

**COMPARISON OF THE HUMPBACK WHALE CATALOGUES
BETWEEN ECUADOR, PERU AND AMERICAN SAMOA.
EVIDENCE OF THE ENLARGEMENT OF THE
BREEDING STOCK G TO PERU.**

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ABSTRACT

We compared the catalogues of photo-identified humpback whales from four research groups working in Southern Hemisphere breeding areas collected between 1996 and 2010. The entire dataset included individuals: 1470 from Ecuador 96 from Peru and 168 from America Samoa (Breeding Stock E-3). Two matches were found between Ecuador and Peru catalogs, all of them were inter-year re-sightings. Our data confirms that the breeding area of the Stock G extends approximately 700 km to south of Ecuador. Our study suggests and adds further evidence the northern Peru coastal area may be considered as the southern limit of the breeding area for BS-G. In addition, our study highlights the importance of continuing the exchange of catalogs with other adjacent and on/adjacent, which would have implications for management and conservation.

KEY WORDS: *Megaptera novaengliae*, breeding grounds, photo-ID, movements, stock G, America Samoa, Peru, Ecuador.

INTRODUCTION

Southern Hemisphere humpback whales (*Megaptera novaengliae*) migrate from their feeding grounds in Antarctic waters to the tropics (Matthews, 1937). The breeding stock G humpbacks migrate from the Area I (west of the Antarctic Peninsula) (Stone et al. 1990, Stevick et al. 2004) and Magellan Strait in Chile (Acevedo et al. 2007; Capella et al. 2008) during the austral summer until off Ecuador and Colombia during the austral winter (Florez-Gonzalez et al. 1998; Scheidat et al. 2000, Felix and Haase 2001). In recent years, southeast Pacific humpback whales have been found further north, off Panama, Costa Rica (Acevedo and Smultea 1995; Flórez-González et al. 1998, Rasmussen et al. 2007) and north of Peru (Castro et al. 2008; Pacheco et al. 2009; 2011).

Photographic identification of individual humpback whales has established and confirmed migratory movements all over the world (Kaufman et al. 1990, Stone et al. 1990, Darling & Cerchio 1993, Stevick et al. 1998, 2004). An connection has been established between whales breeding in tropical areas on the west coast of Central and South America with those using feeding sites located in southern Chile (Acevedo et al., 2007), western Antarctic Peninsula (Stone, et al., 1990, Stevick et al., 2004, Rasmussen et al. 2007; Castro et al., 2008). Individual humpback whale movements between nearby areas in Panama, Colombia, Ecuador and Peru suggest the species have a continuous distribution in such coastal areas (Flórez-González et al., 1998; Castro et al. 2008; Felix et al. 2009). Some additional humpback exchanges between Ecuador and Peru were presented by Castro et al. (2008), with recaptures discovered due to minimal effort in Peru until 2007. Since 2008, two research

groups have been collecting data about Humpbacks distribution in two different areas of northern Peru thus, new catalogues are available.

There is evidence of movement of humpback whales between American Samoa and Magellan Strait (Robbins et al 2011). The Magellan Strait is the feeding area of humpback whales from BS-G (Acevedo *et al.*, 2007). Available information on stock structure based on mitochondrial DNA from 6 breeding grounds: New Caledonia, Tonga, Cook Islands, eastern Polynesia (Society Islands of French Polynesia), Colombia and Western Australia, and other areas in French Polynesia, suggested that the population has a panmictic distribution with significant differentiation, at both the haplotype and nucleotide level (Olavaria *et al.*, 2007). There is few photo identification efforts have been made to find whale movements from American Samoa to elsewhere. Robbins *et al.* (2011) recorded two individuals from American Samoa. Similarly Ecuadorian humpback whales have been resighted in the Antarctic Peninsula (Acevedo *et al.*, 2007).

Here we present the first information on matches of individuals recorded in coastal waters between Ecuador and Peru, showing the connection of the whales identified in Peru and Ecuador (BS-G). This confirms the hypothesis of northern Peru could be considered the southern limit of the breeding area for BS-G (Ramírez, 1988a; Van Waerebeek *et al.*, 1996; Pacheco *et al.*, 2009; 2011). We also report on the results from the first comparison of catalogs from Ecuador and Peru (BS-G) and America Samoa (BS - E3).

MATERIALS AND METHODS

Study area

The study area includes five sites in three countries: two in Ecuador, two in Peru and one in America Samoa.

Peru: Dedicated surveys were conducted in two sites for two research groups: Los Órganos (04°10'38.78"S, 81°8'04.40"W) in the period 2009 – 2010 and Sechura Bay (05°50'S, 80°W) in the period 2006 – 2010.

America Samoa: Surveys were conducted annually in the near-shore waters of Tutuila (14° 12' S, 170° 30' W), the main island of American Samoa, between 2003 and 2009.

Ecuador: Surveys were conducted in two sites: Machalilla National Park (Puerto Lopez-La Plata Island) (1996-2009) (1°16'S, 81°06'W) and Salinas (2001) (2°10'S, 81°20'W).

