

Observations relevant to the Conservation Committee's review of the Southern Ocean Sanctuary.

Delegation of Australia

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 Sanctuary took place in 2004 and the next review was scheduled to commence in 2014.

Initial guidance for reviewing sanctuaries was agreed by the Commission in 2001, through Annex E to the Scientific Committee report, 'Instructions from the Commission to the Scientific Committee for Reviews of Sanctuaries' and in 2002 through Resolution 2002-1 'Guidance to the Scientific Committee on the Sanctuary Review Process'.

Sanctuary Review 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.

Scientific Committee advice 2014 (SC65b)

At its meeting in May 2014, the IWC Scientific Committee was instructed by the Commission Chair that, as 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. The group's report was submitted to the Commission for consideration 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. Although the Commission set up a steering group, it was 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.

The SC subsequently invited three external scientists who participated in the review as invited participants.

Sanctuary Review 2014/15

Although the 2004 review provided a suite of recommendations to improve future reviews of the Sanctuary, in the intervening decade since that review, 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) that clear the way for the current SOS review.

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.

The objectives and terms of reference that follow 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 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.

Observations on the objectives

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 by CCAMLR is conservative, and krill fishing is currently concentrated in the South Atlantic. Only those species that primarily feed to the north of the SOS could be considered at risk due 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. 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 also 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 will be achieved in future if the SOS remains in force if non-zero catch limits for commercial whaling are set elsewhere.

This is a prudent safeguard in light of the IWC's difficult history with the regulation of whaling. In general, that history demonstrated that when regulating commercial whaling the IWC found it easier to reach a consensus on proposals to maintain the status quo or even increase catch limits. Where catch limits were not agreed whaling was assumed to be unregulated. The 'moratorium' provided a break with this unfortunate history, and afforded the opportunity to put in place safeguards to prevent its recurrence if the moratorium is revised. However, despite considerable efforts, the management system for possible future commercial whaling by the IWC is not complete, with some elements such as the Revised Management Scheme at an impasse. Experience thus far with the RMP is its independent application by Norway (under its objection). Norway has made several adjustments to its version of 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.

In other discussions about the application of the RMP, the Commission has had before proposals to set catch limits that purport to be calculated under the RMP, but which have in fact been at best based on implementation simulation trials or other calculations that do not represent a proper application of the procedure. Such cases include discussions under the 'Future of the IWC Process' and more recently to set catch limits for 'small type' whaling in the North Pacific.

Even though the RMP is reputed to be a very conservative management procedure, it can be applied using management options that may not be conservative. The SC has already experienced divergent views about defining plausible stock boundaries where these have appreciable effects on the calculation of catch limits in implementation simulation trials. Since the RMP was developed, new technologies have been developed that 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. Thus maintaining the SOS will enable the evolution and evaluation of the RMP and RMS before considering their application in the Antarctic.

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.*

For convenient reference in the observations by Australia below, the advice from the SC under each term of reference is also included. In general Australia welcomes and endorses the recommendations and advice of the SC. In some instances Australia makes some additional observations about the advice of the SC, and of course elaborates on those terms of reference that fall within the mandate of the Conservation Committee.

Observations under the terms of reference

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 are provided to the Commission in IWC 2014, and specific information on abundance and trends is updated in Annex Q of the Report of the Scientific Committee (IWC/66Rep01). The advice recent from the SC is:

Narrowly speaking the SOS 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).

The Committee notes that human induced threats are likely to be much lower in the SOS than the adjacent IOS, given the much lower levels of ship traffic and human activity. This is one of the reasons why the SOS was chosen as a Sanctuary. With other threats being much lower than elsewhere, the recovery of whale stocks was likely to be relatively rapid.

The Committee agrees that the SOS is not inconsistent with other measures to protect whales from anthropogenic and other environmental factors, (e.g. measures established by the Commission for the Conservation of Antarctic Marine Living Resources, CCAMLR).

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.

Many Southern Hemisphere 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.

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.*

The Scientific Committee reported its agreement that *"the SOS is not inconsistent with other measures to protect whales from anthropogenic and other environmental factors"*.

Apart from the possibility of the resumption of 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 approach, but these fisheries are expected to expand. Although CCAMLR has an ecosystem monitoring programme (CEMP) this relies primarily on monitoring changes in predator populations that can be studied on land (seals and penguins). CCAMLR is developing a feedback management procedure for krill fisheries, and in due course one of the questions will be whether this procedure will offer adequate allowance for whales as krill dependent predators if predator monitoring focuses on land-based species.

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. Recent studies have shown that ocean acidification adversely affects krill larval development (Kawaguchi *et al.*, 2013). The other 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 SC advises:

The combined SOS and IOS provide complete protection from any future commercial whaling by IWC member nations for the populations of baleen whales that breed in the Indian Ocean. 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.

In addition, while the evaluation of the effectiveness of the Sanctuaries can be carried out for these collectively, individual evaluation is also needed. Simulation studies have suggested that partial Sanctuaries, covering only some stocks, constitute an improved approach to estimation of some parameters that are important for management, compared to full exploitation or all-encompassing Sanctuaries (Rademeyer and Butterworth, 2004).

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.

b. International agreements concerning biodiversity and conservation of nature.

The SC reports:

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.

The Committee notes that the effectiveness of the SOS and adjacent IWC Sanctuaries will be enhanced by cooperation with other international organisations such as the CCAMLR and the International Maritime Organisation (IMO).

- 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.*

The SC advice is:

The SOS has allowed for the conduct of scientific research useful for meeting general IWC objectives. Many of the projects outlined in Appendix II of SC/66b/SAN/01 represent long-term, coordinated, integrated, international research programmes involving collaborators from multiple IWC member countries. A common aim of many of these projects is to assess trends in whale abundance and distribution, and monitor species recovery although some of them are not associated with the objectives of SOS but with other objectives such as resumption of commercial whaling.

