Seafood Risk Assessment

Commonwealth Great Australian Bight Trawl Fishery

Prepared for the Fisheries Research and Development Corporation

Assessment Summary

Commonwealth GAB Trawl Fishery	Unit/s of Assessment:	
	Product Name/s:	***Deepwater Flathead; Bight Redfish; Gould's Squid; Ocean Jacket***
	Species:	*Neoplatycephalus conatus; Centroberyx gerrardi; Nototodarus gouldi ayraud*
	Stock:	Deepwater Flathead – South eastern Australia Bight Redfish - GAB Trawl Sector management region Gould's Squid – South eastern Australia Ocean Jacket - GAB Trawl Sector management region
	Gear type:	Demersal Otter Trawl (Deepwater Flathead; Bight Redfish; Gould's squid; Ocean Jacket) Danish seine (Deepwater Flathead)
	Year of Assessment:	2017

Fishery Overview

The following overview was adapted from Moore and Koduah (2017):

The former Great Australian Bight Trawl Fishery was amalgamated with the Southern and Eastern Scalefish and Shark Fishery (SESSF) in 2003 to become the Great Australian Bight Trawl Sector (GABTS; Figure 1) of the SESSF. The GABTS can be divided into a continental-shelf fishery (in depths of less than 200 m), an upper continental-slope fishery (at about 200–700 m) and a deepwater fishery (on the mid- to lower slope, 700–1000 m). In shelf waters, trawling is usually conducted at 120–200 m, targeting mainly Deepwater Flathead (*Platycephalus conatus*) and Bight Redfish (*Centroberyx gerrardi*). The shelf fishery operates year-round.

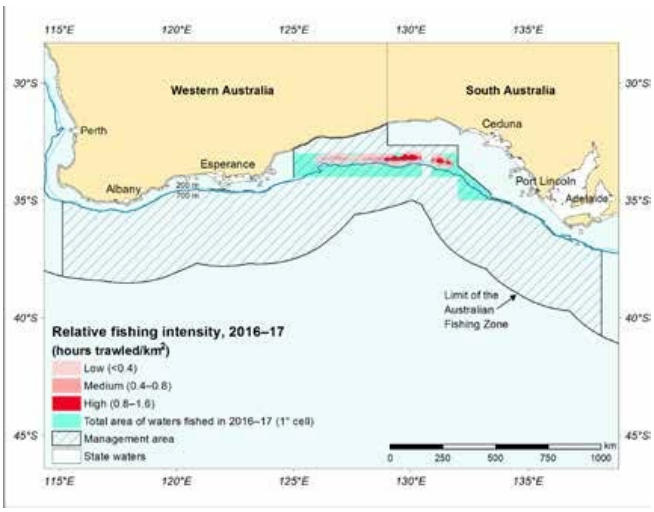

Figure 1: Relative fishing intensity in the Great Australian Bight Trawl Sector in the 2016-7 fishing season. (Moore and Koduah, 2017)

The fishing methods used in the GABTS are otter trawl and Danish-seine. Deepwater Flathead catches and catch rates peak from October to December, and Bight Redfish catches and catch rates peak from February to April. Ocean Jacket (*Nelusetta ayraud*) is an important byproduct species, with 228 t landed in 2016-17. Other byproduct species include Angelshark (*Squatina* spp.), Yellow-spotted Boarfish (*Paristiopterus gallipavo*), Latchet (*Pterygotrigla polyommata*) and Jackass Morwong (*Nemadactylus macropterus*). Danish-seine targets Deepwater Flathead on the continental shelf.

The fishery has 10 boat statutory fishing rights that allow a boat to fish in the fishery, and separate quota statutory fishing rights that allow quota species to be landed. Four trawl vessels and one Danish-seine vessel operated in the fishery in 2016–17. Total trawl fishing effort across all depths in 2016–17 was 12,480 trawl hours, down from the 2004–05 peak of 30 866 trawl hours. The continental shelf continues to be the focus of fishing effort, with 11,888 trawl hours in 2016–17.

Reduced effort in the fishery has led to reduced catches of key target species over time. Deepwater Flathead continues to dominate catches, with 636 t landed in the 2016–17 fishing season, which was 55 per cent of the TAC.

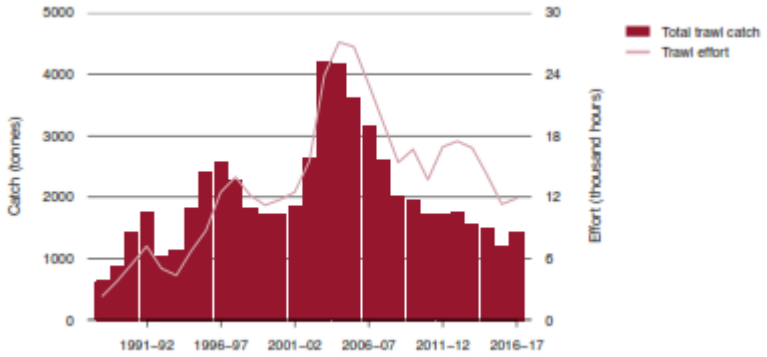

Figure 2: Catch and effort in the GABTS shelf fishery, 1998-99 to 2016-17. (Moore and Koduah, 2017).

Five units of assessment are examined in this report:

- Deepwater Flathead – demersal otter trawl
- Deepwater Flathead – Danish seine
- Bight Redfish - demersal otter trawl
- Gould's Squid - demersal otter trawl
- Ocean Jacket - demersal otter trawl.

For this assessment, target species have been selected by FRDC to allow for risk assessments using this framework to be tested. Additional target species may be added in future assessments.

Scoring

Performance Indicator	Deepwater Flathead – Trawl	Deepwater Flathead – Danish seine	Bight Redfish - Trawl	Gould's Squid - Trawl	Ocean Jacket – Trawl
COMPONENT 1					
1A: Stock Status	LOW RISK	LOW RISK	LOW RISK	LOW RISK	MEDIUM RISK
1B: Harvest Strategy	LOW RISK	LOW RISK	LOW RISK	LOW RISK	PHR
1C: Information and Assessment	LOW RISK	LOW RISK	LOW RISK	LOW RISK	MEDIUM RISK
OVERALL	LOW RISK	LOW RISK	LOW RISK	LOW RISK	MEDIUM RISK
COMPONENT 2					
2A: Non-target Species	LOW RISK	LOW RISK	LOW RISK	LOW RISK	LOW RISK
2B: ETP Species	LOW RISK	LOW RISK	LOW RISK	LOW RISK	LOW RISK
2C: Habitats	LOW RISK	LOW RISK	LOW RISK	LOW RISK	LOW RISK
2D: Ecosystems	LOW RISK	LOW RISK	LOW RISK	LOW RISK	LOW RISK
OVERALL	LOW RISK	LOW RISK	LOW RISK	LOW RISK	LOW RISK
COMPONENT 3					
3A: Governance and Policy	LOW RISK	LOW RISK	LOW RISK	LOW RISK	LOW RISK
3B: Fishery-specific Management System	LOW RISK	LOW RISK	LOW RISK	LOW RISK	LOW RISK
OVERALL	LOW RISK	LOW RISK	LOW RISK	LOW RISK	LOW RISK

Summary of main issues

- The main target stocks are generally well-positioned against Component 1 indicators.
- Ocean Jacket is a byproduct species. There is no quantitative stock assessment and high levels of discarding historically mean that catch per unit effort may not be a robust indicator of abundance. The most recent fishery-independent trawl survey reported substantial declines in relative biomass of Ocean Jacket compared to earlier surveys.
- There is some uncertainty around the spatial overlap of the fishery with vulnerable benthic habitats on the outer continental shelf.

- There is limited specific information on habitat and bycatch impacts from the Danish seine sector, although effort is currently very low.

Outlook

Deepwater Flathead - Trawl

Component	Outlook	Comments
Target species	Stable	The most recent assessment (2013) estimated the stock was at or around the target reference point, and catches are currently below the recommended biological catch (RBC). Nevertheless, the most recent fishery independent survey (2015) found a decrease in relative biomass compared with previous surveys, which is consistent with industry observations of decreased availability. An updated stock assessment was scheduled for 2016 and it possible that risk scores may increase with the new assessment.
Environmental impacts of fishing	Stable	No major changes are expected to Component 2 arrangements, although the introduction of the Commonwealth's South West marine reserves may increase the level of vulnerable habitat protection.
Management system	Stable	No major changes are expected to Component 3 arrangements.

Deepwater Flathead – Danish seine

Component	Outlook	Comments
Target species	Stable	The most recent assessment (2013) estimated the stock was at or around the target reference point, and catches are currently below the recommended biological catch (RBC). Nevertheless, the most recent fishery independent survey (2015) found a decrease in relative biomass compared with previous surveys, which is consistent with industry observations of decreased availability. An updated stock assessment was scheduled for 2016 and it possible that risk scores may increase with the new assessment.
Environmental impacts of fishing	Stable	No major changes are expected to Component 2 arrangements, although the introduction of the Commonwealth's South West marine reserves may increase the level of vulnerable habitat protection.
Management system	Stable	No major changes are expected to Component 3 arrangements.

Bight Redfish - Trawl

Component	Outlook	Comments
Target species	Stable	The stock is currently well above the target reference point, and catches are well below the RBC.
Environmental impacts of fishing	Stable	No major changes are expected to Component 2 arrangements, although the introduction of the Commonwealth's South West marine reserves may increase the level of vulnerable habitat protection.
Management system	Stable	No major changes are expected to Component 3 arrangements.

Gould's Squid - Trawl

Component	Outlook	Comments
Target species	Stable	Fishing effort is currently low in the context of historical effort levels, influenced by economic conditions.
Environmental impacts of fishing	Stable	No major changes are expected to Component 2 arrangements, although the introduction of the Commonwealth's South West marine reserves may increase the level of vulnerable habitat protection.
Management system	Stable	No major changes are expected to Component 3 arrangements.

Ocean Jacket - Trawl

Component	Outlook	Comments

Target species	Uncertain	Ocean Jacket is a bycatch species in the GABTS, and has been subject to large fluctuations in abundance elsewhere. Relative biomass fell substantially in the 2015 fishery independent survey compared to the 2011 survey. Standardised catch rates to 2013 remained high by historical levels, although there is uncertainty around the robustness of standardised CPUE as an index of abundance as a result of high levels of historical discarding.
Environmental impacts of fishing	Stable	No major changes are expected to Component 2 arrangements, although the introduction of the Commonwealth's South West marine reserves may increase the level of vulnerable habitat protection.
Management system	Stable	No major changes are expected to Component 3 arrangements.

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Disclaimer

This assessment has been undertaken in a limited timeframe based on publicly available information. Although all reasonable efforts have been made to ensure the quality of the report, neither this company nor the assessment' s authors warrant that the information contained in this assessment is free from errors or omissions. To the maximum extent permitted by law, equity or statute, neither this company nor the authors accept any form of liability, it contractual, tortious or otherwise, for the contents of this report or for any consequences arising from misuse or any reliance placed on it.

Background

This report sets out the results of an assessment against a seafood risk assessment procedure, originally developed for Coles Supermarkets Australia by MRAG Asia Pacific. FRDC is grateful for Coles' permission to use its Responsibly Sourced Seafood Framework. The aim of the procedure was to allow for the rapid screening of uncertified source fisheries to identify major sustainability problems, and to assist seafood buyers in procuring seafood from fisheries that are relatively well-managed and have lower relative risk to the aquatic environment. It uses elements from the GSSI benchmarked MSC Fishery Standard version 2.0, but is neither a duplicate of it nor a substitute for it. The methodology used to apply the framework differs substantially from an MSC Certification. Consequently, any claim about the rating of the fishery based on this assessment should not make any reference to the MSC.

This report is a "live" document that will be reviewed and updated on an annual basis.

Methods

Risk Assessment

Detailed methodology for the risk assessment procedure is found in MRAG AP (2015). The following provides a brief summary of the method as it relates to the information provided in this report.

Assessments are undertaken according to a 'unit of assessment' (UoA). The UoA is a combination of three main components: (i) the target species and stock; (ii) the gear type used by the fishery; and (iii) the management system under which the UoA operates.

