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Committee
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Australia's SIOFA Bottom Fishing Impact Assessment

Relates to agenda item: 6.2

Working paper Info paper

Delegation of Australia

Abstract

This paper summarises Australia's Bottom Fishing Impact Assessment for SIOFA fisheries in accordance with the requirement under CMM 2017/01. It describes the alignment between Australia's BFIA (published in 2011), CMM 2017/01 (adopted in 2016) and the SIOFA BFIAS (adopted in 2017).

As part of Australia's response to UNGA Resolutions 61/105 and 64/72 and the *FAO International Guidelines for the Management of Deep-sea Fisheries in the High Seas* (FAO 2008), Australia produced a Bottom Fishing Impacts Assessment for SIOFA in 2011 ([Williams et al. 2011](#)). This BFIA considered the impact, risk and existing monitoring, management and mitigation measures in assessing the potential for Significant Adverse Impacts (SAIs) on Vulnerable Marine Ecosystems (VMEs). The long-term sustainability of deep-sea stocks was assessed on the basis of trends in historical catch and effort because quantitative methods of stock assessment (including those based on harvest strategies) require estimates of total catches in the SIOFA Area (from all Flag States and non-signatories).

The BFIA conducted for Australian vessels fishing in the SIOFA Area concluded that overall risk of SAIs on VMEs by Australian vessels fishing with bottom trawls and bottom-set auto-longlines was low. The BFIA concluded that the current overall risk of SAIs on VMEs from midwater trawling and drop-lining by Australian vessels was negligible.

Recommendations *(working papers only)*

It is recommended that the SC:

- **Note** that Australia has provided a Bottom Fishery Impact Assessment (BFIA) to SIOFA in accordance with the requirement under CMM 2017/01 (bottom fishing).
 - **Note** that during 2017 Australia reviewed the alignment between its BFIA and the SIOFA Bottom Fishing Impact Assessment Standard (BFIAS).
 - **Note** that the review identified a number of areas in the SIOFA BFIAS that do not appear to assist in the assessment of bottom fishing impact.
 - **Note** that Australia complies with the requirements of CMM 2017/01 relating to the provision of a BFIA and accept that the BFIA satisfies the requirements of the SIOFA BFIAS and international standards in accordance with paragraph 15(b) of CMM 2017/01.
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Australia's SIOFA Bottom Fishing Impact Assessment

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Purpose and rationale

CMM 2017/01 paragraph 14(a) notes that any Contracting Party, CNCP or PFE that authorises or is seeking to authorise any vessel flying its flag to bottom fish in the Agreement Area shall, at least 30 days prior to the commencement of the ordinary meeting of the Scientific Committee in 2018, submit to the Secretariat a BFIA for its individual bottom fishing activities in the Agreement Area that, to the extent possible, accords with CMM 2017/01 (paragraph 18). The CMM also notes that any CP, CNCP and PFE that has prepared, or prepares, a BFIA prior to this CMM entering into force is encouraged to submit this BFIA to the SC as soon as possible.

CMM 2017/01 paragraph 15 notes that the SC shall consider all BFIA received under paragraph 14(a) at its ordinary meeting in 2018 and provide advice in its meeting report as to:

- (a) the likely cumulative impacts of bottom fishing impact activity from vessels flying the flag of a Contracting Party, CNCP or PFE in the Agreement Area; and
- (b) whether each BFIA meets an appropriate standard in light of international standards and the SIOFA BFIAS, where applicable.

This paper summarises Australia's Bottom Fishing Impact Assessment for SIOFA fisheries ([Williams et al. 2011](#)) in accordance with the requirement under CMM 2017/01. It describes the alignment between Australia's BFIA (published in 2011), CMM 2017/01 (adopted in 2016) and the SIOFA BFIAS (adopted in 2017). A number of findings from this alignment, detailed herein, may assist in any future review of the SIOFA BFIAS.

Background

As part of Australia's response to UNGA Resolutions 61/105 and 64/72 and the *FAO International Guidelines for the Management of Deep-sea Fisheries in the High Seas* (FAO 2008), Australia produced a Bottom Fishing Impacts Assessment for SIOFA in 2011 ([Williams et al. 2011](#)). This BFIA considered the impact, risk and existing monitoring, management and mitigation measures in assessing the potential for Significant Adverse Impacts (SAIs) on Vulnerable Marine Ecosystems (VMEs). The long-term sustainability of deep-sea stocks was assessed only on the basis of trends in historical catch and effort because quantitative methods

of stock assessment (including those based on harvest strategies) require estimates of total catches in the SIOFA Area (from all Flag States and non-signatories).

