMF, including ongoing review and progress reporting on its implementation.

Documents relevant to the PFTIMF's assessment can be found on the Commonwealth Department of the Environment, Water, Heritage and the Arts' (DEWHA's) website www.environment.gov.au.

2.2 Process So Far

In March 2002, stakeholders with an interest in the development of the Bycatch Action Plan for the PFTIMF were sent a discussion paper to begin the process. Feedback from these stakeholders was generally supportive.

Recognition was included of the need to firstly identify and then quantify all of the 'bycatch' in the fishery. This proved to be a difficult task as demersal trawling has the capacity to catch a wide range of species in the PFTIMF. The decision to retain landed fish aboard a trawler is not only contingent on the species caught, but whether the fish is of marketable size, and, importantly, profitable to sell at market at that point in time.

Significant resources have also been invested in monitoring bycatch in the PFTIMF and trialling mitigation devices/methods. This work enabled a revised Bycatch Action Plan to be released for public comment in June 2006. All submissions received were taken into consideration in the finalisation of this plan.

The intention is for this plan to remain as a 'living' document so that stakeholders can continue to work together towards mitigating bycatch issues in the PFTIMF.

2.3 Objective of Plan

This plan has been developed to provide objectives, actions, responsibilities and timeframes for addressing bycatch in the PFTIMF. The objective of this plan is:

<i>To increase understanding of the nature and degree of bycatch in the Pilbara Fish Trawl Interim Managed Fishery; and to develop and implement appropriate and effective mitigation devices, operational procedures and/or management strategies, to reduce the level of bycatch in the fishery (particularly for listed/protected species).</i>
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2.4 What is “Bycatch”?

Demersal trawling in the PFTIMF results in the catch of additional untargeted organisms. Most of them are not commercially valuable and subsequently returned to the water either alive or dead. In addition, untargeted organisms may be returned to the water for other reasons, including legal prohibitions on their take (e.g. size limits).

Traditionally, these non-targeted organisms have been termed “bycatch”. Bycatch in the Fishery is predominantly comprised of unmarketable scalefish, sharks, rays (though the retention of sharks and rays has been prohibited since May 2008) and epibenthic species (sponges and corals). In addition, the Fishery interacts with protected/listed species including dolphins, marine turtles, seasnakes, sygnathids and sawfish.

For the purpose of this document, the following definitions have been adopted. These are consistent with those contained within the Western Australian and National Policies on Fisheries Bycatch:

- **Target Species** – the species that the gear or fishing method is designed to catch.
- **Bycatch** – the discards plus any organisms that are not retained.
- **By-product** – the retained non-target catch, which is destined for sale.
- **Discards** – the non-retained catch that is returned to the water, either because they have no value (for example there is no market or they are toxic), or because regulations preclude them from being retained.
- **Bycatch Reduction Device (BRD)** – a device fitted to existing fishing gear that reduces the amount of bycatch, or number of bycatch species, taken during fishing. There have been several types of BRDs used for trawl gear including grids (which exclude large organisms such as turtles, sharks and rays).

2.5 Policy Framework

As the steward of Western Australia’s fish resources, the Department of Fisheries has a particular responsibility to lead and coordinate efforts to evaluate ecological sustainability of bycatch. In developing this Bycatch Action Plan, the Department has demonstrated its commitments to obligations under a number of State and Commonwealth legislation, agreements and policies. These are:

State

- *Fish Resources Management Act 1994*;
- Western Australian Policy on Fisheries Bycatch; and
- Policy for the Implementation of Ecologically Sustainability Development for Fisheries and Aquaculture within Western Australia (Fisheries Management Paper No. 157)

Commonwealth

- Australia’s Oceans Policy;
- *Environment Protection and Biodiversity Conservation Act 1999*;
- National Policy on Fisheries Bycatch;
- Draft Recovery Plan for Marine Turtles in Australia; and
- National Strategy for the Conservation of Australia’s Biological Diversity

3.0 OVERVIEW OF THE PILBARA FISH TRAWL FISHERY

The PFTIMF is situated in the Pilbara region in the north-west of Australia. It occupies the waters north of latitude 21°35' S and between longitudes 114°9'36 E and 120° E. The fishery is seaward of the 50 m isobath and landward of the 200 m isobath (Figure 1). It is a demersal otter trawl fishery that targets a variety of scalefish species including emperors, snappers and cods.

The PFTIMF consists of two zones, Zone 1 in the south-west of the fishery (which is closed to trawling) and Zone 2 in the North, which consists of six management areas (Figure 1). Areas 1 to 6 each cover 1,300, 1,800, 880, 1,500, 2,300 and 7,200 square nautical miles respectively with Areas 3 and 6 closed to fishing. The total area available for trawling is 14,980 square nautical miles, with around 40% of the available area fished.