The ongoing research coordinated by the Southern Ocean Research Partnership (IWC-SORP) in the Southern Hemisphere demonstrates that there is expertise within the Scientific Committee to generate effective, multi-national research programs capable of producing information relevant to the IWC within the SOS.

*The Committee **agrees** that a Sanctuary such as the SOS has, in principle, the potential to encourage collaboration and to facilitate development of coordinated scientific research and monitoring programs. However, it is not possible to fully evaluate whether the collaborative projects that have been undertaken would have occurred without the Sanctuary designation.*

Appendices I to III of SC66/SAN01 (of which I and II are reproduced below) demonstrate that the SOS and IOS have allowed for the conduct of scientific research useful for meeting IWC objectives. A total of 315 scientific documents are listed in the selective bibliography of Appendix III of SC/66/SAN01, 198 of which are peer-reviewed publications. This list is 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 might peak and decline.

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

From the report of the SC:

The precautionary approach, as defined in Principle 15 of the 1992 Rio Declaration states that 'In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.' 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, and the concepts underlying a Sanctuary, have been and remain consistent with the precautionary principle.

The concept of the precautionary approach is commonly invoked in the literature to justify the establishment of marine reserves and marine protected areas, particularly in cases where fisheries management strategies are said to have failed. It was noted however, that in many cases, 'failure' of fisheries management strategies has been a result of their not having been properly implemented. It was suggested that a possible approach to evaluate the consistency of the SOS with the precautionary approach is to assess how it applies to each individual threat within the Sanctuary, and if it could be properly implemented. This, however, would not allow for suitable assessment of the cumulative effect of threats in combination. The resilience (ability to recover from depletion) of a stock could be reduced if it is subject to multiple sources of impact. In this sense, it was pointed out that the establishment of a Sanctuary will improve resilience if it contributes to reducing the impact of one or multiple threats to a stock.

Conclusions

Based on the advice of the SC and the observations above, Australia concludes that the SOS has, and will continue to fulfil its objectives, and therefore should be maintained. We note and generally endorse the recommendations by the SC that:

At the completion of the review of scientific aspects of the SOS, the Committee agreed to a set of consolidated recommendations, which took into consideration those made at the 2004 SOS review (IWC, 2005c) and the discussions during this meeting (Table 1, Annex Q).

The Committee reiterates the need to develop a management plan for the Sanctuary. Therefore, the Committee recommends and advises:

(1) Performance measures: Each SOS objective should be linked to appropriate performance measures and to field monitoring programmes that allow performance evaluation. The Committee is willing to advise the Commission on appropriate performance measures in relation to the scientific objectives of the SOS (and monitoring approaches for these). Some of these can draw on existing mechanisms, e.g. the In-Depth assessment process.

(2) Management Plan: The Committee advises the Commission of the need to develop a Management Plan for the Sanctuary and of its willingness to assist in the scientific component of this process. This assistance may include collating information on relevant recent Scientific Committee activities and the output from existing research programmes and likely output from future programmes. The Plan should clearly outline (a) the broad strategies and specific actions needed to achieve Sanctuary objectives, (b) performance measures, (c) a monitoring strategy, (d) a co-ordinated research programme and (e) review criteria and a regular review mechanism.

(3) Funding: The development and implementation of a management plan will require explicit funding. The Scientific Committee suggests that the Commission investigates whether this plan could be developed and at least in part funded under the framework of an area-based Conservation Management Plan.

(4) Review: Once a management plan has been developed, it should be reviewed and refined periodically to account for ecological, oceanographic and possible other changes in an adaptive fashion. This should take account of progress on how to account for such changes (e.g. relationship between whale distributions and environmental/oceanographic conditions). The review criteria should be linked to performance measures and should reflect the goals

and objectives of the SOS. These could be based on the 2014 Terms of Reference (IWC, 2005c).

Australia is of the view that the Conservation Committee is the appropriate group to develop such a management plan, drawing on the advice of the SC in those areas outlined in its advice above. We also note with appreciation the draft management plan attached to the SAWS (IWC/66/??) proposal and consider that to be an appropriate model to draw on for developing a management plan for the SOS. The question of how this work is organised and funded through the Conservation and Scientific Committee will require further discussion in the Commission.

