First record of a fin whale (*Balaenoptera physalus*) in coastal waters of Ecuador in a century

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ABSTRACT

A male 16.9m fin whale (*Balaenoptera physalus*) was stranded on 3 April 2019 at Chanduy southwestern Ecuador (2°23'29.4"S, 80°44'17.96"W). Its colouration pattern, including the white-coloured right side of the mouth and around 200 cream-coloured baleens, are characteristics of the species. This is the first confirmed record of the species in almost a century in mainland Ecuador. A skin sample was taken for molecular studies. Fragments of the D-loop and CytB mitochondrial genes were amplified and compared with global databases. The D-loop fragment matched with a haplotype found in a fin whale from the Central-south of Chile and the CytB with several populations in both hemispheres. Our findings confirm that the Ecuadorian coast is part of the distribution area of southeastern Pacific fin whales.

KEYWORDS: STRANDINGS; DISTRIBUTION; SOUTH AMERICA; GENETICS; FIN WHALE

INTRODUCTION

The fin whale (*Balaenoptera physalus*) is the second largest among baleen whales. Its distribution is cosmopolitan along temperate and subpolar waters in both hemispheres, including large inner seas such as the Mediterranean and the Gulf of California, but is considered rare in tropical areas (Jefferson *et al*., 2008; Edwards *et al*., 2015). Most fin whale populations were depleted by whaling activities at the end of the 19th century and during most of the 20th century. For this reason, its hunting was prohibited in the North Pacific and the Antarctic in 1976 by the International Whaling Commission (IWC), and is listed as Vulnerable in the IUCN Red List of threatened species (Cooke, 2018). Abundance surveys in both hemispheres show that the species is recovering, especially in the northern hemisphere (Cooke, 2018). Although fairly well-known in areas where the species concentrates, its population structure, migration routes, breeding areas, and seasonal distribution are poorly known (Jefferson *et al*., 2008; Edwards *et al*., 2015; Cooke, 2018). The taxonomy of the species is not sufficiently defined yet, and molecular studies show a high divergence between ocean basins in the Northern Hemisphere and between hemispheres (Berube *et al*., 1998; Archer *et al*., 2013; 2019). The Committee on Taxonomy of the Society for Marine Mammalogy (2021) recognises four subspecies: *B. p. physalus* in the North Atlantic, *B. p. velifera* in the North Pacific, *B. p. quoyi* and a smaller and darker form *B. p. patachonica* in the southern hemisphere. The North Pacific fin whale population has a complex population structure with up to six different subpopulations (Mizroch *et al*., 2009). There are at least three different clades in the Northeast Pacific living in sympatry, composed of a genetically isolated population in the Gulf of California (Berube *et al*., 2002), and at least two clades with some level of association with populations from the Southern Hemisphere (Archer *et al*., 2013; 2019).

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Fin whales in the Southeast Pacific are by far less known than in the North Pacific. Between 1908 and 1975, a total of 8,241 fin whales were taken from whaling stations in Peru and Chile (Clarke *et al*., 1980). The most important whaling area was the south-central coast of Chile (37°S and 44°S) (Risting, 1928). Whaling records from Paita, northern Peru (5°S) show that the species was taken mainly between October and February (Ramírez, 1988). The considerably smaller size of the animals from Peru (average, males 16.4 and females 16.9) (Ramírez, 1988) versus those from Antarctic (20.1–21.6 m), and the inconsistency in the total length of specimens taken by the Japanese fleet versus other fleets in Antarctic waters (60–90cm) (Clark, 1983), led to the hypothesis on the existence of the pygmy subspecies *B. p. patachonica* in the Southeast Pacific (Clarke, 2004). For decades, fin whales have been recorded throughout the year, both in coastal and oceanic waters of Chile (Clarke, 1962; Clarke *et al*., 1978; Acevedo *et al*., 2012; Pacheco *et al*., 2015; Toro *et al*., 2016). Some specimens tagged off central Chile in the late 1950s with Discovery tags were recovered in whaling campaigns in Antarctica in Areas I and II showing that some fin whales distributed off Chile are part of the Antarctic stock (Clarke, 1962). Recently, individuals instrumented with satellite tags off central Chile showed a mixed movement pattern with a whale traveling south towards Antarctic waters, but others stayed in medium latitudes, probably feeding in the highly productive Chilean waters (Sepúlveda *et al*., 2018). Residence periods of three months and interannual re-sightings have been reported off central Chile, highlighting its importance as a feeding area for the species (Toro *et al*., 2016). The record of a large group likely > 100 animals 1,517nm off central Chile (21°S) in May 2010 indicates that the species is widely distributed in oceanic waters in the Southeast Pacific (Acevedo *et al*., 2012).

