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MOP-11-27-Rev1

Research cruise of the *R/V Dr Fridtjof Nansen*

The FAO DSF Project and the SIOFA Secretariat

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Distribution	Public <input checked="" type="checkbox"/> Restricted ¹ <input type="checkbox"/> Closed session document ² <input type="checkbox"/>
Abstract	<p>SIOFA is a partner of the FAO Deep-sea Fisheries Project, but currently lacks a consistent framework for authorising scientific research in the SIOFA Area, especially for vessels not flagged to SIOFA parties.</p> <p>During the last annual meeting of the SIOFA SC, FAO, in line with the activities foreseen in the DSF Project document, proposed to undertake a research cruise using the <i>R/V Dr Fridtjof Nansen</i>, tentatively planned for 12–30 June 2025 around the Walter's Shoal or the SW Indian Ridge, and operating alongside the <i>F/V Will Watch</i> to provide a comparison between a research vessel and a fishing vessel.</p> <p>The purpose of the cruise is to support SIOFAs science programme through acoustic biomass estimates for alfonso and/or orange roughy, benthic surveys for the distribution of vulnerable marine ecosystems, and on deepwater shark identification. Training of scientists and observers will also occur.</p> <p>The SIOFA SC requested that the proponents of the research cruise, namely the Cook Islands, France on behalf of its Indian Ocean Territories, and the DSF Project, provide a more detailed cruise plan to the MoP for consideration, and provided indications on the elements to be considered in the plan. The SC also recommended that the MoP should consider the type of fishing gear, the areas proposed to be fished, potential benthic impacts, the species proposed to be caught and the amount of catch proposed to be taken before approving the <i>R/V Dr Fridtjof Nansen</i> research cruise.</p>

¹ Restricted documents may contain confidential information. Please do not distribute restricted documents in any form without the explicit permission of the SIOFA Secretariat and the data owner(s)/provider(s).

² Documents available only to members invited to closed sessions.

This document ~~has been~~will be updated following approval from the Nansen program meeting taking place on 1 June 2024, and discussions with the Cook Islands (acoustics), France on behalf of its Indian Ocean Territories (benthic sampling), and VIMS (deepwater shark identification).

Recommendations ~~(for proposals and working papers only)~~

It is recommended that the MoP ~~either:~~

- **approves** the research cruise plan and **grants** permission for the *R/V Dr Fridtjof Nansen* to undertake the cruise in the SIOFA Agreement Area in 2025 according to the details provided in this document, ~~OR including the use of a bottom trawl should the *F/V Will Watch* not be available.~~
- ~~agrees on an intersessional process to re-examine this research cruise plan prior to the end of the 2024 year with a view to grant permission to undertake the research cruise in June 2025.~~

Research cruise of the R/V Dr Fridtjof Nansen

Note on updates included in the Rev1 of this paper

This document has been updated to include additional details following the Nansen project meeting of early June 2024, and discussions with the Cook Islands (on acoustic work), with France on behalf of its Indian Ocean Territories (on benthic work), with the Virginia Institute of Marine Science (on deepwater shark work), and with the Institute of Marine Research, Norway (R/V Dr Fridtjof Nansen program). These updates include further information on:

- Data sharing
- Confidentiality
- Risk assessment
- Post-cruise analysis and sample treatment
- Draft work plan

Introduction

SIOFA is a partner ~~of~~ the FAO implemented Deep-sea Fisheries (DSF) Project that runs from 2022 to 2027³. One of the activities of the project includes a research survey in the Indian Ocean with the *R/V Dr Fridtjof Nansen*, in collaboration with the FAO EAF Nansen programme [1]. The plan to include this cruise in project activities was presented to SIOFA at MoP6, MoP7 and MoP8, however, the current document could only be developed once the cruise was formally endorsed by the Nansen Steering Committee in March 2024, as well as the Norwegian agency for development cooperation (NORAD) on 1 June 2024.

In its letter of contribution to the DSF Project, signed in February 2022, SIOFA indicated its interest to support the Nansen cruise, by supporting acoustic surveys and other assessments.

Originally, the cruise was planned for 2023, but it was delayed due to changes in the scheduling of the Nansen Programme.

The cruise is ~~provisionally~~ now planned for 12–30 June 2025 and will involve fishing operations on either Walter’s Shoal or the SW Indian Ridge. It is planned that the survey will operate alongside the *F/V Will Watch* to provide a comparison between a research vessel and a fishing vessel.

