

AN ANDREW'S BEAKED WHALE *MESOPLODON BOWDOINI* (CETACEA, ZIPHIIDAE) STRANDED ON THE ATLANTIC COAST OF URUGUAY

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Abstract: On 24 May 2003, a fresh dead specimen of Andrew's beaked whale was found stranded at La Coronilla beach (33°54'50"S, 53°30'15"W), Department of Rocha, Uruguay. Morphological and osteological characters were used to identify the specimen and genetic analyses confirmed the species identification. Although basic body morphology was consistent with published descriptions, the Uruguayan specimen exhibited subadult characteristics, in spite of its total length (430cm), typical of an adult male. The color pattern differed from the previously described for a male of this species, being more similar to an adult female *M. carlhubbsi*. Its CBL (800mm) was beyond the reported range for the species (645-783mm), making it the largest known skull for *M. bowdoini*. The teeth were similar to those of an adult female *M. bowdoini*, being very small in relation to CBL and total length. Pulp cavity was partially closed and the crowns were erupted 9mm from the gum with no signs of wear. This study provides the first indication of accelerated growth in *M. bowdoini* and shows data on a specimen with an intermediate development status. The antorbital notch is more bulky and solid than the antorbital notches of New Zealand and Australian *M. bowdoini*. The jugal extended into the antorbital notch as occurs in most specimens and is more developed and more similar in form to that of *M. carlhubbsi*. This is the first occurrence of *M. bowdoini* on the Uruguayan coast and the northernmost record for the species in the Atlantic Ocean.

Resumen: El 24 de mayo de 2003 se encontró un ejemplar de zífido de Andrews muerto y fresco en la playa de La Coronilla (33°54'50"S, 53°30'15"W), Departamento de Rocha, Uruguay. Se utilizaron caracteres morfológicos y osteológicos para identificar al ejemplar y estudios genéticos para confirmar la identificación de la especie. Si bien el aspecto corporal básico fue consistente con las descripciones publicadas, el ejemplar uruguayo presentó características de un individuo subadulto con relación a su longitud total (430cm), típica de un macho adulto. El patrón de coloración difirió de los previamente descritos para un macho de esta especie, siendo más similar al de una hembra adulta de *M. carlhubbsi*. Su LCB (800mm) estuvo fuera del rango reportado para la especie (645-783mm), siendo el cráneo más grande conocido para *M. bowdoini*. Los dientes fueron similares a los de una hembra adulta de *M. bowdoini*, siendo muy pequeños en relación al LCB y a la longitud total. La cavidad pulpar estaba parcialmente cerrada y las coronas emergían 9mm de las encías sin ningún tipo de desgaste. Este trabajo señala el primer signo de crecimiento acelerado en *M. bowdoini* y revela datos de un espécimen con un estado de desarrollo intermedio. La escotadura antorbital es más robusta y sólida que la encontrada en los ejemplares de *M. bowdoini* de Nueva Zelanda y Australia. El yugal se extendió dentro de la escotadura antorbital como ocurre en la mayoría de los ejemplares y es más desarrollado y similar en forma al de *M. carlhubbsi*. Este es el primer registro de *M. bowdoini* para la costa uruguaya y el registro más septentrional para la especie en el Océano Atlántico.

Key words: Andrew's beaked whale, Ziphiidae, *Mesoplodon bowdoini*, genetic analyses, morphology, Uruguay.

Introduction

Andrew's beaked whale, *Mesoplodon bowdoini* Andrews, 1908 is one of the least known of the 14 species of the genus *Mesoplodon*. It has a circumpolar distribution north of the Antarctic convergence, between 32° and 54°30'S in the Southwestern Pacific and Indian oceans, and from 36° to 52°S in the Atlantic Ocean (Baker, 2001). Species of *Mesoplodon* are rarely observed at sea and prefer deep waters, which make their identification to species level difficult. Almost all what is known about this genus results from stranding records. In the Southwestern Atlantic Ocean, six species of *Mesoplodon* are recorded: *M. densirostris*, *M. layardii*, *M. hectori*, *M. europaeus*, *M. bowdoini* and *M. grayi* (Table 1). In particular, *M. bowdoini* is known from a few individuals found ashore in Falkland/Malvinas Islands, Tristan da Cunha (Baker, 2001) and Tierra del Fuego (Goodall *et al.*, 2004⁵).

On 24 May 2003, a fresh dead specimen of an unknown ziphiid was found stranded on the beach of La Coronilla (33°54'50"S, 53°30'15"W), Department of Rocha, Uruguay. We could not initially reconcile the specimen with any of the previously known ziphiids of the region. As the color pattern did not allow species determination, it was named *Mesoplodon* sp. First the skull was analysed concluding it could belong to two species *Mesoplodon carlhubbsi* or *M. bowdoini*. Under such suspicion, photographs of the skull were sent to Dr. Natalie Goodall, Tierra del Fuego, Dr. Alan Baker in New Zealand, Dr. Julio Reyes in Peru and Dr. Colin MacLeod in United Kingdom, who helped in identifying the species as *M. bowdoini*. This determination was confirmed later through mtDNA analyses.

The objective of this note is to provide the first report of *M. bowdoini* for the Uruguayan coast and to analyze color and skull features useful in comparative analyses with published studies.

