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Migratory movements of humpback whales (*Megaptera novaeangliae*) between Machalilla National Park, Ecuador and Southeast Pacific.

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ABSTRACT

This paper investigates migratory movements of humpback whales (*Megapera novaeangliae*) from Ecuador within their breeding area in the tropical southeast Pacific to their feeding area in Antarctic waters. The Ecuadorian photo-identification catalogue was compared to catalogues of Costa Rica, Panama, Colombia and Peru as well as with the Antarctic Whale catalogue (including Magellan Strait). Results show that 15 individuals present in the Ecuadorian catalogue where also found in the catalogues of Costa Rica, Panama and Colombia. 60 individuals where also identified in the feeding grounds, representing about 15% of the identified humpback whales in the Ecuadorian catalogue. This study demonstrates the importance of combining the photo-identification effort of different countries to increase our knowledge on migration patterns of Southern Hemisphere humpback whales.

KEYWORDS: *Antarctic, Southern Hemisphere, South America, Pacific Ocean, Breeding Grounds, Feeding Grounds, Migration, Movements, Photo-id*

INTRODUCTION

Southern Hemisphere humpback whales (*Megaptera novaeangliae*) migrate from their feeding grounds in Antarctic waters to the tropics where they reproduce in the austral winter (Matthews, 1937). In the South Pacific humpback whales *Megaptera novaeangliae* migrate from high latitude regions in the summer for feeding to low latitude regions in the winter for breeding and calving.

The reproductive area for humpback whales in the eastern tropical Pacific is around the Gorgona Islands in Colombia (Flórez-González, 1991), around Coco Island in Costa Rica (Acevedo and Smultea, 1995, Rasmussen *et al.* 2007), Panama (Flórez-González *et al.*, 1998, Rasmussen *et al.* 2007) and Ecuador (Scheidat *et al*., 2000; Félix and Haase, 2001). Humpback whales are sighted off the Ecuadorian mainland in the marine area of the Machalilla National Park from June to September (Scheidat *et al.*, 1997). Within the last ten years, a small whalewatching industry has developed in the fishing village of Puerto Lopez. We know these areas are important for successful reproduction. However the factors which influence the choice of these areas are still poorly understood.

Re-sightings with Antarctic humpbacks have been confirmed between Breeding Stock G and Antarctic Waters (Stone *et al.*, 1990, Florez-Gonzalez *et* al. 1998, Stevick *et* al 2004 and Acevedo *et* al. 2008) as well as between Colombia and Ecuador (Florez-Gonzalez *et* al. 1998, Stevick *et* al 2004).

This paper presents evidence of the migratory patterns of the humpback whales sighted in Ecuador between the breeding area (Costa Rica, Colombia and Peru) and their feeding area (Magellan Strait and Antarctic Peninsula). These results are based upon movements of individual whales identified by several researchers and catalogues in South America.

MATERIALS AND METHODS

Photographs of the ventral side of humpback whale flukes were taken in the South Pacific breeding and feeding areas. Catalogues from the breeding areas were from Columbia, Peru, Costa Rica, and Ecuador. Feeding area catalogues included Antarctica and Chile.

Each country took pictures of the ventral side of the whale's fluke for identification purposes. Individual whales were assigned a number and placed into a master catalogue of that area's whales, so that all researchers can identify the same animal.

Digital catalogues between the feeding and breeding areas were exchanged to look for matches between the two areas. Whales were placed into separate categories depending on their tail's natural markings, pigmentation, trailing end, and scars. Categories ranged from all white to black and white to all black. Tails were compared one to one. Whales that contained several photographs within the same catalogue were only used once. A whale was considered a match if the researchers of both catalogues the whale was found in agreed that it was a resighting.

RESULTS AND DISCUSSION

A total 1172 individuals from Machalilla National Park were compared and analyzed with 1191 individuals identified in the southeast pacific of six regions and ten different catalogs (See table 1).

There were seventy five individuals matched between Ecuador and their Breeding Area (Stock G) and Feeding Area I. Of those, fifty six individuals showed interchange between the Antarctic Peninsula, four with Magellan Strait/ Chile, eleven with Colombia and 4 individuals showed interchange between Costa Rica and Ecuador. No matches of identified humpbacks were made with Peru. Some of this data is reported in Stevick *et al.* (2004), Acevedo *et al.* (2007) and Acevedo *et al*. (2008).

However, when revising the individual's dates of their sightings, only thirty whales have been identified and shown to travel among their breeding and feeding areas continually (See table 2). This was the case for one individual from Magellan Strait and twelve individuals from the Antarctic Peninsula.

