

# **PHOTO-IDENTIFICATION OF HUMPBACK WHALES, *Megaptera novaeangliae*, IN THE PUERTO LOPEZ PART OF MACHALILLA NATIONAL PARK ON THE ECUADORIAN COAST – SOUTH AMERICA: 1996 TO 2007**

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## **SUMMARY**

Between 1996 and 2007 a photo-identification study of Southeastern Pacific Humpback Whales (*Megaptera novaeangliae*) was carried out off the coast of the Ecuadorian mainland (1°S, 80°W). During this 11 year period, 1,172 whales were identified. A total of 79 (6.74%) humpback whales were resighted between years in Ecuador. The longest span between capture and recapture was 10 years. Eighty-two individually identified humpbacks whales (6.99%) were resighted within the same year. The maximum period between first and last recapture within a season was 98 days, while the minimum was one day.

**KEYWORDS:** Southern Hemisphere, South America, Pacific Ocean, Mark-recapture, Photo-id

## **INTRODUCTION**

The humpback whales of the Southeastern Pacific are part of Breeding Area G, which includes Costa Rica, Panama, Columbia, and Ecuador. These whales feed in Area I, which consists of southern Chile and the Antarctic peninsula (Felix *et al* 2008).

Before the onset of commercial whaling the number of humpback whales in the Southern Ocean was estimated to lie around 100,000 (Nowak 1999). In the 19<sup>th</sup> century Area G was a popular destination for whaling. In the 20<sup>th</sup> century humpback whales were hunted close to extinction. Between 1908 and 1975, an estimated 2,281 whales were caught in the waters off Peru and Chile (Stevick. *et al* 2004). In 1964 hunting humpback whales in the Southern Hemisphere became illegal (Stevick *et al* 2004). Curry-Lindahl (1972) estimated that in 1965 less than 3,000 animals were left in the Southern Ocean. Information on population size, migration and stocks in the eastern Pacific are scarce, but would be essential for monitoring a possible recovery of these humpback whales, as has been documented along the African east coast (Findlay and Best 1996) and the Australian east coast (Chaloupka *et al.* 1999; Paterson and Paterson 1989). The most recent estimate of the number of humpback whales found along the Ecuadorian coast was 3,387 in 2006 (Felix 2008).

Off the Ecuadorian mainland, humpback whales are found in the marine area of the Machalilla National Park from June to October. The first photo-identification studies of humpback whales in Machalilla National Park began in 1996 and in 2000, Machalilla National Park was recognized as an important breeding area for the Southeastern Pacific humpback whales (Scheidat *et al* 2000). Pacific Whale Foundation has supported Ecuadorian researchers in their study of the humpback whales along the Ecuadorian coast since 2001.

In this paper we will discuss the inter- and intra-annual recaptures rates for the population of humpback whales in the Machalilla National Park along Ecuador's coast. Site fidelity in Machalilla National Park is investigated by photo-identification of individual animals.

## **MATERIALS AND METHODS**

### **Study area**

The study area extends from 01° 00' S to 01° 16' S, limited in the west by Isla de la Plata (81° 06' W) and in the east by the Ecuadorian coast (See Figure 1). It is a large bight that forms part of the continental shelf with an approximate length of 25 nautical miles and a maximum width of 20 nm (40 km.). The sea bottom is mostly made up of sand, gravel, rocky areas and coral reefs (Ayón 1988). Beyond the Isla de la Plata the continental shelf drops down rapidly to depths of more than 3000 m.

The study area is influenced by several large current systems. During the dry season (June to September), the Ecuadorian counter-current arrives from the west somewhere between 4° and 10° N and is deflected by the continent so that it splits into the north and south equatorial currents. Another large current is the Humboldt Current which arrives from the south. It forms the equatorial front when it meets the south equatorial current. During the dry season this front lies in the study area between 1° and 5° S and is characterized by moderate salinity and a high quantity of nutrients (Anonymous 1997). These waters show a high zooplankton and fish density and support a local fishing industry, suggesting that the bay exhibits a level of primary productivity that is atypical of tropical marine systems (Anonymous 1997). From May to September the trade winds are regular and blow from the south-east.

