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Updated observations relevant to the Scientific Committee's 3rd decadal review of the Southern Ocean Sanctuary (SOS).

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Introduction

This document updates the research bibliography of SC/66b/SAN01 presented in 2016. The Southern Ocean Sanctuary (SOS) was established by the Commission in 1994. The area covered by the SOS in combination with the complementary Indian Ocean Sanctuary (IOS) is shown in Figure 1. The southern boundary of the IOS is contiguous with the northern boundary of the SOS. The Schedule amendment establishing the Southern Ocean Sanctuary requires the Sanctuary to be reviewed at succeeding ten year intervals, unless this timing is revised by the Commission.

The first review of the SOS took place in 2004; a second review was completed in 2016. The third decadal review will be conducted in 2024. An important component of the review process will involve an assessment of the scientific research undertaken within the SOS and the contiguous IOS against Objectives 4 and 6, and Term of Reference 4, in particular. In readiness, a compilation of the research conducted in the SOS since 2016 is underway. This document presents a draft compilation; it is currently incomplete and non-exhaustive.

This paper also introduces a new online portal hosted by the IWC Secretariat, available to assist researchers in submitting summaries of research for the upcoming and future SOS and IOS reviews. Submissions are invited during the 2023/24 intersessional period to ensure that, as much as practicable, all research has been captured for the SOS review in 2024.

Summary of previous Southern Ocean Sanctuary reviews

1st Decadal Review of the SOS, 2004

In 2004, the first review of the SOS was undertaken by the Scientific Committee's Working Group to Review Sanctuaries and comprised three external scientific experts (IWC, 2005). The external experts were requested to:

1. assess the Sanctuary against its objectives and the evaluation criteria developed by the Scientific Committee and approved by the Commission; and
2. provide advice on how to introduce Marine Protected Area scientific concepts into IWC Sanctuaries and on establishing monitoring programmes.

In completing its review, the Scientific Committee took into consideration the report of the external experts, other relevant documents and the outcomes of an inter-sessional workshop, and agreed that:

a. Whales are not effectively protected from whaling in the Sanctuary, because such Sanctuaries only apply to commercial whaling, and because (apart from stocks that migrate to the Indian Ocean Sanctuary) whales also migrate out of the Sanctuary boundaries.
b. The boundaries of the Sanctuary were appropriately established for some, but not for all, stocks.
c. It was not possible to completely evaluate the effectiveness of the Sanctuary because the scientific objectives are not clear and are not associated with quantifiable performance measures.

The Commission noted the report of the Scientific Committee and further endorsed seven recommendations of the 2004 review that would improve future review processes and help incorporate marine protected area concepts into IWC Sanctuaries, as follows:

i. The purpose(s) of the Sanctuaries should be better articulated through a set of refined overall objectives (e.g. preserving species biodiversity; promoting recovery of depleted stocks; increasing whaling yield). In particular, the relationships between the Revised Management Procedure (RMP) and any Sanctuary programme should be articulated.
ii. Appropriate performance measures for Sanctuaries should be developed. These performance measures should link the objectives of a Sanctuary with field monitoring programmes.
iii. Systematic inventory and research programmes should be established or further developed so as to build the required information base for a Sanctuary management plan and subsequent monitoring programs.

iv. A Sanctuary management plan should clearly outline the broad strategies and specific actions needed to achieve Sanctuary objectives (e.g. how to protect x% of a given feeding area for stock y).
v. A monitoring strategy that measures progress toward achieving the Sanctuary objectives should be undertaken. A key component of this monitoring strategy should be the development of tangible indicators to monitor progress.
vi. Review criteria that reflect the goals and objectives of the Sanctuary (as described above) should be established.
vii. The Sanctuary management plan should be refined periodically to account for ecological, oceanographic and possible other changes in an adaptive fashion.

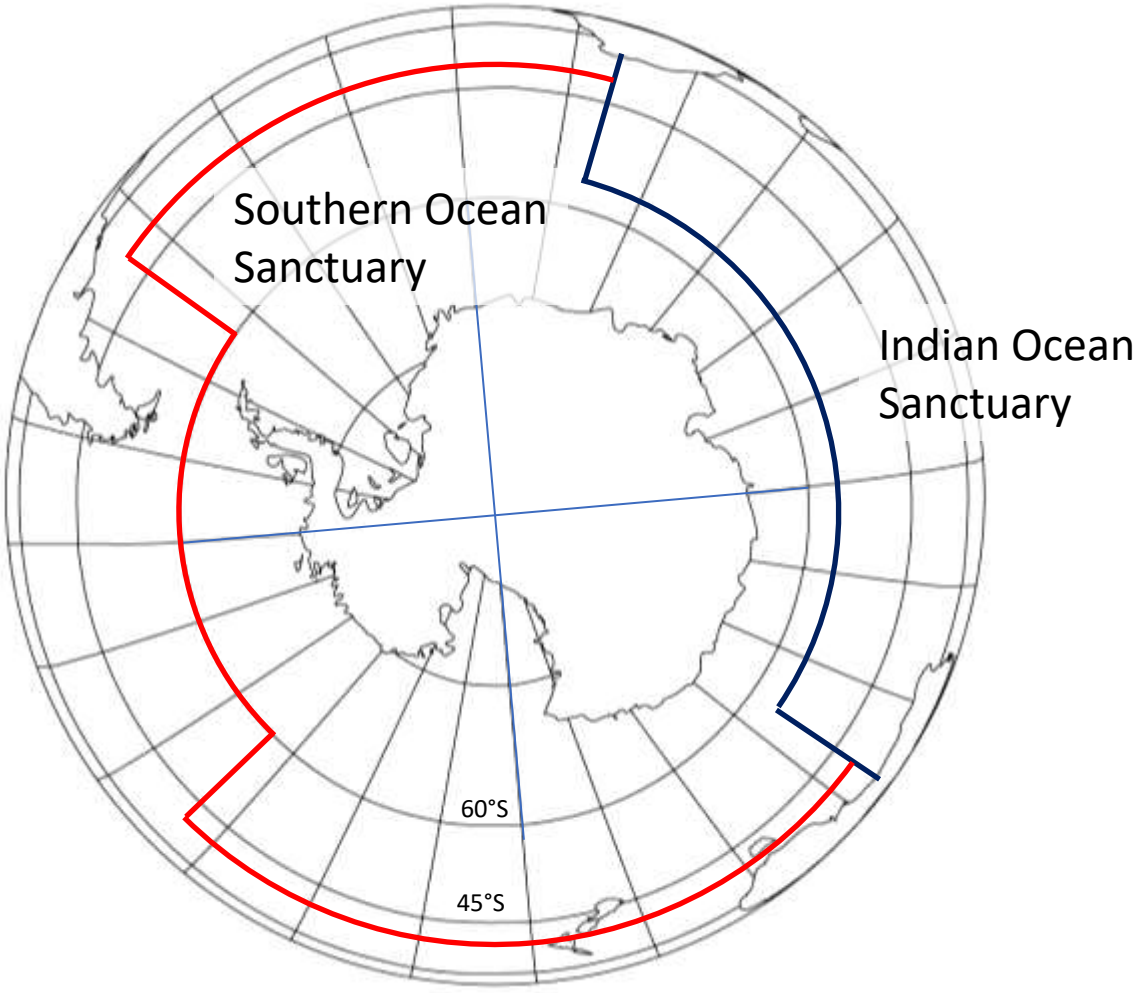

Figure 1. Boundary of the Southern Ocean Sanctuary (red). The southern boundary of the Indian Ocean Sanctuary (blue) coincides with the northern boundary of the Southern Ocean Sanctuary. Factory ship whaling is forbidden in southern hemisphere waters north of 40°S.

Scientific Committee advice 2014 (SC65b)

At its meeting in May 2014, the IWC Scientific Committee was instructed by the Commission Chair that since the Commission had not yet agreed on scientific objectives for the review of the Sanctuary, the Committee could commence its review process by assembling information necessary to establish scientific objectives. The Chair further noted that the Commission would provide advice to the Scientific Committee regarding the review of the Sanctuary at IWC65 following Commission consideration of the proposed review. Based on the Chair's direction, the Scientific Committee established an inter-sessional correspondence group to assemble scientific information that might assist the Commission to establish scientific objectives for the Sanctuary. The group prepared a report

summarising information on the distribution, migration, current abundance, status and trends, threats, and catches by species/stock in the Sanctuary. That was endorsed by the Commission at IWC65 (IWC, 2014).

A paper on the Review of the Southern Ocean Sanctuary was submitted by Japan (2014; SC/65b/O01) to the 2014 meeting of the Scientific Committee. The paper proposed a process for reviewing the Sanctuary in which the Scientific Committee in the first instance should initiate the review by assembling information necessary for the Commission to establish scientific objectives. This step was substantially completed in IWC/65/CCRep08 Rev1. SC/65b/O01 further proposed that an inter-sessional Steering Group be established by the Scientific Committee to facilitate the review. The Commission did set up a steering group but under the auspices of the Conservation Committee.

SC/65b/O01 also proposed that the SC steering group should appoint a panel of non-IWC affiliated scientists to undertake the review and report to the inter-sessional steering group. It is further proposed that an inter-sessional meeting of the steering group be held immediately prior to the 2016 meeting of the Scientific Committee, to consider the panel's report. The Commission left it to the SC to decide whether it wished to engage external scientists in the review. That proposal will need to be discussed at this meeting.

2nd Decadal Review of the SOS, 2014-2016

Although the 2004 review provided a suite of recommendations to improve future reviews of the Sanctuary, no action was undertaken by the Commission to follow up on review recommendations until 2014, when the Commission adopted by consensus objectives and terms of reference (reproduced below). The 2nd decadal review was completed in 2016. The 3rd Decadal Review (2024) will take into account the same objectives and Terms of Reference.

Objectives

The Commission adopted these objectives for the SOS:
Taking into account the objectives referred to in the original proposal by France and subsequently agreed by the Commission, the objectives of the Sanctuary are to:

1. *Contribute to the rehabilitation of a marine ecosystem damaged by the over-exploitation of whales and allow for the restoration of a complex of whale species and populations.*
2. *Secure a long-term satisfactory habitat for cetaceans and other marine life.*
3. *In combination with the Indian Ocean Sanctuary, fully protect at least one population of each of the great whales throughout its migratory range and life-cycle, i.e. on feeding and breeding grounds, to provide for their long-term conservation.*
4. *Provide a reference area to allow for the collection of information on levels and trends on unexploited and recovering whale populations.*
5. *Allow for the monitoring of the recovery of ecosystems without their being disturbed by further commercial whaling.*
6. *Allow for coordinated research on the effects of environmental change on whale stocks.*
7. *Allow for the Comprehensive Assessment of the effects of setting zero catch limits on whale stocks.*
8. *Allow for application of the Revised Management Procedure (RMP) to be phased in over limited geographic ranges and species.*

Consequently, the SOS is consistent with the IUCN (2008) definition "*A protected area is a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values".*

It could be further classified as IUCN category IV:

> *Category IV protected areas aim to protect particular species or habitats and management reflects this priority. Many category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category.*

Terms of reference

The Commission adopted in 2014 the terms of reference reproduced below:

Taking into account the objectives for the Sanctuary, the Commission instructs the Conservation Committee and Scientific Committee according to their respective mandates to:

1. *Provide advice on the status and trends of whale stocks in the Southern Ocean Whale Sanctuary in so far as these are known. Assess the present and potential threats to whale populations and their habitats in the area of the Sanctuary and the complementary Indian Ocean Sanctuary and how the Sanctuaries address these.*
2. *Consider whether the Sanctuary is consistent with other measures to protect whales from anthropogenic and other environmental factors.*
3. *Assess the effects of the Sanctuary and the complementary Indian Ocean Sanctuary in terms of:*
    a. *The protection of whales in breeding areas, feeding grounds, and/or migratory routes.*
    b. *International agreements concerning biodiversity and conservation of nature.*
4. *Evaluate whether the Sanctuary allows for the conduct of scientific research useful for meeting IWC objectives or coordinated integrated research and monitoring programmes across the range of issues of global relevance.*
5. *Provide advice on whether the sanctuary is consistent with the precautionary approach.*

Due to the major impacts of climate change in the Southern Ocean, in 2022 the Scientific Committee agreed that climate change should be explicitly noted as an anthropogenic factor in Term 2 (SC68d, 2022) for the 3rd Decadal Review.