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⁵ Goodall, R.N.P., Boy, C.C., Pimper, L.E., and Nacnie, S.M. (2004) Range extensions and exceptional records of cetaceans for Tierra del Fuego. Page 158 in *Abstracts*, 11^o Reunión de Trabajadores de Especialistas en Mamíferos Acuáticos de América del Sur y 5^o Congreso de la SOLAMAC, 11-17 September 2004, Quito, Ecuador.

Table 1. Species of the genus *Mesoplodon* cited for the South-western Atlantic Ocean.

SPECIES	LOCATION	SOURCE
<i>Mesoplodon densirostris</i> (Blainville, 1817)	42Km south of Cassino, RS, Brazil	Castello and Pinedo (1980) Secchi and Zarzur (1999)
<i>Mesoplodon europaeus</i> (Gervais, 1855)	São Vicente, SP, Brazil Bitupita Beach, BA, Brazil	Santos <i>et al.</i> (2003) Martins <i>et al.</i> (2004)
<i>Mesoplodons mirus</i> (True, 1913)	Praia Baleia, São Sebastião, SP, Brazil	de Souza <i>et al.</i> (this issue)
<i>Mesoplodon hectori</i> (Gray, 1871)	Falkland/Malvinas Islands Tierra del Fuego, Argentina Golfo San José, Argentina Prov. Buenos Aires, Argentina Pinamar, Prov. Buenos Aires, Argentina Prov. Buenos Aires, Argentina 80Km N Rio Grande, RS, Brazil	Fraser (1950) Goodall (1978) Mermoz (1979) Lichter (1986) Rodríguez <i>et al.</i> (1994) ¹ Cappozzo <i>et al.</i> (this issue) Zerbini and Secchi (2001)
<i>Mesoplodon grayi</i> Haast, 1876	Tierra del Fuego, Argentina Prov. Buenos Aires, Argentina Prov. Buenos Aires, Argentina Pinamar, Prov. Buenos Aires, Argentina Chubut, Argentina 80Km N Lagoa dos Patos, RS, Brazil	Goodall (1978) Moreno (1895); Lichter (1986) Urquiola (1970) Rodríguez <i>et al.</i> (1991) Mermoz (1979) Soto and Vega (1997)
<i>Mesoplodon layardii</i> (Gray, 1865)	Falkland/Malvinas Islands Tierra del Fuego, Argentina Santa Cruz, Argentina Río Negro, Argentina Chubut, Argentina Uruguay Rio Grande do Sul, Brazil	Turner (1880) Goodall (1978) Lichter (1986) Lichter (1986) Lichter (1986) Praderi (1972) Pinedo <i>et al.</i> (2001)
<i>Mesoplodon bowdoini</i> Andrews, 1908	Bahía San Sebastián, Tierra del Fuego, Argentina Falkland/Malvinas Islands La Coronilla, Uruguay	Goodall <i>et al.</i> (2004) ² Baker (2001) This paper

¹ Rodríguez, D., Prieto, G., Moron, S., Rivero, L., Rodríguez Heredia, S., Alvarez, K. and Bastida, R. (1994) Varamiento de una ballena rostrada de Gray en Pinamar, Argentina. Page 126 in *Abstracts*, 6^o Reunión de Trabajo de Especialistas de América del Sur, 24-28 October. Florianópolis, Brasil.

² Goodall, R.N.P., Boy, C.C., Pimper, L.E., and Nacnie, S.M. (2004) Range extensions and exceptional records of cetaceans for Tierra del Fuego. Page 158 in *Abstracts*, 11^o Reunión de Trabajo de Especialistas en Mamíferos Acuáticos de América del Sur y 5^o Congreso de la SOLAMAC, 11-17 September 2004, Quito, Ecuador.

Material and Methods

Stranding event

As the specimen was found in late afternoon, the visual inspection was brief and basic body measurements, tissues samples, skull and photographs were taken. The advanced time of the day and tide level variation impeded further studies. The next morning, the carcass was removed by the sea, and it re-appeared 7 km north, 44 days later in advanced state of decay. As the carcass was recovered, some measurements were checked again and the skeleton was obtained. Despite the advanced state of decomposition and scavengers' effect, the stomach content was inspected and right testis measurements and intestine length were recorded.

Morphology

External body measurements were taken following Norris (1961). The color pattern was recorded from direct observation and photographs taken of the fresh specimen. The skull, postcranial skeleton and tissue samples were collected. The stomach content was inspected after laparotomy, the right testis was measured with a 0.1mm precision calliper and intestine length was recorded with a 1mm precision fiber-glass meter after the remotion of the mesentery and the intestine extension on the ground.

Osteology

Skull and post-cranium skeleton were measured with a 0.5mm precision calliper following Ross (1984) and

deposited at the Museo Nacional de Historia Natural y Antropología (MUNHINA 4743), Montevideo, Uruguay. The diagnostic characters used for the species identification were: morphology of skull, proportions of the rostrum, shape and position of teeth, shape of the prominent notches, nature of antorbital tubercles, ventral arrangement of the bones of antorbital process (jugal, lacrimal, frontal and maxilla), separation of the nasals, vertex and minimal distance between premaxillary foramina.