Within Machalilla National Park, humpback whales are commonly found near the Isla de la Plata (81° 04' W, 01° 16' S). The island is covered in part by a dry coastal forest and is a breeding place for a variety of sea birds, such as magnificent frigate birds (*Fregata magnificens*), blue-footed (*Sula nebouxii*), red-footed (*Sula sula*) and masked boobies (*Sula dactylatra*), and waved albatrosses (*Diomedea irrorata*). Originally it was free of terrestrial mammals but goats, cats and rats have been introduced by man. Other marine mammals around the island are spotted dolphins (*Stenella attenuata*), false killer whale (*Pseudorca crasidens*), bottlenose dolphins (*Tursiops truncatus*), killer whales (*Orcinus orca*) and several male sea lions (*Zalophus californianus wollebaeki*).

### **Data collection**

Boat-based photo-identification of humpback whales was conducted daily, weather permitting. Observations took place from two different types of commercial vessels: whale watching vessels and vessels providing day trips to the Isla de La Plata. Whale watching vessels offered two three-hour trips daily that were solely dedicated to observing whales. In contrast, whales could only be observed while traveling to and from the island when La Plata Island day trip vessels were used. In total, 28 different companies from Puerto Lopez were used, all of which operated 10 m long fiberglass vessels powered by 75 to 115 horsepower engines. These vessels were designed specifically for whale watching and could hold sixteen passengers in the cabin with a naturalist guide. The researcher remained above with the captain and took photographs from the helm.

Surveys were conducted in a non-systematic fashion within the study area depending on reports of sightings, as well as weather conditions. Approaches to whales were made as non-intrusively as possible in order to ensure that the ongoing behavior of the whales was not changed by the presence of the boat.

Data was collected opportunistically in the form of digital photographs, audio tape recordings, and real time observations recorded on preformatted data sheets. Digital photographs of the left and right views of the lateral body, ventral surface of the tail flukes and genital areas (when presented) were obtained using Canon D10 cameras equipped with motor drives and 100-300 mm lenses. Each pod was designated a code number composed of the calendar date and pod number to indicate each consecutive encounter with humpback whale pods during the day (Forestell et al., 2003). For each pod encountered, the following data was recorded: date, time, location (determined by GPS: Garmin, GPSMap 176c, and plotted using Garmin Mapsource, Version 6.3 and Garmin Pacific Blue Chart v. 4.01 and 5.0), group size and composition (e.g., calf, adult, sub-adult), and general activity of the whales. In addition, observers recorded the following information while photo-identifying whales: image number and content (e.g. fluke, lateral body, etc.) of each image taken. All images were subsequently catalogued and recorded according to image number, time, location, date, pod composition, size, and sex (if determined).

### **Data analysis**

Photographs used in the data analysis were taken in the marine area of Machalilla National Park, Ecuador between 1996 to 2007. This catalogue contains over 1,200 individually identified animals. During the matching of fluke photographs, a whale that was identified on more than one occasion was assigned an “animal” number (Ex: EC145), allowing us to reference all fluke identifications of that individual.

The best fluke photograph for each animal was selected for the catalogue using the following criteria: it was clear, had good markings, and showed the majority of the tail fluke. If a photograph showed only half of the tail fluke, but it was a clear photograph with good (easily identifiable) markings then that photograph was also included in our catalogue. Photographs that were far away or blurry but had good markings were included in the catalogue as well. Photographs not selected for the catalogue were saved in other files in case they were needed for further identification.

Digital and print versions of the catalogue were created. Photographs were printed in color with an image size of 6x4 inches. Both digital and print photographs were then sorted into the following fluke pigmentation categories: 1 (all white), 2 (white with a black line on the bottom), 3 (white with thin black connecting line, 4-5 (white with thick black connecting line), 6 (4 or 5 with black wings on top), 7 (4 or 5 with black wings on the bottom), 8 (80% black), or 9 (all black). In the print catalogue, flukes were also categorized based on

similar markings. For example orca scars, nicks, lines, or circles, etc. Once placed in their appropriate categories, each fluke photograph was compared to the others in the catalogue one at a time.

## **RESULTS AND DISCUSSIONS**

Between 1997 and 2007, 4,116 humpback whales were observed in Machalilla National Park during 868 trips on 629 days on water (Table 1). A total of 1,172 whales were individually identified and catalogued.

### *INTER-ANNUAL COMPARISONS*

A total of 79 (6.74%) identified humpback whales were sighted in more than one season, with sighting intervals ranging from one to ten years. Of these, 37 % were sighted in the year following their first sighting. Twenty percent were sighted within two years of their first sighting. Eighteen percent were sighted within three years of their first sighting and twenty-five percent were sighted between four and ten years after their first sighting. The animal with the longest interval between sightings, (EC035) was first sighted on August 1996 in the marine area of Machalilla National Park (01° 23' S - 80° 58' W) and again on 16 August 2006. This animal was observed in the same region ten years after it was first photographed (Fig 2).

