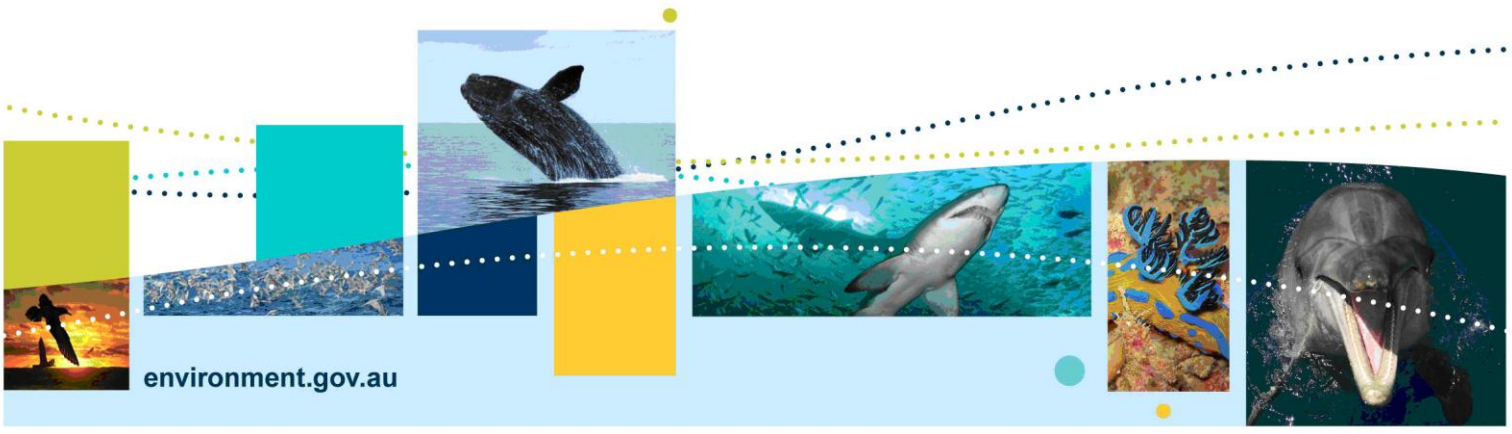
Australian Government
Department of Sustainability, Environment,
Water, Population and Communities

Assessment of risks that commercial fishing methods may pose to conservation values of the South-west Marine Region

Discussion Paper

(February 2010)



Contents

1. Purpose of this paper and summary of findings

This paper sets out the analysis and recommendations arising from the South-west Fishing Gear Risk Assessment (FGRA). The assessment was undertaken to determine the potential risks posed by fishing methods to the conservation values and marine biodiversity identified within areas for further assessment in the South-west Marine Region. The outcome of this assessment will determine which fishing methods are incompatible with the conservation objectives of new Commonwealth marine reserves which are being developed in order to protect those conservation values. This assessment is not designed to assess the overall sustainability of particular gear types or to override the Department's EPBC Act Fisheries Assessment process, but to assess fishing gears in the context of the higher protection requirements that apply within marine reserves.

The paper describes the policy parameters relevant to the assessment, describes the assessment methodology and findings, and articulates the arguments supporting the following findings:

- three fishing methods – demersal longline; demersal trawl and demersal gillnet - are considered as being "incompatible" with respect to the conservation values of all areas for further assessment;
- one fishing method – pelagic longline - is considered to be "incompatible pending further assessment" of the effectiveness of mitigating risks to the conservation values;
- three fishing methods – non-benthic components of mid-water trawl, lobster pots and purse seine - are considered to be "compatible given mitigation measures"; and
- four fishing methods – giant crab, trolling, minor line and squid jig – are considered "compatible".

2. Policy context

The *Goals and Principles for the Establishment of the National Representative System of Marine Protected Areas* (DEWR, 2007) guide the design of Commonwealth marine reserves through the marine bioregional planning program, in accordance with the national *Guidelines for establishing the National System of Marine Protected Areas* (MPAs; ANZECC 1998). In Australia, MPAs are established and managed with the primary purpose being to:

> "..contribute to the long-term ecological viability of marine systems, to maintain ecological processes and systems and to protect Australia's biological diversity at all levels." (ANZECC 1998)

In relation to the zoning of new reserves, where multiple activities are allowed, the Goals and Principles specify that zoning will be based on the IUCN Categories as interpreted in Schedule 8 of the *Environment Protection and Biodiversity Conservation Regulations 2000* (EPBC Regulations). Additionally, Principles 19 and 20 (DEWR, 2007) state:

> "19 – Zoning will be based on the consideration of the threat that specific activities pose to the conservation objectives of each MPA."
>
> "20 – Zoning of MPAs will seek to ensure that the conservation objectives of the area are protected, taking into account a precautionary approach to threats as well as the relative costs and benefits (economic, social and environmental) of different zoning arrangements."

The EPBC Regulations set out the management principles for each of the zone categories; for 'managed resource protected areas' (i.e. multiple-use zone Category VI), the zone is to be managed primarily for the sustainable use of natural ecosystems based on the principles that:

- The biological diversity and other natural values of the reserve or zone should be protected and maintained in the long term;
- Management practices should be applied to ensure ecologically sustainable use of the reserve or zone;
- Management of the reserve should contribute to regional and national development to the extent that this is consistent with these principles.

Against these broad policy goals and management principles, more specific conservation objectives are set for the regional network and each of the component marine reserves. In the South-west, areas for further assessment have been identified within which new Commonwealth marine reserves will be established (see

Figure 1). Areas for further assessment are not proposed reserves. They have been identified through the assessment of information compiled using the Goals and Principles (DEWHA 2009a) and encompass representative examples of the range of biodiversity and ecosystems within Commonwealth waters.

Broad conservation objectives have been developed for reserves that will be designed within the areas for further assessment. The objectives relate to the conservation assets identified within each area as well the protection of marine biodiversity generally. The conservation objectives are underpinned by the understanding, based on best available data and knowledge, of the biodiversity values that exist within each area. Values are identified in relation to:

- bioregional representativeness (i.e. the bioregional units that exist within region and the depth gradients, seafloor features and large scale ecological units known to occur within each bioregion);
- conservation values including key ecological features and protected species;
- biologically important areas (BIAs) for threatened and migratory species. BIAs have been identified for protected species where, on the basis of sound scientific information, they are known or are likely to exhibit biologically important behaviour including breeding, foraging, aggregation and migration;
- spatially predictable pelagic features of regional significance for productivity and ecosystem functioning.

Additionally, draft regional priorities have been identified as part of the marine bioregional planning process. The priorities are based on an analysis of potential threats to the Regions' conservation values and the Government's overall policy objectives. The regional priorities provide strategic direction for marine bioregional planning and for prioritising marine research and monitoring and are intended to inform decision-making and investment by the Government over the life of the Marine Bioregional Plan. Of the fifteen draft regional priorities articulated in the Draft South-west Marine Bioregional Plan, six have relevance for the design of the regional reserves network, including for the development of zoning arrangements:

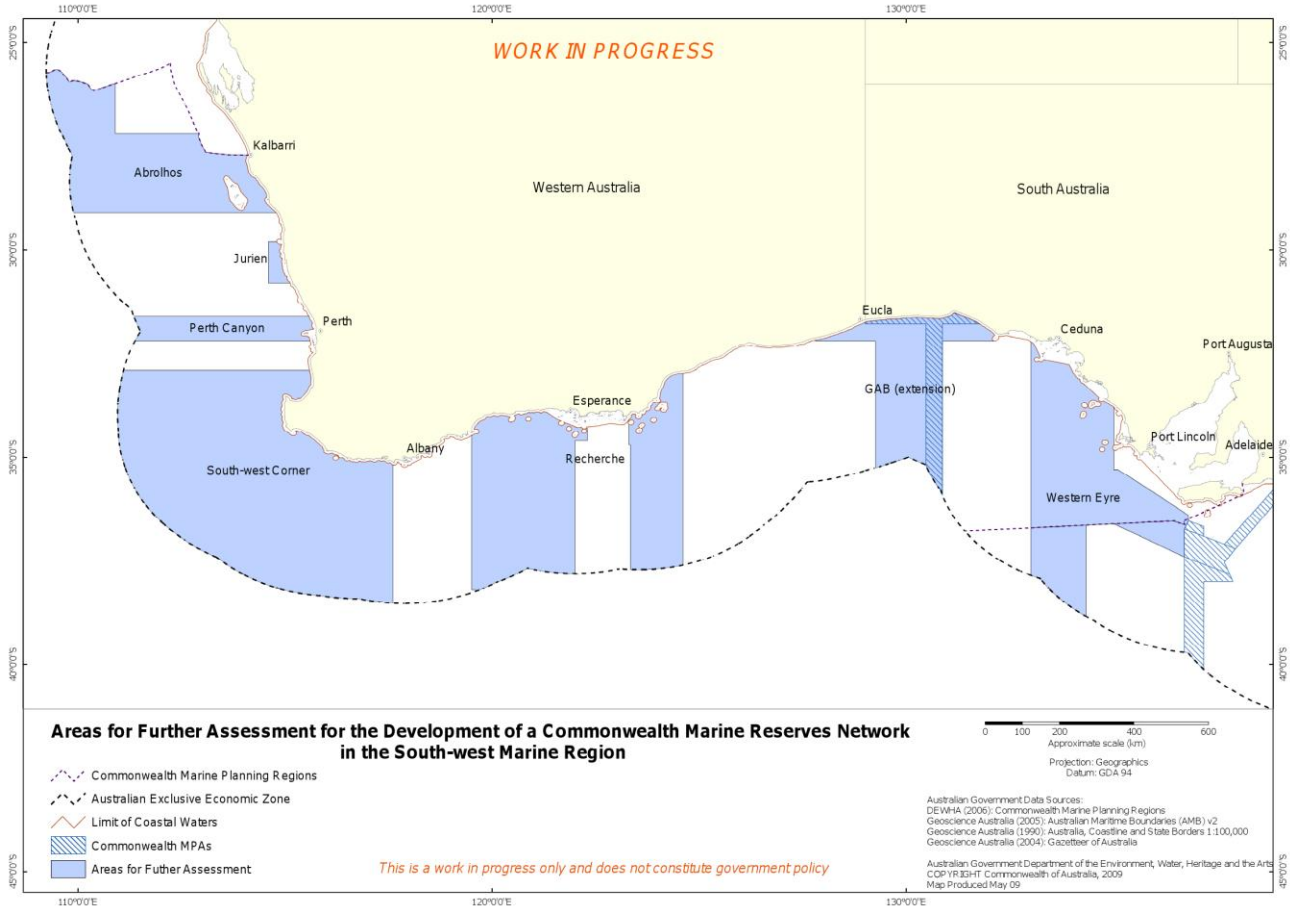
- Improving the understanding, protection and monitoring of key ecological features of the South-west marine region
- Reversing the decline of the Australian sea lion and assisting the recovery of the species throughout its range
- Protecting and conserving areas of global significance for biodiversity, such as the marine habitats surrounding the Houtman-Abrolhos and the Recherche Archipelagos
- Increase the resilience of threatened and otherwise protected seabirds and their capability to adapt to climate change
- Sustain the recovery of the Southern right whale populations and their expansion into suitable breeding habitats in the region
- Improve the understanding of the ecological role of sharks and rays in the region, and protect and conserve the species accordingly

