

Southernmost records of bottlenose dolphins, *Tursiops truncatus*

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Abstract Bottlenose dolphins (*Tursiops spp.*) are cosmopolitan animals widely distributed in waters of both hemispheres. The taxonomy of *Tursiops* has long been controversial, with over 20 specific names being published, and subspecies and inshore/offshore forms being proposed. In the southwestern South Atlantic, subspecies *T. truncatus truncatus* and *T. truncatus gephyreus* were proposed for specimens along the coasts of Brazil, Uruguay, and Argentina. Sightings of bottlenose dolphins are common along the coast of Argentina as far south as the Province of Chubut (ca. 46°S). Here, we summarize and discuss the southernmost records of bottlenose dolphins. We cannot make inferences about the species or subspecies to which these animals belong given the small number of specimens.

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Future studies of external measurements, pigmentation, DNA, and isotopes from both sides of the continent should help clarify the situation off southern South America. Furthermore, research is needed to explore a possible link between an effect of general global warming and the *Tursiops* specimens found this far south. The sighting and specimens described here, at 53°S–nearly 55°S, are the southernmost records for the genus and extend the range of the species in the southern South Atlantic.

Keywords Bottlenose dolphin · *Tursiops truncatus* · Southern South Atlantic · Distribution

Introduction

Bottlenose dolphins (*Tursiops spp.*) are cosmopolitan animals widely distributed in both coastal and pelagic habitats in warm and temperate waters of both hemispheres and are among the best-known cetaceans (Leatherwood and Reeves 1990; Rice 1998; Wells and Scott 2008). Individuals and groups of this genus vary in size, morphology, pigmentation, and habitat and occur in both coastal and offshore waters. Groups with differing skull morphology have been identified even over relatively short distances (Turner and Worthy 2003). Although bottlenose dolphins have been under intensive study in many parts of the world, the taxonomy of *Tursiops* has long been controversial, with over 20 specific names being published, and subspecies and inshore/offshore forms being proposed (Hershkovitz 1966; Van Waerebeek et al. 1990; Rice 1998; Wells and Scott 2008; among others). However, there is no general consensus on the validity of these names (Mead and Potter 1990; Ross and Cockcroft 1990). Of the many species names proposed, *T. truncatus* (common bottlenose dolphin)

and *T. aduncus* (Indo-Pacific bottlenose dolphin) are the only two recognized officially by the International Whaling Commission (2010). Recent reviews on recognized marine mammal species agree with these two species, adding two subspecies: *T. truncatus truncatus* (Montegu 1821) and the Black Sea bottlenose dolphin, *T. truncatus ponticus* (Barbash-Nikiforov 1940; Committee on Taxonomy 2009; Perrin et al. 2009).

In the southwestern South Atlantic, the species *T. gephyreus* was proposed by Lahille (1908) for two specimens collected near Buenos Aires. Lahille named his specimens *gephyreus* (bridge) because the skulls seemed to be an intermediate form between *Tursiops* and *Sotalia*. Although this species has normally been considered a synonym of *T. truncatus* (Jefferson et al. 2008; Perrin et al. 2009), new genetic and morphometrical studies have considered this a subspecies (*T. t. gephyreus*), reporting the presence of the latter and *T. t. truncatus* along the coasts of Brazil, Uruguay, and Argentina (Barreto 2000).

Sightings of bottlenose dolphins (and a few specimens) are common along the coast of Argentina as far south as the Province of Chubut, where population ecology, photo-identification, and dolphin–tourism interaction studies are conducted (Würsig 1978; Würsig and Würsig 1979; Crespo et al. 2008; Vermeulen and Cammareri 2009 a, b). South of Chubut, two sightings have been reported for the Province of Santa Cruz (47°12'S, 65°44'W), and two males stranded on the shores of the West Falkland (Malvinas) Islands (51°45'S, 60°25'W) along with about 100 pilot whales, in May 1984 (Strange 1992; Bastida and Rodríguez 2005). The southernmost records for the southwestern South Atlantic are a sighting and stranded animals from Tierra del Fuego (Goodall 1989; Goodall et al. 2004; 2008).