References

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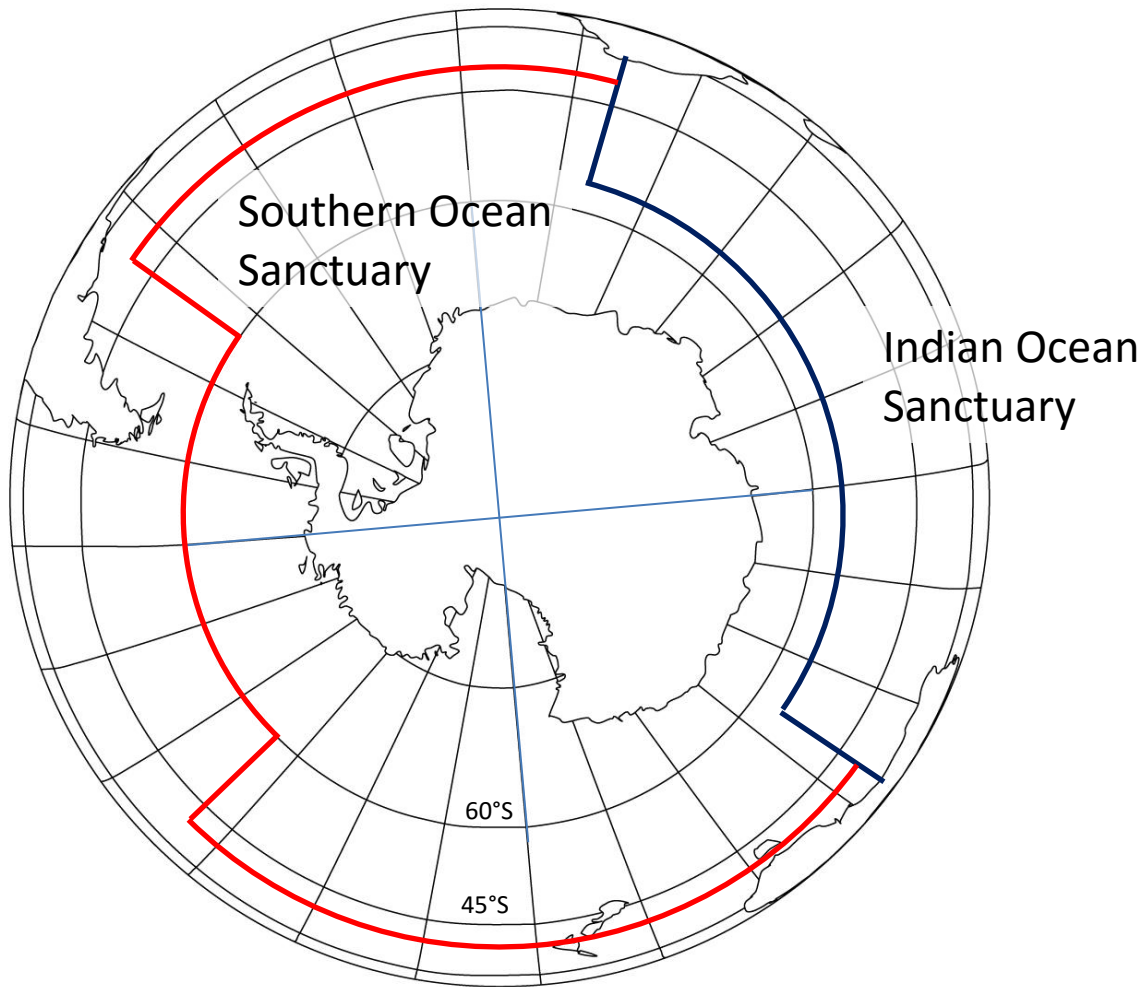


Fig 1. Boundary of the Southern Ocean Sanctuary. The southern boundary of the Indian Ocean Sanctuary coincides with the northern boundary of the Southern Ocean Sanctuary. Factory ship whaling is forbidden in southern hemisphere waters north of 40°S.

APPENDIX I: Overview of scientific research in the Southern ocean and Indian Ocean Sanctuaries

Research	Contributors	Location	Dates	Aims	Key Output	
					Summary	References (Appendix III)
SOUTHERN OCEAN SANCTUARY: Non-Lethal Research						
IWC-SORP (Southern Ocean Research Partnership): Antarctic Blue Whale Project	Australia, UK, USA, South Africa, NZ, Argentina, Chile, France, Norway	Southern Ocean	2012-Current	<ul style="list-style-type: none"> • Develop methods to locate and sample Antarctic blue whales • Deliver a new circumpolar abundance estimate • Study population structure, habitat use, and behaviour 	<ul style="list-style-type: none"> • Development of acoustically-assisted tracking methods for locating blue whales • Five voyages to date, collecting a range of acoustic, photo-ID, biopsy, satellite track, environmental, and prey data • Further information 	1-27
IWC-SORP: Killer Whales in the Southern Ocean	USA, South Africa, Brazil, France, Canada	Antarctic Peninsula; Ross Sea; Marion Island	2006-Current	<ul style="list-style-type: none"> • Investigate distribution, relative abundance, migration patterns, and foraging ecology 	<ul style="list-style-type: none"> • Annual fieldwork collecting a range of data including: identification photographs, biopsy samples, satellite tracks, and behavioural observations • Further information 	28-51
IWC-SORP: Interactions between Minke and Humpback Whales and Krill	USA, Australia	Antarctic Peninsula	2009-Current	<ul style="list-style-type: none"> • Investigate short and long term movement patterns and behaviour in relation to prey and environmental variability 	<ul style="list-style-type: none"> • Fieldwork since 2009 collecting a range of data including identification photos, satellite tracks, dive tracks, behavioural observations, environmental and prey data • Further information 	52-63
IWC-SORP: Blue and Fin Whale Acoustic Trends Project	France, USA, Germany, Australia, South Africa, UK	Southern Ocean	2009-Current	<ul style="list-style-type: none"> • 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) 	<ul style="list-style-type: none"> • SOHN recording sites have been identified • Successful deployment of several long-term recorders by multiple research groups • Further information 	64-74
IWC-SORP: Movements and Mixing of Humpback Whales	New Zealand, Australia, USA, France, Samoa, Tonga	Southern Ocean	1998-Current	<ul style="list-style-type: none"> • Study the movements and mixing of humpback whales around the Southern Ocean 	<ul style="list-style-type: none"> • Genetic catalogue of whales back to 1998 • A dedicated voyage in 2010 collected photo-id, biopsy, and satellite track data • Subsequent IWC-SORP voyages have contributed humpback whale data • Further information 	75-93