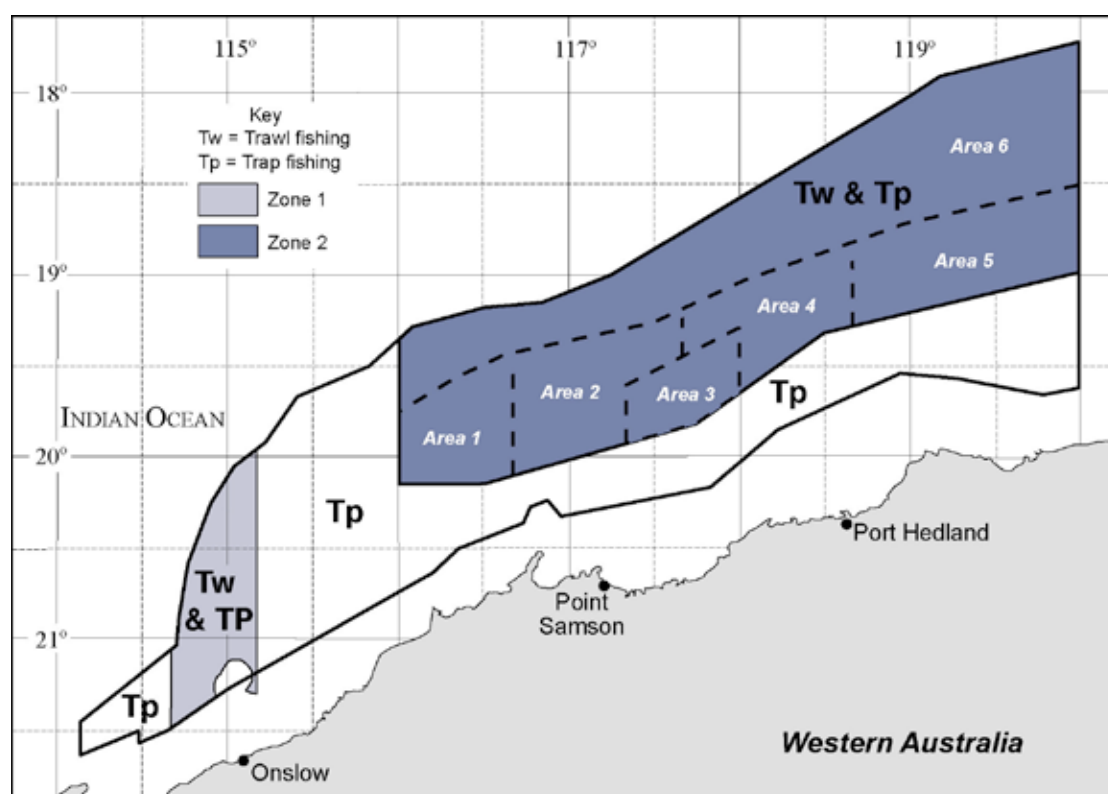


Figure 1. Location of the Pilbara Fish Trawl Fishery (Western Australia).

The PFTIMF produces approximately 1,500 tonnes of demersal scalefish annually, with a gross value of production of approximately \$5 - 6 million. The catch is mostly sold within the Perth domestic market.

More detailed information on the PFTIMF can be found in the following sections of this document and in the Department's annual *State of the Fisheries* reports.

3.1 Catch

The main target species of the PFTIMF are blue spotted emperor (*Lethrinus punctulatus*), rosy threadfin bream (*Nemipterus furcosus*), crimson snapper (*Lutjanus erythropterus*), trevally spp., brownstripe snapper (*Lutjanus vitta*), red emperor (*Lutjanus sebae*), goldband snapper (*Pristipomoides multidens*), frypan snapper (*Argyrops spinifer*), saddletail snapper (*Lutjanus malabaricus*), spangled emperor (*Lethrinus nebulosus*) and Rankin cod (*Epinephelus multinotatus*).

Retained by-product in the fishery includes bugs (*Thenus orientalis*), cuttlefish and squid; all are generally sold in domestic markets.

Interaction with protected/listed species [sea snakes, marine turtles (protected under EPBC¹, WCA²), seahorses, sea dragons, pipefish (all protected under EPBC), and sawfish (listed on the IUCN³ Red List of threatened species)] is a significant issue for the PFTIMF, with dolphins being the key issue.

3.2 Methods and Gear

Vessels in the PFTIMF are permitted to tow one net with two otter boards. The net towed by the vessel must be of mesh size not less than 100 mm, with a head rope length not exceeding 36.58 metres, and with the overall trawl gear (including sweeps, bridles, and headrope) not exceeding 274.32 metres.

The ground (or foot) rope of the net opening has rubber discs (bobbins) and lead weights attached which must not be more than 350 mm in diameter. These are spaced between 0.5 and 1.3 metre apart along the ground rope. The sweep and lower bridle provide most of the ballast required to keep the lower wing end of the net near the seabed. In water, the rubber discs are nearly neutrally buoyant. The lead weights along the groundrope provide the extra down-force required to keep the ground gear in seabed contact while trawling. The goal is to keep the overall ground-gear weight to a minimum, i.e. so the rubber discs just skip along the bottom in light ground contact.

The location and duration of trawl shots, the catch of target species, and the total catch are recorded on a skippers' logbook. The shot duration can be anywhere between a half-hour to five hours with an average time of three hours.

Trawling occurs in water between 50 and 100 metres deep. The net is retrieved on a net drum, with the catch being spilled on the deck or, alternatively, into a hopper which transfers the fish below deck. The entrance to the hopper is fitted with a steel grid with square openings so that large animals and sponges, etc, do not pass through.

Deckhands release the bycatch of animals and sponges down the stern ramp almost immediately after the codend is spilt. The remaining catch is sorted by species and then transferred to a refrigerated brine tank for chilling. A few hours later, the catch is transferred to a cold room and packed by species into polythene-lined tubs (~20 kg per tub). The catch is held at 1 – 4°C to ensure maximum shelf life.

Shot locations are recorded by the skipper on a plotter, and the start and finish position is recorded in a statutory logbook provided by Department of Fisheries. A vessel's position is also recorded independently via the Department of Fisheries satellite-based Vessel Monitoring System. Trip duration is generally between five and nine days.

Trawling is permitted all year but due to inclement weather there is reduced effort between December to March (i.e. the cyclone season).

3.3 Current Management Regime

The PFTIMF is managed through a combination of area closures, gear restrictions and effort limitations. Current management strategies aim to limit fishing mortality of target species through setting the total allowable effort, which is allocated to individual licences as Individual Transferred Effort (ITE) units. ITE units are monitored by the Department of Fisheries' Vessel Monitoring System.

Number of vessels

There are a limited number of vessels operating in the PFTIMF. There are 11 permits with varying time allocations throughout the various areas, with the allocation currently being consolidated onto three full-time vessels.

Area closures

Currently a large amount of the PFTIMF is closed to trawling and has been since the implementation of the (Interim) Management Plan. Zone 1 of the fishery has been closed to trawling since 1998. Area 3 of Zone 2 has also been closed since 1998 as this area represents a relatively undisturbed area with the potential to supply progeny to the other areas within Zone 2 through egg and larval dispersal, which would thus benefit the large majority of targeted teleost species.

In addition, Area 6 of Zone 2 has been closed since the commencement of the plan except for two periods of research trawling in 1998 and 1999. The area inshore of the 50-metre depth isobath is also closed to trawling to avoid conflict with other users (recreational fishers) of the area.

Areas 1, 2, 4 and 5 are open to fishing all year, with separate effort allocations (in hours) in each area, as stipulated in the (Interim) Management Plan. Logbook records show that the open areas of the fishery are trawled with varying intensity due to effort allocation, substrate composition and economic considerations (e.g. distance from port).

