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# Photo-identification of Antarctic blue whales 1991 to 2016

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## ABSTRACT

Identification photographs of individual Antarctic blue whales were collected from multiple sources, 1991-2016, and compiled into the Antarctic Blue Whale Catalogue. Sources include the IWC IDCR/SOWER cruises, IWC-SORP voyages, the Institute of Cetacean Research, and naturalists and collegial scientists working in the Antarctic region. This year, seventeen new individual Antarctic blue whales were identified from 260 photographs collected opportunistically in the years 2005-2016. That brings the total number of identified whales to 416, represented by 315 left sides and 306 right sides. This is 14-18% of the most recent accepted estimate of abundance of 2,280 in 1997/1998 (CV=0.36; Branch, 2007). There are fifteen inter-annual re-sights of fourteen whales, with sighting intervals of 1-12 years, and distances ranging from 19 to 6,650km between sighting locations. The distance of 6,650km over a six-year period is the longest movement of an Antarctic blue whale recorded to date. Within-season sighting rates from five survey years ranged from 7-22%. Both inter-annual and within-season re-sightings reflected small and large scale movements. It is recommended that the collection of Antarctic blue whale identification photographs be continued as they provide data for capture-recapture estimates of abundance as well as information on the movement of individual blue whales within the Antarctic region.

KEYWORDS: ANTARCTIC, SOUTHERN OCEAN, PHOTO-ID, MOVEMENT

## INTRODUCTION

The population status of the endangered Antarctic blue whale (*Balaenoptera musculus intermedia*) is a subject of interest of the IWC Scientific Committee, which initiated an in-depth assessment of Southern Hemisphere blue whales in 2006 (IWC, 2006). In support of the assessment, in 2007 the archiving and analysis of blue whale identification photographs collected during IWC IDCR/SOWER<sup>1</sup> research cruises was undertaken. Photographs collected during 20 years of circumpolar IWC IDCR/SOWER cruises became the foundation of the Antarctic Blue Whale Catalogue (Olson, 2010).

The photo-identification data from this catalogue have produced information on inter-annual whale movement (Olson, 2012; Olson *et al.* 2013a), within season sighting rates (Olson *et al.*, 2015), and a pilot capture-recapture study (Olson and Kinzey, in press).

The status of blue whales in the Antarctic is also of concern to IWC-SORP<sup>2</sup>, which in 2009 established the Antarctic Blue Whale Project (Bell, 2012). The use of photo-identification data in a capture-recapture analysis for the production of a contemporary (new) estimate of abundance of Antarctic blue whales is a key component of the Antarctic Blue Whale Project (Bell, 2012).

Since the establishment of the Antarctic Blue Whale Catalogue in 2007, the number of photo-identified Antarctic blue whales has increased, with photographs collected during voyages conducted under IWC-SORP in 2013 and 2015 (Double *et al.*, 2013; Double *et al.*, 2015), with photographs from the Institute of Cetacean Research (ICR), Japan (Matsuoka and Pastene, 2009; Olson *et al.*, 2013b, Olson *et al.*, 2014), and with opportunistic photographs contributed by scientists working on other projects in the Antarctic. By June 2015 the total number of photo-identified Antarctic blue whales from all of these sources totalled 399 (Olson *et al.*, 2015).

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<sup>1</sup> International Decade of Cetacean Research/Southern Ocean Whale and Ecosystem Research

<sup>2</sup> Southern Ocean Research Partnership

In recent months, photographs of blue whales collected opportunistically by naturalists and scientists working in the Antarctic region were forwarded to the first author. This paper presents the results of the comparison of the new photographs to the existing catalogue (of 399 individuals) and summarizes all findings 1991-2016.

## METHODS

An assortment of 260 Antarctic blue whale photographs were collected opportunistically by naturalists aboard tour vessels and by scientists conducting other (non-blue whale) research in east Antarctica, the Ross Sea, the Drake Passage, South Georgia Island and the Sandwich Islands during the years 2005-2016 (Table 1). Photographs were judged to meet minimum criteria of quality based on distance to the subject (whale), angle, exposure, and focus. Only photos containing a whale's dorsal fin were used for identification, as the fin is necessary for comparison to the identification photos in the Antarctic catalogue as well as other photo collections. Whales were examined for unique natural markings and identified as individuals following methods outlined in Sears *et al.* (1990) and Gendron and Ugalde de la Cruz (2012).