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					Summary	References (Appendix III)
Southern Right Whale Research	NZ, USA, Australia, UK	Auckland Islands, Campbell Island, Mainland NZ	1995-Current	<ul style="list-style-type: none"> Assess population size and dynamics Study recolonisation and movement between sub-Antarctic and mainland NZ 	<ul style="list-style-type: none"> Winter field surveys at Auckland Islands and Campbell Island involving biopsy sampling, photo-identification, satellite tracking, habitat surveys, and acoustic recordings Opportunistic data collection around mainland NZ 	94-109
Sperm Whale Research	NZ	Kaikoura, NZ	1990-Current	<ul style="list-style-type: none"> Study seasonal distribution, residency, abundance, size, vocal behaviour, and diving behaviour Assess the effects of tourism 	<ul style="list-style-type: none"> Long-term research projects since 1990 collecting distribution, photo-id, behaviour, and acoustic data 	110-141
Minke Whale Research	Germany	Weddell Sea & Antarctic Peninsula	2006-2015	<ul style="list-style-type: none"> Study abundance and distribution of cetaceans, particularly Antarctic minke whales, in the pack-ice 	<ul style="list-style-type: none"> Six concurrent helicopter and shipboard line-transect surveys with sightings of over 330 minke whales 	142-151
Minke Whale Research	Australia	Vincennes Bay – Davis Sea	2008-2010	<ul style="list-style-type: none"> Study abundance and distribution of Antarctic minke whales in the pack-ice 	<ul style="list-style-type: none"> Two fixed-wing aerial surveys resulting in 65 sightings of 94 minke whales Further information 	152-157
IWC/IDCR-SOWER: International Decade of Cetacean Research – Southern Ocean Whale Ecosystem Research	Over 200 scientists from 15 Member Countries	Southern Ocean	1978-2010	<ul style="list-style-type: none"> Estimate Antarctic minke whale abundance Study the distribution of Antarctic cetaceans 	<ul style="list-style-type: none"> 32 annual research voyages totalling to 3 circumpolar surveys Line-transect surveys collecting photo-id, biopsy, and acoustic data Abundance estimates for Antarctic minke whales and almost every other cetacean occurring in Antarctic waters \ Further information 	158-183
IWC-SO GLOBEC Survey (Southern Ocean Global Ecosystem Dynamics)	USA, Germany, Australia, UK	Antarctica	2001-2005	<ul style="list-style-type: none"> Study marine mammal presence and distribution in relation to the physical environment and krill 	<ul style="list-style-type: none"> Multidisciplinary Antarctic voyages involving line-transect surveys, photographic identification, biopsy sampling and passive acoustic recording 	184-195
BROKE-West Survey (Baseline Research on Oceanography, Krill and the Environment)	Australia	Antarctica (30-80°E)	2006	<ul style="list-style-type: none"> Study marine mammal presence and distribution in relation to oceanography and krill 	<ul style="list-style-type: none"> A multidisciplinary voyage including a cetacean line-transect survey over 3300 n.mi with 142 sightings 162 hours of passive acoustic recordings 	196-197

Research	Contributors	Location	Dates	Aims	Key Output	
					Summary	References (Appendix III)
BROKE Survey (Baseline Research on Oceanography, Krill and the Environment)	Australia	Antarctica (80-150°E)	1996	<ul style="list-style-type: none"> Investigate relationships between biological and oceanographic parameters and the distribution and relative abundance of cetaceans 	<ul style="list-style-type: none"> A multidisciplinary voyage including a cetacean line-transect survey of over 350 hours with 342 sightings of 746 individuals Over 124 hours of passive acoustic recordings 	198-201
Theoretical Modelling	Worldwide	Southern Ocean	Ongoing	<ul style="list-style-type: none"> To develop models on the energetics and interactions of whales in the Southern Ocean ecosystem 	<ul style="list-style-type: none"> A wide variety of research including models of predator-prey interactions and nutrient recycling, and how these are affected by a change in whale abundance 	202-212
SOUTHERN OCEAN SANCTUARY: Lethal Research						
JARPA/JARPA II (Japanese Whale Research Programs)	Japan	Southern Ocean	JARPA: 1988-2005; JARPA II: 2005-2014	<ul style="list-style-type: none"> Estimate biological parameters to improve stock management of Southern Hemisphere minke whale Study stock structure Elucidate role of whales in the marine ecosystem and effect of environmental change 	<ul style="list-style-type: none"> Annual 'scientific' whaling voyages with a combination of sighting and lethal sampling surveys 	213-232
INDIAN OCEAN SANCTUARY: Non-Lethal Research						
Humpback Whale Research	Australia	Western Australia	1963-Current	<ul style="list-style-type: none"> Monitor abundance, movements, and mixing Describe migratory distribution and behaviour 	<ul style="list-style-type: none"> Long-term aerial surveys to monitor abundance since 1963 Boat-based studies collecting photo-ID, behaviour, acoustic, and genetic data Recent studies in 2009/2011 represent the first large-scale deployment of satellite tags on humpback whales in Australia 	233-259
Southern Right Whale Research – Australia	Australia, NZ	South-Western Australia	1976-Current	<ul style="list-style-type: none"> Assess population dynamics and movements 	<ul style="list-style-type: none"> Annual aerial surveys since 1976 including photo-ID of individuals Shore and boat-based surveys collecting sighting, photo-ID, biopsy, and acoustic data Recent satellite tagging to track movements 	260-278

Research	Contributors	Location	Dates	Aims	Key Output	
					Summary	References (Appendix III)
Southern Right Whale Research – South Africa	South Africa	South Africa	1979-Current	<ul style="list-style-type: none"> Assess population demographics, movements, and behaviour 	<ul style="list-style-type: none"> Annual aerial surveys since 1979 collecting photo-ID and count data Boat-based surveys collecting biopsy and satellite tagging data Shore-based observations 	279-295
Pygmy Blue Whale Research – Western Australia	Australia	Western Australia	1999-Current	<ul style="list-style-type: none"> Study the acoustics, behaviour and connectivity between different blue whale populations 	<ul style="list-style-type: none"> Boat-based and aerial surveys collecting sighting, behaviour, genetic and photo-ID data. Recent satellite tagging in 2008/2011 tracking movements from the Perth Canyon Acoustic data collection from the International Monitoring System (IMS) hydrophone at Cape Leeuwin since 2002 and the IMOS logger in the Perth Canyon since 2009 	296-311