Gear controls

There is a set of gear controls aimed at:

- limiting the catching capacity of the gear (i.e. via a total maximum length restriction on the sweep/bridle wire and headrope);
- maintaining a given level of mesh selectivity (i.e. by having a minimum mesh size);
- restricting trawling activity to flatter/softer regions of seabed i.e. by placing a maximum size (diameter) restriction on rubber ground-gear discs; and
- reducing the take of large fauna and flora through the use of a grid in the net.

Vessel Monitoring System

The Vessel Monitoring System enables the Department to monitor vessel time allocation, as well as location, to permit the surveillance of closed areas.

Bycatch Reduction Devices (BRDs)

Reducing dolphin interaction has been the key bycatch issue since the inception of the fishery. In 2004/05 a Fisheries Research and Development Corporation (FRDC) funded project tested the effectiveness of acoustic 'Savewave pingers' and exclusion grids to reduce dolphin bycatch. The project found that the acoustic 'pingers' were not an effective mitigation measure (Stephenson 2005). Results of the effectiveness of grids were inconclusive (Stephenson 2005) and further work was therefore instigated.

The Department of Fisheries' Chief Executive Officer established the Dolphin Reference Group in 2004. The Dolphin Reference Group had four members including an independent chair (Dr John Keesing of CSIRO Marine Research), a dolphin behaviour expert (Dr Richard Connor of the University of Massachusetts), an industry representative (Mr Graeme Stewart) and a departmental representative (Dr Lindsay Joll). A number of expert observers were also involved

in the Dolphin Reference Group process including representatives from the Conservation Council, Department of Environment and Conservation, Commonwealth SeaNet program and the PFTIMF observer program.

In December 2005, the Department, the industry and the Dolphin Reference Group commenced an additional grid trial (using underwater video cameras) to:

- complement the previous mitigation gear trials, and
- provide the data needed to draw a firm conclusion on the effectiveness of dolphin exclusion grids used in the fishery at that time.

The use of grids was made mandatory in the fishery from 1 March 2006. Observer data collected in 2005 and 2006 revealed that these grids were effective in reducing dolphin bycatch; in 2005 trawl nets without grids caught 15.2 dolphins per 1,000 shots, whereas trawls equipped with grids in 2006 only caught 7.8 dolphins per 1,000 shots.

In 2007, the Department of Fisheries sought assistance from several well-qualified cetacean researchers in the Fish and Fisheries Research Centre at Murdoch University. With financial support from the FRDC, licensees and the Department of Fisheries, the services of these people was secured in 2008 on a project titled '*Reducing Dolphin Bycatch in the Pilbara Finfish Trawl Fishery*'. The objectives of the project were to:

1. Reduce the potential for interaction between dolphins and the Pilbara Fish Trawl Interim Managed Fishery through an examination of the fine scale spatial, seasonal and daily data on fishing effort and dolphin interactions.
2. Reduce the chance of harm and mortality to dolphins if interactions do occur by evaluating:
a) net designs and dolphin behaviour, and, b) exclusion devices, alternative net designs and the effective operation of the nets. Identify the species and genetic diversity of dolphins interacting with the fishery.

The project involved strong communication and engagement with the Pilbara Fish Trawl industry, Murdoch University, the Department of Fisheries and net-makers to modify and trial different net designs. Following research findings (Stephenson 2005) and discussion with industry regarding their observations of dolphin behaviour, the exclusion grids were moved forward to the start of the net extensions in June 2008.

The project compared three broad categories of net designs including 1) trawl nets with no exclusion grid or escape hatch; 2) trawl nets with an exclusion grid and bottom escape opening built into the aft end of the net extension (just in front of the codend); and 3) trawl nets with exclusion grids and bottom escape openings moved forward in the net to the start of the net extension.

After the introduction of exclusion grids, there was a clear (~50 per cent) reduction in dolphin catch rates. The trends in skipper and observer reported catch rates were not consistent for the forward grid design.

Additionally, the FRDC research project identified three key areas where further work was needed:

1. The need for further net modifications (i.e. the installation of top opening escape hatches) to potentially further reduce dolphin capture rates.
2. Observer coverage combined with deployment of net-mounted video cameras in underwater housings for these trials were recommended to confirm fishing efficiency of targeted species with top opening escape hatches.

3. In order to resolve the taxonomic uncertainties surrounding the dolphin population/s impacted by the fishery, genetic sampling should be combined with osteological and morphometric assessments and post-mortem examinations on dolphins that are caught in the fishery (Allen and Loneragan 2010).

3.4 Marine Environment

Bycatch is a consequence of interactions between trawl gear and the physical and biological environment. Fishing activity can impact on bycatch either directly or indirectly. Direct impacts can be quantified through catch records and underwater observations of bycatch interacting with the fishing gear. Indirect impacts are much more difficult to assess. Therefore, in order to understand the impacts of bycatch within a fishery, it is necessary to understand the environment in which the fishery operates, as well as have a good understanding of the fishing impact on that supporting marine environment.

The substrate of the main fishing grounds of the PFTIMF is variable and includes limestone ridges, coarse sand, mud and gravel bottoms (Harris and Baker 1988). The major vegetation types in the trawl grounds of the fishery are sparse beds of macro-algae and encrusting algae associated with some of the harder substrates. A diverse range of sessile epibenthic fauna (e.g. sponges, gorgonians, sea whips, soft corals) also occur in the trawl grounds of the fishery. Epibenthic fauna provide structurally complex habitat that is used by many of the target species caught by the fishery.

Demersal trawling is potentially destructive to epibenthos, although the rate of trawl-induced disturbance varies with the type of trawl gear used, and also with the size and morphology of epibenthic organisms (Moran and Stephenson 2000). Demersal otter trawling (as conducted in the fishery) in the Pilbara region was found to reduce large epibenthos (organisms >20 cm) density by 15.5 per cent per trawl pass, although only four per cent of the detached benthos is retained in the net (Moran and Stephenson 2000).

At the 1999 level of effort, most of the area open to trawling was estimated to have a disturbance of 0.5 – 10 per cent per year, with some small spots of higher mortality in Area 1 (where, historically there has been a greater effort allocation) (Moran and Stephenson 2000). The seabed (particularly in shallower waters) within the trawl managed fishing area is also altered by the occasional occurrence of severe tropical cyclones with wind speeds greater than 50 knots during the summer and autumn months (December to April).