The Southern Ocean Sanctuary Management Plan

During both the 1st and 2nd decadal reviews of the Southern Ocean Sanctuary (SOS), it was recommended that the SOS should have a management plan that linked objectives to measurable or identifiable outcomes.

The Scientific Committee subsequently made the following recommendations (IWC, 2017):

- Each SOS objective should be linked to an appropriate performance measure.
- Appropriate performance measures for the SOS should be developed. These should link the objectives of the SOS with field monitoring programmes.
- Performance measures for some scientific objectives could draw on existing mechanisms, such as the In-Depth Assessment process.
- The SC could provide suggestions for appropriate performance measures in relation to the scientific objectives of the SOS to the Commission in future, should the Commission request it.
- Outputs from existing and planned research programmes should be incorporated into the development of a management plan for the SOS and subsequent monitoring programmes.
- A Management Plan for the SOS should be developed to clearly outline the broad strategies and specific actions needed to achieve SOS objectives. This information could be collated, based on the Committee's recent relevant activities.
- Review criteria in the Management Plan should be linked to performance measures.
- The Management Plan should be refined periodically.

Taking into account these recommendations, the *SOS Management Plan* (henceforward termed the Plan) was drafted for the consideration of the Scientific and Conservation Committees in 2018 (SC/67b/SAN01). While the draft Plan does contain performance measures, it does not contain criteria for its own review.

The purpose of the Plan is twofold: (1) to inform the Commission and public about the sanctuary objectives and actions planned for the next ten years, and (2) to propose strategies toward the achievement of the SOS's goals using the best means available, and provide clear performance measures for each proposed action (IWC/67/Rep01(2018), Annex R).

The Plan is designed to guide the mitigation of threats faced by whales and the assessment of their recovery for the next ten years in the SOS. The operative part of the Plan is a *Research and Action Plan* that involves assessing and addressing threats and research on the recovery of whale populations and their habitats. The Research and Action Plan is structured based on the Commission's agreed objectives for the SOS. Each objective is linked directly to a measureable objective, action or approach and performance measure. The management plan was endorsed by Commission in 2018 (IWC67, 2018).

Upcoming 3rd Decadal Review of the SOS, 2024

In 2024, the IWC's Scientific Committee will undertake the 3rd decadal review of the Southern Ocean Sanctuary (SOS). In order to address Objectives 4 and 6 and Term of Reference 4, in particular, an important component of the review process is an assessment of the scientific research undertaken within the SOS and the contiguous Indian Ocean Sanctuary (IOS). In readiness, a compilation of the research conducted in the SOS and IOS since 2016 is

underway (as per SC/66b/SAN01). This document presents a draft compilation; it is currently incomplete and non-exhaustive.

An online form (https://forms.office.com/e/qWDVfn2xf0) has been created to capture high level information about research projects and voyages, the type and volume of data collected, the outputs generated and other details about research in the SOS and IOS. Details are requested from all members of the IWC's Scientific Committee about research that they have conducted (or are aware of being conducted) within the SOS and contiguous IOS since and including 2016. The online form will remain live during the intersessional period 2023/24. A final paper summarising SOS and IOS research will be submitted to the panel established to review the SOS in 2024.

Partially updated observations on the objectives for the 2024 review

The objectives and terms of reference of the review need to be interpreted in light of the management actions available to the Commission. For this reason it is not appropriate to apply criteria to the SOS as if it were a marine protected area (MPA) wholly under the jurisdiction of a sovereign state. The only management action in the SOS available to the Commission is setting zero catch limits for commercial whaling. The Commission can encourage members to undertake Scientific Research but does not itself have the capacity to do so.

1. *Contribute to the rehabilitation of a marine ecosystem damaged by the over-exploitation of whales and allow for the restoration of a complex of whale species and populations.*

The SOS meets this objective by setting catch limits for commercial whaling to zero.

2. *Secure a long-term satisfactory habitat for cetaceans and other marine life.*

This objective requires complementary actions by other international agencies and range states (including in the Indian Ocean). The management of krill fisheries in the Antarctic is considered conservative and precautionary by CCAMLR, according to its ecosystem-based approach to management. Krill fishing is currently concentrated in the South Atlantic, but there has been recent experimental fishing for krill in East Antarctica. Only those species that primarily feed to the north of the SOS could be considered at risk due to bycatch and competition with fisheries for small pelagic fish, but these are relatively small scale in the Indian Ocean and in much of the remainder of the Southern Hemisphere.

3. *In combination with the Indian Ocean Sanctuary, fully protect at least one population of each of the great whales throughout its migratory range and life-cycle, i.e. on feeding and breeding grounds, to provide for their long-term conservation.*

The words "fully protect" need to be understood in the context that the only management action in the SOS available to the Commission is setting commercial whaling catch limits to zero. Given this limitation, this objective is likely to be largely achieved for populations of baleen whales that breed in the Indian Ocean. If we include sperm whales in the category of great whales the available information is too sparse to reach a reliable conclusion in their case. Other recognised threats due to krill fishing and climate change (including ocean acidification) fall outside the Commission's direct mandate. The Commission is active in encouraging Contracting Governments and other international organisations to address other threats, particularly ship-strikes, entanglements and the effects of pollution. These latter issues are of more substantial outside the SOS, and are potentially more important in the IOS.

4. *Provide a reference area to allow for the collection of information on levels and trends on unexploited and recovering whale populations.*

Information on trends in the abundance of baleen whales in the Antarctic has been collected over several decades and research continues on these subjects (as summarised in the Appendices). The SOS thus functions as a reference area in relation to the estimation of abundance and trends in lower latitudes, which is only currently directly practicable for species that migrate along coasts. However, acoustic methods for monitoring trends for some species have made substantial progress (e.g. van Opzeeland *et al.*, 2014; Miller *et al.*, 2015).

5. *Allow for the monitoring of the recovery of ecosystems without their being disturbed by further commercial whaling.*

The SOS meets this objective by setting catch limits for commercial whaling to zero.

6. *Allow for coordinated research on the effects of environmental change on whale stocks.*

Coordinated research on the effect of environmental change on whale stocks is challenging because it is difficult to attribute which effects might be due to environmental change and which may be due to recovery from previous exploitation. Nonetheless progress is being made, although the time scale required may run to decades because the information required comes from monitoring the trends in the whale populations while also monitoring the environmental effects on whale prey, especially Antarctic krill.

7. *Allow for the Comprehensive Assessment of the effects of setting zero catch limits on whale stocks.*

The primary method for the Comprehensive Assessment of the effects of setting zero catch limits is through monitoring abundance and trends of whale stocks. This objective has to some extent been addressed by the development of the RMP, which has the consequence that this objective is also related to 8 below.

8. *Allow for application of the Revised Management Procedure (RMP) to be phased in over limited geographic ranges and species.*

This management oriented objective is met by the setting catch limits for commercial whaling in the SOS to zero. It is achieved if the SOS remains in force when non-zero catch limits for commercial whaling are set elsewhere. The management system for the IWC is not complete, with some elements such as the Revised Management Scheme at an impasse. New technologies allow whale concentrations of some species to be identified from considerable distances and tracked in real time (e.g. Miller *et al.* 2015). Whether this needs to be taken into account in future management remains to be determined. Experience thus far with the RMP is its independent application by Norway (under its objection). Norway has made several adjustments to the RMP that have the effect of increasing catch limits. This demonstrates that pressures to amend the RMP will also be likely to occur in future within the IWC. Thus the SOS would enable for the evolution of the RMP and RMS before their application to the Antarctic.

Partially updated observations under the Terms of Reference for the 2024 review

1. *Provide advice on the status and trends of whale stocks in the Southern Ocean Whale Sanctuary in so far as these are known. Assess the present and potential threats to whale populations and their habitats in the area of the Sanctuary and the complementary Indian Ocean Sanctuary and how the Sanctuaries address these.*

Advice on the status and trends of whales and potential threats in the SOS were provided to the Commission at its meeting in 2014 (IWC, 2014). As explained above the IWC does not have the regulatory power to address directly other threats to whale populations. However, the sanctuaries are consistent with the Commission's efforts to encourage and coordinate work to mitigate threats undertaken by Contracting and other Governments and other international and regional organisations.

Various countries protect whales within their Exclusive Economic Zones (EEZ). One example is the corridor provided by the Australian, New Zealand and French (New Caledonia) EEZs which allow whales to pass through contiguous areas of protection from their wintering grounds to their breeding grounds off the coast of Queensland, the Coral Triangle, and much of the south Pacific, where further protection is provided by some Pacific Island and metropolitan states. The prospect of further large areas of protection around PNG may further extend this complex of protected areas to give whole of life and whole of migration protection to a larger proportion of the whales that summer in the Southern Ocean Sanctuary.

Other observations relevant to this term of reference are discussed under (2) below.

2. *Consider whether the Sanctuary is consistent with other measures to protect whales from anthropogenic and other environmental factors.*

Narrowly speaking the SOS and IOS can only protect whales from commercial whaling. The primary anthropogenic and other environmental factors likely to affect whales in the SOS are those due to krill fisheries and climate change (including ocean acidification).

Krill fisheries are currently managed conservatively under a precautionary ecosystem-based approach, but these fisheries are expected to expand. Although CCAMLR has an ecosystem monitoring programme (CEMP) this is focussed primarily on monitoring changes in predator populations that can be studied on land (seals and penguins and flying seabirds). CCAMLR is now seeking to incorporate the needs of krill predators into a revised krill management approach (CCAMLR-38, Paragraph 5.17) via a spatial overlap analysis, which requires estimates of predator consumption of krill at different spatial and temporal scales. The CEMP is also about to undergo a review (commencing in 2023), in particular to ensure it is fit for purpose for the revised krill management approach (SC-

CAMLR-41, Paragraph 3.41), and will include consideration of the needs of baleen whales, and whether CEMP could be expanded to consider these explicitly.

Due to the major impacts of climate change in the Southern Ocean, in 2022 the Scientific Committee agreed that climate change should be explicitly noted as an anthropogenic factor under this term of reference (SC68d, 2022) for the 3rd Decadal Review.

It is difficult to predict the effects of climate change and ocean acidification on whales in the SOS. It is generally considered likely that reductions in sea ice will adversely affect krill abundance. Studies have shown that ocean acidification adversely affects krill larval development (Kawaguchi et al., 2013). Another relevant consideration is the role that whales may play in the global carbon cycle. The "iron fertilisation hypothesis" (Smetacek and Nicol, 2005) indicates that the recovery of depleted whale population is likely to be important in the continuing drawdown of atmospheric carbon dioxide and its transport to the deep ocean in the form of organic detritus. These mechanisms may help mitigate global climate change and the local Southern Ocean effects of ocean acidification.

