

Fin Whales (*Balaenoptera physalus*) Feeding on *Euphausia mucronata* in Nearshore Waters off North-Central Chile

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Abstract

This paper reports the presence and feeding activity of fin whales (*Balaenoptera physalus*) during the austral summers of 2004 and 2005 in coastal waters near the Reserva Nacional Pinguino de Humboldt, north of Chile. The main prey item of the species was identified as the euphausiid *Euphausia mucronata*. The presence of *B. physalus* is associated with a high concentration of potential prey probably produced by an upwelling system that is frequently detected slightly south of the study area during summer. This information is a contribution to the knowledge of distribution, feeding behavior, and diet of *B. physalus*. Additionally, it constitutes the first record of a direct observation of feeding activity of *B. physalus* along the Chilean coast.

Key Words: Fin whale, *Balaenoptera physalus*, *Euphausia mucronata*, feeding activity, Chile

Introduction

The fin whale (*Balaenoptera physalus*) inhabits all major oceans (Jefferson et al., 1993), usually from temperate to polar latitudes and less commonly in the tropics (Folkens et al., 2002). Due to its frequently pelagic distribution, the species is among the least known of all mysticetes (Aguilar, 2002). *B. physalus* has an important exploitation history in the Antarctic and off the central coast of Chile, becoming the first whaling target for the Antarctic between 1911 and 1929 and for Chile between 1929 and 1983. The abundance of fin whales in the southeastern Pacific was reduced drastically from 1958 to 1964, likely due to Antarctic whaling and also due to intensive hunting off Chile in 1964-1966 (Clarke et al., 1964). After the end of commercial catches, its presence in Chile has been reported from Antofagasta (23° 29' S) to Cape Horn (56° 48' S), including the offshore Archipelago Juan Fernández (Aguayo-Lobo et al., 1998);

however, there are no records or feeding areas within the waters of the Exclusive Economic Zone (EEZ).

B. physalus is a known predator of a wide spectrum of marine organisms, although the species mainly feeds on krill (Tershy, 1992). The euphausiids *Thyasanoessa macrura*, *Euphausia vallentini*, *E. frigid*, *E. crystallorophias*, and *E. superba* are important prey items for fin whales in the southern ocean (Aguilar, 2002). In Chile, studies on living fin whales are scarce, and the only description of its prey items comes from stomach analysis of one individual. A 19.4-m female captured in April 1961 off the Concepción coast had its first stomach full of *E. mucronata* (Antezana, 1970).

In the last decades, available records of fin whales obtained during sighting cruises (Clarke, 1962; Clarke et al., 1978; Aguayo et al., 1998b; Hucke-Gaete, 1998) or long-term cetacean's surveys (Guerra et al., 1987; Capella et al., 1999) off the coast of Chile have been scarce; however, in recent years, fin whales were sporadically observed in coastal waters around the Reserva Nacional Pinguino de Humboldt (RNPH) (29° 02' S, 71° 36' W), north of Chile (Capella et al., 1999). In this note, we report new sightings, feeding activity, and prey item identification of fin whales observed in nearshore waters around RNPH.

Materials and Methods

Between February 2003 and February 2005, monthly boat-based surveys were performed off the northern Chilean coast as part of a study on photo-identification of bottlenose dolphins (*Tursiops truncatus*) in the RNPH. During the study period, we carried out 20 surveys of 7- to 8-h vessel-days, completing a total of 155 h of effort. During this study, fin whales were observed in the area, and information on location of sightings, number of individuals, activity, and prey items were recorded.

The study area comprises about 270 km² of maritime area around three islands belonging to

RNPH: Chañaral ($29^{\circ} 02' S$, $71^{\circ} 36' W$), Choros ($29^{\circ} 14' S$, $71^{\circ} 32' W$), and Damas ($29^{\circ} 13' S$, $71^{\circ} 32' W$) (Figure 1).