3.5 Bycatch in the Pilbara Fish Trawl Fishery

Bycatch in the fishery is predominantly unmarketable scalefish (Table 1), but there are also sharks and rays (Table 2) and epibenthic species (sponges and corals) (Table 3). In addition, the fishery interacts with protected/listed species including dolphins, marine turtles, seasnakes, sygnathids and sawfish. A summary of catch of protected/listed species in the Fishery for the period 1 January 2008 to 31 December 2008 (from skippers' logbooks and observer data) is provided in Table 4.

Table 1. Main species of scalefish discarded by the Fishery as estimated from the 2002 Natural Heritage Trust funded bycatch survey (472 trawls).

Common name	Scientific name
Lizardfish	<i>Sauridida undosquamis</i>
Triggerfish	<i>Abalistes stellaris</i>
Trevally	<i>Caranx</i> spp. <i>Carangoides</i> spp.
Bigeye	<i>Priacanthus macracanthus</i>
Javelin fish	<i>Pomadasys kaakan</i>
Catfish	<i>Arius</i> spp.
Toadfish	<i>Lagocephalus sceleratus</i> <i>Lagocephalus</i> spp.
Squirrelfish	Holocentridae
Five-lined flagfish	<i>Lutjanus quinquelineatus</i>
Sea pike	<i>Sphyræna</i> spp.
Albacore	<i>Thunnus alalunga</i>
Blacktip tripodfish	<i>Trixiphichthys weberi</i>
Batfish	<i>Platax batavianus</i> <i>Zabidius novemaculeatus</i>
Flutemouth	<i>Fistularia commersonii</i> <i>Fistularia petimba</i>
False flagfish	<i>Lutjanus lutjanus</i>
Fortesque	<i>Siganus fuscescens</i>
Blotched javelinfish	<i>Pomadasys maculatum</i>
Bonito	<i>Cybiosarda elegans</i>
Barracuda	<i>Sphyræna barracuda</i>
Striped catfish	<i>Plotosus lineatus</i>
Frigate mackerel	<i>Auxis thazard</i>

3.5.1 Sharks and Rays

Following the implementation of bycatch exclusion grids in all nets in the fishery from 1 March 2006, the bycatch of larger sharks and rays (>150 cm length) was reduced.

The shark and ray species caught in the 2002 Natural Heritage Trust-funded bycatch survey is shown in Table 2. In this survey nearly all discarded small sharks (<1 metre) were returned to the water dead. Larger sharks (>1 metre) were generally alive and in good condition when they were returned to the water.

Consideration of the abundance, distribution, and biological characteristics would indicate green and narrow sawfish are at highest risk, with white-spot guitarfish, milk shark, sandbar shark, shovelnose ray, banded catshark, whitecheek shark, sharkray, weasel shark, northern wobbegong, scalloped hammerhead, and sharpnose shark at lesser risk.

Further evidence of dolphins, sea snakes, sharks and a turtle swimming upward upon interacting with the grid was obtained during FRDC Project 2008/048, indicating that a top-opening escape hatch would be the logical next step in reducing the bycatch of megafauna (Allen and Loneragan 2010).

Retention of sharks and rays in the fishery is now prohibited.

Table 2. Species of shark and rays observed in the 2002 Natural Heritage Trust-funded bycatch survey (472 survey shots).

Common name	Scientific name
SHARKS	
Banded catshark	<i>Atelomycterus sp. A</i>
Bignose	<i>Carcharhinus altimus</i>
Blacktip	<i>Carcharhinus tilstoni/limbatus</i>
Fossil	<i>Hemipristis elongata</i>
Great hammerhead	<i>Sphyrna mokarran</i>
Green sawfish	<i>Pristis zijsron</i>
Grey carpet	<i>Chiloscyllium punctatum</i>
Leopard/zebra	<i>Stegastoma fasciatum</i>
Milk	<i>Rhizoprionodon acutus</i>
Narrow sawfish	<i>Anoxypristis cuspidata</i>
Northern wobbegong	<i>Orectolobus wardi</i>
Pigeye	<i>Carcharhinus amboinensis</i>
Scalloped hammerhead	<i>Sphyrna lewini</i>
Sharkray	<i>Rhina ancylostoma</i>
Sharpnose	<i>Rhizoprionodon taylori</i>
Giant shovelnose ray	<i>Rhinobatos typus</i>
Golden shovelnose ray	<i>Rhinobatos sp. A</i>
Sliteye	<i>Loxodon macrorhinus</i>
Smooth hammerhead	<i>Sphyrna zygaena</i>
Spinner	<i>Carcharhinus brevipinna</i>
Spot tail	<i>Carcharhinus sorrah</i>
Tasselled wobbegong	<i>Eucrossorhinus dasyopogon</i>
Tawny nurse	<i>Nebrius ferrugineus</i>
Sandbar	<i>Carcharhinus plumbeus</i>
Tiger	<i>Galeocerdo cuvier</i>
Weasel	<i>Hemigaleus microstoma</i>
Whitecheek	<i>Carcharhinus dussumieri</i>
White-spot guitarfish	<i>Rhynchobatus djiddensis</i>
Winghead	<i>Eusphyra blochii</i>
RAYS	
White-spotted eagle ray	<i>Aetobatus narinari</i>
Blotched fantail ray	<i>TaeniuraMeyeni</i>
Reticulate whipray	<i>Himantura uarnak</i>
Brown whipray	<i>Himanatura sp.</i>
Blue-spotted maskray	<i>DasyatisKuhlii</i>
N/a	<i>Dasyiatis spp.</i>
Australian butterfly ray	<i>Gymnura australis</i>

3.5.2 Benthos

The fishing nets in the PFTIMF have rubber discs attached to the ground-rope that aim to allow the net to fish slightly off the bottom and ride over obstructions, including benthos. The maximum disc size is stipulated in the (Interim) Management Plan as a maximum diameter of 350mm, aimed at restricting the movement of trawlers into rough country.

A study on trawl benthos removal (Moran and Stephenson 2000), using nets similar to those in the fishery, revealed that 15.3 per cent of the benthos over 20 cm was removed with each trawl pass, with the cumulative removal being approximately 0.5 per cent to 10 per cent per year, with some of the more intensely fished areas registering 20 per cent per year. Removal rates peaked in the west of the trawl fishery where effort was highest.