The removal of whales by commercial whaling may both exacerbate the effects of anthropogenic and other environmental factors and diminish the local and global mitigation of climate change and ocean acidification. Consequently, the SOS is broadly consistent with other measures to protect whales from anthropogenic and other environmental factors.

3. *Assess the effects of the Sanctuary and the complementary Indian Ocean Sanctuary in terms of:*

    a. *The protection of whales in breeding areas, feeding grounds, and/or migratory routes.*

The combined SOS and IOS provide relatively complete protection from any future commercial whaling for the populations of baleen whales that breed in the Indian Ocean. Populations of whales in other oceans that breed in coastal waters are currently substantially protected in the EEZs of southern hemisphere coastal states. Oceanic populations in other oceans in the southern hemisphere are protected by the existing ban on factory ship operations north of 40° S (Schedule paragraph 8). The existing system provides relatively complete coverage for all baleen whales in the southern hemisphere. Although whaling has occurred in feeding areas under special permit this has not been on a scale that would substantially undermine the objectives of the SOS.

    b. *International agreements concerning biodiversity and conservation of nature.*

The UN 1992 Convention on Biological Diversity (CBD) notes that "the fundamental requirement for the conservation of biological diversity is the in-situ conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings". The Convention defines "Biological diversity" as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems". The SOS is consistent with the CBD.

4. *Evaluate whether the Sanctuary allows for the conduct of scientific research useful for meeting IWC objectives or coordinated integrated research and monitoring programmes across the range of issues of global relevance.*

Appendices I to III demonstrate that the SOS and IOS have allowed for the conduct of scientific research useful for meeting IWC objectives. A total of 211 scientific documents written since the 2nd Decadal Review of the SOS are listed in the selective bibliography of Appendix III. A further 359 documents related to scientific research conducted in the SOS and IOS prior to 2016, are listed in SC/66b/SAN01. These list are not intended to be exhaustive. Each scientific document corresponds to the outcomes of scientific research or monitoring carried out within the areas of the SOS or IOS. Many of the projects outlined in Appendix II represent long-term, coordinated, integrated, international research programmes involving collaborators from multiple IWC member countries. A common aim of all projects is to assess trends in whale abundance and distribution, and monitor species recovery.

The "experiment" of the massive depletion of baleen whales in the Southern Ocean in principle creates an opportunity to estimate the fundamental ecology of inter-species interactions from trends in the abundance of the various species. Differential recovery rates between species reflect both properties of the environment and the interactions between the species. The fastest recovering species could be expected to reach a peak in abundance and then decline as the species with slower recovery rates increase in abundance (see de la Mare 2010 for an example). The recent review of MSY rates relied on estimating the rate of recovery of depleted stocks (IWC, 2013). Observing abundance trends in the SOS thus meet IWC objectives relating to the future management of whaling. Relevant observations of abundance have been underway for three decades but observations over more decades will be needed to estimate the effects of inter-specific interactions. The resumption of commercial

whaling would confound these observations by truncating the recovery of the fast recovery populations before they otherwise would peak and decline.

5. *Provide advice on whether the sanctuary is consistent with the precautionary approach.*

The precautionary principle states in essence that "... lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation" (UN Rio Declaration, 1992). At the time of the adoption of the SOS, the state of science in relation to whale conservation was clearly uncertain. Although, progress has been made over the last 20 years, many of the earlier uncertainties remain, while new uncertainties have arisen due to the potential impacts of anthropogenic and other environmental factors. Consequently, the SOS has been and remains consistent with the precautionary principle.

Work to be undertaken in preparation for the 3rd Decadal Review of the SOS, 2024

The following work will be undertaken during the intersessional period 2023/34, to update this paper and prepare for the 3rd decadal review of the Southern Ocean Sanctuary (SOS):

- Continued compilation of the research conducted in the SOS and IOS since 2016 (to address Objectives 4 and 6 and Term of Reference 4).
- Promotion of the online form (https://forms.office.com/e/qWDVfn2xf0) created to capture high level information about research projects and voyages, the type and volume of data collected, the outputs generated and other details about research in the SOS and IOS.
- Collation of the information submitted directly by member nations or collected from other sources.
- Completion of a paper summarising SOS and IOS research for submission to the panel established to review the SOS in 2024.

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APPENDIX I: Overview of scientific research in the Southern Ocean Sanctuary

Research Title/Project	Contributors	Location	Dates	Main Species	Aims	Key Output	
						Summary	References (Appendix III)
SOUTHERN OCEAN SANCTUARY: Non-Lethal Research							
Dynamics of a recovering population of southern right whales	NZ	Auckland Islands	2016-2018	Southern right whale	Better understand recovery and size structure of SRWs visiting Port Ross	Fieldwork collecting photo-ID and drone photogrammetry	1-2
IWC-SORP (1) Antarctic blue whale project	Australia, UK, USA, South Africa, NZ, Argentina, Chile, France, Norway	Southern Ocean	2012-Current	Antarctic blue whale	• Identify the most appropriate and efficient method to deliver a new circumpolar abundance • Improve survey efficiency; • Deliver a new circumpolar abundance estimate • Improve understanding of population structure; • Improve understanding of linkages between breeding and feeding grounds; • Characterise behaviour on the feeding grounds.	Acoustically-assisted tracking methods for locating blue whales have been developed and successfully used to find Antarctic blue whales during several research voyages. Eight voyages since 2016 collecting a range of visual sighting, acoustic, photo-ID, biopsy, environmental and prey data	3-31
IWC-SORP (2) Killer Whales in the Southern Ocean	USA, South Africa, Brazil, France, Canada	Antarctic Peninsula; Ross Sea; Marion Island	2006-Current	Killer whale	Investigate distribution, relative abundance, migration patterns, and foraging ecology	Fieldwork collecting a range of data including: photo-ID, biopsy samples, satellite tracks, behavioural observations and acoustics	32-51
IWC-SORP (3) Interactions between baleen whales and krill	USA, Australia	Antarctic Peninsula	2009-Current	Humpback whale Minke whale	Investigate short and long term movement patterns and behaviour in relation to prey and environmental variability	Fieldwork collecting a range of data including photo-ID, satellite tracks, dive tracks, behavioural observations, environmental and prey data	52-85
IWC-SORP (4) Movements and mixing of humpback whales	New Zealand, Australia, USA, France, Samoa, Tonga	Southern Ocean	1998-Current	Humpback whale	Study the movements and mixing of humpback whales around the Southern Ocean	Fieldwork collecting photo-id, biopsy, satellite tracks, behavioural observations and acoustic data. A	106-113

Research Title/Project	Contributors	Location	Dates	Main Species	Aims	Key Output	
						Summary	**References (Appendix III)**
						Genetic catalogue of whales back to 1998	
IWC-SORP (5) Blue and fin whale acoustic trends project	France, USA, Germany, Australia, South Africa, UK	Southern Ocean	2009-Current	Blue whale Fin whale	• Examine trends in blue and fin whale population growth, distribution, and seasonal presence using passive acoustic monitoring • Implement a long-term Southern Ocean Hydrophone Network (SOHN)	Successful deployment of several long-term recorders by multiple research groups	114-148
IWC-SORP (6) Foraging ecology and population recovery of southern right whales	NZ, South Africa, Argentina, Australia, Brazil	Southern Hemisphere	2018-Current	Southern right whale	Better understand foraging ecology, population dynamics and the impact of climate change on population recovery	Fieldwork collecting photo-ID and genetic data, and the collation and analysis of long-term datasets	149-184
IWC-SORP (7) Recovery and ecology of Southern Hemisphere fin whales	Germany, Norway, USA, Argentina, UK, Australia, Brazil	Southern Ocean, Antarctic Peninsula and Western Antarctic	2019-Current	Fin whale	Collate previous opportunistic data collected on fin whales in the Southern Hemisphere and undertake dedicated fin whale research to enhance our understanding of current SHFW population status and recovery	Collation of previous data and new fieldwork collecting tracking and behavioural data	185-188
JASS-A (Japanese Abundance and Stock-structure Surveys in the Antarctic)	Japan	Southern Ocean	2020-Current	Antarctic blue whale Antarctic minke whale Fin whale Humpback whale	Study trends in abundance, distribution, migration and stock structure of large cetaceans in the Antarctic Ocean	Fieldwork collecting sighting, photo_ID, genetic, tracking and beahvioural data	189-194
ORCA Southern Ocean distance sampling programme	UK	Southern Ocean around the Antarctic Peninsula	2022-2023	Antarctic blue whale Antarctic minke whale Arnoux's beaked whale Fin whale Hourglass dolphin Humpback whale Killer whale Southern right whale Sei whale	Estimate cetacean abundance and distribution, density	Fieldwork on cruise expedition vessels collecting distance sampling data	-
Parāoa (sperm whales) of the South Pacific	NZ	NZ shelf and slope (Northland,	2021-2024	Sperm whale	Better understand NZ sperm whale population connections and	Fieldwork colleting photo-ID, genetic, behavioural and acoustic data	-

Research Title/Project	Contributors	Location	Dates	Main Species	Aims	Key Output	
						Summary	**References (Appendix III)**
		Kaikoura, Otago)			strengthen connections with local communities		
Study of the pelagic ecosystem in the Bransfield Strait	Peru	Bransfield Strait	2018-2020	Fin whale Humpback whale Killer whale	Study the structure and functioning of the Antarctic pelagic ecosystem with emphasis on krill and potential relationships with flora and fauna, predators and oceanographic conditions	Fieldwork collecting acoustic recordings of krill, visual sightings and oceanographic data	195
SOUTHERN OCEAN SANCTUARY: Lethal Research							
NEWREP-A (New Scientific Whale Research Program in the Antarctic Ocean)	Japan	Southern Ocean	2015-2019	Minke whale	• Improvement in the precision of biological and ecological information for the application of the RMP to Antarctic minke whales • Antarctic marine ecosystem modelling	'Scientific' whaling voyages with a combination of sighting and lethal sampling surveys	196-204
INDIAN OCEAN SANCTUARY: Non-Lethal Research							
Distribution, movements, and feeding behaviour of killer whales in the tropical Southwest Indian Ocean	UK, France, Mozambique, Madagascar, Seychelles, Tanzania, Kenya, South Africa	SWIO	2021-2025	Humpback whale Killer whale	Study the distribution, abundance, movements and feeding behaviour of killer whales in the SWIO	Fieldwork collecting sighting, photo-ID, PAM, dietary and behavioural data	205
Migration routes of *Megaptera novaeanglia*	Reunion/France	SWIO	2013, 2022	Humpback whale	Describe migrations routes, identify feeding areas and environmental influences	Satellite tags to document migration	206
Occurrence, habitat preferences and relative abundance of cetaceans in Seychelles	USA, Seychelles	Seychelles	2020-2025	Bottlenose dolphin Bryde's whale Cuvier's beaked whale False killer whale Killer whale Pilot whale Pygmy blue whale Antarctic Blue whale Antarctic minke whale	Assess the occurrence, distribution, habitat preferences, and the abundance of cetaceans in Seychelles	Fieldwork collecting vessel-based visual data and passive acoustics	-

Research Title/Project	Contributors	Location	Dates	Main Species	Aims	Key Output	
						Summary	**References (Appendix III)**
				Sperm whale Humpback whale Sei whale			
Rapid assessment of marine mammals in Tanzania	Tanzania, UK	Tanzania	2014-2015	Humpback dolphin Bottlenose dolphin	Gather baseline data on species presence, relative abundance and threats	Fieldwork collecting data on visual acoustic and interview surveys	207
Tanzania citizen science whale network	Tanzania	Tanzania	2019-2023	Humpback whale	Document the number of whales using Tanzanian waters	A network of reported opportunistic sightings of humpback whales	208-211

APPENDIX II: Detailed compilation of research in the Southern Ocean Sanctuary

1 SOUTHERN OCEAN SANCTUARY: NON-LETHAL RESEARCH

1.1 Dynamics of a recovering population of southern right whales

AIMS
This project aims to better understand the recovery and size structure of southern right whales visiting Port Ross.

