Antarctic Blue Whale Project

Project Overview

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A project of the Southern Ocean Research Partnership
of the International Whaling Commission

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Executive Summary

This document outlines the background, rationale and strategy for the Antarctic Blue Whale Project, a major project of the Southern Ocean Research Partnership. It describes our current understanding of the status of the Antarctic blue whales after fifty years of protection from exploitation, the role of these whales in the Antarctic ecosystem and what scientific information is now required to assist in the ongoing conservation and management of this iconic animal. We outline how this information could be collected, given that these whales remain so rare in the vast and often inhospitable Southern Ocean.

During the twentieth century, about a third of a million Antarctic blue whales were taken during commercial whaling in the Southern Hemisphere. Close to extinction, in 1964 the International Whaling Commission banned the hunting of blue whales, although some whales were still caught by illegal operations until 1973. Today, the Antarctic blue whale is classified as critically endangered by the International Union for Conservation of Nature and is of global interest as one of the most at risk baleen whale species in the Southern Ocean.

The catch records from the whaling fleets and subsequent sighting surveys allow the reconstruction of the rapid depletion and very slow recovery of Antarctic blue whales; nevertheless a new, accurate and precise abundance estimate is required to assess the current status of these whales. As systematic sightings surveys are no longer conducted around Antarctica, this project's first objective is to identify the most efficient approach to derive a new abundance estimate for Antarctic blue whales. Initial analyses recommend the mark-recapture method, which will also provide an opportunity to deliver information on the project's secondary objectives of investigating population structure, migratory movements and behaviour on the feeding grounds. However further development of mark-recapture survey techniques will be required.

This project is ambitious and will need coordinated and sustained international cooperation to deliver the necessary data to achieve a new abundance estimate for Antarctic blue whales. This document also describes how the project and its science will be coordinated in order to achieve the objectives of the Antarctic Blue Whale Project.

1. The Southern Ocean Research Partnership of the International Whaling Commission

The Southern Ocean Research Partnership (SORP) is a multilateral partnership of the International Whaling Commission (IWC), developing and implementing a suite of non-lethal methods to conduct research on cetaceans. The Partnership aims to maximise conservation outcomes for whales in the Southern Ocean, through an understanding of their post-exploitation health, population dynamics, physical habitat and the current threats that they face. The projects of the SORP, detailed at www.marinemammals.gov.au/sorp have been selected to align closely with the priority areas of the IWC.

The Antarctic Blue Whale Project (ABWP) is central to the SORP, which currently has five collaborative research projects:

- the Antarctic Blue Whale Project — towards an improved circumpolar abundance estimate;
- distribution and seasonal presence of Antarctic blue and fin whales;
- distribution, abundance, migration patterns and foraging ecology of killer whales;
- foraging ecology and predator-prey interactions between baleen whales and krill;
- distribution and extent of mixing of humpback whale populations around Antarctica.

Nations in the partnership to date include Argentina, Australia, Brazil, Chile, France, Germany, New Zealand, Norway, South Africa, United Kingdom and the United States.

2. The Antarctic blue whale and the ecosystem of the Southern Ocean

This project is concerned primarily with the Antarctic blue whale, *Balaenoptera musculus intermedia*. Another subspecies — the pygmy blue whale (*B. m. brevicauda*) — also inhabits the Southern Hemisphere but usually occurs in more temperate or tropical waters. A third subspecies has also been proposed off Chile (Branch *et al.* 2007).

The Antarctic blue whale is the largest animal ever to have existed on our planet, reaching more than 30 m in length and 100 tonnes in weight. It is also arguably the loudest, with males vocalising at source levels of about 179 dB in intense, low-frequency calls that transmit over long distances (Samaran and Guinet 2010). During the austral summer, most individuals feed in the krill-rich waters of the Antarctic Zone south of the Antarctic Convergence, many entering the pack-ice close to the Antarctic continent (Rice 1998). The whales are part of the seasonal feeding activity at the edge of the ice; an Antarctic blue whale consumes about 3% of its body mass of krill per day during the summer period (Wiedenmann *et al*. 2011).