The research vessel used was a 7-m rigid wooden fishing boat with a 40-hp outboard engine. During every survey, the area was visually scanned by 3 to 5 observers, using both naked eye and 8x50 binoculars. Once whales were encountered, we attempted visual identification of the species and then photographed each dorsal fin of individuals with a Canon digital SLR camera and 100- to 300-mm auto focus lens. The whale's position was recorded by a portable Geographic Positioning System (GPS).

Presence of euphausiid swarms was detected by a notorious red colour patch on the sea surface. Krill samples were collected with a plankton net, stored in 70% ethanol, and analyzed for identification purposes by means of a Leica stereoscopic microscope Wild M3Z following the *Chilean Euphausiid Species Identification Key* (Guzmán, 2002).

Results

Published records and the new sightings of fin whale presence off the north and central coast of Chile are shown in Table 1. Ten of the sightings

recorded were originated in oceanic waters. In addition, we recorded a total of six new sightings within the study area, comprising 28 whales, in January 2004, November 2004, and January and February 2005.

During three of these encounters (11 individuals), feeding activity was observed; however, in two (3 individuals), a "direct observation" was recorded and supported with samples of the prey item.

On 16 January 2004, seven fin whales (3 groups of 2 whales and a single individual) were sighted and photographed south of Choros Island ($29^{\circ} 18' 03'' S$, $71^{\circ} 30' 01'' W$). The whales were moving slowly into different krill patches. Two whales emerged on the surface and then dove slowly below our boat, opening their mouths and engulfing krill while expanding their ventral pleats. A krill sample was collected from the same notorious red color plankton patch. Then, on 22 January 2005, two fin whales were observed southwest of Chañaral Island ($29^{\circ} 02' 44.8'' S$, $71^{\circ} 34' 11.5'' W$). Whales were slowly diving near to the surface where a plankton patch was located. No direct observation of a feeding activity was made. On 23 January, at the south of Choros Island ($29^{\circ} 17' 38.5'' S$, $71^{\circ} 31' 16.3'' W$), a fin whale was observed feeding