The average in days from the feeding areas to the breeding areas was 176 days, the maximum period within season between the first and last sighting was 213, while the minimum was 140 days. Movements of individuals between Ecuador and Gorgona Island -Colombia have been previously demonstrated by Florez-Gonzalez *et* al. (1998) and Stevick et al. (2004). These new matches show that the movements between Ecuador and Costa Rica cover approximately 1200 km and others new areas in the north of Colombia, such us Tribuga Golf.

One identified humpback whale (EC1034/IG018) was first sighted on August 26, 1986 in the marine area of Gorgona Island (02º 47'N-78º 18'W) in Colombia for the Yubarta Foundation and for several occasion in different years in the same region. It was last sighted on July 30th, 2006 in Machalilla National Park Park (01º 23' S - 80º 58' W) in Ecuador. It was observed after 20 years of first photo-ID with multiple sightings in Colombia. This could be oldest whale documented in this breeding area and indicates the importance of the breeding grounds for this stock of humpback whales.

The results of this study not only give new insights into the site- fidelity and migration patterns of humpback whales in southeast Pacific waters. It also demonstrates the importance of combining the photo-identification effort of different countries, and different catalogues within a country. Only with such combined efforts can we obtain reliable information on these animals.

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Table 1. The numbers and matches of individual humpback whales identified between Ecuador and their feeding area I and Breeding Stock G.

	REGION	# CATALOGS COMPARED	# INDIVIDUALS COMPARED	# MATCHES	%
BREEDING STOCK G	Costa Rica and Panama	2 catalogs	110	4	3,64
	Colombia	2 catalogs	335	11	3,28
	Peru	1 catalog	14	0	0
FEEDING AREA I	Chile	1 catalog	78	4	5,12
	Antartica	4 catalogs	611	56	9,16

Table 2. Dates of the twelve individuals identified between Ecuador and Peninsula Antarctic and Magellan Strait.

	Ecuador ID PWF	Date	Place	Feeding Area I	Date	Place	# days	*# km. aprox.*
1	EC0059	08/08/1998	Machalilla National Park (01 23 S - 80 58 W)	PB057	12-jan-99	Gerlache Strait (64-27,4'/ 62.7,4)	157,0	7300
2	EC0097	17-ago-01	Machalilla National Park (01 23 S - 80 58 W)	PB155	03-feb-01	Gerlache Strait (64-27,4'/ 62.7,4)	195,0	7300
3	EC0225	11-aug-2003, 9-aug-2003, 8-aug-2003	Machalilla National Park (01 23 S - 80 58 W)	PB305	07-jan-03	Bahía del Almirante (62.4,13-58.25,56)	213,0	7400
4	EC0203	13-ago-02	Machalilla National Park (01 23 S - 80 58 W)	PB347	21-feb-03	Gerlache Strait (64-27,4'/ 62.7,4)	192,0	7300
5	EC0066	08/08/1998	Machalilla National Park (01 23 S - 80 58 W)	INACH#0120/ 1CH98D120	07-jan-1998	Paso Drake	213,0	7000
6	EC0011	30-JUN-1999, 10-AUG-2000	Machalilla National Park (01 23 S - 80 58 W)	INACH#0143/ 2CH99G143	1999	Gerlache Strait (64-27,4'/ 62.7,4)		7300
7	EC0826	25/08/2005	Machalilla National Park (01 23 S - 80 58 W)	INACH#0209	18-jan-2006	Gerlache Strait (64-27,4'/ 62.7,4)	146,0	7300
8	EC0983	16/08/2006	Machalilla National Park (01 23 S - 80 58 W)	AHWC#3109	15-jan-07	Gerlache Strait (64-27,4'/ 62.7,4)	152,0	7300
9	EC0711	24/07/2005	Machalilla National Park (01 23 S - 80 58 W)	AHWC#3187	01-feb-06	Gerlache Strait (64-27,4'/ 62.7,4)	192,0	7300
10	EC0487	24/07/2004 - 16/08/2006	Machalilla National Park (01 23 S - 80 58 W)	AHWC#3189	01-feb-06	Gerlache Strait (64-27,4'/ 62.7,4)	196,0	7300
11	EC0905	19/08/2005	Machalilla National Park (01 23 S - 80 58 W)	AHWC#3220	06-jan-06	Gerlache Strait (64-27,4'/ 62.7,4)	140,0	7300
12	EC0267	09/09/2003	Machalilla National Park (01 23 S - 80 58 W)	CEQUA#038	11-feb-2004	Magellan Strait	155,0	6.400
13	EC0091	17-ago-01	Machalilla National Park (01 23 S - 80 58 W)	PB188 (OA19-PB60)	02-mar-01	Gerlache Strait (64-27,4'/ 62.7,4)	168,0	7300

Figure 1. Map showing the location of the Machalilla National Park breeding area and the locations of the re-sightings in the feeding areas.