SC/66a/SH/26

Photo-identification of Antarctic blue whales during the New Zealand-Australia Antarctic Ecosystems Voyage 2015

Paula A. Olson, Natalie Schmitt, Paul Ensor, Kym Collins, David Donnelly, Russell Leaper, Susannah Calderan, Brian S. Miller, Kim Goetz, Michael C. Double

INTERNATIONAL WHALING COMMISSION

Photo-identification of Antarctic blue whales during the New Zealand-Australia Antarctic Ecosystems Voyage 2015

Paula A. Olson[1], Natalie Schmitt[2], Paul Ensor[2], Kym Collins[2], David Donnelly[2], Russell Leaper[2], Susannah Calderan[2], Brian, S. Miller[2], Kim Goetz[3], Michael C. Double[2]

[1]Marine Mammal and Turtle Division, Southwest Fisheries Science Center NMFS/NOAA, 8901 La Jolla Shores Drive, La Jolla, CA 92037 USA

[2]Australian Marine Mammal Centre, Australian Antarctic Division, 203 Channel Highway, Kingston, Tasmania 7001 Australia

[3]National Institute of Water and Atmospheric Research, 301 Evans Bay Parade, Wellington 6021, New Zealand

Paula.Olson@noaa.gov

ABSTRACT

Forty-six Antarctic blue whales were photo-identified during an interdisciplinary research voyage in the northern Ross Sea region of the Southern Ocean. The majority of blue whales approached for photo-ID were aggregated in two hotspots, which were surveyed during two time periods, 8-14 February and 24 February-2 March 2015. Thirty-six whales were photo-identified in the first hotspot and nine in the second hotspot (including one re-sight from hotspot 1). Two whales were photographed at the Balleny Islands on 6 February. Seven whales were re-sighted during the voyage; the re-sighting rate was 15%, similar to the re-sighting rates from the 2013 Antarctic Blue Whale Voyage and recent IWC/SOWER cruises. Time intervals between re-sights in 2015 ranged from 1 to 20 days and straight-line distances between re-sights ranged from 8km to 268km. Photographs of one whale from the voyage matched to the circumpolar Antarctic Blue Whale Catalogue with a time interval of two years and 103km between sighting locations. The 2015 voyage was conducted as part of the Antarctic Blue Whale Project under the Southern Ocean Research Partnership. The photo-identification data collected during the voyage will contribute towards a new abundance estimate of Antarctic blue whales using mark-recapture methods.

KEYWORDS: ANTARCTIC, BLUE WHALE, PHOTO-ID, MOVEMENTS, MARK-RECAPTURE

INTRODUCTION

In 2015 the Australian Antarctic Division (AAD) conducted blue whale research during the interdisciplinary New Zealand-Australia Antarctic Ecosystems Voyage (see Double *et al*., 2015). The research was carried out as part of the Antarctic Blue Whale Project under the auspices of the Southern Ocean Research Partnership (SORP) (Bell, 2015). The 2015 voyage is one of a series of SORP voyages focused on Antarctic blue whales (*Balaenoptera musculus intermedia*), with goals including the production of a contemporary circumpolar estimate of abundance. Obtaining a current estimate of abundance is considered fundamental for the assessment of the status of the Antarctic blue whale population and in monitoring its recovery.

One of the research objectives of the voyage was to collect identification photos of Antarctic blue whales at a number sufficient for estimating abundance using mark-recapture methods. Key methodology for the voyage was the use of passive acoustics to track and target vocalising Antarctic blue whales in order to maximize the number of individual blue whales photographed (Double *et al*., 2015; Miller *et al*. 2015). The photo-ID data will also provide information on blue whale population structure and movement. Photo-identification of Antarctic blue whales was undertaken previously during the 2013 Antarctic Blue Whale Voyage and during IWC IDCR/SOWER surveys. Photographs from these cruises, and from those collected from other sources, are compiled in the Antarctic Blue Whale Catalogue (Olson, 2012; Olson *et al*., 2013; Olson *et al*., 2014). Prior to the 2015 voyage, the catalogue contained 354 identified individuals, representing 15% of the most recent population estimate of 2,280 (Branch, 2007). New identification photographs collected during the New Zealand-Australia Antarctic Ecosystems Voyage will expand upon that work.