Photographs of identified individuals from this assortment of photographs were compared to one another and to the Antarctic Blue Whale Catalogue.

Note that more rigorous quality coding of photographs based on a 4-tiered system is currently underway and may slightly alter results presented in the future.

Table 1. Photographs of Antarctic blue whales collected opportunistically, 2005-2016.

Date	Location	IWC Area	No. of photographs submitted	No. left side ID's	No. right side ID's	Total no. identified blue whales	Contributors
06 Mar 2005	So. Orkney Is.	II	15	2	0	2	Imberti
Feb 2008	Ross Sea	V	05	0	1	1	Steele
19 Dec 2010	Commonwealth Bay	V	12	1	1	1	Ovsyanikova
17 Jan 2013	East Antarctica	V	07	1	0	1	Ovsyanikova
29 Dec 2014	Drake Passage	I	28	0	2	2	Carr
06 Feb 2015	South Georgia	II	32	4	4	4	Greenfelder, Imberti
28 Feb 2015	South Georgia	II	116	4	0	4	Ballance/Pitman, Lamb
17 Dec 2015	Drake Passage	I	09	0	1	1	Brehm
26 Feb 2016	So. Sandwich Is.	II	36	0	1	1	Brehm, Engelke

## RESULTS AND DISCUSSION

Seventeen new individual whales were identified from the 260 opportunistic photographs (Table 1). No photographic matches were found. The addition of 17 new photo-identified Antarctic blue whales brings the total number of identified whales in the Antarctic to 416, represented by 315 left sides and 306 right sides. The minimum (315) and maximum (416) number of unique individuals represents 14% and 18%, respectively, of the most recent accepted estimate of abundance of Antarctic blue whales, 2,280 in 1997/1998 (Branch, 2007). Whales were photo-identified in the circumpolar Antarctic region in all six IWC Management Areas, 1991-2016.

### Re-sights and movements

A relatively small proportion of individual blue whales were re-sighted inter-annually: 3% (14/416).

Fourteen whales have been re-sighted between years including one whale (#0623) that was sighted in three subsequent years (Table 2). The time intervals ranged between 1 and 12 years. Five whales were re-sighted within 19–753km of their original location and four whales were re-sighted long distances, over 2,000km from their original sighting. Whale #0758 exhibits the greatest distance between sighting locations with a distance of 6,650km; this is the longest movement recorded for an Antarctic blue whale to date.

Table 2. Sighting histories of Antarctic blue whales re-sighted between years. Distances were calculated using rhumb lines on a Mercator projection measured between points.

Whale ID	Capture Date/Area	Recapture Date/Area	Time interval (years)	Distance (km)
#0761	Jan 2005/III	Feb 2007/III	2	19
#1343	Feb 2013/V	Feb 2015/V	2	103
#0623	2005/III	2006/III	1	302
#0623 <sup>1</sup>	2006/III	2007/III	1	355
#0622	2006/III	2007/III	1	447
#0104	2001/VI	2004/V	3	753
#0607	2006/III	Dec 2007/III	2	1,560
#1005	2010/V	2013/V	3	1,796
#0802	2008/IV	2013/V	5	1,848
#0772	1995/III	2007/III	12	2,222
#1322 <sup>2</sup>	Feb 2006/IV	Feb 2013/V	7	2,543
#0738	2007/III	2010/II	3	2,818
#1313	Feb 2006/IV	Feb 2013/V	7	3,433
#0617 <sup>1</sup>	2002/V	2006/III	4	5,677
#0758	2007/III	2013/V	6	6,650

<sup>1</sup> Genetic recapture reported in Sremba *et al.* (2012), Table 3.

<sup>2</sup> Whale #1322 satellite tagged in 2013.

