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# Preliminary report on the photo-identification of blue whales off Isla de Chiloé, Chile from 2004 to 2006

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## ABSTRACT

Photo identification of individual blue whales during summer and autumn off the northwestern Isla de Chiloé, southern Chile, were collected from marine surveys conducted from 2004 to 2006. Re-sightings of individual whales both within and between years may provide evidence of residency and site fidelity by blue whales in the area. These records further document the importance of the northwestern Isla de Chiloé as a feeding area for blue whales. These records also highlight the necessity of further comparisons with photographic catalogues from other areas in southern Chile, off the northwestern coast of South America and the Pacific coast of Central America to better understand seasonal movements, distribution of individuals along the eastern South Pacific, and their wintering areas.

## INTRODUCTION

Blue whales (*Balaenoptera musculus*) range from the tropics north and south into the pack ice of the Arctic and Antarctic Ocean. In the southern hemisphere, two subspecies are currently accepted: *B. m. breviceauda*, the “pygmy” blue whale in the Subantarctic zone and *B. m. intermedia*, for the whales that summer in the Antarctic Zone (Rice, 1998).

During the 20th century, blue whales became a principal target of the whaling industry throughout the world, notably following the opening in 1904 of the rich whaling grounds in the Southern Ocean. Knowledge of blue whale populations is limited and few data are available to assess the status of the different populations, particularly in the Southern Hemisphere where blue whale numbers were dramatically reduced by decades of poor management and illegal whaling (Clapham *et al.*, 1999).

In Chile, catches of blue whales occurred in waters along the continent and in Antarctic waters. Approximately 2,982 individuals were taken in continental waters off Chile between 1929 and 1971, and at least 27,720 from 1911 to 1929 in the Chilean Antarctic Territory (Aguayo *et al.* 1998). Although the distribution and historical catches of each subspecies in Chile remains undetermined, new information is increasing our knowledge of blue whales in Chilean waters. We have assigned the blue whales off Isla de Chiloé to *B. m. breviceauda*.

Here we report on results from photo-identification of blue whales off northwestern Isla de Chiloé from 2004 to 2006 and comment on residency by analyzing minimum residency times and re-sighting rates, including the first recapture between years of a photo-identified blue whale.

## MATERIAL AND METHODS

Blue whales are individually identifiable from the unique pattern of mottling on both sides of the body near the dorsal fin, the size and shape of the dorsal fin and scars (Sears *et al.*, 1990). Photo-identification has been shown to significantly contribute to identifying critical habitats in terms of minimum residency times, site fidelity, habitat use and seasonal variations in occupancy and movements patterns between areas (Clapham *et al.*, 1995; Whitehead, 1995).

Research on blue whales off Isla de Chiloé using photographic identification techniques has been conducted by the staff of CCC, between February and March, 2004 to 2006, through periodically marine surveys on board artisanal fishing vessels and Chilean marine navy vessels. Marine surveys usually are conducted off northwestern Isla de Chiloé, between 41°45'S and 42°12'S and within 22km from the coastline. However, during 2004, one marine survey was conducted around the Corcovado Gulf.

When a whale or group of whales were sighted, they were approached to take photo-IDs using standard procedures with two digital professional cameras and 300 mm and 400 mm stabilized lenses. Both right and left flanks, dorsal fins and prevalent scars were photographed and data on group composition, behavior and associated fauna were collected. Location was recorded with a GPS device.

Clear, well-focused photographs of left and right flanks and dorsal fin of individual blue whales were compared within year to determine the number of individuals sighted as well as sighting frequency. Individual blue whales from each year then were compared to our catalogue. A new identification number was assigned to unmatched whales only when photographs were determined to be of suitable quality. Photographs of low quality or whales only partially photographed were not included in the catalogue but were archived independently for future analysis as more individuals are added to the catalogue.

Using the Photo-ID data for each year, we examined the number of days individual whales were re-sighted; minimum residency time (the number of days between first and last sightings within the same season); and re-sighting rate (the proportion of individual whales identified on more than one day within the same season). Re-sighting rate and minimum residency time were obtained for both, left and right data sets and calculated on records from 2005 and 2006. Data from 2004 included only two marine surveys in different areas and was not used in the analysis. Latitude and longitude recorded for each sighting was used to calculate movement distances between multiple sightings of the same individual.

