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Ecological Risk Assessment for Effects of Fishing

Final Report for the Demersal Longline sub-fishery of the Heard Island and McDonald Islands Fishery 2010/11-2014/15

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Notes to this document:

This fishery ERA Report document contains figures and tables with numbers that correspond to the full methodology document for the ERAEF method:

> Hobday, A. J., A. Smith, H. Webb, R. Daley, S. Wayte, C. Bulman, J. Dowdney, A. Williams, M. Sporcic, J. Dambacher, M. Fuller, T. Walker. (2007) Ecological Risk Assessment for the Effects of Fishing: Methodology. Report R04/1072 for the Australian Fisheries Management Authority, Canberra

Thus, table and figure numbers within the fishery ERA Report document are not sequential as not all are relevant to the fishery ERA Report results.

Additional details on the rationale and the background to the methods development are contained in the ERAEF Final Report:

> Smith, A., A. Hobday, H. Webb, R. Daley, S. Wayte, C. Bulman, J. Dowdney, A. Williams, M. Sporcic, J. Dambacher, M. Fuller, D. Furlani, T. Walker. (2007) Ecological Risk Assessment for the Effects of Fishing: Final Report R04/1072 for the Australian Fisheries Management Authority, Canberra.

This document also reflects some changes in methods that are detailed in AFMA's ERA guide (2016).

> Australian Fisheries Management Authority (2016). Draft Guide to AFMA's Ecological Risk Management. 130 pp. (Commonwealth of Australia, Canberra).

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Acknowledgments

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Executive summary

This assessment of the ecological impacts of the Heard Island and McDonald Islands Demersal Longline Fishery for the fishing seasons 2010/11-2014/15 was undertaken using the ERAEF method version 9.2. ERAEF stands for "Ecological Risk Assessment for Effect of Fishing", and was developed jointly by CSIRO Marine and Atmospheric Research, and the Australian Fisheries Management Authority. ERAEF provides a hierarchical framework for a comprehensive assessment of the ecological risks arising from fishing, with impacts assessed against five ecological components – target species; by-product and by-catch species; threatened, endangered and protected (TEP) species; habitats; and (ecological) communities.

ERAEF proceeds through four stages of analysis: scoping; an expert judgement based Level 1 analysis (SICA – Scale Intensity Consequence Analysis); an empirically based Level 2 analysis (PSA – Productivity Susceptibility Analysis); and a model based Level 3 analysis. This hierarchical approach provides a cost-efficient way of screening hazards, with increasing time and attention paid only to those hazards that are not eliminated at lower levels in the analysis. Risk management responses may be identified at any level in the analysis.

Application of the ERAEF methods to a fishery can be thought of as a set of screening or prioritization steps that work towards a full quantitative ecological risk assessment. At the start of the process, all components are assumed to be at high risk. Each step, or Level, potentially screens out issues that are of low concern. The Scoping stage screens out activities that do not occur in the fishery. Level 1 screens out activities that are judged to have low impact, and potentially screens out whole ecological components as well. Level 2 is a screening or prioritization process for individual species, habitats and communities at risk from direct impacts of fishing. The Level 2 methods do not provide absolute measures of risk. Instead they combine information on productivity and exposure to fishing to assess potential risk – the term used at Level 2 is risk. Because of the precautionary approach to uncertainty, there will be more false positives than false negatives at Level 2, and the list of high risk species or habitats should not be interpreted as all being at high risk from fishing. Level 2 is a screening process to identify species or habitats that require further investigation. Some of these may require only a little further investigation to identify them as a false positive; for some of them managers and industry may decide to implement a management response; others will require further analysis using Level 3 methods, which do assess absolute levels of risk.

This assessment of the Heard Island and McDonald Islands Demersal Longline Fishery includes the following:

- Scoping
- Level 1 results for all components

Fishery Description

Gear: Demersal longline (autoline)

Area: Heard Island and McDonald Islands Fishery

Depth range: av. depth ~1200m, 500–2000 m

Fleet size: 2-6 vessels

Effort: 4-16 million hooks

Landings: 1381t in 2010/11-4020t in 2014/15

Bycatch rate: 6-13%

Target species: Patagonian toothfish

Management: Quota management system for 1 species/stocks and catch limits on 6 bycatch species/groups

Observer program: Observer program operating since beginning of fishery in 1997

Table 2.1 Stock and other related assessments and status of key commercial and bycatch species in the HIMI longline sub-fishery.

Role in fishery	Common name, scientific name	Stock status (ABARES[1])	Year last assessed	Data included and/or Source
Key commercial	Patagonian toothfish *Dissostichus eleginoides*	Not subject to overfishing Not overfished	2015	RSTS 2014/15; 2009-2014 fishery data. CCAMLR 2015b
Bycatch	Unicorn icefish *Channichthys rhinoceratus*		2015	RSTS 2013/14 WG-FSA-15/50
	Grey rockcod *Lepidonotothen squamifrons*		1998	SC-CAMLR-XVII, Annex 5, 4.204 to 4.206.
			2015	Maschette (2015) Maschette *et al*. 2015
	Skates and rays*		1997	SC-CAMLR-XVI, 5.119 to 5.122
			2014	1997 (2003 for longline)-2014: Nowara *et al.* 2017
	Macrourus caml and *M. whitsoni*		2015	RSTS 2013/14 WG-FSA-15/50 and 15/63
	M. halotrachys and *M. carinatus*		2003	CCAMLR 2015a, 2015b

[1]Patterson and Skirtun (2015) * N.B. Assessment for skates and rays has been updated recently 2017

Ecological Units Assessed

Table 2.2 Comparison of ecological units assessed in 2016 and 2006 SICA analyses

COMPONENT	UNITS ASSESSED IN 2016	UNITS ASSESSED IN 2006
Key commercial species	-	1
By-product/bycatch species	1/88	17/ 1
Protected species	37	84
Habitats	2 pelagic	-
Communities	7 benthic/3 pelagic	6 benthic/3 pelagic

Level 1 Results

The key commercial component for the direct impact of fishing was not assessed because the Patagonian toothfish has an biennial stock assessment, equivalent of a level 3 assessment (quantitative stock assessment)(Table 1.2). Other hazards of this component were assessed but all were low risk.

Benthic habitats for this fishery were also not assessed because a comprehensive habitat assessment was conducted recently (Welsford et al. 2014). However, hazards impacting two pelgaic habitats were assessed (Table 1.3) but all were low risk.

Risk scores ranged from 1 - 3 across all 32 hazards (fishing activities) considered for the five ecological components assessed. Most hazards were eliminated at Level 1 (risk scores 1 or 2). One hazard had risk scores of $\geq$3:

Fishing (direct impact with capture on community component)

No external hazards had risk scores of $\geq$3 for any of the five components.

Table 2.3 Outcomes of assessments for ecological components conducted or *triggered in 2016 and 2006

ECOLOGICAL COMPONENT	2016	2006
Key/secondary commercial species	Level 1	Level 2
Byproduct and bycatch	Level 1	Level 2
Protected species	Level 1	Level 1
Habitats	Level 1[#]	-
Communities	Level 2*	Level 2*

[#]Partial assessment-pelagic only. Benthic assessment by Welsford *et al.* 2014. - No habitat assessments were conducted in 2006

*triggered but due to lack of methodology available in 2006 and ecosystem modelling projects underway in 2016 this component was not assessed at L2 in the ERA process.

Four of the five ecological components were eliminated at Level 1 (Table ES1.3). The rate of byproduct/bycatch has been low in this fishery and the catches of these species were generally 10-50% of the catch limit. For protected species, stringent seabird bycatch mitigation measures are employed by the fishery when setting and hauling gear have resulted in very low mortality rates of seabirds. The worst case scenario considered was the impact of capture fishing on the giant petrels and black-browed albatross. These species are all listed as endangered, and the Black browed albatross has the smallest population of all seabirds found within the HIMI region. No Black- browed albatross were caught. Five giant petrels were caught but it was not considered that this level of mortality would adversely affect either of these two species. The Southern Elephant Seals were also considered because 13 were captured in longlining operations. It is listed as Vulnerbale despite the population at Heard Island is >200,000 and considered to be stable but the species is unable to be de-listed due to lack of data.

The component assessed at risk (from direct impact of capture) was community, as a result of lack of knowledge of the broader ecosystem consequences of removal of toothfish, particularly the larger-sized fish. However, an ensemble of ecosystem models e.g. size-based models, SEAPODYM, EwE and Atlantis, for the Kerguelen Axis which includes the HIMI region, are currently being developed and will enable exploration and assessment of the broader ecosystem effects of fishing in the near future. Also, CCAMLR decision rules that apply to the HIMI Fishery pertaining to sustainable catch levels take into account predator-prey relationships and associated trophic requirements.

Summary

Compared to the previous assessment, the fishing effort in the longline fishery has increased and is now the major method for capture of Patagonian toothfish. Nevertheless, the assessment of the fishery remains similar or better than the previous assessment. More research and improved methodology has provided better stock assessments of both the key commercial species as well as the minor species although a high variability in the latter contribute to uncertainty (see Table ES1.1). Ongoing stringent mitigation measures to reduce incidental bycatch of birds have also resulted in maintaining low mortality rates. However, elephant seals were more frequently killed in the fishery but not at a rate that would impact its population. However it was recommended by the Threatened Species Committee that the population be more closely monitored. The rate of removal of non-target species is very low and unlikely to impact the communities. The removal of Patagonian toothfish from communities has been considered in the precautionary TAC setting process which accounts for uncertainties around the removal of target species . The reduction in catch of skates and rays to less than 25% of that in the previous assessment is significant, resulting in a downgrading of the consequence score for byproduct/bycatch species. However, continuation of the very recent increase in effort in this fishery may impact the skates in future and should be flagged for future monitoring.

Compared to the previous assessment, the risk for translocation of species (via bait) was also reduced. The risks associated with frozen bait are assessed by AQIS, and bait bought in Australia is licenced. Although much of the bait is actually bought outside Australia, the consequence was downgraded in the absence of any evidence to suggest there had been adverse consequences on the species, or more broadly on the communities, from introduced pathogens since the beginning of the longline fishery in 2003.

Compared to the previous assessment, the threat of impact from IUU fishing has been significantly reduced with no reports of IUU activity in the HIMI or adjacent French Division 58.5.1 during the assessment period.

Managing identified risks

Using the results of the ecological risk assessment, the next steps are usually to consider and implement appropriate management responses to address these risks. To ensure a consistent process for responding to the ERA outcomes, AFMA has developed an Ecological Risk Management (ERM) framework.

For the HIMI fishery, the current research and development of ecosystem models for the Kerguelen Axis, which includes the HIMI region, we assume will address concerns about the broader ecosystem effects of fishing relevant to the risk identified to the community component.

These results have been presented and discussed with stakeholders, an important step in the ERAEF process.

1 Overview

1.1 Ecological Risk Assessment for the Effects of Fishing (ERAEF) Framework

1.1.1 The Hierarchical Approach

The Ecological Risk Assessment for the Effects of Fishing (ERAEF) framework involves a hierarchical approach that moves from a comprehensive but largely qualitative analysis of risk at Level 1, through a more focused and semi-quantitative approach at Level 2, to a highly focused and fully quantitative "model-based" approach at Level 3 (Figure 1.1). This approach is efficient because many potential risks are screened out at Level 1, so that the more intensive and quantitative analyses at Level 2 (and ultimately at Level 3) are limited to a subset of the higher risk activities associated with fishing. It also leads to rapid identification of high-risk activities, which in turn can lead to immediate remedial action (risk management response). The ERAEF approach is also precautionary, in the sense that risks will be scored high in the absence of information, evidence or logical argument to the contrary.

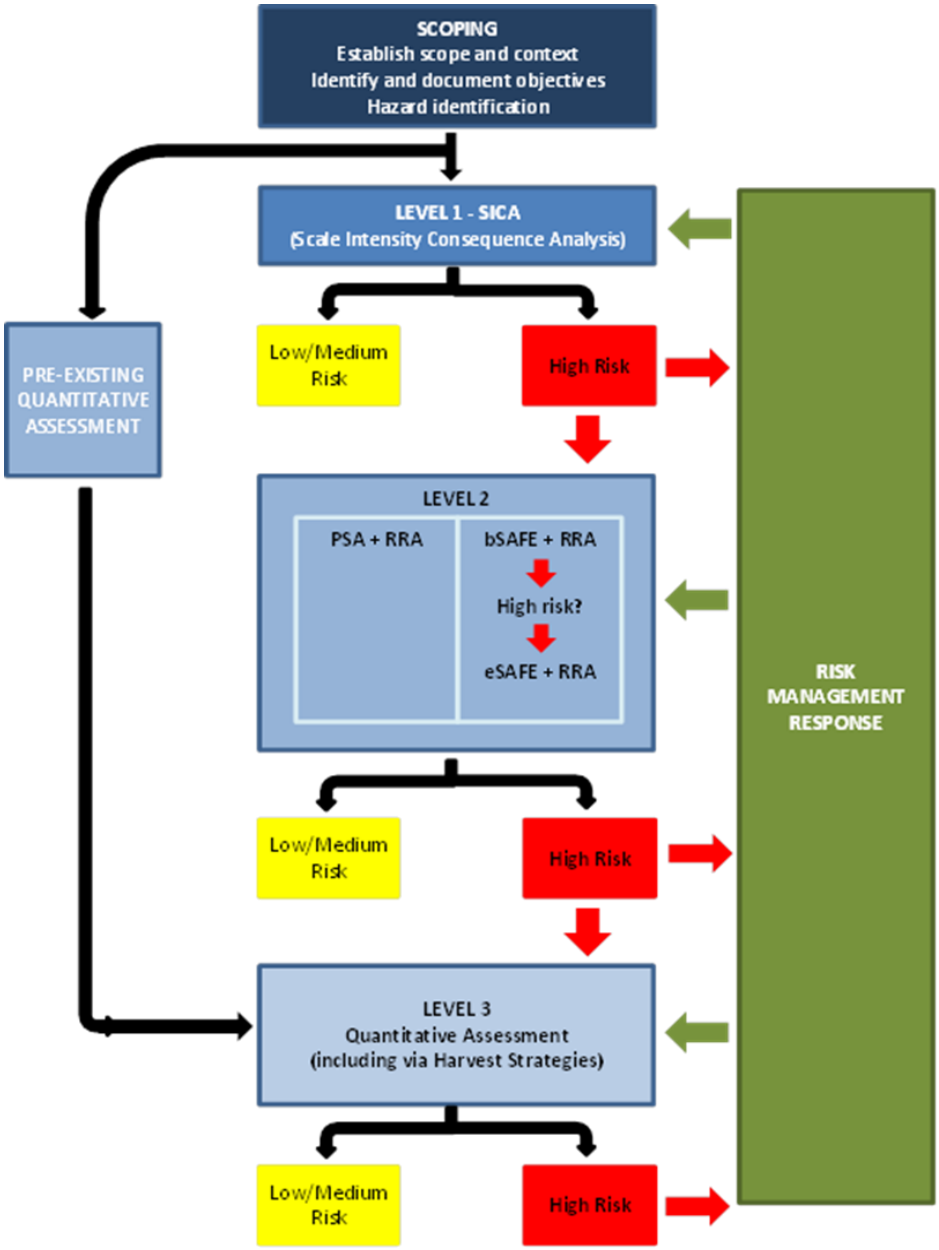


Figure 1.1. Structure of the 3 level hierarchical ERAEF methodology. SICA – Scale Intensity Consequence Analysis; PSA – Productivity Susceptibility Analysis; SAFE – Sustainability Assessment for Fishing Effects; RRA – Residual Risk Analysis. T1 – Tier 1. eSAFE may be used for species classified as high risk by bSAFE.

Conceptual Model

The approach makes use of a general conceptual model of how fishing impacts on ecological systems, which is used as the basis for the risk assessment evaluations at each level of analysis (Levels 1-3). For the ERAEF approach, five general ecological component are evaluated, corresponding to five areas of focus in evaluating impacts of fishing for strategic assessment under EPBC legislation. The five revised *components* are:

- Key commercial species and secondary commercial species
- Byproduct and bycatch species
- Protected[1] species (formerly referred to as threatened, endangered and protected[2] species or TEPs)
- Habitats
- Ecological comunities

This conceptual model (Figure 1.2) progresses from *fishery characteristics* of the fishery or sub-fishery, → *fishing activities* associated with fishing and *external activities*, which may impact the five ecological components (target, byproduct and bycatch species, protected species, habitats, and communities); → *effects of fishing and external activities* which are the direct impacts of fishing and external activities; → *natural processes and resources* that are affected by the impacts of fishing and external activities; → *sub-components* which are affected by impacts to natural processes and resources; → *components*, which are affected by impacts to the sub-components. Impacts to the sub-components and components in turn affect achievement of management objectives.

[1] The term "protected species" refers to species listed under [Part 13] of the EPBC Act (1999) and replaces the term "Threatened, endangered and protected species (TEPs)" commonly used in past Commonwealth (including AFMA) documents.

[2] Note "protected" (with small "p") refers to all species covered by the EPBC Act (1999) while "Protected" (capital P) refers only to those protected species that are threatened (vulnerable, endangered or critically endangered).

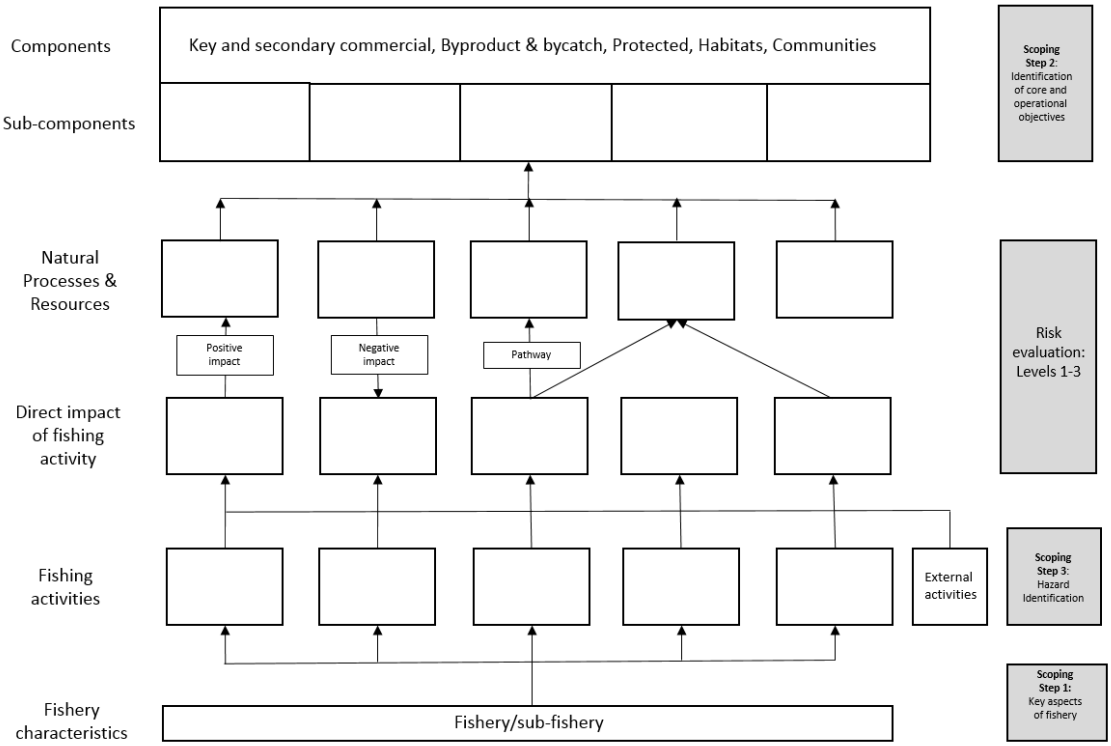


Figure 1.2. Generic conceptual model used in ERAEF.

The external activities that may impact the fishery objectives are also identified at the Scoping stage and evaluated at Level 1. This provides information on the additional impacts on the ecological components being evaluated, even though management of the external activities is outside the scope of management for that fishery.

The assessment of risk at each level takes into account current management strategies and arrangements. A crucial process in the risk assessment framework is to document the rationale behind assessments and decisions at each step in the analysis. The decision to proceed to subsequent levels depends on

- Estimated risk at the previous level
- Availability of data to proceed to the next level
- Management response (e.g. if the risk is high but immediate changes to management regulations or fishing practices will reduce the risk, then analysis at the next level may be unnecessary).

1.1.2 ERAEF stakeholder engagement process

A recognized part of conventional risk assessment is the involvement of stakeholders involved in the activities being assessed. Stakeholders can make an important

contribution by providing expert judgment, fishery-specific and ecological knowledge, and process and outcome ownership. The ERAEF method also relies on stakeholder involvement at each stage in the process, as outlined below. Stakeholder interactions are recorded.

1.1.3 Scoping

In the first instance, scoping is based on review of existing documents and information, with much of it collected and completed to a draft stage prior to full stakeholder involvement. This provides all the stakeholders with information on the relevant background issues. Three key outputs are required from the scoping, each requiring stakeholder input.

Identification of units of analysis (species, habitats and communities) potentially impacted by fishery activities (Section 2.2.2; Scoping Documents S2A, S2B1, S2B2 and S2C1, S2C2).

Selection of objectives (Section 2.2.3; Scoping Document S3). The primary objective to be pursued for species assessed under ERAF is that of ensuring populations are maintained at biomass levels above which recruitment failure is likely, as stated in Chapter 2 (AFMA (2016), ERM Guide). This is consistent with current legislation and fisheries policies and represents a change from when the ERAEF was first developed and there was less policy or legislation based guidance on sustainability objectives, with stakeholders able to choose from a range of "sustainability" objectives (eg: tables 5A-C in Hobday et al. 2007).

Selection of activities (hazards) (Section 2.2.4; Scoping Document S4) that occur in the sub-fishery is made using a checklist of potential activities provided. The checklist was developed following extensive review, and allows repeatability between fisheries. Additional activities raised by the stakeholders can be included in this checklist (and would feed back into the original checklist). The background information and consultation with the stakeholders is used to finalize the set of activities. Many activities will be self-evident (e.g. fishing, which obviously occurs), but for others, expert or anecdotal evidence may be required.

1.1.4 Level 1. SICA (Scale, Intensity, Consequence Analysis)

The SICA analysis evaluates the risk to ecological components resulting from the stakeholder-agreed set of activities. Evaluation of the temporal and spatial scale, intensity, sub-component, unit of analysis, and credible scenario (consequence for a sub-component) should be prepared by the draft fishery ERAF report author and reviewed at an appropriate stakeholder meeting (e.g. Resource Assessment Group

meeting). Due to the number of activities (up to 24) in each of five components (resulting in up to 120 SICA elements), preparation before involving the full set of stakeholders may allow time and attention to be focused on the uncertain or controversial or high risk elements. Documenting the rationale for each SICA element ahead of time for the straw-man scenarios is crucial to allow the workshop debate to focus on the right portions of the logical progression that resulted in the consequence score.

SICA elements are scored on a scale of 1 to 6 (negligible to extreme) using a "plausible worst case" approach (see ERAEF Methods Document for details; Smith et al. 2007). Level 1 analysis potentially result in the elimination of activities (hazards) and in some cases whole components. Any SICA element that scores 2 or less is documented, but not considered further for analysis or management response.

1.1.5 Level 2. PSA and SAFE (semi-quantitative and quantitative methods)

When the risk of an activity at Level 1 (SICA) on a species component is moderate or higher and no planned management interventions that would remove this risk are identified, an assessment is required at Level 2 (to determine if the risk is real and provide further information on the risk). The tools used to assess risk at Level 2 allow units (e.g. all individual species) within any of the ecological species components (e.g. key/secondary commercial, byproduct/bycatch, and protected species) to be effectively and comprehensively screened for risk. The analysis units are identified at the scoping stage. To date, Level 2 tools have been designed to measure risk from direct impacts of fishing only (i.e. risk of overfishing, leading to an overfished fishery), which in all assessments to date has been the hazard with the greatest risks identified at Level 1[3].

In the period since the first ERAEF was implemented across Commonwealth fisheries, much of the management focus has been on the assessment results associated with Level 2 and Level 2.5 or 3 risk assessment methods, which comprise semi-quantitative or rapid simple quantitative methods (e.g. PSA and SAFE). This level has been subject to the greatest level of change and improvement which are discussed in the following sections. Additional improvements are being developed for implementation in the near future (see Chapter 4.13 of AFMA ERM Guide, AFMA (2016)).

[3] Future iterations of the methodology will include PSAs modified to measure the risk due to other activities, such as gear loss.

Level 2 was originally designed to rely on a single risk assessment methodology, the Productivity-Susceptibility Analysis (PSA) (see Chapter 4.8.3 of AFMA ERM Guide, AFMA (2016)), however a more quantitative method called the Sustainability Assessment for Fishing Effects (SAFE) (see Chapter 4.8.4 of AFMA ERM Guide, AFMA (2016)) was developed early in the implementation of the ERAEF and classed as a Level 2.5 or Level 3 tool.