Data analyzes

Photographic identification of humpback whale flukes has been established and confirmed along migratory routes worldwide (Kaufman *et al.* 1990, Stone *et al.* 1990, Darling & Cerchio 1993, Gilí & Burton 1995, Darling *et al.* 1996, Stevick *et al.* 1998, 2004). For the purpose of this work, the digitized catalogs belonging to three research institutions and individual researchers from Peru, America Samoa and Ecuador were analyzed for resight. Photographs were taken on board different vessels, including whale-watching boats and small boats specifically for research.

Effort

In total, 1734 individual humpback whales (1470 from Ecuador, 168 from America Samoa and 96 from Peru) were morphologically compared using the ventral pigmentation and shape of the flukes (Katona & Whitehead 1981). The Ecuadorian dataset includes photographs from Pacific Whale Foundation (June to October, 1996-2009), the Peru dataset includes two research's groups (Pacheco and Santillan) from June to September, 2006-2010 and the America Samoa (Princetowns Center for Coastal Studies) from 2003 – 2009.

RESULTS

The comparison of photographs showed two matches between Ecuador (EC130 and 1322) and Peru; all of them corresponded to inter-year re-sightings (Table 1). The two individuals were recorded in Machalilla National Park-Ecuador in two different years and have been recorded only once (2001 and 2008). The EC130 animal was previously compared to photo-ID catalogs from Colombia, Chile, Costa Rica, Antarctic Peninsula and Panama with no matches found (Acevedo *et al.*, 2007; Castro *et al.*,

2008). The EC1322 was analyzed only with Ecuador, however, have begun efforts to comparison with other areas (Figure 1). The largest span of time between sightings was 5 years (Table 1)

To date we have found no matches between American Samoa and Ecuador. But search efforts continue, the data have been compared to half of 2009.

Table 1: Sighting dates of the animals in common from Ecuador and Peru

ID Number	Sighting Ecuador date	Sighting date Peru	Years
EC130/ SE160706	August 11, 2001	June 16, 2006	5
EC1322/#9PA21bAgo09	July 3, 2008	August 21, 2009	1

Figure 1: Photographs and ID numbers of the common individuals between Ecuador (left column) and Peru (right column).



EC130 / August 11, 2001 in Puerto Lopez / Ecuador



SE160706 / June 16, 2006 in Sechura Bay / Peru



EC1322 / July 3, 2008 in Puerto Lopez / Ecuador



#9PA21bAgo09 / August 21, 2009 in Los Organos / Peru

DISCUSSION

Our results confirm that some whales of the Breeding Stock G frequent the coasts of Ecuador and Peru during the breeding season. While our records refer only to inter annual re-sightings, it is not excluded that some whales could frequent these sites during the same season.

Our data confirms the extension to south the breeding area for BS G humpbacks to the Sechura Bay (05°50'S, 80°W) and records the first movements of whales between Ecuador and Peru. This finding extends the southern boundary of the BS G breeding area approximately 700 km and includes the coasts of at least five countries from Peru to Costa Rica. Observations of mothers and calves, and presence of mating behaviors confirms breeding and nursing activities in Los Organos in Peru (Pacheco *et al.*, 2009, 2011).

Although Acevedo *et al.* (2007) suggested site fidelity exists between feeding areas and breeding areas, it is unknown where feeding areas frequented by humpbacks off Peru may be located. Differences in the time spent in this breeding area has not been established according to sex or reproductive status, but the low within year re-sighting rates reported in several sites of the southeast Pacific (see Flórez-González, *et al.* 2007) suggests that whales are moving continuously within the breeding area. In that sense, Southeastern humpback whales have similar behavior as whales breeding in the Hawaiian archipelago, where whales of all classes make extensive movements within the Archipelago during the breeding season (Cerchio *et al.*, 1998, Mate *et al.*, 1998). It is necessary to begin the comparison of catalogs of Peru with other areas in the BS G and with different catalogs in known feeding areas to understand the connections and movements of the stock.

Our study yielded no direct matches between American Samoa and Ecuador, even though genetic evidence suggest exchange is possible (Olavarria *et al.* 2007). Given the recently reported matches between America Samoa and Peninsula Antarctic (Robbins *et al.*, 2011), finding a match is possible and we will continue with our comparison effort.

Although an extensive photo-ID catalogue for BS G humpback whales exists, few inter-regional resights have been made. This may be, in part, due to lack of complete regional catalog reconciliations, lack of economic support or the failure to share catalogs with other regions. In addition there are known regions where humpback whales frequent where it is difficult to obtain photographs from (e.g. Galapagos archipelago, Lobos de tierra, Isla de Los Cocos). Without this data it is very difficult to establish movements, site fidelity and migration corridors for BS G humpbacks. Further study is needed on humpback whale distribution and movements along the southeast Pacific corridor between Ecuador (Galapagos Archipelago), Costa Rica (Cocos Island) and Peru (Lobos de tierra among others) and other regions in the area.

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