During the period of intensive commercial exploitation, about two million whales were removed from the ecosystem of the Southern Ocean; about a third of a million were Antarctic blue whales (Clapham and Baker 2002). By 1964, when the International Whaling Commission banned the hunting of blue whales, the subspecies was close to extinction. Nevertheless, they were still caught by illegal Soviet whaling operations until

1973 (Branch *et al.* 2004). Today, the Antarctic blue whale is classified as critically endangered by the International Union for Conservation of Nature (Reilly *et al.* 2008) and is of global interest as one of the most at risk baleen whale species in the Southern Ocean.

The catch data from the logbooks of whaling vessels describe the historical abundance and distribution of Antarctic blue whales, although some areas such as the Amundsen Sea were hardly visited by whalers (de la Mare 2012). Circumpolar sighting surveys were initiated in 1978/79 as part of the International Decade of Cetacean Research (IDCR) and later the Southern Ocean Whale Ecosystem Research (SOWER). The three circumpolar surveys (Figure 1) provide the main source of post-exploitation information on the population abundance and spatial distribution of Antarctic blue whales (Branch and Butterworth 2001) and indicate that blue whales remain circumpolar in distribution although in very low numbers (Branch 2008). The winter distribution of these whales remains poorly known but acoustics data suggest they migrate to lower latitudes presumably to breed. The winter migration of baleen whale represents a seasonal removal of biomass from the Antarctic ecosystem (Trites *et al.* 2004).