The number of re-sightings between years varied from two to five sightings per individual. Eighty three percent (N=66) of the individuals were sighted in two different years. Fourteen percent (N=14) were sighted in three different years and three percent (N=2) were sighted in four or more different years. As an example, one individual (EC001) was sighted in the same region on seven occasions in five different years, in 1996, 09 August 1997, 26 and 29 August 1998, 25 and 27 August 1999 and 25 September 2002. Another individual (EC314) was first sighted on 10 August and 14 August 2002. It was then resighted in 2006 on 17 June, 17 August and 23 September, with 98 days between the first and last sighting within season.

The recapture rate between years in Ecuador is comparable to the levels reported in other wintering grounds of the South Pacific, where they have been estimated at 24% for New Caledonia and 12% for Tonga (Garrigue et al. 2006). Twenty-one animals demonstrate both inter-annual and intra-annual sightings. These matches indicate that individuals may show fidelity to this particular breeding area in the Puerto López part of Machalilla National Park and La Plata Island off the Ecuadorian Coast.

## *INTRA-ANNUAL COMPARISONS*

Eighty-two individually identified humpback whales (7%) were resighted within the same year. The maximum period within season between first and last recapture was 98 days (animal EC314), while the minimum was one day. This is similar to the intra-annual comparisons found in other wintering grounds, such as the West Indies where 9.1% of identified whales were sighted again within the same season (Mattila et al. 1989). The use of photo-ID techniques precludes the inference of residency patterns of individuals within the area, since it is not possible to determine if whales are constantly using the study area, or alternatively moving further north into other areas, such as Colombia (Florez-Gonzalez 1991) or Costa Rica.

In Table 2, we report the average number of days between intra-annual sightings. In 2004, we had 22 whales sighted in the same season with an average of 13.86 days between sightings. In 2005, seventeen animals were sighted with an average of 17 days between sightings. This is the first report of intra-annual comparisons in Ecuador. In other areas in Ecuador, such as Salinas, the percentage of intra-annual comparisons is much lower than is presented here.

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## **LITERATURE CITED**

Acevedo J, Rasmussen K, Félix F, Castro C, Aguayo- Lobo A, Haase B, Scheidat M, Olavarría C., Forestell P, Acuña P, Pastene L, Kaufman G. (2005) Further information on the migratory destination of humpback whales of the Magellan Strait feeding ground. Report SC/57/SH10 presented to the Scientific committee of the International Whaling Commission.

- Ayón, H. 1988. Grandes rasgos geomorfológicos de la costa ecuatoriana. *Serie informes # 1. PMRC (Programa del Manejo de Recursos Costeros)*. Ecuador. [In Spanish]
- Anonymous. 1997. Evualuación del área marina del Parque Nacional Machalilla; Parte 1 y 2. Instituto Ecuatoriano Forestal y de Areas Naturales y Vida Silvestre (INEFAN) y Dirección Nacional de Areas Naturales y Vida Silvestre (DNANVS).
- Castro C &, González J (2002) Población de la Ballena Jorobada Megaptera novaeangliae, Balaenopteridae, en el Parque Nacional Machalilla, Ecuador. Tesis presentada como requisito para optar el Título de Doctor en Biología. Universidad Central del Ecuador. (In Spanish).
- Chaloupka, M., Osmond, M. and Kaufman, G. 1999. Estimating seasonal abundance trends and survival probabilities of humpback whales in Hervey Bay (east coast Australia). *Mar. Ecol. Prog. Ser.* 184:291-301
- Curry-Lindahl, K. 1972. *Let them live*. William Morrow & Company, Inc.: New York, NY, USA
- IWC (1998) Report of the sub-committee comprehensive assessment of southern hemisphere humpback whales. Report of the Scientific Committee. Annex G. report of the International Whaling Commission 48: 170-182.
- Felix, F., Castro, C., Laake, J.L., Haase, B. and Scheidat, M. 2008. Abundance estimates of the Southeastern Pacific Humpback Whale stock from 1991-2006 photo-identification surveys in Ecuador.
- Félix F, Haase B (2001) The humpback whales off the coast of Ecuador, population parameters and behavior. *Revista de Biología Marina y Oceanografía* 36: 61-74.
- Findlay, K. P. and Best, P. B. 1996. Assessment of heterogeneity in sighting probabilities of humpback whales within viewing range of Cape Vidal, South Africa. *Mar. Mamm. Sci* 12(3):335-353
- Floréz-González L., Capella J, Haase B, Bravo G, Félix F, Gerrodette T (1998) Changes in winter destinations and the northernmost record of southeastern Pacific humpback whales. *Marine mammal Science* 14 : 189 - 196.
- Florez-Gonzalez, L. (1991). Humpback Whales Megaptera novaeangliae in the Gorgona Island, Colombian Pacific breeding waters: population and pod characteristics. *Memoirs of the Queensland Museum*, 30(2): 291-295.