The aim of this paper is to describe and update the southernmost records of bottlenose dolphins.

Materials and methods

Since 1975, as part of a long-term opportunistic study of marine mammals in Tierra del Fuego (TdF), Argentina, sighting reports have been gathered from commercial and tourist ships and beach surveys have been carried out from October to April for stranded and incidentally taken marine mammals and birds. The northeastern coasts of TdF, with their high tides and wide, shallow beaches, are examined periodically on foot or by all-terrain-cycle (ATC). The specimens found are studied following Norris (1961), including external measurements, necropsy, and organ weights, among others. Tissue samples and skeletons are collected and stored in the RNP collection, held in the Museo Acatushún de Aves y Mamíferos Marinos Australes at Estancia Harberton, TdF, Argentina (Goodall 1978;

Goodall et al. 2008). Collections were also made by LGB, which are held in the Museo de la Ciudad Virginia Choquintel, Río Grande, TdF.

The initial condition and type of the specimens collected in this study were classified following Goodall et al. (1988). The cleaned skeletons were examined for physical maturity based on fusion of the vertebral epiphyses (Goodall et al. 1988). The vertebrae were counted, and skeletal (cranial and postcranial) measurements were taken with an anthropometer to the nearest cm and by dial calipers to the nearest mm following Perrin (1975).

Results

Although many sighting forms of various species were returned to us over the years, there was only one sighting of bottlenose dolphins in Fuegian waters, of at least three animals in the Beagle Channel east of Ushuaia (54°55'S, 67°34'W), by M. Jørgensen on 22 February 2003 (personal communication with photographic confirmation of species identity) (Fig. 1).

The specimens found are listed in Table 1, and locations shown in Fig. 1. The first record of a common bottlenose dolphin in TdF was a specimen found buried in the mud of Bahía San Sebastián, on the northeast coast of TdF, in 1977 (Goodall 1989). This specimen includes a worn skull, mandibles, most of the vertebrae, ribs, and miscellaneous small bones. No further specimens were found until March 2003, when a mass stranding of four animals, two males and two females, one with a large fetus, occurred on the shores of Bahía San Sebastián. In the winter of 2004, the skeletal remains of the sixth specimen were found on the NE coast of Puerto Harberton (54°52'S, 67°19'W), a bay off the eastern Beagle Channel in southern TdF. This specimen had been cleaned by condors, but the skull and



Fig. 1 Location of the specimens of *Tursiops*: dark circles Stranded animals; open circles Sighting of six animals in Estero Condor, Chile (Olavarria et al. 2010) and three animals in the Beagle Channel (M. Jørgensen, pers. commn)

most of the postcranial skeleton remained. The seventh specimen was a male stranded at Punta Popper on the south shore of the Río Grande in December 2006. This animal was freshly dead, had healed damage to its flippers and the posterior border of the flukes, and had extensive vertebral pathologies, as well as a deformed lower jaw and worn teeth.

Total length and external measurements are available for six TdF animals, including the fetus (Table 2). The specimens ranged from 277 cm, the pregnant female, to 305.7 cm, the largest males. The two female specimens were sexually mature; the pregnant female was a subadult according to epiphyseal fusion, while the larger animal was physically adult, as were the three males (286–305.7 cm), with all the epiphyses fused.

Organ weights were available for the mass-stranded specimens (Online Resource 1); stomach contents have not yet been analyzed. Cranial measurements and number of teeth/alveoli are shown in Online Resource 2. The condylobasal length (CBL) of the two females measured 508–511 mm and ranged from 509 to 538 mm in the three males. The skull of unknown sex (specimen RNP 2363) was 514 mm long. The skull of female RNP 2325 is shown in Fig. 2. Postcranial measurements and meristics are shown in Online Resource 3. The vertebral counts ranged from 63 to 65. The vertebral formula was $C_7, T_{13-15}, L_{14-17}, Ca_{25-29}$.