METHODS

The voyage was conducted from 29 January to 11 March 2015 (42 days) aboard the New Zealand National Institute of Water and Atmospheric Research (NIWA) vessel *RV Tangaroa*. During the interdisciplinary voyage

13.5 days were spent conducting research on Antarctic blue whales. Passive acoustics were used to locate and direct the ship to vocalising Antarctic blue whales (Double *et al*., 2015; Miller *et al*., 2015). When acoustically targeted blue whales were detected visually they were approached for photo-ID, weather permitting. One member of the research team would guide the ship (specific directions called to the bridge personnel) for the best approach to the whale(s). Both sides of each whale were photographed whenever possible. In good weather a focal follow of whale(s) was often conducted for an hour prior to a close approach for photo-ID. Biopsy was conducted at the same time as photography: typically two photographers and two biopsiers worked from the bow of the *Tangaroa*. In rough weather photography only was attempted. DSLR cameras with image-stabilized zoom lenses were used.

Photographs of blue whales were judged to meet minimum criteria of quality based on distance to the subject (whale), focus, angle and lighting. Photographs meeting these criteria were considered suitable for identifying individual blue whales and were analysed for this report. Note that a more rigorous quality coding of photographs based on a 4-tiered system is currently underway and may slightly alter results presented in the future.

Identification photographs from the voyage were compared within season and to the Antarctic Blue Whale Catalogue, which contains photographs from the circumpolar Antarctic 1991-2013. Methods used followed those outlined in Sears *et al*. (1990) and Gendron and Ugalde de la Cruz (2012).

RESULTS

The first two identification photographs of Antarctic blue whales were collected at the Balleny Islands (67°S 164°E) on 6 February, opportunistically during a non-blue whale research phase of the interdisciplinary voyage. The majority of the identification photographs were obtained during two time periods dedicated to blue whale research during the voyage: 8-14 February (7 days) and 24 February-2 March (6.5 days). During those two time periods, two "hotspots" of blue whales, at the pack ice edge, were worked for photo-ID (coincident with other sampling methods, see Double *et al*. 2015). The first aggregation of blue whales (hotspot 1) was estimated at approximately 80 individuals – the aggregation remained relatively cohesive through the 7-day research period, slowly moving to the southeast. The second aggregation (hotspot 2) was located further southeast than the previous aggregation. Triangulation to recorded blue whale vocalisations (Miller *et al.* 2015) during each of these two study periods suggest that the aggregation of whales had moved southeast from hotspot 1 to hotspot 2 in the intervening period. Opportunities for photo-ID were more limited for hotspot 2 due to poor weather and because many of the whales were far enough in the ice pack as to be unapproachable by the ship.

In all, twenty-one groups of an estimated 80 Antarctic blue whales were approached for photo-ID; 58 of these whales were photographed. Post-voyage analysis of the photos identified 46 individual whales (36 left sides, 37 right sides). The other 12 identification photos (out of 58) were either of whales recognized as within-day re-sights or the photos were poor quality due to weather - whales obscured by snow or sea state preventing a sufficiently close approach by the ship. Thirty-six whales were photo-identified at hotspot 1, nine whales were photo-identified at hotspot 2, and two whales photo-identified at the Balleny Islands (Figure 1).

Re-sights within 2015 season

Seven Antarctic blue whales were re-sighted within the voyage with a time interval ≥1 calendar day. Time intervals between re-sights ranged from 1 to 20 days (Table 1). Six of the whales were re-sighted within the hotspot 1 aggregation, with one whale (#1503) re-sighted twice. No whales were re-sighted within hotspot 2. Only one whale (#1505) was re-sighted between the two hotspots. Straight-line distances between re-sights ranged from 8km to 268km. Re-sighted after 20 days, whale #1505 had moved ESE with minimum daily movement of 13.4km/day.

Table 1. Sighting histories for seven Antarctic blue whales photographed during 2015. Distances were calculated using rhumb lines on a Mercator projection.

Whale ID	Date first sighting	Date re-sighting	Date re-sighting	Time interval between re-sights (days)	Distance between re-sights (km)
#1503	09 Feb	10 Feb	12 Feb	1 & 2	45 & 107
#1504	09 Feb	12 Feb	-	3	138
#1505	09 Feb	01 Mar	-	20	268
#1508	11 Feb	14 Feb	-	3	39
#1513	12 Feb	14 Feb	-	2	25
#1516	12 Feb	14 Feb	-	2	8
#1517	12 Feb	14 Feb	-	2	3