The purpose of the survey is to:

- Improve acoustic biomass estimates for alfonsino and/or orange roughy
- Undertake benthic surveys to study the distribution of vulnerable marine ecosystems and improve the distribution modelling.
- Extend work on deepwater shark identification and further trial the smart identification key
- ~~To provide~~ Provide opportunities for the training of up to 19 officers, crew, deckhands, scientists and /or observers from SIOFA members

³ For further background information on this project, see MoP-10-INFO-13 and MoP-11-INFO-17

Approval for the survey by the EAF Nansen programme

The EAF Nansen programme provisionally approved the survey at its annual meeting in March 2024. A decision on the final approval will be made ~~was given by the Norwegian agency for development cooperation (NORAD) on 1 June 2024.~~

Review by SIOFA Scientific Committee

A working paper and draft survey plan were presented to the SIOFA Scientific Committee (SC9) in Bangkok, Thailand, 18-27 March 2024 (SC-09-32 Rev1; [Appendix Annex A](#)). The SC made the following comments in their report [2]:

157. The SC agreed that it would be useful to conduct non-extractive acoustic work so that orange roughy stock biomass in the BPAs can be monitored and included in the stock assessments. These acoustic surveys could be undertaken by the R.V Fridtjof Nansen.

393. The SC recommended that the MoP should consider the type of fishing gear, the areas proposed to be fished, potential benthic impacts, the species proposed to be caught and the amount of catch proposed to be taken before approving the R.V. Dr Fridtjof Nansen research cruise.

396. The SC requested that the DSF Project work with the SIOFA Secretariat to assess the interest level among SIOFA CCPs to engage in:

- c. planning a joint R.V Dr Fridtjof Nansen cruise in the SIOFA Area.

Table 5: 2025 projects in the SC9 workplan (black) and potential projects that will be developed and prioritized at SC10 (red). Priority indicates the priority assigned by SC9.

Project code	Lead	Summary Title	Budget	Funding source	Project Status	Priority
NAN-2025-01	TBD	Nansen cruise in the SIOFA area	TBD	TBD	TBD	TBD

Permission [for the R/V Dr Fridtjof Nansen to fish](#)

The Southern Indian Ocean Fisheries Agreement [3] states:

ARTICLE 1 - DEFINITIONS

(g) "fishing" means:

- (i) the actual or attempted searching for, catching, taking or harvesting of fishery resources;
- (ii) engaging in any activity which can reasonably be expected to result in the locating, catching, taking or harvesting of fishery resources for any purpose including scientific research;

The DSF Project and SIOFA Secretariat **request permission from the MoP for the R/V Dr. Fridtjof Nansen to be ~~permitted-allowed~~ to undertake fishing operations ~~subject to the~~ and conduct scientific surveys as follows**, ~~following overall~~ with further details provided in the draft work plan ([Appendix Annex A](#)).²

~~The R/V Dr. Fridtjof Nansen plans to sail from Port Louis, Mauritius, on 12 June 2025 and return on 30 June 2025. It intends~~The R/V Dr. Fridtjof Nansen will to undertake acoustic and ~~bottom~~ fishing surveys ~~for alfonso and orange roughy~~ and benthic sampling for VMEs at Walter’s Shoal or SW Indian Ridge within the SIOFA Area ~~of Agreement~~.

It is intended that the vessel works alongside the *F/V Will Watch* to compare information collected from a research vessel and a commercial fishing vessel. However, the availability of the *F/V Will Watch* can only be confirmed at a later date.

Concretely, it is proposed that the *R/V Dr. Fridtjof Nansen* conducts:

- acoustic sampling for alfonsino and orange roughy,
- bottom trawls (in the case that the *F/V Will Watch* is not available) and midwater trawls, to validate acoustic signals and carry out biological sampling down to 800 m, and
- benthic mapping, including bottom profiling echosounders, video cameras on towed sledges and grab samples

Any bottom fishing trawl deployments will be within the SIOFA bottom fishing footprint and outside of the benthic protected areas (BPAs⁴). The acoustic sampling, any mid-water trawling and the benthic mapping may be conducted within the SIOFA bottom-fishing footprint and inside of select BPAs.

The possible BPAs are Walter's Shoal Point, Coral Point, Middle of What Point, and Atlantis Bank. The choice depends on the final location of the surveys and according to the availability of the *R/V Will Watch*. No more than two BPAs will be surveyed in total.

It is estimated that no more than 20 tonnes of alfonsino and orange roughy, combined over the duration of the survey, will be caught. Catches of other species may also be taken as bycatch, including deepwater sharks, and will be used for research and training purposes, as appropriate. All fish and other species caught will be discarded (except for small numbers of fish that may be taken for research purposes).

There will be a ~~Scientist in-charge (SIC)~~ ~~cruise leader~~ from Norway and a ~~co-cruise leader~~ ~~local counter-part SIC~~ ~~from a SIOFA Contracting Party~~. The vessel can take up to 19 invited officers, crew, deckhands, scientists and/or observers ~~scientists/observers~~ with a target M:F ratio of 60%: female representation of at least 40%.

