

First record of orca predation on franciscana dolphins (*Pontoporia blainvillei*) in Argentina

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The orca, or killer whale (*Orcinus orca*), is a cosmopolitan cetacean species that is known as a predator of a wide range of prey, including bony fishes, sharks, sea birds, sea turtles, sea otters, pinnipeds, dolphins, and whales (Jefferson *et al.*, 1991; Visser, 2005; Ford, 2017; Wright *et al.*, 2021).

Previous reports of the orca diet off Argentina include broadnose sevengill sharks (*Notorynchus cepedianus*) (Reyes and Garcia-Borboroglu, 2004), birds (Copello *et al.*, 2021) and marine mammals such as dusky (*Lagenorhynchus obscurus*) and common (*Delphinus delphis*) dolphins (Coscarella *et al.*, 2015), southern right whales (*Eubalaena australis*) (Sironi *et al.*, 2008), South American sea lions (*Otaria flavescens*) (López and López, 1985; Grandi *et al.*, 2012), and southern elephant seals (*Mirounga leonina*) (Hoelzel, 1991). However, all these records came from observational studies in Patagonia.

In northern Argentina, the trophic ecology of orcas is poorly known. This may be related to the fact that historically orcas seemed to be sporadic visitors near the coast with only a few sightings per year, and that stranding events are very infrequent in this region. However, recent records of sightings suggest that there is an increasing trend in their occurrence in the area (Biología,

Ecología y Conservación de Mamíferos Marinos, unpub. data). In the last few years, there were two orca mass strandings in northern Argentina, along the Buenos Aires coast. The first event occurred on 25 August 2018, where six females live stranded between Mar de Ajó (36°43'13" S, 56°41'16" W) and Mar del Plata (38°00' S, 57°33' W) (Fig. 1); three of them died, and the other three were released. Unfortunately, it was not possible to take samples of these individuals.

The second event took place on 16 September 2019, when seven orcas stranded alive in La Caleta (37°46'44" S, 57°27'50" W; Fig. 1). Following the morphometric relationships adopted by Best *et al.* (2010), there were four mature females (> 6 m total length), two calves (< 6 m) of unidentified sex, and a mature male (6.5 m of total length –TL, and a percentage height of dorsal fin to TL > 14.8%). Six of the seven individuals were released, whereas the male died on the beach (Fig. 2A) where a necropsy was performed.

The franciscana dolphin *Pontoporia blainvillei* is a small cetacean endemic to the Southwest Atlantic Ocean, from Itaúnas, Brazil (18°35' S, 64°48' W) to Peninsula Valdés, Argentina (42°35' S, 64°48' W) (Siciliano, 1994; Crespo *et al.*, 1998; Bastida *et al.*, 2007; Danilewicz *et al.*, 2009). It is considered the most threatened small cetacean in the Southwest Atlantic Ocean, classified as 'Vulnerable' by the International Union for the Conservation of Nature (Zerbini *et al.*, 2017) and the Society for Mammals in Argentina (Denuncio *et al.*, 2019). The main threat to the species is incidental mortality in gillnet fisheries which has been observed since at least the mid-1960s (Van Erp, 1969). The latest mortality estimation ranged between 360-539 dolphins/year, representing > 2% of the species abundance (between 15,000 and 19,000, Crespo *et al.*, 2010; 2020) in Buenos Aires, Argentina (Negri *et al.*, 2012). Herein, we report the first evidence of an orca predation on the franciscana dolphin in Argentina, from stomach content analysis.

Highly digested prey items were identified in the stomach contents of an adult male orca, including beaks of four long-finned squids *Loligo sanpaulensis* (Class: Cephalopoda), a partially digested cetacean rib, and 14 odontocete teeth (Fig. 2B and 2C). The size and the shape of the teeth found in the stomach

ARTICLE INFO

Manuscript type: Note

Article History

Received: 14 January 2022

Received in revised form: 28 February 2022

Accepted: 02 March 2022

Available online: 29 March 2022

Responsible Editor: Carolina Loch

Citation:

Padula, A.D., Gana, J.C.M., Giardino, G.V., De Leon, M.C., Elissamburu, A., Rodriguez, D.H. and Denuncio, P. (2022) First records of orca predation on franciscana dolphins (*Pontoporia blainvillei*) in Argentina. *Latin American Journal of Aquatic Mammals* 17(1): 68-72. <https://doi.org/10.5597/lajam00283>