The estimated annual catch of epibenthic species based on a projection of the 2002 bycatch survey, is presented in Table 3. A more thorough analysis of catch by depth can be found in Stephenson and Chidlow (2003).

Table 3. Estimated annual catch* of epibenthic species (determined by multiplying the 2002 bycatch survey catch with the total fishing effort in that year) and locations of highest catch rates.

Name	Total catch*	Locations of highest catch rates in fishery
Small sponges	83,655	similar catch rates in all Areas; higher catch rates in shallow water.
Medium sponges	28,418	higher catch rates in Area 1; higher catch rates in shallow water.
Large sponges	5,538	higher catch rates in Area 1; higher catch rates in shallow water.
Hard coral	598	similar catch rates in all Areas; higher catch rates in shallow water.
Soft coral (<i>Dendronephthya</i> spp.)	4,212	similar catch rates in all Areas & depths.
Coralline algae (Corallinaceae)	17,017	higher catch rates in Areas 4 & 5; higher catch rates in deep water.
Seafans (<i>Subergorgia</i> spp., <i>Ctenocella</i> spp.)	22,269	similar catch rates in all Areas; higher catch rates in deep water.
Seawhip (<i>Junceela</i> spp.)	910	found only in Areas 1 & 2; mainly in deep water.

* Catch measured as number of individuals (seafans, seawhips, soft coral) or pieces (sponges, hard coral, coralline algae)
 'small' = can be lifted in one hand, 'medium' = can be lifted by one person, 'large' = can be lifted by two people.

3.5.3 Protected and Listed Species

The species caught during the 2002 bycatch survey which are listed under section 248 of the *Environmental Protection and Biodiversity Conservation Act 1999* are bottlenose dolphins (*Tursiops truncatus*), pallid pipefish (*Solegnathus hardwickii*), spiny sea horse (*Hippocampus hystrix*), seasnake (*Hydrophis elegans*), loggerhead turtle (*Caretta caretta*) and green turtle (*Chelonia mydas*).

In June 2004 the Department of Fisheries and industry agreed on a three-phase process for achieving outcomes for protected/listed species:

1. The collection of baseline data (to clarify the extent of the problem);
2. The development and trialling of mitigation measures; and
3. The implementation of new policy and management arrangements (including legislation).

It has been essential, however, to prioritise research projects and as such the main focus has been on the reduction of dolphin, turtle and shark bycatch in the fishery.

Table 4. Summary of catch of protected/listed species in the fishery for the period 1 January 2008 to 31 December 2008 (from skippers' logbooks and observer data).

Listed & Protected Species	Alive	Dead	Total Reported
Dolphins	3	10	13
Pipefish	25	83	108
Sawfish, Green	15	3	18
Sawfish, Narrow	27	6	33
Seahorses	4	5	9
Sea Snakes	69	25	94
Turtles, Green	3	0	3
Turtles, Loggerhead	0	0	0
Turtles, Flatback	0	0	0

Green turtle (Chelonia mydas), loggerhead turtle (Caretta caretta), and flatback turtle (Narator depressus).

The number of turtles caught in the fishery in 2007/08 was minimal and all were released alive. The risk to the stock is considered low for each of the three species due to the small catch in relation to the stock size.

Sea snakes

The most common species of seasnake captured in the fishery is the bar bellied seasnake (*Hydrophis elegans*). The majority of caught seasnakes are returned alive and as such have low priority in this Bycatch Action Plan.

Sygnathids

The two most common species of sygnathid captured in the fishery include the pallid pipefish (*Solegnathus hardwickii*) and western spiny seahorse (*Hippocampus angustus*).

Dolphins

The Department of Fisheries and industry have identified the reduction of dolphin bycatch as the top priority for the development of bycatch reduction programs. It was recognised that abatement measures that successfully reduce dolphin bycatch may prove to be effective for other large marine animals as well (e.g. sharks and turtles).

The Dolphin Reference Group (and observers) first met on 3 December 2004 and assembled a list of information that was crucial to progression in this field continuing. These ‘gaps in knowledge’, were:

1. Dolphin mortality in the PFTIMF each year;
2. An appropriate experimental protocol for trialling mitigation devices, including underwater footage to complement experiments;
3. Dolphin behaviour patterns in the vicinity of these trawls;
4. The physiology and morphology of landed dolphins (e.g. sex, age and photographs) to determine any patterns or selectivity;
5. The species of dolphin(s) being caught;
6. The cause of death, and location of entanglement within the net; and
7. A population estimate of the species involved.

Priorities 1 to 6 have been the focus of research programs to date (Appendix 2). There is no clear temporal (i.e. seasonal) or spatial (i.e. by management area or water depth) variations, but FRDC Project 2008/048 found catches to be significantly lower during the early morning period (00:00 to 5:59) than other times of day (Allen and Loneragan 2010).

Priority 7 has not been addressed. In 2010, the Australian Marine Mammal Centre in conjunction with Murdoch University intends to research fishery-impacted dolphin population genetic structure and abundance in the Pilbara region of north-western Australia via FRDC Project 2008/048. This ongoing research will potentially provide the information necessary to address priority 7, but also allow assessment of the level of impact that interactions with the fishery are having on local dolphin population(s).