(4)

Data sharing

The survey will generate information needed for the sustainable management of fisheries resources and the distribution of benthic habitats in the Indian Ocean. The data from *R/V Dr Fridtjof Nansen*, in the case of ABNJ work, belongs to the relevant RFMO partners involved in the cruise⁵. The primary partner is SIOFA and as such the data will be provided to the SIOFA Secretariat for archiving and distribution, as appropriate.

Confidentiality

The information collected by the *R/V Dr Fridtjof Nansen*, including any positions associated with sampling, is shared with its partners. This will not directly reference any information that may be considered commercially sensitive, including any references to commercial fishing operations.

⁴ Referred to as Interim Protected Areas in CMM 01 (2023), but benthic protectic area (BPA) is commonly used by the SIOFA SC.

⁵ [data_policy \[Nansen surveys\] \(imr.no\)](#)

Subsequent publications, and any additional post-cruise information, will be the responsibility of the partners of the cruise, possibly with support from the FAO DSF Project.

As is hoped for, the R/V Dr Fridtjof Nansen will work alongside the F/V Will Watch but will not directly report on any fishing operations conducted by the F/V Will Watch, even in support of its work. Any subsequent publication of potentially sensitive information will be undertaken with consultation of the owners of the F/V Will Watch and following any SIOFA publication guidelines.

Risk analysis

Overall, the R/V Dr Fridtjof Nansen will be conducting few operations that may cause risk to commercial stocks and vulnerable species. All are classified as low to negligible risk. These are provided below:

Commercial stocks (alfonsino and orange roughy): limiting total catch to no more than 20 tonnes during the research cruise. Currently the commercial catch is between 3000 and 4000 tonnes per year of alfonsino and 1000 tonnes per year of orange roughy.

Deepwater sharks: These will be incidental catches. The catches are likely to be less than 2 tonnes during the cruise. Currently the commercial catch is between 500 and 1000 tonnes per year of deepwater sharks. CCM 12 (2023) applies, including conducting research to identify nursery areas. A 5nm move-on rule will apply to any large catches of shark.

VMEs: The bottom trawl (used only if the F/V Will Watch is not available) may have some impact on VMEs should they occur within the existing fishing footprint. However, the small number of trawls and the short towing duration (less than 15 minutes) means that impacts will be small when compared to commercial bottom trawling and longlining. The use of the grab and sledge, owing to their small size, would have negligible impacts inside or outside of BPAs. There will be no bottom trawling within BPAs. CMM 01 (2023) applies, including the move-on following any encounters above threshold with the grab and bottom trawl.

Seabirds and marine mammals: It is not expected that any gears will interact with either seabirds or marine mammals. The gears to be deployed do not have mitigation measures included in CMM 13(2022).

Post-cruise analysis and sample treatment

The acoustic and benthic survey data, as well as the deepwater shark data, will be provided to SIOFA which can, through its Scientific Committee, devise the best ways to analyse the information collected and present the results of the analysis to the SIOFA MoP.

Note on Appendix A – Draft work plan (Annex A)

The draft work plan will be updated as soon as final permission is granted by NORAD and further information and coordination is provided by SIOFA scientists. This will be coordinated with the F/V Will Watch. It is hoped that a revised paper will be submitted to the MoP before the meeting.

The draft work plan (Appendix Annex A) has been updated in this Rev1 to include:

- [1. General and background information](#)
- [2. Acoustic work](#)
- [3. Benthic sampling](#)
- [4. Deepwater sharks](#)

References

[1] EAF-Nansen Programme | Food and Agriculture Organization of the United Nations (fao.org)
<https://www.fao.org/in-action/eaf-nansen/en>

[2] SIOFA. 2024. Report of the Ninth Meeting of the Scientific Committee of the Southern Indian Ocean Fisheries Agreement (SIOFA) Berkeley Hotel Pratunam, Bangkok, Thailand 18–27 March 2024.
<https://siofa.org/sites/default/files/2024-04/SIOFA-SC9-Report.pdf>

[3] Southern Indian Ocean Fisheries Agreement.
<https://siofa.org/sites/default/files/documents/SIOFA-Agreement-Digital-ENG.pdf>

[4] Trawl equipment on Dr Fridtjof Nansen. [https://nansen-surveys.imr.no/doku.php?id=trawl equipment on dr. fridtjof nansen](https://nansen-surveys.imr.no/doku.php?id=trawl+equipment+on+dr.+fridtjof+nansen)

APPENDIX-ANNEX A

Deep-sea Fisheries under the Ecosystem Approach (DSF project)

Cooperation between the FAO DSF project, SIOFA (RFMO) and the fishing industry (Sealord, SIODFA) in the southwestern Indian Ocean through a joint cruise with the EAF-Nansen Programme

Draft work plan

1. Overview

Lead organisations/countries

The Southern Indian Ocean Fisheries Agreement (SIOFA) would be the lead partner, with the main contact person being Dr Marco Milardi (Science Officer, Secretariat). SIOFA is listed by the EAF-Nansen programme as an “Other partner and stakeholder”. SIOFA has a strong history and partnership with the Southwest Indian Ocean Fisheries Commission (SWIOFC), which is listed as a “Main partner” and it may be possible to further develop this partnership through this work.