Based on the considerations above (i.e. goals and principles; IUCN categories regulations and draft regional priorities), the key policy parameters that underpin the South-west FGRA, as well as the assessment of risk posed by activities other than fishing, can be summarised as follows:

- the compatibility of activities in a multiple-use reserve is to be based upon the consideration of risk (relying on best available information) to the conservation values in each area for further assessment, in the context of the overarching biodiversity conservation goal and with consideration of the regional priorities;
- in attributing risk ratings and determining the overall compatibility of a given method, when information is incomplete and there is uncertainty, a precautionary approach is to be applied; and
- the legislative management purpose and principles for multiple-use zones require careful consideration of the potential to mitigate risks to an ecologically sustainable level.

A final important policy consideration is the need to establish marine protected areas that achieve the conservation goals and objectives at the least cost to marine users. For this reason, the South-west FGRA has been conducted at a point in the process when it is possible to incorporate information about "incompatible" fishing methods in the design of the network, with the purpose of minimising overlap with areas of value to those fishing methods that would be excluded from multiple-zone MPAs.

Figure 1: Areas for further assessment in the South-west Marine Region



3. Background – the 2005 South-east Fishing Risk Assessment and Ecological Risk Assessment for Effects of Fishing

The South-west FGRA has used the South-east FGRA as a starting point, undertaken in 2005 as part of the development of the South-east Network of Commonwealth Marine Reserves. The South-east FGRA was undertaken by an external consultant through workshops involving industry and other stakeholders. The main outcome of this process was that demersal trawl, Danish seine and scallop dredging were found to have incompatible levels of risk to the regional network's conservation values (E-Systems, 2005), and as a result were excluded from South-east marine reserves. Pelagic and demersal longlining were also found to have incompatible risk levels to some conservation values, however, were not completely excluded from multiple-use zones. Other gear type, such as giant crab traps and minor line were found to have compatible levels of risk. The report from the South-east FGRA can be obtained upon request.

Since the South-east FGRA was completed, the Australian Fisheries Management Authority (AFMA) has made significant progress towards ecosystem based fisheries management through the implementation of an ecological risk management framework (see www.afma.gov.au/environment/eco_based/eras). *Ecological Risk Assessments for Effects of Fishing* (ERAs) have now been completed to Level 3[1] for nearly all Commonwealth fisheries. ERAs assess the impact, direct and indirect, that fishing activities may have on aspects of marine ecosystems including target species, bycatch and byproduct species, threatened, endangered and protected species (TEPS), habitats and communities (although community impacts have only been assessed using qualitative methods to date). The ERA work has resulted in detailed information

1 The Ecological Risk Assessment methodology uses a hierarchical approach involving:

- an initial scoping of the fishery
- Level 1 assessment – a comprehensive, qualitative assessment of risks in the fishery
- Level 2 assessment – a more focused, semi-quantitative assessment of the risk to species
- Level 3 assessment - a highly focused and fully quantitative risk assessment (e.g. a stock assessment)

about the level of risk to species and habitats which have not previously been available. For this reason the South-west FGRA has drawn heavily on these assessments to build on the findings of the South-east FGRA.

The ERA methodology comprises three stages of analysis which are increasingly quantitative. In the SWMR, all but one of the Commonwealth fisheries have been assessed to Level 3, the fully quantitative Sustainability Assessment for Fishing Effects (SAFE). However, for the purposes of this Fishing Risk Assessment, the Department has relied primarily on the semi-quantitative Level 2 Productivity Susceptibility Analysis for several reasons:

- The Level 2 PSA analysis assesses how productive each species (or habitat) is, whether it is likely to come into contact with the gear, and how likely the species is to interact with the gear. This process leads to an assessment of *potential* risk rather than *actual* for species and habitats; potential risk remains valid independent of future changes in levels of effort. In contrast, fishing intensity is critical in the Level 3 SAFE methodology which calculates *absolute* levels of risk based on species overlap with fishing activity, current levels of fishing effort, the 'catchability' of the species by the gear type, and post capture mortality. In the South-east FGRA, an across the board moderate to high level of fishing effort was adopted for all gear types in order to be precautionary and to reduce the need for further risk assessments should levels of effort increased over time.
- Level 3 ERAs do not consider impacts on the benthic environment or protected species other than sharks and rays.
- Some Level 3 ERAs are thought to overestimate sustainable exploitation rates for sharks and rays, thereby underestimating the risks posed to sharks and rays by particular gear types.
- Some Level 3 ERAs may be unreliable when assessing the risk of some gear types to species associated with patchy habitats
- In 2009 the CSIRO reviewed the Level 3 SAFE methodology and concluded that sustainable exploitation rates for sharks and rays were lower than for other fish. The new sustainability reference points are subject to ongoing review and verification (Zhou, et. al., 2009). It was also found that while the methodology works well in areas such as the Gulf of Carpentaria where habitats are relatively uniform, other areas, such as the Great Australian Bight, have extremely patchy habitats. In particular, the risk at the edge of the shelf and the upper slope may have been underestimated. Quantitative species analysis from the Great Australian Bight habitat mapping project shows that some ERA vulnerable species are concentrated in these restricted habitats (R. Daley [CSIRO] 2009, pers. comm., 25 September).

The Level 2 PSA is highly precautionary, designed to be a screening process to identify species or habitats that require further investigation. The analysis begins with an assumption of high risk for ecological components, which is then successively reduced as data and information is analysed. The results do not directly account for all management measures used within a fishery. In consultation with CSIRO and stakeholders, AFMA has developed a set of Residual Risk Guidelines to assist AFMA fisheries managers to calculate the level of risk remaining after Level 2 PSA and the consideration of mitigation and other fishery management measures. The guidelines have been used to develop Residual Risk Assessments (RRAs) of those species found to be at high risk after the Level 2 PSA for each fishery.

In consultation with AFMA, the Department has incorporated the results of the RRAs into the SW FGRA. Using the RRAs is consistent with the precautionary approach applied in the Level 2 PSA, with risk ratings remaining high unless there is evidence to the contrary. Habitats are not assessed in the RRA and so FGRA risk ratings are based on Level 2 PSA results. Where the RRA lowers risk ratings based on the Level 3 SAFE analysis, the results from the Level 2 PSA are used to avoid the influence of effort.

More information about Level 2 ERA Residual Risk Assessments for Commonwealth Fisheries is available at: www.afma.gov.au/environment/eco_based/eras/res_assessments.htm

4. Methods and approach

The South-west FGRA followed broadly the same approach used in the South-east, but applied the ERA findings as key input rather than risk ratings agreed through workshops as in the South-east. This approach is considered appropriate given that the CSIRO had consulted with the relevant industry representatives in the development phase of the ERAs, and that these are based on the best available science and expert input. Beside the South-east FGRA ratings and input from the ERAs, the South-west process also included information from the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) sustainable fisheries reports (including State government submissions).

The assessment was completed in two stages:

- Stage one involved identifying those South-east FGRA findings that could be safely transferred to the South-west region and, conversely, what gaps existed in terms of fishing methods or conservation values exclusive to the South-west.
- Stage two consisted of the assessment of risk posed by those methods that were found to have a medium-high risk in the South-east. Purse seine was the one exception to this; despite being found to have a low risk rating in the South-east FGRA, it was re-examined in the SW FGRA due to concern about potential seabird and cetacean interactions (DoF WA, 2008; DEH, 2005).