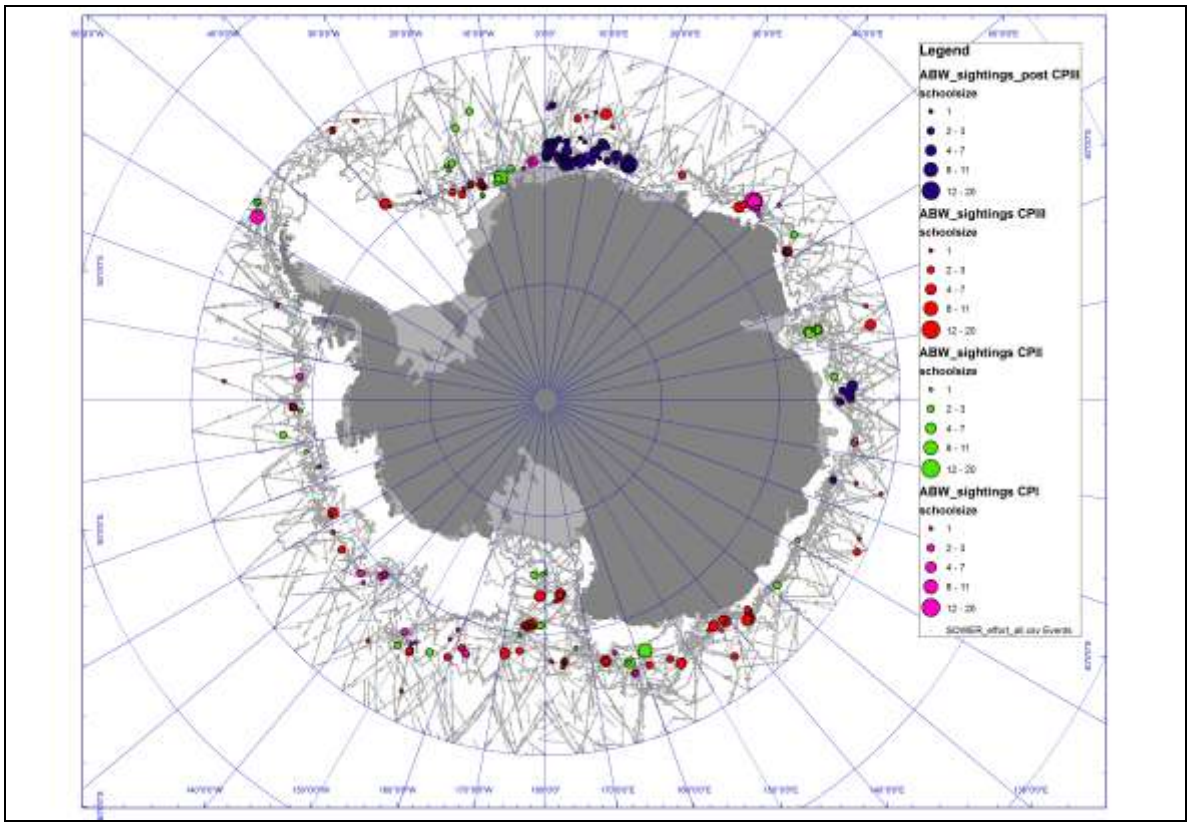

Figure 1. All sightings of Antarctic blue whales made throughout the IDCR/SOWER programme (1978/79-2009/10). Sightings are presented as circles; the colour and size indicate circumpolar (CP) survey and group size, respectively. Grey lines indicate survey effort. Adapted from Branch (2007).

Branch *et al*. (2007) used catch and sightings data in a Bayesian modelling framework to describe the population history of Antarctic blue whales (Figure 2). The estimated population was 2,280 (with a coefficient of variation of 0.36) in 1998. Branch (2007) estimated the rate of increase in the size of the Antarctic blue whale population since the late 1970s to be about 8.2% per year (95% confidence interval of 1.6–14.8%). By the late 1990s, the population of blue whales still remained at < 0.2 % of its original size. There has been no update of the estimate of abundance since the IDCR-SOWER surveys ceased at the end of the 2003/04 season, so our understanding of the status of the Antarctic blue whale is based on information that is 10 years old and needs to be updated.

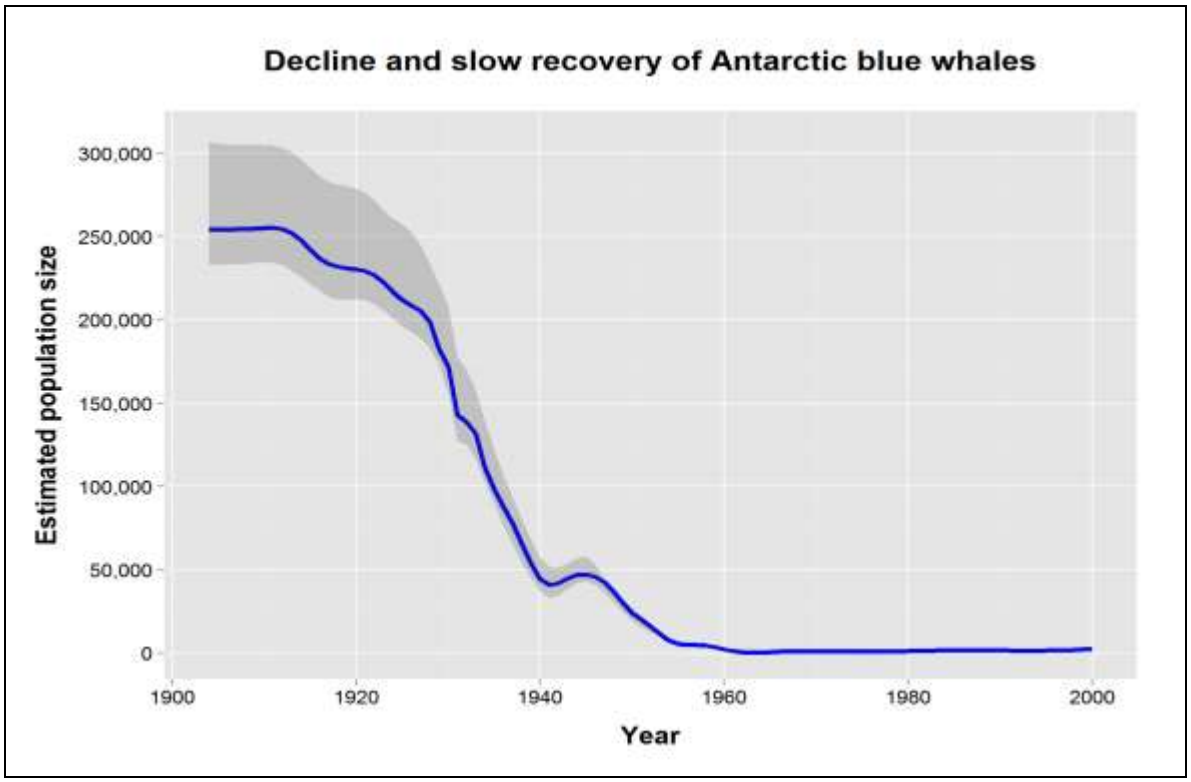

Figure 2. Decline and slow recovery of Antarctic blue whales. Adapted from Branch (2008).