GEF-eligible Parties to SIOFA for the purpose of this work plan are Comoros, Cook Islands, India, Mauritius, Seychelles, and Thailand. Other Parties, from developed nations, may also be included in this work plan.

Research vessel

R/V Dr Fridtjof Nansen is a Norwegian research vessel operated by Institute of Marine Research (IMR), Bergen, for the FAO EAF-Nansen programme and sails under the Norwegian flag. It carries scientists from IMR and EAF-Nansen partner countries to improve fisheries management in line with the ecosystem approach to fisheries (EAF), strengthening the capacities of fisheries institutions and generating scientific knowledge on marine resources and ecosystems.

This proposed cruise in the southwestern Indian Ocean will require:

- 1) EK-80 echosounder to monitor and survey populations of alfonsino fish species, with the possibility to include orange roughy and other fish living on or close to the seafloor around the seamounts. Equipment to undertake comparative acoustic work of target strength estimation.
- 2) ~~Bottom~~ (if F/V Will Watch is not available) and ~~m~~Midwater fishing capabilities to validate acoustic signals, pelagic trawl for biological sampling down to 800 m.
- 3) CTD (conductivity, temperature, and depth) profiler - that can go down to 3500 m
- 4) Echosounding capabilities for seafloor profiling. A Simrad multibeam (EM710) and single-beam (EK60) echosounders or similar.
- 5) A towed camera for benthic surveys.
- 6) Deep sea benthic sampling capabilities - A Van Veen grab.
- 7) Shark identification guide testing capabilities. New style deepwater shark identification keys for training purposes (to be developed by the DSF Project).

- ~~1) Acoustic capabilities for monitoring populations of orange roughy, alfonsino, and other fish living on or close to the seafloor around the seamounts. Also to undertake comparative acoustic work of target strength estimation.~~
 - ~~• CTD profiler – sound velocity adjustment for acoustics (if this is needed??)~~

- ~~2) Deep sea fishing capabilities to validate acoustic signals. A benthic trawl for biological sampling (trawling may in part be better undertaken by the commercial vessel *F/V Will Watch*).~~
- ~~3) Echosounding capabilities for seafloor profiling. A Simrad multibeam (EM710) and single-beam (EK60) echosounders or similar.~~
- ~~4) Deep sea ROV capabilities for seafloor surveys. Towed 'CAMPOD' video rig, pan-tilt HD camera, two 400-W strobe lights, 10×10 cm laser pointers, and a backward-looking camera.~~
- ~~5) Deep sea benthic sampling capabilities. A Van Veen grab~~
- ~~6) Shark identification guide testing capabilities. New style deepwater shark identification keys for training purposes (to be developed by the DSF Project)~~

Commercial vessel

The *F/V Will Watch* is a commercial "bottom" trawling fishing vessel operated by Sealord under the Cook Islands flag. She is 74m LOA and 1587 GRT and has been operating in the Indian Oceans for decades. The officers and crew are high skilled fishers targeting mainly orange roughy, alfonso, and other associated species.

She is equipped with ~~state~~ state-of-the-art electronics including a fully calibrated Simrad EK80 split-beam echosounder and benthic-pelagic fishing gear. She will be carrying a trained scientific observer ~~that~~ who collects scientific data and reports catches to the Cook Islands and SIOFA.

Dates

~~Preliminary dates are~~ 12-30 June 2025 (including sailing time to survey site).

Sailing

From Port Louis, Mauritius, to survey site, and returning to Port Louis, Mauritius.

Location of work

The primary aim is to work alongside a commercial fishing vessel for both independent and comparative analyses. The *F/V Will Watch* will be fishing in the Indian Ocean during June 2025 but owing to market uncertainties it is currently uncertain where she will be operating. There are two possibilities:

- Around Walter's Shoal (34°S 44°E), which is among SIOFA interim protected areas, or
- Along the SW Indian Ridge (40°S 46°E to 28°S 62°E) (Figure 1).