The approach used in the Australian BFIA to broadly determine where VMEs are known or likely to occur—that depth and underwater features serve as proxies for VMEs—is in line with the BFIAS under circumstances of limited data. The BFIA concluded that overall risk of SAIs on VMEs by Australian vessels fishing with bottom trawls and bottom-set auto-longlines was low. The BFIA concluded that the current overall risk of SAIs on VMEs from midwater trawling and drop-lining by Australian vessels was negligible.

Alignment of Australia’s BFIA against the SIOFA BFIAS

Most of the information on past activities required under the SIOFA BFIAS is contained in the Australian BFIA and in a combination of additional reports produced since 2011, including the November 2012 report on the sustainability of harvest levels by Australian flagged vessels ([Woodhams et al. 2012](#)) and the Australian annual reports submitted to the SIOFA Scientific Committee. Data provided in accordance with CMM 2017/01 have superseded some of the data provided in the BFIA.

Table 1 (below) contains specific responses to each requirement of the BFIAS structured around the status of available information.

Table 1. Status of information to support Australia's BFIA against the requirements of the BFIAS and CMM 2017/01

BFIAS section	Requirement	Status of information	BFIAS page number	Comments in relation to the utility of the current BFIAS
5.1 Description of the proposed fishing activities	General	The information expected in a fishing plan can be found in various places in the Australian BFIA as well as the annual reports and domestic documentation. Additionally, an application for a national permit includes proposed targeted species, catch, gear and area. The annual reports also include relevant data on fishing activities, and the associated permit conditions include specified area, vessel identification, unloading ports, gear limitations, species and catch limitations, move on provisions, observer and reporting obligations. Logbook data records include distribution of fishing effort and levels of target catch and bycatch, including VME taxa.	5-8, 12-15, 18-23, 52-57	
	Details of the vessels to be used	Details of the vessels to be used (or which are used) in the fishery can be found in the SIOFA Record of Authorised Vessels .		This information is available elsewhere in SIOFA documentation.
	Data Standards for vessel data, and confirmation that they appear on the list of approved SIOFA vessels	Data standards are included in the management rules supporting national permit requirements. These can be found in the AFMA High Seas Management Arrangements Booklet 2017 . The list of approved vessels is available in the SIOFA Record of Authorised Vessels . Australia also provides annual updates on its compliance with relevant CMMs, such as through paper MoP-04-INFO-02 Australia – Report on Implementation of SIOFA CMMs.		This information is required in the data standards CMM and vessels are listed on SIOFA Record of Authorised Vessels .
	Detailed description of fishing methods, range in fishing height off bottom, net opening and any factors affecting gear selectivity	Historical detail is listed in Australian BFIA under 2.1.1 <i>Trawl</i> and 2.1.2 <i>Demersal</i> . Trawl and longline methods are described in the BFIA. There is currently no fishing using trap and dropline fishing methods. Assessment could be undertaken if there is a proposal to use such methods. Gillnet fishing was prohibited in 2008 and there are no records of gillnetting before 2008.	5, 6	