APPENDIX II: Detailed compilation of research in the Southern Ocean & Indian Ocean Sanctuaries

1 SOUTHERN OCEAN SANCTUARY: NON-LETHAL RESEARCH

1.1 Southern Ocean Research Partnership (IWC-SORP)

The aim of IWC-SORP is to develop a multilateral, non-lethal scientific whale research program that will improve the coordinated and cooperative delivery of science to the IWC. Current Partnership members include Argentina, Australia, Brazil, Chile, France, Germany, Italy, New Zealand, Norway, South Africa and the United States of America.

1.1.1 IWC-SORP: 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:

- continue the development and refinement of methods to locate and sample Antarctic blue whales in the Southern Ocean
- employ these methods to collect sufficient data to deliver a new circumpolar abundance estimate for Antarctic blue whales
- improve understanding of Antarctic blue whale population structure, the linkages between breeding and feeding grounds, and characterise whale behaviour on the feeding grounds.

Further Information

See: <http://www.marinemammals.gov.au/sorp/antarctic-blue-whale-project>

Key Outputs

Project Development

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 and tested by the Australian Antarctic Division. Two voyages were conducted in 2012 in Northern Bass Strait to test a real-time passive acoustic tracking system using DIRFAR (directional) sonobuoys. These tracking methods have since been used as key tools to successfully find Antarctic Blue Whales in the Southern Ocean during other research voyages.

The international partnership of the Antarctic Blue Whale Project (ABWP) has recently cooperated on seven voyages to the Southern Ocean. Further voyages are planned over the next twelve years to collect sufficient samples to realise the ambitious aims of this project and ships of opportunity are contributing sightings information to the online reporting system: <http://www.marinemammals.gov.au/sorp/sightings>

Research Voyages

Australian Antarctic Division. Pygmy Blue Whale Voyages. Jan & Mar 2012. Northern Bass Strait.

- 1508 n.mi surveyed
- 500 hours of acoustic recordings with over 7000 calls analysed in real-time
- 32 vocalising blue whales targeted yielding 29 visual sightings of one or more whales
- 47 individual blue whales photographically identified

Australian Antarctic Division. Antarctic Blue Whale Voyage. Jan-Mar 2013. Southern Ocean.

- 5021 n.mi. surveyed
- 733 hours of acoustic recordings with 27034 ABW calls analysed in real-time
- 52 vocalising blue whale groups targeted yielding 33 visual sightings of one or more whales
- Estimated 84 ABWs sighted with 50 individual whales photographically identified
- 23 ABW biopsy samples collected
- 2 satellite tags deployed
- Collection of photogrammetric movement data

South African Antarctic Blue Whale Survey. SANAE. Dec 2013-Feb 2014. Weddell Sea.

- 998 n.mi. surveyed
- 17 groups of 26 ABWs sighted with an estimated 16 whales photographically identified
- 4 ABW biopsy samples collected
- Collection of prey data

Centre for Whale Research, Australia. Whale Song Antarctic Voyage for Ecosystem Studies (WAVES). Jan 2014. Southern Ocean.

- Recorded pygmy and Antarctic blue whale calls
- Photo-identification of 1 Antarctic and 1 pygmy blue whale

Argentina. South American Consortium Whale Voyage R/V Tango. Feb 2014. Antarctic Peninsula.

- 1331 n.mi. surveyed
- 1 sighting of an Antarctic blue whale

France. CETA Program. Opportunistic Cetacean Surveys. R/V Astrolabe. 2010, 2011, 2014. Dumont d'Urville Sea.

- 3 blue whales photo-identified

Australian Antarctic Division. New Zealand-Australian Antarctic Ecosystems Voyage. Jan-Mar 2015. Southern Ocean.

- 435 survey hours
- 24 sightings of approximately 58 ABWs
- 520 hours of acoustic recordings with over 40000 ABW calls analysed in real-time
- Photo-identification of 58 ABWs, 22 humpback whales, and 9 killer whales
- 1 ABW biopsy sample
- 15 hours of focal follow video data
- Eleven active acoustic and trawl surveys of krill in association with ABW sightings

Peer-reviewed Publications

Appendix III: 1-6

Unpublished Reports

Appendix III: 7-27

1.1.2 IWC-SORP: Killer Whales in the Southern Ocean

Aims

This project aims to investigate the distribution, relative abundance, migration patterns, and foraging ecology of three ecotypes of killer whales in the Southern Ocean waters.

Further Information

See: <http://www.marinemammals.gov.au/sorp/killer-whales-in-the-southern-ocean>

Key Outputs

Research

Since 2009, Pitman & Durban have been conducting research on killer whales in Antarctic waters, mainly at the Antarctic Peninsula but also in the southern Ross Sea. To date they have described five morphologically distinct

types of killer whales. The team are currently investigating the systematics and ecology of these different types using satellite tagging, photo-identification, biopsy sampling, acoustic recordings, and focal follow behavioural studies:

M/V National Geographic Explorer. Jan-Feb 2011. Western Antarctic Peninsula.

- **150 individuals photographically identified**
- **5 satellite tags deployed**
- **10 biopsy samples**

M/V National Geographic Explorer. Jan-Feb 2012. Western Antarctic Peninsula.

- **Over 200 individuals photographically identified**
- **3 satellite tags deployed**
- **2 biopsy samples**

Top Predator study in McMurdo Sound. Dec 2012-Jan 2013. Ross Sea.