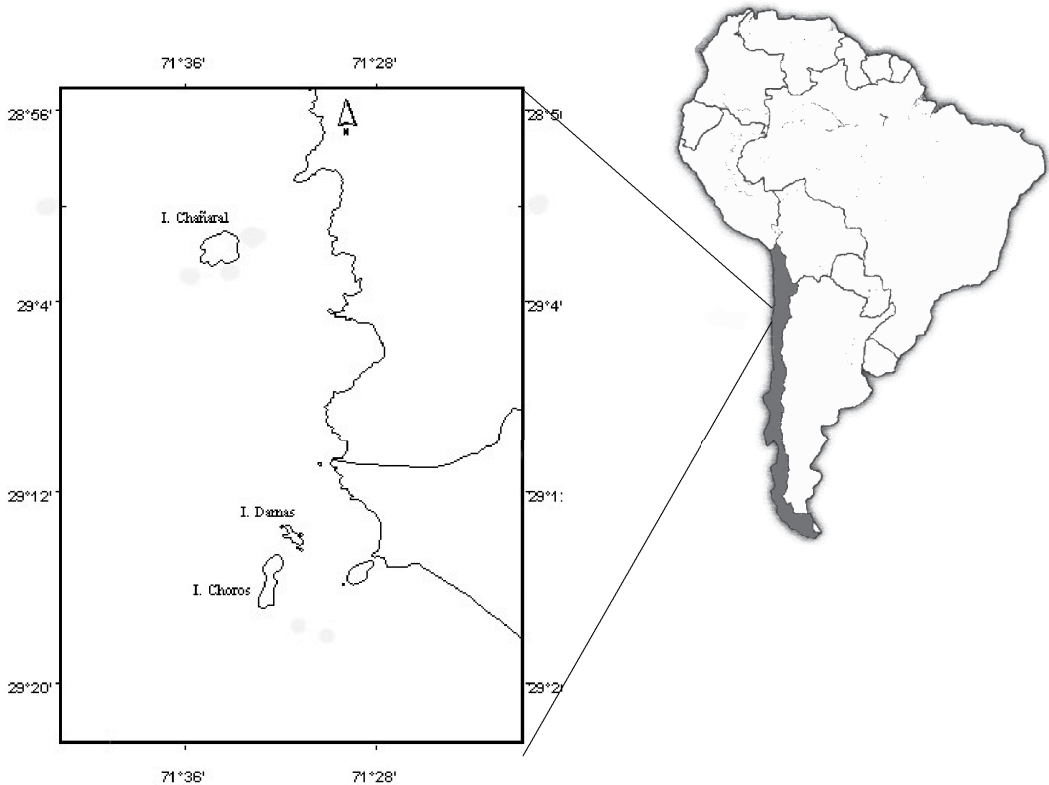


Figure 1. Study area, Reserva Nacional Pinguino de Humboldt (RNPH), on the north-central coast of Chile

Table 1. Fin whale sighting records off the north-central coast of Chile (29° S to 32° S) over the last decade; * represents encounters where feeding activity was observed, and () represents number of whales directly observed in a feeding activity.

	Date	Location	No. of whales	Source
1	28 October 1958	30°30'S, 73°10'W	1	Clarke, 1962
2	25 September 1993	31°58'S, 88°38'W	2	Aguayo et al., 1982
3	28 September 1994	33°08'S, 73°42'W	1	Aguayo et al., 1982
4	28 September 1994	33°09'S, 73°54'W	1	Aguayo et al., 1982
5	28 September 1994	33°01'S, 72°27'W	1	Aguayo et al., 1982
6	28 September 1994	33°01'S, 72°24'W	2	Aguayo et al., 1982
7	28 September 1994	33°02'S, 72°42'W	3	Aguayo et al., 1982
8	15 September 1995	31°41'S, 88°49'W	2	Aguayo et al., 1982
9	15 September 1995	31°43'S, 88°37'W	2	Aguayo et al., 1982
10	14 June 1995	33°21'S, 75°16'W	6	Aguayo et al., 1982
11	13 December 1997	31°39'S, 74°30'W	1	Hucke-Gaete, 1998
12	13 February 1993	29°02'S, 71°55'W	5	Capella et al., 1999
13	14 February 1993	29°03'S, 71°62'W	2	Capella et al., 1999
14	15 February 1993	29°07'S, 71°58'W	2	Capella et al., 1999
15	18 February 1993	29°03'S, 71°51'W	2	Capella et al., 1999
16	1 April 1994	29°06'S, 71°58'W	6	Capella et al., 1999
17	2 April 1994	29°06'S, 71°56'W	3	Capella et al., 1999
18	3 April 1994	29°09'S, 71°58'W	2	Capella et al., 1999
19	23 January 1995	29°03'S, 71°52'W	3	Capella et al., 1999
20	24 January 1995	28°98'S, 71°61'W	3	Capella et al., 1999
21	16 January 2004	29°18'03"S, 71°30'01"W	7* (2)	New sighting records
22	16 January 2004	29°02'58"S, 71°35'51"W	6	New sighting records
23	28 November 2004	29°01'16"S, 71°33'25"W	5	New sighting records
24	22 January 2005	29°04'27"S, 71°33'01"W	3*	New sighting records
25	23 January 2005	29°17'38"S, 71°1'16"W	1* (1)	New sighting records
26	20 February 2005	29°02'46"S, 71°33'24"W	6	New sighting records

on a krill patch with its right side directed to the surface (Figure 2). Our boat was located near the feeding event, so the second direct observation of feeding activity was recorded, and a zooplankton sample was collected.

The krill samples collected during the two direct observations of fin whales feeding were identified as *E. mucronata* (Figure 3), based on the presence

of a distinctive spine in the third abdominal segment (Guzmán, 2002).

