Short Note

From Breeding to Feeding Grounds: Tracking the Survival of a White Humpback Whale (*Megaptera novaeangliae*)

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The humpback whale (Megaptera novaeangliae) has populations distributed throughout the world's oceans (Clapham & Mead, 1999). The population inhabiting the eastern South Pacific breeds from northern Peru to southern Nicaragua between early May and late October (Scheidat et al., 2000; Acevedo et al., 2007; Guidino et al., 2014; Ávila et al., 2020; De Weerdt et al., 2020). These humpback whales migrate to their feeding grounds during the austral summer, from December to May, in the waters surrounding the Antarctic Peninsula, the Fueguino Archipelago in the Strait of Magellan, and the Gulf of Corcovado in southern Chile (Gibbons et al., 2003; Acevedo et al., 2006, 2007, 2013, 2017; Hucke-Gaete et al., 2013).

In the eastern South Pacific, the peak abundance of humpback whale calves at breeding grounds occurs between August and September (Chittleborough, 1958; Félix & Haase, 2001; Guidino et al., 2014; Ávila et al., 2020; Martinez-Fernández, 2021; Pacheco et al., 2021). Breeding habitats are important for physical growth, cognitive development, and the maintenance of whale populations. However, in this habitat and throughout their migration route, calves are vulnerable to several threats that compromise their survival such as mortality from ship strikes and entanglement in fishing gear (Van Waerebeek et al., 2007; García-Godos et al., 2013; Ávila et al., 2017, 2022; Félix et al., 2020; Costanza et al., 2021). The first-year survival rate in this species is lower than that of adults, with the highest expected survival rate to be 6 mo or younger (Gabriele et al., 2001; Mizroch et al., 2004; Zerbini et al., 2010).

Most cetacean species have a characteristic dark skin coloration produced by melanin (Behrmann, 1998). However, white coloration or hypopigmentation can occur due to an abnormality in the tyrosinase gene responsible for melanin production (Behrmann, 1998). This phenotypic condition can manifest in different forms, such as albinism, leucism, or partial discoloration, and can be caused by approximately 100 possible mutations in the tyrosinase gene (Oetting et al., 2009). Hypopigmented cetaceans are a rare occurrence in nature, but this condition has been reported in at least 25 species, including humpback whales (Hain & Leatherwood, 1982; Fertl et al., 1999, 2004). Patterns of body coloration of humpback whale populations in the eastern South Pacific have not been studied in detail. However, according to Acevedo et al. (2017), an analysis of fluke coloration suggests that whales in the southern part of the breeding ground tend to have white ventral regions, while those in the northern area predominantly exhibit dark or black coloration.

Previous reports have indicated the presence of hypopigmented humpback whale individuals in different ocean regions (Forestell et al., 2001; Castro et al., 2007; Polanowski et al., 2012; Lydersen et al., 2013; Koper et al., 2017; De Weerdt, 2023). Albinism was only confirmed by genetic analysis of an adult male whale (known as "Migaloo") in eastern Australia (Forestell et al., 2001; Polanowski et al., 2012). Except for Migaloo, whose sightings have been recorded for almost 30 y (Pirotta et al., 2023), resightings of white humpback whales are unusual. Herein, we document and analyze the first-year survival of a white humpback whale from the eastern South Pacific population, aiming to enhance the understanding of the migratory movements of the species in the region.

We reconstructed the timeline of sightings of the white humpback whale using our observations (GPS positions and photographs) in breeding areas during 2022 and 2023. Also, we include the information from a sighting in the Antarctic feeding grounds recorded on the Happywhale web platform in 2023. Distances between sighting points and the distance from the sighting locations to the nearest perpendicular point on the coast were estimated with the 'Measure Line' tool of QGIS, Version 3.16. For reporting purposes, we contacted all relevant colleagues and tour operators from Costa Rica to Chile to notify them of the presence of the white humpback whale. We monitored social media for any sightings; and, in cases where evidence was found, observers were requested to provide comprehensive details,

including timing, exact location, and behavioral observations.

The white humpback whale was sighted a total of eight times in three locations over nearly 14 mo in three countries/regions (Table 1; Figure 1) as described in the following three sections.

Costa Rica

The initial sighting of the white humpback whale took place on 2 October 2022. Two whales were sighted from an aircraft off the coast of the Ostional Wildlife Refuge in northwestern Costa Rica (9° 56' 24.9" N, 85° 40' 25.6" W) at 0850 h (Figure 1B). Photographs revealed that the white humpback whale was approximately half the size of the larger whale (white whale: ~ 5 m in length; adult whale: ~10 m in length) and had an almost completely unfurled dorsal fin (Figure 2A). Based on the size proportion and their close interaction, it was assumed that the pair consisted of a mother and her hypopigmented calf. Over the following 2 wks, five additional boat sightings were confirmed along the central and southern coasts of Costa Rica (Figure 1B). Sightings of the mother-calf pair occurred in coastal waters at an average distance of 1.8 km from the shoreline. The last sighting was recorded on 16 October 2022 at 0943 h in Osa (9° 07' 56.750" N, 83° 46' 23.870" W). By 1039 h, the whales had moved into deeper waters, apparently avoiding a group of 22 false killer whales (Pseudorca crassidens) reported 7.6 km away (9° 06' 10.950" N, 83° 44' 34.160" W) at 1140 h. The distance between the first and last sighting