Where possible, the conservation values used in the assessment were categorised consistently with those in South-east FGRA to allow outcomes to be transferred. Conservation values and objectives specific to the South-west areas for further assessment were added to the assessment. The location of biologically important areas[2] for threatened, endangered and protected species (where known) were also noted. Each gear type was given a risk rating for each conservation value in each area for further assessment (detailed South-west FGRA tables can be obtained upon request).

The process for assessment was the same for each of the conservation values identified: likelihood (whether an interaction with the gear type is possible) and consequence (risk of mortality) were rated. These ratings were either based on the South-east FGRA or the AFMA ERA ratings (which included a susceptibility component). When the two ratings – South-east FGRA and ERAs - were not in agreement, the ERA rating was used on the basis that AFMA ERAs provide the most comprehensive advice. For State managed fisheries, information was drawn primarily from the reports prepared for EPBC Act sustainable fisheries assessments and relevant literature. Where information on State-managed fisheries was insufficient, ERA findings for Commonwealth fisheries using the same gear type were applied where target species and location was similar. Where there was insufficient information to make an assessment, a precautionary approach was taken and the gear type was assessed as incompatible pending further assessment. Assessments were made according to all biological components, regardless of their role in the fishery, that is, whether they are considered target, byproduct or bycatch species.

The AFMA ERA reports give a risk rating to each species and habitat assessed. For the purpose of aggregating these results to obtain an overall assessment of the fishing method, the South-west FGRA considered groups of species and habitats and, consistent with Principle 20 of the Goals and Principles, implemented a precautionary approach in determining an overall rating. Careful consideration was given to whether effective mitigation measures were available that could, if applied, reduce the level of risk. In particular for Commonwealth fisheries, information on mitigation measures included in the Residual Risk Assessment reports was considered where available (see also section 3 above). The 'translation' from ERAs risk ratings to an assessment of compatibility of the method within each SW area for further assessment is provided in Table 1.

The approach, findings and review outcomes of the SW FGRA will be made publicly available at the time of release of the Draft Plan, to enable interested parties, including industry and other stakeholders, to comment on the basis of the proposed zoning arrangements.

[2] Biologically Important Areas are defined as areas where protected species are known or likely to exhibit important behaviours such as breeding, foraging, aggregation and migration. BIAs are being used to inform MPA design and will be included in regional guidance to assist proponents of activities determine the likelihood of significant impacts on matters of national environmental significance.

Table 1: Relationship between ERAs risk ratings and the SW FGRA compatibility rating

Overall SW FGRA Rating	ERAs Ratings comparison and policy considerations
Incompatible	This overall assessment was given to fishing methods when ERAs found that: ▪ potentially high risk exists for elements of the marine environment that are identified as conservation values to be protected, AND ▪ for which mitigation measures were not found or are of limited effectiveness ▪ higher levels of precaution were used for those conservation values also identified as regional conservation priorities
Incompatible pending further assessment	This overall assessment was given to fishing methods when ERAs found that: ▪ potentially high risk exists for elements of the marine environment that are identified as conservation values to be protected, AND ▪ there is uncertainty about the effectiveness of mitigation measures ▪ higher levels of precaution were used for those conservation values also identified as regional conservation priorities
Compatible with mitigation measures and conditions	This overall assessment was given to fishing methods when ERAs found that: ▪ a range of risk levels exists for elements of the marine environment that are identified as conservation values to be protected, AND ▪ for which there are mitigation measures currently in place, or in the process of being implemented, which have been shown to have some effectiveness ▪ higher levels of precaution were used for those conservation values also identified as regional conservation priorities The full implementation of existing and proven mitigation measures will be a condition of operation within future Commonwealth marine reserves. Mitigation measures and conditions will be developed in consultation with industry and fisheries managers.
Compatible (some conditions maybe required)	This overall assessment was given to fishing methods assessed in the South-east FGRA or ERAs as having a low risk and were not further assessed in the South-west.

5. Outcomes of the Fishing Risk Assessment

5.1 Transferability and gaps from the South-east FGRA

The majority of conservation values, such as seafloor habitats at various depth ranges and broad species groups, are comparable across temperate marine environments of the South-east and South-west regions. Two important conservation values of the SWMR were not been assessed in the South-east FGRA: spatially predictable pelagic features and demersal biota (SE FGRA focused on only benthic sessile organisms). These were considered in the SW FGRA.

The South-east FGRA assessed 16 fishing methods; of these, seven were considered to have the potential for low risk to conservation values. The South-west FGRA considered that these results were safely transferable to the same gear when used in the South-west region, given similarities in target species and associated habitats.

Nine fishing methods were judged in the South-east FGRA to have the potential for medium to high risk to specific conservation values. Findings of the South-east FGRA in relation to bottom trawling were considered safely transferable to the SW, given that the broad benthic characterisation used in the South-east applies directly to the south-west areas for further assessment. Additionally, a rapid assessment of the findings from the ERAs for the GABTF and the WDWTF identified high risk levels to a number of benthic habitats, supporting the 'transferability' of the South-east findings (see Table 2). It was considered that the remaining methods required specific assessment of their risk to the South-west conservation values. As mentioned above, purse seine was also reassessed.
Trolling was the only gear type not assessed in the South-east FGRA that is used in the SWMR. It is a minor gear type in two fisheries in the region and its assessment relied on information from a New Zealand fishery (Ministry of Fisheries, 2007).

5.2 Results of the South-west Fishing Risk Assessment

Table 2 summarises the overall ratings for the 11 gear types used in the South-west Region, including those with ratings based on the South-east FGRA. Detailed results of the South-west FGRA can be obtained upon request. The results pertaining to the four methods rated as incompatible (including "incompatible pending further assessment") – demersal trawl, demersal longline, pelagic longline and demersal gillnet - are detailed below in Section 5.2.1 below.

Table 2: Summary of the South-west Fishing Risk Assessment results:

Fishing method:	South-west Assessment:	Rationale:
1. Demersal/ bottom trawl	Incompatible level of risk on: ▪ benthic and demersal communities and habitats across all areas for further assessment ▪ threatened, endangered & protected species (TEPS) ▪ sharks and rays (a regional priority)	Findings of 'incompatible risk' from the South-east FGRA were considered transferable to the South-west. Additionally, the overall risk rating was supported by the multiple high risk ratings in Level 2 ERA reports (Wayte, et. al., 2007; Daley, et. al., 2007d), including high risk ratings for many chondrichthyans (sharks & rays; 18 & 11 high risk in the GABT & WDTF respectively), seafloor habitats (21 & 20 habitats rated high risk in the GABT & WDTF). This includes high risk ratings for the threatened (vulnerable) grey nurse sharks by the GABT ERA and the also threatened (conservation dependent) school shark, a byproduct species of both fisheries. Other high risk sharks in the WDTF included the Endeavour Dogfish, Dusky Shark (both on Finalised Priority Assessment Lists), and the Ornate Angel Shark and Whitefin Chimaera (AFMA, 2010) - two endemics with restricted ranges (Last and Stevens, 2009). The vulnerable White Shark, Dusky Shark and Southern Dogfish (both of which are on the Finalised Priority Assessment List) were rated medium risk after residual risk assessment (AFMA, 2008).
2. Mid-water trawl	Compatible level of risk for non-benthic components of this fishing method, with mitigation measures and conditions to: ▪ minimise interactions with seals, small beaked whales, dolphins, white shark and grey nurse shark ▪ avoid contact with the seafloor	Risk ratings that support this overall rating are multiple high, medium & low risk ratings in the ERA (Daley, et. al, 2007b). Eight marine mammals were rated high risk after Residual Risk Assessment: Australian fur seals and 6 dolphin species. Interactions with MWT have been recorded in the SPF for both dolphins and Australian fur seals. Following the dolphin event there was a period of high observer coverage which found that interactions with dolphins are a relatively rare event. Trials of top opening SEDs have to date been unsuccessful but a new project is likely to start in July 2010 (AFMA, 2010a). Lyle & Willcox (2008) also identify seal bycatch in mid-water trawl as an issue that needs to be addressed in the SPF. Three sharks (white, grey nurse & whale shark) were rated at medium risk, although observer comments indicate this may be overestimating the level of threat. There is some evidence that when targeting species with a demersal habit, mid-water trawl may also come into contact with the seafloor and cause damage to benthic habitats. The ERA for the Small Pelagic Fishery identifies this as likely to be minimal when compared to other methods, however, it does acknowledge the gear contacts the seafloor from time to time (Daley, et. al., 2007b). Observer data from other mid-water trawl fisheries have, on occasions, recorded significant quantities of rocks being brought up from the seafloor in trawl nets (R. Daley [CSIRO] 2009, pers. comm., 9 November).
3. Demersal longline	Incompatible level of risk on: ▪ shark and ray species (regional conservation priority) across all areas for further assessment ▪ benthic and demersal communities and habitats across all areas for further assessment	Underpinning the overall risk rating are multiple high risk ratings by the ERA (Daley, et. al, 2007e). These include high risk ratings for 17 sharks, including the Southern Dogfish, which is on the Finalised Priority Assessment List. There were also high risk ratings for 3 skates, 8 teleosts, & 21 seafloor habitats (15 upper slope, 4 in canyons, 2 outer shelf). Further seafloor habitats were rated medium (outer shelf & canyons). After Residual Risk Assessment 26 seabird species were reduced from high to medium risk because of compliance with mitigation measures in the Threat Abatement Plan (AFMA, 2010b).
4. Pelagic longline	Incompatible level of risk (pending further assessment) on: ▪ shark and ray species (regional priority) across all areas for further assessment	Underpinning the overall risk rating are multiple high & medium-high risk ratings by the Level 2 ERA (Webb, et. al, 2007). Six shark species are considered at high risk, including Dusky Shark and Porbeagle Shark (listed as migratory) & the vulnerable White and Grey Nurse Sharks. 26 sharks & rays were rated at medium risk based on Level 2 ERA. 16 seabirds were considered medium risk after Level 2 ERA Residual Risk Assessment (AFMA, 2008). 42 marine mammals were considered at medium risk after Level 2 ERA, including whales, dolphins and pinnipeds. 2008 Fishery Status Reports (Wilson, et. al., 2009) consider 2 target species are currently being overfished (Yellowfin Tuna and Broadbill Swordfish), while another two have an uncertain status (Albacore and Bigeye Tuna). Oceanic longline fishing is listed as "Key Threatening Process" for seabirds under the EPBC Act.