Under the revised ERAEF:

- bSAFE has now been reclassified as the preferred Level 2 method (over PSA) where sufficient spatial and biological data (to support bSAFE) are available. Typically this has been used for teleost and chondricthyan species.
- Species estimated to be at high risk under bSAFE may then be assessed under eSAFE which may provide reduced estimates of uncertainty pertaining to the actual risk.
- Where either the data or species biological characteristics are insufficient to support bSAFE analyses, it is recommended that PSA be applied instead. This will be the case for many protected species, invertebrate bycatch species and some other species.

At Level 2, either PSA or SAFE methods should be applied to any given species, not both.

For high risk species it is a management choice whether to progress to eSAFE, pursue a Level 3 fully quantitative stock assessment, or to take more immediate management action to reduce the risk. The types of considerations required in making that choice (ie: moving up the ERAEF assessment hierarchy or taking direct management action) are outlined in Chapter 5.5 of the AFMA ERM Guide (AFMA (2016).

It is also recognised that a number of additional tools, including some of the “data poor” assessment tools that are used to inform harvest strategies, could potentially be included within the Level 2 toolkit. They are distinguished from Level 3 quantitative tools (i.e. stock assessment models) that are more data rich and able to more precisely quantify uncertainty.

PSA (Productivity Susceptibility Analysis))

Details of the PSA method are described in the accompanying ERAEF Methods Document and also summarised in Section 4.8.3 of the AFMA ERM Guide (AFMA 2016). Stakeholders can provide input and suggestions on appropriate attributes, including novel ones, for evaluating risk in the specific fishery. Attribute values for many of the units (e.g. age at maturity, depth range, mean trophic level) can be obtained from published literature and other resources (e.g. scientific experts) without initial stakeholder involvement. Stakeholder input is required after preliminary attribute

values are obtained. In particular, where information is missing, expert opinion can be used to derive the most “reasonable” conservative estimate. For example, if species attribute values for annual fecundity have been categorized as low, medium or high on the set (<5, 5-500, >500), estimates for species with no data can still be made. Also, estimated fecundity of a broadcast-spawning fish species with unknown fecundity is still likely to be greater than the high fecundity category (>500). Susceptibility attribute estimates, such as “fraction alive when landed”, can also be made based on input from experts such as scientific observers. Feedback to stakeholders regarding comments received during the preliminary PSA consultations is considered crucial. The final PSA is completed by scientists and results are presented to the relevant stakeholder group (e.g. RAG and/or MAC) before decisions regarding Level 3 analysis are considered. The stakeholder group may also decide on priorities for analysis at Level 3.

Residual Risk Analysis

There were several limitations due to the semi-quantitative nature of a Level 2 PSA assessment. For example, certain management arrangements which mitigate the risks posed by a fishery, as well as additional information concerning levels of direct mortality, may not be easily taken into account in assessments. To overcome this, Residual risk analyses (RRA) are used to consider additional information, particularly mitigating effects of management arrangements that were not explicitly included in the ERAs or introduced after the ERA process commenced. Priority for this process has typically been focused on those species attributed a high risk rating (those likely to be most at risk from fishing activities). It could in theory be used to also determine if some species have been incorrectly classified as low risk.

Recently revised Residual risk guidelines have been developed (see below) to assist in making accurate judgments of residual risk consistently across all fisheries. At the moment, they are applied to species and not applicable to habitats or communities.

These guidelines are not seen as a definitive guide on the determination of residual risk and it is expected they may not apply in a small number of cases. Care must also be taken when applying them to ensure residual risk results are appropriate in a practical sense. There are a number of conditions which underpin the residual risk guidelines and should be understood before the guidelines are applied:

All assessments and management measures used within the residual risk assessment must be implemented prior to the assessment with sufficient data to demonstrate the effect. Any planned or proposed measures can be referred to in the assessment but cannot be used to revise the risk score.

When applied, the guidelines generally result in changes to particular "attribute" scores for a particular species. Only after all of the guidelines have been applied to a

particular species, should the overall risk category be re-calculated. This will ensure consistency, as well as facilitating the application of multiple guidelines.

Unless there is clear and substantiated information to support applying an individual guideline, then the attribute and residual risk score should remain unchanged. All supporting information considered in applying these Guidelines must be clearly documented and referenced where applicable. This is consistent with the precautionary approach applied in ERAs, with residual risk remaining high unless there is evidence to the contrary ensuring a transparent process is applied.

The results (including supporting information and justifications) from residual risk analyses must be documented in "Residual Risk Reports" for each fishery (or can be integrated into the Level 2 risk assessment report). These will be publically available documents.

SAFE (Sustainability Assessment for Fishing Effects)

The SAFE method developed is split into two categories: base SAFE (bSAFE) and an enhanced SAFE (eSAFE). eSAFE has greater data processing requirements and is recommended to only be used to assess species estimated to be at high risk via the bSAFE. It is also able to more appropriately model spatial availability aspects when sufficient data are available.

bSAFE

Relative to the PSA approach, the bSAFE approach (Zhou and Griffiths, 2008; Zhou et al. 2011):

- is a more quantitative approach (analogous to stock assessment) that is able to provide absolute measures of risk by estimating fishing mortality rates relative to fishing mortality rate reference points (based on life history parameters);
- requires less productivity data than the PSA;
- is able to account for cumulative risk and
- potentially out performs PSA in several areas, including strength of relationship to Tier 1 assessment classifications (Zhou et al. 2016).

Like PSA, the bSAFE method is a transparent, relatively rapid and cost effective process for screening large numbers of species for risk, and is far less demanding of data and much simpler to apply than a typical quantitative stock assessment.

As such it is recommended that bSAFE be used as the preferred Level 2 assessment tool for all fish species and some invertebrates and reptiles (eg: some sea snakes) with sufficient data.

In estimating fishing mortality, bSAFE utilises much of the same information as the PSA, to estimate:

- Spatial overlap between species distribution and fishing effort distribution.
- Catchability resulting from the probability of encountering the gear and size-dependent selectivity. And;
- Post-capture mortality.

The fishing mortality is essentially the fraction of overlap between fished area and the species distribution area within the jurisdiction, adjusted by catchability and post-capture mortality. Uncertainty around the estimated fishing mortality is estimated by including variances in encounterability, selectivity, survival rate and fishing effort between years.

The three biological reference points are based on a simple surplus production model:

- F_{MSY} – instantaneous fishing mortality rate that corresponds to the maximum number of fish in the population that can be killed by fishing in the long term. The latter is the maximum sustainable fishing mortality (MSM) at B_{MSM}, similar to target species MSY.
- F_{LIM} – instantaneous fishing mortality rate that corresponds to the limit biomass B_{LIM} where B_{LIM} is a assumed to be half of the biomass that supports a maximum sustainable fishing mortality ($0.5B_{MSM}$)
- F_{CRASH} – minimum unsustainable instantaneous fishing mortality rate that, in theory, will lead to population extinction in the long term.

This methodology produces quantified indicators of performance against fishing mortality based reference points and as such does allow calibration with other stock assessment and risk assessment tools that measure fishing mortality. It allows the risk of overfishing to be determined, via the score relative to the reference line. Uncertainty (error bars) are related to the variation in the estimation of the scores for each axis.

It is recommended that species assessed as being potentially at high risk under bSAFE are then progressed to analysis by eSAFE which is able to narrow uncertainties around the risk (but is more time and resource intensive than bSAFE).

Assumptions and issues to be aware of:

- Comparisons of PSA and SAFE analyses for the same fisheries and species support the claim that the PSA method generally avoids false negatives but can result in many false positives. Limited testing of SAFE results against full quantitative stock assessments suggest that there is less “bias” in the method, but that both false negatives and false positives can arise.

– SAFE analyses retain some of the key precautionary elements of the PSA method, including assumptions that fisheries are impacting local stocks (within the jurisdictional area of the fishery).

Although the bSAFE analyses provide direct estimates of uncertainty in both the exploitation rate and associated reference points, they are less explicit about uncertainties arising from key assumptions in the method, including spatial distribution and movement of stocks.

The method assumes there would be no local depletion effects from repeat trawls at the same location (ie: populations rapidly mix between fished and unfished areas). The fishing mortality will likely be overestimated if this assumption is not satisfied (ERA TWG 2015)[4].

The method also assumes that the mean fish density does not vary between fished area and non-fished area within their distributional range. Hence, the level of risk would be over-estimated for species found primarily in non-fished habitat, while risk would be under-estimated for species that prefer fished habitat (ERA TWG 2015)[4].

The SAFE methodology makes greater assumptions than Tier 1 stock assessments in coming to its F estimates (due to a lack of the data relative to that used in a Tier 1 assessment) and it is not capable of measuring risk of a stock being already overfished (so the type of risk it measures relates only to overfishing, which may then lead to future overfished state). The limitations of SAFE with respect to measuring overfished risks are the same essentially as for PSA.

eSAFE

Enhanced SAFE (eSAFE) appears, based on calibration with Level 3 assessments, to provide improved estimates of fishing mortality relative to the base SAFE (bSAFE) method. The eSAFE requires more spatially explicit data and takes more analysis time than bSAFE, and so might only be used to further assess species that were identified as at high risk using bSAFE (and which have not had further direct management action taken). The eSAFE enhances the bSAFE method by estimating varying fish density across their distribution range as well as species- and gear-specific catch efficiency for each species.

[4] ERA Technical Working Group, September 2015

1.1.6 Level 3

This stage of the risk assessment is fully-quantitative and relies on in-depth scientific studies on the units identified as at medium or greater risk in the Level 2. It will be both time and data-intensive. Individual stakeholders are engaged as required in a more intensive and directed fashion. Results are presented to the stakeholder group and feedback incorporated, but live modification is not considered likely.

1.1.7 Conclusion and final risk assessment report

The conclusion of the stakeholder consultation process will result in a final risk assessment report for the individual fishery according to the ERAEF methods. It is envisaged that the completed assessment will be adopted by the fishery management group and used by AFMA for a range of management purposes, including to address the requirements of the EPBC Act as evaluated by Department of the Environment and Energy.

1.1.8 Subsequent risk assessment iterations for a fishery

The frequency at which each fishery must revise and update the risk assessment is not fully prescribed. As new information arises or management changes occur, the risks can be re-evaluated, and documented as before. The fishery management group or AFMA may take ownership of this process, or scientific consultants may be engaged. In any case the ERAEF should again be based on the input of the full set of stakeholders and reviewed by independent experts familiar with the process.

Fishery re-assessments for byproduct and bycatch species under the ERAEF will be undertaken every five years[5] or sooner if triggered by re-assessment triggers. The five year timeframe is based on a number of factors including:

- The time it takes to implement risk management measures; for populations to respond to those measures to a degree detectable by monitoring processes; and to collect sufficient data to determine the effectiveness of those measures.
- Alignment with other management and accreditation processes.
- The cost of re-assessments.
- The review period for Fisheries Management Strategy (FMS).

[5] Based on a recommendation by the ERA Technical Working Group, September 2015.

For byproduct and bycatch species, in the periods between scheduled 5 year ERA reviews[6], AFMA will develop and monitor a set of fishery indicators and triggers, on an annual basis, so as to detect any changes (increase or decrease) in the level of risk posed by the fishery to any species. Where indicators exceed specified trigger levels, AFMA will investigate the causes and provide opportunity for RAG comment/advice during that process. Pending outcomes of that review, and RAG advice, AFMA can if necessary, request a species specific or full fishery re-assessment (i.e. prior to the scheduled re-assessment dates).

The ERA TWG (September 2015) identified five key indicators upon which such triggers could be based, these being changes in:

- Gear type/use
- Mitigation measures (use or type)
- Area fished
- Catch or interaction rate
- Fishing effort

Where possible, the triggers should look to take into account additional sources of risk from interacting non-Commonwealth fisheries. In addition, if a major management change is planned for a fishery, such as a move from input to output controls, the fishery will need to be reassessed prior to that management change coming into effect. In considering each indicator and trigger level, the RAG should consider the following:

The data upon which the indicator is based must be sufficiently representative of actual changes in catch, effort, area, gear or mitigation methods. Consideration should be given to the level of uncertainty associated with the data underpinning any prospective indicator.

The trigger level chosen should not be overly sensitive to the normal inter-annual variance that is typical of the indicator and independent of fishing pressure, assuming such variance is unlikely to relate to a significant change in the risk posed by the fishery to any or all species.

[6] In contrast to key and secondary commercial species managed via catch/effort limits under Harvest Strategies, which depending on species and Harvest Strategy, can be re-assessed any time between 1 and 5 years.

The trigger level should equate to the minimum level of change that the RAG (by its expert opinion) considers might potentially represent a significant change in the risk posed by the fishery.

The trigger level could represent an absolute change (number/level) in an indicator or a percentage change in an indicator.

The RAG should consider whether a "temporal" condition should be placed on the trigger (i.e. the trigger is breached 2 years in a row) to further reduce the likelihood of natural population variance or data errors triggering a re-assessment unnecessarily.

The final set of indicators and triggers will be developed for each fishery by AFMA in consultation with its fishery RAG (or for fisheries lacking a RAG, the ERA TWG), in association with the next planned re-assessment (see Table 8 in AFMA ERM Guide, AFMA (2016)). A RAG may choose a subset of these indicators and triggers, or include an additional indicator/trigger(s), based on consideration of the availability and reliability of data upon which to base any of the above indicators/triggers, however justification of this must be provided.

Research is currently underway to develop specific guidance for RAG to aid in the selection of appropriate triggers, which will in the meantime be determined using RAG expert opinion. In the longer term it may be possible to refine indicators and triggers using the existing PSA and SAFE methods to test to which attributes the end risk scores are most sensitive (ERA TWG 2015)[7]. The RAG will record both the final set of indicators and triggers chosen, and a justification for those, in the RAG minutes. Once the final set of indicators and triggers is determined for a fishery, they will require implementation within the FMS and a monitoring and review process.

[7] ERA TWG recommendation, September 2015

2 Results

The focus of analysis is the fishery as identified by the responsible management authority. The assessment area is defined by the fishery management jurisdiction within the AFZ. The fishery may also be divided into sub-fisheries on the basis of fishing method and/or spatial coverage. These sub-fisheries should be clearly identified and described during the scoping stage. Portions of the scoping and analysis at Level 1 and beyond, is specific to a particular sub-fishery. The fishery is a group of people carrying out certain activities as defined under a management plan. Depending on the jurisdiction, the fishery/sub-fishery may include any combination of commercial, recreational, and/or indigenous fishers.

The results presented below are for HIMI Longline sub-fishery.

2.1 Stakeholder engagement

Table 2.1 Summary Document SD1. Summary of stakeholder involvement for HIMI longline sub-fishery

FISHERY ERA REPORT STAGE	TYPE OF STAKEHOLDER INTERACTION	DATE OF STAKEHOLDER INTERACTION	COMPOSITION OF STAKEHOLDER GROUP (NAMES OR ROLES)	SUMMARY OF OUTCOME
Scoping	Email	August 2016	AFMA HIMI manager	Data summaries, observer reports, clarification of specific management arrangements
SICA/ Draft report	Meeting	Sept 2016	SARAG	Clarification of data issues, species lists, operations, research
Draft report	Meeting/emails	Sept 22 2016	G. Nowara, J. Melbourne-Thomas, A. Constable	Summary of ecosystem and modelling projects in development
Draft report	Draft review	October 2016	Gabrielle Nowara (AAD)	Review & commented
Draft report	Draft review	26 April 2017	Jo Fisher (AFMA), Martin Exel (Industry), Rhys Arangio (Industry)	Review & commented

2.2 Scoping

The aim in the Scoping stage is to develop a profile of the fishery being assessed. This provides information needed to complete Levels 1 and 2 and at stakeholder meetings. The focus of analysis is the fishery, which may be divided into sub-fisheries on the basis of fishing method and/or spatial coverage. Scoping involves six steps:

- Step 1 Documenting the general fishery characteristics
- Step 2 Generating "unit of analysis" lists (species, habitat types, communities)
- Step 3 Selection of objectives
- Step 4 Hazard identification
- Step 5 Bibliography
- Step 6 Decision rules to move to Level 1

2.2.1 General Fishery Characteristics (Step 1).

The information used to complete this step may come from a range of documents such as the Fishery's Management Plan, Assessment Reports, Bycatch Action Plans, and any other relevant background documents. The level and range of information available will vary. Some fisheries/sub-fisheries will have a range of reliable information, whereas others may have limited information.

Scoping Document S1 General Fishery Characteristics

Fishery Name: Heard Island and MacDonald Islands – Demersal Longline

Date of assessment: October 2016

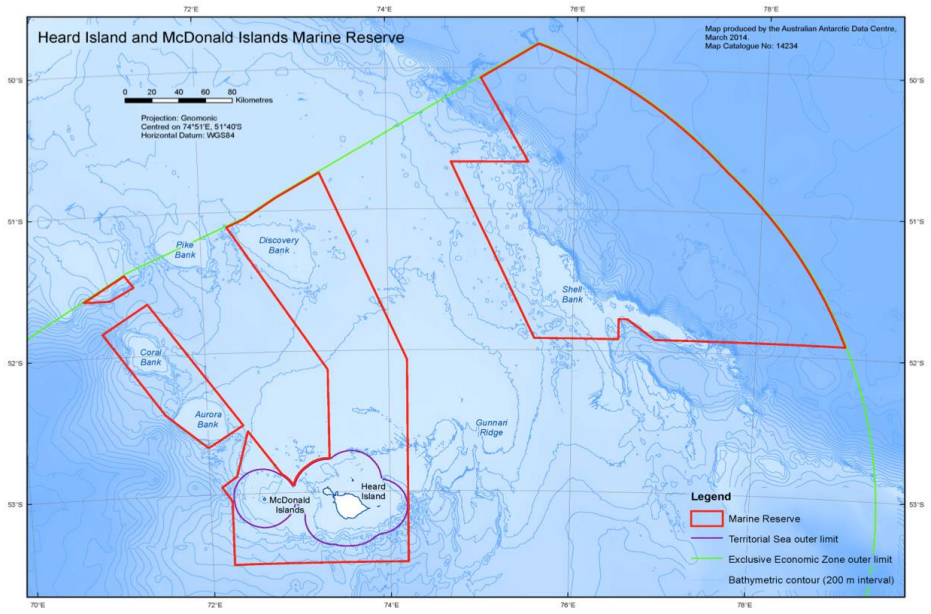
Assessor: C. Bulman (CSIRO)

Table 2.2 General fishery characteristics

GENERAL FISHERY CHARACTERISTICS	
Fishery Name	Heard Island and McDonald Islands (HIMI) Fisheries *(CCAMLR Statistical Division 58.5.2)*
Sub-fisheries	There are currently four sub-fisheries based on fishing methods, the first of which could be considered as two sub-fisheries because two species are targetted: 1. **Demersal otter board trawling** for *Dissostichus eleginoides* Patagonian toothfish and *Champsocephalus gunnari* Mackerel icefish. 2. **Mid-water trawling** for *C. gunnari* Mackerel icefish. 3. **Demersal longlining** for *D. eleginoides* Patagonian toothfish began in May 2003 season under scientific permits.

GENERAL FISHERY CHARACTERISTICS	
	4. **Pot and trap fishing.** Although a permitted method in the HIM Fishery, pot fishing has not been used recently and therefore hasn't been included in the current ERA process.
Sub-fisheries assessed	Demersal longlining for *Dissostichus eleginoides* Patagonian toothfish.
Start date/history	There are records of Soviet and Polish vessels fishing both *Dissostichus eleginoides* Patagonian toothfish and *Champsocephalus gunnari* Mackerel icefish in the region in the 1970s and some research surveys were conducted by AAD in the early 1990s before the establishment of the EEZs of Australia and France. The Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) came into force in 1982, as part of the Antarctic Treaty System, with the aim of regulating exploitation rather than outright protection. CCAMLR was established at a time when commercial interests in krill were growing rapidly; it began to be truly effective as a management regime in 1991 when the first catch limits were set. From the outset CCAMLR was based on the principle that management of fisheries should include not just the target species but also dependent and associated species and their ecological relationships. CCAMLR and AFMA are committed to minimise impacts on the marine environment from fishing in the Heard Island and McDonald Islands area and strict environmental management measures have been in place since access to the fishery was first granted in 1995. These measures are incorporated in the Heard Island and McDonald Islands Fishery Management Plan 2002 (the HIMI Plan) and supporting legislative instruments, developed under the Fisheries Management Act 1991. Commercial fishing for Patagonian toothfish and Mackerel icefish by Australian operators commenced in March 1997 using demersal and midwater trawls in accordance with CCAMLR Conservation Measure 110/XV. Longlining for Patagonian toothfish became an approved fishing method in the fishery in 2005 following a successful trial of the method beginning in 2003. Longline fishing has expanded in recent years. A pot fishing trial was undertaken during the 2005/06, 2008/09, 2009/10, 2010/11 and 2012/13 seasons with low Patagonian toothfish catch (~35.9 t in 2010/11; 43.84 t in 2012/13). Pot fishing is very selective with very little bycatch (~4 t (mostly starfishes – unidentified in 2010/11) and 0.5 t (2012/13)) and there is less impact than demersal trawl on the benthic habitats. The HIMI Fishery Direction which prohibited fishing methods other than trawling and longlining expired November 2010 and was not renewed. The SFR conditions for the fishery were amended to limit permitted fishing methods to trawl, longline and pot fishing. The HIMI Fishery was the first Commonwealth fishery to be accredited for export approval/accreditation under the EPBC Act. The initial accreditation was granted in May 2002 for a period of 5 years. A further two 5 year exemption periods were granted, and more recently a ten year exemption was granted with the current period expiring on 9 October 2026. The HIMI fishery was certified as sustainable in March 2012 by the Marine Stewardship Council both trawling and longlining Patagonian toothfish and has re-entered re-assessment in July 2016 (https://www.msc.org/track-a-fishery/fisheries-in-the-program/certified/southern-ocean/heard_island_and_mcdonald_islands_himi_toothfish). The HIMI Mackerel icefish fishery was certified in 2011. Illegal, unregulated or unreported (IUU) fishing is of concern because it has the potential to undermine attempts to manage fish stocks. In 1999, CCAMLR adopted a

GENERAL FISHERY CHARACTERISTICS	
	catch documentation scheme (CDS) which has helped prevent illegally caught fish entering the markets of CCAMLR nations. The CDS was implemented in 2000. No illegal foreign fishing vessels have been detected inside the Australian Fishing Zone of the HIMI area since 2007 (CCAMLR Fishery Report 2015). There were 142 surveillance patrol days by Australian Government vessels in 2014-15 in the southern ocean (against a target of 172 days) (Australian Customs and Borders Protection Service 2015). There are cooperative arrangements with the French Government. Electronic surveillance methods and range of other approaches are also used to combating risks from IUU fishing in areas outside Australia's jurisdiction (SCS Global Services; https://www.msc.org/track-a-fishery/fisheries-in-the-program/certified/southern-ocean/heard_island_and_mcdonald_islands_himi_toothfish/assessment-downloads-1/20150901_SR_TOO227.pdf).
Geographic extent of fishery	The fishery operates in sub-Antarctic waters adjacent to Heard Island and the McDonald Islands. Heard Island and McDonald Islands (HIMI) are external territories of Australia located in the Southern Indian Ocean about 4,000 km south-west of Perth, south of the Polar Front. The Islands are listed on the Register of the National Estate as the only unmodified example of a sub-Antarctic island ecosystem and the Reserve is listed on the World Heritage List. The Islands and the 12 nautical mile territorial sea around them - form part of the Heard Island and McDonald Island Marine Reserve (formerly Wilderness Reserve) and is closed to fishing (Commonwealth of Australia 2014). In addition, fishing is prohibited in a buffer zone of 1 nm surrounding the Reserve. The fishery therefore extends from 13 nautical miles offshore to the edge of the 200 nautical mile Australian Economic Exclusive Zone (EEZ) around the Islands and is managed by the Australian Fisheries Management Authority. The fishery lies in CCAMLR Statistical Division 58.5.2.
Regions or Zones within the fishery	The HIMI Fishery for Patagonian toothfish is divided into 3 main fishing grounds A, B and C that will not be identified further by AFMA to retain confidentiality of the licensed operators of the fishery. The trawl grounds are on the Heard Island plateau between 450 m and 700 m deep (Williams *et al.* 2002). The longline fishery operates in the deeper water between 1000 and 2500m and catches larger fish than the trawl fishery. **Heard Island and McDonald Islands Marine Reserve** In October 2002 the Heard Island and McDonald Islands (HIMI) Marine Reserve was declared under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). It is located in Australia's remote subantarctic waters, approximately 4000 kilometres south-west of the Australian mainland and 1000 kilometres north of Antarctica and includes Heard Island and the McDonald Islands, the surrounding 12 nautical mile territorial sea, plus an extended marine area (including the seabed and subsoil to a depth of 1000 metres) which extends in parts to the 200 nautical mile Exclusive Economic Zone (EEZ) boundary. It was extended by 6 200 km^2 in March 2014 to cover a total area of 71 200 km^2.