- 100-200 individuals photographically identified
- 7 satellite tags deployed
- 4 biopsy samples
- 3 hours of killer whale vocalisations recorded

M/V National Geographic Explorer. Jan 2013. Western Antarctic Peninsula.

- 11 groups of killer whales photographically identified
- 5 satellite tags deployed

Duke University NSF R/V Pt. Sur. Jan 2013. Western Antarctic Peninsula.

- 11 groups of killer whales photographically identified
- 4 satellite tags deployed
- 9 biopsy samples

M/V National Geographic Explorer. Dec 2013-Feb 2014. Western Antarctic Peninsula.

- 18 sightings with 235 individuals photographically identified.
- 7 satellite tags deployed
- 4 biopsies

In 2014, the Brazilian Antarctic Program surveyed the waters of the western Antarctic Peninsula for cetaceans during the Projeto Baleias, contributing to the killer whale project:

Projeto Baleias/Brazilian Antarctic Program. Feb 2013. Western Antarctic Peninsula.

- 319 n.mi survey effort
- 3 groups of killer whales photographically identified
- 1 biopsy sample
- 30 min vocalisations recorded

A sub-Antarctic research project at Marion Island is led by de Bruyn and colleagues as part of the South African National Antarctic Programme (SANAP). This research has been supported by SORP since March 2013 and incorporates research undertaken since 2006. Since 2011, satellite tagging has been undertaken to study local and wider-scale movements of killer whales around the Island.

2006-2015

- **Uninterrupted research involving observation and photo-identification**
- **Over 8000 hours of dedicated land based observation**
- **Over 27000 images taken for photographic mark-recapture**
- **60 catalogued individual killer whales**

2011-2015

- **Biopsy samples from over 30 known individuals**
- **20 killer whales tracked with satellite tags for longer than 24 hours**
- **9 satellite tracks lasting longer than 10 days**

Peer-reviewed Publications

Appendix III: 28-48

Unpublished Reports

Appendix III: 49-51

1.1.3 IWC-SORP: Interactions between Minke & Humpback Whales and Krill

Aims

This project aims to conduct ecological research on cetaceans around the Antarctic Peninsula and develop methodological tools that can be applied across Antarctic regions to better understand the short and long term movement patterns and behaviours of baleen whales (in particular, humpback and minke whales) in relation to prey and environmental variability.

Further Information

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

Key Outputs

Research

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.

US National Science Foundation. 2009-2013 Western Antarctic Peninsula

- **Satellite tags deployed (30 humpback; 16 minke whale)**
- **Suction cup tags deployed (23 humpback; 2 minke)**
- **Humpback and minke whale individuals photographically identified**
- **Biopsy samples collected**
- **Collection of prey data**

US National Science Foundation Ecological Research Cruise. Dec 2013-Feb 2014. Western Antarctic Peninsula.

- Individual whales photographically identified
- 104 biopsy samples collected (101 humpback; 3 minke whale)
- Collection of prey data

Peer-reviewed Publications

Appendix III: 52-62

Unpublished Reports

Appendix III: 63

1.1.4 IWC-SORP: 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. To initiate a long-term structured monitoring program and the gathering of baseline acoustic data, the implementation of a passive acoustic monitoring network has been proposed, consisting of a 'necklace' of Passive Acoustic Recorders surrounding the Antarctic continent: the Southern Ocean Hydrophone Network (SOHN). One of the core objectives driving the SOHN project is to understand geographic and temporal variation in distribution patterns of animals through their calling behaviour. Given the

distinctive and repetitive nature of certain call types produced by blue and fin whales as well as the long-range propagation of these sounds, passive acoustic monitoring offers a robust means to monitor these species over long time periods in remote areas, including the Southern Ocean.

Further Information

See: <http://www.marinemammals.gov.au/sorp/antarctic-blue-whales-and-fin-whales-acoustic-program>

Key Outputs

Project Development

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 is being analysed to provide information on the geographic and seasonal occurrence of these species around the Antarctic. Locations of future SOHN recording sites have been proposed and locations of current recording sites that may be used as part of SOHN have been identified. A whitepaper has recently been published, detailing technical and logistical information for SOHN deployment (van Opzeeland et al. 2014). A 'blueprint' paper addressing analysis methods is currently underway. A number of research groups, including the Alfred-Wegener-Institute, Australian Antarctic Division, and South African National Antarctic Programme, have deployed passive acoustic recorders with on-going acoustic monitoring effort in various parts of the Southern Ocean.

Peer-reviewed Publications

Appendix III: 64-71

Unpublished Reports

Appendix III: 72-74

1.1.5 IWC-SORP: 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. The two main questions of interest are:

- What is the connection between the humpback whales from Area V feeding grounds and their migratory corridors and breeding grounds in Australia and Oceania?
- Do whales from Area V represent a single breeding ground or are they a mix of individuals from several distinct breeding grounds?

Further Information

See:

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

Key Outputs

Project Development

With the success of the genotype and photo-ID matching of the 2010 Antarctic Whale Expedition (Gales 2010; Constantine et al., 2014) the project will now focus on using satellite telemetry to understand the connections between Oceania breeding grounds and feeding grounds. Voyages to Raoul Island (Kermadec Islands) and American Samoa are now being planned to satellite tag whales as they undertake their southern migration to currently unknown Antarctic feeding grounds.

Research

New Zealand genetic analyses have been carried out since 1998. A total of 193 humpback whale biopsy samples have been collected from whales on their northbound migration through Cook Strait, and 18 from stranded specimens.

American/Independent Samoa genetic analyses have been carried out since 2001 on a total of 131 biopsy samples representing 117 unique individual humpback whales.