Each UoA is assessed against three components:

1. Target fish stocks;
2. Environmental impact of fishing; and
3. Management system.

Each component has a number of performance indicators (PIs). In turn, each PI has associated criteria, scoring issues (SIs) and scoring guideposts (SGs). For each UoA, each PI is assigned one of the following scores, according to how well the fishery performs against the SGs:

- Low risk;
- Medium risk;
- Precautionary high risk; or
- High risk

Scores at the PI level are determined by the aggregate of the SI scores. For example, if there are five SIs in a PI and three of them are scored low risk with two medium risk, the overall PI score is low risk. If three are medium risk and two are low risk, the overall PI score is medium risk. If there are an equal number of low risk and medium risk SI scores, the PI is scored medium risk. If any SI scores precautionary high risk, the PI scores precautionary high risk. If any SI scores high risk, the PI scores high risk.

For this assessment, each component has also been given an overall risk score based on the scores of the PIs. Overall risk scores are either low, medium or high. The overall component risk score is low where the majority of PI risk scores are low. The overall risk score is high where any one PI is scored high risk, or two or more PIs score precautionary high risk. The overall risk score is medium for all other combinations (e.g. equal number of medium/low risk PI scores; majority medium PI scores; one PHR score, others low/medium).

Outlook

For each UoA, an assessment of the future 'outlook' is provided against each component. Assessments are essentially a qualitative judgement of the assessor based on the likely future performance of the fishery against the relevant risk assessment criteria over the short to medium term (0-3 years). Assessments are based on the available information for the UoA and take into account any known management changes. Outlook scores are provided for information only and do not influence current or future risk scoring.

Table 1: Outlook scoring categories.

Outlook score	Guidance
Improving	The performance of the UoA is expected to improve against the relevant risk assessment criteria.
Stable	The performance of the UoA is expected to remain generally stable against the relevant risk assessment criteria.
Uncertain	The likely performance of the UoA against the relevant risk assessment criteria is uncertain.
Declining	The performance of the UoA is expected to decline against the relevant risk assessment criteria.

Information sources

Information to support scoring is obtained from publicly available sources, unless otherwise specified. Scores are assigned on the basis of the objective evidence available to the assessor. A brief justification is provided to accompany the score for each PI. Information sources may include information gathered from the internet, fishery management agencies, scientific organisations or other sources.

Assessment Results

COMPONENT 1: Target fish stocks

1A: Stock Status

CRITERIA: (i)The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing.

(a) Stock Status

Deepwater Flathead **LOW RISK**

Deepwater Flathead are found at 70-490 m in southern temperate Australian waters from central Victoria to WA. The biological stock structure of Deepwater Flathead is unknown, and the stock is considered to be one biological stock for the purposes of management (Moore and Koduah, 2017).

The 2013 tier 1 stock assessment for Deepwater Flathead (Klaer, 2013) was updated in 2016 (Haddon, 2016; in Moore and Koduah, 2017). The 2016 base-case assessment predicted the female spawning biomass at the start of 2016–17 to be 45 per cent of unexploited female spawning stock biomass, above the target reference point of $0.43SB_0$.

The results of the 2015 fishery-independent trawl survey (Knuckey et al. 2015) suggested that estimated relative biomass of Deepwater Flathead had decreased to 5 065 t (CV 0.09), compared with 9 227 t in the 2011 survey (CV 0.05). Nevertheless, catches continue to be below the Recommended Biological Catch (RBC) and there is no evidence of a truncation in size or age structure of Deepwater Flathead (Knuckey et al, 2015).

Based on the most recent assessment, the stock appears highly likely to be above the point of recruitment impairment (PRI) and probably fluctuating at or around a level consistent with MSY.

Bight Redfish **LOW RISK**

The biological stock structure of Bight Redfish is unknown. It is considered to be a single biological stock in the GABTS for assessment and management purposes (Moore and Koduah, 2017).

The 2011 tier 1 stock assessment for bight redfish (Klaer, 2011) was updated in 2015 (Haddon, 2015). The base-case assessment predicted the female spawning biomass at the start of 2015–16 to be 63 per cent of unexploited female spawning stock biomass, above the target reference point of $0.41SB_0$. Catch in recent seasons has been below the RBC.

Based on the most recent assessment, the stock appears highly likely to be above the point of recruitment impairment (PRI) and probably fluctuating at or above a level consistent with MSY.

Gould's squid **LOW RISK**

Genetic studies support the hypothesis of a single biological stock of Gould's Squid throughout south-eastern Australian waters (Noriega et al, 2016).

Noriega et al (2016) report that "*no formal stock assessment is available for the Gould's Squid biological stock in Australia. Gould's Squid is short lived (less than 1 year), spawns multiple times during its life, and displays highly variable growth rates, and size and age at maturity[1]. These characteristics mean that the population can rapidly increase in biomass during favourable environmental conditions; it is therefore less susceptible to becoming recruitment overfished than longer-lived species. However, as the fishery targets individuals less than 1 year of age, there is potential for the population to be recruitment overfished if insufficient animals survive long enough to reproduce.*"

Emery and Bath (2017) report that:

- *In 2008, the Squid Resource Assessment Group analysed catch, catch rates and effort since 2000 for four regions in the SSJF. Only one region—the central region from Cape Otway in Victoria to Robe in South Australia—had levels of fishing that could cause substantial depletion. During the 2001 fishing season, high catch rates were reported for the central region, and the total jig fishery catch was the second highest on record. A preliminary depletion analysis of the central region using jig catch-and-effort data indicated that, despite the high catches, the stock was not overfished in that region in that year.*
- *ABARES conducted further depletion analyses for the central region of the SSJF for 1995 to 2006 (Barnes et al. 2015). The initial depletion curve results show declines in stock during most seasons, with escapement in five seasons estimated to be between 30 and 40 per cent. However, these results are for only one region of the fishery and do not indicate exploitation rates for the whole stock. Limited data are available on squid growth in this region. Interpretation of the depletion estimates is further complicated by the lack of an agreed estimate of natural mortality, the possible presence of multiple cohorts each year (as a result of multiple spawning events) and a lack of knowledge about squid movement in the region.*
- *Trawl catch rates from the CTS have been stable over the past 15 years, suggesting long-term stability in the availability, and perhaps biomass, of Gould's squid in the areas trawled. The 2012 average trawl catch rate for Gould's squid in the CTS was the highest reported in the past 20 years. The extent to which squid are targeted on trawl grounds is unclear.*
- *The high historical catches taken by foreign vessels in the late 1970s and 1980s indicate that a high annual harvest can be taken from the stock in years of high abundance without greatly reducing recruitment and biomass for subsequent seasons. The results of retrospective depletion analysis, stable catch rates in the trawl fishery over an extended period and high average catch rates (with the exception of the 2014 season, when effort declined) indicate that the stock has not yet been overfished in any season.*

On the basis of the above, they conclude that the stock is not overfished.

Although there is limited empirical evidence estimating a conventional B_{MSY} or proxies, the weight of available evidence suggests the stock is currently being fished at very low levels and probably highly likely to be above the point of recruitment impairment. The fact that overall catch and effort in recent years has been is substantially lower than in 2001 when a preliminary depletion analysis suggested the stock was not overfished, provides a plausible argument to suggest there is no reason why the stock is not capable of producing maximum sustainable yield based on environmental drivers.

Ocean Jacket MEDIUM RISK

The biological stock structure of Ocean Jacket is unknown, therefore it is assessed as a separate stock to that in the Commonwealth Trawl Sector (Moore and Koduah, 2017).

Ocean Jacket is a relatively short-lived species (~6 years), reaching maturity within two to three years. Large cyclical changes in abundance appear to have occurred off eastern Australia (Miller & Stewart 2009). There are no age data for Ocean Jacket from the GABTS, and the available historical length-frequency data are too old to be used as an index of abundance.

There are some conflicting signals in relevant stock indicators for Ocean Jacket in the GABTS area. The most recent estimate of standardised catch rates suggested that catch rates in 2013 were high by historical standards (Figure 3) (Tuck, 2015), suggesting that the stock was at least likely to be above PRI. Moreover, Zhou et al (2012) identified no teleost species in the GAB Trawl or Danish seine sub-fisheries for which current levels of fishing mortality was estimated to be above the maximum sustainable mortality, based on fishing effort levels between 2007 and 2010. Catches of Ocean Jacket have remained relatively stable since that time, with overall effort in the fishery declining (Moore and Koduah, 2017).

Nevertheless, a substantial decline in estimated relative biomass occurred in the 2015 fishery-independent trawl surveys, compared with those undertaken in 2006, 2008, 2009 and 2011 (Moore and Koduah, 2017). In the 2015 survey, Ocean Jacket represented 7 per cent of the catch with an estimated relative biomass of 3 702 t (CV 0.19) (Knuckey et al. 2015) compared with 27 712 t (CV 0.20) in 2011. There is also some concern about the use of commercial catch-per-unit-effort as an index of abundance for this species given Ocean Jackets have frequently been discarded (Knuckey & Brown 2002).

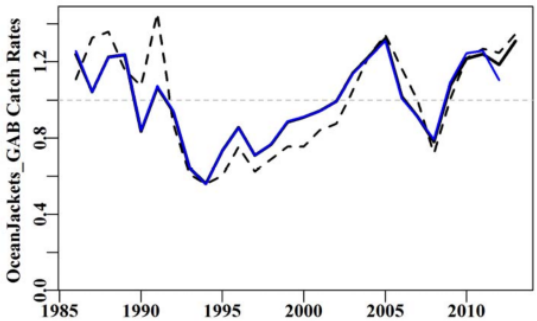

Figure 3: Standardised catch rates for Ocean Jackets from zones 82 and 83 in depths 80 to 220 m by Trawl. The dashed black line represents the geometric mean catch rate, solid black line the standardized catch rates and blue line the standardized catch rates based on last year's analysis. The graph standardizes catch rates relative to the mean of the standardized catch rates. (Tuck, 2015)

Notwithstanding the conflicting signals, Moore and Koduah (2017) concluded that "*life history characteristics suggest that it is unlikely that the stock is overfished. The level of catch in 2016–17 is unlikely to constitute overfishing. On this basis, Ocean Jacket in the GABTS is classified as not overfished and not subject to overfishing*".

Given the Moore and Koduah (2017) assessment, we have scored the stock medium risk on the basis that it is at least likely the stock is above PRI. Nevertheless, we note the evidence base is comparatively weak and continuing low biomass estimates from fishery independent surveys may see the risk scoring increased.

PI SCORE	LOW RISK – Deepwater Flathead, Bight Redfish, Gould's squid
	MEDIUM RISK – Ocean Jacket

1B: Harvest Strategy

CRITERIA: (i) There is a robust and precautionary harvest strategy in place.

(a) Harvest Strategy

The GABTS harvest strategy consists of:

- Limited entry;
- Catch controls through TACs and ITQs;
- Gear restrictions;
- Monitoring through logbooks and catch disposal records (CDRs);
- Monitoring through VMS.

A harvest strategy (HS) framework has been in place in the SESSF since 2005. The most recent version of SESSF Harvest Strategy was agreed in 2015 (AFMA, 2017a). The SESSF HS is designed to meet the objectives of the Commonwealth Fisheries Harvest Strategy Policy 2007 (HSP), namely "the sustainable and profitable use of Australia's Commonwealth fisheries in perpetuity through the

implementation of harvest strategies that maintain key commercial stocks at ecologically sustainable levels, and within this context, maximise the economic returns to the Australian community" (DAFF, 2007). To meet this objective, harvest strategies are designed to pursue an exploitation rate that keeps fish stocks at a level required to produce maximum economic yield (MEY) and ensure stocks remain above a limit biomass level (B_{LIM}) at least 90% of the time. Alternative reference points may be adopted for some stocks to better pursue the objective of maximising economic returns across the fishery as a whole (AFMA, 2017a).

The following summary of the HSF structure and processes is adapted from AFMA (2017a):

The HSF uses a three tier approach designed to apply different types of assessments and cater for different amount of data available for different stocks. The HSF adopts increased levels of precaution that correspond to increasing levels of uncertainty about stock status, in order to reduce the level of risk associated with uncertainty. Tier 1 represents the highest quality of information available (i.e. a robust integrated quantitative stock assessment).

Each Tier has its own harvest control rule (HCR) that is used to determine a recommended biological catch (RBC). The RBCs provide the best scientific advice on what the total fishing mortality (landings from all sectors plus discards) should be for each species/stock. For all Tier levels, once the RBC is determined from the results of the assessment and the application of the relevant HCR, a recommended total allowable catch (TAC) is calculated based on the TAC setting rules.