BFIAS section	Requirement	Status of information	BFIAS page number	Comments in relation to the utility of the current BFIAS
	Seabed depth range to be fished	This information is covered in 2.1.1 <i>Midwater Trawl</i> , 2.1.2 <i>Demersal Trawl</i> , and 3.1.3 <i>Fishing ground analysis</i> .	5, 6, 8	
	Target species, and likely or potential by-catch species	Historical catch of targeted species is listed under <i>Status of Stocks</i> in 5.1.1 <i>Demersal Trawl</i> , 5.1.2 <i>Midwater Trawl</i> , and 5.1.3 <i>Line Methods</i> . Australia provides information on bycatch through its data submissions in accordance with CMM2017/01 and in its annual reports.	52-55	
	Intended period and duration of fishing	Australia has provided information on historical fishing to the Secretariat in accordance with CMM 2017/02.		It is unclear how this information adds to an initial fishing impact assessment and reviews of the BFIAS may wish to consider the usefulness of this section.
	Effort indices: How many vessels, how many tows (cumulative effects), estimated tow durations or distance (ranges)	Overall totals are included in Figure 4.1.4.3.	32	This is very detailed information which also changes every year; it is questionable how useful this is in an initial impact assessment.
	Estimated total catch and discard quantities by target and bycatch species	Australia has provided information on historical fishing to the Secretariat in accordance with CMM 2017/02. Data provided in accordance with CMM 2017/01 have superseded data provided in the BFIA.		
5.2 Mapping and description of proposed fishing areas	General	Section 3 covers mapping and description of the Australian fishing footprint between 1999-2009. It defines SIOFA fishable area as depths <2000m (Figure 3.1.1.1), defines five ecologically meaningful bathomes (Tables 3.1.1.1 and 3.1.2.1) and defines the Australian fishing footprint (Section 3.1.2).	8-15	
	Maps of the (intended) fishing areas, at the appropriate resolution in relation to the most recent SIOFA maps of historically fished areas	Historical catch is reported in Figure 3.1.2.1, Figure 3.1.3.1 and Table 3.1.3.1. A map of areas voluntarily closed to fishing is also included (Table 3.1.4.1 and Figure 3.1.4.1).	8-15	

BFIAS section	Requirement	Status of information	BFIA page number	Comments in relation to the utility of the current BFIAS
	Area, or topographic features likely to support such VMEs	This is covered in Section 4.1.4, Figures 4.1.4.1, 4.1.4.2 and 4.1.4.3 and Table 4.1.4.1. VME indicator mapping is also discussed.	23, 26, 27, 30, 32	
	Mapping of all known VMEs, or evidence of VMEs	This is covered in Sections 4.1.4 and 4.2.5, Tables 4.1.4.1, 4.1.4.2, 4.1.4.3, 4.1.4.4, 4.1.4.5, 4.1.5.1, 4.1.5.2 and 4.1.5.3, and Figure 4.1.5.1. Voluntary BPAs include some seamount features where VMEs or VME taxa have been reported, or can be inferred in Figure 4.1.4.3. VME taxa is also reported in Australian observer data in Table 4.1.5.1 Information on VMEs and any VME indicator threshold triggers or interactions is included in Australia's annual reports and is provided in accordance with CMM 2017/02.	23-38	
	Mapping of the results of predictive habitat modelling for VMEs	Depth and underwater features were used as proxies for broadly determining where VMEs are known or likely to occur as recommended by the BFIAS under circumstances of limited data.		
	Baseline data and description of the proposed fishing areas	Details of the historical footprint are included in Section 3 and impacts assessment is covered in Section 4.	8-52	
5.3 Impact assessment	Scoping of issues of concern	Section 4.1 <i>Scoping of issues and concerns</i> , outlines Australia's approach to establishing context, identifying and documenting objectives and identifying hazards. The definition of VMEs and SAIs is covered in 4.1.1. Management arrangements for Australian vessels in the SIOFA area, outlined in Section 4.1.2, include reporting of VME encounters and move-on rules. Bottom fishing effort is spatially confined within the Australian historical footprint (1999-2009) (Section 1.1). Section 4.1.3 provides a description of the impacts of different fishing gears. Opportunities and constraints to mapping VMEs and relevance to assessing impacts and risk is outlined in Section 4.1.4 and documentation processes for collecting and interpreting evidence of VMEs is provided in Section 4.1.5. The primary hazard identified is the risk associated with the direct impact of fishing gear on the seabed during fishing. The Australian BFIA does not include reference to the potential impacts associated with the loss of bottom fishing gear as a hazard. There is a requirement in Australian permits to record any loss of gear in log books.	16-38	