Whaling statistics from northern Peru (6°) suggested that fin whales were relatively abundant in the northwestern coast of South America (Ramírez, 1988; Clarke *et al*., 1980). Nevertheless, the last record of the presence of this species in Ecuador´s coastal waters dates of 1926, when fin whales, blue whales (*B. musculus*) and humpback whales (*Megaptera novaeangliae*) were taken during a whaling campaign (Norsk Hvalfangsttid, 1927; cited in Clarke, 1962). Most fin and blue whales taken in this campaign were considered young according to their size (Risting, 1928). A specific reference to the presence of the subspecies *B. p. patachonica* off the coast of Ecuador was made by Christensen (1926, cited by Clarke, 2004) based on sightings in 1912, 1914 and 1925–26. Since then, there have been no records of the species on coastal waters of Ecuador. Numerous research efforts were carried out in the Galapagos Islands, 1,000km west of the Ecuadorian coast. These include cruises carried out by the United States NOAA, as part of its marine mammal population assessment program in the Eastern Tropical Pacific (Hamilton *et al*., 2009), and from whaling exploration campaigns by Japanese ships during 1963 and 1964 between the coast of Ecuador and the Galapagos (Loesch, 1966). However, there are only over a dozen sightings in waters around the archipelago (Denkinger *et al*., 2013). Thus, the case we report here is an exceptional event for mainland Ecuador.

The event

On 3 April 2019 a male fin whale of 16.9m in length beached alive at Playa Real, Chanduy, a rocky and narrow shore located on the northern part of the Gulf of Guayaquil, southwestern Ecuador (2°23’29.4” S, 80°44’17.96” W) (Fig. 1). According to local people, the whale had arrived around 11:00 and died approximately 6 hours later. This information is consistent with the series of lacerations and superficial wounds found in different parts of the body when we examined the specimen the next morning. Such superficial wounds with hemorrhages were located mainly on the ventral side and could have been caused by the stones on the beach when the animal was still alive.

When examined, the specimen maintained its colouration pattern on most of its body, dark greyish on the dorsal area and flanks. White in the ventral part, including the throat and ventral pleats, belly, genital area and most of the ventral side of the flukes. The white colouration extended slightly upward to the flanks above the genital area. It had white mandibles and maxillary tips on the right side. We counted more than 400 baleen plates in the right mandible, from which 200 were cream-coloured, thin plates. They formed about one-third of the total baleen length. The remaining two-thirds of the plates (> 200) were black. Although the number of black and cream-coloured plates is about 200 each, the black ones were thicker and therefore occupied about two-thirds of the total right baleen strip.

Fig. 1. Fin whale stranded alive at Chanduy, Ecuador. Note the cream-coloured baleens along the distal tip of the maxillary and the white colour of both mandible and maxillary in the right side of the mouth.

The number of ventral pleats was between 70 and 80. We took five external measures: (1) total length (16.9m); (2) length of the mouth (3.35m); (3) length of the pectoral fin (2.2m); (4) width of the flipper; and (5) span of the flukes (3.58m).

No evident cause of death was derived from the external examination. The specimen was complete with flippers, flukes and dorsal fin, and no signs of fishing gear or blunt trauma on its body. A skin sample for molecular studies was preserved in ethanol 95% and maintained in refrigeration until laboratory analysis at Pontificia Universidad Católica del Ecuador (PUCE) (Catalogue No. QCAZ-18874). The right pectoral fin, 180 baleen plates and both mandibles were collected and curated at Museo de Ballenas (Cat. Number MBP 20190406 BA PH).

Molecular studies

DNA was extracted from the sample collected using the guanidine isothycianate protocol (Torres-Carvajal and Hinojosa, 2020). Nucleotide sequences were obtained using the T-Pro-whale (TCACCCAAAGCTGRARTTCTA) and Dlp8G (GGAGTACTATGTCCTGTAACCA) primers to amplify a fragment of 727bp of the D-loop gene, and the Tglu (TGACTTGAARAACCAYCGTTG) and CB2 (CCCTCAGAATGATATTTGTCCTCA) primers to amplify a fragment of 433bp of the CytB gene. The polymerase chain reaction (PCR) amplification of gene fragments was performed in a final volume of 13µl reactions using 1X PCR Buffer (–Mg), 3mM MgCl2, 0.2mM dNTP mix, 0.2µM of each primer, 0.1 U/µl of Platinum® Taq DNA Polymerase (Invitrogen, Carlsbad, CA) and 1µl of extracted DNA. Finally, sequencing in both directions of the genes was conducted by Macrogen Inc. The comparison with sequences stored in the GenBank database showed that the D-loop fragment of the Ecuadorian specimen matched with the sequence MW266419 reported by Perez *et al*. (2021) from a fin whale sampled in Chile, and the CytB fragment matched with 19 sequences found in fin whales sampled in the North Pacific, Atlantic and Austral Oceans (Archer *et al*., 2013).

