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## Progress on Southern Hemisphere Blue Whale Catalogue

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### INTRODUCTION

Two subspecies of blue whales currently are accepted in the Southern Hemisphere: the pygmy blue whale (*B.m. brevicauda*) in the Subantarctic zone; and the Antarctic or true blue whale (*B. m. intermedia*) that summers in the Antarctic Zone (Rice, 1998). Recently, Branch *et al.* (2007a) proposed that blue whales off Chile belong to a unique population and are likely an unnamed subspecies and this has been accepted by the Taxonomy Committee of the Society of Marine Mammalogy.

Outside Antarctic waters, aggregation areas used by blue whales in the Southern Hemisphere are poorly known (Branch *et al.*, 2007b) but a few specific feeding areas have been documented off Australia and Chile (Gill, 2002; Huckle-Gaete *et al.*, 2004; Cabrera *et al.*, 2005; Galletti Vernazzani *et al.*, 2012).

In 2006 the Scientific Committee of the International Whaling Commission (IWC) agreed to initiate an in-depth assessment of Southern Hemisphere blue whales (IWC, 2006) and in 2008, the Committee endorsed a proposal to establish a central web-based catalogue of blue whale identification photographs, known as the Southern Hemisphere Blue Whale Catalogue (SHBWC) (IWC, 2008).

Currently the SHBWC holds photo-identification catalogues of researchers from major areas off Antarctica, Australia, Eastern South Pacific and the Eastern Tropical Pacific (IWC, 2011). Comparisons between catalogues off Chile found one match over ten years (Galletti Vernazzani and Cabrera, 2011). Progress on comparisons between the eastern South Pacific Ocean, Eastern Tropical Pacific Ocean (ETP) and Southern Ocean have been reported at the last IWC Scientific Committee meeting with no matches found to date (Galletti Vernazzani and Olson, 2012)

Here we present results of 2012-2013 comparisons of photo-identification catalogues of blue whales between the eastern South Pacific Ocean, ETP and Southern Ocean and a review of SHBWC contributions.

### METHODS

Individual blue whales are identifiable from unique patterns of mottling on both sides of the body near the dorsal fin (Sears *et al.*, 1990) and in some cases, permanent scars can be used to identify or confirm individuals.

The catalogue is a specially designed web-based platform that allows for online simultaneous upload and comparisons of catalogues from different areas (IWC, 2011).

Catalogues currently maintained at the SHBWC include waters off Antarctica, Chile, Peru, Ecuador-Galapagos, Eastern Tropical Pacific, southeastern Australia, western Australia, Timor Leste and Sri Lanka. To date, seven groups are in the process of or have finished uploading their catalogues. Catalogues from South America, ETP and Antarctica have been fully uploaded. The Indonesia/Australia/New Zealand area is in the process of uploading catalogues.

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The Antarctic sub-catalogue uploaded to the SHBWC includes photographs of 208 individual blue whales meeting quality criteria collected during IWC IDCR/SOWER surveys from 1987-1988 to 2008-2009 and covers all six IWC Management Areas (Olson, 2012).

The eastern South Pacific Ocean sub-catalogue includes photographs of a total of 418 individuals including those photographed during the 1997/98 IWC/SOWER survey off Chile (Findlay *et al.*, 1998; Galletti Vernazzani and Cabrera, 2011) and the catalogue of Centro de Conservacion Cetacea of whales photographed off southern Chile between 2004 and 2009 (Galletti Vernazzani *et al.*, 2010).

The ETP sub-catalogue includes photographs of 84 individuals contributed by the SWFSC/NOAA collected during various years from 1992 to 2009. Of these, 11 whales were photographed near the Galapagos Islands, 23 in the oceanographic cold equatorial tongue that extends westward from the Galapagos, 18 in Peruvian waters, and 32 at the Costa Rica Dome (Gerrodette and Olson, unpublished data; see Fig. 7 Branch *et al.* 2007b).

The Indonesia/Australian/New Zealand sub-catalogue includes photographs of 174 individuals contributed by Blue Whale Study Inc. (BWS) from Bonney Upwelling, Western Whale Research (WWR) from Geographe Bay & Timor Leste and Center for Whale Research Western Australia (CWR) from Perth Canyon.

Individual photographs are compared separately by left and right side as not all individuals have been photographed on both sides.

## RESULTS

A total of 884 blue whales are catalogued, including, 649 photo-identified from the right side, 654 from the left and 23 from flukes (Table 1).