5. Gillnet	Incompatible level of risk on: ▪ Australian sea lions in the GAB Extension and Wester Eyre areas for further assessment ▪ shark and ray species (regional conservation priority) across all areas for further assessment ▪ benthic and demersal communities and habitats Incompatible level of risk pending further assessment on: ▪ Australian sea lions in the WA west south coast areas for further assessment	Entanglement of Australian sea lions is a major concern with this fishing method. Underpinning the overall risk rating are multiple high risk ratings in the ERA report (Walker, et. al., 2007). At potentially high risk are: 22 types of outer shelf seafloor habitats, 3 seals & sea lions, & 8 sharks, including Dusky Shark (on the Finalised Priority Assessment List), Shortfin Mako (listed migratory & on the Finalised Priority Assessment List) & vulnerable White Shark (AFMA, 2010c). From 4 main target species in the WA Temperate Shark Fisheries'[3] 2 are rated 'inadequate' & 1 'inadequate but recovering' (DEHWA, 2009). Byproduct fish in this fishery are also depleted (DEWHA, 2009; Mackie, et. al., 2009).
6. Lobster pots	Compatible level of risk with mitigation measures to: ▪ minimise interactions with Australian sea lions, other seals and TEPS ▪ reduce mortality of juvenile seals	Ratings underpinning this overall assessment are based on the SE FGRA (E-Systems, 2005), which were all low, except for seals & Australian sea lions which were considered to be at medium risk. Sea lion exclusion devices (SLEDs) are effective mitigation measures used by these fisheries, although they do not stop juveniles from becoming trapped. Of note is that SLEDs have been trialled but not yet implemented in the Western Rock Lobster Fishery.
7. Purse seine	Compatible level of risk with mitigation measures to: ▪ minimise interactions with seals, dolphins, seabirds and sharks	The ERA ratings relating to purse seine fishing (Daley, et. al, 2007a; Daley, et. al, 2007c; Hobday, et. al, 2007) ranged from high – low. Note, the SBT purse seine method is different to other purse seine fisheries. In this live capture fishery, the net is not closed and the catch is not lifted & crushed. Twenty-nine species of seals, dolphins & whales were considered to be at potentially high risk in the SPF after Residual Risk Assessment, however, lack of observer data means that this rating was uncertain (AFMA, 2010d). This was identified by the ERA as one of the main issues associated with this fishing method. The 2005 variation to the Approved Wildlife Trade Operation declaration required an observer program to be implemented within 6 months to validate rates of interactions with cetaceans. The current target for independent observer coverage is 10% (AFMA, 2009).
8. Giant crab traps	Compatible (some conditions may be required)	Findings of "tolerable risk" from the South-east FGRA were considered transferable to the South-west. No further evaluation was undertaken as part of the South-west FGRA.
9. Minor line	Compatible (some conditions may be required)	
10. Squid jig	Compatible (some conditions may be required)	ERA assessment for this method was not progressed beyond Level 1, which found risk associated with this method to be low.
11. Trolling	Compatible (some conditions may be required)	Trolling is a relatively minor gear type of the Southern Bluefin Tuna and Marine Scalefish fisheries. Research from the Albacore Troll Fishery in New Zealand considers this method has minimal environmental impacts beyond targeted species (Ministry of Fisheries, 2007).

5.2.1 Methods Rated as Incompatible - Demersal/bottom trawl

The SE FGRA finding of 'incompatible risk' was considered transferable to the South-west based on similar gear types and habitats within which demersal trawl operates. In addition, the ERAs for both the Commonwealth bottom trawl fisheries operating in the SWMR identified seafloor habitat degradation and mortality rates of non-target species as key concerns, with numerous seafloor habitats, byproduct and bycatch species rated as being at potentially high risk (Wayte, et. al., 2007; Daley, et. al., 2007d).

The Level 2 ERA for the Great Australian Bight Trawl Sector (GABT) of the SESSF (Daley, et. al., 2007d) states:

> 'Two key issues emerge from the ERA[EF] analysis of the GAB trawl fishery. Both are related to direct impacts from fishing, one on certain vulnerable benthic habitats, and the other on a suite of byproduct and bycatch species not currently managed directly through the quota management system. For both these components, there are species or habitats at risk across a range of depths, mainly on the outer shelf and the upper slope.'

[3] Western Australian Temperate Shark Fisheries are comprised of the:
- Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery, and the
- West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery.

The Level 2 ERA for the Western Deepwater Trawl Fishery (WDTF; Wayte, et. al., 2007) states:

> 'Two issues emerge from the ERA[EF] analysis of the Western Deepwater Trawl Fishery, both related to direct impacts from fishing. There is a suite of about a dozen byproduct and bycatch species that have been assessed to be potentially at high risk, including several species endemic to southern and western Australia. Most of these species are found on the upper slope. There is also a group of habitats with large and erect epifauna that would be at risk if fishing effort increased or spread.'

The Level 2 ERA for the Great Australian Bight Trawl found 58 species and 21 habitats to be at potentially high risk (Daley, et. al., 2007d). After Residual Risk Assessment the number of species considered to be at high risk was reduced to 40 (AFMA, 2008). Habitats are not assessed by this method so there remained 21 high risk and 32 medium risk habitats (Daley, et. al., 2007d). The reduction of risk ratings for 20 species was due to very low recorded catches and the existence of spatial closures, which were considered to reduce susceptibility and overall risk rating. Ten shark species were reduced from high to medium risk rating, including the vulnerable White Shark and the Dusky Shark and Southern Dogfish (AFMA, 2008). The latter two are currently on the Finalised Priority Assessment List of species that have been nominated for listing as threatened under the EPBC Act (DEWHA, 2009b; DEWHA 2008a). The vulnerable Grey Nurse Shark remained high risk as did the conservation dependent School Shark (AFMA, 2008). A total of 14 sharks, 3 rays, 1 chimera and 20 teleosts remained at high risk following the residual risk analysis (AFMA, 2008).

The Level 2 ERA for the Western Deepwater Trawl Fishery found 20 species and 20 habitats to be at potentially high risk (Wayte, et. al., 2007). Residual Risk Assessment concluded the number of species at high risk should be reduced to 5 due to additional scientific assessment in the form of Level 3 (SAFE) assessment, which indicated that the risk was low at current fishing effort (AFMA, 2010). As outlined in section 3 above, the South-west FGRA is not basing its assessment on current fishing intensity, as used in Level 3 assessments, and therefore risk ratings for these species will be based on Level 2 assessment. Of the high risk species identified by the Level 2 ERA, there were 11 chondrichthyans (sharks and rays), 8 teleosts and one invertebrate. The chondrichthyans were generally found to be at risk because they have low productivity and high exposure to fishing, many of them inhabiting upper continental slope areas where fishing effort is concentrated (Wayte, et. al., 2007). High risk sharks include the Endeavour Dogfish, Dusky Shark (both on Finalised Priority Assessment Lists), and the conservation dependent school shark (a byproduct species of both fisheries) as well as the Ornate Angel Shark and Whitefin Chimaera - two endemics with restricted ranges (Last and Stevens, 2009). Habitats are not assessed by this method so there remained 20 high risk and 12 medium risk habitats (Wayte, et. al., 2007).

State managed fisheries have not been assessed under the Commonwealth's quantitative ERA process. There are three fisheries managed by Western Australia that operate demersal trawl within Commonwealth waters of the South-west region:

- the Abrolhos Islands and Mid West Trawl Managed Fishery
- the South West Trawl Managed Fishery
- the South Coast Trawl Fishery.

Due to key differences in target species and the localised nature of these fisheries, specific information was sought for these three fishieries. The Ecologically Sustainable Development (ESD) report on the Abrolhos Islands and Mid West Trawl Fishery, submitted to DEWHA for assessment in 2004, found negligible impacts on bycatch, negligible to low impacts on protected species, and low impacts on benthic habitats (DoF 2004). Similarly, the ESD report on the South Coast Trawl Fishery also found negligible impact on bycatch, negligible to low impacts on protected species and low impacts on benthic habitats (DoF 2005). An ESD report is currently not available for the South West Trawl Managed Fishery; however the 2008-09 WA State of the Fisheries Report states that this fishery also has a low impact on bycatch, protected species and ecosystems (DoF 2009). An assessment of impacts on the marine environment of the Abrolhos Islands, conducted in 2002 (Webster, et al., 2002), highlights the localised nature of the fishery, which mostly operates on soft sediments, but acknowledges that:

> 'incidental trawling occurs in sensitive habitats such as algal/marine plant, sponge garden and reef habitats.'