For Tier 1, the HCR is based on the following reference points:

- The limit biomass B_{LIM} –The default B_{LIM} proxy is B20 = 20% of the unfished spawning biomass;
- The B_{MSY} – the default B_{MSY} proxy is B40 = 40% of the unfished spawning biomass;
- The target biomass B_{TARG} (MEY) – BTARG is generally equal to B_{MEY}, for which the default proxy is approximated by $1.2*B_{MSY}$. If the default B_{MSY} proxy is used, this results in B48 = 48% of the unfished spawning biomass.

The Tier 1 harvest control rule applies to species and/or stocks where there is a robust quantitative assessment that provides estimates of current biomass levels, and where estimates or appropriate proxies are available for B_{LIM}, B_{TARG} and F_{TARG}.

Tier 3 and Tier 4 assessments use other indicators (relating to fishing mortality and catch rates respectively) and reference points which are taken as proxies for the biomass reference points for Tier 1.

The status of fish stocks in the GABTS, and how they are tracking against the HSF, is reported to the Great Australian Bight Resource Assessment Group (GABRAG), the GAB Management Advisory Committee (GABMAC) and the AFMA Commission as part of the yearly TAC Setting process. The data used for input into the stock assessment process are collected by the ISMP, AFMA logbooks and CDRs and FISs. Otoliths from the biological sampling are provided to a private contractor for ageing. All sampling and age data are provided to stock assessment scientists for analysis or reporting. The stock assessment reports provide recommended biological catch (RBC) amounts for each quota species. Other sources of mortality arising from discarded catch, catch taken by other jurisdictions (e.g. State and recreational sectors) or research catch allowance, are subtracted from the RBC to produce a Commonwealth TAC.

Each stock is assessed under the appropriate Tier level as advised by GABRAG. In mid-December, AFMA produces a position paper with recommended TACs for quota species for the upcoming fishing season, based on the stock assessments and RAG advice. The paper is distributed to interested parties and undergoes a public comment period. The outcomes of GABRAG and GABMAC together with the AFMA position paper and any public comments received, are then sent to the AFMA Commission to determine TACs for the upcoming fishing season in mid-February.

Deepwater Flathead **LOW RISK**

Deepwater Flathead operates as a Tier 1 stock under the SESSF HSF. For the 2016-17 fishing year, the AFMA Commission adopted a TAC of 1150t consistent with the third year of a three-year multi-year TAC beginning in 2014-15. It also recommended that the percentage for undercatch and overcatch be determined at 10 %. In December 2016, GABMAC considered the updated stock assessment and single and multi-year RBCs. Based on the available information, GABMAC recommended a three-year TAC of 1,128t consistent with the 20:35:43 harvest control rule (HCR). AFMA supported this recommendation (AFMA, 2017b).

Based on the above, the harvest strategy is responsive to the state of the stock and all of the elements work together towards achieving the stock management objectives reflected in Criterion 1A (i).

Bight Redfish **LOW RISK**

Bight Redfish is managed as a Tier 1 stock under the SESSF HSF. A new assessment was completed for bight redfish in 2015. Based on the outcomes of the assessment, GABRAG recommended an average five–year RBC of 797 tonnes. The Great Australian Bight Industry Association (GABIA) recommended a five year TAC of 800 tonnes, which was set by the AFMA Commission. At its meeting in December 2016, GABMAC noted that breakout rules for Bight Redfish had not been triggered and the TAC was only 7% caught (GABMAC, 2016). Both the RAG and MAC recommended continuing with the current five-year TAC of 800t, and noted the stock was under no threat. AFMA supported this recommendation (AFMA, 2017b).

Based on the above, the harvest strategy is responsive to the state of the stock and all of the elements work together towards achieving the stock management objectives reflected in Criterion 1A (i).

Gould's squid **LOW RISK**

The southern Australia biological stock of *N. gouldi* is harvested by a range of fisheries including:

- The Commonwealth Southern Squid Jig Fishery (SSJF);
- The Commonwealth Southern and Eastern Scalefish and Shark Fishery (SESSF) (Commonwealth Trawl Sector – CTS – and Great Australian Bight Trawl Sector – GABTS);
- The Tasmanian Scalefish Fishery (TSF); and
- Recreational fisheries.

Catches in the two Commonwealth fisheries have historically dominated total landings, however substantial catches were taken in the TSF in 2012-13 (Figure 4). Recreational catches in Tasmania were estimated at 21t in 2012-13 (Noriega et al, 2016).

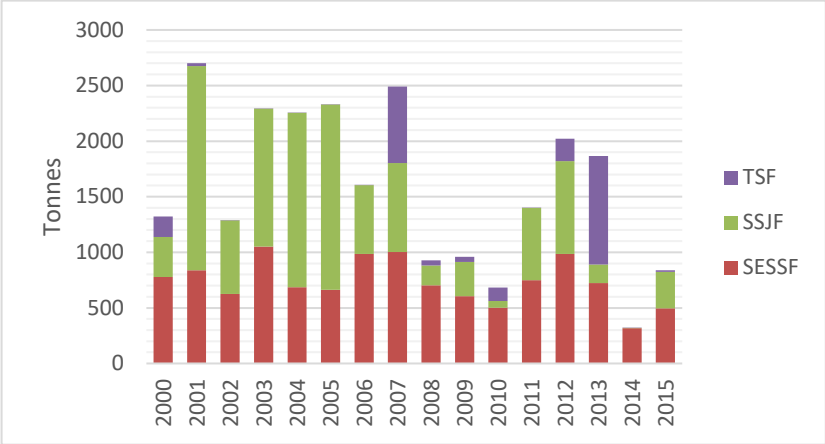

Figure 4: Australian Gould's squid commercial catches between 2000 and 2015.

The SSJF and SESSF are subject to management arrangements specified in the Arrow Squid Fishery Harvest Strategy. This harvest strategy details processes for monitoring and conducting assessments of the biological and economic conditions of the fishery. The harvest strategy covers the SSJF as well as sectors of the SESSF and other Commonwealth fisheries which may take Gould's squid in the Australian Fishing Zone. The Arrow Squid Fishery Harvest Strategy was implemented on 1 January 2008.

In the absence of biomass estimates, the harvest strategy uses suites of intermediate and limit catch and effort triggers based on recent catch history, with values well below historical high catch levels. A series of defined actions are associated with each trigger (e.g. re-assess the fishery using depletion analysis if a trigger of 5,000t from the SSJF or 6,000t overall is reached). These do not specify catch reductions (or increases) but are consistent with the existing lightly-exploited nature of the fishery (Anon, undated). Under the current SSJF Management Plan, advice will be provided by a Southern Squid Jig Fishery Resource Advisory Group (SquidRAG) on an appropriate management response, should any of the trigger catch levels be reached.

The TSF uses jigs and is subject to limited entry, vessel restrictions (<20m) and spatial and temporal closures. There were 12 active vessels in the TSF in 2015, and the number of automatic squid jigging licenses is limited to 7 in 2016-17 [1].

Notwithstanding larger catches in 2011-12 and 2012-13, catch remains well below historical levels. The harvest strategy in the Commonwealth sectors, which have dominated catches except for 2012-13, is responsive to the state of stock and the elements work together towards achieving the stock management objectives reflected in Performance Indicator 1A(i). Catches in the TSF should continue to be monitored in the context of ensuring effective management arrangements across the full range of the stock.

Ocean Jacket MEDIUM RISK

There are no species-specific management arrangements for Ocean Jacket in the SESSF. As a byproduct species, the 'harvest strategy' consists of limiting overall effort in the fishery through the application of TACs on quota-managed species, limited entry, gear restrictions, spatial closures, together with ongoing catch and effort monitoring and periodic assessment. Catch and effort for the stock are reported through commercial logbooks, verified through observer data and the stock is subject to periodic standardized CPUE based assessments. In addition, the stock is subject to periodic estimates of biomass based on fishery-independent trawl surveys (e.g. Knuckey et al, 2015).

A bycatch and discarding workplan is in place for the SESSF, although the primary objective of the plan is to reduce catch of species identified as high risk or greater during the ERA process. Zhou et al (2012) identified no teleost species in the GAB Trawl or Danish seine sub-fisheries for which current levels of fishing mortality was estimated to be able the maximum sustainable mortality.

This scoring issue is ranked as medium risk on the basis that the stock is not considered overfished or subject to overfishing (Moore and Koduah, 2017), the species is largely taken as opportunistic bycatch, the stock is regularly monitored and tools are available to management agency to reduce exploitation should indicators suggest the stock is approaching PRI (e.g. daily/trip limits, 'move on' provisions). For example, the management agency in cooperation with industry has introduced measures to limit catches of non-quota species in other sectors (e.g. snapper in the CTS otter trawl sector through 'move-on' provisions). The current broader harvest strategy arrangements appear to have been sufficient to date to achieve the stock management objectives in criterion 1A(i) under current effort levels. Nevertheless, the most recent estimates of biomass from fishery-independent surveys were substantially lower than previous surveys. The extent to which the management system responds to any future surveys showing ongoing low biomass should be considered in future assessments.

(b) Shark-finning

NA – this SI is scored only where the target species is a shark

CRITERIA: (ii) There are well defined and effective harvest control rules (HCRs) and tools in place.

(a) HCR Design and application

Deepwater Flathead LOW RISK

There is a well-defined harvest control rule in place for Deepwater Flathead. The Commonwealth Fisheries Harvest Strategy Policy (HSP; DAFF, 2007) and the SESSF Harvest Strategy Framework (AFMA 2017a) apply to Deepwater Flathead. Under the framework,

[1] http://dpipwe.tas.gov.au/sea-fishing-aquaculture/commercial-fishing/scalefish-fishery/commercial-scalefish

recommended biological catches (RBCs) are usually based on achieving a default target reference point of 48 per cent of the unfished biomass ($0.48B_0$), as a proxy for the biomass producing maximum economic yield (B_{MEY}). However, a bio-economic model (Kompas et al. 2012) estimated B_{MEY} target reference points of $0.43B_0$ for Deepwater Flathead in the GABTS. In 2014, the AFMA Commission determined a TAC for Deepwater Flathead based on a three year multi-year TAC (MYTAC) recommendation. Application of the 20:35:43 harvest control rule[2] produced an RBC for 2014–15 of 1 146 t. The multiyear TAC of 1 150 t was retained for the 2016–17 fishing season (Moore and Koduah, 2017).

The above information, together with the latest stock assessment estimates showing biomass levels greater than the target reference point, is objective evidence that the HCR is expected to maintain stocks at or fluctuating around MSY.

Bight Redfish **LOW RISK**

There is a well-defined harvest control rule in place for Bight Redfish. The Commonwealth Fisheries Harvest Strategy Policy (HSP; DAFF, 2007) and the SESSF Harvest Strategy Framework (AFMA 2017a) apply to Bight Redfish. Under the framework, recommended biological catches (RBCs) are usually based on achieving a default target reference point of 48 per cent of the unfished biomass ($0.48B_0$), as a proxy for the biomass producing maximum economic yield (B_{MEY}). However, a bio-economic model (Kompas et al. 2012) estimated B_{MEY} target reference points of $0.41B_0$ for Bight Redfish in the GABTS. Based on the outcomes of the 2015 assessment, application of the 20:35:41 HCR produced an RBC of 797t. The AFMA Commission established a five-year TAC of 800t commencing in 2016-17, and has subsequently recommended maintaining the TAC for 2017-18 (AFMA, 2017b). Breakout rules allow for the TAC to be adjusted within the five year period if exceptional circumstances arise.

Gould's squid **LOW RISK**

The Commonwealth Arrow (Gould's) Squid Fishery Harvest Strategy uses a system of within-season monitoring against catch triggers for the jig and trawl sectors that signal the need for formal assessment. The main harvest strategy control rules are outlined in Table 2. Due to relatively low effort in the last few years, these triggers have far exceeded the catch and effort in the fishery.

Table 2: Harvest controls for the SSJF (Source: AFMA, 2009).