Considering the information above, we recorded a total of 11 fin whale individuals feeding on plankton patch—eight south of Choros Island and three whales near Chañaral Island. In both of these opportunities in which a direct feeding activity (3



Figure 2. Fin whale feeding on a krill patch off the northern Chilean coast in January 2005



Figure 3. Euphausiid sample collected on the study area and identified as *Euphausia mucronata*; the circle shows the diagnostic spine of the euphausiid.

whales) was observed, the prey item was identified as *E. mucronata*.

Discussion

The published fin whale presence records are mainly originated in oceanic waters, more than 60 km off the Chilean coast (Clarke, 1962; Aguayo et al., 1998b; Hucke-Gaete, 1998). Clarke (1962) mentioned that during a sighting cruise made off the north-central Chilean coast in 1962, no fin whales were seen nearer than 193 km to the coast. He mentioned a large number of fin whales seen at a considerable distance from the coast (249 to 275 km) in a locality almost entirely unexplored by whale catchers. Additionally, another sighting expedition carried out in 1964 recorded only one fin whale at 154.5 km off the coast of Constitución (35° 16' S, 74° 18' W) and showed an impoverishment of fin whales explained by an overfishing of this cetacean species on the pelagic grounds of the Antarctic. As a consequence, there has been a severe decline in the southern fin whale population (Clarke et al., 1978).

The presence of fin whales in the study area has been recorded during the last decades. It may be associated with a high concentration of potential prey. Litaye et al. (2004) related the presence of fin whales to areas of high primary productivity that sustained a large biomass of zooplankton and established a relationship between the seasonal distribution of the whales and food availability. The seasonality of the fin whale around the RNPH coincides with previous sightings recorded during the austral summer season (February 1993, April 1994, and January 1995; Capella et al., 1999). This seasonal pattern could be linked to the availability of prey, determined by primary production, the basis of a productive food web.

High productivity may be related to local upwelling events. Consequently, Marín & Delgado (2003) described that at 30° S, the wind-driven, seaward, Ekman transport is the dominant advective process, at least during spring and summer when the two phases (spin-up and spin-down) of an upwelling event occurs. The upwelling off Coquimbo, Chile (30° S) in the Humboldt Current ecosystem represents a highly dynamic coastal environment that supports one of the most productive global fisheries. This high production in pelagic ecosystems influenced by upwelling can be explained by the maintenance of highly efficient phytoplankton assemblages in a regime of enhanced turbulence and nutrient supply (Montecino et al., 1996; Montecino & Quiroz, 2000).

The study area is characterized by a great diversity of marine animals, including marine birds such as Humboldt's penguins (*Spheniscus*

humboldtii), Peruvian diving petrel (*Pelecanoides garnotti*), Peruvian booby (*Sula variegata*), Neotropic cormorant (*Phalacrocorax bougainvillii*), Red legged cormorant (*P. gaimardi*), and Band-tailed gull (*Larus belcheri*) (Simeone et al., 2003); and cetaceans such as bottlenose dolphins (*Tursiops truncatus*) (Gonzalez et al., 1989; Capella et al., 1999; Sanino & Yañez, 2001), minke whale (*Balaenoptera acutorostrata*), humpback whale (*Megaptera novaeangliae*), long-finned pilot whale (*Globicephala melas*), orca (*Orcinus orca*), and dusky dolphin (*Lagenorhynchus obscurus*) (Capella et al., 1999).

Euphausiid species form an abundant component of the zooplankton fauna in the Humboldt Current System and around areas of coastal blooms (Fernández et al., 2002). *E. mucronata* mainly inhabits the Chilean-Peruvian Current, and its distribution area extends up to the 42° S. This species was previously recorded as prey of one fin whale in Chile (Antezana, 1970), and our observations confirm this fact.

This report of fin whale occurrence off the Chilean coast shows the existence of feeding areas within the nearshore waters and constitutes the first record of a direct observation of fin whale feeding activity off the Chilean coast. Ecological knowledge about fin whales along the coast of Chile is scarce. We therefore highlight the importance of increasing sighting efforts around the RNPH during upwelling events so as to understand if fin whale presence follows some cyclic pattern or simply reflects sporadic events.

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