## RESULTS

Between 2004 and 2006, 22 marine surveys totaling 114.05 hours were conducted and 97 sightings of 173 blue whales were recorded (Table 1). Two catalogues, left flank and dorsal fin and right flank and dorsal fin were established. Currently the catalogue consists of 70 right and 68 left flanks and dorsal fins; within them, 36 were photographed on both sides. Two of the left side photo-IDs were made opportunistically by local members of CCC Marine Mammal Sighting Network.

Of all whales photographed from 2004 to 2006, twelve unmatched whales (15%) were either of low quality or only partially photographed and not included in the catalogue.

Year	Number of marine surveys	Duration (hrs)	Sightings of blue whales	Minimum number of blue whales	New left side photo-IDs	New right side photo-IDs	Recapture within season left photo-IDs	Recapture within season right photo-IDs	Recapture between years
2004	2 <sup>1</sup>	17:35	2	3	4 <sup>2</sup>	2	0	0	0
2005	8	29:13	25	58	12	7	1	1	0
2006	12	67:15	70	112	52	61	8	9	1 <sup>3</sup>
<b>TOTAL</b>	<b>22</b>	<b>114:03</b>	<b>97</b>	<b>173</b>	<b>68</b>	<b>70</b>	<b>9</b>	<b>10</b>	<b>1</b>

<sup>1</sup> One marine survey of 10,25 hrs at the Corcovado Gulf.

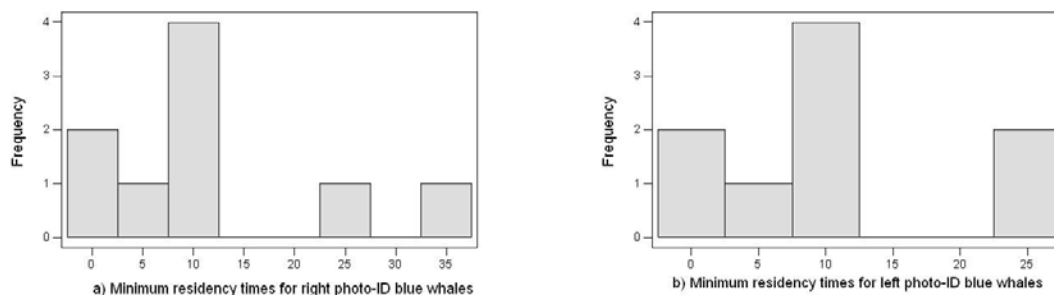
<sup>2</sup> Two opportunistically left side photo-ID whales.

<sup>3</sup> Left side photo-ID whale.

**Table 1 – Details on photographic individual identification of blue whales off northwestern of Isla de Chiloé**

During 2005, one individual was observed on multiple occasions (8.3% comparing left flank photographs and 14.3% comparing right flank photographs) and during 2006, 8 individuals (15.1%) comparing left flank photographs or 9 individuals (14.8%) comparing right flank photographs. Analyses of the 2005/2006 data

set indicates a residency rate of 13.8% comparing left flank photographs and 14.7% comparing right flank photographs. The minimum residency time of all re-sighted blue whales comparing right flanks ranged from 2 to 34 days, with a mean of 11.60 (S.D.=10.50) days (Figure 1a) and from 2 to 27 days comparing left flank photographs, with a mean of 11.20 (S.D.=9.44) days (Figure 1b).



**Figure 1 – Histogram of minimum residency times for a) right side and b) left side photo-ID blue whales**

Of the ten whales re-sighted within a season, one individual was identified on three occasions over a period of 34 days, in an area of 5x11 km<sup>2</sup>. The second longest minimum residency time was 27 days, for two individuals sighted on two occasions each, at 14km and 20km respectively, from their previous locations.

The first individual recaptured between years off Isla de Chiloé was documented on 21 March 2006; the individual initially was photographed on 10 February 2005. The re-sighting was recorded at approximately 13 km north of the 2005 location.

Identification photographs from 2004 and 2005, were sent to others with east Pacific blue whale catalogues (which include photos from Mexico and the Pacific coast of Central America) for comparisons. To date, no matches have been reported.

