

Short Note

Sightings of an Adult Male Killer Whale Match Humpback Whale Breeding Seasons in Both Hemispheres in the Eastern Tropical Pacific

Aldo S. Pacheco,^{1,2} Cristina Castro,³ Romina Carnero-Huaman,^{2,4}
Damian Villagra,² Santiago Pinilla,⁵ Judith Denkinge,⁶ José D. Palacios-Alfaro,⁷
Cristina Sánchez-Godinez,⁷ Rocío González-Ruelas,⁸ Sebastian Silva,²
Belen Alcorta,² and Jorge Urbán R.⁸

¹*Instituto de Ciencias Naturales Alexander von Humboldt, CENSOR Laboratory, Universidad de Antofagasta, Antofagasta, Chile*
E-mail: babuchapv@yahoo.com

²*Pacifico Adventures-Manejo Integral del Ambiente Marino S.A.C., Los Organos, Perú*

³*Pacific Whale Foundation, Ecuador*

⁴*Department of Biology, University of Louisiana at Lafayette, LA, USA*

⁵*Madre Agua Ecoturismo e Investigación, Chocó, Colombia*

⁶*Colegio de Ciencias Biológicas y Ambientales, Universidad San Francisco de Quito, Ecuador*

⁷*Fundacion Keto, Costa Rica*

⁸*Departamento Académico de Ciencias Marinas y Costeras, Universidad Autónoma de Baja California Sur, México*

Killer whales (*Orcinus orca*) are apex predators distributed in all ocean basins and appear to be more common towards cold temperate and polar waters at high latitudes in high productivity marine ecosystems (Ford et al., 1998; Häussermann et al., 2013). Killer whales in any marine region (Visser, 1999; Pitman & Ensor, 2003) can be distinguished between different ecotypes (Ford, 2008; Morin et al., 2010)—for example, resident fish eating and transient mammal eating. The ecotypes differ in body size, morphology, habitat, prey preferences, behaviour, and genetics (Ford, 2008; Morin et al., 2010). Observations in warmer regions, such as the Eastern Tropical Pacific, are scarce; nevertheless, in recent years, information regarding their presence in tropical regions has been increasing (Guerrero-Ruiz et al., 1998; Merlen, 1999; Visser & Bonaccorso, 2003; Castro & Scheidat, 2005; Weir et al., 2010; Rankin et al., 2013; Pitman et al., 2015) and provides new insights into the ecology of this charismatic species.

Despite the strong matrilineal bonds that some ecotypes of killer whales form in their pods (e.g., Baird & Whitehead, 2000), lone killer whales, mostly males, are occasionally sighted in several regions (e.g., Lodi & Farias-Júnior, 2011). Within killer whale pods of the “transient mammal-eating” ecotype (also known as Bigg’s), juvenile or adult males may leave the pod for extended periods or permanently and roam over long distances

(Ford, 2008). Solitary adult males may leave their maternal group and occasionally join other pods with potentially reproductive females (Baird & Whitehead, 2000; Pilot et al., 2010). Although killer whales are widely distributed in the Eastern Tropical Pacific (Dahlheim et al., 1982; García-Godos, 2004) and important data exist for the Galápagos Islands (Brennan & Rodriguez, 1994; Sorisio et al., 2006; Alava et al., 2013), information about dispersal and movements of solitary killer whales in this region is scarce in coastal areas particularly towards the southeast. Long distance travel of killer whales from the northern to the southern hemisphere has been previously documented. An individual killer whale was photographically identified at Magdalena Bay (4 April 1988; 24° 18' N, 112° 01' W) and La Paz Bay (5 July 1994; 24° 36' N, 110° 26' W) in the Mexican Pacific and resighted off central Peru (27 March 2001; 12° 52' S, 77° 53' W) traveling a minimum distance of 5,535 km (Guerrero-Ruiz et al., 2005). The information about killer whales off Peru points to both oceanic and neritic distribution with predation observations reported targeting bottlenose dolphins (*Tursiops truncatus*), pilot whales (*Globicephala* spp.), pinnipeds (*Arctocephalus australis* and *Otaria flavescens*), and baleen whales (*Megaptera novaeangliae* and *Balaenoptera musculus*) (García-Godos, 2004; Testino et al., 2018).