KEY OUTPUTS
RESEARCH SUMMARY
Systematic photo-ID and drone photogrammetry surveys were conducted in Port Ross during 3 week long expeditions in 2016, 2017, 2018. The photo-ID data added to the catalogue curated by University of Otago, but with contributions by University of Auckland, Oregon State University, Australian Antarctic Division and Department of Conservation.

- **Number of cetacean sightings:** Not reported
- **Species encountered:** Southern right whale
- **Images collected:** Camera (lateral photo-ID images); drone (photogrammetry)
- **Number of photo-IDs:** 239 calving females
- **Number of samples:** None
- **Number of tags deployed:** None
- **Acoustic recordings:** None
- **Other data:** None

Peer-reviewed Publications
Appendix III: 1
Unpublished Reports
Appendix III: 2

1.2 IWC-SORP (1) Antarctic blue whale project

AIMS
This project represents a coordinated, international research programme, focused on understanding both the recovery of Antarctic blue whales and their important role in the Southern Ocean ecosystem. It employs a multi-disciplinary approach to investigate foraging ecology, habitat preferences, and ultimately contribute to a precise circumpolar Antarctic blue whale (ABW) abundance estimate. It aims to:

- Identify the most appropriate and efficient method to deliver a new circumpolar abundance estimate of Antarctic blue whales;
- Develop and refine methods to improve survey efficiency;
- Deliver a new circumpolar Antarctic blue whale abundance estimate;
- Improve understanding of Antarctic blue whale population structure;
- Improve understanding of linkages between Antarctic blue whale breeding and feeding grounds;
- Characterise the behaviour of Antarctic blue whale on the feeding grounds.

FURTHER INFORMATION
http://www.marinemammals.gov.au/sorp/antarctic-blue-whale-project

KEY OUTPUTS

Research Summary
The ABWP is undertaken as an international collaboration, led by the Australian Antarctic Division. To guide the development of the ABWP, international experts have formed a Scientific Steering Committee and four Technical Committees relating to Survey Methods, Passive Acoustics, Photo Identification, and Genetic Identification. Acoustically-assisted tracking methods for locating blue whales have been developed by the Australian Antarctic Division and used as key tools to successfully find Antarctic Blue Whales in the Southern Ocean during several research voyages.

Since 2016, the ABWP has cooperated on 8 research voyages to the Southern Ocean as outlined below.

2016 RV Tango voyage. WAP. Argentina.

- **Number of cetacean sightings:** 133 sightings
- **Species encountered:** 7 identified species
- **Images collected:** None
- **Number of photo-IDs:** None
- **Number of samples:** None
- **Number of tags deployed:** None
- **Acoustic recordings:** 121 hours from hydrophone array
- **Other data:** None

2017 Perfecto Garcia voyage. WAP. Argentina.

- **Number of cetacean sightings:** 156 sightings
- **Species encountered:** 7 identified species
- **Images collected:** None
- **Number of photo-IDs:** None
- **Number of samples:** None
- **Number of tags deployed:** None
- **Acoustic recordings:** 167 hours from hydrophone array
- **Other data:** None

2018 Perfecto Garcia voyage. WAP. Argentina.

- **Number of cetacean sightings:** 210 sightings
- **Species encountered:** 6 identified species
- **Images collected:** None
- **Number of photo-IDs:** None
- **Number of samples:** None
- **Number of tags deployed:** None
- **Acoustic recordings:** 148 hours from hydrophone array
- **Other data:** None

2019 ARA Almirante Irizar voyage. Southern Ocean. Argentina.

- **Number of cetacean sightings:** 146 sightings
- **Species encountered:** 7 identified species
- **Images collected:** Camera
- **Number of photo-IDs:** Some
- **Number of samples:** None
- **Number of tags deployed:** None
- **Acoustic recordings:** 103 hours from hydrophone array
- **Other data:** None

2019 ENRICH voyage. Southern Ocean. Australian Antarctic Division.

- **Number of whale sightings:** 569 sightings of 1380 individuals
- **Species encountered:** 10 identified species (mostly humpback, fin, blue and minke whales)
- **Images collected:** Camera and drone
- **Number of photo-IDs:** 25
- **Number of samples:** None
- **Number of tags deployed:** None
- **Acoustic recordings:** Passive acoustic data from 295 sonobuoys totalling 574 hours. Active acoustic krill monitoring.
- **Other data:** Video tracking, UAV flights, 110 biogeochemistry deployments.

2020 ARA Almirante Irizar voyage. WAP and Weddell Sea. Argentina.

- **Number of cetacean sightings:** 209 sightings
- **Species encountered:** 5 identified species
- **Images collected:** Camera
- **Number of photo-IDs:** At least 15

- **Number of samples:** 2 skin and blubber
- **Number of tags deployed:** None
- **Acoustic recordings:** 216 hours from hydrophone array; 16 hours from soundtrap
- **Other data:** None

2021 TEMPO voyage. Southern Ocean. Australian Antarctic Division.

- **Number of cetacean sightings:** 479 sightings of 1363 individuals
- **Species encountered:** 11 identified species (mostly humpback and fin whales)
- **Images collected:** None
- **Number of photo-IDs:** None
- **Number of samples:** None
- **Number of tags deployed:** None
- **Acoustic recordings:** Passive acoustic data from 199 sonobuoys. Deep sea mooring (KOMBI) deployed. Active acoustic krill monitoring.
- **Other data:** Euphausiid; Oceanography; CPR

2022 ARA Almirante Irizar voyage. Scotia Sea and WAP. Argentina.

- **Number of whale sightings:** 80
- **Species encountered:** Humpback, fin, minke and killer whales
- **Images collected:** Camera
- **Number of photo-IDs:** Some
- **Number of samples:** None
- **Number of tags deployed:** None
- **Acoustic recordings:** 110 hours from hydrophone array
- **Other data:** None

Peer-reviewed Publications
Appendix III: 3-25
Unpublished Reports
Appendix III: 26-31

1.3 IWC-SORP (2) Killer whales in the Southern Ocean

AIMS
This project is investigating the ecosystem impact the different ecotypes of killer whales that occur in Antarctic and adjacent waters, by focusing on their systematic relationships, abundance, demographics, distribution, movement patterns, health, and prey preferences.

FURTHER INFORMATION
http://www.marinemammals.gov.au/sorp/killer-whales-in-the-southern-ocean

KEY OUTPUTS

Research Summary
From 2009 to 2018, R. Pitman, J. Durban (USA) conducted annual fieldwork on killer whales in Antarctic waters, mainly at the Western Antarctic Peninsula but also in the southern Ross Sea (McMurdo Sound). They have described five morphologically distinct types of killer whales and investigated the systematics and ecology of these different types using satellite tagging, photo-identification, biopsy sampling, acoustic recordings, and focal follow behavioural studies. From the Antarctic Peninsula and adjacent waters, they have > 73,000 killer whale images, representing over 519 killer whale encounters, with high capture probabilities and resighting rates, which will enable robust and precise population estimates for each of the three killer whale types that regularly occur in the Antarctic Peninsula area.

2016-17. M/V National Geographic Explorer. Western Antarctic Peninsula.

- **Number of whale sightings:** 10 groups (5 x Type A; 1 x Type B1; 4 x Type B2)
- **Species encountered:** Killer whales
- **Images collected:** 9288 camera images and 16585 drone images
- **Number of photo-IDs:** 10 groups of killer whales
- **Number of samples:** None
- **Number of tags deployed:** None

- **Acoustic recordings:** None
- **Other data:** None

2017-18. M/V National Geographic Explorer. Western Antarctic Peninsula.

- **Number of whale sightings:** 10 groups of killer whales; 25 humpback whales; 35 minke whales
- **Species encountered:** Killer whales, humpback whales, Antarctic minke whales
- **Images collected:** 7416 camera images and 2749 drone images of killer whales; 4336 drone images of humpback whales; 4015 images of minke whales
- **Number of photo-IDs:** 10 groups of killer whales; 25 humpback whales; 35 minke whales
- **Number of samples:** skin and blubber samples: 10 killer whale, 11 humpback, 2 minke; blow samples: 7 minke whale
- **Number of tags deployed:** None
- **Acoustic recordings:** None
- **Other data:** None

The Brazilian Antarctic Program have surveyed the waters of the Antarctic Peninsula for cetaceans during the Projeto Baleias from 1997-2018. This work has contributed to the killer whale project through line-transect surveys to investigate distribution and relative abundance, photo-identification, acoustics, and biopsy sampling for genetics, contaminant and stable isotope analyses.

2017. Almirante Maximiano. Antarctic Peninsula.

- **Number of whale sightings:** 286 on-effort sightings total (four sightings of killer whales totally ~100 individuals)
- **Species encountered:** 5
- **Images collected:** Camera (>3000 photos)
- **Number of photo-IDs:** 40+ Type B; 10+ Type A
- **Number of samples:** 5 biopsy
- **Number of tags deployed:** 1 LIMPET-SPLASH
- **Acoustic recordings:** None
- **Other data:** None

2018. Almirante Maximiano. Antarctic Peninsula.

- **Number of whale sightings:** 337 on-effort sightings total (one group of 12 killer whales sighted on-effort, 3 more sightings opportunistically)
- **Species encountered:** 4
- **Images collected:** Camera (1903 photos)
- **Number of photo-IDs:** 12+
- **Number of samples:** None
- **Number of tags deployed:** None
- **Acoustic recordings:** None
- **Other data:** None

A sub-Antarctic research project at Prince Edward Islands, Crozet Islands and South African coast waters has been led by the South African National Antarctic Programme (SANAP). Photo-ID data have provided information on demographic parameters, social structure and population connectivity, as well as novel longitudinal data on individuals in this region. Fieldwork also includes biopsy sampling, tagging and acoustic monitoring at longline fisheries. Genetic results will soon give insights into the comparative ecology of killer whale populations in the southern Atlantic and Indian Oceans.

2016-2019. Marion Island fieldwork summary.

- **Number of whale sightings:** 620 dedicated and 473 opportunistic
- **Species encountered:** Killer whales
- **Images collected:** Camera
- **Number of photo-IDs:** 69 unique individuals to date
- **Number of samples:** 22
- **Number of tags deployed:** 13
- **Acoustic recordings:** None
- **Other data:** None

Peer-reviewed Publications
Appendix III: 32-49

Unpublished Reports
Appendix III: 50-51

1.4 IWC-SORP (3) Interactions between baleen (minke & humpback) whales and krill

AIMS
The objectives of this research program are to use technological advances in animal biotelemetry to elucidate the behaviour and ecological role of cetaceans in the nearshore waters around the Antarctic Peninsula, and to relate these to climate-driven changes that are currently occurring.

FURTHER INFORMATION
See: http://www.marinemammals.gov.au/sorp/interactions-between-baleen-whales-and-krill

KEY OUTPUTS

Research Summary
Through a series of collaborative, multi-disciplinary research cruises supported by the National Science Foundation, the Southern Ocean Research Partnership, and the Australian Antarctic Division, this project has begun to quantify and understand the foraging ecology of humpback and minke whales in Antarctic waters in unprecedented ways.