Garrigue C, C Olavarria, CS Baker, D steel, R Dodemont, R Constantine and K Russell. 2006. Demographic and genetic isolation of New Caledonia (E2) and Tonga (E3) breeding stocks. SC7A06/HW19 presented to the Intersessional workshop for the Comprehensive Assessment of Southern Hemisphere humpback whales, IWC.

Gibbons J, Capella J, Valladares C (2003) Rediscovery of a humpback whale (*Megaptera novaeangliae*) feeding ground in the Straits of Magellan, Chile. *Journal of Cetacean Research and Management* 5: 203-208.

Matthews, L. H. 1937. The humpback whale, *Megaptera nodosa*. *Discovery Rep.* XVII: 7-92 (2 plates)

Mackintosh NA (1965) The stocks of whales. Fishing News (Books) Ltd. London.

Mattila, D. K., Clapham, P. J., Katona, S. K. and Stone, G. S. 1989. Population composition of humpback whales, *Megaptera novaeangliae*, on Silver Bank, 1984. *Can. J. Zool.* 63: 762-72

Nowak, R. M. 1999. Walker's Mammals of the World. 6th Ed. The Johns Hopkins Univ. Press: Baltimore.

Rasmussen K, Calambokidis J, Steiger GH (2004) Humpback whales and other marine mammals off Costa Rica and surrounding waters, 1996-2003. Unpublished report available from Cascadia Research, Olympia, Washington.

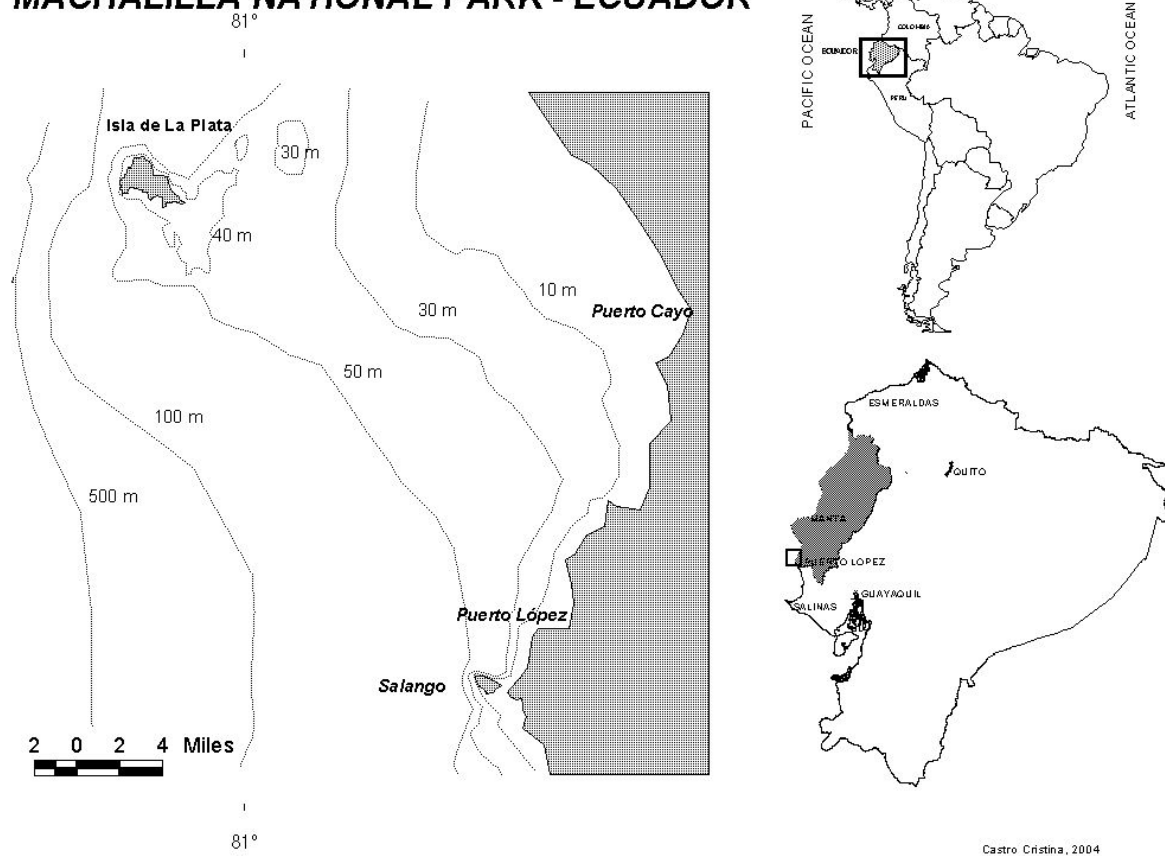
Scheidat M, Castro C, Denkinger J, González J, Adelung D (2000) A breeding area for humpback whales (*Megaptera novaeangliae*) off Ecuador. *Journal of Cetacean Research and Management* 2(3): 165-172.