In addition to understanding the conservation status of a critically endangered subspecies, the ABWP objective of estimating the abundance of Antarctic blue whales is important in understanding the ecosystem of the Southern Ocean (Leaper and Miller 2012). In the context of climate change and other anthropogenic effects, environmental changes of relevance include an increase in sea temperature (changing sea ice conditions in the feeding grounds), acidification (effect on survival of krill larvae), ocean noise, shipping and pollution (Tin *et al*. 2009).

3. Scope and objectives

The inception of the Antarctic Blue Whale Project was inspired by the cessation of the systematic circumpolar sightings surveys in 2003/04 and the lack of a new strategy to assess the status and recovery of this severely impacted, rare and iconic species.

The objectives of the ABWP are:

- to identify the most appropriate and efficient method to deliver a new circumpolar abundance estimate;
- to develop and refine methods to improve survey efficiency;
- to deliver a new circumpolar abundance estimate;
- to improve understanding of population structure;
- to improve understanding of linkages between breeding and feeding grounds;
- to characterise the behaviour on the feeding grounds.

The Scientific Committee of the IWC acknowledged that "given the amount of effort, ship time, high risk of poor weather and cost of sighting cruises it is unlikely that the tremendous shipboard effort of IDCR/SOWER will be repeated" (IWC 2012). Hence, there is a critical need for a new, more cost-effective means of estimating the abundance of Antarctic blue whales.

Initial analyses have already gone some way to address the first objective, to generate a new abundance estimate. Kelly *et al.* (2011, 2012) assessed the relative effort required, based on either line-transect (sightings survey) or mark-recapture methods. Mark-recapture relies on the individual identification of whales through genetics (from biopsy samples) or photographs to build individual sightings histories over time. These sightings histories can be used to produce an abundance estimate. Kelly *et al.* (2012) concluded that mark-recapture, assisted by acoustic detection, will be the most efficient method to estimate the circumpolar abundance of Antarctic blue whales.

Efficient mark-recapture relies on maximising the sightings rate and this can be achieved practically in three ways: targeting hotspots, operating within 200 km of the ice edge, and using passive acoustics to locate calling blue whales (Kelly *et al.* 2011). Improving the utility of passive acoustics to locate whales is the focus of the ABWP's second objective (Miller *et al.* 2012). Work directed at addressing this objective has demonstrated that the rate of encounters can be increased using passive acoustics in a study of pygmy blue whales off south eastern Australia (Miller 2012).

To test whether acoustic detection and localisation of Antarctic blue whales can facilitate the collection of an adequate sample of photo-identifications and biopsies to serve as a foundation for a new estimate of Antarctic blue whale abundance (the first three objectives above), the first in a series of voyages was conducted in early 2013. The 65-m *FV Amaltal Explorer* was chartered by the Australian government for a 47-day voyage during January – March, leaving from and returning to Nelson, New Zealand and conducting studies in Antarctic waters between 135° E and 170° W in the Ross Sea area.

During the voyage, disposable directional hydrophones (DIFAR sonobuoys) were able to detect concentrated areas of Antarctic blue whale abundance at distances of hundreds of

kilometres. Following acoustic bearing angles, these concentrations of whales were located and sampled. Photographs of 57 individuals and biopsy samples from 23 individuals were obtained from the *Amaltal Explorer* and an outboard-powered launch. Approximately thirty hours of detailed behavioural data were collected to help link acoustic behaviour to a broader context of Antarctic blue whale behaviour. Rigorous sighting surveys detected 39 sightings of 84 individual Antarctic blue whales in 10 595 km of searching in the survey area (530 sightings of 1 313 all species of cetaceans, including Antarctic blue whales). Two satellite tags were deployed on Antarctic blue whales, the first in history.