Herein, we report a sighting of an adult male killer whale for the first time in northern Peru, who has also been observed at several locations throughout coastal, island, and offshore archipelago areas of the Eastern Tropical Pacific (Figure 1). The post-ocular eye patch was “ghost-like” shaped on his right side (Figure 2), which led to the nickname “Phantom.” After the sighting in northern Peru, photographs were shared with research groups in Ecuador, Colombia, Costa Rica, and Mexico, and they were compared with the NOAA catalog (Olson & Gerrodette, 2008). Comparisons with photo-identification catalogs of killer whales from locations within those countries confirmed that this male killer whale had traveled throughout the Eastern Tropical Pacific from Banderas Bay (Mexico), off Isla del Caño (Costa Rica), and in Ecuador off Isla de la Plata, Puerto López, and Esmeraldas on the mainland, as well as off two islands within the Galápagos Islands. Locations, geographic positions, and dates of all sightings of Phantom are provided (Table 1).

Mexico

The earliest sighting of Phantom occurred in Banderas Bay three times across three different years in February 2001, March 2003, and February 2005. During the first two sightings, the killer whale was alone; and on a third occasion, he was with another male. In all three occasions, he was attacking humpback whales. There were no further details available regarding the number or the presence of calves of humpbacks whales.

Costa Rica

In August 2013, Phantom was seen alone 2 nmi north of Isla del Caño. He was traveling slowly throughout the area without a defined course. A group of three adult humpback whales were at close vicinity, around 1.5 nmi southwards, close to the Jardin area of the island.

Ecuador

About 1,000 km off the continental coast at the Galápagos Islands, Phantom was observed attacking a Bryde’s whale (*Balaenoptera* sp.) in July 2003; while in February 2014, Phantom was observed and photographed as part of two male and three female or juvenile killer whales preying on green sea turtles (*Chelonia mydas*) at Kicker Rock. One of us (JD) was scuba diving at Kicker Rock right after the attack and observed at least 30 green turtles in the area. Another adult male was identified within this pod. In August 2005 and September 2006, during a whale-watching trip from Puerto López to Isla de la Plata, Phantom was observed alone traveling in a southeast direction. No attacks on humpback whales are recorded nearby. On September 2015, during navigation in Punta Escalera on Isla de la Plata, Phantom was observed attacking a humpback whale calf, and the mother was separated from the calf. During the observation, the calf sunk with the killer whale and did not resurface (Figure 2), although the killer whale was observed several more times. On September 2017, at Isla de la Plata, Phantom displayed active behaviours, including breaching as well as tail and pectoral flipper splashing for twenty continuous minutes after which he continued traveling. While a group of

Table 1. Sighting localities, geographical position, and dates of the killer whale “Phantom” throughout the Eastern Tropical Pacific; sightings listed by location from north to south.

Location	Country	Position	Date	Code
Banderas Bay †	Mexico	20°42'40"N, 105°24'48"W	14/2/2001	UABCS-Oo-Dd-M27
Banderas Bay †	Mexico	20°42'17"N, 105°34'06"W	19/3/2003	UABCS-Oo-Dd-M27
Banderas Bay †	Mexico	20°38'25"N, 105°26'30"W	8/2/2005	UABCS-Oo-Dd-M27
Isla del Caño*	Costa Rica	8°44'34"N, 83°52'26"W	14/8/2013	OsaOo_03
Esmeraldas ¥	Ecuador	0°59'00.7"N, 79°56'06.9"W	8/8/2005	orca 0064
Leon Dormido ¥	Ecuador	(GI)0°46'49.6"S, 89°31'09.5"W	2/8/2014	orca 0064
Punta Albemarle ¥	Ecuador	(GI)0°14'42.6"S, 91°20'27.2"W	2/2/2017	orca 0064
Isla de la Plata §	Ecuador	1°20'11.21"S, 80°56'4.14"W	23/8/2005	ECpl0022
Puerto Lopez §	Ecuador	1°17'25.52"S, 81°0'43.32"W	5/9/2006	ECpl0022
Isla de la Plata §	Ecuador	1°16'53.86"S, 81°2'48.75"W	13/9/2015	ECpl0022
Isla de la Plata §	Ecuador	1°17'30.87"S, 81°2'49.80"W	14/9/2017	ECpl0022
Los Organos δ	Peru	4°6'44.71"S, 81°7'12.00"W	6/10/2017	PA6oct17Oc