Genetic Analyses

In order to confirm the specimen's identity, the control region of the mitochondrial DNA was sequenced. This sequence was compared with sequences of *Mesoplodon* genetically close reported in the GENBANK (*M. bowdoini*: AY579536, *M. carlhubbsi*: U70461; *M. ginkgodens*: AY579517; *M. perrini*: AF441256; *M. stejnegeri*: AY579527; *M. layardii*: AY579523; *M. hectori*: AY579522; *M. mirus*: AY579525; *M. grayi*: AY579520; and *M. densirostris*: AY579514). *Ziphius cavirostris* (AY579531) was used as the outgroup.

DNA extraction from muscle preserved in 95% alcohol was done following Miller *et al.* (1988) and Maniatis *et al.* (1992). The sequence reported here was amplified using primers Fraser 14 (5'-TAAWGTCTCTTCCTTGAGTCTTA-3') designed by the Evolution Laboratory (Facultad de Ciencias, Universidad de la República, Montevideo, Uruguay) and TDKD (Kocher *et al.*, 1989).

The conditions of the cycling were optimized in a Rapid-Cycler thermocycler (Idaho Technology) in a 3 min. initial denaturalization at 93°C, followed by 30 cycles of denaturalization at 93°C for 1 min., annealing at 45°C, for 1 min., extension at 72°C for 1 min., followed by a final extension of 3 min. at 72°C. Sequences were edited using the Sequence Navigator Program (Applied Biosystems Inc., Ver. 1.0.1) and aligned using ClustalX Program (Thompson *et al.*, 1997) with the options set by default.

In order to conduct maximum parsimony analyses, the PAUP program (Swofford, 2000) was used. The heuristic search was done by means of simple sequential addition and the "Tree-Bisection-Reconnection" (TBR) algorithm, which are options by program default. The support of the nodes was evaluated by means of bootstrap using 1000 replicates (Felsenstein, 1985).

Results and Discussion

Morphological Description

The freshly stranded specimen was a male with a total length of 430cm (Figure 1). External characters and measurements are consistent with data from literature (Table 2) (Leatherwood *et al.*, 1976; Evans, 1987; Mead, 1989). This species is one of the smaller beaked whales, usually under 450cm when fully adult (Baker, 2001). Six males and seven females accurately measured ranged from 341 to 440cm and 365 to 438cm, respectively, and

the maximum estimated body length for a female is 487cm (Baker, 2001). Taking into consideration all these reported data, our male 430cm long, MUNHINA 4743, is within the range of an adult.

The overall dorsal aspect is bluish gray or slate colored (Figure 1a-g). Ventrally, the coloration gradually becomes lighter: whitish gray at the midlength with scattered grayish and irregular whitish spots, and white around the anogenital area. A mesh of irregular lighter and darker areas masks the distinction to the ventral pattern. Dorsally, the contour of the flipper is dark grey, surrounding a faint lighter area at the center. A dark "flipper pocket" sharply distinguishes from the surrounding body wall. The caudal peduncle and dorsal aspect of the fluke share the dorsal pattern. The ventral side of the fluke exhibits a white central area surrounded by the darker pigmentation observed dorsally. The tip of the rostrum and lower jaw are white. At the midlength of the rostrum, the transition to the dorsal pattern is accompanied by grayish and whitish spots. The white area of the lower jaw gradually becomes greyish at the level of the tusk. This color pattern was not previously found in a male of this species. Rather, this specimen is very similar to a *M. carlhubbsi* adult female (see Figure 5 in Mead *et al.*, 1982), in which females and sub-adult males are alike in their coloration (Mead *et al.*, 1982).

The inspection of the skin revealed a moderate number of body scars on the exposed side (Figure 1d). The greatest linear scars are restricted to the posterior dorsal half of the body, whereas oval, circular and notched scars are found anteriorly in relation to the pectoral fin and posteriorly in ventral area. All of them are restricted to the epidermis and are light colored or white. According to McCann (1974), linear scars can be ascribed to intraspecific play or combat. Their scarcity is not consistent with a history of violent fights for this individual. Observed healed oval, circular and notched scars can be the consequence of predators (as cookie-cutter shark and/or lampreys) and/or external parasites and epizoans (*e.g.* barnacles and copepods). The absence of external parasites and epizoans found in the fresh carcass supports the predator explanation as the most reliable.

Although no fluke notch is present in ziphiids as a rule (Leatherwood *et al.*, 1983), the specimen exhibits a slight indentation masked by the projections of the rear margin of each half of the fluke towards the midline. These lobes overlap on the midline, making an apparent projection (Figure 1g).

The pyloric stomach was empty whereas a bit of sand was found in the main stomach. The intestine length (from pylorus to anus) was 10.5m. The size of right testis was 10.4x5.2x2.6cm (without the epididymus). Little reproductive data are known for *Mesoplodon* species (Mead, 1984). The size of the right testis was within the range of those examined in other species of *Mesoplodon* (Mead *et al.*, 1982), but no other data on testis sizes are available for this species.

