MOVEMENT OF A HUMPBACK WHALE (*MEGAPTERA NOVAEANGLIAE*) BETWEEN THE REVILLAGIGEDO AND HAWAIIAN ARCHIPELAGOS WITHIN A WINTER BREEDING SEASON

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ABSTRACT: On 5 February 1986 a humpback whale was photographed near Isla Clarión, in the Revillagigedo Archipelago, Mexico, and again 51 days later near the island of Kauai in the Hawaiian Archipelago. The straight-line distance between the two sightings is approximately 4700km. This resighting constitutes the only known instance in which the same humpback whale has been documented in two discretely different breeding areas within the same season. This finding reinforces the conclusion from other studies that the humpback whale aggregation of the Revillagigedo Archipelago constitutes a separate sub-population from mainland Mexico.

RESUMEN: En 1986 una ballena jorobada fue fotografiada en la costa de Isla Clarión, del Archipiélago de Revillagigedo, México, y 51 días después se fotografió cerca de isla Kauai, del Archipiélago de Hawaii. La distancia en línea directa entre los dos lugares donde so observó es de aproximadamente 4700 kilómetros. Éste es el único caso conocido en el cual la misma ballena jorobada se ha observado en dos áreas de crianza diferentes en la misma temporada. Esta observación refuerza la conclusión de otros estudios de que las ballenas que se congregan en el Archipiélago de Revillagigedo constituyen a subpoblación diferente a las de la costa continental de México.

KEY WORDS: Humpback whale, Megaptera novaeangliae, migration, photo-identification, Hawaii, Mexico, North Pacific.

Introduction

Humpback whales are found throughout the world's oceans, and engage in one of the longest-known migrations of any mammal (Stone et al., 1990; Darling et al., 1996; Calambokidis et al., 2001). Whaling records (Townsend, 1935) and recovery of Discovery marks (Omura and Ohsumi, 1964; Dawbin, 1966; Ivashin, 1973) provided limited information on the general distribution and movement of humpback whales in both the Northern and Southern Hemispheres. Since the 1980's more detailed knowledge has resulted from the recognition of individual animals from photographs of unique markings on the ventral surface of the tail flukes (Katona et al., 1979), the flanks (Kaufman et al., 1987), and around the mouth (Glockner and Venus, 1983). Comparison among photographs from different study areas in the North Pacific has resulted in documentation of migratory movement across broad areas. While a number of multi-site analyses of fluke identifications of North Pacific humpback whales have been reported since 1980, the most comprehensive assessment to date was undertaken by Calambokidis et al. (2001). Further analyses, involving systematic effort in all known humpback whale feeding and wintering areas of the North Pacific during five field seasons from 2004 - 2006, are currently underway (Cascadia Research, 2007). Distribution and movement patterns of North Pacific humpback whales have also been studied through satellite telemetry (Mate et al., 1998), acoustic recordings (Helweg et al., 1990; Norris et al., 1999), and genetic analysis (Baker et al., 1998).

Humpback whales typically feed in temperate waters during the summer, and move to tropical areas during the winter, where mating and calving occur (Mackintosh, 1965; Clapham, 2000; Silvers et al., 2002). In the North Pacific, humpback whales feed in nearshore temperate waters along the entire western coast of North America, through the Aleutian Islands, north and westerly into the Bering and Chukchi Seas, and down into the Sea of Okhotsk and off the coast of northern Japan (Tomilin, 1957; Rice, 1978; Calambokidis *et al.*, 2001). In winter they migrate to three relatively discrete areas: in the western North Pacific from Japan to the Philippines; in the Central Pacific around the main Hawaiian Islands; and in the eastern North Pacific off the coasts of Mexico and Central America (Herman et al., 1980; Urbán et al., 1987; Darling and Mori, 1993; Acevedo and Smultea, 1995).

On 5 February 1986 a humpback whale was photographed near Isla Clarión in the Revillagigedo Islands off the western coast of Mexico (approx. 115°W, 18°N). On 28 March, 51 days later, the same whale was photographed near Kauai, Hawaii (approx. 160°W, 22°N). The whale was photographed again on 29 March in the same vicinity. The direct travel distance between the Mexico and Hawaii sightings is approximately 4700km. The match between the photographs of the Hawaii and Mexico sightings was initially documented by staff of the National Marine Mammal Laboratory (NMML), Seattle, using their computer photographic identification system (Mizroch *et al.*, 1990). Figure 1 shows images of the underside of the tail flukes obtained in 1986 near Isla Clarión (Figure 1*a*) and Kauai (Figure 1*b*).