2016/17: *LM Gould.* NSF LTER. Palmer Station, Western Antarctic Peninsula.
- **Number of whale sightings:** Not reported
- **Species encountered:** Humpback whale, minke whale, killer whale
- **Images collected:** Camera and drone
- **Number of photo-IDs:** 120 individual drone measurements
- **Number of samples:** >200 biopsy samples
- **Number of tags deployed:** 4 suction cup tags on humpbacks; 4 LIMPET tags on minke whales
- **Acoustic recordings:** Active acoustic for prey mapping
- **Other data:** Krill abundance measured from echosounders

2017/18: *LM Gould.* NSF LTER. Palmer Station, Western Antarctic Peninsula.
- **Number of whale sightings:** Not reported
- **Species encountered:** Humpback whale, minke whale, killer whale
- **Images collected:** Camera and drone
- **Number of photo-IDs:** Not reported
- **Number of samples:** ~200 biopsy samples
- **Number of tags deployed:** 20 suction cup tags (10 humpback, 9 minke, 1 killer whale)
- **Acoustic recordings:** Active acoustic for prey mapping
- **Other data:** Beach surveys, Krill abundance measured from echosounders

2018/19: *LM Gould.* NSF LTER. Palmer Station, Western Antarctic Peninsula.
- **Number of whale sightings:** Not reported
- **Species encountered:** Humpback whale, minke whale
- **Images collected:** Camera and drone
- **Number of photo-IDs:** Not reported
- **Number of samples:** ~200 biopsy samples
- **Number of tags deployed:** 36 suction cup tags (12 humpback, 24 minke)
- **Acoustic recordings:** Active acoustic for prey mapping
- **Other data:** Beach surveys, Krill abundance measured from echosounder

2019/20. *LM Gould.* NSF LTER. Palmer Station, Western Antarctic Peninsula.
- **Number of whale sightings:** 275 humpback, 17 minke whales
- **Species encountered:** Humpback whale, minke whale
- **Images collected:** Camera and drone
- **Number of photo-IDs:** 152

- **Number of samples:** 196 biopsy samples (171 humpback adults, 20 humpback calves, and 5 minke whales)
- **Number of tags deployed:** 11 suction cup tags
- **Acoustic recordings:** Active acoustic for prey mapping
- **Other data:** Krill abundance measured from echosounders, pinniped habitat mapping

2020. *Roald Amundsen*. Hurtigruten. Western Antarctic Peninsula.

- **Number of whale sightings:** 16 humpback (11 adults, 5 calves)
- **Species encountered:** Humpback whale, fin whale, killer whale, minke whale.
- **Images collected:** Drone
- **Number of photo-IDs:** None
- **Number of samples:** 19 skin and blubber samples
- **Number of tags deployed:** None
- **Acoustic recordings:** 10 hours from Ocean Instruments SoundTrap STD
- **Other data:** None

In recent years, fieldwork has been paused due to the COVID-19 pandemic and effort has been focused on publishing existing information on baleen whales and their relationship to the Antarctic environment.

Peer-reviewed Publications
Appendix III: 52-104
Unpublished Reports
Appendix III: 85

1.5 IWC-SORP (4) Movements and mixing of humpback whales

AIMS
This project aims to improve understanding of the movements and mixing of humpback whales around the Southern Ocean by investigating 1) The connection between the humpback whales from Area V feeding grounds and their migratory corridors and breeding grounds in Australia and Oceania, and 2) If whales from Area V represent a single breeding ground or are a mix of individuals from several distinct breeding grounds 3) A circumpolar analysis of the foraging behaviour of humpback whales spanning all ocean basins. 4) The reproductive rates of humpback whales and implications for population recovery across populations.

FURTHER INFORMATION
http://www.marinemammals.gov.au/sorp/movements-and-mixing-of-humpback-whales-around-antarctica

KEY OUTPUTS

Research Summary
The expansion of this project has revealed the value of large-scale collaborative efforts to advance our understanding of whale distribution, behaviour, genetic connectivity and reproduction. Recent research efforts have shifted the focus of this project from within Oceania to understanding genetic connections to the distinct breeding stock of South America and the feeding grounds of the Antarctic Peninsula; understanding reproductive rates of humpback whales on different migration paths; and the circumpolar analysis of satellite tag data to determine feeding ground use of humpback whales. This moves the humpback connectivity to other regions that require greater knowledge of connectivity between their populations and stock recovery.

2015. Kermadec Island voyage. New Zealand.

- **Number of whale sightings:** 127 pods (cumulative total 235 adults and 37 calves)
- **Species encountered:** Humpback whale
- **Images collected:** Camera and drone
- **Number of photo-IDs:** 136
- **Number of samples:** 84 tissue samples
- **Number of tags deployed:** 25 SPOT-5 satellite tags (Wildlife Computers)
- **Acoustic recordings:** None
- **Other data:** None

2016. Great Barrier Reef breeding ground. Australia.

- **Number of whale sightings:** 67 pods (146 whales including 30 calves)

- **Species encountered:** Humpback whale
- **Images collected:** Camera
- **Number of photo-IDs:** Not reported
- **Number of samples:** 26 tissue samples
- **Number of tags deployed:** None
- **Acoustic recordings:** None
- **Other data:** None

2016. O.V Alis. MARACAS 1 Chesterfield-Bellona archipelago voyage. New Caledonia.

- **Number of whale sightings:** 13 pods
- **Species encountered:** Humpback whale
- **Images collected:** Camera
- **Number of photo-IDs:** 18
- **Number of samples:** 7 (5 biopsy, 2 sloughed skin)
- **Number of tags deployed:** None
- **Acoustic recordings:** 49 hydrophone deployments
- **Other data:** None

2017. Kermadec Island opportunistic data collection. New Zealand.

- **Number of whale sightings:** 29 pods
- **Species encountered:** Humpback whale
- **Images collected:** Camera
- **Number of photo-IDs:** 43
- **Number of samples:** 16 sloughed skin samples
- **Number of tags deployed:** None
- **Acoustic recordings:** None
- **Other data:** None

2017. Fiordland pilot study. New Zealand.

- **Number of whale sightings:** 11 pods
- **Species encountered:** Humpback whale
- **Images collected:** Camera
- **Number of photo-IDs:** 6
- **Number of samples:** 6 biopsy samples
- **Number of tags deployed:** None
- **Acoustic recordings:** None
- **Other data:** None

2017. Ross Sea voyage. New Zealand.

- **Number of whale sightings:** 64 groups (incl. 24 humpback , 2 blue, 17 fin, 8 minke, 2 killer, 1 pilot whale).
- **Species encountered:** Humpback, blue, fin, minke, killer, pilot whales
- **Images collected:** Camera
- **Number of photo-IDs:** 30 humpback whales
- **Number of samples:** 11 humpback biopsy samples
- **Number of tags deployed:** None
- **Acoustic recordings:** None
- **Other data:** None

2017. O.V Alis. MARACAS 3 Chesterfield-Bellona archipelago voyage. New Caledonia.

- **Number of whale sightings:** 45 pods, 63 individuals
- **Species encountered:** Humpback whale
- **Images collected:** Camera
- **Number of photo-IDs:** 63
- **Number of samples:** 32
- **Number of tags deployed:** None
- **Acoustic recordings:** SoundTrap 3000 deployments
- **Other data:** None

2017. Great Barrier Reef breeding ground. Australia.

- **Number of whale sightings:** 118 pods (cumulative total 228 adults and 42 calves)
- **Species encountered:** Humpback whale
- **Images collected:** Camera
- **Number of photo-IDs:** 66
- **Number of samples:** 31 tissue samples
- **Number of tags deployed:** None
- **Acoustic recordings:** 8 h 31 min
- **Other data:** None

2018. Great Barrier Reef breeding ground. Australia.

- **Number of whale sightings:** 186 pods (cumulative total 333 adults and 44 calves)
- **Species encountered:** Humpback whale
- **Images collected:** Camera
- **Number of photo-IDs:** Not reported
- **Number of samples:** 21 tissue samples
- **Number of tags deployed:** None
- **Acoustic recordings:** 9 h 51 min
- **Other data:** None

Circumpolar analysis of foraging behaviour of humpback whales in Antarctica.

- This work aggregated a circumpolar dataset of 378 humpback whale tracks from 11 different research programs.

Peer-reviewed Publications
Appendix III: 106-113

1.6 IWC-SORP (5) Blue and fin whale acoustic trends project

AIMS
This initiative aims to implement a long term acoustic research program that will examine trends in Southern Ocean blue and fin whale population growth, distribution, and seasonal presence through the use of passive acoustic monitoring techniques.

FURTHER INFORMATION
http://www.marinemammals.gov.au/sorp/antarctic-blue-whales-and-fin-whales-acoustic-program

KEY OUTPUTS

Research Summary
The Acoustic Trends Project is undertaken as an international collaboration, guided by a Scientific Steering Group with members from France, USA, Germany, Australia, South Africa, and the UK. Data from blue and fin whale recordings are being analysed to provide information on the geographic and seasonal occurrence of these species around the Antarctic and fill four key knowledge gaps in: 1) Distribution & occupancy; 2) Population structure; 3) Animal behaviour; 4) Abundance & density estimation.

A number of research groups, including the Alfred-Wegener-Institute, Australian Antarctic Division, ENSTA Bretagne, CEAZA Research Center and South African National Antarctic Programme, continue to deploy passive acoustic recorders with on-going acoustic monitoring effort in various parts of the Southern Ocean and at lower latitudes. Several important projects on method development have been undertaken in recent years, including development of the largest dataset of source levels for blue and fin whales to date, an IWC-SORP funded annotated library of blue and fin whale sounds, improved detection algorithms, and a standardised analytical framework for robustly detecting trends in passive acoustic data that is crucial for the ultimate goal of call density estimation.

Acoustic data collection efforts include the Southern Ocean Hydrophone Network (SOHN): a network of autonomous underwater acoustic recording stations surrounding Antarctica, with the aim of at least one recording site in each of the six IWC management areas. Long-term recording sites include: Southern Kerguelen Plateau, Dumont d'Urville, Ross Sea, East Antarctica and the Weddell Sea.

Group members have also deployed a number of autonomous recorders at low and mid-latitudes in the Indian, Atlantic, and Pacific oceans, and the data from these instruments are expected to add value to and supplement

those from the SOHN. Recording sites include: Northern Chile, Corcovado Gulf, Heard Island, Crozet Island, Mozambique Channel and South Africa.

Additional acoustic data collection has occurred during the following fieldwork:

2016/17 Antarctic Circumnavigation Expedition (ACE). Southern Ocean. Australian Antarctic Division.
Passive acoustic data from 301 DIFAR sonobuoys totalling 492 hours.

2019 ENRICH voyage. Southern Ocean. Australian Antarctic Division.
Passive acoustic data from 295 DIFAR sonobuoys totalling 574 hours.