BFIAS section	Requirement	Status of information	BFIAS page number	Comments in relation to the utility of the current BFIAS
	Risk assessment	<p>Australia applied the Draft SPRFMO BFIAS as a template for the evaluation of its vessels in the SIOFA Area. Although termed an 'impact' assessment, the SPRFMO BFIAS specifies that evaluation of risk, management and mitigation are required.</p> <p>The BFIAS notes that inadequacies of data exclude quantitative consideration of the ecological risk for VMEs in the area. It defines the risk as not achieving the stated objective, that is no SAI from bottom fishing on VMEs ('no impacts which compromise ecosystem integrity in a manner that impairs the ability of affected populations to replace themselves and that degrades the long-term natural productivity of habitats, or causes on more than a temporary basis significant loss of species richness, habitat or community types').</p>	16-52	
	Determination of the level of risk posed by an activity, against 1. Intensity, 2. Duration, 3. Spatial extent and 4. Cumulative impact	The Australian BFIAS identifies these elements as those against which the level of risk should be specifically evaluated, and notes that currently there is no SIOFA mechanism for collective work on cumulative impact.	40	There is a need for SIOFA to consider how to progress analysis of cumulative impact. A full ecological risk assessment for VMEs in high seas areas, and the development of risk management frameworks, would be needed to account for the potential cumulative effects across different fishing gears, across Flag States, and across other threatening processes – deep sea mining, hydrocarbon extraction, pollution, ocean acidification and others.
	Overall risk	<p>Tables 4.3.1.1 and 4.3.1.2 summarise impact and risk assessment of bottom trawling, and demersal trawling and auto-longline fishing on VMEs in the SIOFA Area. Table 6.1.1 summarises the elements of impact and risk in Australia's BFIAS showing key sources of uncertainty that affect the confidence or ratings and the opportunities that exist to reduce uncertainty.</p> <p>The Australian BFIAS notes that it is not possible to consider ecological risk for VMEs in high seas areas in a quantitative way due to several key uncertainties in the data (Section 4.1.4, 'Spatial dependencies'), and the absence of data on cumulative impacts.</p>	23, 46, 47, 57	

BFIAS section	Requirement	Status of information	BFIAS page number	Comments in relation to the utility of the current BFIAS
		<p>A full ecological risk assessment for VMEs in high seas areas and the development of risk management frameworks would be needed to account for the potential cumulative effects across different fishing gears, across Flag States, and across other threatening processes including deep sea mining, hydrocarbon extraction, pollution, ocean acidification and others.</p> <p>The absence of data to undertake any form of cumulative impact cannot be fully resolved without sufficiently detailed information on past bottom fishing activity in the SIOFA area by all fleets combined. It should be recognized that records of such fishing activity go back to the 1970s (Gianni 2004).</p>		
	Interactions with VMEs: Impacts likely to result from the fishing gears to be used	<p>The poor knowledge of VME distribution at fine scales prevented accurate calculation of spatial overlap of fishing with VMEs.</p> <p>Resolving the spatial scale of analysis by using seabed topography to indicate where VMEs are more likely to be located can help to reduce this 'VME distributional uncertainty'. However, datasets of topographic features and predictive methods used to infer their suitability for supporting VMEs are also prone to a range of uncertainties including data density and resolution, and scaling issues (Section 4.1.4).</p> <p>The absence of visual mapping of the VMEs in an area where bottom fishing is permitted to occur and knowing the precise location of the contact of the gear on the bottom makes an accurate assessment challenging. Proxies provide some assistance but are not equivalent to visual mapping.</p>	23, 39	
	Interactions with VMEs: The probability, likely extent (% of habitat targeted) and intensity of the interaction between the proposed fishing gear/targeting practices on the VMEs	The probability, extent and intensity of interaction is presumed to be relatively small at the regional scale given the limited effort. The VME encounter measures are expected to indicate if VMEs are present in the direct vicinity of the bottom fishery.		
	Interactions with VMEs: Characteristics of the habitats and benthic	Q1: What are the characteristics of the habitats and benthic communities which may be impacted? The Australian BFIA notes that in many if not most cases the characteristics that may be impacted are unknown but most benthic species/communities are likely to be slow growing, long-lived, low fecundity,	ix, 28, 31-34, 44	