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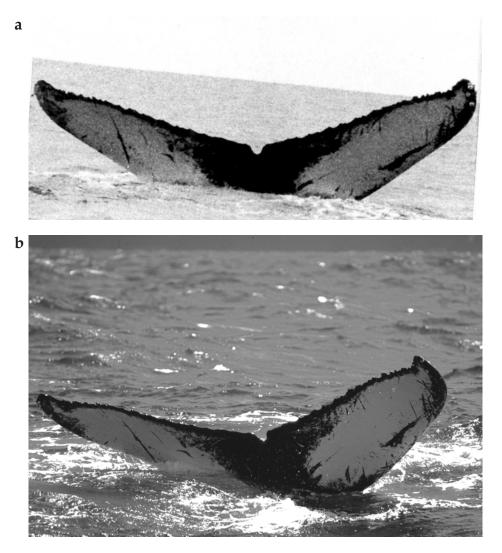


Figure 1a. Fluke of animal 089 photographed off Mexico on 5 February 1986. (Photo: Jorge Urbán: 2M-86-R003); figure 1b. Fluke of animal 089 photographed off Hawaii on 29 March 1986. (Photo: Rob Slade/Pacific Whale Foundation: KA-86-045-20)

This same whale was photographed by the Pacific Whale Foundation (PWF) on six occasions before and after the 1986 sightings, as shown in Table 1. All observations of this animal (identified as animal 089 by the PWF), with the exception of the first observation in 1984, indicate that it was either an escort in mother-calf pods or a competitive adult in large, surface active groups. Such behavior has been generally associated with males (Glockner, 1983; Baker and Herman, 1984; Clapham, 2000; Clambokidis *et al.*, 2001). In each of the five wintering seasons during which it was observed, animal 089 spent at least a portion of the winter in Hawaii. It has been documented in Mexico on only one occasion to date.

The 1986 match between Revillagigedo and Hawaii constitutes the only known movement of an identified whale between discrete wintering grounds within a given season anywhere in the world, despite nearly 20 years of marking with Discovery-type tags by the commercial whaling industry, and a further 30 years of photographic

identification field studies. Although there is no direct way to determine what line of travel animal 089 took between Mexico and Hawaii, a straight-line crossing of 4700km in 51 days (the most time it could have taken between sightings) would require an average speed of 3.8km/h. A report based on photo-identification records by Gabriele et al. (1996) documented a 39-day transit of a humpback whale between Southeast Alaska and Hawaii, a distance of 4440km requiring an average speed of 4.7km/h. Mate et al. (1998) placed satellite tags on six humpback whales in Hawaii, and tracked three of them (one mother with a calf and two of unidentified sex) heading almost due north to Alaska. The female was tracked over 670km moving at an average speed of 6.2km/h. The other two whales were tracked for 14.7 and 17 days traveling at an average sped of 4.5km/h. Zerbini et al. (2006) tracked two whales by satellite in the southwest Atlantic Ocean that traveled in excess of 3500km at mean speeds of 2.6km/h and 3.8km/h. Chittleborough (1953) reported a mean speed of 4.3knots

(7.96km/h) during humpback whale migration along the east coast of Australia, based on aerial observations. More recently, Noad and Cato (2007) tracked humpback whales along the east coast of Australia by shore-based observer and hydrophone, and reported that singing whales move significantly slower than non-singing whales, with the latter traveling at an average speed of 4.0km/h. The somewhat slower migratory speed shown by the animal reported here might indicate that the actual transit from Mexico to Hawaii was less than the 51 days between photo-identification events.