Research groups that provided sightings of Phantom: † = Universidad Autónoma de Baja California Sur, * = Fundacion Keto, ¥ = Universidad San Francisco de Quito, § = Pacific Whale Foundation, and δ = Pacifico Adventures. GI = Galápagos Islands.

humpback whales (mother, escort, and calf) were at 200 m from the killer whale, no attack was observed. On the mainland coast of Ecuador, off Esmeraldas, this killer whale was observed together with another male killer whale chasing humpback whale mother and calf pairs in August 2005 (see also Pitman et al., 2017). On the mainland coast of Ecuador, off Esmeraldas, this killer whale was observed together with another male killer whale chasing humpback whale mother and calf pairs in August 2005 (see also Pitman et al., 2017).

Peru

During a whale-watching trip off Los Organos, northern Peru, on 6 October 2017 at 0812 h, we (RC-H, DV, and SP) encountered a humpback whale mother–calf pair moving in a southwest direction close to the shore. At 0840 h, another humpback whale breached at *ca.* 500 m distance, and we proceeded towards that individual navigating to the east. A lone killer whale was first documented at an approximate distance of *ca.* 200 m from the mother–calf pair. The killer whale appeared to be following the humpback whales, diving at 4-min intervals, and was repeatedly tail slapping the sea surface. At 0930 h, the killer whale, identified as Phantom,

disappeared from the visual range. The encounter was documented with a photographic camera Nikon 1 J5 with a Nikkor 30-110 mm f/3.8-5.6 vr. Lens. Photographs of the dorsal fin, saddle, eye patches, and fluke were taken for individual identification purposes. Phantom had a slightly wobbly yet straight dorsal fin with the tip of the fin subtly inclined to the left. The fluke had a notch on the left side and between five to 10 coronulid barnacles (*Xenobalanus globicipitis*) attached. Photographs of Phantom at all sighting locations are provided in Figure 2.

Discussion

The southeast Pacific population of humpback whales (designated as Stock G by the International Whaling Commission [IWC], 1998) breed from northern Peru to Costa Rica during the austral winter/spring (Scheidat et al., 2000; Félix & Haase, 2001; Rasmussen et al., 2011; Guidino et al., 2014; Valdivia et al., 2017). On the other hand, the northeast Pacific population known as Distinct Population Segment Central America (National Oceanic and Atmospheric Administration [NOAA], 2016) breeds during the boreal winter/spring in