A dedicated IWC-SORP research voyage to study Antarctic humpback whales took place in 2010 and subsequent IWC-SORP Antarctic Blue Whale Voyages have collected data on all humpback whales encountered:

Australia-New Zealand Antarctic Whale Expedition. Feb-Mar 2010. Southern Ocean.

- 5800 n.mi surveyed
- 61 humpback whales photographically identified
- 64 biopsy samples from 57 individual humpback whales
- 30 satellite tags deployed on humpback whales
- Acoustic recordings of baleen whales
- Collection of prey data

Australian Antarctic Division. Antarctic Blue Whale Voyage. Jan-Mar 2013. Southern Ocean.

- 1508 n.mi surveyed
- 20 humpback whales photographically identified

New Zealand-Australian Antarctic Ecosystems Voyage. Jan-Mar 2015. Southern Ocean.

- Currently underway, collecting humpback photo-identification, biopsy samples, acoustic recordings, and prey data.

Peer-reviewed Publications

Appendix III: 75-84

Unpublished Reports

Appendix III: 85-93

1.2 Southern Right Whale Research – Sub-Antarctic & Mainland New Zealand

Aims

This research aims to study the population size and dynamics of southern right whales, and their recolonisation and movement between sub-Antarctic and mainland New Zealand.

Key Outputs

Research

Winter field surveys have been carried out at the Auckland Islands between 1995-1998, 2006-2009, and 2010-2012; and at Campbell Island in 1995, 1997, and 2014. Data collected include biopsy samples, photo-identification, satellite tracks, habitat information, and acoustic recordings. This research involves collaboration from various New Zealand institutes, as well as scientists from the USA, Australia, and the UK. Data are also collected during opportunistic encounters around mainland NZ.

Peer-reviewed Publications

Appendix III: 94-106

Unpublished Reports

Appendix III: 107-109

1.3 Sperm Whale Research – Kaikoura, New Zealand

Aims

This ongoing research aims to study the seasonal distribution, residency, abundance, size, vocal behaviour, and diving behaviour of sperm whales in Kaikoura, as well as the effects of tourism.

Key Outputs

Research

A variety of long-term research projects have taken place in this region since 1990, collecting data on sperm whale photographic identification, vocalisations, distribution, behaviour, and growth.

Peer-reviewed Publications

Appendix III: 110-130

Unpublished reports

Appendix III: 131-141

1.4 Minke Whale Research – Weddell Sea & Antarctic Peninsula

Aims

This work aims to study the distribution and abundance of cetaceans, particularly Antarctic minke whales, in the pack-ice.

Key Outputs

Research

Five concurrent aerial and shipboard line-transect surveys have been carried out from the German research vessel Polarstern in the austral summers of 2006/07, 2008/09, 2010/11, 2011/12 and 2012/13. A total of 40985 km of trackline has been surveyed by helicopter over 106 days. Overall, 288 minke whales have been recorded from 157 sightings.

During the most recent expedition in 2014/15, 3783 km of trackline was surveyed by helicopter and 896 km by ship, with 7 and 51 minke whales sighted respectively. A further survey has been proposed for the 2017/18 season.

Peer-reviewed Publications

Appendix III: 142-143

Unpublished Reports

Appendix III: 144-151

1.5 Minke Whale Research – Davis Sea

Aims

This work was undertaken with the aim of studying the abundance and distribution of Antarctic minke whales in the pack-ice of east Antarctica.

Further Information

See: <http://www.marinemammals.gov.au/research-and-activities/science/surveys-and-abundance>

Key Outputs

Research

Fixed-wing aerial surveys were carried out by the Australian Antarctic Division in the austral summers of 2008/09 and 2009/10. Survey effort covered 15000 km across 20° of longitude and resulted in a total of 65 sightings of 94 minke whales.

Unpublished Reports

Appendix III: 152-157

1.6 IWC/IDCR-SOWER (International Decade of Cetacean Research - Southern Ocean Whale Ecosystem Research)

Aims

This research programme commenced in 1978 as part of the International Decade of Cetacean Research (IDCR) and was organised through the IWC. The primary aim of the programme was to estimate Antarctic minke whale abundance, though all cetacean sightings were recorded. The programme represents a successful international collaboration, with over 200 scientists from 15 member countries participating.

Further Information

See: <https://iwc.int/sower>

Key Outputs

Research Voyages

SOWER Voyages were conducted annually for 32 years, between 1978/79 and 2010. The research was supported by the IWC, with the provision of vessels by the Government of Japan (and initially the Soviet Union). Up to four vessels were used in early surveys, but two vessels (the Shonan Maru and Shonan Maru 2) were used from 1981/82 onwards.

Over the 32 years, a total of 216,000 n.mi were surveyed south of 60°S over 4112 days, totalling 3 circumpolar surveys. These resulted in:

- 43,000 cetacean sightings (25,333 of Antarctic minke whales; 400 of Antarctic blue whales)
- Abundance estimates for Antarctic minke whales and almost every other cetacean occurring in higher latitudes
- 2748 discovery tags deployed on minke whales during first circumpolar survey
- ~1500 biopsy samples collected
- Over 3000 whales photographically identified (219 blue whales)
- Thousands of hours of acoustic recordings

Peer-reviewed Publications

Appendix III: 158-173

Unpublished Reports

Over 200 reports on the IWC/IDCR-SOWER programme have been presented to the IWC Scientific Committee since the establishment of the Southern Ocean Sanctuary in 1994. These are listed within the Scientific Committee Document List (<https://iwc.int/doclist#lists>) and a selection are included in Appendix III: 174-183

1.7 IWC-SO GLOBEC (Southern Ocean Global Ecosystem Dynamics)

Aims

This work has aimed to study the presence and distribution of marine mammals in relation to the characteristics of the physical environment and krill.