GENERAL FISHERY CHARACTERISTICS	
	 Source: (Commonwealth of Australia 2014) **Management of the HIMI Marine Reserve** Classified as an IUCN Category 1a (Strict nature reserve) it is managed in accordance with an IUCN categorisation and zoning scheme that provides for its appropriate use and protection. Administration of the HIMI Marine Reserve is the responsibility of the Australian Antarctic Division. The EPBC Act requires that management must be based on IUCN category IA reserve management principles, and be not inconsistent with Australian World Heritage management principles. The latest Heard Island and McDonald Islands Marine Reserve Management Plan 2014-2024 (Commonwealth of Australia 2014) is the third for the HIMI region and the second under the EPBC Act for the Reserve. It has been developed against the following key result areas: – Natural heritage management – Biodiversity science, knowledge management and use – Cultural heritage management – Use and appreciation of protected areas – Stakeholders and partnerships – Business management Each section of the plan contains a list of *aims* that describe the desired result of Reserve management activities, and a series of prescriptions that provide Reserve management strategies for the fulfilment of these aims (Commonwealth of Australia 2014).
Fishing season	The current fishing season is from 1 May to 14 September 2016 (Conservation Measure 41-08 (2015)). The season may be extended from 1 April to 30 April and 15 September to 30 November for any vessel which has demonstrated full compliance with Conservation Measure 25-02 in the previous season but if a vessel catches more than 3 seabirds in the season extension periods, fishing throughout the season extension periods is to cease immediately for that vessel for the remainder of that season.

GENERAL FISHERY CHARACTERISTICS	
Target species and stock status	**Patagonian toothfish (*Dissostichus eleginoides*)** The Patagonian toothfish is widely distributed throughout large areas of the Antarctic oceans. It is a demersal (found at or near the sea bottom) species found at depths up to 2,500 metres, although it is reported to be pelagic (living at or near the ocean surface) throughout some periods of its life (eggs to young juveniles). Patagonian toothfish occur throughout the Plateau from shallow depths to 2500m. Younger fish, less than 600mm TL, occur in less than 500m and as they grow they move deeper into depths to 800m, where they can become locally abundant. Older fish move into depths>1000m where they are caught by longline mainly between 1000 and around 1500m. The largest fish are assumed to be in depths >1200m and are targeted by the longlining fishery. Genetic studies have shown that populations at HIMI are distinct from Macquarie Island and South Georgia but that there is no distinction between those at HIMI, Kerguelen, Crozet and Marion/Prince Edward Islands (CCAMLR 2015). Tagging studies suggest that a metapopulation exists in the Indian ocean sector of the Southern Ocean. Collaborative research on stock structure with French scientists is continuing to refine population models and improve management in the Kerguelen Plateau (Patterson and Savage 2016). The Harvest Strategy for HIMI Fishery (toothfish) is precautionary aiming to set TACS at a level that the probability of the spawning biomass falling below 20% of the pre-exploitation level over the 35 year projection period is not greater 0.1 and the median escapement for the Fishery of the spawning biomass is not be less than 50% over a 35 year projection. Stock status has been classified as not overfished and not subject to overfishing since 2006 (Patterson and Skirtun 2015). The 2015 assessment followed the recommendations of WG-FSA-14 and the Working Group on Statistics, Assessments and Modelling in 2015 (WG-SAM-15), and incorporated new ageing data, tagging data, updated growth models, changes in priors for survey catchability q, unfished spawning biomass B_0 and year-class strength (YCS), and a split of the trawl sub-fishery into two periods . The 2015 assessment model estimated a virgin spawning stock biomass B_0 of 87 077 tonnes (95% CI: 78 500–97 547 tonnes) and an estimated SSB status in 2015 of 0.64 (95% CI: 0.59–0.69)(CCAMLR 2015).
Bait Collection and usage	The risks associated with frozen bait are assessed by AQIS and bait bought from Australia is licenced but some bait is also bought outside Australia. There has been no detection of introduced pathogens resulting from bait or any other means, nor of any adverse consequences on the species or more broadly on the communities.
Current entitlements	2-6 vessels.
Current and recent TACs, quota trends by method	**Annual TACs (tonnes) for Patagonian toothfish for past 5 fishing seasons** 2010-11: 2550 2011-12: 2730 2012-13: 2730 2013-14: 2730 2014-15: 4410 2015-16 (CURRENT): 3405 Source: CCAMLR Conservation Measures 41-08; CCAMLR Fishery Report 2015.

GENERAL FISHERY CHARACTERISTICS

Current and previous catch limits for bycatch in place for Division 58.5.2

SPECIES	2014-15	2015-16 (CURRENT)
Channichthys rhinoceratus Unicorn icefish	150	1663
Lepidonotothen squamifrons Grey rockcod	80	80
Skates and rays*	120	120
Macrourus carinatus and *M. holotrachys* **	360	360
Macrourus caml and *M. whitsoni*	-	409
Other species	50	50?

*Since 2003
** Since 2015/16. The previous catch limit since 2004 for all *Macrourus* spp. combined was 360 t.

Source: CCAMLR Conservation Measures 41-08; Conservation measure 33-02 (2015), CCAMLR Fishery Report 2015

Current and recent fishery effort trends by method

Annual estimates of effort (hooks) in longline fishery for past 5 fishing seasons

2010-11	2011-12	2012-13	2013-14	2014-15
4,424,250	4,453,500	6,729,750	8,971,706	16,184,807

Source: Source: AAD observer data 2016

Current and recent fishery catch trends by method

Annual longline catches (tonnes) for Patagonian toothfish over past 5 fishing seasons

2010-11	2011-12	2012-13	2013-14	2014-15
1,372	1,349	2,112	2,642	3,865

Source: AAD observer data 2016

Annual catches (tonnes) of bycatch species by longline

SPECIES	2010-11	2011-12	2012-13	2013-14	2014-15
Channichthys rhinoceratus Unicorn icefish#	-	-	-	-	-
Lepidonotothen squamifrons Grey rockcod	-	8	5	3	-
Skates and rays	19	8	13	14	20
Macrourus spp.	148	89	156	176	311
Other species*	10	7	12	14	36

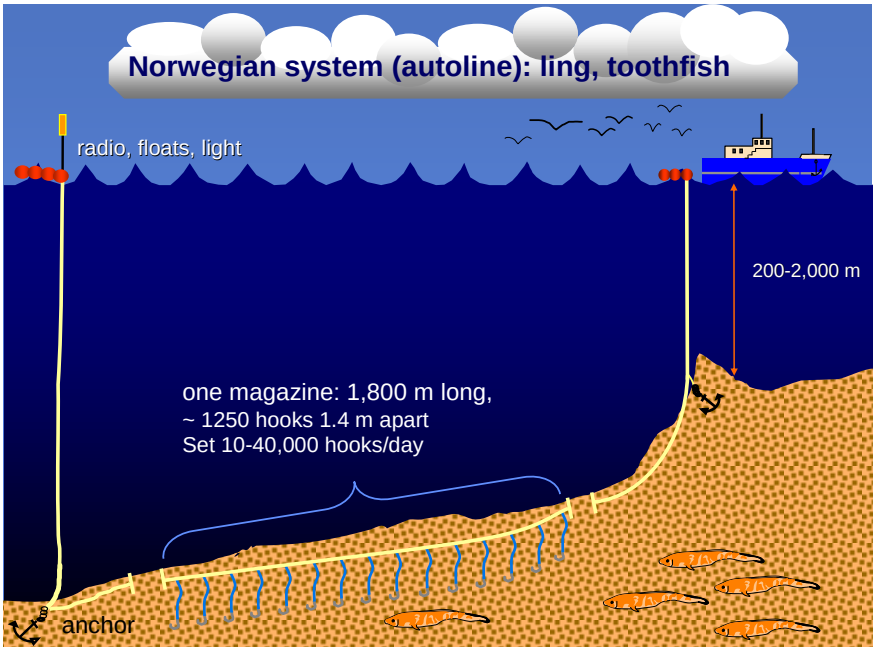
28 t of *C. rhinoceratus* has been caught in the current fishing year (not in assessment period)
*Other species includes all fish including *Antimoro rostrata,* Channicthyhidae and invertebrates retained or discarded.

Source: AAD Observer data 2016

Current and recent value of fishery ($)

Not available

GENERAL FISHERY CHARACTERISTICS	
Relationship with other fisheries	There are no cross-jurisdictional management arrangements in this fishery. The HIMI Fishery is conducted in a remote territory which is managed solely by the Commonwealth. However the toothfish stock is shared on the Kerguelen Plateau with the French zone (CCAMLR Statistical Area 58.5.1). Australian and French scientists are conducting joint research to determine the extent the toothfish stock is shared on the Kerguelen Plateau. The recent Patagonian Toothfish catches from the French zone around Kerguelen Island as reported by CCAMLR are 5,235 t (2010/11), 4897 t (2011/12), 5341 t (2012/13) and 5326 t for 2013/14. Historically, the longline fishery operating in the French Exclusive Economic Zones (EEZs) of Crozet and Kerguelen Islands (Subarea 58.6 and Division 58.5.1 respectively) killed many thousands of seabirds (26 668 seabirds between September 2001 and August 2003)(ACAP). Since then, seabird mortality has been reduced significantly. Over the past 5 fishing seasons (2011-2015), 158 birds have been killed or injured. (CCAMLR Fishery Report 2015; *Dissostichus eleginoides* Kerguelen Islands French EEZ (Division 58.5.1))
Gear	
Fishing gear and methods	Auto longline is the primary method used.
Fishing gear restrictions	A range of restrictions are prescribed under Conservation Measures24-02 and 25-02 for vessels using autoline systems, which include the weighting of the hookline with either an integrated weight (IW) of at least 50g/m, or manually added weights of 5kgs at 5050m – 60m intervals (specifications in CM 24-02), streamer lines in accordance with specifications of streamer lines and method of deployment in Annex 25-02A, and bird excluder devices i.e. brickle curtains in Annex 25-02B. There is also a limited season prescribed for longline operations under Conservation Measure 41-08.
Selectivity of gear and fishing methods	The gear selects for larger Patagonian toothfish. Longline gear has a lower selectivity for skates and rays than trawling.
Spatial gear zone set	Deep water mostly off the Southern Slope /abyssal plain, Eastern and Western Trough (around McDonald Island).
Depth range gear set	Gear is generally deployed between 500 and 2370m, an average of ~1250m (AFMA logbook 2016).
How gear set	The autoline system is most commonly used by 'Norwegian-style' vessels and typically has a simple configuration (see Figure). Auto longline fishing is a type of bottom longlining, where gear is set horizontally along the ocean floor and held in place using anchors. The primary difference between auto longline and demersal longline fishing is that hooks are baited by a machine rather than by hand. When set, the longline can be many kilometres in length, incorporating up to 15,000 hooks. The system consists of a single, long 'main-line' containing several thousand, short (~ 400 millimetres), evenly-spaced 'snoods' each with a baited hook on the terminal end. Each snood is attached via a collar to the mainline in a manner that allows the snood to rotate 360º around the main-line, as well as 360º about a swivel. Snoods are spaced 1.4 metres apart. The longline is 'shot away' from the shooting room at the stern of the vessel. Each end of the mainline is attached to heavy grapnel anchors (40-100kg) which in turn are attached to a downline with radio beacon and buoys attached at the surface. Heavy grapnel anchors cause the longline to rapidly submerge and eventually grab onto the

GENERAL FISHERY CHARACTERISTICS	
	ocean floor. The downline (the initial length of the line from the buoys to the anchors) does not contain hooks. The anchors stabilise one end of the longline as the vessel continues to steam away from the fixed end of the longline at 2-10 knots, causing the central, hook portion of the longline (the mainline) to be paid out from the stern of the vessel. Each hook passes through an automatic baiting machine (where hooks are baited with about 93% success) before they enter the water. Autoline vessels deploy negatively buoyant longlines. Weights may be clipped to the longline at various intervals to further aid sink rates. The longline is then gradually set on the ocean floor (often following topographic features as identified from an on board acoustic sounder). A second set of grapnels stabilises the proximal end of the longline. Currently Australian vessels are using integrated weight line (9.5 – 12 millimetres diameter) with an internal lead core of 50 grams/metre used to sink the line rather than the attachment of external weights. The bottom-set hooks are then left to attract toothfish for up to 24 hours. The vessel then travels slowly (1-2 knots) towards the distal end of the longline, steadily hauling the longline back onto the vessel.  Indicative longline configuration (Graham Robertson, AAD) (Source: AFMA 2012)
Area of gear impact per set or shot	Longlining in the HIMI Fishery occurs over an area of about 95,000 sq. km. The major area on the southern slope of the Eastern Trough is about 30,000 sq. km. Each longline could be up to 15-20 km long with a width 0.4 m assuming fully extended snoods, with an overall ground “footprint” of ~6000-8000 sq. m per set.
Capacity of gear	The largest longline catch of Patagonian toothfish from a single haul recorded in logbooks during the past 5 fishing years was 14 t with an average weight between 2.2 and 3 t (AFMA data 2016).
Effort per annum all boats	**Annual estimates of effort (hooks, days , active vessels) in longline fishery for past 5 fishing seasons** 2010-11 2011-12 2012-13 2013-14 2014-15

GENERAL FISHERY CHARACTERISTICS					
	Hooks	4,424,250	4,453,500	6,729,750	8,971,706	16,184,807
	Days	187	171	179	219	244
	Vessels	2	3	4	4	6
	Source: AAD Observer data 2016, AFMA logbook data 2016					
Lost gear and ghost fishing	Gear loss is generally low (average lost hooks =1.1%). A change to SFR conditions in the 2016/17 season allowed gear retrieval to occur both within and outside the longline fishing season and, as a consequence, gear retrievals have increased slightly. Gear loss was higher than normal in 2015/16 (SARAG minutes Sept 2015) but significantly more of that lost gear has been successfully retrieved more recently (pers. comm. Martin Exel 18 May 2017). The hooks are reported to be clean of bait, hooked or entangled fish or other biota (pers. comm. Martin Exel 18 May 2017 as verified by AFMA observers and reported to AFMA on retrieval).					
		2010-11	2011-12	2012-13	2013-14	2014-15
	Hooks deployed	4,424,250	4,453,500	6,729,750	8,971,706	16,184,807
	Lost hooks (%)	28,925 (0. 7)	96,352 (2.2)	23,541 (0. 3)	114,285 (1.3)	184,784 (1.1)
	Recovered hooks (%)					5910 (3.2)
	Lost backbone (m)	40495	135217	32818	150923	258097
	Recovered backbone (%)	600 (1.5)	3500 (2.6)			4220 (1.6)
Issues						
Commercial species issues	Genetic studies have shown that populations at HIMI are distinct from Macquarie Island and South Georgia but that there is no distinction between those at HIMI, Kerguelen, Crozet or Marion/Prince Edward Islands. Tagging studies suggest that a metapopulation exists in the Indian ocean sector. Collaborative research on stock structure with French scientists is continuing to refine population models and improve management in the Kerguelen Plateau (CCAMLR Fishery Report 2015, Patterson and Savage 2016) .					
Byproduct and bycatch issues and interactions	Bycatch or byproduct is not considered a major issue in Antarctic fisheries. There are two observers on all trips to the regions, which has resulted in accurate catch and bycatch reporting. The major bycatch species are skates and rays, and macrourids**.** Catch limits are set for by-catch species groups (see TACs). Landed by-catch in the longline fisheries ranged from 6 to 13% of the total catch. No by-catch species was caught in quantities approaching the catch limit (CCAMLR 2015). "A quantitative risk assessment of the Caml grenadier (*Macrourus caml*) was undertaken in 2015 and WG-FSA-15 recommended a catch limit of 409 tonnes for *M. caml* and Whitson's grenadier (*M. whitsoni*) combined based on the risk assessment in WG-FSA-15/63, and a catch limit of 360 tonnes for bigeye grenadier (*M. holotrachys*) and ridge-scaled grenadier (*M. carinatus*) combined based on the previous assessment from 2003. The current by-catch limits for rajids (*Bathyraja* spp.) were set in 1997 (SC-CAMLR-XVI, paragraphs 5.119 to 5.122)" (CCAMLR 2015).					

GENERAL FISHERY CHARACTERISTICS	
	"An analysis of the by-catch species unicorn icefish (*Channichthys rhinoceratus*) and grey rock cod (*Lepidonotothen squamifrons*) indicated that both species are widespread over the plateau in depths of <1 000 m (WG-FSA-15/50). Up to 2015, the catch limits of *C. rhinoceratus* and *L. squamifrons* were based on assessments carried out in 1998 (SC-CAMLR-XVII, Annex 5). Catches of each of these species were well below the limits set by CCAMLR since 2004. A quantitative risk assessment of *C. rhinoceratus* was undertaken in 2015 and WG-FSA-15 recommended a catch limit of 1 663 tonnes for *C. rhinoceratus*" (CCAMLR 2015). Catch limits are set for three by-catch species groups (macrourids, rajids and grey rock cod and none approached their catch limits(CCAMLR 2015). Skates are also caught during the trawl surveys which has allowed for an ongoing program of collection of biological data (Nowara *et al.* 2014). Skate by-catch across both the HIMI and Kerguelen fisheries from the trawl fisheries is low and did not show any evidence of depletion in the main fishing although average size of *B eatoni* has decreased slightly (Nowara *et al.* 2017). In the deeper longline fishery, *B. irrasa* is commonly caught and has showed a slight decline in catch rate. All live skates are released but post-capture survival rates are unknown. In the past, non-target fishes were retained for milling into meal which was sold ashore or dumped on return to port but this practice no longer occurs and bycatch is macerated and then discarded at sea outside the EEZ.
Protected species issues and interactions	Conservation Measures 24-02, 25-02 and 25-03 are in force to minimise the incidence of seabird mortality during long-lining (see Regulations). The Australian Fisheries Management Authority limits the fishery to a 4 ½ month core season over the winter months when seabirds are less active. The core season can then be extended into autumn and spring for eligible boats. Interactions causing injury or death to seabirds and marine mammals have been extremely low to date in Antarctic longline operations. The third Annual Surveillance investigation for re-certification under MSC Principle 2 (Ecosystem Impacts from Fishing) (SCS 2015) found that the current fishing operations were highly unlikely to pose any adverse impacts on protected species populations (or of fished species, or trophic function more broadly). **Interactions in longline operations reported in AAD Wildlife Observations (including incomplete 2015/15 fishing year). Fatal = fatal or *serious injury , non-fatal = no apparent injury or unknown**

	2010/11		2011/12		2012/13		2013/14		2014/15		2015/16		TOTAL	
Species	Fatal	Non-fatal	Fatal	Non-fatal	Fatal	Non-fatal	Fatal	Non-fatal	Fatal	Non-fatal	Fatal	Non-fatal	Fatal	Non-fatal
Arctocephalus gazella		2												2
Daption capense		5		12		5		4	1	4			1	30
Diomedea chrysostoma											1		1	
Diving Petrel		1	1			1			1				2	3
Fulmarus glacialoides		2		2		1			1	2			1	7
Halobaena caerulea		3							1				1	3
Macronectes giganteus		4		3	1	1		2		3			1	13
Macronectes halli		3		4			1	4		6			1	17
Macronectes spp				3						3				6
Oceanites oceanicus		1		1										2

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	Pachyptila desolata											1*		1	
	Pachyptila spp		6				1				1				8
	Pagodroma nivea												1		1
	Procellaria aequinoctialis				1						1				2
	Pterodroma brevirostris	1	1											1	1
	Storm Petrel		33										1		34
	Thalassarche melanophrys		1												1
	Total	**1**	**62**	**1**	**26**	**1**	**9**	**1**	**10**	**4**	**20**	**2**	**2**	**10**	**129**

Source: AAD (Observer data) 2016

In addition to the above table, the CCAMLR Fishery Assessment Reports and the interactions reported to AFMA also contained interactions particularly with marine mammals and penguins (all listed in protected species lists Table 2.7). There was inconsistency in the observer wildlife data and that reported to AFMA by the vessels. In AFMA quarterly reports, a total of 5 giant petrels were reported killed in *cf* 2 above and total of 13 Southern Elephant seals *Mirounga leonina* were reported killed. Population size at Kerguelen/Heard Islands is about ~220 000 and stable although populations have declined by about 50% since 1949 (http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=26). They feed mainly of deepwater squid and benthic fish, and are expert divers remaining submerged for 90% of their time http://www.environment.gov.au/biodiversity/threatened/species/pubs/26-conservation-advice-07122016.pdf. They are likely to be in the vicinity of the shallower longlining operations on the upper slope and shelf edges. Interactions with fisheries were considered to have a minor consequence however there is a lack of monitoring data It listed as vulnerable although there is evidence to suggest that it could be delisted but insufficient for the TSSC to act upon http://www.environment.gov.au/biodiversity/threatened/species/pubs/26-conservation-advice-07122016.pdf

Habitat issues and interactions	A comprehensive assessment of the vulnerability of benthic habitats in the HIMI and surrounding Southern Ocean including the Kerguelen Plateau to impact from demersal fishing gear was made by Welsford *et al.* (2014). The approach was to combine data on the fishing footprint from 1997-2013 with estimates of taxa-specific vulnerability to different gear types and modelled distributions of habitats and taxa. Underwater camera equipment attached to the fishing gear (trawl, longline and pot) enabled assessments of interactions on the benthic environment by the different gear types. A risk categorisation framework was then applied that allowed the seascape around HIMI to be categorised and the level of protection afforded by the Marine Reserve to be quantified. The HIMI Marine Reserve, an IUCN Category 1a reserve and one of the world's largest protected marine reserves, protects representative ecosystem protection across the physiological classifications for over 39% of waters shallower than 1000m. The marine reserve covers a total area of 71 200 km^2, which in March 2014 was extended by 6 200 km^2 (Commonwealth of Australia 2014). The assessment found that the majority of vulnerable benthic organisms occurred in depths less than 1200 m, the depths in which the trawl fishery operates (400-1200m). However, on average more than half the biomass of the vulnerable structure-forming biota is protected by the current Marine Reserve (based on Table 17 in Welsford *et al.* 2014). Furthermore, demersal trawling effort focused on only a few relatively small fishing grounds and less than 1.5% of all biomass was estimated to be damaged or destroyed by demersal trawl.