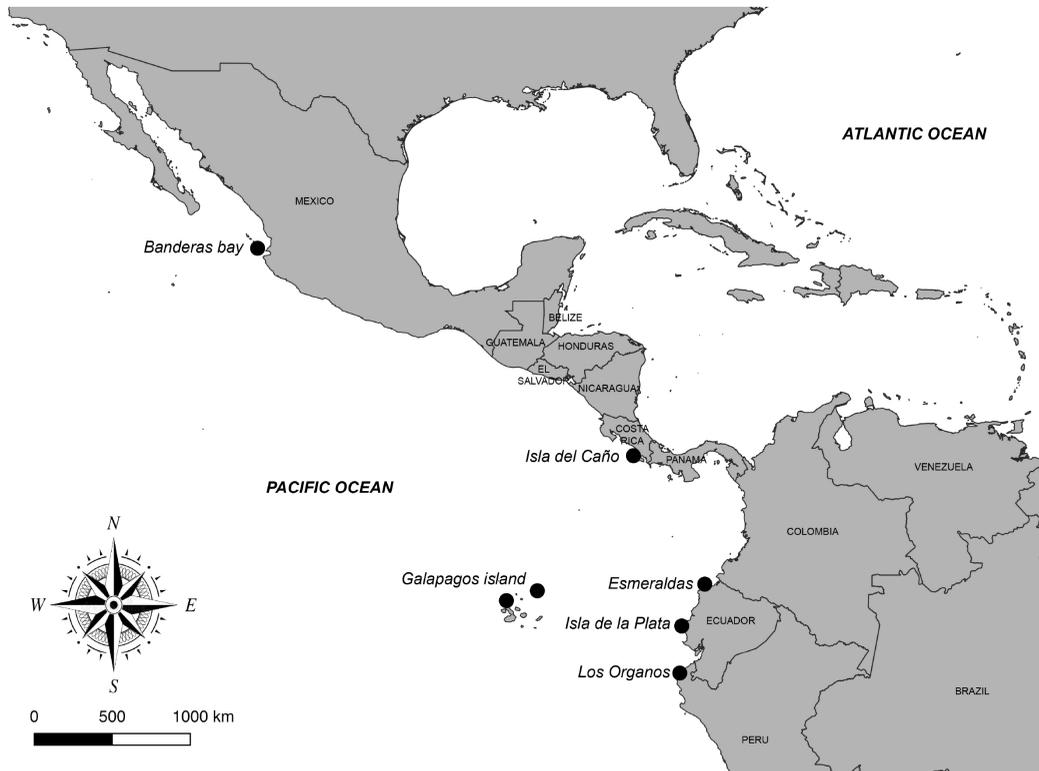


Figure 1. Map of the Eastern Tropical Pacific region showing sighting localities of Phantom; see Table 1 for sighting details.



Figure 2. Photographs of the individual sighted at each locality. The characteristic eye patch is presented next to the Banderas Bay photograph (Mexico). White arrows point to the distinctive notch in the fluke. Views of Phantom near a humpback whale calf are visible at the right side of the Isla de la Plata photo.

Mexican waters and off the coast of Central America (Urbán & Aguayo, 1987; Rasmussen et al., 2011). The sightings of Phantom at the locations reported herein (i.e., in both hemispheres) coincided with the breeding season of humpback whales except for sightings off the Galápagos Islands where there are more reports of killer whales in comparison to Peru, coastal Ecuador, and Costa Rica (Merlen, 1999; Denkinger et al., 2014). Concerning killer whale presence related to humpback whales, the latter can be seen year-round in the Galápagos (Denkinger et al., 2014), but it is not yet known whether humpback whales use the Galápagos Islands as a breeding area (Acevedo et al., 2017). Previous records of killer whales in the Eastern Tropical Pacific suggest that this species may feed or attack baleen whale calves (e.g., humpback whales off Colombia [Flórez-González et al., 1994] and Isla de la Plata [Scheidat et al., 2000; Castro & Scheidat, 2005], Ecuador; and blue whales [*Balaenoptera musculus*] off the Costa Rica Dome [Pitman et al., 2007]). Steiger et al. (2008) examined the incidence of killer whale rake marks on humpback whale flukes throughout the North Pacific and found that the population off mainland Mexico has a higher percentage of killer whale attacks (31%). The first three sightings of Phantom discussed in this note occurred in this region (2001–2005).

Our pooled observations suggest that Phantom is primarily solo and seems to focus (for our observations at least) foraging attention on humpback whale calves. However, killer whales in the Eastern Tropical Pacific consume a wide variety of prey and not only marine mammals. Off the coastal waters of Costa Rica, killer whales have been observed preying on sharks (either bull [*Carcharhinus leucas*] or lemon [*Negaprion brevirostris*] sharks; Fertl et al., 1996). At the Galápagos Islands, killer whales have been observed preying on sharks (*Sphyrna lewini*), rays (*Manta* sp., *M. birostris*, *Myliobatis* sp., and *Dasyatis* sp.), sea turtles (*Chelonia mydas*), sunfish (*Mola* sp.), finfish, and marine mammals other than humpbacks (de Roy, 1993; Brennan & Rodriguez, 1994; Merlen, 1999; Sorisio et al., 2006; Alava & Merlen, 2009; Alava et al., 2013). One of us (JD) saw Phantom preying on sea turtles while being part of a pod of five killer whales, including a juvenile, at the Galápagos Islands.