Calambokidis et al. (2001) carried out an extensive analysis of 3650 suitable-quality photographic images of humpback whale flukes obtained by 16 independent research groups throughout the North Pacific between 1990 and 1993. Of 1056 individual animals identified in the Hawaiian wintering area (central stock), three were also documented near the Ogasawara Islands off Japan (western stock) and five were identified in the Revillagigedo Islands off Mexico (eastern stock). None of the eight resightings were within the same season. Overall, Calambokidis et al. (2001) concluded that humpback whales in the North Pacific are most likely to return to the same general feeding and breeding areas from year to year. More recent photoidentification results summarized by Cascadia Research (2007) were based on identifications of more than 10000 individuals throughout the North Pacific between 2004 and 2006. Whales identified in Hawaii were resighted primarily in the Gulf of Alaska, Southeast Alaska and northern British Columbia. Humpback whales found in the eastern North Pacific wintering areas showed two primary patterns. Those from the Revillagigedo Islands were resighted primarily in the Gulf of Alaska. Those observed off mainland Mexico and Central America were resighted in California and Oregon. An additional group of animals photographed off Baja California, Mexico were found widely distributed across all known feeding areas between California and the Aleutians. The relationship between the group of humpback whales in the Revillagigedo Archipelago (which stretches from 528km off the Baja California Peninsula to 615km off the mainland coast of Mexico) and groups of whales elsewhere in the North Pacific has yet to be established.

Urbán et al. (2000) carried out an extensive resighting analysis of 1304 photographic images of humpback whales from mainland Mexico, Baja Mexico, and the Revillagigedo Islands. The images were compared with those obtained from a number of known feeding areas from the coast of California all the way north and northwest through the western Gulf of Alaska. Based on the patterns of resightings between breeding and feeding areas, Urbán et al. (2000) concluded that the Revillagigedo Islands constitute a separate sub-population from the mainland Mexico and Baja animals. Calambokidis et al. (2001) found a higher number of matches between Hawaii and Revillagigedo than between Hawaii and mainland Mexico or Baja. Further effort to understand the migratory connections between the Revillagigedo Islands and other areas of the Pacific has recently been carried out using satellite telemetry (Lagerquist *et al.*, in press). Despite the evidence that humpback whales tend to return to the same general breeding and feeding areas, a number of exceptions have been documented in the North Pacific. These include observations of whales moving between Mexico and Hawaii (Darling and Jurasz, 1983), Japan and Hawaii (Darling and Cerchio, 1993; Salden et al., 1999), California and Hawaii (Perry et al., 1990), and British Columbia and Japan (Darling et al., 1996). All of these observations documented interchange between areas across seasons or years. The overall pattern of a small number of dominant migratory connections, with evidence of occasional exchange taking place through anomalous movements is consistent with what has so far been documented for humpback whales in the western North Atlantic (Katona and Beard, 1991, based on photoidentification studies) and in the South Pacific (Dawbin, 1966, based on Discovery-type dart recapture studies; Garrigue et al., 2000 and Rock et al., 2006, based on photoidentification). None of the movements reported to date have occurred within the same season.

	Table 1. Sighting record	ds of anima	ıl 089 documente	d by p	hotograph.
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Date	LOCATION	POD TYPE*	ACTIVITY	Photographer
12/2/84	Maui, Hawaii	2A	medium swim	Carol Hart (PWF)
5/2/86	Revillagigedo, Mex	no info	no info	J. Urbán (UNAM)
28/3/86	Kauai, Hawaii	Mo/Ca, 2E	no info	R. Slade (PWF)
29/3/86	Kauai, Hawaii	5A	no info	R. Slade (PWF)
11/3/87	Maui, Hawaii	4A, 2S	surface active	Mari Smultea (PWF)
30/3/89	Maui, Hawaii	3A, 1S	milling	Barb Lagerquist (PWF)
13/3/90	Maui, Hawaii	11A	surface active	Barb Lagerquist (PWF)
20/3/90	Maui, Hawaii	Mo/Ca, 2E, 1S	surface active	Curt Jenner (PWF)
20/3/90	Maui, Hawaii	Mo/Ca, 2E, 2S	surface active	Curt Jenner (PWF)

*Mo=Mother, Ca=Calf, A=Adult, E=Escort, S=Subadult.

Chittleborough (1955), Dawbin (1966), Darling et al. (1996) and Baker et al. (1998) have all suggested that movement between breeding grounds may provide an opportunity for gene flow between otherwise separate populations. In the North Atlantic, humpback whales from virtually all of the feeding areas migrate to a single known breeding area in the West Indies (Mattila et al., 1994). In the Southern Hemisphere Noad et al. (2000) analyzed vocalization patterns of whales in two discrete breeding areas off the east and west coasts of Australia. They found incorporation of unique west coast patterns into the east coast song over a two-year period, and concluded that one or a few individual whales must have moved between the two breeding stocks. This suggestion is reinforced by historical Discovery tag results (Dawbin, 1966) and more recent photographic evidence (Cochrane and Kaufman, pers. com.). In the North Pacific, there is genetic (Baker et al., 1998), acoustic (Helweg et al., 1990) and photographic (Calambokidis et al., 2001) evidence of exchange among the western, central and eastern stocks. In none of the movements documented to date has there been evidence of movement between breeding areas within a single season.