## DISCUSSION AND CONCLUSIONS

An important feeding ground for blue whales during summer/autumn has been described off the coast of Isla de Chiloé and the Corcovado Gulf (Cabrera *et al.*, 2005; Hucke-Gaete *et al.*, 2004). In 2005, 58 blue whales were recorded in 7 marine surveys and 32 blue whales in two aerial surveys in the northwestern coast of Isla de Chiloé (Galletti Vernazani *et al.*, 2005a); 30 blue whales were observed in 16 marine surveys and 11 blue whales in one aerial survey at the Corcovado Gulf during the same year (Hucke-Gaete *et al.*, 2005b). These results suggest that a relatively higher density of blue whales occurred in 2005 off northwestern of Isla de Chiloé. Additionally, the northward extent of the seasonal feeding ground of blue whales is not sufficiently documented (Galletti Vernazzani *et al.* 2005b).

Understanding blue whale movement patterns is important for assessing the effectiveness of regional protective areas for their conservation. However, while satellite tags of two individuals revealed migration movements to the region of the Nazca Ridge (Hucke-Gaete & Mate, 2005a), to date, no information on fine-scale movements has been reported for blue whales off Isla de Chiloé and Corcovado Gulf.

Seventy individual blue whales have been identified from photographs of right flanks and dorsal fins in the northwestern area of Isla de Chiloé. The number of catalogued animals of eastern South Pacific blue whales within our study area is comparatively low compared to the western North Atlantic and eastern North Pacific long-term studies of Sears *et al.* (1990), with 203 individual blue whales identified in the Gulf of St. Lawrence between 1979 and 1988, and by Calambokidis *et al.* (2004), with 1,070 blue whales identified between 1986 and 1997. This does not necessarily reflect a smaller population but possibly a smaller sample size in terms of effort and longevity.

Our results indicate that approximately 14% of all whales identified were sighted on multiple days within a season, with the majority of whales identified only on one occasion during the study period. According to the longest minimum residency time, blue whales were in residence for a minimum of 34 days in the area.

The results on minimum residency time indicate that blue whales show a level of residency in the feeding area. If the whales move randomly within the feeding area, they are less likely to be photo-identified in one area on more than one occasion. Thus, a re-sighting rate of 14% could suggest that the blue whales off northwestern Isla de Chiloé are not in the same area for long periods of time and probably disperse randomly within a greater feeding area that is yet to be defined. This is consistent with previous studies that report a noticeable variation in seasonal distribution of blue whales off Isla de Chiloé from aerial surveys (Galletti Vernazzani *et al.*, 2005a). Furthermore, studies of blue whales habitat and foraging strategies off California Channel Islands revealed that blue whales feeding aggregations are dynamic, whales may move between feeding grounds during summer and on the feeding ground disperse from day to day. It has been also found that the dynamics of prey aggregations may be a very important factor affecting whale distribution (Fiedler *et al.*, 1998). Additionally, it has been noticed that blue whales undertake frequent long distance movements along the coast within the California Current (Croll *et al.*, 2005). However, it is also possible that the low proportion of whales re-sighted could indicate a higher density of whales in northwestern Isla de Chiloé and therefore a difficulty in photographing all whales present in this area.

The first recapture between years of an individually photographed blue whale off Isla de Chiloé may indicate that they could be regulars and have some seasonal site fidelity on the feeding ground found in the waters off the northwestern coast of Isla de Chiloé.

Although these records confirm the importance of northwestern Isla de Chiloé for blue whales, our knowledge of fine-scale movements is minimal and it is important to understand how individual whales use the feeding grounds during their stay. To accurately assess residency and movements patterns of blue whales and define their feeding grounds, it is necessary to compare catalogues of photographed individuals from other nearby areas as well as along the entire South Pacific.

Increased collaboration and comparison of photographic data will lead to a greater understanding of habitat use, site fidelity, movement patterns, residency patterns and wintering areas that will contribute to enhance blue whale conservation strategies for the East South Pacific region and the implementation of sound Marine Protected Areas that effectively protect the blue whale feeding ground of southern Chile.

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