Fishery	Trigger	Control rule - Management response
Jig fishery	3000t catch or 30 active vessels	Fishing continues. Requires a depletion analysis and increased investment in fishery monitoring and biological data collection. If there is no indication of impact (depletion) fishing may continue to the next trigger limit.
	5000t catch or 45 active vessels	Further catches are suspended pending another depletion analysis. If there is no indication of depletion a further, higher trigger may be considered. If there is impact, catch or effort may be capped. Fishing beyond this trigger will require more rapid realtime monitoring of the fishery.
Combined trawl sector	2000t	Fishing continues. Decision rules require depletion analyses equivalent to those required for the jig fishery rules. Catch limits may be set depending on the outcome of the analyses.
Combined jig fishery and trawl sector	4000t	The combined jig and trawl catch triggers the decision rules at this level are equivalent to those applying to the 3000t intermediate jig catch trigger however assessment would involve depletion analysis for both fisheries.
	6000t	Decision rules are equivalent to the 5000t jig catch trigger however assessment will involve depletion analysis using data for both fisheries and any changes to catch triggers will require agreement from both the SSJF and the SESSF resource assessment groups.

Although the Commonwealth HCRs do not apply to the TSF, given the historically low levels of catch and the greater potential for fishing effort in the Commonwealth sectors, these rules are likely to ensure that exploitation is reduced as PRI is approached.

Ocean Jacket **PRECAUTIONARY HIGH RISK**

No formal HCR exists for Ocean Jacket, although the stock is assessed annually based on CPUE trends and biomass is estimated through periodic fishery-independent trawl surveys (e.g. Knuckey et al, 2015). Given ongoing stock monitoring and the overarching framework of the HSP, the species could be considered to have 'generally understood' HCRs in place and tools that are 'available' consistent with medium risk. Nevertheless, the stock is only eligible to score medium risk using 'generally understood' and 'available' HCRs and tools where there is evidence that the stock has not been reduced below MSY levels, or there is no evidence that the stock has declined significantly over time (MSC, 2014). The most recent (2015) fishery-independent trawl survey reported a substantial decline in estimated relative biomass compared with those undertaken in 2006, 2008, 2009 and 2011, and there is some uncertainty about the accuracy of CPUE-based assessments given evidence of discarding. On that basis, it is not clear that the stock has been maintained above MSY level and there is recent evidence of stock decline. Although Moore and Koduah (2017) conclude that the stock is not overfished or subject to overfishing, no well-defined HCRs are in place for Ocean Jacket that would serve to reduce exploitation as the PRI is approached. Accordingly, we have scored this SI precautionary high risk.

PI SCORE	LOW RISK – Deepwater Flathead, Bight Redfish, Gould's squid
	PRECAUTIONARY HIGH RISK – Ocean Jacket

[2] Under which, broadly, where the stock is above $35\%B_0$ TACs are set consistent with a level of fishing mortality equal to F_{43}; where the stock is below $35\%B_0$ but above $20\%B_0$, TACs are set consistent with a level of fishing mortality that will recover the stock to $43\%B_0$; and TACs are set at zero targeted catch where the stock falls below $20\%B_0$ (AFMA, 2017a).

1C: Information and Assessment

CRITERIA: (i) Relevant information is collected to support the harvest strategy.

(a) Range of information

Deepwater Flathead **LOW RISK**

The stock structure of Deepwater Flathead is not well known, although sufficient information appears to be available to support an effective harvest strategy. The distribution and fisheries biology are relatively well-known (e.g. see Moore and Koduah, 2017), and there is very good information on the composition and characteristics of the fleet in the GABTS. The available information has been sufficient to develop a Tier 1 stock assessment and fishery-independent surveys to provide an independent index of abundance. Available information is reviewed at RAG and MAC meetings.

Bight Redfish **LOW RISK**

The stock structure of Bight Redfish is not well known, although sufficient information appears to be available to support an effective harvest strategy. The distribution and fisheries biology is relatively well-known (e.g. Stokie, 2004), and there is very good information on the composition and characteristics of the fleet in the GABTS. The available information has been sufficient to develop a Tier 1 stock assessment and fishery-independent surveys to provide an independent index of abundance. Available information is reviewed at RAG and MAC meetings.

Gould's squid **LOW RISK**

Notwithstanding difficulties in estimating biomass, sufficient information on stock structure, stock productivity and fleet composition are available to support the harvest strategy (see for example Jackson et al, 2003a,b; Virtue et al, 2011; Noriega et al, 2016; Emery and Bath, 2017, and references therein).

Ocean Jacket **MEDIUM RISK**

The stock structure of Ocean Jackets is unknown, and as a result the Great Australia Bight Trawl Sector is managed independently of the CTS and the Scalefish Hook and Gillnet sector of the SESSF. Some information is available on the biological characteristics of the stock (see Moore and Koduah, 2017), and there is very good information on the composition and characteristics of the fleet in the GABTS. Stock abundance is assessed using standardised CPUE, although historical discarding of Ocean Jackets means the CPUE may not be valuable index of abundance. More recently, fishery independent surveys have provided an alternate index of abundance (e.g. Knuckey et al, 2015). There are no age data for Ocean Jacket from the GABTS, and the available historical length-frequency data are too old to be used as an index of abundance (Moore and Koduah, 2017). Accordingly, some relevant information is available to support the harvest strategy, consistent with medium risk.

(b) Monitoring and comprehensiveness

Deepwater Flathead **LOW RISK**

In the GABTS, removals from the stock are monitored using daily catch and effort logbooks, catch disposal records (which provide accurate weights of retained catch upon landing) and occasional observer coverage. Observer coverage 1.35% of trawl hours in 2015-16 (Moore et al, 2016) and 2.93% of trawl hours in 2016-17 (Moore and Koduah, 2017). Observer data provides information on the quantity, size and age composition of retained and discarded quota species as well as bycatch caught in the GABTF. There are limited catches of Deepwater Flathead outside of the GABTS.

In 2005, the GABTS implemented a fishery independent survey (FIS) for its two main target species (Bight Redfish and Deepwater Flathead). These surveys, which have been regularly undertaken to 2015, aim to provide an alternative index of abundance for a range of species that is independent of changes in fishing effort / commercial fishing.

Stock abundance is monitored using a Tier 1 integrated stock assessment, fitted to a range of data including standardised CPUE, fishery independent surveys, age and length compositions (Klaer, 2013). These programs ensure stock abundance and UoA removals are monitored at a level of accuracy and coverage consistent with the HCR.

Bight Redfish **LOW RISK**

Monitoring arrangements for Bight Redfish are very similar to those described for Deepwater Flathead above.

Gould's squid **LOW RISK**

Given the highly variable nature of the stock, the need for abundance monitoring and other assessments (e.g. depletion analysis) is determined by monitoring catch against trigger points in the Commonwealth Arrow (Gould's) Squid Fishery Harvest Strategy. Where effort and catch remain at low levels, no specific abundance monitoring is required (other than nominal CPUE/catch). In Commonwealth fisheries, removals from the stock are monitored using daily catch and effort logbooks, catch disposal records and occasional observer coverage. Removals from the stock by the TSF are monitored through compulsory catch and effort logbooks. In the Commonwealth sector, monitoring arrangements are consistent with the HCR.

Ocean Jacket **MEDIUM RISK**

Monitoring arrangements for Ocean Jackets are similar to those described for Deepwater Flathead above. There is no formal HCR for Ocean Jacket, although abundance is monitored through standardised CPUE and fishery-independent surveys (Moore and Koduah, 2017). High levels of discarding of Ocean Jackets historically mean that CPUE may not be a robust index of abundance. Nevethless, removals from the stock are monitored and at least one indicator of abundance (trawl survey abundance) is monitored with sufficient

frequency to support the introduction of catch controls if the stock is deemed to be approaching PRI.

CRITERIA: (ii) There is an adequate assessment of the stock status.

(a) Stock assessment

Deepwater Flathead **LOW RISK**

The most recent Tier 1 integrated stock assessment for Deepwater Flathead in the GABTS was undertaken in 2016 (Haddon, 2016; in Moore and Koduah, 2017). The assessment updated an earlier an age-length and sex structured population dynamics model implemented in Stock Synthesis v3.24f (Klaer, 2013). The model was fitted to data including standardised CPUE, fishery independent survey results and age and length data. The outcomes of the assessment were accepted by GABRAG. The assessment is appropriate for the stock and estimates status relative to reference points that are appropriate and can be estimated.

Bight Redfish **LOW RISK**

The most recent assessment of the Bight Redfish stock was undertaken in 2015 (Haddon, 2015). The assessment is an age-length and sex structured population dynamics model implemented in Stock Synthesis v3.24u. Data inputs include catch (landings plus discards), standardized commercial CPUE, an index of relative abundance from the Fishery Independent Survey (FIS), age composition data from the Integrated Scientific Monitoring Program (ISMP) and from the FIS, and length composition data from the ISMP (keeping port sampling separate from the on-board sampling), from the FIS, and from crew sampling from on-board. The model has been reviewed and accepted by GABRAG and is appropriate for the stock. The assessment estimates status relative to reference points that have been empirically estimated (Kompas, 2012).

Gould's squid **MEDIUM RISK**

No formal stock assessment exists for this stock (Noriega et al, 2016). AFMA (2009) note that given the high natural variability of arrow squid, the standard stock assessment techniques used for fish such as teleosts or chondrichthyans are not appropriate. Current knowledge of the southern squid resource is insufficient to allow biomass or suitable proxies for reference points to be estimated. Nevertheless, Noriega et al (2016) and Emery and Bath (2017) use alternative empirical indicators including catch rates and total catch to estimate stock status using a weight of evidence approach. This approach estimates stock status relative to generic reference points appropriate to the species category.

Ocean Jacket **MEDIUM RISK**

As a bycatch species, Ocean Jacket has not been the subject of formal stock assessments. Stock status is assessed using standardised CPUE, although there are acknowledged uncertainties in the assessment relating high levels of discarding (Moore and Koduah, 2017). An independent index is available through the fishery-independent surveys (e.g. Knuckey et al, 2015). Notwithstanding the uncertainties, the available information is sufficient to assess status relative to historical levels and make a judgement of likely status against generic reference points (e.g. overfished/not overfished; Moore and Koduah, 2017).

(b) Uncertainty and Peer review

Deepwater Flathead **LOW RISK**

Although the most recent assessment (Haddon, 2016) was not yet publicly available for review, the model is reportedly an update of the 2013 assessment (Klaer, 2013). The 2013 assessment took uncertainty into account by developing a base case model and undertaking multiple alternate model runs to test sensitivity to different input parameters (Klaer, 2013). The assessment noted that if Danish seine catches continue to be a significant proportion of the total, length samples should be collected to investigate whether a different selectivity to otter trawl should be estimated for that fleet. Stock assessments are presented to the GABRAG for review and discussion.

Bight Redfish **LOW RISK**

The 2015 updated assessment took a range of uncertainties into account (e.g. tested impacts of new software version; aging error; variances in age/length/CPUE; natural mortality). The assessment is subject to external review through the GABRAG process which includes stakeholders and independent scientists (e.g. GABRAG, 2015).

Gould's squid **LOW RISK**

The main uncertainties are taken into account in the weight of evidence approach used by Noriega et al (2016). Although not a formal assessment, their conclusions are subject to external assessment.

Ocean Jacket **MEDIUM RISK**

Historical catch data indicate substantial variations in Ocean Jacket abundance off south-eastern Australia in the 1920s and 1950s (Miller & Stewart 2009). There are attempts to deal with some forms of uncertainty through the process of standardizing CPUE (Tuck, 2015), although substantial uncertainty remains around the impact of historical discarding and the effect of discarding on this trend in abundance is unknown. Available data are reviewed through GABRAG.

PI SCORE	**LOW RISK – Deepwater Flathead, Bight Redfish, Gould's squid**
	MEDIUM RISK – Ocean Jacket

COMPONENT 2: Environmental impact of fishing

2A: Other Species

CRITERIA: (i) The UoA aims to maintain other species above the point where recruitment would be impaired (PRI) and does not hinder recovery of other species if they are below the PRI.

(a) Main other species stock status

Otter trawl MEDIUM RISK

The intent of this scoring issue is to examine the impact of the fishery on 'main' other species taken while harvesting the target species. 'Main' is defined as any species which comprises >5% of the total catch (retained species + discards) by weight in the UoA, or >2% if it is a 'less resilient' species. The aim is to maintain other species above the point where recruitment would be impaired and ensure that, for species below PRI, there are effective measures in place to ensure the fishery does not hinder recovery and rebuilding.