Even though how Phantom moved among locations remains unknown, the longest estimated distance is 3,839 km between Banderas Bay (Mexico) and Los Organos (Peru). Some killer whales at the Eastern Tropical Pacific are known to travel long distances (for just a few examples, see Guerrero-Ruiz et al., 2005; Dahlheim et al., 2008), and movements between humpback whale breeding areas of both hemispheres seems to be well justified since

it increases the possibilities to prey on calves. Although humpback whales fiercely defend their calves against killer whales (Pitman et al., 2017), the calves can constitute an important source of energy. Killer and humpback whale interactions have been very well described in Western Australia breeding grounds where killer whales kill and consume humpback whale calves (64% out of 22 documented attacks resulted in kill and consumption; Pitman et al., 2015). Considering that high success rate, Pitman et al. (2015) argued that this could be related to the high recovery of humpback whales in this area after the moratorium on commercial whaling and, thus, an increased amount of prey (i.e., calves) for killer whales. Possibly similar conditions resulted in the north and southeast Pacific, where humpback whale populations are also increasing in both hemispheres (Barlow et al., 2011; Félix et al., 2011). Most sightings of Phantom occurred towards the latter half of the humpback whale breeding season when mother–calf pairs remained in the area (Guidino et al., 2014).

Conclusions

The timing, patterns of movements, and predatory behavior displayed by this individual killer whale were observed concurrent to late humpback whale breeding seasons since most of our research effort is conducted during that period. There is uncertainty about whether Phantom (and others in the Eastern Tropical Pacific) follows humpback whales consistently or opportunistically. Observations of killer whale behavior and travel patterns are required outside of the humpback whale breeding seasons to address whether they take advantage of concurrent presence or focus attention on humpback whales. Although the findings reported herein suggest a link between humpback whales and Phantom, opportunistic feeding on available prey items was also supported given this killer whale's foraging behavior near the Galápagos Islands. However, it could be predicted that Phantom potentially belongs to a population that preys on a wide spectrum of prey. To increase our knowledge about killer whales in this part of the Pacific, we encourage further collaborative research in the region via comparisons of available killer whale photo-identification catalogs and year-round investigative effort.

Acknowledgments

In Peru, we thank the Pacifico Adventures crew—in particular, the skippers Luis Chapas, Alex Marchan, and Aldo Muñoz. We thank the tour guides of Linblad Expeditions for providing sighting information at the Galápagos. In Ecuador, we thank Palo

Santo Travel Tour and the skipper Jaime Parrales. Research in Puerto Lopez was funded by the Pacific Whale Foundation (PWF). PWF also thanks Marcel Morais, Luna Barragan, and Annie Macie. PWF dedicates this note to Gregory Kaufman, who inspired us to continue with our research. Comments by Ingrid Visser, Kathleen Dudzinski, and an anonymous reviewer helped us to improve this manuscript.