In addition, while the impact on bycatch is thought to be low in this fishery, DEWHA has noted the lack of species specific identification of small elasmobranches caught in the fishery (DEWHA 2008b). The general lack of reliable information on shark catches and population assessments has been identified as a key issue in the National Plan of Action for the Conservation and Management of Sharks (DAFF 2004). In the absence of detailed information about bycatch or byproduct mortality on shark species, and consistent with a precautionary approach, these fisheries are considered incompatible with the conservation objectives of Commonwealth marine reserves.

5.2.2 Methods Rated as Incompatible - Demersal longline (including auto-longline)

Two key issues emerge from the ERA analysis of the SESSF demersal auto-longlining sub-fishery. Both are related to direct impacts from fishing;

- impacts on a suite of byproduct and bycatch species, particularly sharks and rays, and
- damage to certain outer shelf, canyon and upper slope seafloor habitats by the longline gear.

The ERA for Auto-longline sub-fishery (ALL) of the SESSF (Daley, et. al., 2007e) states:

> 'The most important issue to emerge from the ERA[EF] analysis of the SESSF ALL fishery is the ecological sustainability of catches of very low productivity species such as gulper sharks, and several other chondrichthyan species, whose core depth ranges coincide with the ALL fishery, and whose habitat preferences also coincide with key target species for the fishery.'

The Level 2 ERA for the Auto-longline sub-fishery of the SESSF found 56 species and 17 habitats to be at potentially high risk (Daley, et. al., 2007e). Residual Risk Assessment concluded the number of species at high risk should be reduced to 9, in many cases due to additional scientific assessment in the form of Level 3 (SAFE) assessment, which indicated that the risk was low at current fishing effort (AFMA, 2010b). As outlined in section 3 above, the South-west FGRA is not basing its assessment on current fishing intensity, as used in Level 3 assessments, and therefore risk ratings for these species are based on Level 2 assessment.
Seventeen sharks were found to be at high risk after the Level 2 ERA, with one reduced to medium after the RRA due to little or no catch being recorded for the fishery (AFMA, 2010b). There were also 3 skates and 8 teleosts remaining at high risk with the exclusion of the Level 3 analysis.

The byproduct species likely to be at highest risk is the Southern Dogfish, one of the gulper sharks (Daley, et. al., 2007e). This species is endemic to southern Australia and is on the Finalised Priority Assessment List of species that have been nominated for listing as threatened under the EPBC Act (DEWHA, 2008). It lives in similar habitat to ling, one of the target species for the fishery, has very low productivity, and is known to be susceptible to being caught by line fishing. Another species of concern, also identified as being at high risk by the ERA is the Harrison's Dogfish. Since the completion of the ERAs, the group previously thought to be the western population of Harrison's Dogfish has now been identified as the newly described Western Gulper Shark (Patterson and Tudman, 2009). The Western Gulper Shark is endemic to Western Australian waters from Shark Bay to Cape Leeuwin (Last and Stevens, 2009; White, et. al., 2008). It is considered to be a high risk discard species and is also of particular concern (Patterson and Tudman, 2009). The Western Gulper Shark is considered to be overfished, however when the Harrison's, Endeavour and Southern Dogfish were nominated for listing in 2005 as threatened species under the EPBC Act, the Western Gulper Shark was not recognised as a separate species (Patterson and Tudman, 2009). The Green-eyed Dogfish, which have been caught at rates as high as one in three hooks (Daley, et. al., 2007e), are also of concern, as are two species of endemic skate, which occur within the main depth range of the fishery. Fishery research indicates local and near extinctions of several species of skate have been reported in other parts of the world (Dulvy, et. al., 2000). The conservation dependent School Shark is also considered at high risk after Level 2 ERA, although the majority of incidental capture occurs in fisheries targeting gummy shark (the Gillnet, Hook and Trap sectors of the SESSF) and trawl fisheries (AFMA, 2008a).

Habitats are not assessed by the Level 2 Residual Risk Assessment so there remained 17 high risk and 98 medium risk habitats (Daley, et. al., 2007e). Of the high risk habitats, two were on the outer shelf at between 100-200m depth, and 15 were on the upper slope, at 200-700m depth (including shelf break and canyon habitats). Habitats at most risk include hard and soft bottoms with large, erect or delicate seafloor fauna, including octocorals (sea fans, sea pens and soft corals), crinoids (feather stars), large sponges, and mixed seafloor communities.

Longlines can be set in strong currents, up to tens of kilometres long in a collective set, they are set taut, and can sometimes move up to 1.5km during sets (Daley, et. al., 2007e). The impact of a demersal longline under tension on seafloor communities has not been assessed in detail, however, it is thought "*that auto-longlines may act as 'cheese wires', severing or damaging fauna"* (Daley et al. 2007e). Impacts on seafloor communities are difficult to assess through surface-based observer programs because it appears that benthic organisms caught by the line drop out when the gear is retrieved to the surface (Welsford and Kilpatrick, 2008). Research is currently being undertaken in a project entitled *Demersal fishing interactions with marine benthos in the Australian EEZ of the Southern Ocean: an assessment of the vulnerability of benthic habitats to impact by demersal gears*, being undertaken by the Australian Antarctic Division, funded

by the Australian Fisheries Research and Development Corporation, industry stakeholders and the Australian Fisheries Management Authority. A key objective of this project is to develop methods for assessing the extent of interaction between longlines and benthic habitats, using gear-mounted cameras and other sensors (Constable et al., 2007). Initial results support the few previous observations that benthic invertebrates are removed by this gear, indicating that previous assessments of no impacts to the seafloor may have underestimated the area affected.

After Residual Risk Assessment 26 seabird species were reduced from high to medium risk because of compliance with mitigation measures in the Threat Abatement Plan (TAP) for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations (AFMA, 2010b). Compliance with mitigation measures reduces the encounterability of birds to hooks through line weighting, tori lines, use of thawed bait and prohibition on offal discharge for all vessels. The Threat Abatement Plan also requires the SESSF to have an observer program that covers 10% of all hooks set and hauled in all areas (DEWR, 2006); which the Auto-longline sub-fishery has met since 2005 and previously exceeded (AFMA, 2010b).

The Western Australian Temperate Shark Fisheries (WATSF) are the only WA managed fisheries which currently employ demersal longlines. The Gascoyne Fisheries Environmental Management Review states that bycatch is low in this fishery and that rates of entanglement of birds, reptiles and mammals are also low (Shaw 2000). Similarly, the ESD report on this fishery, submitted to DEWHA for assessment in 2005, found low impacts on bycatch species and low levels of interactions with protected species (DoF 2005). Further work on rates of bycatch mortality of Australian sea lions is required in light of recent findings in the SESSF that the rate of "drop out" are as high as 80% (Goldsworthy et al. 2010). No information is available on the effect of the gear on the sea floor. In the absence of information and consistent with a precautionary approach, the SW FGRA assumes that potential damage to benthic habitats thought to be associated with other demersal longline fisheries also applies to the WATSF.

5.2.3 Methods Rated as Incompatible - Pelagic longline

The key concern with pelagic longlining in the context of marine reserves is the high level of mortality of non-target species. Ward and Curran (2004) found that bycatch species outnumbered the commercial target species in longline fishing operations off Western Australia. Sharks dominate the bycatch and blue sharks were the most frequently caught species. The Western Tuna and Billfish Fishery is the only fishery that uses pelagic longlines in the South-west region. The Level 2 ERA for the Western Tuna and Billfish Fishery (WTBF; Webb, et. al, 2007) states:

> 'There remains considerable uncertainty about many high risk species for this fishery. Those that should be the focus of initial management response include several chondrichthyan species (including byproduct, bycatch and TEP), and several groups of marine birds (including albatross, petrels and shearwaters).'

The primary group of bycatch in terms of number of species at risk, are seabirds, in particular albatrosses, petrels and shearwaters, however, there are several mitigation measures that are now in place to reduce seabird capture. After Residual Risk Assessment 16 seabirds were reduced from high to medium risk and five were reduced from high to low risk. The main reason for the changes risk rating was the high level of compliance with mitigation measures in the Threat Abatement Plan (TAP) for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations (AFMA, 2009a). Compliance with mitigation measures (Guideline 7) reduces the encounterability of birds to hooks through line weighting, tori lines, use of thawed bait and prohibition on offal discharge for all vessels. The Threat Abatement Plan also requires the WTBF to have an observer program that covers 5% of all hooks set and hauled in all areas (DEWR, 2006); the average coverage for the fishery over the past five years has been 6.8% (AFMA, 2009a).

A number of biologically important areas for threatened seabirds have been identified in the South-west region and many of these are represented in the areas for further assessment (for example, "high density foraging areas" for the soft plumaged petrel off the Abrolhos Islands; "high density foraging areas" for the Indian yellow-nosed albatross off the South-west Corner).