Date Country Location Position Reporters 2 Oct. 2022 9° 56' 24.9" N, Felipe Chávez, Instituto de Formación Costa Rica Playa Guiones 85° 40' 25.6" W Aeronáutica 3 Oct. 2022 Costa Rica Cabo Blanco. 9° 42' 15.4" N, Juan Diego Vallejos Espinoza, Ti Marouba Tambor 84° 57' 30.2" W 9° 43' 33.3" N. 4 Oct. 2022 Costa Rica Golfo de Nicoya Eduardo Gonzales Barrientos 84° 56' 28.9" W 5 Oct. 2022 9° 43' 08.7" N Costa Rica Bahía Ballena. Brandon Muñoz, Pura Vida Tours 84° 57' 52.3" W Tambor 7 Oct. 2022 Costa Rica Golfo de Nicoya 9° 42' 49.7" N Randall Garcia Canales, Hidden Wood 84° 40' 29.9" W 16 Oct. 2022 Costa Rica Bahía Ballena 9° 10' 04.3" N Reimer Brenes, Bahía Aventuras & 83° 48' 46.9" W Junior Monge, Fragata Tours El Ñuro 16 Aug. 2023 Peru 4° 11' 03.5" S Sarai Cortez-Casamayor, Caterina 81° 10' 49.5" W Gutierrez & Benny Guillen, Pacifico Adventures 22 Dec. 2023 Antarctic 66° 32' 24.0" S, Marta Passage Alex Cowan, Aurora Expeditions' Peninsula 67° 43' 12.0" W Greg Mortimer

Table 1. Chronological sighting of the white humpback whale (Megaptera novaeangliae) between 2022 and 2023



Figure 1. (A) Map showing the white humpback whale's (*Megaptera novaeangliae*) sighting locations (black dots) in Costa Rica (1), Peru (2), and Antarctica (3); (B) six sighting positions were recorded in Costa Rica in October 2002; the red arrow represents the timing and direction of the sightings in the coastal waters of Costa Rica; (C) sighting position off El Ñuro, northern Peru, in August 2023; and (D) the last sighting position recorded in the Matha Strait, Antarctica, in December 2023.

of the mother–calf pair in Costa Rica was about 240 km. The whale calf was named "Suru," which means "white" in the aboriginal language of the native Costa Rican people.

Peru

The following year, on 16 August 2023 at 0905 h, a solo white humpback whale was observed during a whale-watching expedition off El Ñuro, Piura, northern Peru (4° 11' 03.5" S, 81° 10' 49.5" W; Figure 1C). The whale was found 2.7 km from the coast in proximity to a group of pantropical spotted dolphins (*Stenella attenuata*). During the sighting, the whale did not show evasive behavior

and approached one of the three whale-watching vessels present to a proximity of 2 m. Color pigmentation was not evident in eyes or blowholes, and the only contrast to its white coloration was the darker round aspect produced by the epibiont barnacles on the dorsal region (Figure 2B). The whale had rake marks on its fluke (Figure 2C & D), but it appeared healthy and showed no signs of distress. A length estimate of 8 m was derived using the nearby boat as a reference for measurement in a parallel position. Vessels followed the whale for 4 km and left the animal at 1015 h off Cabo Blanco (4° 12' 31.7" S, 81° 12' 24.5" W). Photographs taken during this sighting were



Figure 2. (A) First sighting of the white humpback whale, Suru, in Costa Rica (CR) in 2022, accompanied by an adult; (B) complete view of the white humpback whale body in Peru (PE) in 2023; (C) rake marks on the dorsal part of its left lobe and (D) on the ventral part of its right lobe near the upper edge of its caudal fin; (E) comparison of dorsal fins; (F) tubercles in 2022 and 2023; red arrows point to the tubercle positions that confirm the identification of the individual; and (G) last sighting on the Antarctic Peninsula (AP) in 2023; the whale was more extensively covered with epibionts at this sighting.

compared with images from Costa Rica. The similarity of the dorsal fin shape, tubercles around the rostrum, and epibiont distribution (Figure 2E & F) confirmed the record of the same white humpback whale sighted a year earlier in Costa Rican waters.

Antarctic Peninsula

On 22 December 2023 at 0615 h, 128 d after the sighting in northern Peru, a white humpback whale was sighted in the Matha Strait, Antarctic Peninsula (66° 32' 24.0" S, 67° 43' 12.0" W; Figure 1D). A video was taken by an anonymous passenger on a tourist cruise ship (Aurora Expeditions' Greg Mortimer). The video was subsequently uploaded to the Happywhale website (https://happywhale. com/individual/110112;enc=424916). Screenshots from the video of the body and dorsal fin were analyzed and compared with pictures taken in Costa Rica and Peru by six team members with expertise in humpback whale photo-identification. The white humpback whale was sighted on its own, with a more yellowish coloration (probably due to the microalgae biofilm covering the body) and more epibionts on the dorsal area (Figure 2G); however, the consistent shape of the dorsal fin in all images confirmed the whale's identification as the same individual previously sighted in Costa Rica and Peru. It traveled an approximate straight-line distance of 7,025 km from the last sighting in Peru and was observed swimming; the short duration of the video precluded us from further descriptions of the whale's behavior.