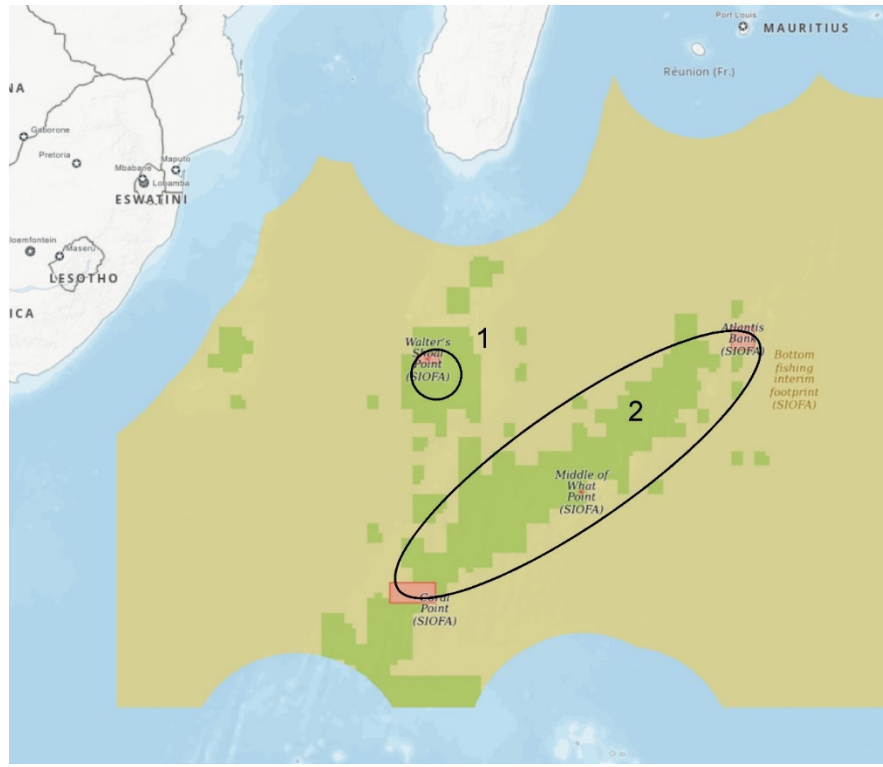


Figure 1. The survey area will be either on Walter's shoal (1) or the SW Indian Ridge (2). The SIOFA bottom fishing areas are in green and the BPAs in red.

Any bottom fishing trawl deployments by the R/V Dr Fridtjof Nansen will be within the SIOFA bottom fishing footprint and outside of the BPAs. Any mid-water trawling may be conducted with in the SIOFA bottom-fishing footprint and inside of the BPAs.

There are BPAs at both locations.

The F/V Will Watch will probably know its fishing locations by mid-May 2025.

Training opportunities

- Use of ID keys
- Training for catch and bycatch recording
- Learning about benthic sampling
- Learning about acoustics
- Learning about research and commercial vessel operations

SIOFA interim protected area

SIOFA has identified Interim Protected Areas and has asked contracting parties to close these areas to bottom trawling (Figure 2). There are four BPAs in the vicinity of the possible fishing locations for this trip-: Walter's Shoal Point, Coral Point, Middle of What Point, and Atlantis Bank.