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	Of the estimated longline footprint of ~380km^2, about a third occurred in these shallower depths constituting about 0.33% of the HIMI EEZ. The remaining two-thirds of longline footprint occurred in depths more than 1200m which can only be fished with longlines and where the abundances of vulnerable biota are low (Welsford *et al.* 2014). This effort was concentrated in a few small areas (maximum effort between 1601-1800m) and constituted about 0.067 % of the HIMI EEZ (calculated from Table 12 Welsford *et al.* 2014). Overall, Welsford *et al.* (2014) concluded that "longline effort does not contribute greatly to the total amount of benthic taxa killed or damaged in our analysis", less than 1%, and that "the risk that fishing will cause significant impacts to benthic biodiversity at HIMI is likely to continue to be low over the medium term."
Community issues and interactions	No specific issues identified. The importance of Antarctic communities is recognised by the CCAMLR approach to ecosystem-based management. AFMA has recognised and incorporated this approach in their management strategies for the HIMI fishery. To enable formulation of management strategies for the HIMI region, ongoing assessments of the ecosystem are needed. Two recent initiatives are being undertaken by the SCAR community: ICED is organising a conference in 2018 (www.MEASO2018.aq) with a principle focus on assessing the status and trends of habitats, species and foodwebs in the Southern Ocean; and SOOS is designing the biological component of its observing system to be complementary to the CCAMLR Ecosystem Monitoring Program and is in the process of developing an initiative to undertake a circumpolar benchmarking of the Southern Ocean ecosystem. These initiatives are been undertaken within a project in the AAD Science Program Stream 3.1 Marine Ecosystem Change. This project aims "to develop a quantitative framework for assessing change in ecosystems (habitats, species and foodwebs) and, in conjunction with the international program Integrating Climate and Ecosystem Dynamics of the Southern Ocean, undertake the first assessment within that framework, focussing on the Indian Sector " https://secure3.aad.gov.au/public/projects/report_project_public.cfm?project_no=4343&season=1415. Also providing fundamental information into this stream, is an ensemble of ecosystem models – together with a set of targeted models for particular ecological processes – that are currently being developed for the region. These include and implementation of the Atlantis model (as part of Australian Antarctic Science project #4347 (https://secure3.aad.gov.au/public/projects/report_project_public.cfm?project_no=4347&season=1516), an implementation of the SEAPODYM model (a stage-based model for fish-based ecosystems (Lehodey 2005) development of size-based models (AAS project #4366: https://secure3.aad.gov.au/public/projects/report_project_public.cfm?project_no=4366&season=1415) and implementations of Ecopath with Ecosim. Process modelling for the region includes individual-based modelling for predator species (http://soki.aq/x/EYArAQ), and larval transport modelling for Patagonian Toothfish (Mori *et al.* 2016). This suite of research will be important for assessing current and future status and trends of the ecosystem in the Kerguelen region. A recent MSC certification audit (SCS 2015) found it "highly unlikely that current catch levels will have any adverse effect on the impacts of the fishery on, or the status of, retained species, bycatch, ETP species, or trophic function." In addition, the management of the HIMI as Wilderness Reserves by the AAD; the prohibition on fishing within 13 nautical miles (including 1 nm buffer zone) of the islands; the establishment of the HIMI Marine Reserve in 2002 and the continued

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	monitoring of top predators both in terms of diet, reproductive rates and overall abundance are seen as key actions in the preservation of community ecosystems.
Discarding	AFMA requires that no offal or bycatch is to be discarded in the area of the fishery to avoid possible provisioning effects.
Management: planned and those implemented	
Management Objectives	The objectives of *Heard Island and McDonald Islands Fishery Management Plan 2002 (2016)* are: 1. to manage the Fishery efficiently and cost effectively for the Commonwealth, 2. to ensure that the exploitation of the resources of the Fishery and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle, and in particular, the need to have regard to the impact of fishing activities on non-target species and the long-term sustainability of the marine environment, 3. to maximise economic efficiency in the exploitation of the resources of the Fishery, 4. to ensure AFMA's accountability to the fishing industry and to the Australian community in management of the resources of the Fishery, 5. to reach Government targets for the recovery of the costs of AFMA in relation to the Fishery, 6. to ensure, through proper conservation and management, that the living resources of the Australian Fishing Zone (AFZ) are not endangered by over-exploitation, 7. to achieve the best use of the living resources of the AFZ, and 8. to ensure that conservation and management measures in the Fishery implement Australia's obligations under international agreements that deal with fish stocks, and other relevant international agreements. Source: Heard Island and McDonald Islands Management Plan 2002 (04/05/2016)(AFMA 2016) In addition the Heard Island and McDonald Islands Marine Reserve Management Plan 2014-2014 was revised recently, coming into effect in October 2016. It has been developed against the following key result areas: Natural heritage management Biodiversity science, knowledge management and use Cultural heritage management Use and appreciation of protected areas Stakeholders and partnerships Business management Aims, strategies and desired outcomes were developed for each of these key result areas for the Reserve management activities against which implementation and progress is to be reported annually. Source: Heard Island and McDonald Islands Marine Reserve Management Plan 2014-2014 (2016)
Fishery management plan	The HIMI fishery was first managed under the HIMI Exploratory Fishery Interim Management Policy November 1996 to August 1997. This was replaced by the HIMI Management Policy 1998 to 2000, which was extended to November 2001. Now the fishery is managed under the HIMI Fishery Management Plan 2002 (AFMA 2016) and a

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	supporting framework of regulations, permit conditions and directions. The most recent amendments were made in 2016. The HIMI fishery falls within the area covered by CCAMLR and is therefore subject to the Conservation Measures set by CCAMLR. Australia's minimum international obligations under CCAMLR are to manage the fishery in accordance with those measures but AFMA may impose additional ones. Apart from the objectives which are the same across most Commonwealth fisheries, the management plan also includes measures for attainment of objectives and performance criteria, bycatch and fishery assessment plans, TAC determinations and allocation of statutory fishing rights and environmental requirements and other obligations of the fishers (see previous section). Source: Heard Island and McDonald Islands Management Plan 2002 (04/05/2016)(AFMA 2016)
Input controls	The HIMI Fishery is managed under a system of input and output controls designed to manage catches of the target and non-target species. Fishing methods are restricted to trawl, longline and trap. Various restrictions apply to the specifications of each type of gear. Input controls are: • AFMA determines a minimum quota holding enacted through a Determination. A trawl operator must hold at least 25.5% of the statutory fishing rights to operate a trawler in the fishery or if using non-trawl methods, holds statutory fishing rights, effectively limiting trawling to a maximum of 3 vessels. • HIMI longline operations are limited to a 'core' season of 1 May-14 September, with season extensions allowed from 15–30 April and 15 September–31 October (where there is full compliance with CCAMLR Conservation Measures in the previous season). • If a vessel catches more than 3 seabirds in the season extension periods, fishing throughout the season extension periods is to cease immediately for that vessel for the remainder of that season. Source: Heard Island and McDonald Islands Management Plan 2002 (04/05/2016)(AFMA 2016)
Output controls	Output controls are: • biennial review and setting of total allowable catches (Conservation Measure 41-08 • catch limits of bycatch species: fishing shall cease if by-catch of any species in either targetted fishery reaches its limit as specified in Conservation Measure 33-02 (Conservation Measure 41-08 and 42-02) • carry-over provision for Patagonian toothfish-any over-catch will be carried into subsequent year and deducted from operators' quota at a rate of: ○ 1:1 for up to 10 tonnes of overcatch ○ 3:1 for between 10 and 20 tonnes of overcatch. Source: Heard Island and McDonald Islands Management Plan 2002 (04/05/2016) (AFMA 2016); CCAMLR Schedule of Conservation Measures
Technical measures	See CCAMLR Conservation Measures in next section
Regulations	**The Fisheries Management Regulations 1992** (Commonwealth of Australia 2011) prescribes detail on the management arrangements implemented in Commonwealth fisheries. Specifically they cover; bans on vessels over 130 m, administration of and standard conditions for fishing concessions including VMS operation, carrying observers, storing of offal and bycatch, marine environment impacts, payments and

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	fees, registers and administration and allocation of statutory fishing rights (SFRs), discarding offal and bycatch in the area of the fishery. Additional regulations were introduced regarding navigation in closures. Under the EPBC Act 1999, interactions with a protected species must be reported within seven days of the incident occurring to the Department of Environment. A Memorandum of Understanding between AFMA and the Department for the Reporting of Fisheries Interactions with Protected Species (Reporting MOU) streamlines those reporting requirements (http://www.afma.gov.au/wp-content/uploads/2010/06/mou.pdf). AFMA reports its protected species interactions to the Department on a quarterly basis. A range of **Conservation Measures** of various categories apply to this fishery in categories of Compliance (10), Notifications (21), Gear (22), Data reporting(23), Research and experiments (24), Minimisation of incidental mortality (25) , Environmental protection(26) , General measures (31), Fishing seasons , closed areas and prohibition of fishing (32), Bycatch limits(33), Toothfish(41), Icefish(42), Krill (51), Protected areas (91). Specifically those to minimize incidental mortality are: **Generally, under Conservation Measure 33-02 (2015) the following regulations apply:** • There shall be no directed fishing for any species other than *Dissostichus eleginoides* and *Champsocephalus gunnari* in Statistical Division 58.5.2 in the 2015/16 fishing season. • In directed fisheries in Statistical Division 58.5.2 in the 2015/16 season, the by-catch of *Channichthys rhinoceratus* shall not exceed 1663 tonnes, the by-catch of *Lepidonotothen squamifrons* shall not exceed 80 tonnes, the by-catch of *Macrourus caml* and *Macrourus whitsoni* combined shall not exceed 409 tonnes, the by-catch of *Macrourus holotrachys* and *Macrourus carinatus* combined shall not exceed 360 tonnes, and the by-catch of skates and rays shall not exceed 120 tonnes. For the purposes of this measure 'skates and rays' should be counted as a single species. • The by-catch of any fish species not mentioned in paragraph 2, and for which there is no other catch limit in force, shall not exceed 50 tonnes in Statistical Division 58.5.2. • If, in the course of a directed fishery, the by-catch in any one haul is equal to, or greater than, 5 tonnes for *Channichthys rhinoceratus*, 3 tonnes for all *Macrourus* spp. combined, or 2 tonnes for *Lepidonotothen squamifrons*, or 2 tonnes of *Somniosus* spp., or 2 tonnes of skates and rays, then the fishing vessel shall not fish using that method of fishing at any point within 5 n miles of the location where the by-catch limit is exceeded for a period of at least five days. The location where the by-catch limit is exceeded is defined as the path4 followed by the fishing vessel. • If, in the course of a directed fishery and in any one haul, the by-catch of any other by-catch species for which by-catch limitations apply under this conservation measure is equal to, or greater than, 1 tonne, then the fishing vessel shall not fish using that method of fishing at any point within 5 n miles of the location where the by-catch exceeded 1 tonne for a period of at least five days. The location where the by-catch exceeded 1 tonne is defined as the path followed by the fishing vessel. **Under Conservation Measure 24-02 (2014)** A range of protocols for prescription of longline weighting to mitigate seabird interactions. **Under Conservation Measure 25-02** (2015)

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	Protocol for minimisation of the incidental mortality of seabirds in the course of longlining in the Convention area which prescribes that: • Hooklines shall sink beyond the reach of birds as soon as possible after deployment • Autoline systems should add weight to the hookline or use integrated weight hooklines. • Spanish method of setting should release weights before line tension occurs • During longline fishing at night, only the minimum ships lights necessary for safety shall be used • Dumping of offal and discards is prohibited while setting lines* • Dumping of offal during the haul shall be avoided* • A streamer line shall be deployed during longline setting to deter birds from approaching the hookline • A bird exclusion device to discourage birds from accessing baits during hauling shall be deployed in areas defined by CCAMLR as average-to-high or high in terms of risks to seabirds, which includes are 58.5.2 (ie the HIMI Fishery) Birds captured alive should be released alive and wherever possible hooks removed without jeopardy to the bird. • Other variations may be tested if appropriate observers are onboard. * The HIMI Fishery Management Plan prohibits the discharge of offal or bycatch from the boat while in the area of the fishery. Under Conservation Measure 25-03 (2016) To reduce the incidental mortality of, or injury to, seabirds and marine mammals during trawl fishing: • The use of net monitor cables on vessels in the CAMLR Convention Area is prohibited. • Vessels operating within the Convention Area should at all times arrange the location and level of lighting so as to minimise illumination directed out from the vessel, consistent with the safe operation of the vessel. • The discharge of offal and discards shall be prohibited during the shooting and hauling of trawl gear. • Nets should be cleaned prior to shooting to remove items that might attract birds. • Vessels should adopt shooting and hauling procedures that minimise the time that the net is lying on the surface of the water with the meshes slack. Net maintenance should, to the extent possible, not be carried out with the net in the water. • Vessels should be encouraged to develop gear configurations that will minimise the chance of birds encountering the parts of the net to which they are most vulnerable. This could include increasing the weighting or decreasing the buoyancy of the net so that it sinks faster, or placing coloured streamers or other devices over particular areas of the net where the mesh sizes create a particular danger to birds. Source: https://www.ccamlr.org/en/system/files/e-schdedule2014-15.pdf Amendments to the **International Maritime Organisation's International Convention for the Prevention of Pollution from Ships (MARPOL)** Annex V which came into force on 1 January 2013 prohibit the discharge of all garbage, from all ships, into the sea (except as provided otherwise, under specific circumstances). Garbage is all kinds of food wastes including brassicas, domestic wastes and operational wastes, all plastics,

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	cargos residues, incinerator ashes, cooking oil, fishing gear, and animal carcasses generated during the normal operation of the ship and liable to be disposed of continuously or periodically except those substances which are defined or listed in other Annexes to the present Convention but not fish as a results of fishing or aquaculture activities. https://www.amsa.gov.au/environment/regulations/garbage-management-plans/sample.asp. Fishing gear is included in the definition of 'garbage' for the Convention (http://www.environment.gov.au/system/files/resources/d945695b-a3b9-4010-91b4-914efcdbae2f/files/tap-review-marine-debris.pdf.) Vessels of over 100 gross tonnage or which carries over 15 persons must have a Garbage Management Plan. Compliance by fishing vessels with the requirements of MARPOL Annex V and domestic marine pollution legislation on Commonwealth-licensed Australian fishing boats is monitored through the observer program (AFMA). Fishers must record loss of gear in vessel logbooks under the management of the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) (http://www.environment.gov.au/system/files/resources/d945695b-a3b9-4010-91b4-914efcdbae2f/files/marine-debris-background-paper.pdf).
Initiatives and strategies	The current **Australian sub-Antarctic fisheries Bycatch and Discard Workplan** (AFMA 2013) outlines measures to minimise bycatch. Other significant programs that are applicable to the HIMI fishery are the **Threat Abatement Plan (TAP) for the Incidental Catch of Seabirds During Oceanic Longline Fishing Operations (2014)** and the **National Recovery Plan for Albatrosses and Giant Petrels 2011-16**. The **Catch Documentation Scheme** was implemented in 2000 by CCAMLR to track catches of toothfish sold in participating countries. It is used to estimate IUU catch.
Enabling processes	Catches and landings are monitored by **logbooks and observer data**. 2 observers are deployed on each voyage to collect data, monitor fishing operations and undertake wildlife observations. **Stock assessments** on target species are conducted annually for icefish and bi-annually for toothfish and less frequently for non-target species. **Monitoring in the form of an annual random stratified trawl survey** is required to ensure that reliable stock assessments can be made for each target species and for monitoring the direct impact of the fishery on non-target species and ecosystem. Assessments on potentially commercial bycatch species (i.e. grey rockcod (*Lepidonotothen squamifrons*) and unicorn icefish (*Channichthys rhinoceratus)*) are based on the results of random stratified trawl surveys. Based on these assessments, TACs have been set even though they are presently non-target species. CCAMLR has also agreed to apply a general precautionary catch limit for other non-target species for which no assessment has been undertaken. Some of these species are not caught by longlining. The status and management of the fisheries is reviewed annually by the Scientific Committee and its specialist working groups using the best available science and information, including detailed data from the fisheries and fishery surveys, and the CCAMLR Scheme of International Scientific Observation.
Other initiatives or agreements	Historically, the declaration of the Heard Island and McDonald Islands (HIMI) Marine Reserve brought into effect the Commonwealth reserve provisions of the EPBC Act for the Reserve, along with those provisions applicable to World Heritage properties, listed heritage places, important wetlands, threatened and migratory species and Commonwealth marine areas. The international agreements include: •Agreement on the Conservation of Albatrosses and Petrels (ACAP)

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	•Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) •Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment (CAMBA) •Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA) Conservations Plans include: •Australia's National Recovery Plan for threatened Albatrosses and Giant Petrels 2011-2016 •Subantarctic Fur Seal and Southern Elephant Seal Recovery Plan 2004 •Threat Abatement Plan for the Incidental Catch (or By-catch) of Seabirds During Oceanic Longline Fishing Operations 2014 •Action Plan for Australian Birds 2000 •Action Plan for Australian Cetaceans 1996 •Action Plan for Australian Seals 1999 Source: http://heardisland.antarctica.gov.au/nature/protection
Data	
Logbook data	All Australian operators are required to complete electronic catch and effort logbooks with total coverage. Data verified through observer program and catch documentation scheme. Under the Fisheries Management Act 1991, the General Conditions 2014/15 require that the SFR holder to complete CCAMLR Data Form CEv2014b (10 day catch and effort report), CCAMLR Data Form C2v2014b (electronic Fine-Scale Catch and Effort Data for Longline Fisheries) and ANT04-VG (longline) in accordance with the instructions contained in the electronic logbooks. Source: Heard Island and McDonald Islands Management Plan 2002 (04/05/2016)(AFMA 2016)
Observer data	The purpose of the Observer Program is to "provide fisheries managers, research organizations, environmental agencies, the fishing industry and the wider community with independent, reliable, verified and accurate information on the fishing catch, effort and practice of a wide range of boats operating inside, and periodically outside, the Australian Fishing Zone" (AFMA http://www.afma.gov.au/fisheries-services/observer-services/: accessed 29 June 2016). AFMA observers are highly experienced in fishery observer work in Australia. They: • collect data on independent boat activity and catch data (not recorded in official logbooks) • collect data and samples for research programs, supporting marine management and other issues relevant to environmental awareness and fisheries management • monitor compliance of the boat with its fishing concession. Observer data is collated in AFMA's centralised database and data have been made available outside AFMA in the form of observer trip reports and as raw data. There are two observers on all HIMI vessels. The observers work 12 hour shifts each, ensuring that an observer is on shift during all fishing operations. All wildlife

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	interactions are also monitored. Observer data are maintained by AAD and a copy held by AFMA.
Other data	**Surveys:** Random Stratified Trawl Surveys (RSTS) have been conducted annually since 1998 to assess the juvenile stocks of Patagonian toothfish and mackerel icefish in the HIMI Fishery. The information collected on the population structure and abundance of Patagonian toothfish and mackerel icefish during these surveys is a critical input to stock assessments of these species, the last one being in 2016. Fishing Vessels participated in the 8-year benthic camera project for the AAD. This now completed project was designed to assess if fishing operations are negatively impacting the seabed (Welsford *et al.* 2014). The HIMI mackerel icefish Fishery is certified by the Marine Stewardship Council (MSC). As part of this certification, a consulting company (SCSglobal) undertakes annual surveillance audits to check if both target species continues to comply with the MSC Requirements for Continued Certification. Annual reports are made available to the public and summarise the current status of the fishery based on recent documentation received.

2.2.2 Unit of Analysis Lists (Step 2)

The units of analysis for the sub-fishery are listed by component:

- Species Components (key commercial, byproduct, bycatch and protected components). [Scoping document S2A Species]
- Habitat Component: habitat types. [Scoping document S2B Habitats]
- Community Component: community types. [Scoping document S2C Communities]

The number of units of analysis examined in this report is shown by component in the following Table.

Table 2.3 Number of units of analysis examined in this report requiring confirmation by stakeholders

KEY COMMERCIAL	BY-PRODUCT	BY-CATCH	PROTECTED	HABITATS	COMMUNITIES
1	1	88	37	2	10

Scoping Document S2A Species list

Each species identified during the scoping is added to the ERAEF database used to run the Level 2 analyses. A CAAB code (Code for Australian Aquatic Biota) is required to input the information. CAAB codes may be found at http://www.marine.csiro.au/caab/

Key/secondary commercial species

This list is as agreed by AFMA.

Table 2.4 Key commercial (C1) species in the HIMI demersal longline sub-fishery.

ERAEF SPECIES ID	ROLE IN FISHERY (COMPONENT)	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	SOURCE
765	C1	Teleost	Nototheniidae	Dissostichus eleginoides*	Patagonian toothfish	37404792	AFMA/AAD logbook

NB There are no C2 (secondary commercial species in this sub-fishery)

*This species has a biennial stock assessment, i.e. equivalent to a L3 analysis, and will not be assessed further for direct capture. Other hazards however, are assessed.

Byproduct species

Byproduct refers to any part of the catch which is kept or sold by the fisher but which is not a target species. This list is obtained by reviewing all available fishery literature, including logbooks, observer reports and discussions with stakeholders.

Table 2.5 Byproduct species in the HIMI demersal longline sub-fishery.

ERAEF SPECIES ID	ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
	BP	Teleost	Nototheniidae	*Dissostichus mawsoni*	Antarctic toothfish	37404795	AFMA/AAD logbook

Bycatch species

Bycatch as defined in the Commonwealth Policy on Fisheries Bycatch 2000 refers to:

- that part of a fisher's catch which is returned to the sea either because it has no commercial value or because regulations preclude it being retained; and
- that part of the 'catch' that does not reach the deck but is affected by interaction with the fishing gear

In sub-Antarctic fisheries, discarding is not permitted in the area of the fishery but that bycatch is retained until it is discarded outside the EEZ. However, skates and rays must be released or returned to the sea soon after capture. The list of bycatch species was obtained directly from AFMA logbook data verfied by AAD, and observer reports. Protected species were excluded. The invertebrate by catch comprised only 1.5% of total catch the majority being sea anemones. This bycatch list includes sessile or sedentary structure-forming invertebrates that constitute the habitat component but are not further expanded here. Only motile groups (defined in Table A3.1, Welsford *et al.* (2014)) were expanded from the species list from the Plateau South East (PSE) habitat (Appendix 8,Welsford *et al.* 2014), if over 100 kg were caught during the assessment period. Identifications that were insufficently resolved taxonomically e.g. invertebrates, crustaceans, rocks, litter , unknown, were excluded.

Table 2.6 Bycatch species (BC) in the HIMI demersal longline sub-fishery

ERAEF SPECIES ID	ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
	BC	Chondrichthyan	Rajidae	Rajiformes	Rays, stingrays, mantas	37031000	AFMA/AAD logbook
	BC	Chondrichthyan	Rajidae	*Bathyraja irrasa*	Kerguelen sandpaper skate	37031000	AFMA/AAD logbook
	BC	Chondrichthyan	Rajidae	*Bathyraja caeluronigricans*	Purple-black skate	not in area	AFMA/AAD logbook
	BC	Chondrichthyan	Rajidae	*Bathyraja murrayi*	Murray's skate	37031048	AFMA/AAD logbook
	BC	Chondrichthyan	Rajidae	*Bathyraja eatonii*	Eaton's skate	37031750	AFMA/AAD logbook
	BC	Chondrichthyan	Rajidae	*Raja georgiana*	Antarctic starry skate	37031753	AFMA/AAD logbook

ERAEF SPECIES ID	ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
	BC	Chondrichthyan	Squalidae	*Etmopterus lucifer*	Blackbelly lanternshark	37020005	AFMA/AAD logbook
	BC	Chondrichthyan	Squalidae	*Etmopterus granulosus*	Southern lanternshark	37020021	AFMA/AAD logbook
	BC	Chondrichthyan	Squalidae	*Somniosus pacificus*	Pacific sleeper shark	37020036	AFMA/AAD logbook
	BC	Teleost	Muraenolepididae	*Muraenolepis* spp	Moray cods	37223901	AFMA/AAD logbook
	BC	Teleost	Muraenolepididae	*Muraenolepis microps*	Smalleye moray cod	Not in CAAB	AFMA/AAD logbook
	BC	Teleost	Macrouridae[1]	*Macrourus holotrachys*	Bigeye grenadier	37232000	AFMA/AAD logbook
	BC	Teleost	Macrouridae	*Macrourus carinatus*	Ridge scaled rattail	37232036	AFMA/AAD logbook
	BC	Teleost	Macrouridae	*Macrourus whitsoni*	Whitson's grenadier	37232753	AFMA/AAD logbook
	BC	Teleost	Macrouridae	*Macrourus caml*	Caml grenadier		AFMA/AAD logbook
	BC	Teleost	Moridae	*Antimora rostrata*	Blue antimora	37224008	AFMA/AAD logbook
	BC	Teleost	Moridae	*Lepidion* spp[2]	Lepidion codlings	37224750	AFMA/AAD logbook
	BC	Teleost	Nototheniidae	*Notothenia kempi*	Striped-eyed rockcod	37404000	AFMA/AAD logbook
	BC	Teleost	Nototheniidae	*Notothenia squamifrons*	Grey rockcod	37404793	AFMA/AAD logbook
	BC	Teleost	Nototheniidae	*Notothenia coriiceps (ex rossi)*	Marbled rockcod	37404798	AFMA/AAD logbook
	BC	Teleost	Nototheniidae	*Trematomus* spp[3]	Trematomus	37404909	AFMA/AAD logbook
	BC	Teleost	Channichthyidae	Channichthyidae[4]	Crocodile icefishes	37407000	AFMA/AAD logbook
	BC	Teleost		*Rhacochilus toxotes*	Rubberlip seaperch	not in area	AFMA/AAD logbook
	BC	Invertebrate		Porifera	Sponges	10000000	observer logbook
	BC	Invertebrate		Anthoathecata	Hydroids	11002000	observer logbook
	BC	Invertebrate		*Periphylla periphylla*	Jellyfish	11128001	observer logbook
	BC	Invertebrate		Alcyonacea	Octocorals	11173000	observer logbook
	BC	Invertebrate		Gorgoniidae	Gorgonians (Octocorals)	11186000	observer logbook
	BC	Invertebrate		Pennatulacea	Sea pens	11208000	observer logbook

ERAEF SPECIES ID	ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
	BC	Invertebrate		Cnidaria	Cnidarians	11500000	observer logbook
	BC	Invertebrate		Scleractinia	Stony corals	11290000	observer logbook
	BC	Invertebrate		Actiniaria	Sea anemones	14410000	observer logbook
	BC	Invertebrate		Actinaria sp A	Sea anemones	14410000	expanded
	BC	Invertebrate		Actinaria sp H	Sea anemones	14410000	expanded
	BC	Invertebrate		Actinaria sp I	Sea anemones	14410000	expanded
	BC	Invertebrate		Actinaria sp M	Sea anemones	14410000	expanded
	BC	Invertebrate		*Capnea georgiana*	Sea anemones	11272001	expanded
	BC	Invertebrate		Hormathiidae spp.	Sea anemones	11256000	expanded
	BC	Invertebrate		L*iponema* spp.	Sea anemones	11260901	expanded
	BC	Invertebrate		Brachipoda	Brachiopods	19100000	observer logbook
	BC	Invertebrate		Bryozoa	Bryozoans	20000000	observer logbook
	BC	Invertebrate		*Aphrodita* sp.	Polychaete worm	22043901	observer logbook
	BC	Invertebrate		Loliginidae, Ommastrephidae	Various squids	23615000	observer logbook
	BC	Invertebrate		Octopodidae	Octopus	23659921	observer logbook
	BC	Invertebrate		*Muusoctopus levis*	Octopus	2365900	expanded
	BC	Invertebrate		*Graneledone antarctica*	Octopus	23659010	expanded
	BC	Invertebrate		Gastropoda	Gastropods	24000000	observer logbook
	BC	Invertebrate		Crinoidea	Crinoids	25001000	observer logbook
	BC	Invertebrate		Asteroidea Sp A	Seastar		expanded from Asteroidea
	BC	Invertebrate		Asteroidea Sp B	Seastar		expanded from Asteroidea
	BC	Invertebrate		Asteroidea Sp C	Seastar		expanded from Asteroidea
	BC	Invertebrate		Asteroidea Sp F	Seastar		expanded from Asteroidea