4.0 OBJECTIVES, ACTIONS, RESPONSIBILITY AND TIMEFRAMES – MARCH 2010

OBJECTIVE	ACTION	RESPONSIBLE	OUTCOMES AND ONGOING PROGRESS
Objective 1. To gain a better understanding of the quantity of protected/listed species bycatch in the Pilbara Fish Trawl Interim Managed Fishery.	Action 1a. Design and implement an on-board observer program to gather information on the nature and quantity of bycatch in the fishery.	Department of Fisheries/Industry	Ongoing. Previous Fisheries Research and Development Corporation (FRDC) projects have achieved this, however, more observer coverage is required in the future.
	Action 1b. To establish the capacity to record interactions with protected and listed species. Also ensure adequate detail is collected on the spatial and temporal patterns in bycatch.	Department of Fisheries/Industry	Complete. Skipper's logbook amended to include provision for reporting listed/protected species bycatch. Protocol agreed with Skippers. Observer Program ongoing. Equip each vessel with a compact underwater camera for periodic random observations of grid and other points of interest in the trawl. Correlate the latter data with logbook entries and back deck camera footage (see 1c below)
	Action 1c. Source and fit 'on-deck' cameras and utilise footage to complement observer program data with a long-term view to replacing on-board observers.	Department of Fisheries/Industry	Ongoing. Recent FRDC project used underwater video footage recorded inside trawl nets to evaluate common bottlenose dolphin subsurface behaviour. A total of 85 hours of footage was collected over 36 daytime trawls. Further video and observer monitoring is planned for second half of 2010 in conjunction with trials of top opening nets.
Objective 2. To determine effective bycatch reduction methods or BRDs for the exclusion, or safe expulsion of, shark and ray species from trawl nets.	Action 2a. Trial the effectiveness of 'pingers' in reducing shark/ray bycatch.	Department of Fisheries/Industry	Complete. Pingers deemed ineffective. Refer to Stephenson 2005.
	Action 2b. Trial the effectiveness of 'electro-magnetic' ropes (fitted to front of the net) in reducing shark/ ray bycatch.	Department of Fisheries/Industry	Trial conducted but found to be ineffective. Refer to Stephenson 2005.
	Action 2c. Trial the effectiveness of grids in reducing shark/ ray bycatch.	Department of Fisheries/Industry	Complete. Following the implementation of grids into all nets in the fishery on 1 March 2006, the bycatch of larger sharks and rays was reduced.

OBJECTIVE	ACTION	RESPONSIBLE	OUTCOMES AND ONGOING PROGRESS
	<p>Action 2d. Trial the effectiveness of other bycatch reduction devices or methods as suggested by the Dolphin Reference Group and other cetacean experts engaged by the Dolphin Reference Group and the Department.</p>	<p>Department of Fisheries/Industry</p>	<p>Complete. The recent FRDC project 'Reducing Dolphin Bycatch in the Pilbara Finfish Trawl Fishery' (2008/048) recommended further investigation into the efficacy of exclusion grids with top-opening escape hatches needed to inform management action in the Pilbara Fish Trawl Interim Managed Fishery. Research based on footage obtained with trawl net-mounted video cameras will allow more accurate estimate of actual (i.e. landed and non landed) dolphin and other species bycatch.</p>
	<p>Action 2e. Seek 'input' from crew on potential bycatch reduction devices or methods.</p>	<p>Department of Fisheries/Industry/ Murdoch University</p>	<p>Complete. Industry meetings held in Point Samson in August 2006, November 2007 and June 2008. Industry is currently developing a proposal on trialling top-opening escape hatches and further observer coverage.</p>
<p>Objective 3. To determine effective bycatch reduction methods or Bycatch Reduction Devices for the exclusion, or safe expulsion of, dolphins from trawl nets.</p>	<p>Action 3a. Trial the effectiveness of 'pingers' in reducing dolphin bycatch.</p>	<p>Department of Fisheries/Industry</p>	<p>Complete. Pingers deemed ineffective.</p>

OBJECTIVE	ACTION	RESPONSIBLE	OUTCOMES AND ONGOING PROGRESS
	<p>Action 3b. Trial the effectiveness of grids in reducing dolphin bycatch.</p>	<p>Department of Fisheries/Industry/ Murdoch University</p>	<p>Ongoing.</p> <p>Further refinement of grids in nets undertaken in 2006/07, using interpretation of underwater video footage to further reduce bycatch. The exclusion grids were then moved forward to the start of the net extensions in June 2008.</p> <p>Three broad categories of net designs have been compared: trawl nets with no exclusion grid or escape hatch; trawl nets with exclusion grids and bottom-opening escape hatches built in to the aft end of the net extension (just in front of the cod end); and, trawl nets with exclusion grids and bottom-opening escape hatches moved forward in the net to the start of the net extension. After the introduction of exclusion grids, there was a clear (~50 per cent) reduction in dolphin catch rates.</p> <p>This research identified the need for further net modifications, i.e. further investigation into the efficacy of exclusion grids with the installation of top opening escape hatches, to further reduce dolphin capture rates. Research based on footage obtained with trawl net-mounted video cameras will allow more accurate estimate of actual (i.e. landed and non landed) dolphin and other species bycatch.</p>
	<p>Action 3c. Trial the effectiveness of other bycatch reduction devices or methods as suggested by the Dolphin Reference Group (e.g. acoustic sounders', 'curtains').</p>	<p>Department of Fisheries/Industry/ Murdoch University</p>	<p>Complete – Acoustic sounders and net curtains unsuccessful.</p> <p>The recent FRDC project recommended further investigation into the efficacy of exclusion grids with top-opening escape hatches needed to inform management action in the Pilbara Fish Trawl Interim Managed Fishery. Research based on footage obtained with trawl net-mounted video cameras will allow more accurate estimate of actual (i.e. landed and non-landed) dolphin and other species bycatch.</p>

OBJECTIVE	ACTION	RESPONSIBLE	OUTCOMES AND ONGOING PROGRESS
	Action 3d. Seek input from crew on potential bycatch reduction devices or methods.	Department of Fisheries/Industry/ Murdoch University	Complete. Industry meetings held in Point Samson in August 2006, November 2007 and June 2008. Industry is currently developing a proposal on trialling top-opening escape hatches and further observer coverage.
	Action 3e. Analyse the behavior of dolphins in the trawl nets, and location of entanglement, to determine further potential catch reduction methods.	Department of Fisheries/Industry/ Murdoch University/Dolphin Reference Group	Complete. Footage collected during the grid trial program was forwarded to Dr Richard Connor in 2006. Interpretation of this footage provided vital insight into refinement opportunities for grids and nets in the fishery for optimal performance of gear. Continued collection and interpretation of underwater video footage continued in 2007. Previous FRDC project (Stephenson 2005) analysed available data on dolphin captures, including location of interactions. Recommendations were made for a more detailed study quantifying the composition and biomass of landed bycatch.
	Action 3f. Collect information on caught dolphins to determine any patterns or selectivity.	Department of Fisheries/ Observers/Murdoch University	Ongoing. Data to be collected by fisheries observers. Recent FRDC project recorded details of captured dolphins. Recent FRDC project lead to a successful grant application to the Australian Marine Mammal Centre to research fishery-impacted dolphin population genetic structure and abundance in the Pilbara region of the north-western Australia. This ongoing research will provide the information necessary to assess the level of impact that interactions with the fishery have on the dolphin population/s.
Objective 4. To set achievable targets for the reduction of bycatch species.	Action 4. Compare 2002 bycatch survey and 2006 grid trial data to determine targets for shark, ray, turtle and dolphin bycatch reduction.	Department of Fisheries/Industry/ Dolphin Reference Group	Complete. Objective not practical and therefore not pursued. A policy of continuous improvement has been adopted rather than 'targets'.