Literature Cited

- Acevedo, J., Aguayo-Lobo, A., Allen, J., Botero-Acosta, N., Castro, C., Dalla Rosa, L., . . . Stevick, P. T. (2017). Migratory preferences of humpback whales between feeding and breeding grounds in the eastern South Pacific. *Marine Mammal Science*, 33(4), 1035-1052. <https://doi.org/10.1111/mms.12423>
- Alava, J. J., & Merlen, G. (2009). Video-documentation of a killer whale (*Orcinus orca*) predatory attack on a giant manta (*Manta birostris*) in the Galápagos Islands. *Latin American Journal of Aquatic Mammals*, 7(1-2), 81-84. <https://doi.org/10.5597/lajam00139>
- Alava, J. J., Smith, K. J., O'Hern, J., Alarcón, D., Merlen, G., & Denkinger, J. (2013). Observations of killer whale (*Orcinus orca*) attacks on Bryde's whales (*Balaenoptera edeni*) in the Galápagos Islands. *Aquatic Mammals*, 39(2), 196-201. <https://doi.org/10.1578/AM.39.2.2013.196>
- Baird, R. W., & Whitehead, H. (2000). Social organization of mammal-eating killer whales: Group stability and dispersal patterns. *Canadian Journal of Zoology*, 78(12), 2096-2105. <https://doi.org/10.1139/z00-155>
- Barlow, J., Calambokidis, J., Falcone, E. A., Baker, C. S., Burdin, A. M., Clapham, P. J., . . . Yamaguchi, M. (2011). Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. *Marine Mammal Science*, 27(4), 793-818. <https://doi.org/10.1111/j.1748-7692.2010.00444.x>
- Brennan, B., & Rodriguez, P. (1994). Report of two orca attacks on cetaceans in Galápagos. *Noticias de Galápagos*, 54, 28-29.
- Castro, C., & Scheidat, M. (2005, December). Current knowledge of orca (*Orcinus orca*) attacks on humpback whale (*Megaptera novaeangliae*) in Machalilla National Park, Ecuador. *Proceedings of the 16th Biennial Conference on the Biology of Marine Mammals*, San Diego, CA.
- Dahlheim, M. E., Leatherwood, S., & Perrin, W. F. (1982). Distribution of killer whales in the warm temperate and tropical Eastern Pacific (SC/Jn81/KW3). *Report of the International Whaling Commission*, 32, 647-653.
- Dahlheim, M. E., Schulman-Janiger, A., Black, N., Ternullo, R., Ellifrit, D., & Balcomb III, K. C. (2008). Eastern temperate North Pacific offshore killer whales (*Orcinus orca*): Occurrence, movements, and insights into feeding ecology. *Marine Mammal Science*, 24(3), 719-729. <https://doi.org/10.1111/j.1748-7692.2008.00206.x>
- Denkinger, J., Oña, J., Alarcón, D., Merlen, G., Salazar, S., & Palacios, D. M. (2013). From whaling to whale watching: Cetacean presence and species diversity in the Galapagos marine reserve. In S. J. Walsh & C. F. Mena (Eds.), *Science and conservation in the Galapagos islands: Frameworks & perspectives, social and ecological interactions in the Galapagos Islands 1* (pp. 217-243). Berlin: Springer Science+Business Media, LLC. https://doi.org/10.1007/978-1-4614-5794-7_13
- de Roy, T. (1993). Orca bull feeding on eagle ray, Santa Cruz, Galápagos. *Ocean Realm*, 55(Jan./Feb.), 55.
- Félix, F., & Haase, B. (2001). The humpback whale off the coast of Ecuador, population parameters and behavior. *Revista de Biología Marina y Oceanografía*, 36(1), 61-74. <https://doi.org/10.4067/S0718-19572001000100006>
- Félix, F., Castro, C., Laake, J. L., Haase, B., & Scheidat, M. (2011). Abundance and survival estimates of the south-eastern Pacific humpback whale from 1991-2006 photo-identification surveys in Ecuador. *Journal of Cetacean Research and Management*, 3(Special issue), 301-307.
- Fertl, D., Acevedo-Gutierrez, A., & Darby, F. L. (1996). A report of killer whales (*Orcinus orca*) feeding on a carcharhinid shark in Costa Rica. *Marine Mammal Science*, 12(4), 606-611. <https://doi.org/10.1111/j.1748-7692.1996.tb00075.x>
- Flórez-González, L., Capella, J. J., & Rosenbaum, H. C. (1994). Attack of killer whales (*Orcinus orca*) on humpback whales (*Megaptera novaeangliae*) on a South American Pacific breeding ground. *Marine Mammal Science*, 10(2), 218-222. <https://doi.org/10.1111/j.1748-7692.1994.tb00264.x>
- Ford, J. K. B. (2008). Killer whale *Orcinus orca*. In W. F. Perrin, B. Würsig, & J. G. M. Thewissen (Eds.), *Encyclopedia of marine mammals* (pp. 650-657). San Diego, CA: Academic Press.
- Ford, J. K. B., Ellis, G. M., Barrett-Lennard, L. G., Morton, A. B., Palm, R. S., & Balcomb III, K. C. (1998). Dietary specialization in two sympatric populations of killer whales (*Orcinus orca*) in coastal British Columbia and adjacent waters. *Canadian Journal of Zoology*, 76(8), 1456-1471. <https://doi.org/10.1139/z98-089>
- García-Godos, I. (2004). Killer whale (*Orcinus orca*) occurrence off Peru, 1995-2003. *Latin American Journal of Aquatic Mammals*, 3(2), 177-180. <https://doi.org/10.5597/lajam00064>
- Guerrero-Ruiz, M., García-Godos, I., & Urbán R., J. (2005). Photographic match of a killer whale (*Orcinus orca*) between Peruvian and Mexican waters. *Aquatic Mammals*, 31(4), 438-441. <https://doi.org/10.1578/AM.31.4.2005.438>
- Guerrero-Ruiz, M., Gendron, D., & Urbán R., J. (1998). Distribution, movements and communities of killer whales (*Orcinus orca*) in the Gulf of California, Mexico (SC/49/SM44). *Report of the International Whaling Commission*, 48, 537-543.
- Guidino, C., Llapasasca, M. A., Silva, S., Alcorta, B., & Pacheco, A. S. (2014). Patterns of spatial and temporal distribution of humpback whales at the southern limit of the Southeast Pacific breeding area. *PLOS ONE*, 9(11), e112627. <https://doi.org/10.1371/journal.pone.0112627>
- Häussermann, V., Acevedo, J., Försterra, G., Bailey, M., & Aguayo-Lobo, A. (2013). Killer whales in Chilean