2020-2021. Fin whale acoustic logger project. Chilean waters. (Chile, USA, France)
Acousonde logger tags deployed on fin (n=28) and blue whales (n=1)

2021 TEMPO voyage. Southern Ocean. Australian Antarctic Division.
DIFAR Sonobuoys deployed at 30 nmi intervals.

Peer-reviewed Publications
Appendix III: 114-144

Unpublished Reports
Appendix III: 145-148

1.7 IWC-SORP (6) Foraging ecology and population recovery of southern right whales

AIMS
This project aims to 1) Increase our understanding of southern right whale foraging ecology. 2) Update our knowledge on southern right whale population dynamics in a comparative framework. 3) Pursue integration of health assessment indicators with long-term monitoring data. 4) Investigate the impact of past and future climate variation at foraging grounds on population recovery

KEY OUTPUTS

Research Summary
Work has been undertaken towards all four objectives, including:
Foraging ecology
Stable isotope and fatty acid analysis to increase our understanding of foraging ecology. Biopsy skin samples were collected during fieldwork in South Africa (2020, n=18), Brazil (2020/21, n=57), Auckland Islands (2020/21, n=599). Deployment of satellite tags from Argentina (2021, n=18), Auckland Islands (2020/21, n=18), and South Africa (2021, n=4) to assess foraging locations.
Population dynamics
A SRW Consortium was developed to facilitate multi-ocean collaboration. 'Flukebook' AI photo-identification cross matching of SRW has been developed and is now available.
Further collection of photo-id data continues through various long-term field programs at the Auckland Islands, South Africa, Southern Brazil, SW Australia and the Great Australian Bight.
Health Assessment
Body condition assessment has been carried out using drone photogrammetry at Peninsula Valdes, the Great Australian Bight and Auckland Islands. Multiple data sources will be integrated including genetic, stable isotope, hormone and body condition, to understand the relationship between foraging ground and health in a future study using these data.
Climate change impact
SRW offshore sighting records South of 40°S have been collated to assess foraging locations. There is ongoing analyses of links between annual abundance and body condition with climatic timeseries data.

Peer-reviewed Publications
Appendix III: 149-168
Unpublished Reports
Appendix III: 169-184

1.8 IWC-SORP (7) Recovery and ecology of Southern Hemisphere fin whales

AIMS
This project aims to collate previous opportunistic data collected on fin whales in the Southern Hemisphere and undertake dedicated fin whale research to enhance our understanding of current SHFW population status and recovery.

The specific objectives are: 1) Enhancing the understanding of distribution patterns and local abundance estimates of SHFW. 2) Investigation of the population structure of SHFW. 3) Identification of SHFW migration routes and migratory destinations. 4) Understanding SHFW feeding ecology: drivers for fin whale distribution, spatial relationships between fin whale and krill distribution, prey selectivity.

KEY OUTPUTS

Research Summary
A network of Southern Hemisphere fin whale researchers has been established, forming an excellent basis for exchange of information and future collaboration.

Two cruises to the Antarctic Peninsula region in 2018 (*RV Polarstern*) and 2019 (*Pelagic Australis*) were dedicated to investigating the repeatedly reported aggregations of fin whales around Elephant Island. Both expeditions re-encountered large aggregations of fin whales. A dedicated aerial survey during the *RV Polarstern* voyage estimated fin whale abundance in the area.

2018/19. RV Polarstern and Pelagic Australis. Elephant Island
- **Number of cetacean sightings:** 30+ aggregations (largest one with ~150 individuals)
- **Species encountered:** Fin whales
- **Images collected:** Aerial video
- **Number of photo-IDs:** None
- **Number of samples:** None
- **Number of tags deployed:** 7 SPLASH tags
- **Acoustic recordings:** None
- **Other data:** Body condition data

2021. Pelagic Australis. Antarctic Peninsula
- **Number of cetacean sightings:** Not reported.
- **Species encountered:** Fin whales
- **Images collected:** Not reported
- **Number of photo-IDs:** None
- **Number of samples:** None
- **Number of tags deployed:** 4 successful, 7 total
- **Acoustic recordings:** None
- **Other data:** None

Peer-reviewed Publications
Appendix III: 185-187
Unpublished Reports
Appendix III: 188

1.9 JASS-A (Japanese Abundance and Stock-structure Surveys in the Antarctic)

AIMS
The main research objectives of JASS-A are to study the abundance and trends, distribution, movement and stock structure of large whale species in the Indo-Pacific region of the Antarctic Ocean. Researchers aim to collect sighting data necessary for estimating the abundance of large whales, photo-IDs, biopsy samples and deploy satellite tags for elucidating whale movement, all of which are useful for stock management. In addition, oceanographic observations are collected to collect habitat information.

FURTHER INFORMATION
http://icrwhale.org/JASS-AgaiyouEng.html

KEY OUTPUTS

Research Summary
Annual surveys have been conducted, with the aim of covering Areas III, IV, V, and VI.

2020/21. RV Yushin-Maru No. 2. Area III, Southern Ocean.

- **Number of cetacean sightings:** Mainly humpback whale (384 groups of 739 individuals); fin whale (153 groups of 257 individuals); minke whale (53 groups of 122 individuals); blue whale (24 groups of 29 individuals).
- **Species encountered:** 8 species
- **Images collected:** Camera and drone
- **Number of photo-IDs:** 20 blue whale; 41 humpback whale; 1 killer whale
- **Number of samples:** Biopsy samples of 8 blue whales; 15 fin whales; 14 minke whales; 16 humpback whales; 1 Bryde's whale
- **Number of tags deployed:** Satellite tags to 7 fin whales and 10 minke whales. Dive loggers to 2 humpback whales
- **Acoustic recordings:** None
- **Other data:** XCTD at 99 stations

2021/22. RV Yushin-Maru No. 2. Area VI, Southern Ocean.

- **Number of cetacean sightings:** Mainly minke whale (106 groups of 169 individuals); fin whale (58 groups of 92 individuals); humpback whale (35 groups of 53 individuals)
- **Species encountered:** 10 species
- **Images collected:** Camera and drone
- **Number of photo-IDs:** 7 blue whale; 9 humpback whale; 10 killer whale
- **Number of samples:** Biopsy samples of 2 blue whales; 12 fin whales; 15 minke whale; 11 humpback whale; 1 Bryde's whale, 2 killer whales
- **Number of tags deployed:** Satellite tags to 9 fin whales and 14 minke whales.
- **Acoustic recordings:** None
- **Other data:** XCTD at 116 stations

2022/23. RV Yushin-Maru No. 2 and No. 3 Area VI, Southern Ocean.

- **Number of cetacean sightings:** Mainly minke whale (317 groups of 634 individuals); fin whale (96 groups of 212 individuals); killer whale (12 groups of 130 individuals); humpback whale (27 groups of 56 individuals); blue whale (21 groups of 32 individuals)
- **Species encountered:** 10 species
- **Images collected:** Camera and drone
- **Number of photo-IDs:** 26 blue whale; 11 humpback whale; 37 killer whale
- **Number of samples:** Biopsy samples of 8 blue whales; 20 fin whales; 6 sei whales; 28 minke whale; 16 humpback whale; 2 pigmy right whale whale, 9 killer whales
- **Number of tags deployed:** Satellite tags to 8 fin whales, 25 minke whales, 2 humpback whales, 2 sei whales, and 1 pigmy right whale.
- **Acoustic recordings:** None
- **Other data:** XCTD at 137 stations

Peer-reviewed Publications
None

Unpublished Reports
Appendix III: 189-194

1.10 ORCA Southern Ocean distance sampling and observation programme

AIMS
This work aims to estimate the abundance and distribution of cetaceans and identify estimates of summer whale density, focused in high vessel-traffic areas in waters around South Georgia and the Antarctic Peninsula. The results of this will be used to inform mitigation measures to reduce ship strike risk and identify important marine mammal habitats and critical areas.

KEY OUTPUTS

Research Summary
Increases in whale abundance have occurred rapidly around South Georgia and the Antarctic Peninsula in the last two decades. For example, whales were rarely seen in the waters around South Georgia in the 1990s, and sightings of large groups only became common after 2010. Vessel traffic is also increasing rapidly in these areas. Globally,

whale population growth is at risk from strikes caused by increasing vessel traffic, and with expedition cruise ships being the fastest-growing segment of the global cruise industry there is a high ship-strike risk in specific areas of the Southern Ocean. ORCA is working in partnership with the Antarctic expedition cruise industry to place highly trained ORCA Marine Mammal Surveyors on dedicated expedition cruises travelling from Chile to the Falkland Islands, South Georgia and the Antarctic Peninsula during the 2022-2023 Antarctic season. Data are collected following line-transect distance sampling techniques, utilising the forward-facing bridge from a platform of opportunity (a cruise expedition vessel) to estimate the abundance and distribution of cetaceans; identifying estimates of summer whale density (a density index) focused in high vessel-traffic areas. These protocols will be repeated during subsequent summer Antarctic expedition cruise seasons.

Since 2019 ORCA has worked in partnership with the Antarctic cruise industry to place highly trained ORCA Ocean Conservationists on board dedicated Antarctic itineraries across the cruise industry. Specialising in combining accessible marine education with conservation activities, ORCA Ocean Conservationists collect effort-based sightings data, following standardised methodologies similar to those employed by ORCA line-transect distance sampling protocols, from the open decks of cruise vessels with the cruise guests. Effort-based data collection has occurred throughout the following cruise transects/itineraries: 08/02/2019 to 01/03/2019 18/11/2021 to 10/12/2021 25/11/2021 to 27/12/2021 04/02/2022 to 18/03/2022 22/10/2022 to 18/01/2023 06/11/2022 to 12/03/2023 11/02/2023 to 25/02/2023.

- **Number of cetacean sightings:** Not reported
- **Species encountered:** 9 reported
- **Images collected:** None
- **Number of photo-IDs:** None
- **Number of samples:** None
- **Number of tags deployed:** None
- **Acoustic recordings:** None
- **Other data:** None

Peer-reviewed Publications
None
Unpublished Reports
None

1.11 Parāoa (sperm whales) of the South Pacific

AIMS
This project aims to better understand connections among sperm whale populations in Aotearoa - New Zealand, and strengthen connections with coastal communities.

FURTHER INFORMATION
https://www.otago.ac.nz/otagomagazine/issue54/otago841218.html

KEY OUTPUTS
Systematic surveys for sperm whales are being conducted off Northland, Kaikōura and Otago, gathering photo-ID, behavioural and acoustic data, and sloughed skin samples for genomic analyses. A key part of this project involves working with local communities to better understand the traditional ecological knowledge (mātauranga) associated with sperm whales, aiming to strengthen these connections.

Research Summary
- **Number of whale sightings:** Northland: 6; Kaikoura: 109; Otago: 19
- **Species encountered:** Sperm whales
- **Images collected:** Camera
- **Number of photo-IDs:** 70
- **Number of samples:** Sloughed skin – Northland: 10; Kaikoura: 15; Otago: 2
- **Number of tags deployed:** None
- **Acoustic recordings:** Short recordings after fluke-up for behaviour and size estimation (Northland: 9 Kaikoura: 45; Otago: 14)
- **Other data:** Behaviour (dive time, surface interval, blow rate)

Peer-reviewed Publications

None
Unpublished Reports
None

1.12 Study of the pelagic ecosystem in the Bransfield Strait

AIMS
This project has aimed to investigate: 1) the patterns of environmental variability at a spatial and temporal scale, in the Bransfield Strait and around the Piloto Pardo Islands of the Antarctic system. 2) the composition, distribution and abundance of plankton biodiversity in the Bransfield Strait and around the Piloto Pardo Islands and its relationship with oceanographic variables, as well as energy transfer. 3) the relationship between the abundance and distribution of marine mammals and birds with the abundance and distribution of krill (Euphausia superba). 4) the distribution, abundance and biomass of krill in the Bransfield Strait, Joinville and around Elephant Island.