ERAEF SPECIES ID	ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
	BC	Invertebrate		Asteroidea Sp L	Seastar		expanded from Asteroidea
	BC	Invertebrate		Asteroidea Sp M	Seastar		expanded from Asteroidea
	BC	Invertebrate		Asteroidea Sp S	Seastar		expanded from Asteroidea
	BC	Invertebrate		Asteroidea Sp T	Seastar		expanded from Asteroidea
	BC	Invertebrate		Asteroidea Sp U	Seastar		expanded from Asteroidea
	BC	Invertebrate		Asteriidae sp A	Seastar		expanded from Asteroidea
	BC	Invertebrate		*Smilasterias* sp A	Seastar	25154902	expanded from Asteroidea
	BC	Invertebrate		*Labidiaster annulatus*	Seastar	25153003	expanded from Asteroidea
	BC	Invertebrate		*Tremaster mirabilis*	Seastar	25140001	expanded from Asteroidea
	BC	Invertebrate		*Bathybiaster loripes*	Seastar	25111024	expanded from Asteroidea
	BC	Invertebrate		*Leptychaster kerguelensis*	Seastar	25111029	expanded from Asteroidea
	BC	Invertebrate		*Cheiraster hirsutus*	Seastar		expanded from Asteroidea
	BC	Invertebrate		*Rhopiella hirsuta*	Seastar		expanded from Asteroidea
	BC	Invertebrate		*Porania antarctica*	Seastar		expanded from Asteroidea
	BC	Invertebrate		*Hymenaster* sp. A	Seastar		expanded from Asteroidea
	BC	Invertebrate		*Pteraster rugatus*	Seastar		expanded from Asteroidea
	BC	Invertebrate		*Pteraster* sp B	Seastar		expanded from Asteroidea
	BC	Invertebrate		*Cuenotaster involutus*	Seastar	25141006	expanded from Asteroidea
	BC	Invertebrate		*Solaster regularis subarctuatus*	Seastar	25136005	expanded from Asteroidea
	BC	Invertebrate		*Hippasteria falklandica*	Seastar	25122077	expanded from Asteroidea
	BC	Invertebrate		*Acodontaster elongatus*	Seastar		expanded from Asteroidea
	BC	Invertebrate		*Odontaser meridionalis*	Seastar	25123006	expanded from Asteroidea

ERAEF SPECIES ID	ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
	BC	Invertebrate		Ophiuroidea sp C	Brittlestar		expanded from Ophiuroidea
	BC	Invertebrate		Ophiuroidea sp D	Brittlestar		expanded from Ophiuroidea
	BC	Invertebrate		Ophiuroidea sp G	Brittlestar		expanded from Ophiuroidea
	BC	Invertebrate		Euryalida	Snake stars	25170911	observer logbook
	BC	Invertebrate		Gorgonocephalidae	Basketstars	25171000	observer logbook
	BC	Invertebrate		Echinoidea	Sea urchins	25200000	observer logbook
	BC	Invertebrate		Holothurian	Sea cucumbers	25400000	observer logbook
	BC	Invertebrate		*Lithodes* sp.	King crabs, stone crabs	28836000	observer logbook
	BC	Invertebrate		*Lithodes macquariae (ex murrayi)*	Subantarctic king crab	28836005	observer logbook
	BC	Invertebrate		*Paralomis* sp.	King crab	28836902	observer logbook
	BC	Invertebrate		*Paralomis aculeata*	King crab	28836902	observer logbook
	BC	Invertebrate		Pycnogonid	Sea spiders	33000000	observer logbook
	BC	Chordata		Ascidian	Sea squirts	35000000	observer logbook
	BC	Chordata		Salpidae	Salps	35103000	observer logbook

[1]The generic Macrourus spp. unit was presumed to include all species within the *Macrourus* genus identified from this subfishery and excluded.
[2]*Lepidion* sp [of McMillan & Stewart] is the only species recorded in CAAB occurring in Antarctic/subantarctic zone
[3]10 species of *Trematomus* recorded in Antarctic/subantarctic zone in CAAB
[4] 12 species in this family recorded in Antarctic/subantarctic zone in CAAB but only *Channichthys rhinoceratus* and *Champsocephalus gunnari* have been specifically identified from earlier or later catch records not in the assessment period).

Protected species

Protected species are those species listed as Threatened, Endangered or Protected under the EPBC Act, and also those that are listed migratory, marine, cetacean or conservation dependent. Protected species are often poorly listed by fisheries due to low frequency of direct interaction.

A list of Protected species has been generated from the interactions recorded in AAD observer logs and reported to AFMA (first part of Table 2.7) and observations of wildlife during setting and hauling from the AAD observer logs (second part of Table 2.7). Because the fishery is reported as 100% observed, this list was deemed comprehensive enough to have captured all protected species interacting throughout the reporting period. Compared to the previous assessment where all species that were reported as potentially occuring within the fishery jurisdiction were listed, this method has resulted in a significant reduction in the number of species listed for assessment.

Table 2.7 Protected Species (PS) in with the HIMI demersal longline sub-fishery

ERAEF SPECIES ID	ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
	PS	Marine bird	Spheniscidae	Rockhopper penguin	*Eudyptes chrysocome*	40001003	AAD observer logs/AFMA
	PS	Marine bird	Diomedeidae	Grey-headed albatross	*Thalassarche chrysostoma*	40040004	AAD observer logs/AFMA
	PS	Marine bird	Diomedeidae	Black-browed albatross	*Thalassarche melanophrys*	40040007	AAD observer logs/AFMA
	PS	Marine bird	Procellariidae	Cape petrel	*Daption capense*	40041003	AAD observer logs/AFMA
	PS	Marine bird	Procellariidae	Southern fulmar	*Fulmarus glacialoides*	40041004	AAD observer logs/AFMA
	PS	Marine bird	Procellariidae	Blue petrel	*Halobaena caerulea*	40041005	AAD observer logs/AFMA
	PS	Marine bird	Procellariidae	Kerguelen petrel	*Lugensa brevirostris*	40041006	AAD observer logs/AFMA
	PS	Marine bird	Procellariidae	Southern giant-petrel	*Macronectes giganteus*	40041007	AAD observer logs/AFMA
	PS	Marine bird	Procellariidae	Northern giant-petrel	*Macronectes halli*	40041008	AAD observer logs/AFMA

ERAEF SPECIES ID	ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
	PS	Marine bird	Procellariidae	Fulmar prion	*Pachyptila crassirostris*	40041010	Expanded from *Pachyptila* spp: AAD observer logs/AFMA
	PS	Marine bird	Procellariidae	Antarctic prion	*Pachyptila desolata*	40041011	AAD observer logs/AFMA
	PS	Marine bird	Procellariidae	Snow petrel	*Pagodroma nivea*	40041015	AAD observer logs/AFMA
	PS	Marine bird	Procellariidae	South Georgian diving petrel	*Pelecanoides georgicus*	40041016	Expanded from Diving petrel: AAD observer logs/AFMA
	PS	Marine bird	Procellariidae	Common diving-petrel	*Pelecanoides urinatrix*	40041017	Expanded from Diving petrel: AAD observer logs/AFMA
	PS	Marine bird	Procellariidae	White-chinned petrel	*Procellaria aequinoctialis*	40041018	AAD observer logs/AFMA
	PS	Marine bird	Hydrobatidae	Black-bellied storm-petrel	*Fregetta tropica*	40042002	Expanded from Storm petrel: AAD observer logs/AFMA
	PS	Marine bird	Hydrobatidae	Grey-backed storm petrel	*Garrodia nereis*	40042003	Expanded from Stormpetrel: AAD observer logs/AFMA
	PS	Marine bird	Hydrobatidae	Wilson's storm petrel (subantarctic)	*Oceanites oceanicus*	40042004	AAD observer logs/AFMA
	PS	Marine mammal	Otariidae	Antarctic fur-seal	*Arctocephalus gazella*	41131002	AAD observer logs/AFMA
	PS	Marine mammal	Phocidae	Southern Elephant seal	*Mirounga leonina*	41136004	AAD observer logs/AFMA
Observed							
	PS	Marine bird	Diomedeidae	Wandering albatross	*Diomedea salvini*		AAD observer logs
	PS	Marine bird	Diomedeidae	Buller's albatross	*Thalassarche bulleri*	40040001	AAD observer logs
	PS	Marine bird	Diomedeidae	Yellow-nosed albatross	*Thalassarche chlororhynchos*	40040003	AAD observer logs
	PS	Marine bird	Diomedeidae	Southern royal albatross	*Diomedea epomophora*	40040005	AAD observer logs

ERAEF SPECIES ID	ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
	PS	Marine bird	Diomedeidae	Wandering albatross	*Diomedea exulans*	40040006	AAD observer logs
	PS	Marine bird	Diomedeidae	Sooty albatross	*Phoebetria fusca*	40040008	AAD observer logs
	PS	Marine bird	Diomedeidae	Light-mantled albatross	*Phoebetria palpebrata*	40040009	AAD observer logs
	PS	Marine bird	Procellariidae	Grey petrel	*Procellaria cinerea*	40041019	AAD observer logs
	PS	Marine bird	Procellariidae	Great-winged petrel	*Pterodroma macroptera*	40041031	AAD observer logs
	PS	Marine bird	Procellariidae	Antarctic petrel	*Thalassoica antarctica*	40041048	AAD observer logs
	PS	Marine bird	Fregatidae	Frigate birds	*Fregata* spp.	40050000	AAD observer logs
	PS	Marine bird	Laridae	Antarctic tern (NZ)	*Sterna vittata*	40128035	AAD observer logs
	PS	Marine bird	Laridae	Great skua	*Catharacta skua*	40128005	Expanded from Stercorariidae AAD observer logs
	PS	Marine mammal	Otariidae	New Zealand fur-seal	*Arctocephalus forsteri*	41131001	AAD observer logs
	PS	Marine mammal	Physeteridae	Sperm whale	*Physeter catadon*	41119003	AAD observer logs
	PS	Marine mammal	Phocidae	Crabeater seal	*Lobodon carcinophagus*	41136003	AAD observer logs
	PS	Marine mammal	Phocidae	Ross seal	*Ommatophoca rossii*	41136005	AAD observer logs

Scoping Document S2B1. Benthic Habitats

A comprehensive assessment of the vulnerability of benthic habitats to impact by demersal fishing gear has been undertaken in the HIMI and surrounding Southern Ocean (Welsford et al. 2014). Consequently, at SARAG's September 2016 meeting, it was greed that to avoid duplication and habitats will not be assessed further. There is no SICA for this component.

Scoping Document S2B2. Pelagic Habitats.

Table 2.8 Pelagic habitats in which fishing activity occurs in HIMI longline sub-fishery (shaded) .

PELAGIC HABITAT NUMBER	PELAGIC HABITAT TYPE	DEPTH (M)	COMMENTS	SOURCE
P1	Eastern Pelagic Province - Coastal	0 – 200		ERA pelagic habitat database based on pelagic communities definitions
P2	Eastern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Community (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P3	Heard/ McDonald Islands Pelagic Provinces - Oceanic	0 - >1000	this is a compilation of the range covered by Oceanic Community (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P4	North Eastern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Community (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P5	Northern Pelagic Province - Coastal	0 – 200		ERA pelagic habitat database based on pelagic communities definitions
P6	North Western Pelagic Province - Oceanic	0 – > 800	this is a compilation of the range covered by Oceanic Community (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P7	Southern Pelagic Province - Coastal	0 – 200	this is a compilation of the range covered by Coastal pelagic Tas and GAB	ERA pelagic habitat database based on pelagic communities definitions

P8	Southern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Communities (1, 2 and 3)	ERA pelagic habitat database based on pelagic communities definitions
P9	Southern Pelagic Province - Seamount Oceanic	0 – > 600	this is a compilation of the range covered by Seamount Oceanic Communities (1), (2), and (3)	ERA pelagic habitat database based on pelagic communities definitions
P10	Western Pelagic Province - Coastal	0 – 200		ERA pelagic habitat database based on pelagic communities definitions
P11	Western Pelagic Province - Oceanic	0 – > 400	this is a compilation of the range covered by Oceanic Community (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P12	Eastern Pelagic Province - Seamount Oceanic	0 – > 600	this is a compilation of the range covered by Seamount Oceanic Communities (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P13	Heard/ McDonald Islands Pelagic Provinces - Plateau	0 -1000	this is a the same as community Heard Plateau 0-1000m	ERA pelagic habitat database based on pelagic communities definitions
P14	North Eastern Pelagic Province - Coastal	0 – 200		ERA pelagic habitat database based on pelagic communities definitions
P15	North Eastern Pelagic Province - Plateau	0 – > 600	this is a compilation of the range covered by the Northeastern Seamount Oceanic (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P16	North Eastern Pelagic Province - Seamount Oceanic	0 – > 600		ERA pelagic habitat database based on pelagic communities definitions
P17	Macquarie Island Pelagic Province - Oceanic	0 – 250		ERA pelagic habitat database based on pelagic communities definitions
P18	Macquarie Island Pelagic Province - Coastal	0 - > 1500	this is a compilation of the range covered by Oceanic Community (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions

Scoping Document S2C1. Demersal communities

In ERAEF, communities are defined as the set of species assemblages that occupy the large scale provinces and biomes identified from national bioregionalisation studies. The biota includes mobile fauna, both vertebrate and invertebrate, but excludes sessile organisms such as corals that are largely structural and are used to identify benthic habitats. The same community lists are used for all fisheries, with those selected as relevant for a particular fishery being identified on the basis of spatial overlap with effort in the fishery. The spatial boundaries for demersal communities are based on IMCRA boundaries for the shelf, and on slope bioregionalisation for the slope (IMCRA 1998; Last *et al*. 2005). The spatial boundaries for the pelagic communities are based on pelagic bioregionalisation and on oceanography (Condie *et al*. 2003; Lyne and Hayes 2004). Fishery and region specific modifications to these boundaries are described in detail in Hobday *et al*. (2007) and briefly outlined in the footnotes to the community tables below.

Table 2.9 Demersal communities in which fishing activity occurs in HIMI longline sub-fishery x). Shaded cells indicate all communities within the provinces. NB In HIMI EEZ communities are combined (see footnote)

	PROVINCE																			
DEMERSAL COMMUNITY	CAPE	NORTH EASTERN	NORTH EASTERN	CENTRAL EASTERN	CENTRAL EASTERN	SOUTH EASTERN	CENTRAL BASS	TASMANIAN	WESTERN TAS TRANSITION	SOUTHERN	SOUTH WESTERN	CENTRAL WESTERN	CENTRAL WESTERN TRANSITION	NORTH WESTERN	NORTH WESTERN	TIMOR	TIMOR TRANSITION	HEARD & MCDONALD IS	MACQUARIE IS
Inner Shelf 0 – 110m [1,2]																			
Outer Shelf 110 – 250m [1,2,]																			
Upper Slope 250 – 565m [3]																			
Mid–Upper Slope 565 – 820m[3]																			
Mid Slope 820 – 1100m[3]																			
Lower slope/ Abyssal > 1100m[6]																		X*	
Reef 0 -110m[7, 8]																			

DEMERSAL COMMUNITY	PROVINCE																		
	CAPE	NORTH EASTERN	NORTH EASTERN	CENTRAL EASTERN	CENTRAL EASTERN	SOUTH EASTERN	CENTRAL BASS	TASMANIAN	WESTERN TAS TRANSITION	SOUTHERN	SOUTH WESTERN	CENTRAL WESTERN	CENTRAL WESTERN TRANSITION	NORTH WESTERN	NORTH WESTERN	TIMOR	TIMOR TRANSITION	HEARD & MCDONALD IS	MACQUARIE IS
Reef 110-250m[8]																			
Seamount 0 – 110m																			
Seamount 110- 250m																			
Seamount 250 – 565m																			
Seamount 565 – 820m																			
Seamount 820 – 1100m																			
Seamount 1100 – 3000m																			
Plateau 0 – 110m																			
Plateau 110- 250m[4]																			
Plateau 250 – 565m[4]																			
Plateau 565 – 820m[5]																		X**	
Plateau 820 – 1100m[5]																			

[1] Four inner shelf communities occur in the Timor Transition (Arafura, Groote, Cape York and Gulf of Carpentaria) and three inner shelf communities occur in the Southern (Eyre, Eucla and South West Coast). At Macquarie Is: 2inner & outer shelves (0-250m), and 3 upper and midslope communities combined (250-1000m). **At Heard/McDonald Is: [4]outer and upper slope plateau communities combined to form four communities: Shell Bank, Inner and Outer Heard Plateau (100-500m) and Western Banks (200-500m), [5]mid and upper plateau communities combined i.e. North East, South East and Western Troughs, Southern Upper Slope and North Eastern Plateau (500-1000m), and [6] 3 groups at Heard Is: Deep Shell Bank (>1000m), Southern and North East Lower slope/abyssal**, [7]Great Barrier Reef in the North Eastern Province and Transition and [8] Rowley Shoals in North Western Transition.

Demersal communities fished were: *Southern and North East Lower Slope Abyssal, Shell Bank Deep; **Southern Upper Slope, South Eastern Trough, North Eastern Trough, and Western Trough.

Scoping Document S2C2. Pelagic communities

Table 2.10 Pelagic communities in which fishing activity occurs in HIMI longline sub-fishery (x). Shaded cells indicate all communities that exist in the province.

PELAGIC COMMUNITY	PROVINCE							
	NORTHEASTERN	EASTERN	SOUTHERN	WESTERN	NORTHERN	NORTHWESTERN	HEARD AND MCDONALD IS2	MACQUARIE IS
Coastal pelagic 0-200m[1,2]								
Oceanic (1) 0 – 600m								
Oceanic (2) >600m								
Seamount oceanic (1) 0 – 600m								
Seamount oceanic (2) 600-3000m								
Oceanic (1) 0 – 200m								
Oceanic (2) 200-600m								
Oceanic (3) >600m								
Seamount oceanic (1) 0 – 200m								
Seamount oceanic (2) 200 – 600m								
Seamount oceanic (3) 600-3000m								
Oceanic (1) 0-400m								
Oceanic (2) >400m								
Oceanic (1) 0-800m								
Oceanic (2) >800m								

PELAGIC COMMUNITY	PROVINCE							
	NORTHEASTERN	EASTERN	SOUTHERN	WESTERN	NORTHERN	NORTHWESTERN	HEARD AND MCDONALD IS2	MACQUARIE IS
Plateau (1) 0-600m								
Plateau (2) >600m								
Heard Plateau 0-1000m [3]							x	
Oceanic (1) 0-1000m							x	
Oceanic (2) >1000m							x	
Oceanic (1) 0-1600m								
Oceanic (2) >1600m								

[1] Northern Province has five coastal pelagic zones (NWS, Bonaparte, Arafura, Gulf and East Cape York) and Southern Province has two zones (Tas, GAB). [2] At Macquarie Is: coastal pelagic zone to 250m. [3] At Heard and McDonald Is: coastal pelagic zone broadened to cover entire plateau to maximum of 1000m

Pelagic communities identified were Heard Plateau 0-1000m, Oceanic 1 (0-1000m) and 2(>1000m) i.e. the latter two communities are offshore over 1000m and greater bottom depth.

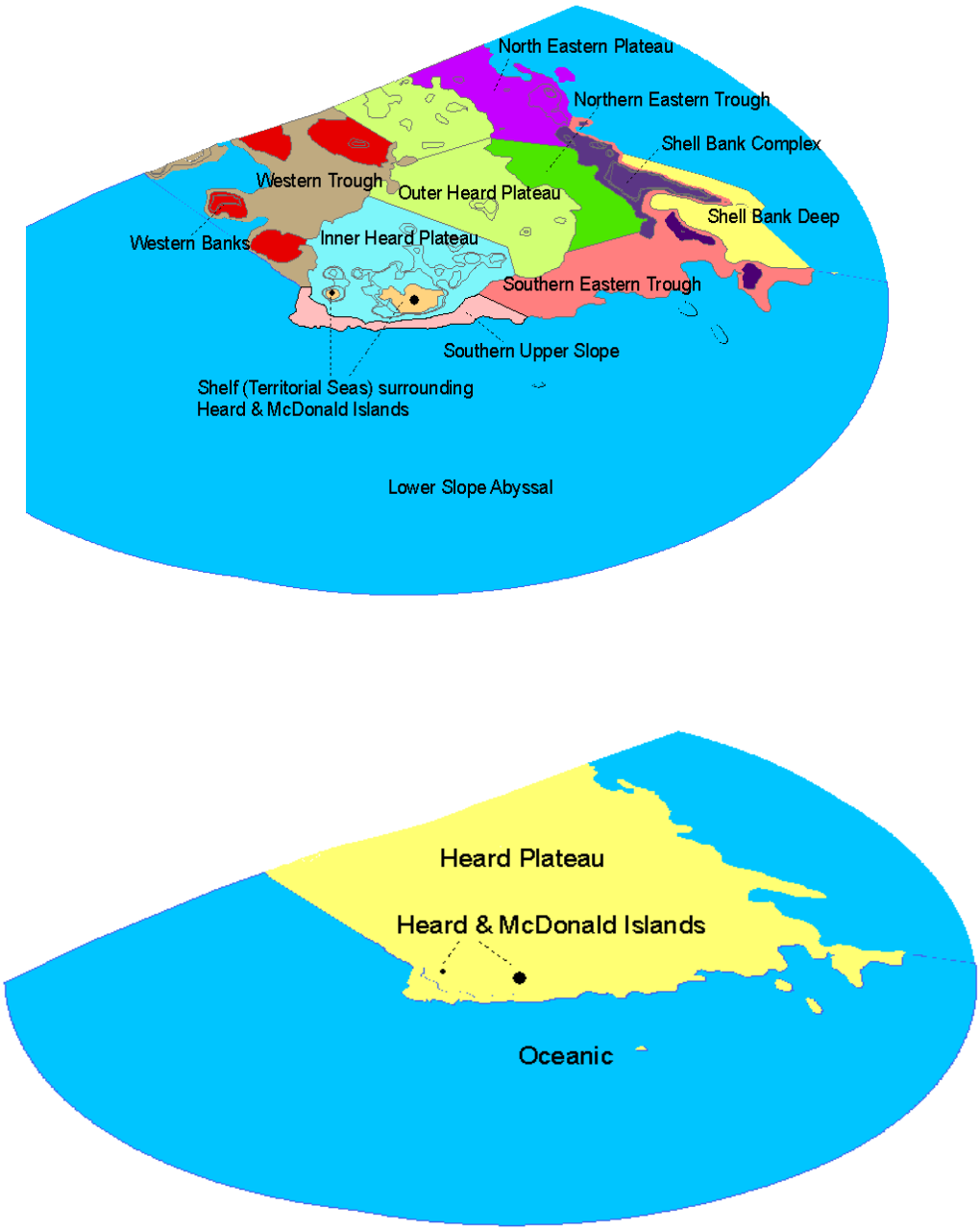

Figure 2.1 (a) Demersal and (b) pelagic communities in the Heard Island and McDonald Islands Fisheries

2.2.3 Identification of Objectives for Components and Sub-components (Step 3)

Objectives are identified for each sub-fishery for the five ecological components (target, bycatch/byproduct and protected species, habitats, and communities) and sub-components, and are clearly documented. It is important to identify objectives that managers, the fishing industry, and other stakeholders can agree on, and that scientists can quantify and assess. The criteria for selecting ecological operational objectives for risk assessment are that they:

- be biologically relevant;
- have an unambiguous operational definition;
- be accessible to prediction and measurement; and
- that the quantities they relate to be exposed to the hazards.

For fisheries that have completed ESD reports, use can be made of the operational objectives stated in those reports.

Each 'operational objective' is matched to example indicators. Scoping Document S3 provides suggested examples of operational objectives and indicators. Where operational objectives are already agreed for a fishery (Existing Management Objectives (EMO)), those should be used (e.g. Strategic Assessment Reports). The objectives need not be exactly specified, with regard to numbers or fractions of removal/impact, but should indicate that an impact in the sub-component is of concern/interest to the sub-fishery. The rationale for including or discarding an operational objective is a crucial part of the table and must explain why the particular objective has or has not been selected for in the (sub) fishery. Only the operational objectives selected for inclusion in the (sub) fishery are used for Level 1 analysis (Level 1 SICA Document L1.1).

Scoping Document S3 Components and Sub-components: Identification of Objectives

Table 2.11 Objectives for components and sub-components. NB Operational objectives that are eliminated are shaded out.