OBJECTIVE	ACTION	RESPONSIBLE	OUTCOMES AND ONGOING PROGRESS
Objective 5. To assist skippers and crew in the implementation of the Bycatch Action Plan.	Action 5a. Assist skippers and crew in the installation and operation of bycatch reduction devices.	Department of Fisheries	Ongoing. Industry meetings held in Point Samson in August 2006, November 2007 and June 2008. Ongoing management meetings with industry provides assistance on this matter.
	Action 5b. Provide information to skippers and crew to aid in the identification of protected species.	Department of Fisheries/Industry	Complete. DEH spp. Identification guides disseminated. To be updated as updates are made available.
	Action 5c. Ensure that all new crew and skippers are aware of their obligations under the Environmental Protection and Biodiversity Conservation Act 1999 and this plan.	Department of Fisheries/Industry	Industry meetings held in Point Samson in August 2006, November 2007 and June 2008. Ongoing management meetings with industry provides assistance on this matter. Licensees responsible for updating new skippers and crew outside of the annual meeting.
Objective 6. Review the effectiveness of Bycatch Reduction Devices and other management initiatives.	Action 6a. Formally review data from the trials to determine effectiveness of bycatch reduction devices.	Department of Fisheries	Complete. FRDC Project 2004/68.
	Action 6b. Department of Fisheries to meet regularly with licensees to discuss management arrangements.	Department of Fisheries	Ongoing.
Objective 7. Report on the progress and review of the operational Bycatch Action Plan.	Action 7a. Annually review the Bycatch Action Plan at industry management meetings and at Dolphin Reference Group meetings.	Department of Fisheries/Industry	Ongoing. Annually in first half of year. Dolphin Reference Group – no longer in place.
	Action 7b. Progress against the Bycatch Action Plan to be reported to the Department of Environment, Water Heritage and the Arts annually.	Department of Fisheries	Ongoing. Copy of Bycatch Action Plan provided to the Department of Environment, Water Heritage and the Arts with annual reports.

5.0 APPENDICES

Appendix 1 Conditions of the Fishery's Wildlife Trade Operation Declaration: September 2009 – June 2010

Condition 1:

Operation of the fishery will be carried out in accordance with the *Pilbara Fish Trawl Fishery (Interim) Management Plan 1997* made under the *Western Australian Fish Resources Management Act 1994*.

Condition 2:

The Department of Fisheries (WA) to advise the Department of Environment, Water, Heritage and the Arts of any intended material change to the Pilbara Fish Trawl Interim Managed Fishery (PFTIMF) legislated management regime and management arrangements that could affect the criteria on which *Environmental Protection and Biodiversity Conservation Act 1999* decisions are based.

Condition 3:

The Department of Fisheries (WA) to produce and present reports to the Department of Environment, Water, Heritage and the Arts annually as per Appendix B of the *Guidelines for the Ecologically Sustainable Management of Fisheries – 2nd Edition*.

Condition 4:

The Department of Fisheries (WA), in consultation with the Department of Environment, Water, Heritage and the Arts, to finalise long-term arrangements to minimise the PFTIMF's interactions with protected species, particularly with Dolphins and Marine Turtles. Specifically, the Department of Environment, Water, Heritage and the Arts, will:

- (a) Finalise, with view to implementation, improved mitigation measures (both national and international);
- (b) Finalise and implement where appropriate, effective mitigation and other management measures, including, but not limited to, improved design bycatch reduction grids (e.g.; top opening hatch, as supported in the research report evidence);
- (c) Implement and standardise across the fishery, further improved mitigation and/or management measures endorsed as effective and appropriate by the Dolphin Reference Group; and

Finalise decisions in regard to implementation of the electronic monitoring system.

Condition 5:

Finalise the Bycatch Action Plan for PFTIMF, in order to satisfactorily meet the requirements of the *Environment Protection and Biodiversity Conservation Act 1999*.

Condition 6:

While no Memorandum of Understanding for the Reporting of Fisheries Interactions with Protected Species is in place between the Department of Fisheries (WA) and the Department of Environment, Water, Heritage and the Arts:

- (a) fishers to continue to notify the Department of Fisheries (WA) of any dolphin or marine turtle interactions;
- (b) fishers to continue to record all interactions with protected species in skippers' logbooks;
- (c) the Department of Fisheries (WA) to continue to provide a summary of all protected species interactions reported in the PFTIMF to the Department of Environment, Water, Heritage and the Arts on a quarterly basis; and,
- (d) the Department of Fisheries (WA) to continue to ensure that industry has the capacity to make protected species interactions reports at an appropriate level of accuracy;
- (e) the Department of Fisheries (WA) to confirm and commit to future observer coverage; and
- (f) the Department of Fisheries (WA) to investigate further setting an appropriate limit on dolphin catch, making it specific to vessels concerned.

Condition 7:

The Department of Fisheries (WA) to:

- (a) implement any ensuing changes to the management arrangements from the stock assessments, prior 1 June 2010;
- (b) continue to carry out further analysis on Rankin cod and obtain suitable reconciliation of catch rates and harvest levels; and
- (c) continue to provide age-structured model stock assessments for goldband snapper and bluespot emperor as the results become available.