Baker and Herman (1984) and Mobley and Herman (1985) have shown that movement patterns and associations between identified whales during the winter are extremely fluid and highly transient. Mobley and Herman (1985) related these factors to the likely tendency for males to prospect widely for females. The observation reported here appears to be of a male, and extends the possible extent of prospecting to include, on at least this occasion, different wintering grounds within the same season.

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References

ACEVEDO, A. AND SMULTEA, M. (1995) First records of humpback whales including calves at Golfo Dulce and Isla del Coco, Costa Rica, suggesting geographical overlap of northern and southern hemisphere populations. *Marine Mammal Science* 11: 554-560.

BAKER, C.S. AND HERMAN, L.H. (1984) Aggressive behavior between humpback whales (*Megaptera novaeangliae*) wintering in Hawaiian waters. *Canadian Journal of Zoology* 62: 1922-1937.

BAKER, C.S., MEDRANO-GONZALEZ, L., CALAMBOKIDIS, J., PERRY, A., PICHLER, F., ROSENBAUM, H., STRALEY, J.M., URBÁN-RAMIREZ,

J., YAMAGUCHI, M. AND VON ZEIGESAR, O. (1998) Population structure of nuclear and mitochondrial DNA variation among humpback whales in the North Pacific. *Molecular Ecology* 7: 695-708.

CALAMBOKIDIS, J., STEIGER, G.H., STRALEY, J.M., HERMAN, L.M., CERCHIO, S., SALDEN, D. R., URBÁN R., J., JACOBSEN, J.K., VON ZIEGESAR, O., BALCOMB, K.C., GABRIELE, C.M., DAHLHEIM, M.E., UCHIDA, S., ELLIS, G., MIYAMURA, Y., DE GUEVARA P., P.L., YAMAGUCHI, M., SATO, F., MIZROCH, S.A., SCHLENDER, L., RASMUSSEN, K. AND BARLOW, J. (2001) MOVEMENTS and population structure of humpback whales in the North Pacific. *Marine Mammal Science* 17: 769-794.

CASCADIA RESEARCH (2007) Status of Humpback Whales & Human Impacts. Final Programmatic Report to National Fish and Wildlife Foundation, #2003-0170-019. Retrieved from http:// www.cascadiaresearch.org/SPLASH/NFWF-FinalReport.pdf, 10 October 2007.

CHITTLEBOROUGH, R.G. (1953) Aerial observations on the humpback whale *Megaptera nodosa* (Bonnaterre), with notes on other species. *Australian Journal of Marine and Freshwater Research* 4: 219-226.

CHITTLEBOROUGH, R.G. (1955) Dynamics of two populations of the humpback whale *Megaptera novaeangliae* (Borowski). *Australian Journal of Marine and Freshwater Research* 16: 33-128.

CLAPHAM, P.J. (2000) The humpback whale: Seasonal feeding and breeding in a baleen whale. Pages 173-196 *in* MANN, J., CONNOR, R.C., TYACK, P.L. AND WHITEHEAD, H. (Eds). *Cetacean Societies: Field Studies of Dolphins and Whales*. University of Chicago Press, Chicago, IL, USA.

DARLING, J.D. AND CERCHIO, S. (1993) Movement of a humpback whale (*Megaptera novaeangliae*) between Japan and Hawaii. *Marine Mammal Science* 9: 84-89.

DARLING, J.D. AND JURASZ, C. (1983) Migratory destinations of North Pacific humpback whales (*Megaptera novaeangliae*) Pages 359-368 *in* PAYNE, R. (Ed) *Communication and Behavior of Whales*. AAAS Selected Symposia Series, Westview Press, Boulder, CO, USA.

DARLING, J.D. AND MORI, K. (1993) Recent observations on the migrations of North Pacific humpback whales (*Megaptera novaeangliae*) in Japanese waters off Ogasawara and Okinawa. *Canadian Journal of Zoology* 63: 308-314.

DARLING, J.D., CALAMBOKIDIS, J., BALCOMB, K.C., BLOEDEL, P., FLYNN, K., MOCHIZUKI, A., MORI, K., SATO, F., SUGANUMA, H. AND YAMAGUCHI, M. (1996) Movement of a humpback whale (*Megaptera novaeangliae*) from Japan to British Columbia and return. *Marine Mammal Science* 12: 281-287.