COMPONENT	CORE OBJECTIVE	SUB-COMPONENT	EXAMPLE OPERATIONAL OBJECTIVES	EXAMPLE INDICATORS	RATIONALE
	"What is the general goal?"		"What you are specifically trying to achieve"	"What you are going to use to measure performance"	Rationale flagged as 'EMO' where Existing Management Objective in place, or 'AMO' where there is an existing AFMA Management Objective in place for other Commonwealth fisheries (assumed that squid fishery will fall into line).
Target species	Maintain key commercial stocks at ecologically sustainable levels Avoid recruitment failure of the target species Avoid negative consequences for species or population sub-components	1. Population size	1.1 No trend in biomass 1.2 Maintain biomass above a specified level 1.3 Maintain catch at specified level 1.4 Species do not approach extinction or become extinct	Biomass, numbers, CPUE, yield, Length frequency,	1.1 Target species managed to maintain biomass above set levels 1.2 EMO and AMO – maintain ecologically viable stock levels 1.3 TACs for each species set by biological reference points based on EMO. Catch levels vary yearly as determined by the TACs. 1.4 Covered by 1.2
		2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across known distribution range	2.1 Fishery managed in two zones and there are regional catch limits for target species per one degree square throughout all fishery for specified vessel
		3. Genetic diversity	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (Ne), number of spawning units	3.1 Not currently monitored in this fishery, difficult and expected to respond at a slower rate than some of the other indicators.
		4. Age/size/sex structure	4.1 Age/size/sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers or relative proportion in age/size/sex classes Biomass of spawners Mean size, sex ratio	4.1 Maintain population size and age structure. Fishery catches can be dominated by few age classes. Need to ensure this does not adversely impact on the entire population

COMPONENT	CORE OBJECTIVE	SUB-COMPONENT	EXAMPLE OPERATIONAL OBJECTIVES	EXAMPLE INDICATORS	RATIONALE
		5. Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1 TACs and Trigger catch limits are set conservatively in the knowledge that the target species have large natural fluctuations in numbers. A change in fecundity might result in lower recruitment to the fishery
		6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bate, lights)	6.1 Populations of target species move widely in response to currents. Trigger TACs set to minimize impacts on spatially or temporally more vulnerable schools
Byproduct and Bycatch species	Avoid recruitment failure of the byproduct and bycatch species Avoid negative consequences for species or population sub-components	1. Population size	1.1 No trend in biomass 1.2 Maintain biomass above a specified level 1.3 Maintain catch at specified level 1.4 Species do not approach extinction or become extinct	Biomass, numbers, density, CPUE, yield	1.1 Byproduct/bycatch catch limits set to ensure catch remains a small proportion of total catch. 1.2 Total catch set to ensure biomass or target and byproduct/bycatch remain at sustainable levels. 1.3 Not desirable to maintain by-catch/by-product at specified level - minimise by-catch/by-product 1.4 EMO - Fishing is conducted in a manner that does not threaten stocks of by-product / by-catch species (AFMA 2002).
		2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across space	2.1 Not currently monitored. No specific management objective based on the geographic range of by-catch/by-product species.
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1 Not currently monitored. No reference levels established. No specific management objective based on the genetic structure of by-catch species.
		4. Age/size/sex structure	4.1 Age/size/sex structure does not	Biomass, numbers or	4.1 Not currently monitored. No reference

COMPONENT	CORE OBJECTIVE	SUB-COMPONENT	EXAMPLE OPERATIONAL OBJECTIVES	EXAMPLE INDICATORS	RATIONALE
			change outside acceptable bounds (e.g. more than X% from reference structure)	relative proportion in age/size/sex classes Biomass of spawners Mean size, sex ratio	levels established. No specific management objective for the age/size structure of byproduct/bycatch species
		5 Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1. Not currently monitored in the fishery. No specific management measures identified to assess changes in reproductive capacity of byproduct/bycatch species
		6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1 Not currently monitored in the fishery. No specific management measures identified to assess changes in reproductive capacity of byproduct/bycatch species
Protected species	Avoid recruitment failure of protected species Avoid negative consequences for protected species or population sub-components Avoid negative impacts on the population from fishing	1. Population size	1.1 No trend in biomass 1.2 Maintain biomass above a specified level 1.3 Maintain catch at specified level 1.4 Species do not further approach extinction or become extinct	Biomass, numbers, density, CPUE, yield	1.1 A positive trend in biomass is desirable for protected species. 1.2 Maintenance of biomass above specified level not currently a fishery operational objective. 1.3 Objective is avoidance of catch 1.4 EMO - The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species (AFMA 2002).
		2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across space, i.e. the GAB	2.1 Change in geographic range of protected species may have serious consequences e.g. population fragmentation and/or forcing species into sub-optimal areas.
		3. Genetic structure	3.1 Genetic diversity does not change	Frequency of genotypes in the population,	3.1 Because population size of protected species is often small, sensitive to

COMPONENT	CORE OBJECTIVE	SUB-COMPONENT	EXAMPLE OPERATIONAL OBJECTIVES	EXAMPLE INDICATORS	RATIONALE
			outside acceptable bounds	effective population size (N_e), number of spawning units	loss of genetic diversity. Genetic monitoring may be an effective approach to measure possible fishery impacts.
		4. Age/size/sex structure	4.1 Age/size/sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers or relative proportion in age/size/sex classes Biomass of spawners Mean size, sex ratio	4.1 Monitoring the age/size/sex structure of protected species populations may be a useful management tool allowing the identification of possible fishery impacts and that cross-section of the population most at risk.
		5. Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) 5.2 Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1 & 5.2 The reproductive capacity of protected species is of concern because potential fishery induced changes in reproductive ability (e.g. reduction in bait fish reduction in seabird brooding success) may have immediate impact on the population size.
		6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1 Longline may attract protected species and alter behaviour and movement patterns, resulting in the attraction of predators. The overall effect may be to further fragment the population. Fishing operations may also influence the behaviour of calving whales by visual/sound stimuli.
		7. Interactions with fishery	7.1 Interactions between PS and the fishery are minimised. 7.2 Survival after interactions is maximised 7.3 Interactions do not affect the viability of the population or its ability to recover	Number of interactions Survival rate of species after interactions Number of interactions, biomass or numbers in population	7.1, 7.2, 7.3 EMO - The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species).

COMPONENT	CORE OBJECTIVE	SUB-COMPONENT	EXAMPLE OPERATIONAL OBJECTIVES	EXAMPLE INDICATORS	RATIONALE
Habitats	Avoid negative impacts on the quality of the environment Avoid reduction in the amount and quality of habitat	1. Water quality	1.1 Water quality does not change outside acceptable bounds	Water chemistry, noise levels, debris levels, turbidity levels, pollutant concentrations, light pollution from artificial light	1.1 Few water quality issues due to few vessels in fishery
		2. Air quality	2.1 Air quality does not change outside acceptable bounds	Air chemistry, noise levels, visual pollution, pollutant concentrations, light pollution from artificial light	2.1 Not currently perceived as an important habitat sub-component.
		3. Substrate quality	3.1 Sediment quality does not change outside acceptable bounds	Sediment chemistry, stability, particle size, debris, pollutant concentrations	3.1 Longline has small footprint on the substrate and does not interfere with substrate
		4. Habitat types	4.1 Relative abundance of habitat types does not vary outside acceptable bounds	Extent and area of habitat types, % cover, spatial pattern, landscape scale	4.1 Longline operations not perceived to result in change of habitat frequency.
		5. Habitat structure and function	5.1 Size, shape and condition of habitat types does not vary outside acceptable bounds	Size structure, species composition and morphology of biotic habitats	5.1 Longline activities unlikely to result in local disruption to pelagic processes
Communi-ties	Avoid negative impacts on the composition/ function/ distribution/ structure of the community	1. Species composition	1.1 Species composition of communities does not vary outside acceptable bounds	Species presence/absence, species numbers or biomass (relative or absolute) Richness Diversity indices Evenness indices	1.1 EMO - The fishery is conducted, in a manner that minimises the impact of fishing operations on ecological communities (AFMA 2002).
		2. Functional group composition	2.1 Functional group composition does not change outside acceptable bounds	Number of functional groups, species per functional group (e.g. autotrophs, filter feeders, herbivores, omnivores, carnivores)	2.1 The presence/abundance of 'functional group' members may fluctuate widely, however in terms of maintenance of ecosystem processes it is important that the aggregate effect of a functional group is maintained.

COMPONENT	CORE OBJECTIVE	SUB-COMPONENT	EXAMPLE OPERATIONAL OBJECTIVES	EXAMPLE INDICATORS	RATIONALE
		3. Distribution of the community	3.1 Community range does not vary outside acceptable bounds	Geographic range of the community, continuity of range, patchiness	3.1 There may be changes to the geographic extent of community components due to associated fishing activities.
		4. Trophic/size structure	4.1 Community size spectra/trophic structure does not vary outside acceptable bounds	Size spectra of the community Biomass/number in each size class Mean trophic level Number of trophic levels	4.1 Extraction of target species or byproduct/ bycatch may change community dynamics
		5 Bio- and geo-chemical cycles	5.1 Cycles do not vary outside acceptable bounds	Indicators of cycles, salinity, carbon, nitrogen, phosphorus flux	5.1 Longline operations not perceived to have a measurable effect on bio and geochemical cycles.

2.2.4 **Hazard Identification (Step 4)**

Hazards are the activities undertaken in the process of fishing, and any external activities, which have the potential to lead to harm.

The effects of fishery/sub-fishery specific hazards are identified under the following categories:

- capture
- direct impact without capture
- addition/movement of biological material
- addition of non biological material
- disturbance of physical processes
- external hazards

These fishing and external activities are scored on a presence/absence basis for each fishery/sub-fishery. An activity is scored as a zero if it does not occur and as a one if it does occur. The rationale for the scoring is also documented in detail and must include if/how the activity occurs and how the hazard may impact on organisms/habitat.

Scoping Document S4. Hazard Identification Scoring Sheet

Fishery Name: Heard Island and McDonald Islands

Sub-fishery Name: Demersal longline sub-fishery

Date: October 2016

Table 2.12 Hazard identification

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	SCORE (0/1)	DOCUMENTATION OF RATIONALE
Capture	Bait collection	0	Bait not caught by this fishery.
	Fishing	1	Longlining specifically targets Patagonian toothfish.
	Incidental behaviour	0	Vessel too large and operating offshore for recreational fishing by crew
Direct impact without capture	Bait collection	0	Bait not caught by this fishery.
	Fishing	1	Disorientation/injury/mortality as a result of momentary entanglement but animal may free itself, e.g. seabird in brickle curtain, escaping target species. Birds may strike vessel.
	Incidental behaviour	0	Vessel too large and offshore for recreational fishing by crew
	Gear loss	1	Major gear loss has been reported.
	Anchoring/ mooring	0	Fishery generally operates in deeper water; vessel does not anchor when not fishing.
	Navigation/steaming	1	Steaming/navigation within fishing grounds may result in collisions (e.g. seabirds or whales vessel interactions), seabird collisions with night-time lights/navigation lights.
Addition/ movement of biological material	Translocation of species	1	Frozen bait- squid.
	On board processing	0	Fish processed on-board but discarding of offal and bycatch prohibited within fishery jurisdiction.
	Discarding catch	0	Discarding prohibited within the fishery jurisdiction
	Stock enhancement	0	None occurs
	Provisioning	0	None occurs
	Organic waste disposal	0	Disposal of organic wastes strictly controlled under MARPOL regulations.
Addition of non-biological material	Debris	0	General rubbish generated during general fishing vessel operations is retained and disposed of ashore or incinerated while at sea.
	Chemical pollution	0	Waste discharge from vessel controlled under MARPOL regulations and Fisheries Management Plan.
	Exhaust	1	Vessel introduces exhaust into the environment.
	Gear loss	1	Minor components may be lost Major gear loss has been reported.
	Navigation/ steaming	1	Fishing vessel navigates to and from fishing grounds.
	Activity/ presence on water	1	Vessel introduces noise and visual stimuli into the environment.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	SCORE (0/1)	DOCUMENTATION OF RATIONALE
Disturb physical processes	Bait collection	0	Bait not collected by this fishery.
	Fishing	1	Longlines may disturb sediment/benthos upon retrieval.
	Boat launching	0	Not applicable. Vessels in fishery come from designated ports.
	Anchoring/ mooring	0	Does not occur on fishing grounds or in area of the fishery.
	Navigation/ steaming	1	Small number of vessels navigate within fishing grounds.
External Hazards (specify the particular example within each activity area)	Other capture fishery methods	1	Demersal trawl, midwater trawl occur in the HIMI. Although permitted, potting does not occur in the fishery. Foreign legal fishing adjacent. No illegal fishing reported.
	Aquaculture	0	
	Coastal development	0	
	Other extractive activities	0	
	Other non-extractive activities	0	
	Other anthropogenic activities	1	Tourist/shipping occurs to Heard Island but unlikely to occur on fishing grounds

Table 2.13 Examples of fishing activities (Modified from Fletcher et al. 2002)

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	EXAMPLES OF ACTIVITIES INCLUDE
Capture		**Activities that result in the capture or removal of organisms. This includes cryptic mortality due to organisms being caught but dropping out prior to the gear's retrieval (i.e. They are caught but not landed)**
	Bait collection	Capture of organisms due to bait gear deployment, retrieval and bait fishing. This includes organisms caught but not landed.
	Fishing	Capture of organisms due to gear deployment, retrieval and actual fishing. This includes organisms caught but not landed.
	Incidental behaviour	Capture of organisms due to crew behaviour incidental to primary fishing activities, possible in the crew's down time; e.g. crew may line or spear fish while anchored, or perform other harvesting activities, including any land-based harvesting that occurs when crew are camping in their down time.
Direct impact, without capture		**This includes any activities that may result in direct impacts (damage or mortality) to organisms without actual capture.**
	Bait collection	Direct impacts (damage or mortality) to organisms due to interactions (excluding capture) with bait gear during deployment, retrieval and bait fishing. This includes: damage/mortality to organisms through contact with the gear that doesn't result in capture, e.g. Damage/mortality to benthic species by gear moving over them, organisms that hit nets but aren't caught.
	Fishing	Direct impacts (damage or mortality) to organisms due to interactions (excluding capture) with fishing gear during deployment, retrieval and fishing. This includes: damage/mortality to organisms through contact with the gear that doesn't result in capture, e.g. Damage/mortality to benthic species by gear moving over them, organisms that hit nets but are not caught.
	Incidental behaviour	Direct impacts (damage or mortality) without capture, to organisms due to behaviour incidental to primary fishing activities, possibly in the crew's down time; e.g. the use of firearms on scavenging species, damage/mortality to organisms through contact with the gear that the crew uses to fish during their down time. This does not include impacts on predator species of removing their prey through fishing.
	Gear loss	Direct impacts (damage or mortality), without capture on organisms due to gear that has been lost from the fishing boat. This includes damage/mortality to species when the lost gear contacts them or if species swallow the lost gear.
	Anchoring/ mooring	Direct impact (damage or mortality) that occurs and when anchoring or mooring. This includes damage/mortality due to physical contact of the anchor, chain or rope with organisms, e.g. An anchor damaging live coral.
	Navigation/ steaming	Direct impact (damage or mortality) without capture may occur while vessels are navigating or steaming. This includes collisions with marine organisms or birds.
Addition/ movement of biological material		**Any activities that result in the addition or movement of biological material to the ecosystem of the fishery.**

	Translocation of species (boat movements, reballasting)	The translocation and introduction of species to the area of the fishery, through transportation of any life stage. This transport can occur through movement on boat hulls or in ballast water as boats move throughout the fishery or from outside areas into the fishery.
	On board processing	The discarding of unwanted sections of target after on board processing introduces or moves biological material, e.g. heading and gutting, retaining fins but discarding trunks.
	Discarding catch	The discarding of unwanted organisms from the catch can introduce or move biological material. This includes individuals of target and byproduct species due to damage (e.g. shark or marine mammal predation), size, high grading and catch limits. Also includes discarding of all non-retained bycatch species. This also includes discarding of catch resulting from incidental fishing by the crew. The discards could be alive or dead.
	Stock enhancement	The addition of larvae, juveniles or adults to the fishery or ecosystem to increase the stock or catches.
	Provisioning	The use of bait or berley in the fishery.
	Organic waste disposal	The disposal of organic wastes (e.g. food scraps, sewage) from the boats.
Addition of non-biological material		**Any activities that result in non-biological material being added to the ecosystem of the fishery, this includes physical debris, chemicals (in the air and water), lost gear, noise and visual stimuli.**
	Debris	Non-biological material may be introduced in the form of debris from fishing vessels or mother ships. This includes debris from the fishing process: e.g. cardboard thrown over from bait boxes, straps and netting bags lost. Debris from non-fishing activities can also contribute to this e.g. Crew rubbish – discarding or food scraps, plastics or other rubbish. Discarding at sea is regulated by MARPOL, which forbids the discarding of plastics.
	Chemical pollution	Chemicals can be introduced to water, sediment and atmosphere through: oil spills, detergents other cleaning agents, any chemicals used during processing or fishing activities.
	Exhaust	Exhaust can be introduced to the atmosphere and water through operation of fishing vessels
	Gear loss	The loss of gear will result in the addition of non-biological material, this includes hooks, line, sinkers, nets, otter boards, light sticks, buoys etc.
	Navigation /steaming	The navigation and steaming of vessels will introduce noise and visual stimuli into the environment. Boat collisions and/or sinking of vessels. Echo-sounding may introduce noise that may disrupt some species (e.g. whales, orange roughy)
	Activity /presence on water	The activity or presence of fishing vessels on the water will noise and visual stimuli into the environment.

Disturb physical processes		**Any activities that will disturb physical processes, particularly processes related to water movement or sediment and hard substrate (e.g. boulders, rocky reef) processes.**
	Bait collection	Bait collection may disturb physical processes if the gear contacts seafloor-disturbing sediment, or if the gear disrupts water flow patterns.
	Fishing	Fishing activities may disturb physical processes if the gear contacts seafloor-disturbing sediment, or if the gear disrupts water flow patterns.
	Boat launching	Boat launching may disturb physical processes, particularly in the intertidal regions, if dredging is required, or the boats are dragged across substrate. This would also include foreshore impacts where fishers drive along beaches to reach fishing locations and launch boats. Impacts of boat launching that occurs within established marinas are outside the scope of this assessment.
	Anchoring /mooring	Anchoring/mooring may affect the physical processes in the area that anchors and anchor chains contact the seafloor.
	Navigation /steaming	Navigation /steaming may affect the physical processes on the benthos and the pelagic by turbulent action of propellers or wake formation.
External hazards		**Any outside activities that will result in an impact on the component in the same location and period that the fishery operates. The particular activity as well as the mechanism for external hazards should be specified.**
	Other capture fishery methods	Take or habitat impact by other commercial, indigenous or recreational fisheries operating in the same region as the fishery under examination
	Aquaculture	Capture of feed species for aquaculture. Impacts of cages on the benthos in the region
	Coastal development	Sewage discharge, ocean dumping, agricultural runoff
	Other extractive activities	Oil and gas pipelines, drilling, seismic activity
	Other non-extractive activities	Defence, shipping lanes, dumping of munitions, submarine cables
	Other anthropogenic activities	Recreational activities, such as scuba diving leading to coral damage, power boats colliding with whales, dugongs, turtles. Shipping, oil spills

2.2.5 Bibliography (Step 5)

All references used in the scoping assessment are included in the References section.

Key documents can be found on the AFMA web page at www.afma.gov.au and include the following:

- HIMI Fishery Management Plan 2002
- HIMI Fishery Regulations 2002
- HIMI Fishery Management Arrangements Booklet
- HIMI Total Allowable Catch and Trawl Fishing Capacity Determination 2015
- HIMI Fishery Patagonian toothfish stock assessments
- Ecological risk assessments
- Bycatch and Discard Workplans
- Antarctic Living Resources Conservation Act 1981

Other publications that provided information:

- Data Summary Reports (logbook and observer)
- Observer trip reports
- ABARES Fishery Status Reports
- DoE Assessments under EPBC ACt
-

2.2.6 Decision rules to move to Level 1 (Step 6)

Any hazards that are identified at Step 4 Hazard Identification as occurring in the fishery are carried forward for analysis at Level 1.

In this case, 15 out of 26 possible internal activities were identified as occurring in this fishery. Four out of 6 external activities were identified. Thus, a total of 19 activity-component scenarios will be considered at Level 1. This results in 95 total scenarios (of 160 possible) to be developed and evaluated using the unit lists (species, habitats, communities).

2.3 Level 1 Scale, Intensity and Consequence Analysis (SICA)

Level 1 aims to identify which hazards lead to a significant impact on any species, habitat or community. Analysis at Level 1 is for whole components (target; bycatch and

byproduct; PS species; habitat; and communities), not individual sub-components. Since Level 1 is used mainly as a rapid screening tool, a "worst case" approach is used to ensure that elements screened out as low risk (either activities or components) are genuinely low risk. Analysis at Level 1 for each component is accomplished by considering the most vulnerable sub-component and the most vulnerable unit of analysis (e.g. most vulnerable species, habitat type or community). This is known as credible scenario evaluation in conventional risk assessment. In addition, where judgments about risk are uncertain, the highest level of risk that is still regarded as plausible is chosen. For this reason, the measures of risk produced at Level 1 cannot be regarded as absolute.

At Level 1 each fishery/sub-fishery is assessed using a scale, intensity and consequence analysis (SICA). SICA is applied to the component as a whole by choosing the most vulnerable sub-component (linked to an operational objective) and most vulnerable unit of analysis. The rationale for these choices must be documented in detail. These steps are outlined below. Scale, intensity, and consequence analysis (SICA) consists of thirteen steps. The first ten steps are performed for each activity and component, and correspond to the columns of the SICA table. The final three steps summarise the results for each component.

Step1: Record the hazard identification score (absence (0) presence (1) scores) identified at step 3 at the scoping level (Scoping Document S3) onto the SICA table

Step 2: Score spatial scale of the activity

Step 3: Score temporal scale of the activity

Step 4: Choose the sub-component most likely to be affected by activity

Step 5: Choose the most vulnerable unit of analysis for the component e.g. species, habitat type or community assemblage

Step 6: Select the most appropriate operational objective

Step 7: Score the intensity of the activity for that sub-component

Step 8: Score the consequence resulting from the intensity for that subcomponent

Step 9: Record confidence/uncertainty for the consequence scores

Step 10: Document rationale for each of the above steps

Step 11: Summary of SICA results

Step 12: Evaluation/discussion of Level 1

Step 13: Components to be examined at Level 2

2.3.1 Record the hazard identification score (absence (0) presence (1) scores) identified at step 3 in the scoping level onto the SICA Document (Step 1)

Record the hazard identification score absence (0) presence (1) identified at Step 3 at the scoping level onto the SICA sheet. A separate sheet will be required for each component (target, bycatch and byproduct, and PS species, habitat, and communities). Only those activities that scored a 1 (presence) will be analysed at Level 1.

2.3.2 Score spatial scale of activity (Step 2)

The greatest spatial extent must be used for determining the spatial scale score for each identified hazard. For example, if fishing (e.g. capture by longline) takes place within an area of 200 nm by 300 nm, then the spatial scale is scored as 4. The score is then recorded onto the SICA Document and the rationale documented.

Table 2.14 Spatial scale score of activity

<1 NM:	1-10 NM:	10-100 NM:	100-500 NM:	500-1000 NM:	>1000 NM:
1	2	3	4	5	6

Maps and graphs may be used to supplement the information (e.g. sketches of the distribution of the activity relative to the distribution of the component) and additional notes describing the nature of the activity should be provided. The spatial scale score at Step 2 is not used directly, but the analysis is used in making judgments about level of intensity at Step 7. Obviously, two activities can score the same with regard to spatial scale, but the intensity of each can differ vastly. The reasons for the score are recorded in the rationale column of the SICA spreadsheet.

2.3.3 Score temporal scale of activity (Step 3)

The highest frequency must be used for determining the temporal scale score for each identified hazard. If the fishing activity occurs daily, the temporal scale is scored as 6. If oil spillage occurs about once per year, then the temporal scale of that hazard scores a 3. The score is then recorded onto the SICA Document and the rationale documented.

Table 2.15 Temporal scale score of activity

DECADAL (1 DAY EVERY 10 YEARS OR SO)	EVERY SEVERAL YEARS (1 DAY EVERY SEVERAL YEARS)	ANNUAL (1-100 DAYS PER YEAR)	QUARTERLY (100-200 DAYS PER YEAR)	WEEKLY (200-300 DAYS PER YEAR)	DAILY (300-365 DAYS PER YEAR)
1	2	3	4	5	6

It may be more logical for some activities to consider the aggregate number of days that an activity occurs. For example, if the activity "fishing" was undertaken by 10 boats during the same 150 days of the year, the score is 3. If the same 10 boats each spend 30 non-overlapping days fishing, the temporal scale of the activity is a sum of 300 days, indicating that a score of 6 is appropriate. In the case where the activity occurs over many days, but only every 10 years, the number of days by the number of years in the cycle is used to determine the score. For example, 100 days of an activity every 10 years averages to 10 days every year, so that a score of 3 is appropriate.

The temporal scale score at Step 3 is not used directly, but the analysis is used in making judgments about level of intensity at Step 7. Obviously, two activities can score the same with regard to temporal scale, but the intensity of each can differ vastly. The reasons for the score are recorded in the rationale column.

2.3.4 Choose the sub-component most likely to be affected by activity (Step 4)

The most vulnerable sub-component must be used for analysis of each identified hazard. This selection must be made on the basis of expected highest potential risk for each 'direct impact of fishing' and 'fishing activity' combination, and recorded in the 'sub-component' column of the SICA Document. The justification is recorded in the rationale column.