Sharks are the second group of non-target species of concern in pelagic longline fisheries. High numbers of some shark species are caught as byproduct species in the WTBF, some of which are retained and some are not (Webb, et. al, 2007; see below). Survival rates of those returned to the sea are unknown and will vary according to the condition they are in when released (Webb, et. al, 2007). A total of six shark species were rated as being at high risk after the Level 2 ERA. Residual Risk Assessment concluded they were at low risk based on Level 3 (SAFE) assessment, mainly due to the current low levels of effort in the fishery. However,

as outlined in section 3 above, the South-west FGRA aims to assess gears independent of levels of effort and therefore uses the results of the Level 2 assessment.

Two byproduct species were assessed to be at high risk: Dusky Shark and Porbeagle Shark. Pelagic Porbeagle Sharks are caught in 'considerable numbers' in the WTBF (Webb, et. al, 2007). The species is listed as vulnerable on the IUCN red list and in 2008 was added to the Convention on Migratory Species. As a result of this the Porbeagle shark was listed as a migratory species under the EPBC Act in January 2010. Dusky (Whaler) Sharks are found in coastal and offshore waters but are not oceanic, and feed on demersal and pelagic species (Froese and Pauly, 2009). The WTBF ERA states (Webb, et. al, 2007):

> 'The byproduct species most vulnerable to capture by fishing is considered to be the Dusky shark. The dusky shark is considered at risk by McAuley and Thomas (2005). As Ward and Curren (2004) explain, this species is also caught by State WA fisheries, and there is concern over additional pressure from the WTBF.'

The WTBF ERA goes on to state (Webb, et. al, 2007):

> 'Department of Fisheries Western Australia (DoFWA) has indicated that dusky shark stocks in Western Australia are overfished and that additional mortality of adults as a result of pelagic longlining is a concern. Catches of inshore whaler shark species are not a large part of the bycatch in the WTBF however some of these species have long life cycles, delayed sexual maturity, low fecundity and long gestation periods which make them vulnerable to fishing pressure. In particular, DoFWA, have stated that (Draft Case Study Comments, July 2004);
>
> - Many coastal sharks were caught in the WTBF in the mid- to late 1990s.
> - Records of these catches are not reliable.
> - The fate of released/escaped sharks remains unknown, but some level of post-release mortality is likely.
> - Dusky shark stocks in Western Australia are currently considered to be over-exploited, a status that has arisen due to increases in mortality of breeding age animals from a variety of sources, including the WTBF.
> - Recent discussions between AFMA, the WTBF representatives and the Department of Fisheries have indicated that [the] shelf break continues to be an area that the fleet would target effort. The distribution of adult dusky sharks is known to extend beyond the shelf break; as such, ongoing bycatch of dusky sharks will occur in the WTBF.'
>
> 'Given that significant numbers of adult dusky shark and other inshore whaler sharks have already been killed by the WTBF, even small levels of mortality should be avoided by the WTBF. DoFWA is sufficiently concerned about the poor status of dusky shark stocks to be moving towards stopping the take of ALL adult dusky sharks in state-managed fisheries by imposing an upper size limit and introducing further gear restrictions' (DoFWA, July 2004, in Webb, et. al, 2007).

Two other byproduct species, Blue and Crocodile Sharks, are '*caught in large numbers and deserve further consideration*', although rated as being at medium risk (Webb, et. al, 2007). The Blue Shark is the most common species caught in the fishery and catches of this species exceed those of any of the target species such as Broadbill Swordfish and Bigeye Tuna (Ward and Curran, 2004; Webb, et. al, 2007). The crocodile shark is the third most frequently caught species off W.A. and this species has low productivity (Webb, et. al, 2007). In 2002 1613 blue sharks were retained and 32 210 were not retained while 426 crocodile sharks were retained and 2855 were not retained. In 2003 1859 blue sharks were retained while 21 517 blue sharks and 10 036 crocodile sharks were not retained.

Three bycatch shark species are also assessed by the ERA to be at potentially high risk: Thintail Thresher Shark, Sherwood's Dogfish, and Smooth Hammerhead Shark. The Thintail Thresher Shark and Sherwood's Dogfish are both pelagic and listed as data deficient by the IUCN red list. The Smooth Hammerhead is listed as near threatened by the IUCN red list and is considered coastal, pelagic, and semi-oceanic, but often bottom associated (Froese and Pauly, 2009). While the Smooth hammerhead shark is classified as high risk and the scalloped hammerhead sharks is classified medium, expert opinion indicates this should probably be the other way around (Webb, et. al, 2007). Data summaries for the WTBF for 2002 - 2003 reported Scalloped and undifferentiated species as bycatch (Webb, et. al, 2007). Both threatened White shark and Grey Nurse Sharks are 'occasionally caught' by longline fisheries as bycatch in the SWMR. The WTBF ERA considers they are at potentially high and medium risk respectively (Webb, et. al, 2007).

Given the level of impact upon ecologically important and biologically vulnerable non-target species and the application of a precautionary approach, pelagic longline is assessed as posing an "incompatible level of risk pending further assessment".

5.2.4 Methods Rated as Incompatible - Gillnets

Two recurring issues emerged from the Level 2 ERA of the SESSF Shark gillnet sub-fishery:

- seafloor habitat damage and
- mortality rates of non-target species.

The ERA for the Shark Gillnet sub-fishery of the SESSF (Walker, et. al., 2007) states:

> 'Two key issues emerge from the ERA [EF] analysis of the SESSF shark gillnet fishery. Both are related to direct impacts from fishing, one on certain vulnerable benthic habitats on the outer shelf, and the other on a suite of byproduct and bycatch chondrichthyan species not currently managed directly through the quota management system.'

The Level 2 ERA for the Shark Gillnet sub-fishery of the SESSF found 21 species and 22 habitats to be at potentially high risk (Walker, et. al., 2007). Residual Risk Assessment concluded that the number of species at high risk should be reduced to 9 (6 sharks and 3 pinnipeds) mainly due to subsequent quantitative assessments which attributed a lower risk rating to these species. Of these, five were subject to complete stock assessments, while the others were reduced by other criteria, including expert override and low recorded interactions. Two species' risk ratings were reduced solely based on consideration of current fishing intensity (Level 3 SAFE results, AFMA, 2010c). As outlined in section 3 above, the South-west FGRA is not basing its assessment on current fishing intensity, as used in Level 3 assessments, and risk ratings for these species are based on Level 2 assessment.

The Australian sea lion and Australian and New Zealand fur seals are considered to be at potentially high risk after RRA (AFMA, 2010c). The ERA report for the Gillnet sub-fishery states (Walker, et. al, 2007):

> 'The sea lion is of greatest concern because of its small population size and complex separate breeding populations in southern Australia.'

Australian sea lions are bottom feeders and can be attracted to fish caught in gillnets set on the seafloor. Individuals can become entangled and this can lead to injury or death (E-Systems, 2005). Australian sea lions are listed as vulnerable to extinction under the EPBC Act and endangered on the IUCN red list (IUCN, 2009). Bycatch and entanglement of Australian Sea lions in gillnet fisheries is recognised as one of the most significant threats to the recovery of the species (DEWHA, 2010a). Marine bioregional planning has identified the need to reverse the decline and fully recover the species as a key regional priority for the South-west. Substantial research has been finalised in 2010 to assess the level of bycatch mortality of the Australian sea lion in the SESSF off South Australian waters (Goldsworthy *et al*. 2010, Hamer *et al*. 2010). This research has been considered in the SW FGRA.

Sharks and rays are the second species group of concern in gillnet fisheries (Walker, et. al., 2007). Eight shark species are considered to be at potentially high risk. Of these, 4 are byproduct species, 3 are discarded and one is the vulnerable White Shark. All are endemic to southern Australia (Walker, et. al., 2007). The other high risk species are not endemic, but most are thought to form separate breeding populations in southern Australia. The high risk byproduct species are the Broadnose Sevengill Shark, Dusky Shark, Bronze Whaler Shark, and Australian Angel Shark. As discussed above, Dusky Sharks are on the Finalised Priority Assessment List of species that have been nominated for listing as threatened under the EPBC Act (DEWHA, 2009b). The Department of Fisheries Western Australia considers that dusky shark stocks in Western Australia are overfished (McAuley, 2008).

Three species are discarded bycatch species: Shortfin Mako (recently listed as a migratory species under the EPBC Act following their listing under the international Convention on Migratory Species), Smooth Hammerhead, and White-Spotted Dogfish, and one is the vulnerable White Shark (Walker, et. al., 2007). Walker, et. al., (2007) explain that these sharks are at risk because they are relatively slow growing, long-lived, slow to reproduce and have relatively low reproductive rates. They are also particularly susceptible to being captured by the gear because they have a high proportion of their range within the fishery area, live in habitats where the gear is likely to be set, and are the appropriate size to be caught by the gillnet mesh size.

The Western Australian Temperate Shark Fisheries (WATSF) are the only WA managed fisheries which currently employ demersal gillnets. The WATSF stock assessments for the four key target species consider Dusky and Sandbar Shark stocks to be at inadequate levels and Whiskery Shark stocks to be inadequate but recovering, There is also concern that both Dusky and Sandbar Shark abundance is continuing to decline (McAuley, 2008). The stock assessment for the other main target species, Gummy Shark, was found

to be adequate (DEHWA, 2009; McAuley, 2008), however, the Residual Risk Assessment for the SESSF shark gillnet sub-fishery considers this species to be at medium risk of overfishing (AFMA, 2010c). Byproduct fish species in the WA Temperate Shark Fisheries are also considered depleted (DEWHA, 2009; Mackie, et. al., 2009). These include stocks of key western Australian aggregating species such as Pink Snapper and the iconic Dhufish, endemic to south-west WA (Mackie, et. al., 2009). The Gascoyne Fisheries Environmental Management Review states that bycatch is low in the WATSF and that rates of entanglement of birds, reptiles and mammals are also low (Shaw 2000). Similarly, the ESD report on this fishery, submitted to DEWHA for assessment in 2005, found low impacts on bycatch species and low levels of interactions with protected species (DoF 2005). However, there is spatial overlap between the WATSF and the foraging range of Australian sea lions and a comprehensive observer program is not yet in place.