DAWBIN, W.H. (1966) The seasonal migratory cycle of humpback whales. Pages 145 -170 *in* NORRIS, K.S. (Ed) *Whales, Dolphins and Porpoises.* University of California Press, Los Angeles, CA, USA.

GABRIELE, C.M., STRALEY, J.M., HERMAN, L.M. AND COLEMAN, R.J. (1996) Fastest documented migration of a North Pacific humpback whale. *Marine Mammal Science* 12: 457-464.

GARRIGUE, C., FORESTELL, P., GREAVES, J., GILL, P., NAESSIG, P., PATENAUDE, N.M. AND BAKER, C.S. (2000) Migratory movements of humpback whales (*Megaptera novaeangliae*) between New Caledonia, East Australia, and New Zealand. *Journal of Cetacean Research and Management* 2: 111-116. GLOCKNER, D.A. (1983) Determining the sex of humpback whales (*Megaptera novaeangliae*) in their natural environment. Pages 447-464 *in* PAYNE, R. (Ed) *Communication and Behavior of Whales*. AAAS Selected Symposia Series, Westview Press, Boulder, CO, USA.

GLOCKNER, D.A. AND VENUS, S.C. (1983) Identification, growth rate, and behavior of humpback whale, *Megaptera novaeangliae*, cows and calves in the waters off Maui, Hawaii, 1977-79. Pages 223-258 *in* PAYNE, R. (Ed) *Communication and Behavior of Whales*. AAAS Selected Symposia Series, Westview Press, Boulder, CO, USA.

HELWEG, D.A., HERMAN, L.M., YAMAMOTO, S. AND FORESTELL, P.H. (1990). Comparison of songs of humpback whales (*Megaptera novaeangliae*) recorded in Japan, Hawaii and Mexico during winter of 1989. *Scientific Reports of Cetacean Research* 1: 1-20.

HERMAN, L.M., FORESTELL, P.H. AND ANTINOJA, R. (1980) *The* 1976/ 77 *migration of humpback whales into Hawaiian waters: Composite description*. Report to the U.S. Marine Mammal Commission; Springfield, VA, National Technical Information Service, Washington, DC, USA.

IVASHIN, M.V. (1973) Marking of whales in the Southern Hemisphere (Soviet materials). *Reports of the International Whaling Commission* 23: 174-191.

KATONA, S., BAXTER, B., BRAZIER, O., KRAUS, S., PERKINS, J. AND WHITEHEAD, H. (1979) Identification of humpback whales by fluke photographs. Pages 33-44 *in* WINN, H.E. AND OLLA, B.L. (Eds) *Behaviour of Marine Animals, Volume* 3. Plenum Press, New York, NY, USA.

KATONA, S.K. AND BEARD, J.A. (1991) Humpback whales (*Megaptera novaeangliae*) in the western North Atlantic Ocean. *Memoirs of the Queensland Museum* 30: 307-321.

KAUFMAN, G.D., SMULTEA, M.A. AND FORESTELL, P.H. (1987) Use of lateral body pigmentation patterns for photographic identification of east Australian (Area V) humpback whales. *Cetus* 7: 5-13.

LAGERQUIST, B.A., MATE, B.R., ORTEGA-ORTIZ, J.G., WINSOR, M., AND URBÁN R., J. (In press) Migratory movements and surfacing rates of humpback whales (*Megaptera novaeangliae*) satellite tagged at Socorro Island, Mexico. *Marine Mammal Science*.

MACKINTOSH, N.A. (1965) *The Stocks of Whales*. Fishing News Books, London, United Kingdom.

MATE, B.R., GISINER, R. AND MOBLEY, J.R. JR. (1998). Local and migratory movements of Hawaiian humpback whales tracked by satellite telemetry. *Canadian Journal of Zoology* 76: 863-868.

MATTILA, D.K., CLAPHAM, P.J., VASQUEZ, O. AND BOWMAN, R.S. (1994) Occurrence, population composition and habitat use of humpback whales in Samana Bay, Dominican Republic. *Canadian Journal of Zoology* 72: 1898-1907.

MIZROCH, S.A., BEARD, J.A. AND LYNDE, M. (1990) Computer assisted photo-identification of humpback whales. *Reports of the International Whaling Commission* (special issue 12): 63-70.