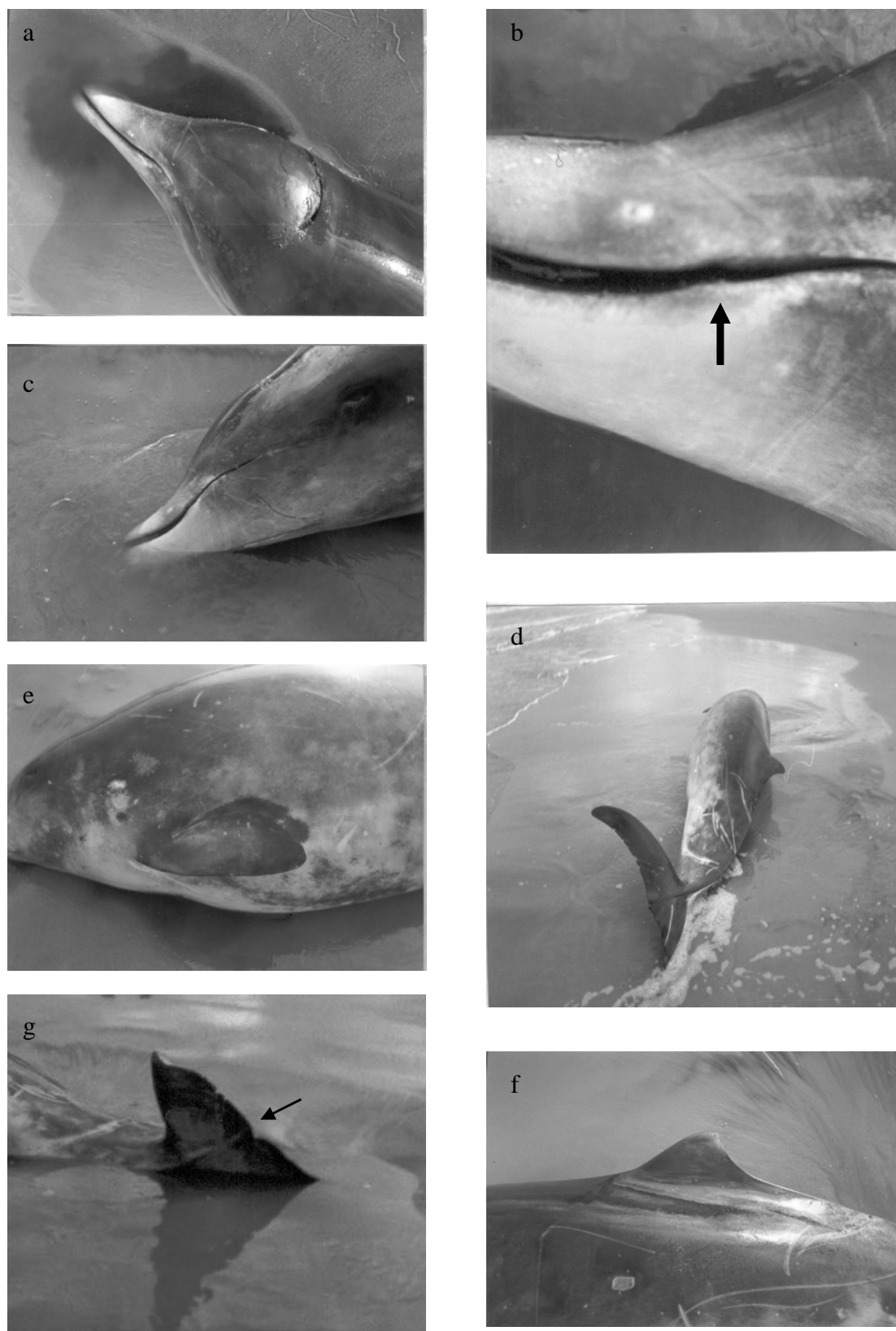


Figure 1. a-g: Freshly stranded male of *M. bowdoini* at La Coronilla, Department of Rocha, Uruguay a, head and blowhole; b, small teeth erupted the gums; c, head and grooves; d underside of body; e, belly and flippers; f, dorsal fin; g, underside of tail- note the small fluke notch.

Table 2. Body measurements of *M. bowdoini* (MUNHINA 4743 specimen) stranded on the Uruguayan coast.

MEASUREMENTS (cm)	MUNHINA 4743	%TL
Total length	434	100
Snout to angle of mouth	27	6.22
Girth maximum	230	53.00
Flipper length anterior	50	11.52
Flipper length posterior	25	5.76
Flipper width	16.5	3.80
Dorsal fin height	17	3.92
Length dorsal fin base	35	8.06
Fluke width	103	23.73

Osteology

The osteological information reveals that the specimen was a subadult, as the mesorostral channel was partially ossified, the cranial sutures were not closed and the vertebral epiphyses were fused only from C1 to C3. The vertebral formula was C7, T10, L10, Ca19 = 46. Double-headed ribs were observed from 1 to 7. There were nine chevrons and the pelvic

bones measurements were: right 68mm x 18mm; left: 69mm x 17mm.

Cranial and mandible measurements are shown in Table 3 and the comparisons of the skull and mandible between our specimen and other *M. bowdoini* specimens are shown in Table 4. The condylobasal length (CBL) of this specimen was 800mm, making it the largest skull known for *M. bowdoini* (645-783mm) and the ratio between basirostral width/zygomatic width was 52.1%, which is not within the known variation for *M. bowdoini* (55.8%-65.4%) reported by Baker (2001). The skull was narrow at the base of the rostrum (144mm, 62.5% of the CBL), and slightly arched distally (Figure 2a). The mandible was thin and also slightly curved at the distal region. Its symphysis was longer than expected (175mm). The symphysis and the alveolus length for an adult *M. bowdoini* specimen from Tierra del Fuego were 125mm and 133mm, respectively (R.N.P. Goodall, pers. comm⁶). The symphysis length/mandible length ratio of our specimen was 24.3%. Such ratio is 21.8% for the largest specimen known, which presents 783mm of CBL (Baker, 2001).