DISCUSSION

The molecular analyses determined that the Ecuadorian specimen most probably belonged to a southern hemisphere population because it shared a D-loop haplotype so far found only in fin whales sampled along the

south-central coast of Chile. However, the date of the stranding on the continental coast of Ecuador challenges the traditional belief that southern baleen whales migrate to low latitudes during the austral winter (June–September). This, along with the belief that the species is absent between 20°N and 20°S (Edwards, 2015), shows how complex the distribution and ecology of the species is in the southern hemisphere. Nevertheless, the date of the event is consistent with previous records during the austral summer in Galapagos from a Japanese exploratory campaign in February 1964 (Loesch, 1966), with whaling records from northern Peru where fin whales were mainly taken between October and February (Ramírez, 1988) and several post whaling sightings off Peru (Van Waerebeek and Engblom, 2007) and Chile (Toro *et al*., 2016; Sepúlveda *et al.*, 2018). Recently, Castro and Félix (2021) reported a "possible" sighting of a fin whale on coastal waters of Ecuador in March 2021 based on its size, behaviour, and its dorsal fin which appeared after the whale breathed. While the lack of records of this species in coastal waters of Ecuador in the last century is probably due to the low research effort during the first half of the year, this could also support the belief that the Southeast Pacific fin whale population is recovering, as suggested by the increased number of records in the central and northern Chile (Toro *et al*., 2016; Pacheco *et al*., 2015). Meanwhile, low efforts in survey cannot rule out that changes in environmental conditions could explain the record in Ecuador, given the opportunistic behaviour of the species (Cooke, 2018).

Based on 37 samples from Chile, Pérez *et al*. (2021) found no evidence of stratification in Southeast Pacific fin whales, whose population would correspond to the subspecies *B. p. quoyi*. The molecular analysis of our specimen is concordant with that result. From the analysed samples of fin whales in both Antarctic (Archer *et al*., 2013; 2019) and Chilean waters (Pérez *et al*., 2021), no evidence of the presence of the pygmy variety in the Southern Hemisphere was obtained. The inconsistencies in the size of the animals between medium and high latitude reported by Clarke (2004), when compared the whaling records of fleets from different countries, could be associated with latitudinal segregation by age classes of *B. p. quoyi* with younger animals distributing further north, rather than with dwarf specimens. For instance, the specimen Clarke examined in 1948, in which he founded his belief of the presence of a darker fin whale morphotype in the Southeast Pacific, could, in fact, be a particularly dark individual of *B. p. quoyi* instead of a dwarf subspecies. In the case of the Ecuadorian specimen, we also ruled out it belonged to this dwarf form, because the colouration pattern corresponds to the common southern fin whale with the belly and right side of the mouth white, and about 50% of baleens on the right side and a portion of baleens on the left side creamed-coloured. It is unknown on which criteria Christensen (1926; cited by Clarke, 2004) determined that the fin whales observed off the coast of Ecuador between 1912 and 1926 were *B. p. patachonica*, as Clarke did not indicate it in his work and Christensen's paper was not available for review by the authors. Clarke (2004) associated the presence of *B. p. patachonica* to a restrained distribution along the Humboldt Current, like what occurs with a blue whale population distributed along the Southeast Pacific between southern Chile, Peru, Ecuador and the Galapagos Islands (Branch *et al*., 2007; Félix *et al*., 2007; Denkinger *et al*., 2013; Torres-Florez *et al*., 2014, 2015; Hucke-Gaete *et al*., 2018). The earlier, however, does not exclude that a dwarf and darker morphotype with a parapatric or even sympatric distribution with *B. p. quoyi* exists, as vast areas in the Southeast Pacific remain unsampled.

The size of the Ecuadorian specimen is consistent with the whaling records from northern Peru (Ramírez, 1988) and with previous records from the early twentieth century (Risting, 1928), which supports the theory of spatial segregation by classes in *B. p. quoyi*. Van Waerebeek and Engblom (2007), noticed a bimodal distribution in the sizes of the animals taken from Peru, with years in which both males and females averaged 14m or less (1964–1967) and years in which both classes averaged more than 18m (1968–1973), which suggest two different stocks were being exploited. Such bimodal distribution could also be explained if whaling vessels worked at different longitudes in different years or environment conditions changed in cycles of 4–5 years. Ramirez (1988) indicated that different whaling companies worked in each period and the effort in the first case was more directed to fin whales than in the second case that was considered complementary of other targeted species. However, is not possible to draw conclusions on the distribution behaviour of the species off Peru as the total effort and whaling areas are unknown nor other biological information is available. The presence of mature animals associated with reproductive behaviour in oceanic waters off Chile suggested by Acevedo *et al*. (2012) also supports longitudinal segregation. Given the complex distribution of fin whales in the Southeast Pacific, we

agree with Van Waerebeek and Engblom (2007) that more studies on distribution, physical maturity and genetics from different areas in the Southeast Pacific are required to elucidate the population structure of fin whales in the region.

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