KEY OUTPUTS

Research Summary
In the study area, an increase in the Sea Surface Temperature (TSM) of ±1.0°C was observed compared to 2019, the Sea Surface Salinity (SSM) decreased by ±0.01 ups as did the density and oxygen; on the other hand, the distribution of krill was reduced. In the 2020 period, a marked proliferation of Salpa thompsoni was recorded, being the dominant species, both for the samples extracted with the 500 µ Bongo net and the IKMT net. In the Bransfield Strait, the highest percentage of juveniles (61.2%) krill was recorded, in the Joinville intermediate zone, the percentage of juveniles decreased to 43.7% and around Elephant Island, adult specimens predominated and the presence of juveniles decreased considerably to 8.6%; The reproductive condition of krill, determined by the reproductive activity index (IAR), indicates that the species registered index values less than 50% in all areas, which is different from what was determined in 2019, where a gradual increase was observed. increased from Bransfield to around Elephant Island. Regarding to marine mammals, 86 sightings were made with a total of 145 individuals, divided into 3 families and 5 species; 74 sightings (125 individuals) of whales, 4 sightings (11 individuals) of dolphins (orca) and 8 of pinnipeds (9 individuals). It is important to highlight that the number of seabirds sighted during this campaign decreased considerably, 1182 individuals compared to 2018, where 8802 individuals were found.

- **Number of whale sightings:** 626
- **Species encountered:** 5
- **Images collected:** Camera
- **Number of photo-IDs:** None
- **Number of samples:** None
- **Number of tags deployed:** None
- **Acoustic recordings:** Krill biomass
- **Other data:** Oceanographic; Euphausiid biomass

Peer-reviewed Publications
None

Unpublished Reports
Appendix III: 195

2 SOUTHERN OCEAN SANCTUARY: LETHAL RESEARCH

2.1 NEWREP-A (New Scientific Whale Research Program in the Antarctic Ocean)

AIMS
NEWREP-A aims to 1) make improvements in the precision of biological and ecological information for the application of the Revised Management Procedure (RMP) to Antarctic minke whales and 2) investigate the structure and dynamics of the Antarctic marine ecosystem through building ecosystem models.

Main Objective I consists of the following sub-objectives:

(i): Abundance estimates for Antarctic minke whales taking into account of g(0) and additional variance.

(ii): Improvement of precision of biological and ecological parameters.

(iii): Refinement of stock structure hypotheses of Antarctic minke whale in Areas III-VI for the implementation of the RMP.

(iv): Specification of the RMP/IST (Implementation Simulation Trials) for the Antarctic minke whales.

Main Objective II consists of the following sub-objectives:

(i): Ecological research (krill abundance estimation and oceanographic observation).

(ii): Abundance estimate of some cetacean species as input data for ecosystem modeling.

(iii): Estimation of prey consumption by the Antarctic minke whale and its nutritional condition.

(iv): Ecosystem modeling (Spatial interaction among baleen whales and consideration of predators-prey system and allometric reasoning).

KEY OUTPUTS
Annual 'scientific' whaling voyages conducted by the Institute of Cetacean Research (ICR) were carried out in the survey area comprising IWC management areas III to VI. These involved a combination of sighting and sampling surveys, where species were targeted for lethal sampling. The number of planned samples was 333 minke whales.

The following are a selection of publications and unpublished reports, resulting primarily from JARPA. A full list can be found on the Institute of Cetacean Research (ICR) website: http://www.icrwhale.org/pdf/appendix1.pdf

Unpublished Reports
Appendix III: 196-204

3 INDIAN OCEAN SANCTUARY: NON-LETHAL RESEARCH

3.1 Distribution, movements, and feeding behaviour of killer whales in the tropical Southwest Indian Ocean

AIMS
This work aims to 1) obtain baseline data (distribution, abundance, movements, site fidelity) on killer whales in the SWIO using opportunistic sighting data. 2) identify killer whale presence and seasonality throughout the region using passive acoustic monitoring methods. 3) investigate the diet and latitudinal movements of killer whales observed in the tropical SWIO. 4) better understand the impact killer whale presence might have on humpback whales with their calves on a breeding ground with the playback analysis. 5) assess predation pressure of killer whales on humpback whales using a rake-mark analysis of SWIO humpback whale flukes.

FURTHER INFORMATION
www.tropicorca.com

KEY OUTPUTS

Research Summary
To obtain baseline data on this apex predator in the SWIO, killer whale sightings, photographs, and predation events are being compiled into a regional database, which currently includes over 40 sightings since 1997 involving more than 60 photo-identified individuals throughout the tropical SWIO. Predation was recorded on elasmobranchs and cetaceans, including humpback whale (Megaptera novaeangliae) calves and manta rays. Passive acoustic monitoring data obtained from SoundTraps being deployed throughout the study region since 2018 will be analysed to identify killer whale presence and seasonality patterns in time and space. Vocalisations such as calls and clicks will be used to identify this species in the available recordings. Stable isotope analysis of annual growth layer groups in teeth from killer whales that stranded within the study area will help investigate the diet of these animals (using carbon and nitrogen isotopes) and try to assess if a given individual remained in tropical waters or instead, travelled to temperate latitudes over the course of its lifetime (using oxygen isotope). Finally, to better understand the impact killer whales might exert on the regional humpback whale population and whether humpback whales consider killer whales as a threat in this region, local killer whale sounds will be played to humpback whales tagged with a D-Tag in the Bazaruto Archipelago (Mozambique), an area considered both as a breeding ground and a migratory path for humpback whales. Their behavioural reactions will be analysed from a combination of tag data and visual observations, and will provide baseline information on the impact of killer whales on humpback whales in the tropics. Available humpback whale flukes from the SWIO populations

will also be analysed to assess the prevalence of rake marks from killer whales visible on their flukes, resulting from an unsuccessful killer whale attack. Results of this large project should fill some important data gaps for killer whales in tropical waters and help assess their regional presence, feeding ecology, and potential impacts on local prey populations.

- **Number of whale sightings:** None
- **Species encountered:** Humpback whales, killer whales
- **Images collected:** Camera
- **Number of photo-IDs:** 60+
- **Number of samples:** None
- **Number of tags deployed:** None
- **Acoustic recordings:** None
- **Other data:** None

Peer-reviewed Publications
Appendix III: 205

Unpublished Reports
None

3.2 Migration routes of Megaptera novaeanglia

AIMS
This project's aims are to 1) Describe migration routes of humpback whales within the SWIO and to Antarctic feeding ground. 2) Identify feeding areas 3) Assess the environmental variables that might influence humpback whale migration patterns and HW occurrence in the breeding ground.

FURTHER INFORMATION
https://www.globice.org/2023/02/01/la-campagne-de-suivi-satellitaire-miromen-ii-prend-fin/

KEY OUTPUTS

Research Summary
A total of 15 satellite tags were deployed on humpback whales around Reunion in August 2013, and 12 in sept 2019-2022. The study allowed to document the first migration tracks from the SWIO to Antarctica and demonstrate the high use of Crozet subantarctic islands, where the whales stayed for up to 2.5 months. This highly productive area might represent feeding stop over for the species, linking the two IO and the Southern Ocean Sanctuary.

- **Number of cetacean sightings:** Not reported
- **Species encountered:** Humpback whales
- **Images collected:** None
- **Number of photo-IDs:** None
- **Number of samples:** None
- **Number of tags deployed:** 27 (SPOT-Argos tags)
- **Acoustic recordings:** None
- **Other data:** None

Peer-reviewed Publications
Appendix III: 206

Unpublished Reports
None

3.3 Occurrence, habitat preferences and relative abundance of cetaceans in Seychelles

AIMS
This project aims to assess the occurrence, distribution, habitat preferences, and the abundance of cetaceans in Seychelles.

FURTHER INFORMATION
https://marineconservationecologylab.com/portfolio/ecology-of-blue-whales-and-other-cetaceans-in-the-seychelles

KEY OUTPUTS

Research Summary
This project aims at assessing the occurrence, distribution, habitat preferences, and the abundance of cetaceans in Seychelles using a combination of vessel-based surveys and passive acoustics. Three field seasons have been completed so far, including two in the northern islands and one off the Amirantes. Future effects (2023-2024) will focus on the Amirantes. However, passive acoustic monitoring devices have been deployed since November 2021 in the northern islands. Additional recorded will be deployed around the main island of Mahe. So far, over 350 cetacean sightings (from 22 species) have been collected, including from blue whales, sei whales, Bryde's whales, and sperm whales.

- **Number of whale sightings:** 350
- **Species encountered:** 22
- **Images collected:** Camera and drone
- **Number of photo-IDs:** Unknown
- **Number of samples:** 60 biopsy samples
- **Number of tags deployed:** None
- **Acoustic recordings:** Continuous recording on 4 ST600 Ocean Instruments since Nov 2021
- **Other data:** Focal follows

Peer-reviewed Publications
None
Unpublished Reports
Three mission reports completed

3.4 Rapid assessment of marine mammals in Tanzania

AIMS
This project aims to gather baseline data on species presence, relative abundance and threats.

KEY OUTPUTS

Research Summary
The rapid assessment was conducted in Tanzania, East Africa, and integrated collection of data on cetaceans from visual, acoustic, and interview surveys with existing information from multiple sources, to provide low resolution data on cetacean community relative abundance, diversity, and threats. Four principal threats were evaluated and compared spatially using a qualitative scale: cetacean mortality in fishing gear (particularly gillnets); cetacean hunting, consumption or use by humans; shipping related collision risk and noise disturbance; and dynamite fishing. Ninety-one groups of 11 species of marine mammal were detected during field surveys. Potentially the most important area for cetaceans was the Pemba Channel, a deep, high-current waterway between Pemba Island and mainland Africa, where by far the highest relative cetacean diversity and high relative abundance were recorded, but which is also subject to threats from fishing. A rapid assessment approach can be applied in data deficient areas to quickly provide information on cetaceans that can be used by governments and managers for marine spatial planning, management of developments, and to target research activities into the most important locations

- **Number of whale sightings:** 75
- **Species encountered:** 11
- **Images collected:** Camera
- **Number of photo-IDs:** None
- **Number of samples:** None
- **Number of tags deployed:** None
- **Acoustic recordings:** 200 hours
- **Other data:** Interview data on bycatch; Citizen science data on species recorded.

Peer-reviewed Publications
Appendix III: 207

3.5 Tanzania citizen science whale network

AIMS
This project aims to document the number of whales using Tanzanian waters

FURTHER INFORMATION
https://iucn-csg.org/gill-braulik/

KEY OUTPUTS

Research Summary
A citizen science effort involving more than 100 people that work on the sea to report sightings of humpback whales through a dedicate group. Each year when the whales are in Tanzania up to 500 individuals are documented, and these are collated annually and published in a newsletter.