Tuck et al (2013) reported that "*Over a range of studies, the annual quantity and composition of bycatch in the market fishery has remained similar (Brown and Knuckey, 2002; Talman and Brown, 2003; Talman et al., 2004; 2005; Koopman et al., 2006; 2007). The percentage (by weight) of the catch retained in GABTS market shots usually ranged from 40% – 60% depending on the region and time. During market fishing, the retained catch was dominated by Deepwater Flathead, Bight Redfish, Blue Grenadier, King Dory (Cyttus traversi), Blue Eye Trevalla, Ornate Angel Shark (Squatina tergocellata) and large (>35cm TL) Ocean Jacket. The discarded catch was dominated by Latchet, Wide Stingaree (Urolophus expansus), Draughtboard Shark (Cephaloscyllium laticeps), Southern Frostfish (Lepidopus caudatus), Sponge, Hard Coral and small Ocean Jacket (Knuckey and Brown 2002).*"

Over 300 species make up the discards of the GABTS, although only a small proportion of these species meet the definition of 'main species' and require assessment. In this assessment, we assess these species together with those identified as 'high risk' in the most recent ecological risk assessment (ERA) undertaken for each species type - i.e. for teleosts the Level 3 SAFE (Zhou et al. 2012) and non-teleost, non- chondrichthyan species the Level 2 Residual Risk Assessment (AFMA, 2012a).

Teleosts/chondrichthyans

Of the retained teleost species, all species likely to comprise >5% of the total catch are assessed here under Component 1. Of the remaining retained teleost species, those retained in substantial numbers between 2013 and 2015 based on Catch Disposal Records were Latchet (5.5% of the retained catch), Yellow-spotted Boarfish (3.8%), Australian Angelshark (3.3%), Ornate Angelshark (2.6%) and Red Gurnard (2.3%). Although total catch (retained + discarded) figures are not available, it is possible that Australian Angelshark and Ornate Angelshark may make up >2% of the catch and be considered less resilient.

Interactions with all teleost and chondrichtyan species were assessed through a Level 3 SAFE assessment undertaken by Zhou et al. (2012). These authors evaluated 204 species of fish (52 chondrichthyans and 152 teleosts) that may be impacted by the GABTS and found no species with a fishing mortality (including uncertainty) greater than any reference point (either F_{msm} or F_{crash} including minimum reference points) (Figure 5). This was largely driven by low overall rates of effort as well as low overlap between fishing effort and species distribution, although depletions at a population level were not assessed due to lack of population data.

While the status in relation to the PRI of many of the teleost and chondrichthyan species potentially qualifying as main other species in the GABTS is unknown, the updated SAFE outcomes (Zhou et al, 2012) provide an objective basis for confidence that the UoAs are highly unlikely to be fishing these species at levels higher than maximum sustainable mortality based on 2007-2010 effort levels. Fishing effort has fallen since that time (Moore and Koduah, 2017).

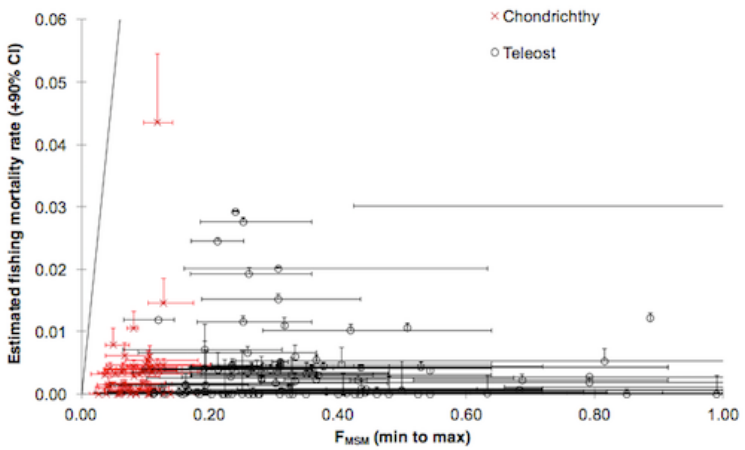

Figure 5: Comparison of estimated fishing mortality in 2007-2010 with maximum sustainable fishing mortality Fmsm for teleost and chondrichthyan species caught in the Great Australian Bight Trawl sub-fishery. The diagonal line is where F = Fmsm (Zhou et al. 2012).

Non-teleost/non-chondrichthyan species

The 'highest' level ERA undertaken on non-teleosts and non-chondrichthyans in the GABTS was a Level 2 Residual Risk Assessment (AFMA, 2012a). Two undifferentiated groups of species – cuttlefish and octopods – were rated high risk and unable to be reduced using any of the Level 2 ERA Residual Risk guidelines. Cuttlefish were assessed as high risk under the (Level 2) PSA because of missing

productivity data. That data was found, which reduces the productivity score from 3.00 to 2.00. However, the susceptibility was still considered too high and cuttlefish remained as a high risk species (AFMA, 2012a). There was a negligible amount of octopods caught in the GABTS, with only 6kg being reported in observer records in the 2009/10 fishing season (AFMA, 2012a). The susceptibility score was reduced to 2, however due to missing data, the productivity score remains at 3 and the risk score remained high.

The main management response to the high risk rating is to improve data collection on both species groups through the GABT Bycatch and Discard Workplan 2014-16. In particular, the ISMP will be refined to add cuttlefishes and octopods to GABT priorities for catch composition reporting to species level by onboard observers.

While the status of both groups in comparison to the PRI is not known, the available information suggests that the existing and planned measures in place in the fishery, together with reduced fishing effort, are probably likely to ensure that the UoAs do not hinder recovery. The average annual catch of octopus between 2000 and 2006 (during the years of highest fishing effort) was 506 kg in the GABTS, and no octopus have been retained since 2011. When compared to the 58t taken each year by the CTS (Walker et al. 2006) and 150t by SA state fisheries in 2010-11, catches in the GABTS are negligible. Moreover, ISMP data found that only 2t of various cuttlefish is caught by the GABTS each year (compared to 82t in the CTS) (Walker et al. 2006). There are at least seven species of cuttlefish that inhabit southern Australian waters, and cuttlefishes ranked as high risk in the GABTS ERA due to missing attributes.

While the Level 3 SAFE ERA (Zhou et al. 2012) did not include these species, it did include less productive species (e.g., sharks) subject to far greater fishing mortality. For these species, the SAFE concluded that fishing mortality was less than F_{MSY} for all species given the low effort in the GABTS. As such, it is reasonable to assume that current levels of catch in the GABTS are unlikely to reduce octopus or cuttlefish species to the PRI, or hinder recovery. Nevertheless, given the high residual risk rating there is probably insufficient evidence to conclude that the species groups are high likely to be above PRI or that there is a demonstrably effective strategy to ensure the fishery does not hinder recovery and thereby meet the low risk SG. Accordingly, we have scored this SI medium risk.

Danish seine **LOW RISK**

Limited information appears to be publicly available on total catch composition in the GAB Danish seine sector. Nevertheless, ecological risk assessments from other parts of the SESSF (e.g. CTS) indicate that the impacts on other species are generally likely to be lower than otter trawl gear (e.g. AFMA, 2012b; AFMA, 2014a), and effort in the sector has been extremely low (one Danish seine vessel operated in 2015-16 and 2016-17). Accordingly, given the outcomes of the otter trawl sector ERAs, it is probably highly likely the fishery will not result in any species falling below the point of recruitment impairment. Nevertheless, confidence in the scoring against this SI would improve with additional information.

CRITERIA: (ii) There is a strategy in place that is designed to maintain or to not hinder rebuilding of other species; and the UoA regularly reviews and implements

(a) Management strategy in place **LOW RISK**

The main management measures in place to monitor and manage impacts on other species include:

- SESSF Harvest Strategy;
- Bycatch and Discarding workplan/Ecological Risk Management (ERM) Strategy for the SESSF (including ERAs for species occurring in the GABTS area);
- Monitoring of catch through logbooks and catch disposal records;
- Fishery independent surveys;
- Observer coverage;
- Spatial and Depth closures;
- Gear restrictions;
- Limited entry.

The implementation of harvest strategies for all Commonwealth managed fisheries is a key component of AFMA's management of key commercial species (target and some byproduct species) (AFMA, 2017a). The GABTS has developed harvest strategies for two major target and several other major byproduct species. The GABTS also has a development strategy for species not currently under a TAC, with actions occurring at specified catch triggers (AFMA, 2017a). This strategy is designed to improve the data collected and the knowledge of these species as catch increases. TACs on the main target species serve to control overall levels of effort in the fishery, which influence levels of fishing mortality on non-target species.

For non-commercial species, formal ecological risk assessments (ERAs) are undertaken to assess impacts and inform management measures. ERAs with increasing levels of precision have been undertaken on the known species occurring within the GABTS area (e.g. Zhou et al, 2012; AFMA, 2012a). The SESSF Bycatch and Discarding Workplan sets out a plan of action to address priorities identified during the ERA process (AFMA, 2015a).

Monitoring of retained commercial species occurs through logbooks and catch disposal records, while discard composition and volume are monitored through occasional observer coverage. Observer coverage was 3.68% in 2014-15 and 1.35% in 2015-16. Fishery independent trawl surveys also provide information on the distribution and abundance of non-target species (e.g. Knuckey et al, 2015).

Research has also been undertaken to examine gear designs which minimize bycatch. For example, the Great Australian Bight Fishing Industry Association (GABIA) initiated research to examine the use of T-90 mesh codends, which have been shown in international studies to improve both selectivity and towing efficiency. During an alternate tow experiment, the T-90 net caught significantly less bycatch (516 kg/shot) compared to the control net (878 kg/shot) (Knuckey et al., 2008). This difference was particularly large during day time shots. Based on the outcomes of this research, T-90 extensions and/or codends were made mandatory in shelf component of the fishery.

Together with other measures in place (e.g. spatial closures to protect orange roughy), these measures constitute at least a partial strategy that is expected to maintain or to not hinder rebuilding of the main other species at/to levels which are highly likely to be

above the PRI.

(b) Management strategy evaluation

Otter trawl **LOW RISK**

The outcomes of the updated SAFE assessment (Zhou et al, 2012) for teleosts and chondrichthyans and the Level 2 Residual Risk Assessment for non-teleosts and non-chondrichthyans (AFMA, 2012a) provide an objective basis for confidence that the strategy in place to limit the impact of the fishery on main other species will work and is being implemented successfully. Stock assessments of Bight Redfish provide an objective basis for confidence that the stock is high likely to above PRI.

Danish seine **MEDIUM RISK**

Given the outcomes of the otter trawl sector ERAs and the very low levels of effort in the Danish seine sector, there is a plausible argument the measures in place are likely to work. Nevertheless, there appears to be limited objective evidence available specifically for the Danish seine sector at present.

(c) Shark-finning **LOW RISK**

Shark-finning is not permitted in the SESSF (further information on the provisions for processing at sea are available in the SESSF Management Arrangement booklet; AFMA, 2017c). In most cases, pectoral, dorsal and caudal fins must remain naturally attached to the body prior to landing.

CRITERIA: (iii) Information on the nature and amount of other species taken is adequate to determine the risk posed by the UoA and the effectiveness of the strategy to manage other species.

(a) Information

Otter trawl **LOW RISK**

The GABTS is a data-rich fishery, with quantitative information available to adequately assess the impact of the UoA on other species. Information available includes:

- Level 2 PSA ERA (Daley et al. 2007)
- Level 2 Risk Residual Analysis (AFMA, 2012a)
- Level 3 SAFE ERA (Zhou et al. 2012)
- ERA extension re Cumulative impacts of fishing (Zhou et al. 2013)
- Fishery Independent Survey reports (e.g., Knuckey et al. 2009, 2011, 2015)
- Monitoring by the ISMP (e.g. Tuck et al. 2013)
- Bycatch and Discard review (Knuckey & Brown 2002; Tuck et al. 2013)
- Trials of new gear including surveys and associated reports (Knuckey et al. 2008)
- VMS spatial effort information.

This information is sufficient to support a partial strategy to manage main 'other species', as well as detect any increase in risk.

Danish seine **MEDIUM RISK**

There appears to be limited information available publicly on total catch composition in the Danish seine sector. Nevertheless, information available from the otter trawl fishery, together with observer information, fishery independent surveys and ecological risk assessments providing some information on the relative risks associated with Danish seine gear versus otter trawl gear in adjacent SESSF sub-sectors (e.g. CTS) is probably sufficient to assess likely impact of the sector on non-target species, as well as support measures to manage impacts.