MOBLEY, J.R. JR. AND HERMAN, L.M. (1985) Transience of social affiliations among humpback whales (*Megaptera novaeangliae*) on the Hawaiian wintering grounds. *Canadian*

Journal of Zoology 63: 762-772.

NOAD, M.J. AND CATO, D.H. (2007) Swimming speeds of singing and non-singing humpback whales during migration. *Marine Mammal Science* 23: 481-495.

Noad, M.J., Cato, D. H., Bryden, M. M., Jenner, M-N. and Jenner, C. (2000) Cultural revolution in whale song. *Nature* 408: 537

NORRIS, T.F., MCDONALD, M. AND BARLOW, J. (1999) Acoustic detections of singing humpback whales (*Megaptera novaeangliae*) in the eastern North Pacific during their northbound migration. *Journal of the Acoustical Society of America* 106: 506-514.

OMURA, H., AND OHSUMI, S. (1964) A review of Japanese whale marking in the North Pacific to the end of 1962, with some information on marking in the Antarctic. *Norsk Hvalfangst-Tidende* 53: 90-112.

PERRY, A., BAKER, C.S. AND HERMAN, L.M. (1990) Population characteristics of individually identified humpback whales in the central and eastern North Pacific: a summary and critique. *Reports of the International Whaling Commission* (special issue 12): 307-318.

RICE, D.W. (1978) The humpback whale in the North Pacific: Distribution, exploitation and numbers *in* NORRIS, K.S. AND REEVES, R.S. (Eds) *Report on a workshop on problems related to humpback whales (Megaptera novaeangliae) in Hawaii*. U.S. Department of Commerce, National Technical Information Service, NTIS PB-280 794, Washington, DC, USA.

ROCK, J., PASTENE, L.A., KAUFMAN, G.D., FORESTELL, P.H., MATSUOKA, K. AND ALLEN, J.A. (2006) A note on East Australia Group V Stock humpback whale movement between feeding and breeding areas based on photoidentification. *Journal of Cetacean Research and Management* 8: 301-305.

SALDEN, D.R., HERMAN, L.M., YAMAGUCHI, M. AND SATO, F. (1999) Multiple visits of individual humpback whales (*Megaptera nova*eangliae) between the Hawaiian and Japanese winter grounds. *Canadian Journal of Zoology* 77: 504-508.

SILVERS, L.E., ROSEL, P.E. AND SALDEN, D.R. (2002) DNA sequence analysis of a North Pacific humpback whale (*Megaptera novaeangliae*) placenta. *Canadian Journal of Zoology* 80: 1141–1144.

STONE, G.S., FLORES-GONZALEZ, L. AND KATONA, S. (1990) Whale migration record. *Nature* 346: 705.

TOMILIN, A.G. (1957) *Mammals of the USSR and Adjacent Countries*. Translation by the Israel Program for Scientific TRANSLATIONS, Jerusalem, Israel.

TOWNSEND, C.H. (1935) The distribution of certain whales as shown by logbook records of American whaleships. *Zoologica* 19: 1-50.

URBÁN-R., J. AND AGUAYO L.A. (1987) Spatial and seasonal distribution of the humpback whale, *Megaptera novaeangliae*, in the Mexican Pacific. *Marine Mammal Science* 3: 333-344.

Urbán-R., J., Jaramillo, A., Aguayo L.A., Ladron de Guevara, P., Salinas, M., Alvarez, C., Medrano, L., Jacobsen, J., Balcomb, K., CLARIDGE, D., CALAMBOKIDIS, J., STEIGER, G., STRALEY, J., VON ZIEGESAR, O., WAITE, M., MIZROCH, S., DAHLHEIM, M., DARLING, J. AND BAKER, S. (2000) Migratory destinations of humpback whales wintering in the Mexican Pacific. *Journal of Cetacean Research and Management* 2:101-10.

ZERBINI, A.N., ANDRIOLO, A., HEIDE-JØRGENSEN, M.P., PIZZORNO, J.L., MAIA, Y.G., VANBLARICOM, G.R., DEMASTER, D.P., SIMÕES-LOPES, P.C., MOREIRA, S. AND BETHLEM, C. (2006) Satellite-monitored movements of humpback whales *Megaptera novaeangliae* in the Southwest Atlantic Ocean. *Marine Ecology Progress Series* 313:295-304.

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