Appendix 2 Monitoring and Research

- In 1993/94, a mortality experiment (Stephenson and Dunk 1996) was undertaken to determine the sustainable level of fishing effort in the Fishery. Five key species were studied: red emperor, Rankin cod, flagfish, bluespot emperor and rosy threadfin bream.
- A subsequent study (Stephenson and Mant 1999) determined age structure and biological characteristics for red emperor, Rankin cod, blue spot emperor, flagfish and rosy threadfin bream. The data was incorporated into a model that determined the likely impact of various levels of fishing effort on stocks of the key species, particularly red emperor and blue spot emperor.
- In 1998, research surveys of the deeper areas adjacent to the existing trawl grounds were completed under a separate FRDC-funded project (Newman *et al.* 2000).
- In 2002, the Department of Fisheries undertook a Natural Heritage Trust-funded bycatch survey of the trawl fishery (Stephenson and Chidlow 2003).
- A structured sampling program to re-assess the age composition of red emperor, Rankin cod, and goldband snapper catches began in June 2004. This involves the collection and processing of fish otoliths.
- The skipper logbook program, which provides valuable spatial and temporal information on the catch of target species was expanded in 2004 to allow skippers to record catches of other selected species, including protected species.
- The Department of Fisheries commenced an on-board observer program in June 2004 as part of a longer-term program to collect data on the bycatch of listed species (in particular dolphins, turtles and sawfish).
- The Department successfully secured funding from the Fisheries Research and Development Corporation (FRDC) to develop and trial bycatch mitigation devices, which resulted in initial trials being conducted on pingers and grids in late 2004/05.
- FRDC 2004/68 *Evaluation of the effectiveness of reducing dolphin catches with pingers and exclusion grids in the Pilbara trawl fishery* was finalised in 2005. “Savewave” acoustic pingers appear to be ineffective in keeping dolphins out of the trawl net in the Pilbara Trawl Fishery. The flexible grid constructed from polypropylene pipe appears to be impractical, as the net and grid combination did not fish properly, with scalefish catch close to zero. The semi-flexible selection grid constructed from a combination of braided stainless wire and pipe appears to reduce dolphin catches. Although three dolphins were caught in 2005 when the grid was deployed, all occurred on the initial trial of the grid and could have been due to initial technical problems.
- In March 2005, industry hired Pelagicus, an Australian Fisheries Management Authority accredited company, to assume the observer function. The level of coverage was relatively low (<10%) until 2006.
- Given the high cost of on-board observers, industry developed a proposal to trial an Electronic Observer System in 2005. Pilot funding was granted through the State’s Industry Development Unit to trial an ‘off-the-shelf’ system. The system, trialled in 2005/06, was found to have limitations. Further funding was successfully sought from the FRDC to further develop the system and conduct a cost-benefit analysis of Electronic Observer System versus on-board observers. However, to date it has not been possible to develop an electronic observer program to replace on-board observers.

- In October 2005 the Minister allocated money from the Development and Better Interests Fund to a further grid trial program in the fishery. The intent was to monitor enough shots in the fishery to statistically determine the effectiveness of grids in reducing dolphin bycatch, a feat not achieved under the FRDC-funded grid trials. The commencement of the trial was delayed due to a number of cyclones in the 2005/06 wet season.
- Preliminary results of the trials were positive and, as such, industry voluntarily fitted grids to all boats in the fishery on 1 March 2006. A formal condition requiring grids to be fitted to all operational nets before operating in the fishery was added to each of the fishery's permits in May 2006. The condition was worded such that operators could continue experimenting with the form and installation of the grids during this period of adjustment.
- To coincide with the introduction of grids, the Department hired an additional observer in the fishery to assist operators with the fitting of the grids and assist the existing observers and the grid trial coordinator in order to further evaluate their effectiveness.
- Collection and interpretation of underwater video footage continued in 2007.
- In 2008, a new FRDC project, Reducing Dolphin Bycatch in the Pilbara Finfish Trawl Fishery commenced. The objectives of this project were to:
 1. Reduce the potential for interaction between dolphins and the Pilbara Fish Trawl Interim Managed Fishery through an examination of the fine scale spatial, seasonal and daily data on fishing effort and dolphin interactions.
 2. Reduce the chance of harm and mortality to dolphins if interactions do occur by evaluating: a) net designs and dolphin behaviour, and, b) exclusion devices, alternative net designs and the effective operation of the nets.
 3. Identify the species and genetic diversity of dolphins interacting with the fishery.

This project compared three broad categories of net designs – trawl nets with no exclusion grid or escape hatch; trawl nets with exclusion grids and bottom-opening escape hatches built into the aft end of the net extension (just in front of the cod end); and, trawl nets with exclusion grids and bottom opening escape hatches moved forward in the net to the start of the net extension.

This research project identified three key areas in which this applied research requires further development in the near future:

1. The need for further net modifications (i.e. the installation of top opening escape hatches) to potentially further reduce dolphin capture rates. Recommendations for a trial to be conducted over a minimum period of six months;
 2. Observer coverage combined with deployment of net-mounted video cameras in underwater housings for these trials were recommended to confirm fishing efficiency of targeted species with top opening escape hatches.
 3. In order to resolve the taxonomic uncertainties surrounding the dolphin population/s impacted by the fishery, genetic sampling should be combined with osteological and morphometric assessments and post-mortem examinations on dolphins that are caught in the fishery (Allen and Loneragan 2010).
- Further net design and development to occur during 2010.
 - Industry funded observer program to assess/validate 2010 net design to take place in 2010/11. Dolphin Population Study funded by the Australian Marine Mammal Centre in conjunction with Murdoch University – to clarify the identity of the dolphins that are interacting with

the fishery and the size of their population, to determine the possible population impacts of different levels of capture – commencing March 2010.

- Development of an electronic observer program – means of increasing the number of trawl shots observed without the associated costs of on-board observers, in order to improve the statistical robustness of measures of dolphin capture rates and allow for meaningful comparisons between different gear designs – commencing March 2010.

Appendix 3 References

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Newman SJ, Evans D, and Ashworth R 2000. Assessment of the outer-shelf fishery resources off the Pilbara coast of tropical Western Australia. FRDC Report No. 97/138.

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Stephenson P 2005. Evaluation of the effectiveness of reducing dolphin catches with pingers and exclusion grids in the Pilbara trawl fishery. Final Report to the Fisheries Research and Development Corporation (FRDC) on Project No. 2004/68. Fisheries Western Australia, Perth, Australia.

The Pilbara Fish Trawl Fishery's application to the Department of Environment and Heritage (DEH) to assess the Fishery against the *Australian Government Guidelines For The Ecologically Sustainable Management Of Fisheries* under the requirements of Part 13 and Part 13A of the *Environment Protection and Biodiversity Conservation Act 1999*.