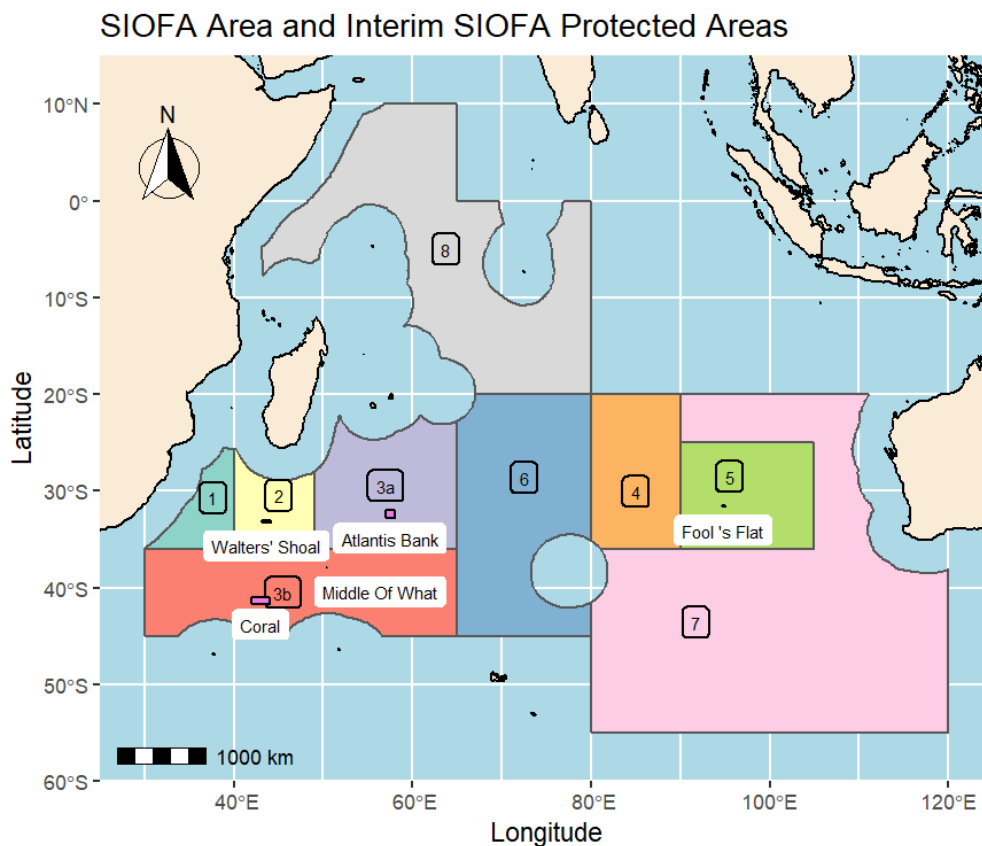


Figure 2. The SIOFA Area and Subareas (source: SIOFA Spatial database). The map highlights SIOFA Interim Protection Areas (in magenta) as defined in CMM 01(2023) (Annex 3). All the interim protection areas have been labelled by name for easier recognition. From the SIOFA Ecosystem Summary 2023.

Previous Nansen work in the Indian Ocean

R/V Dr Fridtjof Nansen, and an earlier ship of the same name, has focused its work mainly in the EEZs off the west African coast and to a lesser extent off the east African coast. She has however undertaken some surveys in the Indian Ocean ABNJ. These are listed below. The information from these cruises is with the relevant partner countries. The most relevant of these surveys to the current cruise was undertaken along the SW Indian Ridge in 2009 by the R/V Dr Fridtjof Nansen and in 2011 by the RSS James Cook between the current Coral and Atlantis Bank BPAs (Rogers et al., 2009; Rogers AD, Taylor ML, 2012). According to IMR, data from the 2015 and 2018 cruises has been sent to SIOFA.

<u>Survey</u>	<u>Start</u>	<u>End</u>	<u>Description</u>
<u>2018406</u>	<u>3 May 2018</u>	<u>4 June 2018</u>	<u>Regional resources and ecosystem survey in the Indian Ocean. LEG 2.1. Characterizing ecosystems and morphology of the Saya de Malha Bank and Nazareth Bank. Seychelles and Mauritius</u>
<u>2018407</u>	<u>10 June 2018</u>	<u>19 June 2018</u>	<u>Oceanographic survey in the Indian Ocean</u>
<u>2015406</u>	<u>26 June 2015</u>	<u>16 July 2015</u>	<u>Survey of the Southern Indian Ocean. Jakarta to Port Louis, IOS leg I</u>
<u>2015407</u>	<u>18 June 2015</u>	<u>6 July 2015</u>	<u>Cruise; Survey of the Southern Indian Ocean. Jakarta to Port Louis, IOS leg II</u>

<u>2009410</u>	<u>12</u> <u>November</u> <u>2009</u>	<u>19</u> <u>December</u> <u>2009</u>	<u>Southern Indian Ocean seamounts</u> <u>(IUCN/UNDP/ASCLME/NERC/EAF Nansen Project 2009</u> <u>Cruise 410)</u>
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There was a cruise in 2009 and one I think in 2018. The 2009 cruise (Alex Rodgers) lead to some EBSA descriptions (see below) but I'm not sure any data was ever made available. The later cruise seems to have been on the Saya de Malha Bank. Walter's Shoal does not appear to have had benthic ROV surveys.

CBD EBSAs

There have been several EBSAs described in the Indian Ocean (Figure 3). The Atlantis Seamount (1) and Coral Seamount and fracture zone (2) were described from data from the 2009 R/V Nansen cruise. There does not appear to have been any benthic surveys around Walter's shoals.

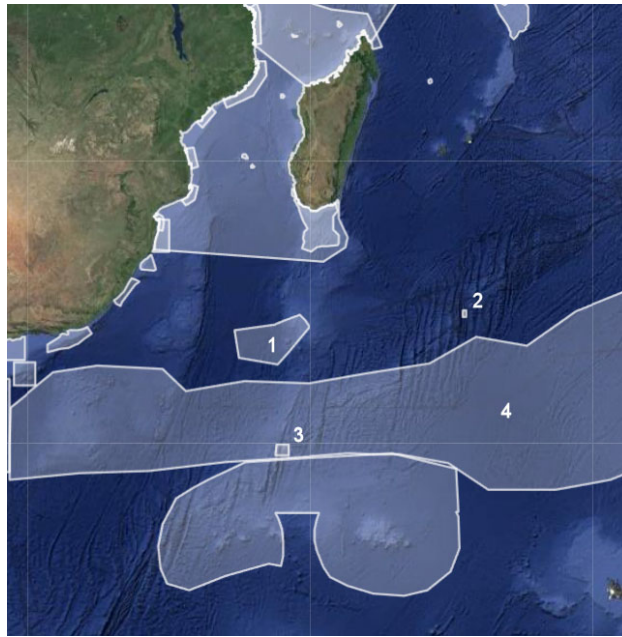


Figure 3. CBD EBSA locations in the Indian Ocean. Ecologically or Biologically Significant Marine Areas (EBSAs) (cbd.int) 1 = Walter's Shoals, 2= Atlantis Seamount, 3= Coral seamount and fracture zone, and 4= Agulhas front (pelagic)

~~There have been several EBSAs described in the Indian Ocean (Figure 3). The Atlantis Seamount (1) and Coral Seamount and fracture zone (2) were described from data (still unpublished??) from the 2009 Nansen cruise. There does not appear to have been any benthic surveys around Walter's shoals.~~

Reported VME incidental catches

Observers on-board have provide the locations of catches of VME indicator species in the SIOFA area (Figure 44). These are in the vicinity of the proposed work and indicate where benthic-pelagic fishing occurs.