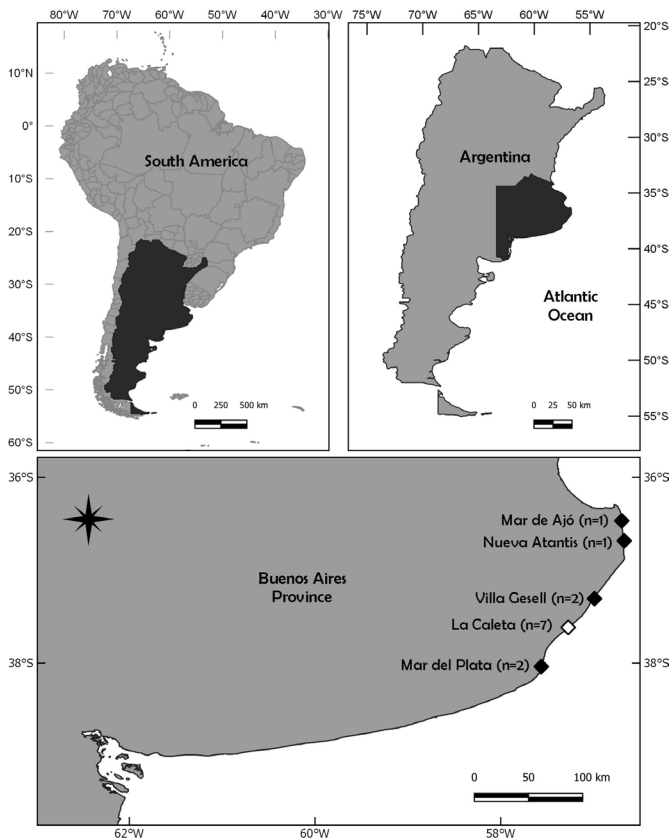


Figure 1. Location of two orca (*Orcinus orca*) strandings (and the number of individuals stranded) in the Buenos Aires Province of Argentina: 25 August 2018 (n = 6, black diamonds), between Mar de Ajó and Mar del Plata; 16 September 2019 (n = 7, white diamond), at La Caleta.

revealed that they belonged to a franciscana dolphin. Kasuya and Brownell (1979) described decades ago that franciscana dolphin teeth range between 7 and 10 mm (length of teeth found: 8.41 mm ± 1.27), with a crown antero-posteriorly compressed, and a root of L or J-shape, and lingual-buccally flattened, characteristic particularly notorious in older specimens. Two measurements were taken at the external surface of each tooth, following Ramos *et al.* (2000): (1) tooth length (L-mm), measured from the apical extremity of the crown to the end of the root; and (2) cingulum width (CW-mm), measured in the maximum width in the intersection of the crown with the root (Fig. 2D). These measurements were compared to a reference teeth collection of *P. blainvillei* of known age (Table 1; Denuncio *et al.*, 2013). Significant differences were found for cingulum width between the year class 1 and 2 of the reference collection and the ones in the stomach (K-W: CW: $\chi^2 = 40.764$, d.f. = 3, $p \leq 0.01$), but there were no significant differences between the year class 0 and the ones found in the present study ($p = 0.69$) (Fig. 2D). These findings indicate that the teeth found seem to belong to a young specimen less than one year of age (up to 108 cm TL; Denuncio *et al.*, 2013).

Orca predation on franciscana dolphins has been previously reported in Brazilian waters. The first record was found in the stomach content of a stranded orca in Rio Grande do Sul (38°48'15" S, 50°32'45" W; Ott and Danilewicz, 1998; Franciscana Management Area III (FMA III; Secchi *et al.*, 2003)). The second record was an observational study in Paraná (25°20' S, 48°05'



Figure 2. (A) Orca (*Orcinus orca*) male specimen stranded at La Caleta, Buenos Aires, Argentina. (B) Partially digested rib found in the stomach content analysis. (C) Comparison of the teeth found in the orca stomach (*) to the reference collection of franciscana (*Pontoporia blainvillei*) sorted by year class (0, 1 and 2 years old, respectively). (D) Scheme indicating the measurements taken. Total Length (L), and cingulum width (CW). Photos: this study.

W; Santos and Netto 2005; FMA II) (Table 2). In Argentina, orcas have only been documented preying on two species of dolphins before (*L. obscurus* and *D. delphis*; Coscarella *et al.*, 2015). To our knowledge, and despite a previous observational record of this behavior in Mar del Plata (Buenos Aires) during the late 1970s to early 1980s (Bastida *et al.*, 2007), this is the first report of a confirmed franciscana dolphin consumed by an orca in Argentina. Only broadnose sevengill shark was known to be a franciscana predator in the area (Lucifora *et al.*, 2005; Table 2).