The other objectives of the ABWP relate to the population structure of Antarctic blue whales and how they use their environment. Some population structure within Antarctic blue whales has been found but genetic analyses have been limited by the distribution and quantity of samples available (Sremba *et al*. 2012). Where possible, vessels will collect new biopsy samples to improve these analyses. To date, individual movements have been inferred from point data such as the retrieval of a Discovery-tag from a whale, photo identification (Branch *et al*. 2007) and genetic data (Sremba *et al*. 2012). In addition to data that can be used to investigate movement patterns of individuals, photo-identification provides a way to estimate population survival rates.

Satellite telemetry generates more comprehensive information on individual movements, providing multiple fixes on the location of tagged whales. Satellite information on large-scale migrations and fine-scale habitat use within feeding grounds will link migration patterns and foraging behaviour to features of the physical environment (Wade *et al*. 2006, Mate *et al.* 2011). Satellite tags have not yet been deployed on Antarctic blue whales; however as tag design and methods of deploying tags improve and the probability of encountering whales through acoustics increases, this challenge can be overcome. An important outcome for conservation is the potential to identify wintering and breeding areas, to ensure protection for key habitat of Antarctic blue whales.

4. Structure and governance

The Antarctic Blue Whale Project was proposed in 2009 as part of the establishment of the SORP initiative. Since then, provisional analyses have been completed to ensure this is a viable and defendable project, with repeated consultation with the Scientific Committee of the IWC (Kelly *et al*. 2011, 2012; Wadley *et al.* 2012). In 2013, an international Scientific Steering Committee (SSC) was appointed by the SORP and endorsed by the IWC to govern and guide the research. The governance structure for the ABWP project is summarised in Figure 3.