- **Number of whale sightings:** 500+
- **Species encountered:** Humpback whales
- **Images collected:** Camera
- **Number of photo-IDs:** 2
- **Number of samples:** None
- **Number of tags deployed:** None
- **Acoustic recordings:** None
- **Other data:** None

Peer-reviewed Publications
None

Unpublished Reports
Appendix III: 208-211

APPENDIX III: A selective bibliography of research in the Southern Ocean Sanctuary

1 SOUTHERN OCEAN SANCTUARY: NON-LETHAL RESEARCH

1.1 Dynamics of a recovering population of southern right whales

Peer-reviewed Publications

1. Johnston, D.R., Rayment, W., Dawson, S.M., 2022. Morphometrics and body condition of southern right whales on the calving grounds at Port Ross, Auckland Islands. Mammalian Biology 102, 1525–1536. https://doi.org/10.1007/s42991-021-00175-6

Unpublished Reports

2. Johnston, D. Dynamics of a recovering population of southern right whales. PhD Thesis submitted 2022.

1.2 IWC-SORP (1) Antarctic blue whale project

Peer-reviewed Publications

3. Bamford, C.C.G., Kelly, N., Dalla Rosa, L., Cade, D.E., Fretwell, P.T., Trathan, P.N., Cubaynes, H.C., Mesquita, A.F.C., Gerrish, L., Friedlaender, A.S., Jackson, J.A., 2020. A comparison of baleen whale density estimates derived from overlapping satellite imagery and a shipborne survey. Scientific Reports 10, 12985. https://doi.org/10.1038/s41598-020-69887-y
4. Barlow DR, Torres LG, Hodge KB, Steel D, Baker CS, Chandler TE, Bott N, Constantine R, Double MC, Gill P, Glasgow D, Hamner RM, Lilley C, Ogle M, Olson PA, Peters C, Stockin KA, Tessaglia-Hymes CT, Klinck H, 2018. Documentation of a New Zealand blue whale population based on multiple lines of evidence. Endang Species Res 36, 27–40.
5. Branch, T.A., Monnahan, C.C., 2021. Sex ratios in blue whales from conception onward: effects of space, time, and body size. Marine Mammal Science 37, 290–313. https://doi.org/10.1111/mms.12741
6. Calderan, S., Miller, B., Collins, K., Ensor, P., Double, M., Leaper, R., Barlow, J., 2014. Low-frequency vocalizations of sei whales (Balaenoptera borealis) in the Southern Ocean. The Journal of the Acoustical Society of America 136, EL418–EL423. https://doi.org/10.1121/1.4902422
7. Calderan SV, Black A, Branch TA, Collins MA, Kelly N, Leaper R, Lurcock S, Miller BS, Moore M, Olson PA, Š irović A, Wood AG, Jackson JA, 2020. South Georgia blue whales five decades after the end of whaling. Endang Species Res 43, 359–373.
8. Cleguer, C., Kelly, N., Tyne, J., Wieser, M., Peel, D., Hodgson, A., 2021. A Novel Method for Using Small Unoccupied Aerial Vehicles to Survey Wildlife Species and Model Their Density Distribution. Frontiers in Marine Science 8. https://doi.org/10.3389/fmars.2021.640338
9. Miller, B., 2012. Real-time tracking of blue whales using DIFAR sonobuoys. Australian Acoustical Society Conference 2012, Acoustics 2012: Acoustics, Development, and the Environment 522–528.
10. Miller, B., Calderan, S., Gillespie, D., Weatherup, G., Leaper, R., Collins, K., Double, M., 2016. Software for real-time localization of baleen whale calls using directional sonobuoys: A case study on Antarctic blue whales. The Journal of the Acoustical Society of America 139, EL83–EL89. https://doi.org/10.1121/1.4943627
11. Miller, B., Calderan, S., Miller, E., Širović, A., Stafford, K., Bell, E., Double, M., 2020. A passive acoustic survey for marine mammals conducted during the 2019 Antarctic voyage on Euphausiids and Nutrient Recycling in Cetacean Hotspots (ENRICH).
12. Miller, B.S., Barlow, J., Calderan, S., Collins, K., Leaper, R., Olson, P.A., Ensor, P.H., Peel, D.A., Donnelly, D.M., Andrews-Goff, V., Olavarría, C., Owen, K., Rekdahl, M.L., Schmitt, N.T., Wadley, V.R., Gedamke, J., Gales, N.J., Double, M.C., 2015. Validating the reliability of passive acoustic localisation: A novel method for encountering rare and remote Antarctic blue whales. Endangered Species Research 26, 257–269.
13. Miller, B.S., Calderan, S., Leaper, R., Miller, E.J., Širović, A., Stafford, K.M., Bell, E., Double, M.C., 2021. Source Level of Antarctic Blue and Fin Whale Sounds Recorded on Sonobuoys Deployed in the Deep-Ocean Off Antarctica. Frontiers in Marine Science 8. https://doi.org/10.3389/fmars.2021.792651
14. Miller, B.S., Leaper, R., Calderan, S., Gedamke, J., 2014. Red Shift, Blue Shift: Investigating Doppler Shifts, Blubber Thickness, and Migration as Explanations of Seasonal Variation in the Tonality of Antarctic Blue Whale Song. PLOS ONE 9, 1–11. https://doi.org/10.1371/journal.pone.0107740

15. Miller, E., Potts, J., Cox, M., Miller, B., Calderan, S., Leaper, R., Olson, P., O'Driscoll, R., Double, M., 2019. The characteristics of krill swarms in relation to aggregating Antarctic blue whales. Scientific Reports 9. https://doi.org/10.1038/s41598-019-52792-4
16. Olson, P., Ensor, P., Olavarria, C., Bott, N., Constantine, R., Weir, J., Childerhouse, S., van der Linde, M., Schmitt, N., Miller, B., Double, M., 2015. New Zealand Blue Whales: Residency, Morphology, and Feeding Behavior of a Little -Known Population. Pacific Science 69, 477–485. https://doi.org/10.2984/69.4.4
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20. Reyes Reyes, M., Baumann-Pickering, S., Simonis, A., Melcón, M., Trickey, J., Hildebrand, J., Iñiguez, M., 2017. High-Frequency Modulated Signals Recorded Off the Antarctic Peninsula Area: Are Killer Whales Emitting Them? Acoustics Australia 45, 1–8. https://doi.org/10.1007/s40857-017-0103-x
21. Rojas Cerda, C., Buchan, S.J., Branch, T.A., Malige, F., Patris, J., Hucke?Gaete, R., Staniland, I., 2022. Presence of Southeast Pacific blue whales (Balaenoptera musculus) off South Georgia in the South Atlantic Ocean. Marine Mammal Science 38, 1425–1441.
22. Smith, A., Nelson, T., Ratnarajah, L., Genovese, C., Westwood, K., Holmes, T., Corkill, M., Townsend, A., Bell, E., Wuttig, K., Lannuzel, D., 2022. Identifying potential sources of iron-binding ligands in coastal Antarctic environments and the wider Southern Ocean. Frontiers in Marine Science 9, 948772. https://doi.org/10.3389/fmars.2022.948772
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Unpublished Reports

26. Branch, T.A., 2021. Little evidence for interchange between north-east Pacific and south-east Pacific blue whale populations despite morphological similarities. IWC paper SC/68c/SH/20.
27. Branch, T.A., 2020. Assignment of South Georgia catches between Southeast Pacific blue whales and Antarctic blue whales. IWC paper SC/68B/SH/16 24 pp.
28. Branch, T.A. et al., 2021. Monthly movements and historical catches of pygmy blue whale populations inferred from song detections. IWC paper SC/68c/SH/17.
29. Branch, T.A., Monnahan, C.C., 2020. Sex ratios in blue whales from conception onward: a comparative analysis across space, time, and size. IWC paper SC/68B/SH01.
30. Double, M.C. et al., 2019. ENRICH Voyage Report, IN2019_V01: The availability of Antarctic krill to large predators and their role in biogeochemical recycling in the Southern Ocean.
31. Lang, A.R. et al., 2020. Evaluating the evidence for population structure within Antarctic blue whales. IWC paper SC/68b/SH/03.

1.3 IWC-SORP (2) Killer whales in the Southern Ocean

Peer-reviewed Publications

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1.4 IWC-SORP (3) Interactions between baleen (minke & humpback) whales and krill

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1.5 IWC-SORP (4) Movements and mixing of humpback whales

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1.6 IWC-SORP (5) Blue and fin whale acoustic trends project

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1.7 IWC-SORP (6) Population recovery of southern right whales

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150. Carroll, E., Dunshea, G., Ott, P., Valenzuela, L., Baker, C., Childerhouse, S., Gaggiotti, O., Flores, P., Groch, K., Hindell, M., Lundquist, D., Oliveira, L., Rowntree, V., Sironi, M., Newsome, S., 2021. Variation in δ13C and δ15N values of mothers and their calves across southern right whale nursery grounds: The effects of nutritional stress? Marine Mammal Science Accepted. https://doi.org/10.1111/mms.12871
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1.8 IWC-SORP (7) Recovery and ecology of Southern Hemisphere fin whales

Peer-reviewed Publications

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191. Konishi, K., Tatsuya, I., 2022. Long-term track movement of Antarctic minke whales revealed by satellite-monitored tag experiments conducted by the Institute of Cetacean Research.
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193. Pastene. L. A. et al., 2021. What do we know about whales and ecosystem in the Indo-Pacific region of the Antarctic? Part 3: population genetic structure of large baleen whales other than Antarctic minke whales. Technical Reports of the Insitute of Cetacean Research.

194. Tamura, T., Matsuoka, K., Yasunaga, G., Pastene, L.A., 2020. What do we know about whales and ecosystem in the Indo-Pacific region of the Antarctic. Part 2: summary of ecological studies. Technical Reports of the Insitute of Cetacean Research.

1.10 ORCA Southern Ocean distance sampling and observation programme

None

1.11 Parāoa (sperm whales) of the South Pacific

None

1.12 Study of the pelagic ecosystem in the Bransfield Strait

Unpublished Reports

195. Aguilar, R., Ochoa, M. 2022. Abundancia y distribución de mamíferos marinos y su relación con la presencia de presas en la Campaña ANTAR XXVI, Verano Austral 2019. Boletín del Instituto del Mar del Perú. https://repositorio.imarpe.gob.pe/handle/20.500.12958/4876 Meza, M. A., Ochoa, M. 2021. Avistamiento de aves marinas antárticas y su relación con el krill (Euphausia superba). ANTAR XXVI. Boletin Instituto del Mar del Perú, 36(1), 54-67.

2 SOUTHERN OCEAN SANCTUARY: LETHAL RESEARCH

2.1 NEWREP-A (New Scientific Whale Research Program in the Antarctic Ocean)

Unpublished Reports

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201. Pastene, L. A. et al., 2017. Progress report of the work conducted in response to NEWREP-A research recommendations by the IWC Scientific Committee. Paper SC/67a/SCSP12 presented to the IWC Scientific Committee, May 2017.
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3 INDIAN OCEAN SANCTUARY: NON-LETHAL RESEARCH

3.1 Distribution, movements, and feeding behaviour of killer whales in the tropical Southwest Indian Ocean

Peer-reviewed Publications

205. Terrapon, M., Kiszka, J.J., Wagner, Jeanne, 2021. Observations of Killer Whale (Orcinus orca) Feeding Behavior in the Tropical Waters of the Northern Mozambique Channel Island of Mayotte, Southwest Indian Ocean. Aquatic Mammals 47, 196–205. https://doi.org/10.1578/AM.47.2.2021.196

3.2 Migration routes of Megaptera novaeanglia

206. Dulau, V., Pinet, P., Geyer, Y., Fayan, J., Mongin, P., Cottarel, G., Zerbini, A., Cerchio, S., 2017. Continuous movement behavior of humpback whales during the breeding season in the southwest Indian Ocean: on the road again! Movement Ecology 5, 11. https://doi.org/10.1186/s40462-017-0101-5

3.3 Occurrence, habitat preferences and relative abundance of cetaceans in Seychelles

None

3.4 Rapid assessment of marine mammals in Tanzania

Peer-reviewed Publications

207. Braulik, G.T., Kasuga, M., Wittich, A., Kiszka, J.J., MacCaulay, J., Gillespie, D., Gordon, J., Said, S.S., Hammond, P.S., 2018. Cetacean rapid assessment: An approach to fill knowledge gaps and target conservation across large data deficient areas. Aquatic Conservation: Marine and Freshwater Ecosystems 28, 216–230. https://doi.org/10.1002/aqc.2833

3.5 Tanzania citizen science whale network

Unpublished Reports

208. Braulik, G. T. and Stern, D. 2019. Tanzanian Whale Network Report. Report of Sightings 2018. 2pp.
209. Braulik, G. T. and Stern, D. 2020. Tanzania Whale Network Report. Report of sightings 2019. 2pp.
210. Stern, D. and Braulik, G. T. 2021. Tanzania Whale Network Report. Report of sightings 2020. 2pp.
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