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	communities which may be impacted	<p>late age at maturity and thus likely to qualify as VMEs or VME indicator species and be vulnerable to SAIs from bottom fishing activities.</p> <p>Q2: Are the fished seabed features likely to support VMEs? The Australian BFIA states that this would be true in many cases - "many taxa characterising VMEs are restricted to particular depth zones (bathomes), with large invertebrate benthic fauna typically most diverse and most abundant within a 'zone of importance' in depths <1500" - i.e. at fishable depths in the SIOFA area (page 28).</p> <p>Q3: Do these VMEs include fragile or biogenic habitat-forming species? Yes.</p> <p>Q4: What proportion of the estimated distribution range of these VMEs areas will the proposed fishing activities impact? The Australian BFIA notes that this is unknown but is presumed to be relatively limited for species with relatively wide distribution.</p> <p>Q5: How widespread or rare are the VMEs/species? The Australian BFIA notes that some types of VME species such as reef forming stony corals may be widespread at certain depths based on habitat suitability modelling.</p> <p>Q6: How vulnerable are the VMEs to impact by the fishing gears to be used? The Australian BFIA notes that vulnerability may be high, based on the characterisation of the impacts of the two main gear types as follows: "the potential for demersal trawling and auto-longlining to severely impact VME fauna at fine ('site') scales, and for impacts to persist and to accumulate through time" (page ix).</p>		
	Interactions with VMEs: How diverse is the ecosystem in the proposed fishing areas, and will the fishing activity reduce this biodiversity?	<p>Data are not available to inform questions 2 and 3.</p> <p>Q1: How diverse is the ecosystem in the proposed fishing area? The Australian BFIA notes that it is likely to be highly diverse but is not fully understood because the overlap between fishing and VMEs is not known.</p> <p>Q2: Do the proposed fishing areas contain rare species which do not occur elsewhere?</p> <p>Q3: What are the levels of endemism – could fishing lead to localised / global extinctions?</p> <p>The Australian BFIA does not address Q2 and Q3 but notes that the southern Indian Ocean is one of the least sampled regions of the global ocean (Rogers et al. 2007) and there is a commensurately scarce knowledge of its biodiversity and ecosystems.</p>	35	
	Interactions with VMEs: What is the likely spatial	Australia has committed to unilateral actions to minimise impact, but notes the need for consideration of the cumulative impact of fishing through time	39-42	

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	scale and duration of the impacts?	and by other flag state vessels. The lack of knowledge of cumulative impacts of fishing across flag states is perhaps single greatest source of uncertainty for conducting individual BFIA because cumulative impact provides essential context.		
	Interactions with VMEs: Are there any other threats or issues of concern expected from the proposed fishing activities?	No other threats or issues of concern are raised.		
5.4 Information on the status of deep-sea stocks to be fished	A list of the intended target and likely by-catch species	The Australian BFIA includes figures capturing total demersal trawl catch and effort in the SIOFA Area by year and by depth zone for the five most commonly caught species and 'other' (Figure 5.1.1.1) and total midwater trawl catch and effort in the SIOFA Area by year and by depth zone for the five most commonly caught species and 'other' (Figure 5.1.2.1). Other relevant data are provided to SIOFA in accordance with CMM 2017/02.	53, 54	
	Tables of historic catches and catch trends of these species in the fishing area	The Australian BFIA covers historic catch and effort between 1999-2009. The main target species are listed in Section 5.1. (Demersal trawl 5.1.1, Midwater Trawl 5.1.2, and line methods covered in 5.1.3.) Figure 5.1.1.1 covers total Demersal Trawl catch and effort in the SIOFA Area by year and by depth zone for the five most commonly caught species and 'other'. Figure 5.1.2.1 covers total Midwater Trawl catch and effort in the SIOFA Area by year and by depth zone for the five most commonly caught species and 'other'. Figure 5.1.3.1 displays Relative distribution of species caught by demersal line methods in the SIOFA Area over 1999-2009.	52-55	
	Tables, figures of analyses of historic nominal and/or standardised CPUE trends	CPUE information is not provided due to the low and spatio-temporally variable effort meaning that nominal CPUE are not thought to provide reliable indices of abundance.		