Key Outputs

Research

The IWC has participated in SO-GLOBEC multidisciplinary Antarctic voyages between 2001 and 2005. The cetacean component of these voyages has involved line-transect surveys with associated photographic identification, biopsy sampling, and passive-acoustic recording.

Peer-reviewed Publications

Appendix III: 184-190

Unpublished Reports

Appendix III: 191-195

1.8 BROKE-West Survey (Baseline Research on Oceanography, Krill and the Environment) - Eastern Antarctica

Aims

This research was carried out as part of the Australian Antarctic program. The aim of the cetacean component was to study marine mammal presence and distribution in the waters off eastern Antarctica.

Key Outputs

Research

A line-transect and systematic passive acoustic survey in eastern Antarctica was conducted as part of the multidisciplinary voyage during the austral summer of 2005/2006. Survey effort of over 3300 n.mi resulted in over 142 sightings and 162 hours of recordings.

Peer-reviewed Publications

Appendix III: 196-197

1.9 BROKE Survey (Baseline Research on Oceanography, Krill and the Environment) – Eastern Antarctica

Aims

This research, carried out with Australian National Antarctic Research Expeditions (ANARE), was primarily designed to survey oceanography and Antarctic krill. The aim of the cetacean research component was to investigate relationships between biological and oceanographic parameters and the distribution and relative abundance of cetaceans.

Key Outputs

Research

A line-transect survey in eastern Antarctica was conducted as part of the multidisciplinary voyage during the austral summer of 1995/96. Search effort of over 350 hours resulted in a total of 342 sightings of 746 individuals. Over 124 hours of passive acoustic recordings were also made using a towed hydrophone array.

Peer-reviewed Publications

Appendix III: 198-199

Unpublished Reports

Appendix III: 200-201

1.10 Theoretical Modelling – Southern Ocean

The following represents a selection of theoretical research relating to whale populations within the Southern Ocean, including energetics modelling, and prey consumption, and how these are affected by changes in whale abundance. Recent studies include modelling how the recovery of whale species could increase the productivity of the Southern Ocean through the recycling of iron.

Key Outputs

Peer-reviewed Publications

Appendix III: 202-212

2 SOUTHERN OCEAN SANCTUARY: LETHAL RESEARCH

2.1 JARPA/JARPA II (Japanese Whale Research Programs) – Southern Ocean

Aims

The objectives of these programs were: to estimate biological parameters to improve the stock management of the Southern Hemisphere minke whale, and study stock structure; to elucidate the role of whales in the Antarctic marine ecosystem, and the effect of environmental change on cetaceans; to model competition among whale species.

Key Outputs

Research

Annual ‘scientific’ whaling voyages conducted by the Institute of Cetacean Research (ICR) were carried out in the Southern Ocean during JARPA (1988-2005) and JARPA II (2005-2014). These involved a combination of sighting and sampling surveys, where species were targeted for lethal sampling.

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>

Peer-reviewed Publications

Appendix III: 213-222

Unpublished Reports

Appendix III: 223-232

3 INDIAN OCEAN SANCTUARY: NON-LETHAL RESEARCH

3.1 Humpback Whale Research – Western Australia

Aims

This research aims to monitor the abundance, movements, and mixing of humpback whales around the Western Australian coast. Recent tagging research has aimed to describe the migratory distribution and behaviour of these whales on their southbound and northbound migration.

Key Outputs

Research

Boat-based studies have collected a suite of data on photo-identification, behaviour, acoustics, and genetics. Long-term aerial surveys to monitor abundance have been carried out since 1963, and recently combined with land-based surveys. Recent studies in 2009 and 2011 deployed a total of 23 and 28 satellite tags respectively, representing the first large-scale deployment of these tags on humpback whales in Australia.

Peer-reviewed Publications

Appendix III: 233-250

Unpublished reports

Appendix III: 251-259

3.2 Southern Right Whale Research – Australia

Aims

This research aims to assess population dynamics and movements of southern right whales around the south-western Australian coast.

Key Outputs

Research

Aerial surveys have been conducted each year since 1976 and 2008, collecting count data and identification photographs of whales around south-western Australia. Shore and boat-based surveys in South Australia have collected sighting and photo-identification data, as well as biopsy samples and acoustic recordings. One satellite tag has been deployed from Tasmania, and recent work in 2015 has deployed three satellite tags from South Australia to track animal movements.

Peer-reviewed Publications

Appendix III: 260-273

Unpublished Reports

Appendix III: 274-278

3.3 Southern Right Whale Research – South Africa

Aims

This research aims to assess the population demographics, movements and behaviour of southern right whales in coastal South Africa.

Key Outputs

Research

Annual aerial surveys have been carried out off the South African coast since 1979, photographs for individual identification and count data. Other research includes surveys collecting biopsy samples and deploying satellite tags, and shore-based observations of movements and behaviour.

Peer-reviewed Publications

Appendix III: 279-293

Unpublished reports

Appendix III: 294-295

3.4 Pygmy Blue Whale Research - Western Australia

Aims

This research aims to study the acoustics and behaviour of pygmy blue whales on their Western Australian feeding ground and the connectivity between different blue whale populations.

Key Outputs

Research

Boat-based and aerial surveys have collected sighting, behavioural, genetic, and photo-identification data. Recent satellite tagging work in 2008 and 2011 has tracked the movements of 11 whales from the Perth Canyon. Acoustic data has been collected since 2002 from the International Monitoring System (IMS) hydrophone deployed at Cape Leeuwin. Recent deployment of an Integrated Marine Observing System (IMOS) logger in 2009 is also collecting acoustic data in the Perth Canyon.

Peer-reviewed Publications

Appendix III: 296-306

Unpublished Reports

Appendix III: 307-311