Generally it is not known if Antarctic blue whales show site tenacity for feeding areas or if they forage widely and randomly. The small sample size of re-sights here does not shed light on a specific pattern as both small and large inter-annual movements are represented, and occurred during varying oceanographic conditions. An interesting sighting history is that of whale #0623, which was sighted three years in a row, within 400km of its initial detection, seemingly to indicate fidelity for that region in Area III. Whale #0761 was re-sighted only 19km from its first detection two years earlier, also in Area III. That contrasts with the sighting history of whale #1322 which was first sighted in Area IV in February 2006, then re-sighted over 2,500km to the east in Area V in February 2013. This whale was also satellite tagged in February 2013 and tracked for 74 days as it moved 5300km westward (Andrews-Goff *et al.*, 2013), passing the location where it was initially sighted in 2006. Results of the Discovery tag data show similar small and large inter-annual movement patterns (Branch *et al.*, 2007).

The within-season movements of Antarctic blue whales also varied between smaller and larger scale movements. The minimum daily movement ranged of Antarctic blue whales ranged between 1.5 and 162km/day (Table 3). This is generally consistent with foraging and transiting behaviors as observed by blue whales in the North Pacific (Mate *et al.*, 1999; Bailey *et al.*, 2009). The two satellite tagged whales from 2013 also exhibited these behaviors (Andrews-Goff *et al.*, 2013). In 2013 three whales moved over 1,000km during the course of 2-4 weeks (Olson *et*

*al.*, 2013a). Yet many whales re-sighted within season do not move far from their initial sighting location, even after 1-3 weeks. Movement within a season is likely related to prey availability/density that particular summer.

Table 3. Sighting histories of Antarctic blue whales re-sighted within a season. Distances represent a minimum straight-line distance between points.

Year	Area	Survey	Percentage of re-sighted whales	Time between re-sights (days)	Distance between re-sights (km)	Average minimum distance (km/day)
2005-2006	III	SOWER	5/45 <b>11%</b>	4 - 15	108 - 248	10 - 46
2005-2006	III/IV	ICR	1/15 <b>7%</b>	20	619	31
2006-2007	III	SOWER	14/80 <b>18%</b>	1 - 8	32 - 250	31 - 162
2008-2009	IV	SOWER	2/9 <b>22%</b>	2 - 4	99 - 176	25 - 88
2013	V	SORP	8/50 <b>16%</b>	1 - 27	15 - 1,172	15 - 93
2015	V	SORP	7/46 <b>15%</b>	1 - 20	3 - 268	1.5 - 53

### Opportunistic photos

The 17 new identifications provide a considerable contribution to the Antarctic Blue Whale Catalogue. In addition to the sizable number of new identifications (relative to the total number in the catalogue), 14 of the identifications came from Areas underrepresented in the catalogue, Areas I and II. In recent summer seasons, there are anecdotal reports that blue whales are occurring more frequently now at South Georgia and in the Drake Passage. It is hoped this will provide the opportunity for identification photographs to be collected opportunistically in the future from these areas. Previously, opportunistically collected photographs have yielded valuable data on recaptured whales. Two of the total 15 inter-annual recaptures include whales photographed opportunistically: whales #0738 and #1005 (Table 2).

The caveat with opportunistic photos is quality. Often it is the case that the vessel of opportunity is unable to follow blue whales and the photographs are obtained at a distance too far to determine detail needed for individual identification. Yet all opportunistic photographers are encouraged to obtain photographs regardless. The photographs of highly distinctive individuals, even taken at a distance, can be useful (if later matched) for information on movement even if the photo would be excluded from capture-recapture analysis. Distant photographs can also be useful in documenting general body condition and occasionally, behavior.

### Conclusion

A cornerstone of the Antarctic Blue Whale Project is to generate new estimates of abundance using photo-ID data for capture-recapture analysis (Bell, 2015; Peel *et al.*, 2015). The most recent accepted estimate of abundance (Branch, 2007) is based on line-transect data now over 18 years old. The continued collection of identification photographs from the Antarctic will provide data toward a set eventually large enough to obtain new estimates of abundance. This subpopulation of blue whales remains on the IUCN Red List as Critically Endangered.

More data are needed to fully understand the movements of Antarctic blue whales between and within seasons, especially with the major climate changes taking place in the Antarctic. The continued collection and analysis of photographs from the Antarctic, along with other research methods, will yield more information on these patterns and will contribute to the understanding of blue whale population structure in the Southern Hemisphere.

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