Habitats are not assessed by the Level 2 Residual Risk Assessment so there remained 22 high risk and 18 medium risk habitats (Walker, et. al., 2007). All of these were on the outer shelf at depths of between 100–200m. Nets can move on the seafloor, drag, roll up, and 'scrub' the animals living on the bottom. Dislodging, entanglement and mortality can occur and nets sometimes contain quantities of mixed fauna when retrieved. These include species of fragile, ridged, erect octocorals, sponges, tunicates, hydroids and bryozoans (Walker, et. al., 2007). For the WATSF, neither the Gascoyne Fisheries Environmental Management Review or the ESD report provides information on the effect of the gear on the sea floor. It is assumed that potential damage to benthic habitats thought to be associated with other gillnet fisheries is also likely to occur in the WATSF.

Due to the number of species and habitat types at high risk from this fishing method, and particularly the risk it poses to the Australian sea lion, the South-west FGRA assessed gillnetting as posing “incompatible levels of risk” in the context of marine reserves.

6. Discussion

Two recurring issues have emerged from the South-west ERAs: mortality rates of non-target species and seafloor habitat damage. Of particular concern among non-target species are impacts on chondrichthyans (sharks and rays) and the Australian sea lion. Serious impacts on sharks and rays are clearly an issue that cuts across all four high risk fishing methods. Impacts on threatened Australian sea lions are also of concern, especially in light of continued declines of some sub-populations (DEWHA, 2010). The risk of degradation and loss of seafloor habitats has been identified as a major concern for three of the four high risk fishing methods.

6.1 Impacts on sharks and rays and MPAs

In recent years there has been concern raised about the global and regional decline of shark populations, due largely to over-fishing (Cavanagh, et. al., 2003; Patterson and Tudman, 2009). In 1999 the Food and Agricultural Organization of the United Nations released an International Plan of Action for the Conservation and Management of Sharks. In 2004 Australia launched a National Plan of Action. Sharks are particularly vulnerable to population pressures because they are typically slow to mature and produce low numbers of off-spring compared to other species. It is estimated that Australia has close to 300 species of sharks, rays and chimaeras and of those about half are found in the SWMR. There are also many species that are endemic to either the southern Australian waters or to the South-west region. This makes the region an important place for shark biodiversity. Understanding the status of, and protecting, species of rays and sharks has been identified as a regional priority for the South-west marine region through the marine bioregional planning process.

The White, and Grey Nurse Shark are listed as vulnerable, and School Shark as ‘conservation dependent’ under the EPBC Act. Porbeagle and Shortfin Mako Sharks are listed as a migratory species under the Act. These species are all found in the region, as are a number of sharks currently being considered for listing as threatened species under the Act. Sharks currently on the Final Priority Assessment List that are of some concern in the region include the Dusky Shark, Shortfin Mako, as well as members of the family Centrophoridae: the Endeavour Dogfish, found on the west coast of WA, and Southern Dogfish, a species endemic to southern Australia and possibly the species of most concern in the South-west. The Western Gulper Shark is also a species of particular concern, however, at the time these sharks were nominated, the

Western Gulper Shark was not recognised as a separate species from the Harrison's Dogfish, as it now is (Last and Stevens, 2009; White, et. al., 2008). The Chondrichthyan Technical Working Group (CTWG; Patterson and Tudman, 2009) states:

> 'Species within the family Centrophoridae are believed to have the lowest reproductive potential of all shark species (Irvine 2004; Kyne and Simpfendorpher 2007), thereby placing them at extreme risk. As a result, the CTWG identified this shark group as the highest priority in terms of mitigation need...'

The IUCN Shark Specialist Group Australia and Oceania Regional Red List Workshop (Cavanagh, et. al., 2003) states:

> 'Chondrichthyans identified as Critically Endangered (the most severe threatened or 'at risk' category, indicating that a species is "facing an extremely high risk of extinction") are two species of deepwater sharks, Harrison's Dogfish *Centrophorus harrissoni* [now replaced by *C. westraliensis* in Western Australia], a regional endemic, and the Southern Dogfish *Centrophorus zeehaani* (assessed as Critically Endangered in Australia). These species [*C. harrissoni* and *C. zeehaani*] have undergone drastic declines of over 99% and 95% respectively in recent years due to commercial fishing activities.'

The Endeavour Dogfish is identified as Endangered by the IUCN Australia and Oceania Regional Red List (classified Data Deficient globally). These assessments are based on overall population declines in Australian waters due to impacts from commercial fishing activities in parts of their ranges. Population declines of over 95% have been recorded along the east coast of Australia, off southern New South Wales (Graham, et. al., 2001). The status of the species in waters off Western Australia is uncertain, however, it is considered to be at potentially high risk of overfishing from the Western Deepwater Trawl Fishery. This fishery retains the species as byproduct and deploys its main effort in the same depth range inhabited by the species – the upper slope (Wayte, et. al., 2007).

The IUCN Shark Specialist Group described deepwater sharks as being possibly the most vulnerable to overexploitation of any marine species group (Cavanagh, et. al., 2003). Low reproductive rates, high longevity and late reproductive age not only result in extremely rapid population depletion through the effects of fishing, but also make recovery after such depletions very slow (Patterson and Tudman, 2009).

Noting Level 2 ERA risk ratings are not able to account for cumulative impacts across fisheries (T. Smith [CSIRO] 2009, pers. comm., 5 August), it remains a concern that many of the same shark species are found to be at high risk by the ERAs for multiple fisheries operating in the region. There are a total of 14 chondrichthyans considered to be at high risk by more than one fishery with the gear types discussed above as posing unacceptably high levels of risk. Of these, four sharks are rated as being at high risk by three different fishery's ERAs: the Dusky Shark, Green-eyed Dogfish, Piked Dogfish, and the School Shark. Ten species have high risk ratings from two fisheries' ERAs: Bight Ghost Shark, Bight Skate, Brier Shark, Bronze Whaler, Common Saw Shark, Ornate Angel Shark, Sawtail Shark, Smooth Hammerhead, Spotted Wobbegong, and White Shark.

The ERA for the Auto-longline sub-fishery of the SESSF (ALL) identifies the Green-eyed Dogfish as being of particular concern, as it is endemic, and a non-target species captured by at least three of the fisheries in the SWMR (GABT, WDTF and ALL). The most recent BRS Fisheries Status Reports (Wilson, et. al., 2009) found that four species of deepwater sharks are overfished. Three species of Gulper Sharks are continuing to be overfished while for one species, the School Shark, whether this is continuing is uncertain. Many of these species are poorly known and some were only described in 2009. Consequently there is no species specific data, which leads to high levels of uncertainty.

Some of the shark species at risk have life history stages that are seafloor-dwelling, while others undergo daily vertical migration. Several other species are truly pelagic. Traditionally there have been arguments against the ability of MPAs to effectively protect pelagic species. Recent work supports spatial closures as effective tools for conservation of some pelagic species (Game, et. al., 2009; Patterson and Tudman, 2009). For example, at least three species considered to be at risk from pelagic longline fisheries (Thresher Shark and Crocodile and Shortfin Mako sharks) are considered to benefit from spatial closures of certain areas and/or at certain times (Patterson and Tudman, 2009). For the first time the reserve design process in the South-west is taking considerations of pelagic species and habitats into account, and where key pelagic environments are captured within the reserve network, protection of pelagic environments and their associated species, is an objective of these reserves.

6.2 Impacts on Australian sea lions

Australian sea lions are the only endemic and least abundant pinniped that breeds in Australia. They are also the species showing the least recovery since hunting ceased in the early 20th Century. Indeed, there is evidence showing further declines in populations in some areas (IUCN, 2009). Australian sea lions are unique in having large numbers of small breeding colonies, low reproductive rates, non-annual and unsynchronised breeding seasons, high site fidelity and low dispersal. Extreme female natal site fidelity and genetic isolation of at least some Australian sea lions indicate that re-colonisation may not readily occur if colonies are destroyed (Campbell et. al., 2008).

Although these factors may limit the rate at which subpopulations grow and disperse, they are not seen as ultimate factors that drive population change. Human-related and mortality-driven factors have been found to be the most likely causes of current decline in Australian sea lion populations and fishery bycatch and entanglement are recognised as one of the most significant contributions (DEWHA, 2005; DEWHA, 2010a; IUCN, 2009). The Australian sea lion Technical Issues Paper states (DEWHA, 2010a):

> 'Population viability analyses of Australian sea lion subpopulations have indicated that low-level, chronic, incidental mortality in fisheries can lead to their extinction…Levels of bycatch mortality reported in the Western Rock Lobster Fishery and estimated for the gillnet sector of the Southern and Eastern Shark and Scalefish Fishery are sufficient to lead to subpopulation extinctions.'