2.3.5 Choose the unit of analysis most likely to be affected by activity and to have highest consequence score (Step 5)

The most vulnerable 'unit of analysis' (i.e. most vulnerable species, habitat type or community) must be used for analysis of each identified hazard. The species, habitats, or communities (depending on which component is being analysed) are selected from Scoping Document S2 (A – C). This selection must be made on the basis of expected highest potential risk for each 'direct impact of fishing' and 'fishing activity' combination, and recorded in the 'unit of analysis' column of the SICA Document. The justification is recorded in the rationale column.

2.3.6 Select the most appropriate operational objective (Step 6)

To provide linkage between the SICA consequence score and the management objectives, the most appropriate operational objective for each sub-component is chosen. The most relevant operational objective code from Scoping Document S3 is recorded in the 'operational objective' column in the SICA document. Note that SICA can only be performed on operational objectives agreed as important for the (sub) fishery during scoping and contained in Scoping Document S3. If the SICA process identifies reasons to include sub-components or operational objectives that were previously not included/eliminated then these sub-components or operational objectives must be re-instated.

2.3.7 Score the intensity of the activity for the component (Step 7)

The score for intensity of an activity considers the direct impacts in line with the categories shown in the conceptual model (Figure 2) (capture, direct impact without capture, addition/movement of biological material, addition of non-biological material, disturbance to physical processes, external hazards). The intensity of the activity is judged based on the scale of the activity, its nature and extent. Activities are scored as per intensity scores below.

Table 2.16 Intensity score of activity (Modified from Fletcher *et al*. 2002)

LEVEL	SCORE	DESCRIPTION
Negligible	1	remote likelihood of detection at any spatial or temporal scale
Minor	2	occurs rarely or in few restricted locations and detectability even at these scales is rare
Moderate	3	moderate at broader spatial scale, or severe but local
Major	4	severe and occurs reasonably often at broad spatial scale
Severe	5	occasional but very severe and localized or less severe but widespread and frequent
Catastrophic	6	local to regional severity or continual and widespread

This score is then recorded on the Level 1 (SICA) Document and the rationale documented.

2.3.8 Score the consequence of intensity for that component (Step 8)

The consequence of the activity is a measure of the likelihood of not achieving the operational objective for the selected sub-component and unit of analysis. It considers the flow on effects of the direct impacts from Step 7 for the relevant indicator (e.g. decline in biomass below the selected threshold due to direct capture). Activities are scored as per consequence scores below. A more detailed description of the

consequences at each level for each component (target, bycatch and byproduct, PS species, habitats, and communities) is provided as a guide for scoring the consequences of the activities in the description of consequences table (see Table 5 Appendix C).

Table 2.17 Consequence score for ERAEF activities (Modified from Fletcher *et al*. 2002).

LEVEL	SCORE	DESCRIPTION
Negligible	1	Impact unlikely to be detectable at the scale of the stock/habitat/community
Minor	2	Minimal impact on stock/habitat/community structure or dynamics
Moderate	3	Maximum impact that still meets an objective (e.g. sustainable level of impact such as full exploitation rate for a target species).
Major	4	Wider and longer term impacts (e.g. long-term decline in CPUE)
Severe	5	Very serious impacts now occurring, with relatively long time period likely to be needed to restore to an acceptable level (e.g. serious decline in spawning biomass limiting population increase).
Intolerable	6	Widespread and permanent/irreversible damage or loss will occur-unlikely to ever be fixed (e.g. extinction)

The score should be based on existing information and/or the expertise of the risk assessment group. The rationale for assigning each consequence score must be documented. The conceptual model may be used to link impact to consequence by showing the pathway that was considered. In the absence of agreement or information, the highest score (worst case scenario) considered plausible is applied to the activity.

2.3.9 Record confidence/uncertainty for the consequence scores (Step 9)

The information used at this level is qualitative and each Step is based on expert (fishers, managers, conservationists, scientists) judgment. The confidence rating for the consequence score is rated as 1 (low confidence) or 2 (high confidence) for the activity/component. The score is recorded on the SICA Document and the rationale documented. The confidence will reflect the levels of uncertainty for each score at Steps 2, 3, 7 and 8.

Table 2.18 Description of Confidence scores for consequences.

CONFIDENCE	SCORE	RATIONALE FOR THE CONFIDENCE SCORE
Low	1	Data exists, but is considered poor or conflicting No data exists Disagreement between experts
High	2	Data exists and is considered sound Consensus between experts Consequence is constrained by logical consideration

2.3.10 **Document rationale for each of the above Steps (Step 10)**

The rationale forms a logical pathway to the consequence score. It is provided for each choice at each Step of the SICA analysis

2.3.11 Level 1 (SICA) Documents

Table 2.19 L1.2 – Target Species Component

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Capture	Bait collection	0									
	Fishing	1	4	3	Age/size structure	Patagonian toothfish	4.1	3			Biennial stock assessments negate the need for assessment -no further action required
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									
	Fishing	1	4	3	Population Size	Patagonian toothfish	1.2	2	2	2	Population size most likely to be affected if escaped fish have reduced survival=>intensity minor -some gear retrieved=> consequence minor escaped fish may have good survival given success of tagging studies and detection of impact unlikely => confidence high, observer data and logbooks
	Incidental behaviour	0									
	Gear loss	1	4	3	Population Size	Patagonian toothfish	1.2	2	1	2	Gear loss occurs often, recovery occurs occasionally => intensity minor - recovery occurs occasionally, baits disappear rapidly so no ghost fishing and due to IWL (integrated weighted line) gear does not ball up thus little

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											risk of entanglement to fish => consequence negligble => confidence high, observer reports all lost gear and reports on retrieved gear.
	Anchoring/ mooring	0									
	Navigation/ steaming	1	4	3	Behaviour/movement	Patagonian toothfish	6.1	1	1	2	Few vessels on grounds and species are deepwater species below 400m therefore cannot interact with vessel => intensity negligble =>consequence negligble =>confidence high, logic
Addition/ movement of biological material	Translocation of species	1	4	3	Population size	Patagonian toothfish	1.2	2	2	1	Frozen bait (squid) used therefore a risk of introducing disease from other area => intensity minor as bait loss probably low or is retrieved with gear and catch=>consequence minor because no detectable impacts have occurred and AQIS strictly regulates and licence importation of bait bought from Australia => confidence low, no data
	On board processing	0									
	Discarding catch	0									
	Stock enhancement	0									

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Provisioning	0									
	Organic waste disposal	0									
Addition of non-biological material	Debris	0									
	Chemical pollution	0									
	Exhaust	1	4	3	Population size	Patagonian toothfish	1.2	1	1	2	Exhaust from vessel daily but dispersed and would have no effect on demersal fish =>intensity negligible=>consequnece negligible=>confidence high, logical
	Gear loss	1	4	3	Population size	Patagonian toothfish	1.2	2	2	1	Gear loss occurs frequently, recovery occurs occasionally => intensity minor - recovery occurs occasionally, baits disappear rapidly so ghost fishing reduced and due to IWL (integrated weighted line) gear does not ball up thus little risk of entanglement to fish => consequence minor => confidence low, observer reports all lost gear but no data concerning risk to fish from entanglent.
	Navigation/ steaming	1	4	3	Behaviour/movement	Patagonian toothfish	6.1	1	1	2	Limited vessels operating in area therefore noise and stimuli from navigation /steaming , collision , echo sounding minimal =>intensity negligible=>consequence negligible as fish are deepwater species=>confidence high, logical

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Activity/ presence on water	1	4	3	Behaviour/movement	Patagonian toothfish	6.1	1	1	2	Limited vessels operating in area therefore noise and stimuli but target species >400m and unlikey to be affected=>intensity negligible=>consequence negligible=>confidence high, logical
Disturb physical processes	Bait collection	0									
	Fishing	1	4	3	Behaviour/movement	Patagonian toothfish	6.1	1	1	1	Lines are weighted internally therefore area of impact very small unless inensity of activity increases and might affect beahviour/movement of target species=>intensity negligible=>consequence negligible=>confidence low, no data
	Boat launching	0									
	Anchoring/ mooring	0									
	Navigation/ steaming	1	4	3	Behaviour/movement	Patagonian toothfish	6.1	1	1	2	Limited vessels operating and disturbance of water column would be undetectable against oceanic processes and at depth of fish =>intensity negligible=>consequence negligible=>confidence high, logical
External Impacts)	Other fisheries: HIMI demersal trawl, HIMI midwater trawl	1	3	3	Population size	Patagonian toothfish	1.1	3	2	2	Demersal and midwater trawling occurs nearby and but at lower effort therefore might have a minor impact. TAC is common across all gears. Occasional scientific surveys take fish but would have minimal impact => intensity moderate=> consequence minor as catches down to 4% of total TAC=> confidence high, logbook & observer data,

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											biennial stock assessments data limits catch to within sustainable levels although stock structure uncertain
	Aquaculture	0									
	Coastal development	0									
	Other extractive activities	0									
	Other non extractive activities	0									
	Other anthropogenic activities	1	3	3	Behaviour/movement	Patagonian toothfish	6.1	1	1	2	Tourist/shipping occurs to Heard Island but unlikely to occur on fishing grounds and to affect deepwater species=>intensity negligble=>consequence negligble=>confidence high

Table 2.20 L1.2 - Byproduct and Bycatch Component

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Capture	Bait collection	0	0	0							
	Fishing	1	4	3	Population size	Skates and rays	1.1	3	2	2	Longlining occurs over an area of at least 95,000 sq km =>fishing occurs average <200 d per year but is increasing=>skates and rays chosen as most vulnerable species because of their known low productivity; over past 5 years catch ~29 t pa (~1% total catch) of which more than half are released ; average of ~10% of TAC of 120 tonnes retained annually => intensity moderate as catch and effort variable but stable => consequence moderate as impacts probably detectable => confidence high, observer data and logbooks
	Incidental behaviour	0	0	0							
Direct impact without capture	Bait collection	0	0	0							
	Fishing	1	4	3	Population size	Skates and rays	1.1	3	2	2	Skates and rays are released from line either before coming on board or shortly after to reduce post-capture mortality => intensity moderate => consequence minor-bycatch levels low in this fishery but post-capture survival is unknown and should be monitored closely (Nowara *et al.* 2017) - 0.5% of total catch => confidence high, observer data and logbooks

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Incidental behaviour	0	0	0							
	Gear loss	1	4	3	Population size	Skates and rays	1.1	2	1	2	Gear loss occurs often, recovery occurs occasionally => intensity minor - recovery occurs occasionally, baits disappear rapidly so no ghost fishing and due to IWL (integrated weighted line) gear does not ball up thus little risk of entanglement to fish => consequence negligible => confidence high, observer reports all lost gear and reports on retrieved gear
	Anchoring/ mooring	0	0	0							
	Navigation/ steaming	1	4	3	Behaviour/movement	Skates and rays	6.1	1	1	2	Limited vessels on grounds and species are deepwater species below 400m therefore would not interact with vessels=> intensity negligible=>consequence negligible=>confidence high, logic
Addition/ movement of biological material	Translocation of species	1	4	3	Population size	Skates and rays	1.1	2	2	1	Frozen (imported) bait (squid, pelagic species) used therefore a risk of introducing disease from other area => intensity minor as bait loss probably low or is retrieved with gear and catch=>consequence minor because no detectable impacts have occurred and AQIS strictly regulates and licence importation of bait bought from Australia => confidence low, no data
	On board processing	0	0	0							

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Discarding catch	0	0	0							
	Stock enhancement	0	0	0							
	Provisioning	0	0	0							
	Organic waste disposal	0	0	0							
Addition of non-biological material	Debris	0	0	0							
	Chemical pollution	0	0	0							
	Exhaust	1	4	3	Population size	Skates and rays	1.1	1	1	2	Exhaust from vessel daily but dispersed and would have no effect on demersal fish =>intensity negligible=>consequence negligible=>confidence high, logical
	Gear loss	1	4	3	Population size	Skates and rays	1.1	2	2	1	Gear loss occurs often, recovery occurs occasionally => intensity minor - recovery occurs occasionally, baits disappear rapidly so no ghost fishing and due to IWL (integrated weighted line) gear does not ball up thus little risk of entanglement to fish => consequence negligible => confidence high, observer reports all lost gear and reports on retrieved gear

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Navigation/ steaming	1	4	3	Behaviour/movement	Skates and rays	6.1	1	1	2	Limited vessels operating in area therefore noise and stimuli from navigation /steaming , collision , echo sounding minimal at depth =>intensity negligible=>consequence negligible as fish are deepwater species=>confidence high, logical
	Activity/ presence on water	1	4	3	Behaviour/movement	Skates and rays	6.1	1	1	2	Limited vessels operating in area therefore noise and stimuli but species are deepwater =>intensity negligible=>consequence negligible=>confidence high, logical
Disturb physical processes	Bait collection	0	0	0							
	Fishing	1	4	3	Behaviour/movement	Skates and rays	6.1	1	1	1	Lines are weighted internally therefore area of impact very small unless intensity of activity increases and might affect behaviour/movement of skates and rays=>intensity negligible=>consequence negligible=>confidence low, no data, logical
	Boat launching	0	0	0							
	Anchoring/ mooring	0	0	0							
	Navigation/ steaming	1	4	3	Behaviour/movement	Skates and rays	6.1	1	1	2	Limited vessels operating and disturbance of water column would be undetectable against oceanic processes =>intensity negligible=>consequence negligible=>confidence high, logical

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
External Impacts	Other fisheries: HIMI demersal trawl, HIMI midwater trawl	1	3	3	Population size	Skates and rays	1.1	2	2	2	Demersal trawling occurs nearby but at much lower effort although much higher catch rate. Midwater trawling insignificant. Common TAC with longlining =>intensity minor =>consequence minor - catch rates of skates from the trawl fisheries are moderate and no evidence of depletion in the main fishing grounds =>confidence high as recent studies of population size suggest recovery
	Aquaculture	0									
	Coastal development	0	0	0							
	Other non-extractive activities	0	0	0							
	Other anthropogenic activities	1	3	3	Behaviour/movement	Skates and rays	6.1	1	1	2	Tourist/shipping occurs to Heard Island but unlikely to occur on fishing grounds and to affect deepwater species=>intensity negligible=>consequence negligible=>confidence high

Table 2.21 L1.3 – Protected Species Component

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE(1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Capture	Bait collection	0	0	0							
	Fishing	1	4	3	Population size	Southern & Northern Giant Petrels *Macronectes giganteus & halli*, Black-browed Albatross *Thalassarche melanophrys* Elephant Seal *Mirounga leonina*	1.1	2	2	2	Longlining occurs over an area of at least 95,000 sq km =>fishing occurs average <200 d per year but is increasing=> 13 Elephant seals caught; Southern Giant Petrel population has declined globally HIMI (~4400 prs total); HIMI population declined by about 50% since 1950s now listed Endangered; much of the decline over last 20 years attributed to illegal fishing activities esp longlining. Black browed albatross seen regularly on fishing grounds therefore at risk from longline fishing: population declined by 25% since 1990s (HIMI ~680 prs total) =>intensity minor -5 giant petrels killed (2 Southern, 2 Northern, 1 undetermined), 1 non-fatal Black-browed =>consequence minor elephant seals populations >200 000 and stable =>confidence high, 100% observer coverage and all records of wildlife interactions are reported.
	Incidental behaviour	0	0	0							
	Bait collection	0	0	0							

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE(1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Direct impact without capture	Fishing	1	4	3	Population size	Southern & Northern Giant Petrels *Macronectes giganteus & halli,* Black-browed Albatross *Thalassarche melanophrys*	1.1	2	2	2	Birds might interact with gear as it is being deployed or hauled however mitigating measures are strictly implemented > However Southern Elephant seals entangled in gear often fatal-13 killed =>intensity minor some giant petrels released alive; =>consequence minor no evidence of post-capture mortality =>confidence high, 100% observer coverage and all records of wildlife interactions are reported.
	Incidental behaviour	0	0	0							
	Gear loss	1	4	3	Population size	Elephant Seal *Mirounga leonina*	1.1	2	1	1	Gear loss occured often but low amounts ~ 1% , recovery occured very occasionally. 13 elephant seals captured during longlining operations => intensity minor=> consequence negligble no evidence of ghost fishing from recovery of gear and population of elephant seals >220 00 and stable=> confidence high, observer reports all lost gear and reports on retrieved gear however only low % of gear recovered
	Anchoring/ mooring	0	0	0							

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE(1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Navigation/steaming	1	4	3	Population size	Southern & Northern Giant Petrels *Macronectes giganteus & halli*	1.1	1	1	2	Smaller petrels particularly Storm and Cape occasionally collide with or land on vessel during operations however mitigating measures are strictly implemented such as minimising lights=> intensity negligible as no Giant Petrels or Albatross have been taken or injured although petrels often interact with vessel => consequence negligible=>confidence high, 100% observer coverage and all records of wildlife interactions are reported.
Addition/ movement of biological material	Translocation of species	1	4	3	Population size	Southern & Northern Giant Petrels *Macronectes giganteus & halli*, Black-browed Albatross *Thalassarche melanophrys*	1.1	2	1	2	Birds less able to take bait from lines due to strict regulations on setting gear with weighted lines to minimise seabird attraction. 1 grey headed albatross fatally injured while interacting with gear and 1 giant petrel non-fatally snagged while attempting to feed =>intensity minor =>consequence negligible => confidence high, 100% observer coverage
	On board processing	0	0	0							
	Discarding catch	0	0	0							
	Stock enhancement	0	0	0							
	Provisioning	0	0	0							

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE(1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Organic waste disposal	0	0	0							
Addition of non-biological material	Debris	0	0	0							
	Chemical pollution	0	0	0							
	Exhaust	1	4	3	Behaviour/movement	Southern & Northern Giant Petrels *Macronectes giganteus & halli*, Black-browed Albatross *Thalassarche melanophrys* , Petrels	6.1	1	1	2	Exhaust from vessel daily but dispersed and would have little effect on birds =>intensity negligible=> consequence negligible=>confidence high, logical
	Gear loss	1	4	3	Population Size	Elephant Seal Mirounga leonina	1.1	2	1	2	Gear loss occurs often. Gear lost on bottom may be encountered by elephant seals =>intensity minor some lost gear recovered =>consequence negligible => confidence high, 100% observer coverage, industry reports no seals captured on gear retrieval

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE(1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Navigation/ steaming	1	4	3	Behaviour/movement	Southern & Northern Giant Petrels *Macronectes giganteus & halli*, Black-browed Albatross *Thalassarche melanophrys* , Wandering Albatross *Diomedea exulans,* Petrels	1.1	1	2	2	Limited vessels operating in area therefore noise and stimuli from navigation /steaming , collision , echo sounding minimal => intensity negligible=> consequence minor as birds may be attracted or repelled temporarily but not persistent change=>confidence high, logical
	Activity/ presence on water	1	4	3	Behaviour/movement	Southern & Northern Giant Petrels *Macronectes giganteus & halli*, Black-browed Albatross *Thalassarche melanophrys,* Light mantled Albatross *Phoebetria palpebrata*, Wandering Albatross *Diomedea exulans*	6.1	1	2	2	Limited vessels operating in area therefore noise and stimuli and unlikely to be affected=>intensity negligible=>consequence minor as birds may be attracted or repelled temporarily but not persistent change=>confidence high, logical

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE(1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Disturb physical processes	Bait collection	0	0	0							
	Fishing	1	4	3	Behaviour/movement	Elephant Seal *Mirounga leonina*	6.1	1	1	1	Gear is weighted and might affect benthic physical processes but area of impact small unless intensity of activity increases; lines and float might affect water column causing disruption to foraging area of Elephant Seals which are known to occur in areas of longline fishing =>intensity negligible => consequence negligible=>confidence low, no data
	Boat launching	0	0	0							
	Anchoring/ mooring	0	0	0							
	Navigation/steaming	1	4	3	Behaviour/movement	Elephant Seal *Mirounga leonina*	6.1	1	1	2	Few vessels operating and disturbance of water column would be undetectable against oceanic processes unlikely to affect marine mammals=>intensity negligible=>consequence negligible=>confidence high, logical

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE(1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
External Impacts	Other fisheries: HIMI demersal trawl; HIMI midwater trawl	1	3	3	Population size	Southern & Northern Giant Petrels *Macronectes giganteus & halli,* Black-browed Albatross *Thalassarche melanophrys,* Light mantled Albatross *Phoebetria palpebrata*	1.1	2	1	2	Demersal and midwater trawling occurred nearby at lower effort, one black-browed albatross being killed during trawling operations. Mortality from adjacent French Division significantly reduced in recent years and unlikely to impact bird populations around HIMI =>intensity minor and trawling effort declining=>consequence negligible => confidence high, high observer coverage
	Aquaculture	0	0	0							
	Coastal development	0	0	0							
	Other extractive activities	0	0	0							
	Other non-extractive activities	0	0	0							
	Other anthropogenic activities	1	3	3	Population size	Southern & Northern Giant Petrels *Macronectes giganteus & halli,* Black-browed Albatross	6.1	1	1	2	Tourist/shipping occurs to Heard Island but unlikely to occur on fishing grounds and to affect bird populations unless fishing=>intensity negligible=>consequence negligible=>confidence high

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE(1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
						Thalassarche melanophrys, Light mantled Albatross *Phoebetria palpebrata*					

Table 2.22 L1.5 - Habitat Component

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE(1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Capture	Bait collection	0	0	0							
	Fishing	1	4	3	Habitat structure and function	Benthic habitats	4.1	3			Habitat assessment negates the need for assessment -no further action required
	Incidental behaviour	0	0	0							
Direct impact without capture	Bait collection	0	0	0							
	Fishing	1	4	3	Habitat structure and function	Benthic habitats	1.1	2			Habitat assessment negates the need for assessment -no further action required
	Incidental behaviour	0	0	0							
	Gear loss	1	4	3	Habitat structure and function	Benthic habitats	1.1	2			Habitat assessment negates the need for assessment -no further action required
	Anchoring/ mooring	0	0	0							
	Navigation/steaming	1	4	3	Water quality	Heard/ McDonald Islands Pelagic Provinces - Oceanic	1.1	3	1	2	Few vessels on grounds and only affect upper few metres of oceanic environment => intensity moderate =>consequence negligible

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE(1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											disturbance of water column would be undetectable against oceanic processes =>confidence high, logical
Addition/ movement of biological material	Translocation of species	1	4	3	Habitat structure and function	Benthic habitats	1.1	3			Habitat assessment negates the need for assessment -no further action required
	On board processing	0	0	0							
	Discarding catch	0	0	0							
	Stock enhancement	0	0	0							
	Provisioning	0	0	0							
	Organic waste disposal	0	0	0							
Addition of non-	Debris	0	0	0							
	Chemical pollution	0	0	0							

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE(1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
biological material	Exhaust	1	4	3	Air quality	Heard/ McDonald Islands Pelagic Provinces - Oceanic	3.1	1	1	2	Exhaust from running engines may impact the air quality of the species within habitat (e.g. birds) =>Intensity negligible =>Consequence negligible due to rapid dispersal of pollutants in winds, and likely to be physically undetectable over very short time frames. =>Confidence high: logical because effect of exhaust was considered to be localised.
	Gear loss	1	4	3	Distribution of community	Benthic habitats	3.1	2			Habitat assessment negates the need for assessment -no further action required
	Navigation/ steaming	1	4	3	Water quality	Heard/ McDonald Islands Pelagic Provinces - Oceanic	3.1	2	1	2	Limited vessels operating in area only upper few m affected =>intensity minor =>consequence negligible unlikely to detect any variations in distribution =>confidence high, logical
	Activity/ presence on water	1	4	3	Water quality	Heard/ McDonald Islands Pelagic Provinces - Oceanic	3.1	2	1	2	Limited vessels operating in area only upper few m affected =>intensity minor

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE(1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											=>consequence negligible unlikely to detect any variations in distribution =>confidence low
Disturb physical processes	Bait collection	0	0	0							
	Fishing	1	4	3	Distribution of community	Benthic habitats-not assessed	3.1	1			
	Boat launching	0	0	0							
	Anchoring/ mooring	0	0	0							
	Navigation/ steaming	1	4	3	Water quality	Heard/ McDonald Islands Pelagic Provinces - Oceanic	3.1	2	1	2	Limited vessels operating only upper few m affected => intensity negligible => consequence negligible disturbance of water column would be undetectable against oceanic processes => confidence high, logical
External Impacts	Other fisheries: HIMI demersal trawl, HIMI midwater trawl	1	3	3	Habitat structure and function	Benthic habitats-not assessed	1.1	3			
	Aquaculture	0	0	0							

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE(1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Coastal development	0	0	0							
	Other extractive activities	0	0	0							
	Other non-extractive activities	0	0	0							
	Other anthropogenic activities	1	3	3	Water quality	Heard/ McDonald Islands Pelagic Provinces - Plateau	3.1	1	1	2	Tourist/shipping occurs to Heard Island –vessels operating only upper few m affected =>intensity negligible =>consequence negligible =>confidence high, logical