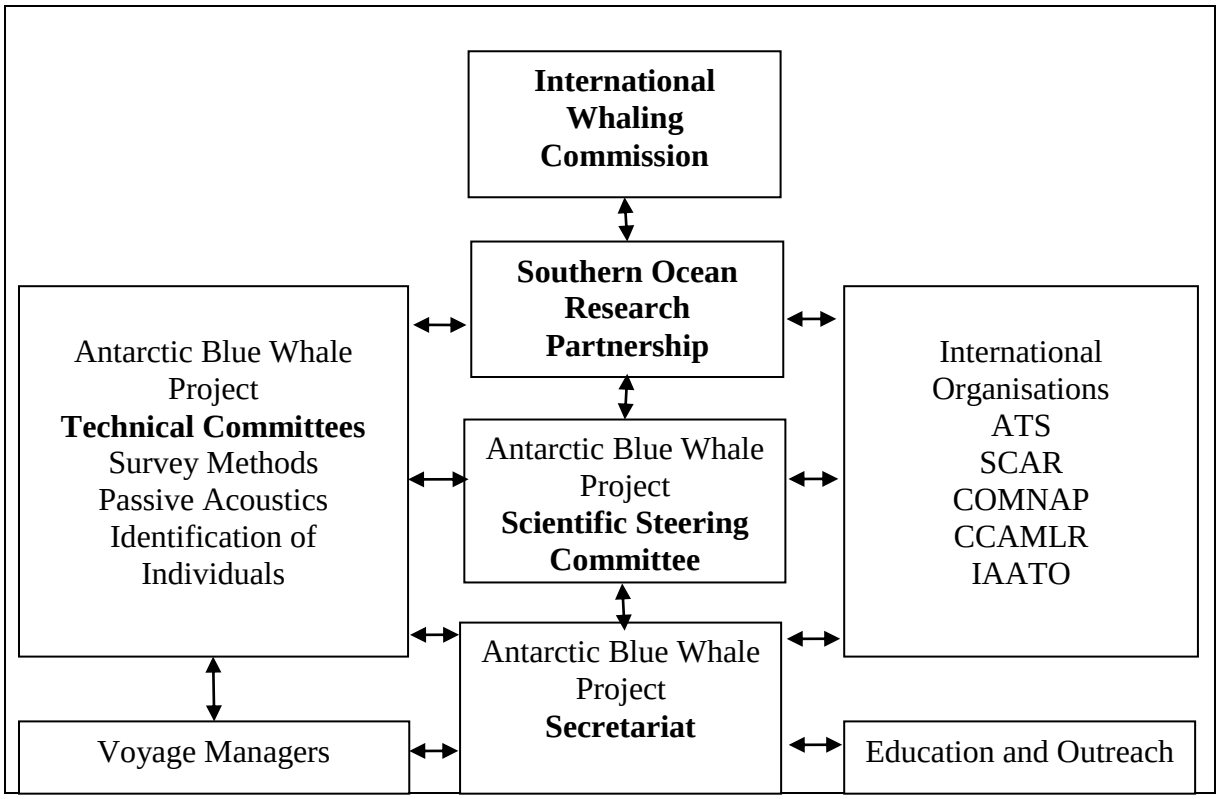

Figure 3. Diagram of the structure of the Antarctic Blue Whale Project.

The Technical Committees will advise on sampling methods, passive acoustics and identification of individual whales. The Convenors of the Technical Committees report to the Scientific Steering Committee and attend its meetings as required. Membership of the Committees reflects the range of scientific disciplines, geographic location and career progression of the participants, with a focus on scientific excellence and standing in the international community. All the Committees are supported by the Project Secretariat, based at the Australian Antarctic Division in Hobart, Tasmania.

5. International organisations and participation

Sufficient survey effort is the key to delivering the objectives of the ABWP and this could be delivered in several forms:

i. Top Option *research icebreaker*

A vessel with capacity for biological and oceanographic studies, undertaking a dedicated voyage as part of an integrated, multidisciplinary marine science mission. The objective would be to characterise the habitat and undertake passive acoustic studies, photo-identification, biopsies and satellite tagging of Antarctic blue whales. Elements of Options ii and iii (below) could be included in this option.

ii. Intermediate Option *vessels with ice-strengthened hulls*

Engaging vessels with capacity for consecutive days at the ice edge, to undertake passive acoustic studies, photo-identification, biopsies and satellite tagging of Antarctic blue whales. The plan could be for opportunistic sea time as part of operational voyages, or in

conjunction with other research studies. Elements of Option iii (below) could be included in this option.

iii. Transit Option *vessels to deploy acoustics moorings*

Collaboration with operational vessels in transit and platforms of opportunity such as tourist ships, for annual deployment and retrieval of acoustics moorings. Likely locations will be determined after discussion with the SSC.

In addition to the excellent work conducted by the circumpolar surveys, a valuable opportunistic contribution would be to access photographs from naval, tourist and fishing vessels (Williams *et al.* 2006). Encounters with blue whales will be so rare that it will not be cost-effective to have trained photographers on board all the time. However, other photographers could follow the guidelines supplied on the IWC Southern Hemisphere Blue Whale Catalogue and at www.marinemammals.gov.au/sorp/sightings Individual whales will be identified from these photos, providing data for mark-recapture analysis and estimation of the abundance of blue whales.

It is crucial therefore that the project engages with organisations that could potentially deliver one of more of these forms of survey effort. By raising the profile of the project at international fora, this cooperation will be pursued. The ABWP plans to engage with international organisations on the basis of cooperative plans to deliver the scientific objectives using robust uniform methodology.

All the countries which participate in the ABWP are represented on the SSC and Technical Committees, providing a wide range of experience and local knowledge. This knowledge covers not only the geographical areas of the Southern Ocean but also the scientific and political expertise required to approach funding bodies and providers of ship time. The funding of research and logistics has a different model in the National Antarctic Program of each country, requiring a tailored approach to coordination. For example, recognising the involvement of naval vessels in the logistics of marine research for many of the countries of South America, a special consortium is addressing this aspect of international participation.