Stevick PT, Aguayo A, Allen J, Avila IC, Capella J, Castro C, Chater K, Engel M, Felix F, Flórez-González L, Freitas A, Hasse B, Llano M, Lodi L, Munoz E, Olavarría C, Secchi E, Scheidat M, Siciliano S (2004) A note on the migrations of individually identified humpback whales between the Antarctic Peninsula and South America. *Journal of Cetacean Research and Management* 6(2): 109-113.

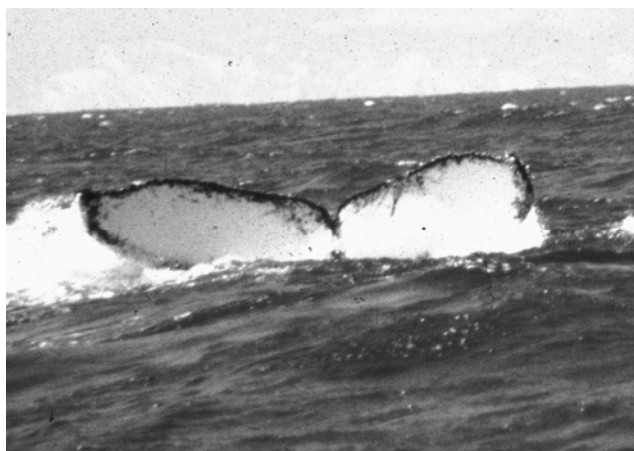


**Figure 1.** Machalilla National Park ( $01^{\circ} 23' \text{ S} - 80^{\circ} 58' \text{ W}$ )

## **MACHALILLA NATIONAL PARK - ECUADOR**



**Figure 2.** EC035 was first sighted on August 1996 (left side) in marine area of Machalilla National Park and again on 16 August 2006 (right side) in the same region.



**Table 1.** Summary of the effort from 1996 to 2007 in Machalilla National Park, Ecuador.

	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>TOTAL</b>
Days on water	w/i	25	44	47	30	50	61	65	75	84	80	68	629
# trips	w/i	36	52	47	30	67	82	89	144	129	101	91	868
# pods	w/i	90	134	129	72	141	135	189	252	223	103	142	1,610
# whales	w/i	102	245	290	185	360	343	442	646	558	585	360	4,116
<b># whales with ID</b>	<b>19</b>	<b>7</b>	<b>24</b>	<b>22</b>	<b>11</b>	<b>59</b>	<b>84</b>	<b>111</b>	<b>234</b>	<b>256</b>	<b>177</b>	<b>168</b>	<b>1,172</b>

**Table 2.** Summary of the Intra-annual comparisons

	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>TOTAL</b>
# INDIVIDUALS	5	4	2	3	6	12	22	17	8	3	82
AVERAGE OCCUPANCY (days)	7.40	3.00	1.00	10.67	14.67	19.62	13.86	8.60	13.63	1.33	9.38
MAX (days)	15	8	1	23	29	50	41	23	98	2	98
MIN (days)	1	1	1	2	1	1	1	1	1	1	1