PI SCORE	**LOW RISK – Otter trawl; Danish seine**

2B: Endangered Threatened and/or Protected (ETP) Species

CRITERIA: (i) The UoA meets national and international requirements for protection of ETP species.
The UoA does not hinder recovery of ETP species.

(a) Effects of the UoA on populations/stocks **LOW RISK**

At least 135 ETP species are thought to occur in the area of the GABTS and were investigated in the Level 2 PSA (Daley et al. 2007). Of these, only 2 species were ranked as high risk:

1. White shark (*Carcharadon carcharias*)
2. Grey Nurse shark (*Carcharias taurus*)

Both of these species were included in Zhou et al's (2012) updated Level 3 SAFE assessment which found that no species within the GABTS was subject to a level of fishing mortality higher than selected sustainability reference points.

Amongst other ETP species groupings, records of the capture of or interaction with marine mammals and seabirds by GABTS vessels are very low (e.g., Knuckey and Brown, 2002). In 2016, two interactions with ETP species were reported: one seahorse and one shy albatross, both of which were dead. Four interactions were reported in 2015 (Moore et al, 2016). Two interactions were reported with shy albatross (*Thalassarche cauta*), both of which were reported to be dead. One interaction was reported with an unidentified

shearwater, which was reported to be dead. One interaction was reported with a New Zealand fur seal (*Arctocephalus forsteri*), which was reported to be alive. In 2014, only one interaction with an ETP species was recorded by fishers; a NZ Fur Seal (*Arctocephalus forsteri*) released alive after entanglement with net. No interactions were reported for 2013.

Three fish species that are also listed as *'conservation dependent'* under the EPBC Act and may be taken in the GABTS. These include:

- Orange Roughy (Hoplostethus atlanticus);
- School Shark (Galeorhinus galeus);
- Southern Dogfish (Centrophorus zeehaani)

Orange roughy is a deepwater species and not taken in association with the stocks assessed here. The species is subject to an Orange Roughy Rebuilding Strategy (AFMA, 2014b), which allows targeting only where stocks are estimated to be above 20% of unfished biomass. In the GABTS, areas where 96% of historical orange roughy catches have been taken are now closed to fishing (Moore and Koduah, 2017). Given that zero or negligible catch of orange roughy has been reported in the GABTS in recent years, Moore and Koduah (2017) conclude that the stock is not subject to overfishing.

School shark is considered overfished, although catch from the GABTS is not likely to hinder recovery of the species. School shark catch from the GABTS was an average of 1.8 t per year between 2000 and 2006 (Walker et al. 2006). Mortality from the GABTS is considered within the Rebuilding Strategy, and current total commercial fishing mortality is within the limits set by the revised Strategy (AFMA 2015b). In 2015, retained catch in the GABTS was only 1.3t (within an overall SESSF TAC of 215t). Accordingly, catches are within national limits and catches within the UoAs are highly unlikely to hinder recovery.

Gulper Sharks (Centrophoridae), including Southern dogfish, have historically been taken as a minor byproduct in the GABTS. Measures to recover stocks of southern dogfish are included in the Upper-Slope Dogfish Management Strategy (AFMA, 2012c), and are designed specifically to rebuild the populations of Harrisson's Dogfish and Southern Dogfish above a limit reference point (B_{LIM}) of B_{25} (25% of unfished biomass), in line with the Commonwealth Fisheries Harvest Strategy Policy. Measures include:

- extensive deepwater spatial closures, a number of which are specifically designed to protect the western stock of Southern Dogfish, and known populations of the central stock;
- move-on provisions with vessel interaction limits for upper-slope dogfish when fishing inside a closure, associated with a 12-month ban from the closure for the vessel reaching the limit; and;
- no retention of gulper sharks implemented across the whole fishery to remove any incentive to target the species (AFMA, 2012c).

The effects of the GABTS on Southern dogfish are relatively well-known, and zero retention limits have been set, monitored through the AFMA compliance system and the ISMP. On the basis that catches are likely to be compliant with the zero limits set and closures have been established with the specific aim of allowing stocks to recover to B_{25}, the know direct effects appear highly likely not to hinder recovery of this species.

Less specific information is available on interactions in the Danish seine sector, although no ETP species interactions were reported in either 2015 or 2016.

On the basis of the above evidence, it appears that current catches of ETP species in the UoAs are within national limits and highly unlikely to hinder recovery.

CRITERIA: (ii) The UoA has in place precautionary management strategies designed to:

- meet national and international requirements; and
- ensure the UoA does not hinder recovery of ETP species.

Also, the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of ETP species

(a) Management strategy in place

LOW RISK

Fishers are required to take all reasonable steps to avoid interactions with protected species (other than those listed as 'conservation dependent') and report all interactions in their logbooks. AFMA reports all interactions with protected species recorded in logbooks to the Commonwealth environment department on a quarterly basis and publishes summaries online.

For seabirds, the GABTS has had mandatory seabird management plans (SMPs) in place since 1 November 2011 for each vessel. This involves management of the discharge of offal, and the use of at least one mitigation device when fishing gear is in the water. The use of Warp deflectors (large floats attached in front of trawl warps to scare birds away—often called 'pinkies') has been mandatory since 2014. These devices have been shown to reduce heavy contact between actively feeding seabirds and warp wires by around 75 per cent (Pierre et al. 2014). More recently, South East Trawl Fishing Industry (SETFIA) led a trial of alternative seabird mitigation devices, including water sprayers and bird bafflers. SETFIA has reported that water sprayers and bird bafflers used in the trial reduced interactions between seabirds and the warp by 90 per cent and 96 per cent, respectively. Following the success of this trial, AFMA has announced that from 1 May 2017, all vessels in the Commonwealth Trawl Sector and GABTS fisheries must use one of the following mitigation devices: sprayers, bird bafflers or pinkies with zero discharge of fish waste.

For all overfished stocks listed under the EPBC Act as *'conservation dependent'*, formal stock rebuilding strategies have been introduced. These include:

- Orange Roughy (*Hoplostethus atlanticus*) Stock Rebuilding Strategy 2014 (AFMA, 2014b);
- School Shark (*Galeorhinus galeus*) Stock Rebuilding Strategy Revised 2015 (AFMA, 2015b);
- Upper-Slope Dogfish Management Strategy (AFMA, 2012c).

Rebuilding strategies are reviewed every five years to monitor the progress of rebuilding and ensure the continued effectiveness of management arrangements which have been implemented.

Together with other measures such as the ERM Strategy and ongoing monitoring through the ISMP, these measures form a strategy that is expected to ensure the UoAs do not hinder recovery of ETP species.

(b) Management strategy implementation **LOW RISK**

The broader impacts of the fishery on ETP species is screened through ERAs of increasing sophistication. The 'highest' level ERAs undertaken in the GAB to date have been a Level 3 SAFE assessment for teleost and chondrichthyan species (Zhou et al, 2012) and a Level 2 Residual Risk Assessment for other species (AFMA, 2012a). Where necessary, species specific investigations have been undertaken to support management measures for some ETP species (e.g. see references in AFMA, 2012b; AFMA, 2015b).

The outcomes of ERAs, together with compulsory logbook and observer information showing low rates of interaction and monitoring of recovery plans for overfished species demonstrating compliance with catch limits, provides an objective basis for confidence that the management measures outlined above at Scoring issue (ii)(a) are likely to work.

CRITERIA: (iii) Relevant information is collected to support the management of UoA impacts on ETP species, including:

- information for the development of the management strategy;
- information to assess the effectiveness of the
- management strategy; and
- information to determine the outcome status of ETP species.

(a) Information **LOW RISK**

The GABTS is a data-rich fishery, with quantitative information available to adequately assess the impact of the UoAs on ETP species. Information on ETP interactions in the GABTS comes from compulsory logbooks, independent scientific observers and targeted research (e.g. Pierre et al, 2014; Williams et al, 2012). Ecological risk assessments of increasing sophistication have been undertaken for all ETP species potentially encountered by the fishery (e.g. AFMA, 2012a; Zhou et al, 2012). A number of independent reviews of bycatch and discarding in the sector have also been undertaken (Knuckey & Brown 2002; Tuck et al. 2013). This information is adequate to assess the impact of the fishery on ETP species and support a strategy to manage impacts.

Limited specific information is available on interactions with ETP species in the Danish seine sector, although given the very low level of effort, compulsory logbook reporting and good knowledge of potential interactions in the otter trawl sector, this is probably sufficient to assess likely impacts and support an effective strategy to manage impacts.

PI SCORE	**LOW RISK - Otter trawl; Danish seine**

2C: Habitats

CRITERIA: (i) The UoA does not cause serious or irreversible harm to habitat structure and function, considered on the basis of the area(s) covered by the governance body(s) responsible for fisheries management

(a) Habitat status

Otter trawl **MEDIUM RISK**

It is recognised that when demersal trawl gear touches the bottom, damage may be done to the benthic environment and the communities that dwell there. Depending on the type of habitat, type of interaction, its duration and frequency; some areas may receive permanent damage while other areas will be able to recover in relatively short time periods. Damage to some habitats occurs with minimal trawling and will be long lasting due to the nature of the benthic organisms and the depth (e.g. biogenic habitat with vertical relief). Damage will, however, be restricted to areas trawled so that, the extent of any damage will be in proportion to the trawl footprint of the fishery.

Examples of "serious or irreversible harm" to habitats include the loss (extinction) of habitat types, depletion of key habitat forming species or associated species to the extent that they meet criteria for high risk of extinction, and significant alteration of habitat cover/mosaic that causes major change in the structure or diversity of the associated species assemblages (MSC, 2014).

The potential impact of the GABTS on habitats has been assessed through a series of ERAs (Daley et al, 2007), as well as dedicated research studies (e.g. Williams et al, 2011; 2013). In the 'highest' level ERA, 77 habitats were assessed at Level 2 using the habitat PSA analysis (Daley et al. 2007). Habitat types were classified based on substratum, geomorphology, and dominant fauna, using photographic data. Of the 77 habitat types, 21 were assessed to be at high risk, 32 medium, and 24 low. Of the 21 high-risk habitats, none were found on the inner shelf (0- 100 m), 8 were on the outer shelf (100-200 m), 5 were on the upper slope (200-700 m), and 8 were on the mid slope (700-1500 m). In 2016-17, around 95% of total fishing effort occurred on the continental shelf (0-200m), with very limited effort (591 trawl hours) on the continental slope (Moore and Koduah, 2017). High risk habitats on the outer shelf were mainly soft sediment seabed types characteristically dominated by large sponges and mixed epifauna, with bryozoan communities at the shelf break.

Williams et al. (2013) used data from the ERAs, logbooks, ISMP observers, a fishers' questionnaire and the CSIRO Seabed photographic/video database to develop multi-scale seabed maps that quantify habitat vulnerability in the GABTS fishing area. Vulnerable benthic habitats (VBH) were identified and the spatial overlap of fishing effort with these habitats was examined to evaluate likely risks. Based on the cumulative trawl footprint from 1986 to 2009, Williams et al (2013) estimated that 30,900km^2 of the available GABTS area of 143,346km^2 (or 21.6%) had been trawled at some point. Within the trawl footprint, around 10% was considered to be VBH, with around 50% of that now encompassed within spatial closures (i.e. much of this in continental slope orange roughy closure areas). In continental shelf waters where most effort occurs, three VBHs were identified with only limited protection (<6% of each) offered to each through spatial closures.

More recently, Pitcher et al (2016) examined the spatial overlap of trawl footprints in Australia's Commonwealth demersal trawl

fisheries with mapped seabed assemblages and areas of spatial management that exclude trawling. In the GABTS, they concluded that around 21.9% of the fishery area is closed to trawling, and the multi-year annual footprint of trawling covers only a small area (~4.9%) of the overall fishery area. Of 13 habitat assemblages identified, most were subject to very low levels of effort (<2% trawled) however, one habitat assemblage along the shelf-edge/upper slope was notably more exposed to trawling (34% annually; 59.1% swept). Pitcher et al (2016) noted that vulnerable habitat-forming benthos types do occur within this assemblage and are likely to be at risk where trawling occurs but actual risk at larger scale remains to be assessed quantitatively. They also note that sensitive habitats may or may not occur in trawl exposed areas and assessment of the actual level of risk in priority assemblages requires information on the occurrence and landscape distribution of habitats susceptible to trawl impacts, their resilience and recovery, and quantitative estimation of their status

Recent modelling on the impacts of fishing on the adjacent South East Marine Region (SEMR), which has historically been subject to higher levels of trawling effort from the SESSF Commonwealth Trawl Sector (CTS), appears to show relatively modest levels of impact on benthic habitats. Pitcher et al (2015) modelled the effects of fishing for 15 spatially unique species assemblages and 10 habitat-forming benthos taxa types in the SEMR. They concluded that *"the lowest total regional abundance (status) of habitat-forming benthos taxa types across the SEMR was ~80–93% of pre-trawl status, after effort peaked during 2000–2005. Subsequently, all taxa were predicted to recover by varying extents (~1–3%) in the following decade".* They also noted that reductions in trawl effort universally improved the status of habitat-forming benthos.