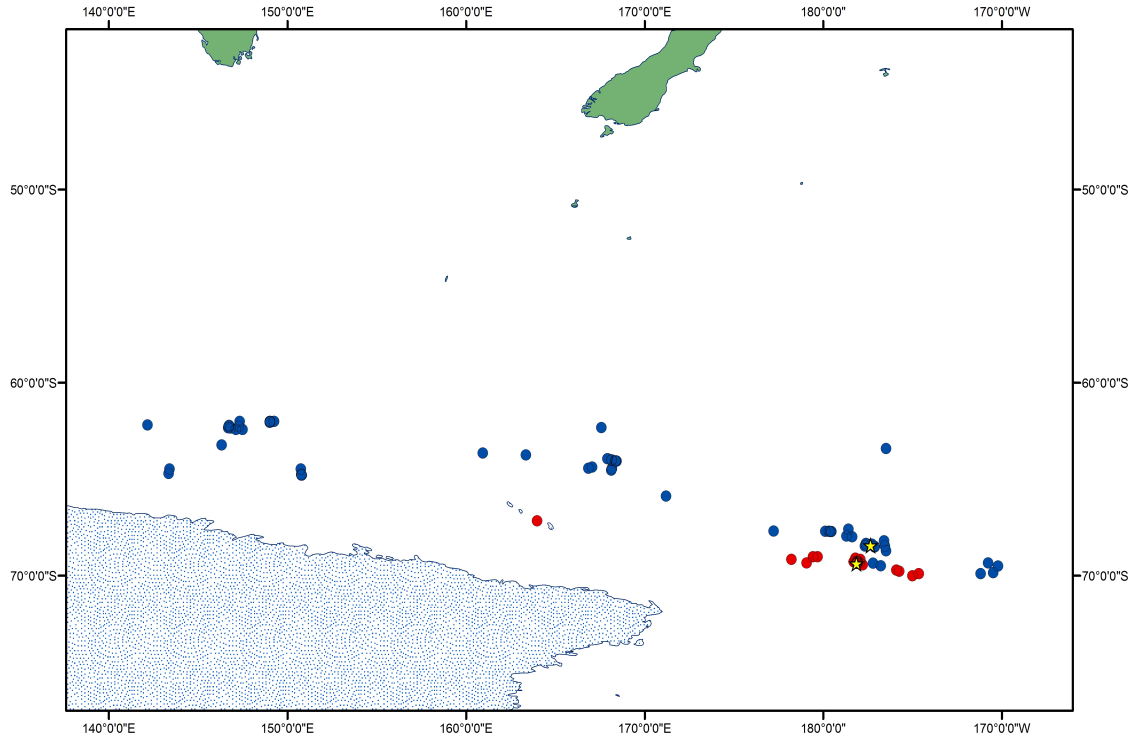

Figure 1. Locations of 46 photo-identified whales in 2015 (red dots) and 50 photo-identified whales in 2013 (blue dots). Two yellow stars indicate the locations of whale #1505, photographed in both years.

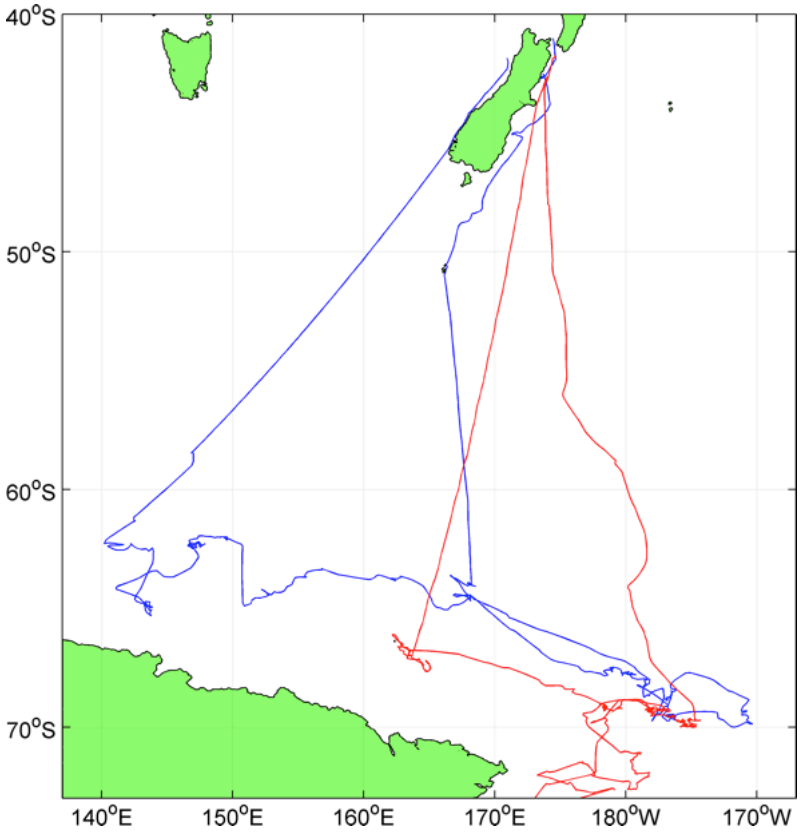

Figure 2. Ship tracks of the 2015 (red) and 2013 (blue) voyages.