Table 3. Cranial and mandible measurements of *M. bowdoini* (MUNHINA 4743) stranded on the Uruguayan coast.

MEASUREMENTS	mm	%CBL
Condylobasal length (CBL)	800	100.0
Tip of rostrum to apices of antorbital notches	500	62.5
Breadth skull across orbital centres	375	46.8
Breadth skull across postorbital process frontals	375	46.8
Breadth skull across zygomatic process squamosals	376	47
Greatest length of right nasal on vertex	48	6
Width rostrum in apices of antorbital notches	144	18
Least distance between main mx foramina	108	13.5
Least distance between pmx foramina	50	6.3
Depth rostrum at mid length rostrum	70	8.8
Mandibular length	692	86.5
Greatest length of symphysis	175	21.9
Length of alveolus	52	6.5
Width of alveolus	11	1.4
Tip of mandible to alveolus	154	19.3
Greatest tooth length (left)	75	9.4
Greatest tooth length (right)	74	9.3
Greatest tooth width (left)	65	8.1
Greatest tooth width (right)	66	8.3
Greatest tooth breadth (left)	10	1.3
Greatest tooth breadth (right)	10	1.3

⁶ Natalie Goodall. Proyecto AMMA, Sarmiento 44, 9410 Ushuaia, Tierra del Fuego, Argentina. 9th July, 2005. ³ Anton van Helden. Museum of New Zealand Te Papa Tongarewa. P.O. Box 467, Wellington, New Zealand. 9 January 2005.

Table 4. Comparison between skulls and mandibles of the *M. bowdoini* holotype specimens, presented in Baker (2001) and the Uruguayan specimen (MUNHINA 4743).

RATIOS	HOLOTYPE (MOORE, 1963)	BAKER (2001)	MUNHINA 4743
Zygomatic width/CBL	46.9%	44.2%-49.8%	46.7%
Basirostral width/Zygomatic width	57.0%	54.8%-64.3%	52.1%
Rostrum length/CBL	59.7%	55.8%-65.4%	62.5%
Symphysis length/Mandible length	24.3%	21.8%-29.6%	24.6%

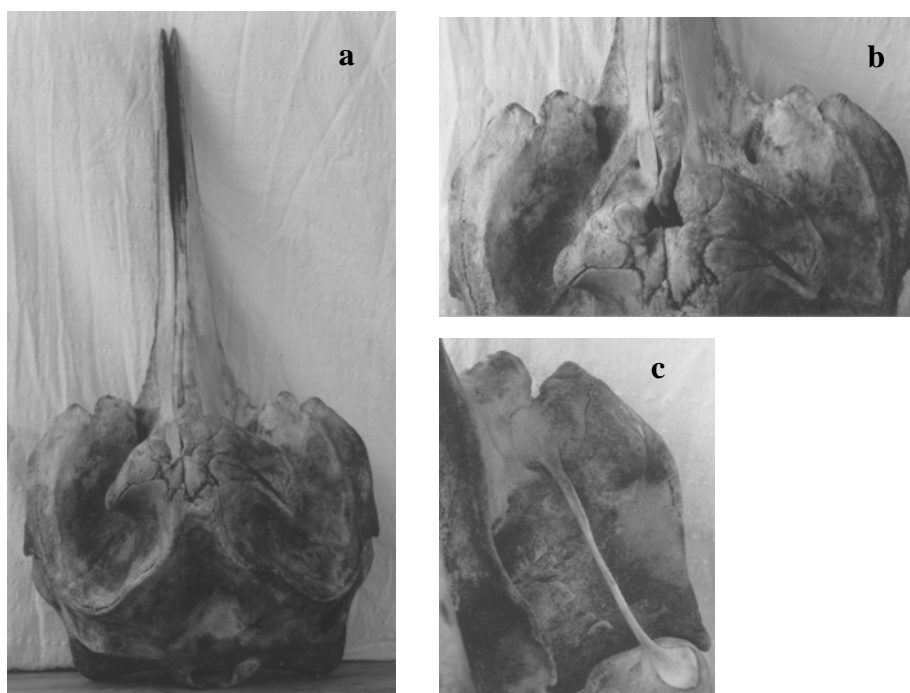


Figure 2. Skull of male *M. bowdoini* (MUNHINA 4743). a. dorsal view, b. enlargement of right antorbital region showing prominent and antorbital notches and tubercles; c. ventral antorbital region showing the disposition of jugal, lacrimal and maxilla.