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	Results of any surveys conducted on the stocks to be fished	No surveys were conducted during the report period, or since.		
	Results of the most recent stock assessments that have been conducted for the stocks to be fished, if any such stock assessments have been conducted	<p>There are no results of stock assessments reported in the BFIAS as no formal stock assessments were conducted during the report period, or since.</p> <p>Informal assessments have been attempted, for example in Woodhams J. I., Stobutzki, R. Noriega and J. Roach, Sustainability of harvest levels by Australian flagged vessels in the high seas areas of the South Pacific Ocean and South Indian Ocean, Research by the Australian Bureau of Agricultural and Resource Economics and Sciences ABARES. November 2012. This Report contains information on stock determination for the SIOFA trawl fishery in the absence of formal stock assessments.</p>		
	Any other information relevant to understanding the status and sustainability of target and bycatch species	<p>The only source of additional information relevant to the understanding and status of target and bycatch species is Woodhams J. I., Stobutzki, R. Noriega and J. Roach, Sustainability of harvest levels by Australian flagged vessels in the high seas areas of the South Pacific Ocean and South Indian Ocean, Research by the Australian Bureau of Agricultural and Resource Economics and Sciences ABARES. November 2012.</p>		
5.5 Monitoring, management and mitigation measures	General	Monitoring, management and mitigation measures are reported in Australia's Annual Report to the Science Committee		<p>This section of the BFIAS is very focused on VMEs and potentially overlooks monitoring, management and mitigation measures for fish stocks, and in particular bycatch species.</p> <p>It would be useful to review the BFIAS to consider explicit inclusion of broader issues for monitoring, management and mitigation.</p>
	Proposals for how fishing activities are planned and managed to avoid or minimise SAIs on VMEs	The Australian BFIAS concludes that the risk of SAI on VMEs is low for the two primary demersal fishing methods used and negligible (although impact and effort not formally assessed) for other methods. It notes that ongoing monitoring, management and mitigation measures are necessary to address the potential impacts arising from demersal trawling (high) and demersal auto-longlining fishing (medium). It acknowledges the scope for risks to	55-58	

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		<p>increase, as well as the high degree of uncertainty about many key elements relevant to assessing impact and risk to VMEs in the SIOFA Area.</p> <p>The Australian BFIAS notes that any 'material' expansion of effort levels or spatial extent would trigger a review of monitoring, management and mitigation measures to ensure that risk of SAI remains low.</p> <p>The Australian BFIAS identifies many actions that could reduce uncertainties in knowledge underlying completion of this and future risk assessments and to increase certainty about the effectiveness of management implementation. Table 6.1.1 summarises elements of impact and risk showing key sources of uncertainty that affect the confidence of ratings, and the opportunities that exist to reduce uncertainty.</p> <p>Australia's fishery logbook system records the distribution of fishing effort and levels of targeted catch and bycatch, including of VME taxa. This forms the basis for evaluation the level of seabed impact by Australian vessels. Logbook data collection is supported by mandatory observer coverage (100% for bottom trawl, and the first trip and ongoing coverage of 10% annually for demersal longline), and satellite VMS and logbook reporting requirements on a short-by-shot basis.</p> <p>Measures implemented to manage the risk of SAI include currently restricting fishing to a 'footprint' area, and implementing an 'evidence of VME' and move-on protocol across the entire Australian fishing footprint.</p>		
	VMS positional information collected in accordance with the SIOFA Data Standards	This information is collected in accordance with SIOFA CMM 2017/02.		This information is provided through other mechanisms/requirements
	Details of catch and effort data collection systems to be used	The Australian BFIAS notes that the Australian logbook system records the distribution of fishing effort and levels of targeted catch and bycatch, including of VME taxa, and that this collection system is augmented by mandatory observer coverage, satellite VMS and logbook reporting requirements on a short-by-shot basis.	3, 18, 19	This information is provided through other mechanisms/requirements
	Details of any scientific observer coverage	Observer coverage levels were not implemented for the entire duration of the period covered by the Australian BFIAS.		This information is provided through other mechanisms/requirements

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	planned for the proposed fishing activity	<p>Mandatory observer coverage includes 100% for bottom trawl, and the first trip and ongoing coverage of 10% annually for demersal longline since 2008.</p> <p>Additionally, observer data was collected from 2002 for those vessels fishing in the SIOFA Area on transit to the Australian HIMI Fishery.</p> <p>This information is reported in Australia's Annual Report to the Science Committee</p>		
	Description of the data provided to the SIOFA Secretariat for the fishing activity	Australia provides the necessary data in accordance with CMM 2017/02.		This information is provided through other mechanisms/requirements

References

Rogers A.D., Clark M.R., Hall-Spencer J.M., Gjerde K.M. (2008) *The Science behind the Guidelines: A Scientific Guide to the FAO Draft International Guidelines (December 2007) for the Management of Deep-Sea Fisheries in the High Seas and Examples of How the Guidelines may be Practically Implemented*. IUCN, Switzerland, 2008. 48pp.

Williams, A, Althaus, F, Fuller, M, Klaer, N & Barker, B (2011) *Bottom Fishery Impact Assessment: Australian report for the Southern Indian Ocean Fisheries Agreement (SIOFA)*, CSIRO Marine and Atmospheric Research, Hobart.

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