Re-sights between years

Photographs of one Antarctic blue whale from 2015 matched with a previously identified whale in the Antarctic Blue Whale Catalogue. Whale #1343 was first photographed 26 February 2013 during the Antarctic Blue Whale Voyage (Double *et al*. 2013), and on 14 February in 2015. The straight-line distance between the two sighting locations is 103km (Figure 1). The research areas of the 2015 and 2013 voyages overlapped spatially (Figure 2).

New Zealand blue whale(s)

One blue whale was photographed in New Zealand waters, on 10 March during the return transit to Wellington from the Antarctic. Identification photos of this whale (left and right sides) were compared to the identification photos of 36 other New Zealand blue whales (from Olson *et al*., in press; Olive Andrews, unpub. data), but no matches were found.

DISCUSSION

The use of passive acoustics to track and target Antarctic blue whales was highly beneficial in obtaining photo-ID images, similar to the success of this method during the 2013 voyage. Our research also benefited from excellent weather and favourable sea ice conditions during the initial seven days allocated to blue whales. Focal follows conducted prior to photo-ID had no noticeable effect on the success of photo-ID operations. These factors enabled the collection of 46 photo-identifications in only 13.5 days. This is a substantial number of ID's given that blue whales are otherwise infrequently encountered in the Southern Ocean (Branch *et al.*, 2007).

The addition of 45 new individuals brings the total number of photo-identified Antarctic blue whales up to 399 individuals. These data are providing the foundation for a contemporary estimate of abundance for Antarctic blue whales using capture-recapture methods.

Prior to this voyage a total of 95 blue whales had been photo-identified from IWC Management Area V; the addition of 45 new ID's brings the total number of whales identified in this Area to 140. Area III is the only IWC

Area with more identifications, with a current total of 166. These sample sizes are approaching levels useful for conducting Area-specific estimates of abundance for these two Management Areas.

The within-season re-sighting rate of 15% for this voyage (7/46) is similar to the within-season re-sighting rates of Antarctic blue whales from the 2013 voyage (16%) and recent IWC/SOWER cruises (11-22%) (Olson, 2010; Olson *et al*., 2013). However, the re-sighting rate from the 2015 voyage may not be directly comparable to those from other years. In 2015 the strategy was for the vessel to remain with the aggregations of whales in each of the hotspots, while in other years the ship continued to move between small aggregations (2013) (Figure 2), or continued along visual line transect survey tracklines (2006, 2007, 2009). The locations of photo-identified whales in 2015 (research area 178°E-175°W) were more concentrated than in 2013 (research area 135°E-170°W) (Figure 1).

The movement of blue whales within the Southern Ocean is not well understood on any scale. Previous matches of individual Antarctic blue whales between summer seasons show a wide variation in the distances between re-sightings (Branch *et al*., 2007; Olson *et al.* 2013, Olson *et al.* 2014) – from just a few kilometers, such as the re-sight from this year, to over 6,000km. The continued collection and analysis of photographs from the Antarctic, along with other research methods, will yield more information on these patterns and contribute to the understanding of blue whale population structure in the Southern Hemisphere. The wide-ranging, ocean basin scale of movements exhibited by individual Antarctic blue whales reinforces the need for international cooperation in the management and conservation of this endangered population.

Future work

The Antarctic blue whale photo-ID data from this voyage will be utilized for capture-recapture analysis to estimate abundance per Kelly *et al*. (2012). Identification photographs will be uploaded into the internationally collaborative Southern Hemisphere Blue Whale Catalogue (IWC, 2008) for comparisons with other regional photo-ID catalogues, exploring potential exchange of individuals between geographic areas and yielding information on population structure.

ACKNOWLEDGEMENTS

Many people contributed to the success of this project, including the scientists and support staff at the Australian Marine Mammal Centre, the Australian Antarctic Division (AAD), and New Zealand's National Institute of Water & Atmospheric Research (NIWA). The International Whaling Commission Scientific Committee and the Southern Ocean Research Partnership provided essential guidance and planning. Special thanks to Elanor Bell, Elanor Miller, and Virginia Andrews-Goff. We thank the capable and talented officers and crew of the *RV Tangaroa*. A hearty thank you to Richard O'Driscoll and our fellow voyage scientists from NIWA. The voyage was funded by NIWA, Antarctica New Zealand, New Zealand Ministry for Business, Innovation and Employment, and the AAD. The US National Oceanic and Atmospheric Administration (NOAA) funded the participation of PAO during the voyage.