The antorbital notches were relatively deep and v-shaped, and the prominent notches were shallow and curved. The antorbital tubercles were blunt, and did not extend farther anteriorly than the maxillary prominences (Figure 2b). The antorbital process was formed by the maxilla and frontal, and it was underlaid by the jugal and the facial surface of the lacrimal. However, the disposition of the ventral bones of antorbital notches is somewhat different to that described for the species. The maxilla spreads over an extensive area of the ventral antorbital tubercle and presents a more ventral surface in this specimen, forming an antorbital notch more bulky and solid than the antorbital notches of New Zealand and Australian *M. bowdoini* (Figure 2c). Additionally, there is a small and distinct prominence on the posterior aspect of the lacrimal in all of

the *M. bowdoini* from New Zealand, which is not present in the Uruguayan specimen (A. von Helden, pers. comm.⁷). The jugal extended into the antorbital notch as occurs in most specimens (Baker, 2001) and is more developed and more similar in form to that of *M. carllhubbsi* (in comparison with the one described by Reyes *et al.*, 1995). These authors stated that the shape and arrangement of the bones in this region, in particular the jugal and the lacrimal, follow a consistent pattern within each species, providing a useful character in the discrimination of *Mesoplodon* species. Although there is scarce information on variability of this feature, the analysis of photographs⁸ of the antorbital process of New Zealand and Australian specimens of *M. bowdoini* and photographs of *M. carllhubbsi* suggests a great variation.

⁷ Museum of New Zealand Te Papa Tongarewa, P.O. Box 467, Wellington, New Zealand. 9 January 2005.

⁸ Photographs of *M. bowdoini* specimens were provided by Julio Reyes: AMNH 35027; NMV C 8442; CSIRO 16212; DBW3; SAM m10628; SAM m14061. Photographs of *M. carllhubbsi* UBC9416 (University of British Columbia) were provided by Tadasu Yamada and photographs of LACM 72153 were provided by John Heyning. Photographs of specimen USNM 278031 were provided by James Mead.

The right nasal length was relatively large (48mm), representing 12.7% of zygomatic width, whereas the range for the species is 20.3% to 29.6% (Baker, 2001). The maxillary foramina were anterior to, and larger than, the premaxillary foramina. The minimal distance between the premaxillary foramina was 59mm and was larger than the maximum of the species' range (31-45mm) (Baker, 2001). All of these ratios represent great ontogenetic changes in the skull. These could be explained by considering the Uruguayan specimen as intermediate between adult and subadult male representative forms. Thus, the different skull proportions could simply be variation that has not been observed prior to the occurrence of this specimen.

The teeth are flattened and triangular (Figure 3b) and their mean measurements were: 66mm in length, 75mm of height and 10mm of width. Pulp cavity was partially closed and the crowns were erupted 9mm from the gum, and no signs of wear present. The teeth are similar to those reported for adult females of *M. bowdoini* (see Figure 4 in Dixon, 1970; Figure 2h and Table 2 in Baker, 2001), which were 51mm high, 64mm long and 9mm wide, and 53mm high, 50.5mm and 8mm wide (Baker, 2001). The maximal known size of an adult male tooth is 136mm high, 77mm long and 17mm wide. However, the teeth of the specimen from Tierra del Fuego were approximately 190mm high and 90mm long, being the biggest teeth recorded, but with a CBL smaller than that of the Uruguayan specimen (R.N.P. Goodall, pers. comm.⁹). Another adult male, which was 400cm long, had teeth 123mm high but only 54mm long (Baker, 2001). However, in the genus *Mesoplodon*, male and female teeth are sometimes similar until sexual maturity

(see Figure 2 in Yamada, 1996; Figure 2 in Baker, 2001; Figure 4 in MacLeod and Herman, 2004). Then the teeth of males begin a period of rapid growth, at which point they erupt beyond the gums for the first time (Yamada, 1996; Baker, 2001; MacLeod and Herman, 2004).

The teeth were 15mm overlapping the symphysis and situated 22.2% of the mandible length (Figure 3a). In adult or subadult males the teeth are situated between 16.6% and 25% ramus length from the tip of the mandibles (Baker, 2001). Unlike the holotype (AMNH 35027) and other specimens in Australia and New Zealand, the anterior edge of the alveoli was adjacent to the posterior end of the symphysis scar by 15mm. Thus, we agree with Baker (2001) in that small or even moderate differences in the position of the alveoli in relation to the symphysis may not always be diagnostic for *M. bowdoini*.

Unlike some species of *Mesoplodon*, e.g. *M. layardii* (specimens in NMNZ, A. Baker, pers. comm.⁹), *M. stejnegeri* (Yamada, 1996) and *M. bidens* (Moore, 1968; MacLeod and Herman, 2004), the shape of the male teeth of *M. bowdoini* does not appear to change markedly during the accelerated growth phase accompanying the onset of sexual maturity (Baker, 2001). In this species, growth spurt seems to be largely in the height of the teeth beginning at around 3.90m TL (Baker, 2001). This phenomenon was not found in the specimens examined in Australia and New Zealand because this intermediate stage of maturity was not previously documented, and probably because the earlier sample was small. The present report provides the first indication of accelerated growth in *M. bowdoini* and reveals data about such intermediate specimen.