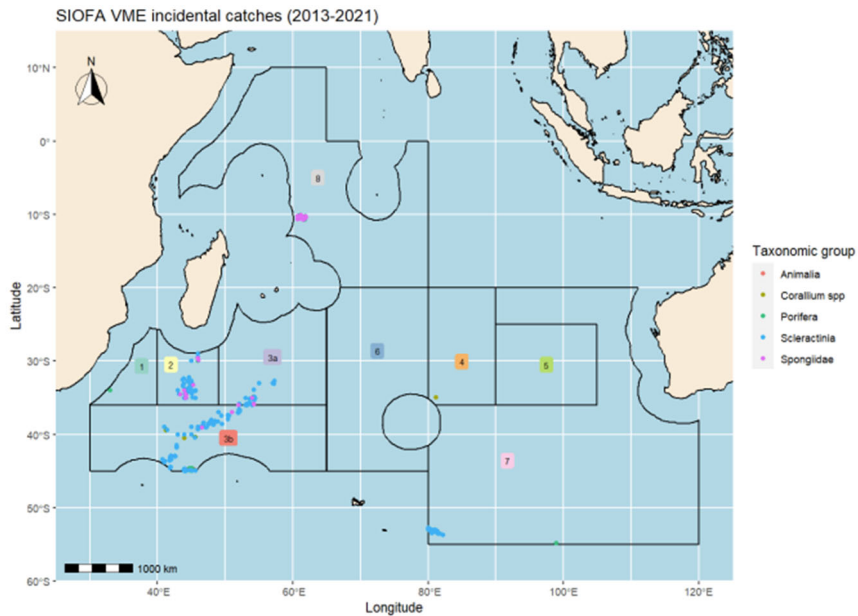


Figure 23 – Reported incidental catch of VME taxa in the SIOFA Area, mapped by taxonomic group (source: SIOFA Observer and HBHCatchEffort databases 2013–2021). Only the top 5 taxa by weight (cumulatively in the full database) are represented in this map. Figure D.4 in Appendix D provides a more detailed map at the highest taxonomic resolution.

Figure 4. Reported catches of VME indicator species in the SIOFA area, mostly on Walter’s Shoal and along the SW Indian Ocean Ridge. All catches were below the threshold weights that trigger management action. From the SIOFA Ecosystem Summary 2023.

Other benthic data sources

Available benthic data from GBIF, OBIS, NOAA and Smithsonian.
https://siofa.org/sites/default/files/sc_works/Annex%203c%20-%20Final%20Report_VMEMapping.pdf

France also did a focused study to select the protected areas which was mostly fishing-derived. In summary, there is very little benthic information for this area.

2. Acoustic survey

This provides the general draft plan of work for the acoustic work. The detailed sampling plan and locations will be decided later but will be within the areas previously described (Figure 1).

Bullet point summary of the acoustic survey design:

- Star shaped transects, centred on the target seamount (Figure 5). Two orthogonal transects in each star with a 5 NM radius. The vessel would point at the peak of the seamount, at a distance of about 5 NM, then start the transect and stop 5 NM after the peak (or earlier if depths >2500m are reached).

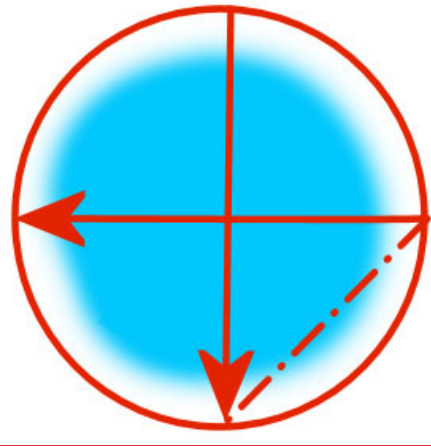


Figure 5. Scheme of acoustic tracks over a seamount (centre of figure).