Discussion

Both recognized species of *Tursiops* occur in the Southern Hemisphere, *T. truncatus* as both an inshore and offshore animal, with *T. aduncus* being mainly inshore and coastal (Ross 1984; Ross and Cockcroft 1990; Hale et al. 2000; Kemper 2004; Best 2007). Specimens of *T. aduncus* are

generally smaller than *T. truncatus*, and adult animals are spotted on the ventral surface. This species has a smaller body and skull, with no differences in size between the sexes, but with more teeth than *T. truncatus*. In the latter, males tend to be larger than females (Ross and Cockcroft 1990; Hale et al. 2000; Kemper 2004; Best 2007). Analysis of mtDNA sequences of pelagic and coastal populations worldwide of *Tursiops* suggests that habitat specialization has occurred independently in different ocean basins, perhaps with *T. aduncus* filling some ecological niches (Tezanos-Pinto et al. 2009). *T. aduncus* has yet to be identified from the southern South Atlantic, although Hershkovitz (1966) considered that *T. geophysus* could belong to this species (Rice 1998), possibly as the ventral region of the original specimen had a few spots (Lahille 1908).

Best (2007) points out that there is a ‘high regional variability of bottlenose dolphins’. Inshore animals off the eastern coast of North America are smaller than offshore animals, although the opposite occurs on the western (Pacific) coast (Wells and Scott 2008). We do not yet know if this is true for South America, as the inshore–offshore movements have not been studied for the east coasts of the continent, although animals off northern Brazil are smaller than those of southern Brazil, Uruguay, and northern Argentina (Barreto 2000).

In the eastern South Pacific, one species (*T. truncatus*) has been assumed. Common bottlenose dolphins are frequent off Colombia, Ecuador, Peru, and north/central Chile (Van Waerebeek et al. 1990; Sanino et al. 2005; Santillán et al. 2008). The largest animal along the Pacific coast was a female from northern Chile (315 cm) (Van Waerebeek et al. 1990). Genetic studies showed little difference in offshore animals along the Pacific coast, suggesting a “single, wide-ranging Peru–Chile offshore stock”, with at least two inshore forms (Sanino et al. 2005). Recent sightings have been made in the northern Chilean Channels

Table 1 Specimens of bottlenose dolphin stranded on the beaches of Tierra del Fuego, Argentina. BSS, Bahía San Sebastián

Museum collection number	Sex	Physical maturity ^a	Date found or studied	Locality	Initial condition of specimen ^b	Type spec. ^c
RNP 624	–	3	11 Dec 77	BSS km 11.5 N	7	B
RNP 2315	F	2	21 Mar 03	BSS, Los Chorrillos W	2	A
RNP 2315f (fetus)	M	0	21 Mar 03	BSS, Los Chorrillos W	2	A
RNP 2316	M	3	21 Mar 03	BSS, Los Chorrillos W	2	A
RNP 2325	F	3	12 Apr 03	BSS km 3 N	2b	A
RNP 2328	M	3	16 Dec 03	BSS km 20 N	2a	A
RNP 2363	–	2	29 Sep 04	Puerto Harberton	6	B
LGB 06.12.05	M	3	05 Dec 06	Río Grande, Punta Popper	2a	A

^a Class 0 Neural spines unfused to the vertebral centra, fetus or neonate; Class 2 Some but not all epiphyses fused, subadult; Class 3 All vertebral epiphyses fused, adult

^b 1 Alive; 2 Freshly dead (2a, entire, 2b, somewhat eaten by predators); 6 Skeleton clean but held together by cartilage; 7 Bones dry and clean

^c A Complete skeleton; B Nearly complete skeleton

Table 2 External measurements (Norris 1961) of bottlenose dolphin specimens from Tierra del Fuego, Argentina