Based on ERA ratings, the commercial fisheries in which bycatch of Australian sea lions are moderately or highly at risk of occurring are rock lobster pot and demersal gillnet fisheries off Western and South Australia (Walker, et. al., 2007; E-Systems, 2005). While the mortality rates from drowning in lobster pots can be reduced through the application of effective exclusion devices, mitigating the impact of gillnet by modifying the gear is not feasible (Patterson and Tudman 2009). Closure scenarios based on either minimum core foraging areas of females or minimum depth ranges have been recommended as the most effective means of reducing bycatch mortality from gillnets (Goldsworthy et.al., 2010). It should be noted that sea lion exclusion devices (SLEDs) have been trialled but not yet implemented across the Western Rock Lobster Fishery.

Since its listing as a vulnerable species under the EPBC Act in 2005, the Australian sea lion has not shown signs of recovery. The range of the Australian sea lion is almost entirely confined to the SWMR and adjacent coastal waters. The vast majority of Australian sea lions are found in waters off South Australia, and it is estimated that over 85% of the total population breeds at colonies in South Australia (Goldsworthy et. al., 2009). The IUCN has recently upgraded the status of the species to endangered and notes that most major colonies are at risk of extinction from fishery by-catch (IUCN, 2009). Reversing the decline of the Australian sea lion and assisting the recovery of the species throughout its range has been identified as one of the strategic priorities for the SWMR.

6.3 Seafloor habitat degradation and loss

Habitat loss and deterioration is recognised as one of the main threats to biodiversity conservation. Seafloor habitats provide some of the most productive environments of our entire ocean systems and international consensus shows that protecting seafloor habitats is an essential part of ecologically sustainable use of our marine resources (Norse, E., et al., 2004; Nellemann, et. al., 2008). Concern about the impacts of bottom trawling was highlighted internationally in 2004 by the publication of the *Scientists' Statement on Protecting the World's Deep-sea Coral and Sponge Ecosystems*. Signatures from 1,136 scientists from 69 countries were collected and the issue was highlighted again in 2006 when the statement was submitted to the United Nations General Assembly (Norse, et. al, 2004). More recently a United Nations Environment Programme report (Nellemann, et. al, 2008) has documented the growing body of empirical evidence showing the severe impacts of bottom trawling. The ERAs conducted by the CSIRO confirm that these concerns apply to habitats and species in the SWMR (Wayte, et. al., 2007; Daley, et. al., 2007d).

The risk of degradation and loss of seafloor habitat has clearly emerged as a cross-cutting issue from the South-west FGRA. The ERA reports that relate to bottom trawling, demersal longlining and gillnetting have all identified numerous seafloor habitats as potentially being at high risk from these fishing methods.

Bottom trawling ERAs (Wayte, et. al., 2007; Daley, et. al., 2007d) consider a range of habitats to be at potentially high risk, although the spatial extent and location of these habitat types is often not well known. They include habitats on the outer shelf, upper slope, and mid slope. Outer shelf (100-200m) habitats were

mainly soft sediment seabeds dominated by large sponges and mixed seafloor fauna. There was also a particular bryozoan-based community at the shelf break rated as high risk. Upper slope (200-700m) habitats included hard and soft bottoms dominated by large sponges, or octocorals (sea fans, sea pens and soft corals) and immobile animals. Canyon habitats at risk occur at this depth zone. Mid slope (700-1500m) habitats included hard and soft bottoms with large, erect or delicate fauna consisting of octocorals and immobile animals.

The ERA of the SESSF demersal auto-longlining sub-fishery identified several habitat types that are potentially at risk of being damaged by demersal longline fishing gear. This is partly because longline fishing can target habitat types not fishable by trawl (Daley, et. al., 2007e). Habitats on the outer shelf, upper slope and within canyons were identified as being at potentially high risk. All high risk habitats have erect, often delicate seafloor fauna, that emerges above the substrate and may be damaged by the movement of longline gear (Daley, et. al., 2007e).

The impact of demersal longline on the seafloor is currently thought to be less than that from bottom trawling; however, this assumption has not been scientifically tested, leading to the initiation of a project entitled *Demersal fishing interactions with marine benthos in the Australian EEZ of the Southern Ocean: an assessment of the vulnerability of benthic habitats to impact by demersal gears*, is research project currently being undertaken by the Australian Antarctic Division, funded by the Australian Fisheries Research and Development Corporation, industry stakeholders and the Australian Fisheries Management Authority (Constable, 2007). The project is developing camera systems which can be deployed on demersal fishing gears, including longlines, and record interactions with the seafloor. Preliminary results have shown that the interactions occur primarily when the gear is being hauled in, by the sideways movement of the gear and further indicate that where previous attempts to assess the fishing area affected found no impact, that this may have underestimated the area affected. Research so far also found that many species are likely to drop from the line once this is retrieved, and as a result, surface based estimates of benthic bycatch are unlikely to accurately reflect the interactions occurring on the seafloor (Welsford and Kilpatrick, 2008).

Habitats at high risk from gillnet fishing were all on the outer shelf and included hard and soft bottom types. The large, erect or delicate seafloor fauna consisted of sponges, crinoids, octocorals, sedimentary animals, or communities of mixed fauna. At a local scale, the intensity of damage to these habitats may be moderate, however, slow regeneration times of deepwater species and the frequent targeting of certain features may leave a lasting impact (Walker, et. al., 2007).

When considering damage to seafloor habitats, it is important to also consider the cumulative effects of the different sub-fisheries that all operate in the same areas. Bottom trawl, longline and gillnet fishing all have the potential to damage and degrade seafloor habitats and all have some of their fishing grounds in the same areas, especially on the outer shelf and upper slope. The individual and combined impacts of these fishing methods have the potential to leave long-term impacts on the seafloor (Wayte, et. al., 2007; Daley, et. al., 2007d; Daley, et. al., 2007e; Walker, et. al., 2007).

Ensuring the long-term protection of key biodiversity-supporting habitats in the region is one of the key conservation objectives for new Commonwealth marine reserves in the South-west Marine Region. The outcomes of the South-west FGRA show there is an unacceptably high level of risk associated with four fishing methods. Seafloor habitat degradation and loss from the impact of these methods is not compatible with the objectives of multiple use zones or ‘managed resource protected areas’ (IUCN Category VI). Commonwealth reserves should be managed based on protection of biological diversity and natural values and their maintenance in the long term (EPBC Regulations, 2000).

7. Conclusions

In summary, the SW FGRA has found that four fishing methods operating in the South-west region within the areas for further assessment, pose incompatible levels of risks to the conservation values of these areas. These methods are demersal trawl, demersal longline, pelagic longline and demersal gillnet.

The risks associated with pelagic longline are the least well understood in terms of their potential impacts on the relevant conservation values, namely sharks, rays and seabirds. The rating of this method has required the application of the precautionary approach, in line with Government's policy. It recognises that better information about the rate of interaction and the effectiveness of mitigation measures may clarify the compatibility of this method within the South-west MPAs.

Three fishing methods – mid-water trawl, lobster pots and purse seine - have been rated as posing an compatible level of risk, subject to mitigation measures and conditions being in place and their effectiveness regularly monitored. Three further methods – trolling, giant crab traps and minor line – have been found to pose a low risk to conservation values.

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Appendix A: Conservation values used in the South-west Fishing Risk Assessment

The conservation values used in the South-west Fishing Risk Assessment were identified in relation to bioregional representativeness, key ecological features, protected species, biologically important areas for threatened and migratory species, and spatially predictable pelagic features of regional significance. These were categorised by species groups and benthic habitats (in varying depth ranges) in order to be consistent with the South-east FGRA, with the addition of conservation values specific to the South-west region.

Additionally, conservation priorities have been identified across the region as part of the marine bioregional planning process. The *draft* conservation priorities relevant to the South-west FGRA are also listed below.

Conservation Values:

Hard bottom habitats – shelf (coastal <25m)
Soft bottom habitats – shelf (coastal < 25 m)
Hard bottom habitats – shelf (inner 25-100m)
Soft bottom habitats – shelf (inner 25-100m)
Hard bottom habitats – shelf (outer 100-200m)
Soft bottom habitats – shelf (outer 100-200m)
Hard bottom habitats – slope (upper 200-700m)
Soft bottom habitats – slope (upper 200-700m)
Hard bottom habitats – slope (mid 700-1500m)
Soft bottom habitats – slope (mid 700-1500m)
Hard bottom habitats – slope (pinnacles 700-1500m)
Soft bottom habitats – slope (pinnacles 700-1500m)
Hard bottom habitats – slope (canyon 100-1500m)
Soft bottom habitats – slope (canyon 100-1500m)
Seals & sea lions
Whales
Dolphins
Seabirds
Turtles
Spatially predictable pelagic features
Sharks
Demersal fish species

Draft Regional Priorities for the SWMR of relevance for design and zoning of new Commonwealth marine reserves

- Improving the understanding, protection and monitoring of key ecological features of the South-west marine region
- Reversing the decline of the Australian sea lion and assisting the recovery of the species throughout its range
- Protecting and conserving areas of global significance for biodiversity, such as the marine habitats surrounding the Houtman-Abrolhos and the Recherche Archipelagos
- Increase the resilience of threatened and otherwise protected seabirds and their capability to adapt to climate change
- Sustain the recovery of the Southern right whale populations and their expansion into suitable breeding habitats in the region
- Improve the understanding of the ecological role of sharks and rays in the region, and protect and conserve the species accordingly.