Table 2.23 L1.5 - Community Component

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Direct impact with capture	Bait collection	0	0	0							
	Fishing	1	4	3	Trophic/size structure	Southern Lower Slope (>1000m)	4.1	3	3	1	Longlining occurs over an area of at least 95,000 sq km, about 30,000 in Southern Lower Slope =>fishing occurs average <200 d per year but is increasing => removal of targe species especially larger size fish may change community dynamics => Intensity moderate => Consequence rated as moderate - catches close to TAC targeting larger fish likely to impacting trophic/size structure of community => Confidence low; survey data for target and major bycatch species e.g. skates and rays, macrourids, grey rockcod suggest populations reasonably stable but highly variable and uncertain.
	Incidental behaviour	0	0	0							
Direct impact without capture	Bait collection	0	0	0							
	Fishing	1	4	3	Species composition	Southern Lower Slope (>1000m)	1.1	2	2	2	Composition of community may be affected by post-capture mortality of bycaught species => Intensity minor=> Consequence rated as minor as

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											unlikely to detect changes up to 5% => Confidence low; survey data for target and major bycatch species e.g. skates and rays, macrourids, grey rockcod suggest populations reasonably stable but high uncertainty.
	Incidental behaviour	0	0	0							
	Gear loss	1	4	3	Species composition	Southern Lower Slope (>1000m)	1.1	2	1	1	Gear loss occurs often but very low rate of loss 1%=> intensity minor and some gear is retrieved, baits readily disappear and weighted line prevents balling this reducing risk of entanglement of fish => consequence negligible if gear retrieved => confidence high, observer reports all lost gear
	Anchoring/ mooring	0	0	0							
	Navigation/ steaming	1	4	3	Species composition	Southern Lower Slope (>1000m)	1.1	1	1	2	Limited vessels on grounds deepwater species => intensity negligible => consequence negligible=> confidence high, logical consideration
Addition/ movement of	Translocation of species	1	4	3	Species composition	Southern Lower Slope (>1000m)	1.1	2	2	1	Frozen bait (squid) used therefore a risk of introducing disease from other area => intensity minor as bait loss probably low =>consequence minor because no detectable impacts have occurred and AQIS strictly regulates and licence

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
biological material											importation of bait bought from Australia => confidence low, no data
	On board processing	0	0	0							
	Discarding catch	0	0	0							
	Stock enhancement	0	0	0							
	Provisioning	0	0	0							
	Organic waste disposal	0	0	0							
Addition of non-biological material	Debris	0	0	0							
	Chemical pollution	0	0	0							
	Exhaust	1	4	3	Distribution of community	Southern Lower Slope (>1000m)	3.1	1	1	2	Exhaust from vessel not impacting on demersal community => Intensity negligible=> consequence negligible=> confidence high, logical
	Gear loss	1	4	3	Distribution of community	Southern Lower Slope (>1000m)	3.1	2	1	1	Gear loss occurs often but small amounts (~1%) , little gear has been recovered but effort currently increasing=>intensity minor - baits readily

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											disappear and weighted line prevents balling thus reducing risk of attraction to and entanglement of fish => consequence minor particularly if gear recovered eventually, possibility of altering distribution of community members from lost gear is unlikely to be detectable=> confidence low , no data on risk to species
	Navigation/ steaming	1	4	3	Distribution of community	Southern Lower Slope (>1000m)	3.1	1	1	1	Limited vessels operating in area therefore noise and stimuli from navigation /steaming , collision , echo sounding minimal but might affect large marine mammals in the area temporarily=> intensity negligible=>consequence negligible unlikely to detect any variations in distribution =>confidence low
	Activity/ presence on water	1	4	3	Distribution of community	Southern Lower Slope (>1000m)	3.1	1	1	2	Limited vessels operating in area therefore noise and stimuli might attract/repel species and affect distribution of pelagic community temporarily=> intensity negligible=> consequence negligible unlikely to detect any variations in distribution => confidence high, logic
Disturb physical processes	Bait collection	0	0	0							
	Fishing	1	4	3	Distribution of community	Southern Lower Slope (>1000m)	3.1	2	1	1	Gear impact might affect distribution of benthic community => intensity minor => consequence

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											negligible –no evidence that gear disturbs /damages benthic biota=> confidence low, no data
	Boat launching	0	0	0							
	Anchoring/ mooring	0	0	0							
	Navigation/steaming	1	4	3	Distribution of community	Southern Lower Slope (>1000m)	3.1	1	1	2	Limited vessels operating and disturbance of water column would be undetectable against oceanic processes => intensity negligible=> consequence negligible=> confidence high, logic
External Impacts	Other fisheries: HIMI demersal trawl, HIMI midwater trawl	1	3	3	Species composition	Southern Eastern Trough 500-1000m	1.1	2	2	1	Demersal trawling occurs marginally in community, greater effort in shallower adjacent communities =>intensity minor=> consequence minor as TACs limits the possibility of impact on population sizes => confidence low as stock structures and population sizes of minor species still uncertain.
	Aquaculture	0	0	0							
	Coastal development	0	0	0							

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Other extractive activities	0	0	0							
	Other non-extractive activities	0	0	0							
	Other anthropogenic activities	1	3	3	Distribution of community	Heard Plateau 0-1000m pelagic	3.1	1	1	2	Tourist/shipping occurs to Heard Island but unlikely to occur on fishing grounds and to affect deep-water species=>intensity negligible=>consequence negligible=>confidence high

Summary of SICA results

Table 2.24 Level 1 (SICA) Document L1.6. Summary table of consequence scores for all activity/component combinations. Those that scored ≥3 are highlighted grey and bolded if high confidence. * existing stock assessment –assessment not required.** existing benthic habitat assessment-assessment not required

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	KEY COMM-ERCIAL	BYCATCH BYPRODUCT	PROTECTED	HABITAT	COMMUNITY
Capture	Bait collection	0	0	0	0	0
	Fishing	*	2	2	**	3
	Incidental behaviour	0	0	0	0	0
Direct impact without capture	Bait collection	0	0	0	0	0
	Fishing	2	2	2	**	2
	Incidental behaviour	0	0	0	0	0
	Gear loss	2	1	1	**	1
	Anchoring/ mooring	0	0	0	0	0
	Navigation/ steaming	1	1	1	1	1
Addition/ movement of biological material	Translocation of species	2	2	1	**	2
	On board processing	0	0	0	0	0
	Discarding catch	0	0	0	0	0
	Stock enhancement	0	0	0	0	0
	Provisioning	0	0	0	0	0
	Organic waste disposal	0	0	0	0	0
Addition of non-biological material	Debris	0	0	0	0	0
	Chemical pollution	0	0	0	0	0
	Exhaust	1	1	1	1	1
	Gear loss	2	1	1	**	1
	Navigation/ steaming	1	1	2	1	1
	Activity/ presence on water	1	1	2	1	1
Disturb physical processes	Bait collection	0	0	0	0	0
	Fishing	1	1	1	**	1
	Boat launching	0	0	0	0	0
	Anchoring/ mooring	0	0	0	0	0
	Navigation/steaming	1	1	1	1	1
External	Other fisheries	2	2	2	**	2
	Aquaculture	0	0	0	0	0
	Coastal development	0	0	0	0	0
	Other extractive activities	0	0	0	0	0
	Other non-extractive activities	0	0	0	0	0
	Other anthropogenic activities	**1**	**1**	**1**	**1**	**1**

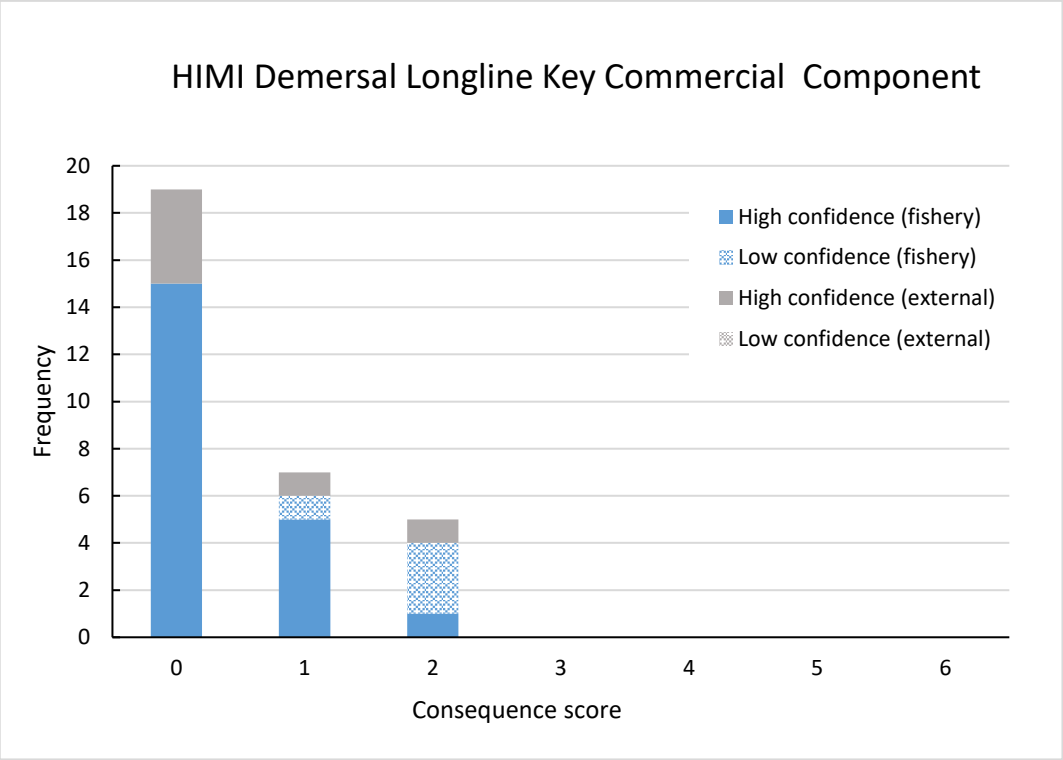

Figure 2.2 Key commercial species: Frequency of consequence score differentiated between high and low confidence

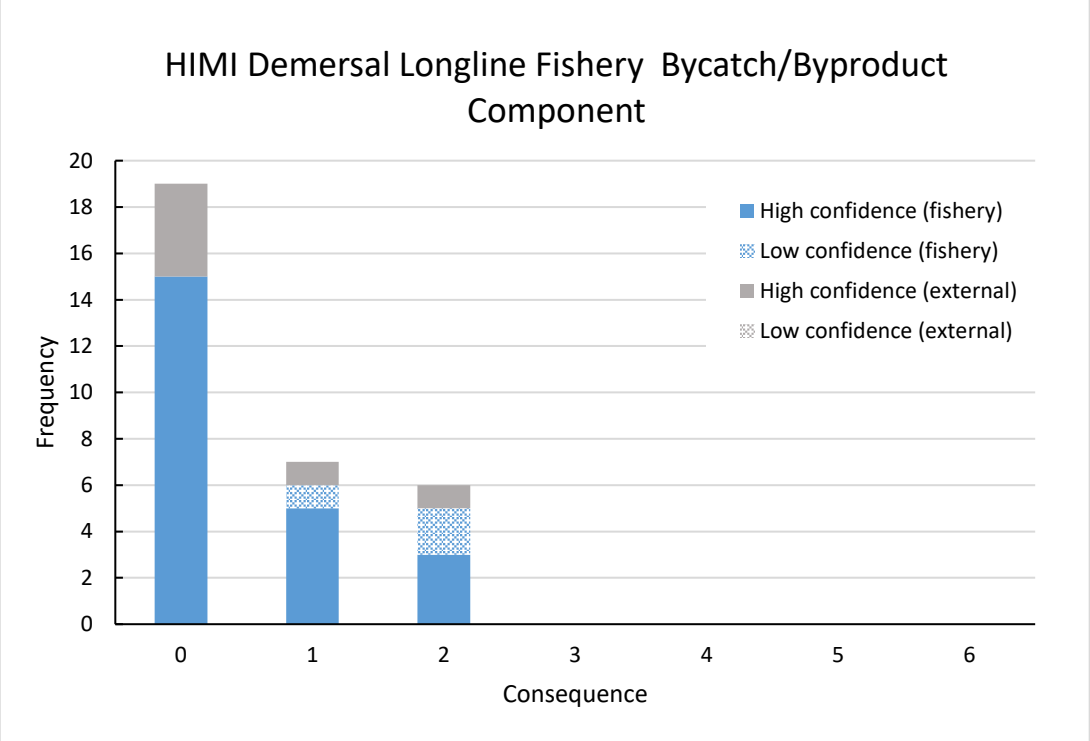

Figure 2.3 Byproduct and bycatch species: Frequency of consequence score differentiated between high and low confidence

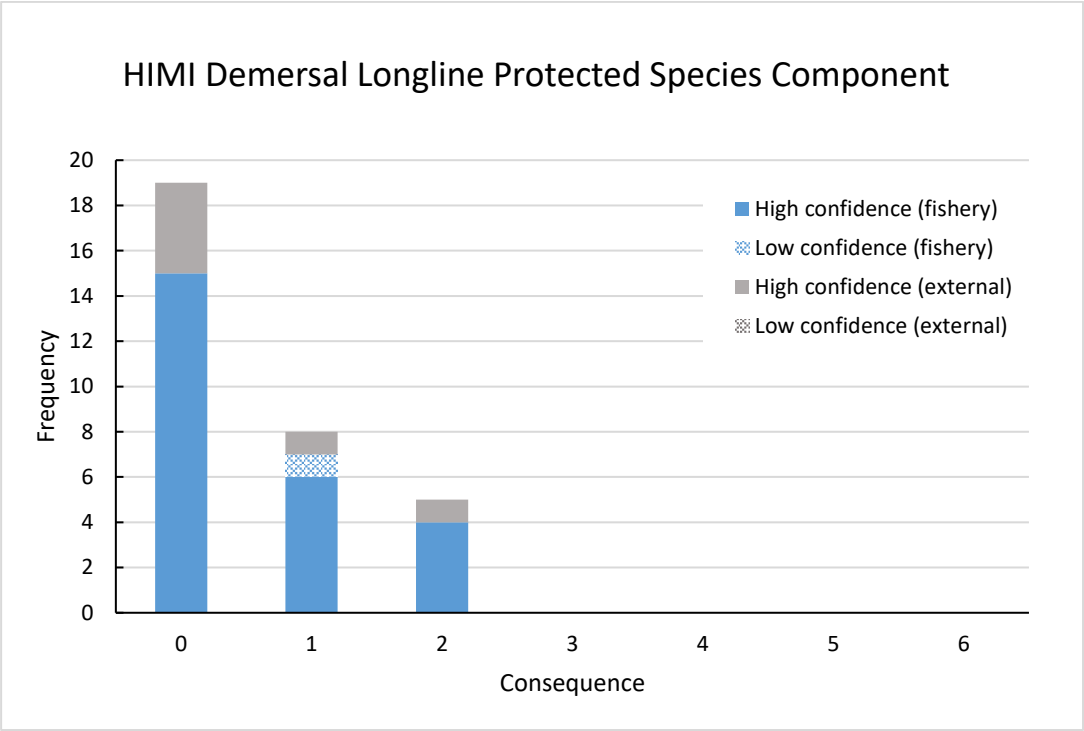

Figure 2.4 Protected species: Frequency of consequence score differentiated between high and low confidence

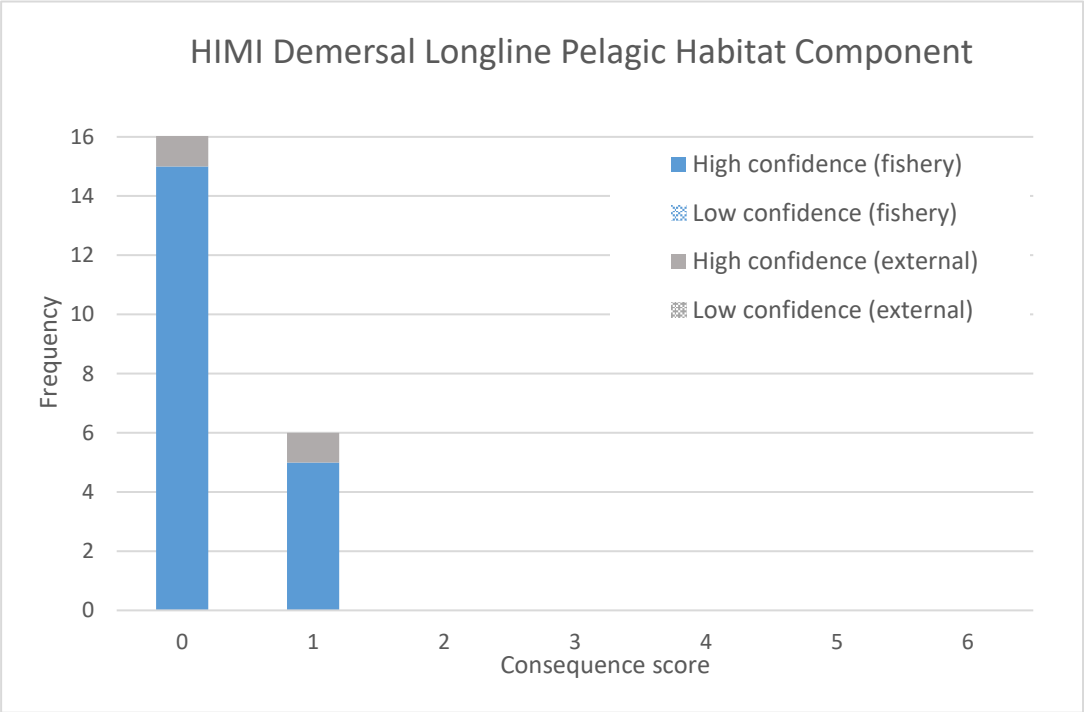

Figure 2.5 Habitats (pelagic only): Frequency of consequence score differentiated between high and low confidence

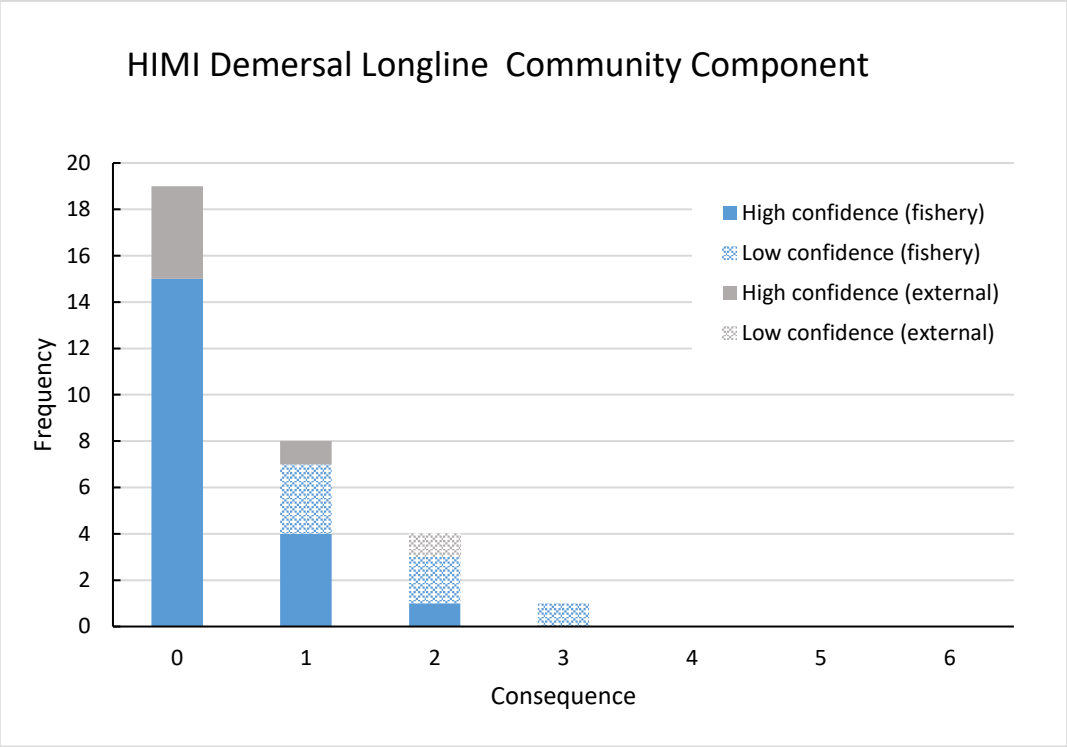

Figure 2.6 Communities: Frequency of consequence score differentiated between high and low confidence

2.3.12 Evaluation/discussion of Level 1

This section provides a brief discussion of the results of the Level 1 analysis. Full details and rationale for the scores are provided in the SICA tables earlier in this section.

The activities of direct impact from capture on key commercial species and any activities hazards affecting benthic habitats were eliminated, leaving 12 and 4 activities respectively. Three components were fully assessed: bycatch/byproduct species , preotected species and communities. In each of these comonents, there were 13 of the 32 possible activities identified as leading to some form of impact (i.e., activities that occurred in the sub-fishery). Of these 55 scenarios (46 internal, 9 external), only one scenario was identified as having an impact of moderate or above (see **Level 1 (SICA) Document L1.6**).

The significant activity identified was fishing (direct impact of capture) on communities i.e. the removal of patagonian toothfish, particualry the large fish, may have altered the trophic /size structure of the functional group or broader community and alter the community trophodynamics. There were no data on effects of the removal of the target species from the community functioning but it was considered that removing large fish would alter the proportions of prey groups consumed overall, with

consequent secondary effects. Several ecosystem models are currently being developed that are likely to be capable of investigating these and other effects of fishing in the HIMI ecosystem.

There were no significant external hazards to the components relevant to the HIMI longline sub-fishery.

This analysis is not significantly different from the previous assessment period although the fishing effort has increased. The TAC for the key commercial species was caught but has only recently been increased. Capture of protected species in other HIMI fisheries was low within the jurisdiction and the seabird bycatch mortality from adjacent longline fisheries in the French Division has been significantly reduced and unlikely to impact resident breeding populations of albatrosses and other species. This has lowered the external fishery risks.

2.3.13 Components to be examined at Level 2

As a result of the preliminary SICA analysis, the components to be examined at Level 2 are those with any consequence scores of 3 or above, i.e. community. However, current development of ecosystem models in the region is considered to be a higher level assessment and therefore may obviate the need for a level 2 PSA analysis.

Glossary

Assemblage	A subset of the species in the community that can be easily recognized and studied. For example, the set of sharks and rays in a community is the Chondricythian assemblage.
Attribute	A general term for a set of properties relating to the productivity or susceptibility of a particular unit of analysis.
Bycatch species	A non-target species captured in a fishery, usually of low value and often discarded (see also Byproduct).
Byproduct species	A non-target species captured in a fishery, but it may have value to the fisher and be retained for sale.
Community	A complete set of interacting species.
Component	A major area of relevance to fisheries with regard to ecological risk assessment (e.g. target species, bycatch and byproduct species, threatened and endangered species, habitats, and communities).
Component model	A conceptual description of the impacts of fishing activities (hazards) on components and sub-components, linked through the processes and resources that determine the level of a component.
Consequence	The effect of an activity on achieving the operational objective for a sub-component.
Core objective	The overall aim of management for a component.
End point	A term used in risk assessment to denote the object of the assessment; equivalent to component or sub-component in ERAEF
Ecosystem	The spatially explicit association of abiotic and biotic elements within which there is a flow of resources, such as nutrients, biomass or energy (Crooks, 2002).
External factor	Factors other than fishing that affect achievement of operational objectives for components and sub-components.
Fishery method	A technique or set of equipment used to harvest fish in a fishery (e.g. long-lining, purse-seining, trawling).
Fishery	A related set of fish harvesting activities regulated by an authority (e.g. South-East Trawl Fishery).
Habitat	The place where fauna or flora complete all or a portion of their life cycle.
Hazard identification	The identification of activities (hazards) that may impact the components of interest.
Indicator	Used to monitor the effect of an activity on a sub-component. An indicator is something that can be measured, such as biomass or abundance.
Likelihood	The chance that a sub-component will be affected by an activity.
Operational objective	A measurable objective for a component or sub-component (typically expressed as “the level of X does not fall outside acceptable bounds”)

Precautionary approach	The approach whereby, if there is uncertainty about the outcome of an action, the benefit of the doubt should be given to the biological entity (such as species, habitat or community).
PSA	Productivity-Susceptibility Analysis. Used at Level 2 in the ERAEF methodology.
Scoping	A general step in an ERA or the first step in the ERAEF involving the identification of the fishery history, management, methods, scope and activities.
SICA	Scale, Impact, Consequence Analysis. Used at Level 1 in the ERAEF methodology.
Sub-component	A more detailed aspect of a component. For example, within the target species component, the sub-components include the population size, geographic range, and the age/size/sex structure.
Sub-fishery	A subdivision of the fishery on the basis of the gear or areal extent of the fishery. Ecological risk is assessed separately for each sub-fishery within a fishery.
Sustainability	Ability to be maintained indefinitely
Target species	A species or group of species whose capture is the goal of a fishery, sub-fishery, or fishing operation.
Trophic position	Location of an individual organism or species within a foodweb.
Unit of analysis	The entities for which attributes are scored in the Level 2 analysis. For example, the units of analysis for the Target Species component are individual “species”, while for Habitats, they are “biotypes”, and for Communities the units are “assemblages”.

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