- Patagonia: Additional sightings, behavioural observations, and individual identifications. *Revista de Biología Marina y Oceanografía*, 48(1), 73-85. <https://doi.org/10.4067/S0718-19572013000100007>
- International Whaling Commission (IWC). (1998). Report of the Sub-Committee on Comprehensive Assessment of Southern Hemisphere Humpback Whales, Annex G. *Report of the International Whaling Commission*, 48, 170-182.
- Lodi, L., & Farias-Júnior, S. (2011). Movements of a solitary adult male killer whale, *Orcinus orca* (Cetacea, Delphinidae), along the coast of south-eastern Brazil. *Pan-American Journal of Aquatic Science*, 6(4), 325-328.
- Merlen, G. (1999). The orca in the Galápagos: 135 sightings. *Noticias de Galápagos*, 60(December), 1-9.
- Morin, P. A., Archer, F. I., Foote, A. D., Vilstrup, J., Allen, E. E., Wade, P., . . . Harkins, T. (2010). Complete mitochondrial genome phylogeographic analysis of killer whales (*Orcinus orca*) indicates multiple species. *Genome Research*, 20, 908-916. <https://doi.org/10.1101/gr.102954.109>
- National Oceanic and Atmospheric Administration (NOAA). (2016). Endangered and threatened species; Identification of 14 distinct population segments of the humpback whale (*Megaptera novaeangliae*) and revision of species-wide listing; Final rule. *Federal Register*, Part II, 81(174). Washington, DC: U.S. Department of Commerce.
- Olson, P. A., & Gerrodette, T. (2008). *Killer whales of the Eastern Tropical Pacific: A catalog of photo-identified individuals* (NOAA-TM-NMFS-SWFSC-428). Silver Spring, MD: National Oceanic and Atmospheric Administration. Retrieved from <https://swfsc.noaa.gov/publications/TM/SWFSC/NOAA-TM-NMFS-SWFSC-428.pdf>
- Pilot, M., Dahlheim, M. E., & Hoelzel, A. R. (2010). Social cohesion among kin, gene flow without dispersal and the evolution of population genetic structure in the killer whale (*Orcinus orca*). *Journal of Evolutionary Biology*, 23, 20-31. <https://doi.org/10.1111/j.1420-9101.2009.01887.x>
- Pitman, R. L., & Ensor, P. (2003). Three forms of killer whales (*Orcinus orca*) in Antarctic waters. *Journal of Cetacean Research and Management*, 5(2), 131-139.
- Pitman, R. L., Fearnbach, H., LeDuc, R., Gilpatrick, J. W., Jr., Ford, J. K. B., & Ballance, L.T. (2007). Killer whales preying on a blue whale calf on the Costa Rica Dome: Genetics, morphometrics, vocalisations and composition of the group. *Journal of Cetacean Research and Management*, 9(2), 151-157.
- Pitman, R. L., Totterdell, J. A., Fearnbach, H., Ballance, L. T., Durban, J. W., & Kemps, H. (2015). Whale killers: Prevalence and ecological implications of killer whale predation on humpback whale calves off Western Australia. *Marine Mammal Science*, 31(2), 629-657. <https://doi.org/10.1111/mms.12182>
- Pitman, R. L., Deecke, V. B., Gabriele, C. M., Srinivasan, M., Black, N., Denking, J., . . . Ternullo, R. (2017). Humpback whales interfering when mammal-eating killer whales attack other species: Mobbing behavior and interspecific altruism? *Marine Mammal Science*, 33(1), 7-58. <https://doi.org/10.1111/mms.12343>