In this short note, the first-year survival and migratory movements of a white humpback whale in the eastern South Pacific Ocean were reported for the first time. Sightings of the whale occurred at breeding areas for two consecutive years and once in the Antarctica feeding grounds. Hypopigmented cetaceans are rare due to their low probability of survival associated with their atypical coloration (Hauser-Davis et al., 2020). This white coloration facilitates predation, decreases foraging efficiency, increases ocular and skin sensitivity, and reduces the success of sexual selection (Hain & Leatherwood, 1982; Fertl et al., 2004; Caro et al., 2011; Polanowski et al., 2012). However, despite this reduced fitness, hypopigmented humpback whales can reach adulthood (Lydersen et al., 2013; De Weerdt, 2023; Pirotta et al., 2023). Photographic evidence, including teeth rake marks on the fluke, also indicates that the white humpback whale successfully escaped an attack or harassment event.

The white humpback whale was sighted for the first time in Costa Rica on 2 October 2022, as reported by Mora et al. (2022), accompanied by a larger, dark-colored whale presumed to be its mother. They also estimated that, based on size, the white humpback whale was a week-old newborn (Mora et al., 2022). However, pictures provided showed a whale one-half the size of the adult with an almost completely unfurled dorsal fin, which very likely corresponds to a more mature whale (Cartwright & Sullivan, 2009). Our last sighting of the white humpback whale in Costa Rica was on 16 October 2022, 14 d after the first sighting and near the end of the breeding season for this population (Guidino et al., 2014). Since mother and calf pairs are the last to leave the Southeast Pacific breeding region (Guidino et al., 2014), the white humpback whale could have been an older calf ready to migrate to feeding grounds farther south (Valdivia et al., 2017). The following year in Peru, the white humpback whale was already weaned, and its latest size estimate was consistent with the 8 to 10 m length that humpback whales reach by the end of their first year of life (Clapham et al., 1999).

The observations by Mora et al. (2022) also indicated that the white humpback calf exhibited a faint pinkness around its blowhole, suggesting that Suru could be albino. However, this coloration was not observed during the subsequent sighting in Peru a year later. To determine the cause of Suru's hypopigmentation, it is important to collect sloughed skin and/or skin biopsy samples (Polanowski et al., 2012) for genetic analysis to determine its origin.

The waters of the western Antarctic Peninsula serve as feeding areas for humpback whales of the Southeast Pacific population. The sighting of the white humpback whale in this area confirms its successful migration to feeding grounds. According to Félix & Guzmán (2014), a Southeast Pacific humpback whale could take an average of 66.4 d using an offshore route and 70.8 d using a coastal route to migrate from breeding to feeding grounds. The migration of the white humpback whale took at most 128 d, longer than the estimated time. It is important to note that the estimations made by Félix & Guzmán are based on satellite-tagged single adults and adults in the company of a calf. In the case of this white humpback whale, this corresponds to the first migration of an independent subadult.

Although the connectivity between the feeding and breeding grounds of the eastern South Pacific humpback whales has been well established (e.g., Acevedo et al., 2017), we provide evidence of (1) the connectivity of critical habitats with a subadult white individual for the first time and (2) the survival of a hypopigmented, advanced-stage calf to a young juvenile in both critical habitats. The strong site fidelity to breeding and feeding areas of humpback whales allows us to predict that the white humpback whale could be seen in the following years. Due to its distinctive appearance, Suru is a potential candidate for long-term observation (Burns et al., 2014; Pirotta et al., 2023). We encourage using citizen science and social media to monitor this white humpback whale and cetaceans in general.

Acknowledgments

Thanks to Felipe Chávez Jimenez, Gustavo Carrasco, and Javier Kanamori for providing additional photographs for the analysis. We thank the Pacifico Adventures crew in Peru-particularly Captain Benny Guillen, Diego Cortés, and Keyssi Rodriguez. In Costa Rica, JDPA, FGA, and FCJ thank the captains and tourism guides for sharing information: Juan Diego Vallejos Espinoza and the Ti Marouba crew; Randall Garcia Canales (Hidden Wood); Eduardo Gonzales Barrientos (Tambor); Dario Mora (Uvita); Reimer Brenes, Nelson Brenes, Rafael Sanchez, and Cindy Thiele (Bahía Aventuras); and Junior Monge (Fragata Tours). Additionally, thanks to the Área de Conservación Osa for Research Permission N°SINAC-ACOSA-DASP-PI-R-060-2021 to Laura May-Collado and JDPA. In Antarctica, TC thanks Alex Cowan for reporting the Marta Passage encounter and sharing media from an anonymous guest. We extend our gratitude to the three anonymous reviewers whose comments have contributed to improve this manuscript.

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