In practical terms, the research will depend on the ship time made available and the geographical area of interest of participating nations; securing ship time on suitable ice-strengthened vessels is a major activity of the project. In addition, fishing vessels, tourist vessels and yachts in the Southern Ocean can provide sampling platforms for the ABWP to achieve the extensive geographic coverage required for a circumpolar estimate of the abundance of Antarctic blue whales.

To ensure consistency in data collected from the various vessels, uniform sampling protocols will be essential. The Technical Committees will develop the protocols as a high priority. In particular, the committee on Sampling Methods is developing strategies for mark-recapture studies, to be purpose-designed for each vessel and its research team.

By nature of the highly-migratory seasonal movement of Antarctic blue whales, research on the species involves many jurisdictions and organisations. The ABWP liaises with many bodies in the international arena which can engage and invest in the project — the most pertinent ones are detailed below.

The IWC is the global intergovernmental body charged with the conservation of whales and the management of whaling. In 1964, the Commission introduced a zero catch limit for blue whales in the Southern Hemisphere and in 1986, for all commercial whaling. A function of the Commission is to promote the recovery of depleted whale populations. The SORP and its ABWP are closely aligned with this function.

The Antarctic Treaty, together with its Protocol on Environmental Protection, emphasizes the importance of scientific cooperation, as discussed annually at the Antarctic Treaty Consultative Meeting. With the expert advice of the Scientific Committee on Antarctic Research (SCAR) and the Council of Managers of National Antarctic Programs (COMNAP), many scientific and operational measures of importance to the Antarctic research programmes are adopted. The network of Antarctic scientists in SCAR provides access to collaborative studies, particularly on the ecosystem aspects of the project and in addressing the current threats to Antarctic blue whales. With SCAR, the Association of Polar Early Career Scientists facilitates liaison with young scientists for capacity building in the ABWP.

COMNAP develops and promotes best practice in managing the support of scientific research in Antarctica. The ABWP is working in cooperation with COMNAP to utilize the vessels around Antarctica to best effect. The International Association of Antarctica Tour Operators (IAATO) promotes environmentally responsible private-sector travel to the Antarctic. The tourist ships and yachts provide valuable platforms for observations of Antarctic blue whales (Williams *et al*. 2006).

The Commission for the Conservation of Antarctic Living Resources (CCAMLR) manages the conservation and sustainable exploitation of marine life in the seas around Antarctica. Adopting an ecosystem-based approach, CCAMLR works in cooperation with the IWC on the management of cetacean stocks and their interactions with other components of the ecosystem. The ABWP will cooperate with CCAMLR to access whale sightings data from observers on krill trawlers and photos of blue whales from fishing vessels.

6. Education and outreach

The iconic status of the Antarctic blue whale provides inspiration, captivating the general public worldwide, including children. The scientific results will appeal primarily to a specialist audience and will be reported as publications in peer-reviewed scientific journals and to the International Whaling Commission. To publicise the results of the ABWP to a wider audience, including the general public, environmental NGOs and policy makers, the findings will be prepared for strategically-targeted publications and general-interest articles. The ABWP Communications Plan will outline the strategy for the project. Each voyage will be reported in real time on the project website.

The project offers capacity-building for researchers, in the form of exciting research and seagoing opportunities for students and early career scientists. A legacy of the ABWP will be the cumulative benefit of long-term data. The current generation of young scientists will be the custodians of the future uptake of these results, bridging the challenging gap between science and policy.

7. Website and documents

Further details are available at:
http://www.marinemammals.gov.au/sorp/projects/antarctic-blue-whale-project
http://www.marinemammals.gov.au/about/research-and-activities/iwc-initiatives/bluewhale-sorp

Documents available online currently include:
http://www.marinemammals.gov.au/sorp/expeditions/antarctic-blue-whale-voyage-2013
http://www.marinemammals.gov.au/sorp/expeditions/aus-nz-antarctic-whale-expedition
http://www.marinemammals.gov.au/sorp/sightings
http://data.marinemammals.gov.au/portal/entry/entry.cfm?type=sorp

These will later be supplemented by:
Uniform sampling protocols
Meeting reports
Data Management
Communications (see also promotion brochures above)
Voyage Schedule

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