- The ID fishing tow should be done during the second transect, and by the *F/V Will Watch* if possible.
- The R/V Nansen could do a tow in a third transect if fish are spotted in midwater.
- Note that fish would most likely scatter even after the first transect, so more transects do not provide additional advantages.
- Since the ID tows will probably be made by the Will Watch, most likely the biological sampling would be done on the same vessel. However, if the weather allows, scientists/observers could be transferred from the Nansen to the Will Watch to do the training.
- If possible, and subject to support, genetic samples of 150 individual fish per area surveyed.
- We believe that given the size of these operations, it's definitely feasible to have 3 surveys on seamounts outside of the BPAs (with full ID tows) and 3 inside the BPAs (with mid-water ID tows)
- More surveys could be done, if time allows, but that would depend on all sorts of local conditions
- Comply with mitigation and observer provisions for SIOFA vessels, as appropriate, during the cruise survey operations

- This design has fewer risks of environmental impact, so it should be easy to account for them

3. Benthic survey

Concerning VMEs and benthic ecosystems, the main aims are:

- carry out an inventory of the species present in these virtually unknown areas, based on specimen collection, including tissues sampling allowing DNA barcoding and isotope analysis to highlight food webs. This can be done with the use of the Van Veen grab and our laboratory facilities.

- not limit data collection to simple presence data, but deploy protocols that record abundance. This is crucial if we are not to produce species lists only, but to be able to carry out genuine community studies. In benthic ecology, we don't need to maximize the quantity of specimens (as in the inventory approaches on which systematics work is based), we also need to record zeros and low abundances to highlight the contrast between communities. For such approach, sampling plan must cover all the study area, not only areas expected to include the highest abundances and diversity.

This can be done by carrying out effort-weighted counts, using the Van Veen grab and/or the collection of benthic organisms caught by trawl nets.

- characterize the spatial and functional structure of communities, so as to assess their sensitivity to fishing activities and highlight assemblages composed of VME indicator organisms. Here, video imaging can be used. If we don't have access to a ROV, we can offer an alternative. Our team is developing underwater cameras for benthos and seafloor observation. We have prototypes that we could deploy for this campaign, which can go down to 3,000 meters for the most powerful model. They can be used to collect video or still images, with one of the models equipped with laser pointers for fine measurements and infrared images. These cameras can be deployed on station on a buoy, on sleeper gear or on the back rope of a trawl net. In addition to observing benthic organisms, the cameras provide high-quality images of the seabed, enabling a typology of substrates to be established. Other instruments can also be attached to these cameras.

Bullet point summary of the benthic sampling design:

- Aim at using video footage as a primary mean of investigation, which enables at least some taxonomy and abundance/density estimates and can be used both inside and outside of protected areas
- A reasonable setup could be to have 4 parallel video transects of 500 m each per each area sampled
- Sample 3 areas outside BPAs and 3 areas inside BPAs using cameras
- Use VanVeen grabs to retrieve material for better taxonomical ID, including barcoding analysis, and stable isotope sampling. These would also be valuable as training for the observer ID
- Using the grabs after the camera could allow better aiming of the physical sampling effort and be used to ID organisms recorded on video
- Have a stepwise approach to bottom grabs. Ideally we should get 3 grabs from each of the 3 areas sampled -but we could adopt a stepwise approach.

4. Deepwater sharks identification (lead by VIMS)

Bullet point summary of the deepwater shark work:

- 1) Incidental catches of deepwater sharks available from the trawling for acoustic ID work.
- 2) A rosette of Niskin bottles remotely triggered to collect water samplers for environmental DNA, and water filtration equipment: vacuum pumps, filters, filter cups, and other basic laboratory equipment. eDNA also requires gloves, forceps, Nalgene bottles, and supplies normally found in laboratories.
- 3) Baited remote underwater video systems (BRUVs) will require deepwater cameras rated to 3000 meters, a lander, a highflier, and line for retrieval. raining opportunities
 - Use of ID keys. participants will learn to use the new style keys to identify shark species, get hands on experience in shark taxonomy, and learn how to trouble shot difficult to identify species. They will also learn what groups of sharks are in the area, which groups are taxonomically ambiguous, and the characters that are most effective in deepwater shark identification.

5. Training of invited SIOFA CCP scientists and observers

The R/V Dr Fridtjof Nansen has five laboratories (for fish, chemical oceanography, plankton, -benthos and acoustics) each being staffed by a Norwegian scientist who will act as trainers.

- Training for catch and bycatch recording. Participants will learn best practices on how to collect data, which parameters are important for life history estimates and fisheries management, and learn data entry and management.
- Learning about benthic sampling
- Learning about acoustics
- Learning about research and commercial vessel operations
- Learning about eDNA surveying, sample collection, and filtration. Participants will learn how eDNA studies work, how to collect eDNA and filter samples, basic data to collect alongside eDNA samples. and what can and cannot be done with eDNA surveys.
- Learning about baited remote underwater video surveys (BRUVs), deployment, and retrieval. Participants will learn the how BRUVs work, and how they are different from other video surveys. They will learn how to deploy BRUVs, retrieve BRUVS, and to how to maintain simple GoPro based BRUVs.

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