Specimen number	RNP 2315	RNP 2315 fetus	RNP 2316	RNP 2325	RNP 2328	LGB 06. 12. 05
Snout to: fluke notch	277.0	116.9	305.7	278.5	286.2	305.7
Melon	10.0	4.7	10.0	–	11.2	8.2
Post. margin of blowhole	36.8	18.4	32.4	36.6	35.6	34.0
Angle of mouth	29.7	16.1	23.4	–	28.2	32.5
Center of eye	37.0	17.7	33.1	33.2	25.8	39.0
Center of ear	44.8	22.5	36.2	–	–	46.0
Ant. insertion of flipper	58.5	28.3	56.3	55.4	55.1	62.0
Ant. insertion of dorsal fin	130.3	59.8	136.2	127.1	126.2	136.0
Posterior tip of dorsal fin	179.9	78.7	175.3	–	160.9	186.0
Umbilicus	139.7	59.4	139.9	–	–	140.0
Center of genital slit	187.0	75.9	188.0	188.7	–	196.0
Center of anus	196.6	83.3	218.5	–	201.2	219.5
Center of eye to: angle of mouth	7.9	3.2	7.3	–	4.3	7.5
Ear	8.6	4.2	4.6	–	–	10.0
Blowhole edge	9.6	13.0	–	–	–	22.0
Flipper: anterior length	39.6	22.5	42.4	38.2	35.0	46.5
Posterior length	27.2	15.5	30.4	28.1	24.0	29.0
Maximum width	13.6	8.0	13.0	15.1	14.1	19.0
Dorsal fin: height	22.6	10.7	45.5	–	–	31.5
Length at base	–	–	20.0	34.2	43.0	62.0
Flukes: width, tip to tip	51.7	31.4	–	–	53.7	70.0
Anterior margin to fluke notch	17.7	10.8	18.8	–	16.4	25.0
Depth of notch	2.5	2.2	2.4	–	–	3.9
Girth: at axial	164.0	71.0	168.0	–	–	–
Maximum (ant. dorsal fin)	184.0	77.0	178.7	–	–	178.0
At anus	86.0	34.0	38.1	–	–	100.0
Midway anus to fluke notch	34.0	22.0	32.0	–	–	66.0
Height midway anus-fluke notch	25.0	10.1	24.0	–	–	33.0
Thickness, same place	9.1	3.4	6.6	–	–	9.5
Aperture length: eye	–	2.1	7.3	–	–	2.7
Blowhole	0.7	0.3	–	–	–	–
Blowhole width	3.2	2.6	–	–	–	–
Genital slit	18.4	2.5	18.0	–	–	20.0

(42°–46°S), but no bottlenose dolphins were seen in the channels south of this area, despite numerous surveys (Aguayo-Lobo et al. 2006). Lately, six bottlenose dolphins were observed over a period of days some 1,000 km to the south at Estero Condor (53°22'S) off the Strait of Magellan (Olavarria et al. 2010, Fig. 1). Due to the distance from other Chilean sightings, these authors proposed that these southern animals were more likely to have come from the South Atlantic populations rather than the South Pacific.

Few published external measurements are available for the southwestern South Atlantic (Barros 1991; Oliveira Santos et al. 2010). Barreto (2000), on the basis of skull measurements and meristic variables described by Lahille (1908) to identify *T. gephyreus* from *T. truncatus*, proposed

the existence of two subspecies of *Tursiops* for the eastern coast of South America: *T. t. truncatus* and *T. t. gephyreus*. The first one refers to smaller animals (CBL 494–541 mm) with thinner teeth, pterygoid processes in contact, and the posterior border perpendicular to the longitudinal axis, from the warmer waters of central and northern Brazil. Barreto (2000) considers *T. t. gephyreus* as animals with larger skulls (CBLs 486–607 mm), wider teeth, pterygoid processes separated with the posterior borders oblique to the longitudinal axis, found south of the Subtropical Convergence (southern Brazil, Uruguay, and Argentina as far as the Province of Chubut). Our specimens (CBLs 508–538 mm) are smaller than the latter, more like the smaller animals of central/northern Brazil. A comparison