Very scarce data on natural mortality is available for franciscana, and therefore orca predation could be an underrepresented source of natural mortality in coastal areas of northern Argentina. However, franciscana dolphins may constitute a profitable prey for orcas, as the franciscana has a predicted occurrence with limited home ranges (Bordino, 2002; Wells *et al.*, 2013), confined to shallow waters (up to 30 m; Danilewicz *et al.*, 2009). Furthermore, from the viewpoint of the predator, franciscana's average blubber layer represents 25-31% of body weight (Caon *et al.*, 2007; Denuncio, 2012), and could therefore satisfy the energetic demands of an

Table 1. Measurements (in mm) of the total length and cingulum width of franciscana (*Pontoporia blainvillei*) teeth (n = 14) found in the stomach content of the orca (*Orcinus orca*) and those from a reference collection (ID) with known ages (0, 1, and 2 years old, respectively).

ID	Age	Total Length			Cingulum Width		
		Range	Average	SD	Range	Average	SD
Pb11	0	7.42-8.84	8.15	0.51	1.4-1.73	1.58	0.1
9496	1	8.54-9.67	9.11	0.3	2.08-3.4	2.4	0.33
Pb60/09	2	7.68-8.67	8.31	0.25	2.33-2.68	2.54	0.1
Orca	?	5.45-10.48	8.01	1.53	0.91-2.4	1.65	0.37

Table 2. Records of predators of the franciscana dolphin (*P. blainvillei*) in the Southwest Atlantic Ocean.

Predator	Date	Location	Type of record	Author
Orca <i>O. orca</i>	19 December 1993	Rio Grande, RS, Brazil (38°48'15" S, 50°32'45" W)	Stomach content	Ott and Danilewicz, 1998
	22 March 2005	Paraná, Brazil (25°20' S, 48°05' W)	Direct observation	Santos and Netto, 2005
	16 September 2019	La Caleta, Buenos Aires, Argentina (37°46'44" S, 57°27'50" W)	Stomach content	This study
Broadnose sevengill shark (<i>Notorynchus cepedianus</i>)	1980-1983	Uruguay (34°52'00" S, 56°10'00" W)	Stomach content	Praderi, 1985
	1998-2001	Anegada Bay (39°50' S, 62° W)	Stomach content	Lucifora <i>et al.</i> , 2005
Tiger shark (<i>Galeocerdo cuvieri</i>)	15 March 2003	Southeastern Brazil	Stomach content	Di Benedetto, 2004

orca (Kriete, 1995; Noren, 2011). Conversely, these characteristics, along with the existence of breeding areas reported near Bahía Samborombón (Denuncio *et al.*, 2013) and their small size (< 150 cm TL and 25-30 kg of body weight, Denuncio *et al.*, 2018), make franciscanas potentially vulnerable for active foraging of orcas.

This note presents three valuable contributions to the trophic ecology of marine mammals in the waters of Argentina: (i) along with previous records in Brazil, it confirms orca predation of the franciscana dolphin in almost the entire distribution range of franciscana's, increasing to at least three the number of natural predators of this endangered small dolphin (Table 2); (ii) it provides valuable information on the previously poorly known diet of orca, this apex predator, from the analysis of stomach contents of a stranded animal; and (iii) it highlights the importance of conducting necropsies to provide insights to the ecology of understudied orca populations on the coast of Buenos Aires, Argentina.

Acknowledgments

The authors would like to thank the reviewers for their comments on an earlier version of the manuscript. Special thanks to Ingrid Visser for the helpful suggestions for improving the manuscript. Also, we would like to thank Alan Rosenthal and staff of Asociación Naturalistas Geselinos, of Fundación Mundo Marino, and of Fundación Aquarium, Faro Querandi Park Rangers, OPDS Park Rangers, Pablo Galindez, Municipality of Mar Chiquita, Juan Timi and Ana Lanfranchi (IIMYC). Special thanks to the other members of Marine Mammals Lab (IIMYC) and volunteers of the Universidad Nacional de Mar del Plata (UNMDP, Salomé López, Ludmila Barrionuevo, Julieta Auciello) who helped us during necropsy in the field. This contribution was part of the ADP bachelor thesis for the UNMDP.

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