REGION	Group	Quantity			Area
		Fluke	Left Side	Right Side	
South America	IWC SOWER CHILE	0	14	9	Chile
	CCC	0	288	299	Chile
	<b>Subtotal</b>	<b>0</b>	<b>302</b>	<b>308</b>	
ETP	NOAA	0	<b>60</b>	<b>53</b>	Peru, Ecuador, ETP
Indonesia-Australian-NewZealand	BWS	23	84	86	Southeastern Australia
	WWR	0	30	23	Timor Leste - Australia
	CWR	0	20	22	Western Australia
	<b>Subtotal</b>	<b>23</b>	<b>134</b>	<b>131</b>	
Southern Ocean	IWC SOWER	<b>0</b>	<b>158</b>	<b>157</b>	Antarctica
	<b>TOTAL</b>	<b>23</b>	<b>654</b>	<b>649</b>	

**Table 1 – Summary of photographic collection of blue whale catalogues under the SHBWC**

Comparisons between the eastern South Pacific and ETP have been completed and no matches have been found. Comparisons between ETP and the Southern Ocean, as well as those from eastern South Pacific and

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the Southern Ocean are approximately 50% complete (all left side photographs of individual blue whales have been finalized; right side comparisons still are underway) and no matches have been found.

Matching for the Indonesia/Australia/NewZealand area will begin once the uploading process is complete.

## DISCUSSION

Although no re-sightings have been found between eastern South Pacific Ocean, ETP and Southern Ocean under the SHBWC, re-sightings within regions previously have been reported. Galletti Vernazzani *et al.* (2012) reported high annual return rates at northwestern Isla Grande de Chiloe, Chile of about 31% between 2004 and 2010, including 16 whales that have been seen in three or four different years. In addition, despite the small sample size from the 1997/98 IWC survey cruise off Chile, the first long-term resighting of blue whales off Chile was found (IWC-SOWER, January 1998 and CCC, March 2008), both sightings occurring in southern Chilean waters approximately 220 km apart (Galletti Vernazzani and Cabrera, 2011). Olson (2012) reported that seven whales from the Southern Ocean were re-sighted in multiple years; four of the whales were re-sighted within 19 to 753 km of their original location and one whale had a 12-year sighting interval. However, none of the 84 whales photographed off ETP have been re-sighted within or outside of the ETP. In Perth Canyon, off Western Australia, twenty-three individuals of the 208 catalogued from 2000 to 2005, were resighted between years and only two whales were resighted in three or more of the six years (Jenner *et al.*, 2008).

Branch *et al.* (2007a) reported that total length measurements of adult female blue whales caught off Chile are between the total lengths of the two subspecies recognized in the Southern Hemisphere and represent a unique population or even a different subspecies. In addition, LeDuc *et al.* (2007) analysed genetic samples from southwestern Australia, the southeastern Pacific (Chile), and the Antarctic and found that the genetic differentiation between Antarctic blue whales and either of the pygmy blue whale populations were as different from each other as were the differences between the Australian and Chilean blue whales.

These photographic data examined to date support the hypothesis that Southern Ocean and eastern South Pacific blue whales are distinct populations as no Chilean blue whales have been observed in the Southern Ocean.

While it is believed that Southern Hemisphere blue whales feed in high latitudes and breed in low latitudes, no breeding ground has been documented for blue whales in the Southern Hemisphere (Gilpatrick and Perryman, 2008). However, it is possible that either Southern Ocean or eastern South Pacific blue whales could use the region near the Equator or the ETP as breeding grounds. Although Antarctic blue whale type calls have been detected in the ETP (Stafford *et al.*, 2004), no recaptures have been found to date between the ETP catalogue and those from the eastern South Pacific and the Southern Ocean. Although the results are considered preliminary as photo comparisons are not yet complete, these data do not provide evidence of exchange between ETP and the eastern South Pacific or the Southern Ocean. This is consistent with the other data (satellite tracking acoustic, and photo-identification) linking the ETP blue whales to blue whales off Baja California, Mexico and California.

Some California blue whales have been tracked via satellite tags to the ETP (Mate *et al.*, 1999) and aggregate around the Costa Rica Dome, a known upwelling region (Fiedler, 2002). Individual matches have been found between California and Costa Rica Dome (Gerrodette *et al.*, 2008). Acoustic calls (A-B type) from blue whales have been recorded along the west coast of the United States, Baja California, Mexico, and in the ETP (Stafford *et al.*, 1999) and these calls are very different from the calls of blue whales off Chile or in other locations in the Southern Ocean (McDonald *et al.*, 2006).

Based on genetic analyses of blue whales off Antarctica and Australia, Attard *et al.* (2012) found strong evidence for four migrant pygmy blue whales and six admixed individuals off Antarctica, showing dispersal from Australia to Antarctica and the first record of hybridization. Therefore, it is expected that photo-identification matching when finalized may reveal some connectivity between those two areas.

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## ACKNOWLEDGEMENT

We would like to thank the IWC, NOAA, CWR, BWS, WWR and CCC for contributing their catalogues to this international effort and especially thanks the captains and crew members of the research vessels that made possible to collect all these photographs. We would also like to thank the IWC for funding support allocated to the SHWBC and the support and comments provided by Carole Carlson and Robert L. Brownell, Jr.

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