REFERENCES

Bell, E. 2015. Annual Report of the Southern Ocean Research Partnership (IWC-SORP) 2014/15. Paper submitted for consideration by the IWC Scientific Committee. SC/66a/SH.

Branch, T.A. 2007. Abundance of Antarctic blue whales south of 60°S from three complete circumpolar sets of surveys. *J. Cetacean Res. Manage*. 9(3): 253-262.

Branch, T.A., Stafford, K.M., Palacios, D.M., Allison, C., Bannister, J.L., Burton, C.L.K., Cabrera, E., Carlson, C.A., Galletti Vernazzani, B., Gill, P.C., Hucke-Gaete, R., Jenner, K.C.S., Jenner, M.N.M., Matsuoka, K., Mikhalev, Y.A., Miyashita, T., Morrice, M.G., Nishiwaki, S., Sturrock, V.J., Tormosov, D., Anderson, R.C., Baker, A.N., Best, P.B., Borsa, P., Brownell Jr., R.L., Childerhouse, S., Findlay, K.P., Gerrodette, T., Ilangakoon, A.D., Joergensen, M., Kahn, B., Ljungblad, D.K., Maughan, B., McCauley, R.D., McKay, S., Norris, T.F., Rankin, S. 2007. Past and present distribution, densities and movements of blue whales *Balaenoptera musculus* in the Southern Hemisphere and northern Indian Ocean. *Mammal Rev*. 37: 116-175.

Double, M.C., Miller, B.S., Leaper, R., Olson, P., Cox, M.J., Miller, E., Calderan, S., Collins, K., Donnelly, D., Ensor, P., Goetz, K., Schmitt, N., Andrews-Goff, V., Bell, E., O'Driscoll, R. 2015. Cruise report on blue whale research from the NZ/Aus Antarctic Ecosystems Voyage 2015 of the Southern Ocean Research Partnership. Paper submitted for consideration by the IWC Scientific Committee. SC/66a/SH.

Gendron, D. and A. Ugalde de la Cruz. 2012. A new classifcation method to simplify blue whale photo-identification technique. *J. Cetacean Res. Manage.* 12:79-84.

International Whaling Commission. 2008. Report of the Scientific Committee. Annex H Other Southern Hemisphere Whale Stocks. IWC SC/60.

Kelly, N., Miller, B., Peel, D., Double, M.C., de la Mare, W. and Gales, N. 2012. Strategies to obtain a new circumpolar abundance estimate for Antarctic Blue Whales: survey design and sampling protocols. IWC SC/64/SH10.

Miller, B.S., Barlow, J., Calderan, S., Collins, K., Leaper, R., Kelly, N., Peel, D., Olson, P., Ensor, P., and Double, M.C. 2015. Long-range acoustic tracking of Antarctic blue whales. *Endangered Species Research* 26: 257-269.

Olson, P.A. 2010. Blue whale photo-identification from IWC IDCR/SOWER cruises 1987/1988 to 2008/2009. IWC SC/62/SH29.

Olson, P.A. 2012. Antarctic blue whale photo-identification catalogue summary. IWC SC/64/SH8.

Olson, P.A., Ensor, P., Schmitt, N., Olavarria, C., and Double, M.C. 2013. Photo-identification of Antarctic blue whales during the SORP Antarctic Blue Whale Voyage 2013. IWC SC/65a/SH11.

Olson, P.A., Ensor, P., Olavarria, C., Bott, N., Constantine, R., Weir, J., Childerhouse, S., van der Linde, M., Schmitt, N., Miller, B.S., and Double, M.C. *In press*. New Zealand blue whales: residency, morphology, and feeding behavior of a little-known population. *Pacific Science*.

Olson, P.A., Matsuoka, K., and Pastene, L.A. 2014. Comparison of Antarctic blue whale photographs from JARPA II to the Antarctic Blue Whale Catalogue. IWC SC/65b/SH20.

Sears, R.J., Williamson, M.J., Wenzel, F.W., Bérubé, M., Gendron, D. and Jones, P. 1990. Photographic identification of the Blue Whale (*Balaenoptera musculus*) in the Gulf of St. Lawrence, Canada. *Rep. Int. Whal. Commn*., Special Issue 12, pp. 335-342.