Accordingly, given the very low rates of predicted trawl coverage for the majority of benthic assemblages in the GABTS area there is a sound basis to conclude that for these habitats the fishery is highly unlikely to reduce habitat structure and function to the point of serious or irreversible harm. Nevertheless, one assemblage is exposed to higher rates of coverage and vulnerable habitat types within this assemblage are likely to be at higher risk. While modelling on rates of impact and recovery for this assemblage has not been undertaken, evidence from the adjacent SEMR, which has been subject to higher levels of effort, indicates relatively modest overall reductions in habitat-forming benthos, with recovery under lower levels of effort. On that basis, there is a plausible argument that the GABTS is unlikely to reduce habitat structure and function to the point of serious or irreversible harm, however the fishery would be better placed with quantitative modelling on benthic impact and recovery in the more exposed benthic assemblage.

Danish seine **LOW RISK**

Danish-seine targets Deepwater Flathead on the continental shelf. There is limited specific information on the habitat impacts of Danish seine gear in the GABTS, although seine gear is generally thought to have more limited impact on habitats than otter trawl gear (e.g. Grieve et al, 2014). Only one vessel operated in 2015-16 and 2016-17. Although detailed information is limited, given the very low level of effort, there is a plausible argument that it is highly unlikely the fishery will impact habitat structure and function to the point of serious or irreversible harm.

CRITERIA: (ii) There is a strategy in place that is designed to ensure the UoA does not pose a risk of serious or irreversible harm to the habitats.

(a) Management strategy in place **LOW RISK**

The main measures in place to limit habitat impacts in the fishery include spatial closures and gear restrictions. TACs on target species will also serve indirectly to limit effort in the fishery.

The Great Australian Bight region has numerous areas closed to the GABTS (Figure 6). The total area of the GAB is 1,025,083 km^2, however almost two thirds (645,981 km^2) of this region is > 1,300 m; these very deep waters are not currently commercial fished (and unlikely to be exploited in the short-medium term). Within the area available to trawl (i.e., < 1300 m), 9,860 km^2 (7%) is fully closed to trawling, and an additional 22,612 km^2 (+9% =16%) is within orange roughy closures (Williams et al, 2013). Pitcher et al (2016) calculated the overall area closed to trawling with the GABTS area at 21.9%.

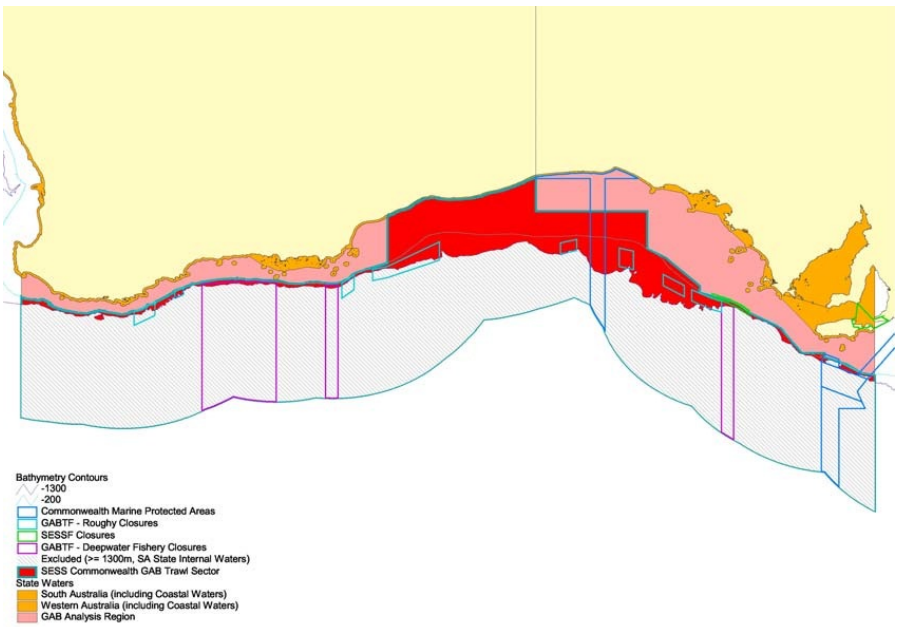

Figure 6: Map showing the area of the fishery available to Commonwealth trawl (red), the areas unavailable to trawling (pink and orange) including the Orange Roughy (OR) Management Zones (light blue) and marine reserves (Williams et al. 2013).

Fishing effort is monitored at a fine spatial scale through compulsory VMS, and likely habitat impacts have been evaluated through ERAs. Considerable collaborative research between scientists and industry has also been directed towards seabed mapping in the GAB including the identification of potentially vulnerable habitat types, as well as habitats likely to be important to fisheries production (Williams et al. 2013). More recently, targeted research has examined the spatial overlap of the trawl footprint with mapped seabed assemblages (Pitcher et al, 2016).

Although some uncertainty remains around the extent of spatial overlap on some VBH on the continental shelf, these measures consitute at least a partial strategy to ensure that the fishery does not result in serious or irreversible harm to habitat strutcure and function.

We also note that a draft management plan for Australian Marine Parks in the South-west Network was released for public comment in July 2017[3]. If implemented, spatial closures proposed under the plan would add to the levels of protection for some habitat types.

(b) Management strategy implementation MEDIUM RISK

The outcomes of Pitcher et al (2016) provide an objective basis for confidence that the proportion of most benthic assemblages exposed to trawling is very small (<2%) and the partial strategy in place will work. While there is more uncertainty around the single assemblage exposed to higher trawl coverage, recovery modelling in the adjacent SEMR (Pitcher et al, 2015) provides a plausible argument that the measures in place (gear restrictions, spatial closures, indirect effort limitation through TACs) will work. Accordingly, we have scored this SI medium risk.

CRITERIA: (iii) Information is adequate to determine the risk posed to the habitat by the UoA and the effectiveness of the strategy to manage impacts on the habitat.

(a) Information quality LOW RISK

The nature, distribution and vulnerability of the main habitats in the fishery are known. Williams et al. (2013) used data from the ERAs, logbooks, ISMP observers, a fishers' questionnaire and the CSIRO Seabed photographic/video database to develop multi-scale seabed maps that quantify habitat vulnerability in the GABTS fishing area. With the collaboration of GABFIA, Williams et al. (2013) successfully produced a credible, quality controlled, map-linked database of spatial information that covers the entire Great Australian Bight fishery in depths from the shoreline to 1300 m (an area of 360,000 km^2).

(b) Information and monitoring adequacy LOW RISK

Information to assess the impacts of the fishery on habitats types in the GAB includes:

- Level 2 PSA ERA (Daley et al. 2007)
- Monitoring by the ISMP (e.g. Tuck et al. 2013)
- Collaborative seabed mapping of the GAB region between scientists and industry (Williams et al. 2013); and
- VMS spatial effort information.

Considerable information is also available on the sedimentology and geomorphology of the GAB region (e.g. Richardson et al, 2005; Potter et al, 2006).

This information is adequate to identify the main impacts of the fishery on the main habitats. Information to detect any increased risk to habitats is collected through VMS monitoring as well as through the ISMP observer program which records habitat type and any interactions with substrate (e.g., catching benthic habitat species). The main information priority highlighted by the Pitcher et al (2016) study is to better quantify the actual impact of the fishery (in terms of impact and recovery) on the single benthic assemblage which is exposed to higher levels of trawl effort.

PI SCORE	LOW RISK – Otter trawl; Danish seine

2D: Ecosystems

CRITERIA: (i) The UoA does not cause serious or irreversible harm to the key elements of ecosystem structure and function.

(i)(a) Ecosystem Status LOW RISK

Serious or irreversible harm in the ecosystem context should be interpreted in relation to the capacity of the ecosystem to deliver ecosystem services (MSC, 2014). Examples include trophic cascades, severely truncated size composition of the ecological community, gross changes in species diversity of the ecological community, or changes in genetic diversity of species caused by selective fishing.

Impacts of the fishery at the community level were assessed by Daley et al (2007) through a Level 1 ERA. Six demersal and three pelagic communities were examined and impacts were assessed to be moderate or lower. Impacts at the community level were not assessed at Level 2 largely because the methodology for assessing communities at Level 2 was not yet developed.

Given the relatively limited impact of the fishery on ETP species and relatively small spatial footprint in the context of the overall fishery area, the main ecosystem level impacts may come from the removal of target and byproduct species from the ecosystem together with trophic impacts associated with discarding. Both main target stocks in the fishery (Deepwater Flathead and Bight Redfish) are currently assessed as being above B_{MSY}, while Zhou et al (2012) found that the current level of fishing mortality exhibited on all fish species is lower than the maximum sustainable fishing mortality. In relation to discards, Tuck et al (2013) reported that

[3] https://parksaustralia.gov.au/marine/parks/south-west/plans/

combined estimates of quota and non-quota species discards in the GABTS were between 30 and 60% in the early 2000s, but had reduced in more recent years based on logbook data. Daley et al (2007) reported that functional group composition is likely to be affected from an increase in abundance of scavenger species from enhanced food supply, although the consequences are likely to be minor with normal behaviour resuming within weeks.

Accordingly, given the healthy position of target stocks, the outcomes of the updated SAFE assessment in relation to impacts on non-target fish species, minor impacts on ETP species and low levels of effort generally, there is a reasonable basis to conclude that the UoAs are highly unlikely to disrupt the key elements of the ecosystem to the point where there would be serious or irreversible harm.

CRITERIA: (ii) There are measures in place to ensure the UoA does not pose a risk of serious or irreversible harm to ecosystem structure and function.

(a) Management Strategy in place **LOW RISK**

The main measures in place to monitor and manage ecosystem impacts from the fishery include:

- The SESSF Harvest Strategy Framework, designed to maintain quota managed species at levels above B_{MSY};
- The Ecological Risk Management Strategy for the SESSF, which sets out measures to limit and manage impacts on priority non-target species, habitats and communities
- Species specific rebuilding plans (e.g. orange roughy, school shark)
- Gear modification requirements (e.g. T90 mesh to minimise capture of juvenile target species and bycatch);
- Spatial closures;
- Ongoing monitoring (observer coverage and logbook assessment);
- Seabed mapping project in collaboration with fishers to identify the vulnerable habitats that are in trawlable areas.

Collectively these measures are likely to be considered at least a partial strategy that could be expected to restrain impacts of the fishery on the ecosystem so as to achieve the outcomes stated in criterion 2D(i).

(b) Management Strategy implementation **LOW RISK**

The outcomes the Level 1 ERA (Daley et al, 2007) which estimated only moderate impacts at the community level, stock assessments for the main target species (Deepwater Flathead and Bight Redfish) showing stocks are above B_{MSY} and the outcomes of the SAFE assessment (Zhou et al, 2012) showing levels of fishing mortality were below sustainable levels for all fish species provide an objective basis for confidence that the measures in place will work.

CRITERIA: (iii) There is adequate knowledge of the impacts of the UoA on the ecosystem.

(a) Information quality **LOW RISK**

Ecological risk assessments are a key aspect of implementing ecosystem-based fisheries management (EBFM) in the GABTS. Three types of ecological risk assessments have been undertaken:

- Level 1 (SICA) and Level 2 (PSA) ERAs (Daley et al. 2007);
- Residual Risk Assessment of the Level 2 Productivity Susceptibility Analysis (AFMA, 2012a); and
- Rapid quantitative sustainability assessment for fishing effects (SAFE), commonly known as the Rapid Level 3 assessment (Zhou et al. 2012).

Considerable information on ecosystem processes in the area of the GABTS has also been assembled to support the Commonwealth's South West marine reserve process (e.g. McClatchie et al, 2006).