- Rankin, S., Archer, F., & Barlow, J. (2013). Vocal activity of tropical dolphins is inhibited by the presence of killer whales, *Orcinus orca*. *Marine Mammal Science*, 29(4), 679-690. <https://doi.org/10.1111/j.1748-7692.2012.00613.x>
- Rasmussen, K., Calambokidis, J., & Steiger, G. H. (2011). Distribution and migratory destinations of humpback whales off the Pacific coast of Central America during the boreal winters of 1996-2003. *Marine Mammal Science*, 28(3), E267-E279. <https://doi.org/10.1111/j.1748-7692.2011.00529.x>
- Scheidat, M., Castro, C., Denking, J., González, J., & Adelung, D. (2000). A breeding area for humpback whales (*Megaptera novaeangliae*) off Ecuador. *Journal of Cetacean Research and Management*, 2(3), 165-171.
- Sorisio, S. L., De Maddalena, A., & Visser, I. N. (2006). Interaction between killer whales (*Orcinus orca*) and hammerhead sharks (*Sphyrna* sp.) in Galápagos waters. *Latin American Journal of Aquatic Mammals*, 5(1), 69-71. <https://doi.org/10.5597/lajam00095>
- Steiger, G. H., Calambokidis, J., Straley, J. M., Herman, L. M., Cerchio, S., Salden, D. R., . . . Barlow, J. (2008). Geographic variation in killer whale attacks on humpback whales in the North Pacific: Implications for predation pressure. *Endangered Species Research*, 4, 247-256. <https://doi.org/10.3354/esr00078>
- Testino, J. P., Petit, A., Alcorta, B., Pacheco, A. S., Silva, S., Alfaro-Shigueto, J., . . . González-Pestana, A. (2018). Killer whale (*Orcinus orca*) occurrence and interactions with marine mammals off Peru. *Pacific Science*, 73(2), 1-13. <https://doi.org/10.2984/73.2.7>
- Urbán R., J., & Aguayo, L. A. (1987). Spatial and seasonal distribution of the humpback whale, *Megaptera novaeangliae*, in the Mexican Pacific. *Marine Mammal Science*, 3(4), 333-344. <https://doi.org/10.1111/j.1748-7692.1987.tb00320.x>
- Valdivia, C., Pacheco, A. S., Félix, F., Haase, B., Rasmussen, K., Santillán, L., Alcorta, B., & Silva, S. (2017). Movements and timing of humpback whale (*Megaptera novaeangliae*) within the breeding region of the eastern South Pacific. *Aquatic Mammals*, 43(3), 324-330. <https://doi.org/10.1578/AM.43.3.2017.324>
- Visser, I. N. (1999). Antarctic orca in New Zealand waters? *New Zealand Journal of Marine and Freshwater Research*, 33, 515-520. <https://doi.org/10.1080/00288330.1999.9516896>
- Visser, I. N., & Bonaccorso, F. J. (2003). New observations and a review of killer whale (*Orcinus orca*) sightings in Papua New Guinea waters. *Aquatic Mammals*, 29(1), 150-172. <https://doi.org/10.1578/016754203101024004>
- Weir, C. R., Collins, T., Carvalho, I., & Rosenbaum, H. C. (2010). Killer whales (*Orcinus orca*) in Angolan and Gulf of Guinea waters, tropical West Africa. *Journal of the Marine Biological Association of the United Kingdom*, 90(8), 1601-1611. <https://doi.org/10.1017/S002531541000072X>