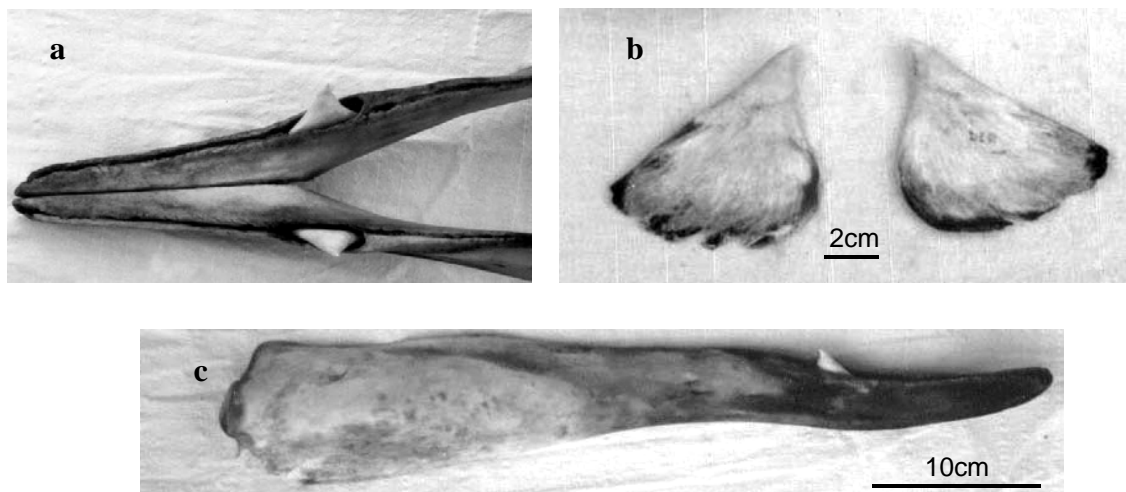


Figure 3. Mandible and tooth of MUNHINA 4743 a, dorsal view of mandible showing the position of teeth in relation to symphysis; b, lateral view of teeth. c, right lateral view of mandible.

⁹ Alan Baker. Cetacean Biology Consultant. 8 Waters Lane RD 2 Kerikeri - Bay of Islands, New Zealand. 20th December 2004.

Mature males of this species have a bulky and relatively short mandible with large teeth resting on a bony abutment like a shoulder. However, the teeth of the Uruguayan specimen are very small in relation to CBL and total length. It could be a sexually immature male, probably very close to becoming sexually mature (430cm TL), with teeth not yet performing their transformation to mature ones. If the teeth of *M. bowdoini* grow isometrically, the tooth of the Uruguayan specimen would grow in height and broaden keeping its shape, when it becomes an adult.

Yamada (1996) pointed out for *Mesoplodon stejnegeri*, that neonate teeth change from almost conical to tall and thick spatular teeth like tusks. He recognized five stages in the shape of the teeth along the ontogenetic development. The first two stages are unisexual with almost conical teeth with tall triangular profile. The following two stages were found only in males, from ovoid or chestnut shape to a tall and large tooth almost spatular in shape. Finally the last stage, similar to stage 4, presents an incision at the anterior edge of the tooth neck. On the basis of their frequencies, the shape change from stage 3 to 4 can be very rapid. Regarding the recent study of MacLeod and Herman (2004), who examined the development of the teeth and associated skeletal structures in *M. bidens* from Scotland, the development associated with male maturity

includes several changes in tusk and jaws. According to the authors, such changes are: an increase in tooth length, an increase in the length of the alveolus, a high level of wear on the tooth, an increase in the depth of the mandible posterior to the alveolus, an increase level of mesorostral ossification and an overall thickening of the rostrum and the symphyseal region of the mandible.

Based on these two studies, we can consider the teeth of the Uruguayan *M. bowdoini* specimen at stage 2: somewhat flattened triangular teeth, also unisexual (Yamada, 1996), as subadult male teeth are similar to those of an adult female (Baker, 2001, MacLeod and Herman, 2004). The female and male teeth of this species are very similar prior to sexual maturity, with triangular and flattened shape. Then they change into taller and wider spatula-shaped teeth, often with signs of great usage in the anterior and the inner edge of the teeth. This could be a general pattern of teeth growth in *Mesoplodon* species.

Molecular Genetic Identification

Among the 332 bp sequenced of the mtDNA control region, 78 variable sites were observed, 54 of which were informative regarding parsimony criteria. The consensus of three shortest trees (length: 79 steps; Consistency Index: 0.578) is depicted in Figure 4.