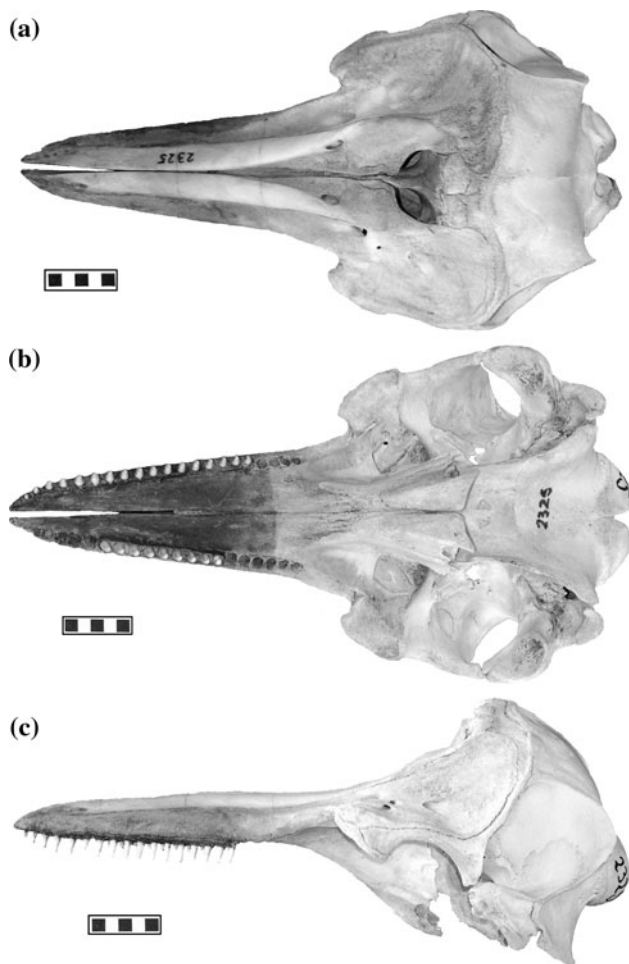


Fig. 2 Dorsal, ventral, and lateral views of the skull of the female *Tursiops* RNP 2325

of measurements of southern South American specimens is shown in Online Resource 4. It has been suggested that perhaps the TdF animals come from the southern South Pacific population due to size but given the small number of specimens, we cannot make inferences about the species or subspecies to which these animals belong. Future studies of external measurements, pigmentation, DNA, and isotopes from both sides of the continent should help clarify the situation off southern South America.

Although the greatest offshore movements for *Tursiops* in the South Atlantic have been considered about 300 km (Würsig 1978; Würsig and Würsig 1979), no real comparisons have been made of offshore/inshore animals. Recent studies of rehabilitated *Tursiops* specimens released in the North Atlantic showed that at least two animals had a large range of movement, covering up to 4,200 km (one-way total distance) in 47 days (Wells et al. 1999). In the Northern Hemisphere, bottlenose dolphin distributions extended northward along the coasts during some El Niño years (Wells et al. 1990). Despite a moderate El Niño event

occurring during 2002–2004 (<http://www.esrl.noaa.gov>), we need more research to explore a possible link between this climatic oscillation and the *Tursiops* specimens found in TdF.

It appears that this species is vagrant, extralimital, or an occasional visitor in Fuegian waters. Although only seven specimens were collected over a period of 36 years of beach surveys, the data from these specimens are of value in determining the range and morphometrics of the species. The sighting and specimens described here, at 53°S–nearly 55°S, are the southernmost records for the genus (Goodall et al. 2004; 2008). They extend the range of the species in the southern South Atlantic, confirming the presence of the bottlenose dolphin in these latitudes and contributing to what little is known of the southernmost bottlenose dolphins.

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