In addition, there has been some trophic modelling in the UoA region (Bulman et al. 2010; Goldsworthy et al. 2013). Goldsworthy et al. (2013) modelled the eastern Great Australian Bight (EGAB) pelagic ecosystem, a region off the South Australian coast that includes continental shelf waters to 200 m depth to assess the level of ecological change with the growth of South Australia's Sardine fishery (mean catches 30,000 t). Some GABTS data was used in the model, although demersal species were not incorporated into the model. Goldsworthy et al. (2013) found that ecosystem indicators identified significant changes in the EGAB ecosystem between 1991 and 2008, the most significant of which was the 4.6-fold increase in total catch, which was entirely attributable to growth in the sardine fishery within southern Spencer Gulf and the Investigator Strait. Interestingly, most functional groups from cephalopods to small pelagic fish and high trophic level predators increased in biomass over the same period.

This information is adequate to broadly understand the key elements of the ecosystem and information provided through ongoing monitoring (logbooks; CDRs; observers) is likely to be sufficient to detect increased risk.

(b) Investigations of UoA impacts **LOW RISK**

The main impacts from the fishery can be inferred from the various levels of ERA, while a number of ecosystem impacts (e.g. habitat impacts – Williams et al, 2013, Pitcher et al, 2016; bycatch and discards - Knuckey et al. 2008; Tuck et al, 2013) have been investigated in detail.

PI SCORE	LOW RISK – Otter trawl; Danish seine

COMPONENT 3: Management system

3A: Governance and Policy

CRITERIA: (i) The management system exists within an appropriate and effective legal and/or customary framework which ensures that it:

- Is capable of delivering sustainability in the UoA(s)
- Observes the legal rights
- Created explicitly or established by custom of people dependent on fishing for food or livelihood.

(a) Compatibility of laws or standards with effective management **LOW RISK**

Relevant Australian Commonwealth Acts, subsidiary legislation and cooperative instruments, including the EPBC Act 1999, Fisheries Management Act (FMA), Fisheries Administration Act (FAA) provide an effective legal framework for the purposes of delivering management outcomes consistent with Components 1 and 2. The FMA takes account of the United Nations Fish Stocks Agreement and FAO's Code of Conduct for Responsible Fisheries.

(b) Respect for Rights **LOW RISK**

The management system has a mechanism to formally commit to the legal rights created explicitly or established by custom on people dependent on fishing for food and livelihood. The Commonwealth Native Title Act 1993 formally commits to the rights of indigenous people who can demonstrate their customary rights to fish in a particular area. This legislation provides a mechanism for the making of binding decisions about native title rights to areas of land and water and thereby ensures access to fish resources for people who depend on fishing for their food. AFMA's jurisdiction typically begins three nautical miles offshore, thus, there is usually no overlap between Commonwealth commercial fishing and customary fishing activity. However, for some fisheries, consideration of customary fishing is largely made through interaction between AFMA's management and the Native Title Act 1993. Where AFMA modifies an act, a direction or other legislative instrument in a way that may affect native title, that change triggers the 'future act' provision of the Native Title Act 1993. In situations where a future act provision could possibly be triggered, AFMA provides the opportunity for relevant native title bodies to be consulted and provide comment. In addition, Fisheries Legislation Amendment (Representation) Bill 2017 is currently before the Commonwealth parliament. The Bill provides for explicit recognition of recreational and Indigenous fishers in Commonwealth legislation and requires AFMA to have regard to ensuring that the interests of all fisheries users are taken into account in Commonwealth fisheries management decisions[4].

Given the above, the management system has a mechanism to observe the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood.

CRITERIA: (ii) The management system has effective consultation processes that are open to interested and affected parties. The roles and responsibilities of organisations and individuals who are involved in the management process are clear and understood by all relevant parties.

(a) Roles and Responsibilities **LOW RISK**

The roles and responsibilities of the main people (e.g. Fisheries Minister, AFMA Commissioners) and organisations (AFMA) involved in the Australian Commonwealth fisheries management process are well-understood, with relationships and key powers explicitly defined in legislation (e.g. FMA, FAA) or relevant policy statements (e.g. AFMA Fisheries Management Paper 1 – Management Advisory Committees). There is a Management Advisory Committee (GABMAC) and Resource Assessment Group (GABRAG) relating to the GABTS.

(b) Consultation Process **LOW RISK**

The management system includes consultation processes that regularly seek and accept relevant information, including local knowledge. The management system demonstrates consideration of the information and explains how it is used or not used.

Resource assessment groups (RAGs) are the bodies responsible for providing scientific advice to the management advisory committees (MACs) and the AFMA Commission on the status of fish stocks, sub-stocks, species (target and non-target), and the impact of fishing on the marine environment. They coordinate, evaluate and regularly undertake fishery assessments, and provide recommendations on issues such as the setting of total allowable catches, stock rebuilding targets, and biological reference points. Membership of the RAGs comprises representatives from the areas of fisheries management, research, industry, fisheries economics and conservation. The broad membership ensures that, in addition to scientific information on each fish stock, industry knowledge and developments in management strategies, market prices and the costs of harvesting are also taken into account.

MACs are the main advisory bodies to AFMA. They provide advice on a variety of issues including fisheries management arrangements, research, and compliance/management costs. The MACs also provide a link between AFMA and those with an interest in the fishery, with membership generally comprising members from commercial industry, fisheries management, the scientific community, the environment/conservation sector and, in some instances, the State governments.

Under the FMA, 'plans of management', or fisheries management plans (FMPs) as they are known, are the way arrangements are set for each fishery. The FMA requires consultation with the public on draft FMPs and provides for ministerial oversight. Under the Act AFMA must set out in writing a FMP for each fishery or, likewise in writing, explain why one is not needed and provide draft plans for public display so interested persons can make representations.

CRITERIA: (iii) The management policy has clear long-term objectives to guide decision making that are consistent with the outcomes expressed by Components 1 and 2, and incorporates the precautionary approach.

(a) Objectives **LOW RISK**

[4] http://www.aph.gov.au/Parliamentary_Business/Bills_Legislation/bd/bd1617a/17bd090

The long term objectives of the management system are specified in the FMA and the EPBC Act, and further defined in the Commonwealth Fisheries Harvest Strategy Policy and Guidelines. The objectives and policy guidance are consistent with Components 1 and 2 and explicitly require application of the precautionary principle. The fishery is also subject to the Commonwealth EPBC Act, which requires periodic assessment against the Guidelines for the Ecologically Sustainable Management of Fisheries. These Guidelines are consistent with the Components 1 and 2 and encourage practical application of the ecosystem approach to fisheries management.

PI SCORE	LOW RISK

3B: Fishery Specific Management System

CRITERIA: (i) The fishery specific management system has clear, specific objectives designed to achieve the outcomes expressed by Components 1 and 2.

(a) Objectives **LOW RISK**

The fisheries management system contains well-defined and measurable short and long term objectives, which are consistent with achieving the outcomes expressed by Components 1 and 2. The SESSF Management Plan 2003 (amended in 2009) reinforces the objectives of the FMA as the objectives of the Plan. Fishery specific objectives can be identified in the Harvest Strategy and ERM Strategy documents. The current SESSF HSF applies to all sectors and all species.

These documents include both short and long term objectives which are consistent with Components 1 and 2 and are explicit within the management system.

CRITERIA: (ii) The fishery specific management system includes effective decision making processes that result in measures and strategies to achieve the objectives and has an appropriate approach to actual disputes in the fishery.

(a) Decision making **LOW RISK**

Australia's Commonwealth fisheries decision making process is well established and set out explicitly in relevant legislation (e.g. FMA, FAA) and policy documents (e.g. Looking to the Future, Commonwealth Harvest Strategy Policy). The decision making processes by AFMA based on advice from GABMAC, working with GABRAG, are transparent with feedback provided by the Commission directly to GABMAC and to stakeholders through media such as the regular AFMA Update and through the annual public meeting of both the MAC and AFMA. There are numerous examples in the last decade of the GABTS management system responding to serious and other matters (e.g. TACC adjustments based on the harvest strategy, ERM reports based on the outcomes of ERAs, orange roughy closures, introduction of T90 codends, seabird management plans, etc).

(c) Accountability and Transparency **LOW RISK**

The AFMA website contains an extensive list of evaluations, research reports and assessments, and evidence exists within the GABMAC and the GABRAG that decisions respond to these findings. GABMAC and GABRAG meeting minutes are also available online. AFMA provide monthly and annual reports, which outline program outcomes and, provide a means for measuring success. Information about the fishery is also available through annually produced Australian Bureau of Agricultural and Resource Economics and Science (ABARES) Fishery Status Reports.

CRITERIA: (iii) Monitoring, control and surveillance mechanisms ensure the management measures in the fishery are enforced and complied with.

(a) MCS Implementation **LOW RISK**

AFMA's framework for its National (Domestic) Compliance and Enforcement Program is set out in the AFMA National Compliance Operations and Enforcement Policy (AFMA, 2015c). The policy is compliant with the Australian Fisheries National Compliance Strategy 2010-15 and aims to "effectively deter illegal fishing in Commonwealth fisheries and the Australian Fishing Zone". Compliance activities are informed by risk assessments undertaken in accordance with the international standard for risk management (ISO 31000:2009) across all major Commonwealth domestic fisheries (AFMA, 2015f). Compliance operations are supported through a centralised structure with separate Intelligence, Planning and Operations units.

More specific annual compliance priorities and risk treatments are set out in AFMA's National Compliance and Enforcement Program 2016 -17 (AFMA, 2015d). Key priorities for 2016-17 include (i) failure to have a Vessel Monitoring System (VMS) or Electronic Monitoring (emonitoring) system operating at all times, (ii) quota evasion and (iii) bycatch mishandling, which has been identified as an emerging risk. Risks are treated through a program of general deterrence (i.e. inspections and patrols designed to target identified high risk ports, boats and fish receivers), and other targeted measures – e.g. physical and technical surveillance, standard investigative activity, intelligence gathering, and media strategies. Compliance Risk Management Teams (CRMTs) may be formed to help address priority risks (e.g. VMS/electronic monitoring offences; quota evasion). All vessels in the GABTS operate with e-logbooks.

These measures constitute a system which has demonstrated an ability to enforce management measures.

(b) Sanctions and Compliance **LOW RISK**

A framework of sanctions for non-compliance is set out in the FMA, Maritime Powers Act 2013 and Fisheries Management Regulations 1992. These include powers to issue warnings, cautions, directions, Observer Compliance Notices, Commonwealth Fisheries Infringement Notices (CFINs), amend fishing concession conditions, suspend or cancel fishing concessions and prosecute offenders through the courts (AFMA, 2015c). Some evidence exists that fishers comply with the management system including providing

information of importance to the effective management of the fishery. Across all years between 2011-12 and 2015-16, no action was required in >90% of boat inspections in Commonwealth fisheries (total inspections 879) (AFMA, 2015d). A 2013 audit of the management of the AFMA Domestic Compliance system did not highlight systematic non-compliance (ANAO, 2013).

CRITERIA: (iv) There is a system for monitoring and evaluating the performance of the fishery specific management system against its objectives.
There is effective and timely review of the fishery specific management system.

(a) Evaluation coverage **LOW RISK**

Measures are in place to evaluate the key parts of the management system including monitoring of the effectiveness of the SESSF harvest strategy for target species, and periodic reviews of ERAs and ERM Strategy documents for non-target species. The outcomes of review processes are considered through the consultative mechanisms underpinning management of the fishery (e.g. GABRAG; GABMAC). In addition, annually produced ABARES *Fishery Status Reports* provide an independent evaluation of the biological, economic and environmental status of fish stocks managed solely or jointly by AFMA. The reports also examine the broader impact of fisheries on the environment, informed by the requirements of the *Fisheries Management Act 1991* and the *Environment Protection and Biodiversity Conservation Act 1999*.

(b) Internal and/or external review **LOW RISK**

The fishery-specific management system is subject to regular internal review through the GABMAC process, which tracks performance of the fishery against the objectives in the Management Plan. AFMA is also required to report in its Annual Report on overall performance against the legislative objectives, statutory requirements and financial reporting, the effectiveness of internal controls and adequacy of the Authority's risk management processes.

The fishery is subject to regular external assessment through the ongoing assessment for export approval under the EPBC Act against the *Guidelines for the Ecologically Sustainable Management of Fisheries*.

PI SCORE	LOW RISK

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