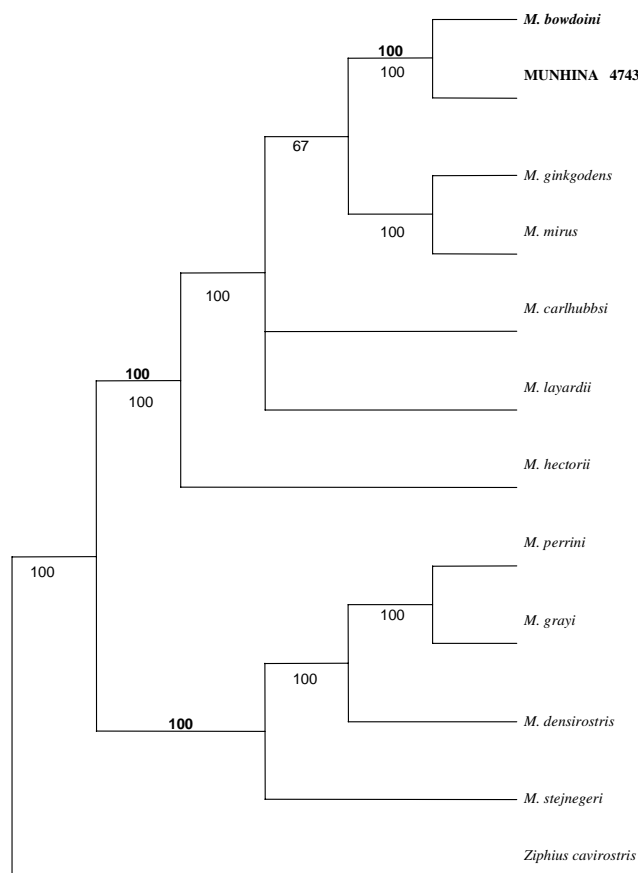


Figure 4. Consensus tree by the majority rule of 3 parsimonious equal trees of *Mesoplodon* haplotypes reconstructed with the Maximum Parsimony criteria by means of the heuristic search. Numbers above nodes are bootstrap values using 1000 replicas; those below are shown in the majority-rule consensus. The *Ziphius cavirostris* haplotype is the outgroup. Sequences were taken from Genebank.

The specimen MUNHINA 4743 appears as sister taxon to *M. bowdoini* with 100% of support. Both specimens showed the shortest pairwise genetic distance (HKY85: 0.6%, Table 5) among them. This confirms that the MUNHINA 4743 specimen from Uruguay belongs to the species *Mesoplodon bowdoini*, as indicated based on skull morphology.

The larger distance obtained between MUNHINA 4743 and the other *Mesoplodon* spp. considered in this study was *M. stejnegeri* (11.2%), followed by *M. mirus* (11%). Coincidentally, that same distance can also be observed between *M. bowdoini* and *M. stejnegeri* (11%), and between *M. bowdoini* and *M. mirus* (11%), which would also support the specimen MUNHINA 4743 belonging to the species *M. bowdoini*.

Based on the geographical distribution and morphology of *Mesoplodon* species, Moore (1963) identified three geographical "lots": "subarctic", represented by *M. stejnegeri*; "north temperate", represented by *M.*

carlhubbsi and "south temperate", represented by *M. bowdoini*. Mead (1989) stated that *M. carlhubbsi* and *M. bowdoini* are morphologically similar and could be sister species, but our study as well as that of Dalebout *et al.* (1998) report genetic differentiation between *M. carlhubbsi*, *M. bowdoini* and *M. stejnegeri*. Nevertheless, similar morphological characteristics are still found in *M. bowdoini* and *M. carlhubbsi*, particularly the color pattern of females and subadult males as well as on some skull characters.

M. layardii is the sole species of *Mesoplodon* previously reported for Uruguay (Praderi, 1972). However, other cold-temperate species of *Mesoplodon* have been recorded from southern Brazil (see Table 1). The specimen described here represents the first record of *M. bowdoini* in Uruguay and confirms its occurrence in the western South Atlantic Ocean, as stated by Baker (2001). It also represent the species' northernmost record in the Atlantic Ocean.

Table 5. Comparisons of pairs of haplotypes. Differences according to the HKY85 model (Hasegawa *et al.*, 1985) between haplotype pairs are shown above the diagonal, and the observed number of nucleotide differences is shown below the diagonal. Sequences were taken from Genbank.

	1	2	3	4	5	6	7	8	9
1 <i>M.bowdoini</i>	-	0.00608	0.08537	0.08232	0.08537	0.07645	0.09119	0.07599	0.10976
2 MUNHINA 4743	2	-	0.08232	0.08537	0.08232	0.07951	0.09422	0.07903	0.11280
3 <i>M.ginkgodens</i>	28	27	-	0.07645	0.10703	0.07951	0.07317	0.07012	0.09786
4 <i>M.perrini</i>	27	28	25	-	0.06402	0.05828	0.06707	0.06707	0.06402
5 <i>M.grayi</i>	28	27	35	21	-	0.07669	0.08841	0.06707	0.08537
6 <i>M.carlhubbsi</i>	25	26	26	19	25	-	0.06422	0.05810	0.06748
7 <i>M.layardii</i>	30	31	24	22	29	21	-	0.06079	0.07317
8 <i>M.hectorii</i>	25	26	23	22	22	19	20	-	0.05793
9 <i>M.stejnegeri</i>	36	37	32	21	28	22	24	19	-
10 <i>M.densirostris</i>	29	29	30	20	23	25	27	24	17
11 <i>Ziphius</i>	34	33	32	30	37	28	28	26	24
12 <i>M.mirus</i>	35	36	29	29	34	27	29	25	27
	10	11	12						
1 <i>M.bowdoini</i>	0.08869	0.10366	0.10703						
2 MUNHINA 4743	0.08869	0.10061	0.11009						
3 <i>M.ginkgodens</i>	0.09174	0.09786	0.08869						
4 <i>M.perrini</i>	0.06116	0.09146	0.08869						
5 <i>M.grayi</i>	0.07034	0.11246	0.10398						
6 <i>M.carlhubbsi</i>	0.07669	0.08589	0.08282						
7 <i>M.layardii</i>	0.08257	0.08537	0.08869						
8 <i>M.hectorii</i>	0.07339	0.07927	0.07645						
9 <i>M.stejnegeri</i>	0.05183	0.07317	0.08232						
10 <i>M.densirostris</i>	-	0.07645	0.10671						
11 <i>Ziphius</i>	25	-	0.09174						
12 <i>M.mirus</i>	35	30	-						

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