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Short Note

A Sowerby's Beaked Whale (*Mesoplodon bidens*) Stranded in the Canary Islands: The Most Southern Record in the Eastern North Atlantic

Vidal Martín,[1] Marisa Tejedor,[1] Mónica Pérez-Gil,[1] Merel L. Dalebout,[2] Manuel Arbelo,[3] and Antonio Fernández[3]

[1] *Society for the Study of Cetacean in the Canary Archipelago (SECAC)/Canary Islands Cetacean Museum (MCC), Edif. Antiguo Varadero 1ª Planta, Local 8B. Urb. Puerto Calero, 35571 Yaiza, Lanzarote, Canary Islands, Spain*
E-mail: vidal@cetaceos.org
[2] *School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, NSW 2052, Australia*
[3] *Institute for Animal Health (IUSA), Veterinary School, University of Las Palmas de Gran Canaria, Trasmontaña s/n, 35413 Arucas, Gran Canaria, Canary Islands, Spain*

The combination of extended dive capacities, cryptic behavior, and the apparent low abundance of the majority of the 21 recognized species (Dalebout et al*.,* 2002; Barlow et al*.,* 2006) make the deep-diving toothed-whales of the family Ziphiidae among the least known of marine mammals. Much of our information about beaked whales has come from strandings. In the Canary Islands, 11 mass strandings of beaked whales have been reported from 1985 to 2011, and at least six coincided, both temporally and geographically, with naval sonar exercises (Simmonds & Lopez-Jurado, 1991; Jepson et al*.,* 2003; Fernández et al*.,* 2004, 2005; Martín et al*.,* 2004; Santos et al*.,* 2007; Martín & Tejedor, 2009). The specific mechanism that involves these strandings is still not completely clear due to the scarce knowledge about the ecology and biology of these species. To date, five species of beaked whales—Cuvier's beaked whale (*Ziphius cavirostris*), Gervais' beaked whale (*Mesoplodon europaeus*), True's beaked whale (*M. mirus*), Blainville's beaked whale (*M. densirostris*), and Northern bottlenose whale (*Hyperoodon ampullatus*)—have been recorded from the Canary Islands (Martín & Tejedor, 2009).

In the early morning of 16 April 2007, a deceased beaked whale was found stranded on Papagayo beach (28º 50' 30" N; 13º 47' 05" W), in the municipality of Yaiza on the south coast of Lanzarote in the Canary Islands. Facilitated by the Society for the Study of Cetacean in the Canary Archipelago, the carcass was transported to the Canary Islands Cetacean Museum (MCC) in order to carry out the corresponding biological and pathological studies. The specimen was considered as fresh code 2, according to the carcass classification proposed by Geraci & Lounsbury (1993). We estimated that the animal had been dead for less than 12 h and that the whale had probably stranded alive that night and died shortly afterwards. Based on the morphology, osteology, dentition, and genetic analysis, the specimen was identified as a Sowerby's beaked whale (*M. bidens,* Sowerby, 1804); it was a mature male with a total body length of 4.56 m. We carried out an external inspection to collect details of the morphology and coloration pattern, and we took a set of morphometric measurements according to Norris (1961). A team of pathologists from the Institute for Animal Health (IUSA*)*, Veterinary School, University of Las Palmas de Gran Canaria, performed a systematic necropsy on the specimen. The genetic analysis of a skin sample preserved in dimethyl sulfoxide (DMSO) was performed at the School of Biological, Earth & Environmental Sciences, University of New South Wales, Sydney, Australia. This involved extraction of whole genomic DNA, PCR amplification of fragments of the mitochondrial DNA (mtDNA) control region and cytochrome b genes, and phylogenetic comparison of these sequences to a reference database for all known beaked whale species (as described in Dalebout et al., 2004, 2007). The complete skeleton and the biological samples were stored at the MCC's collection with the reference number SECAC 0148.

The animal was extremely emaciated (Figure 1A) and had a deep extensive wound on the left side of the head that extended from above the eye to behind the blowhole. This wound may have been caused by a traumatism of unknown origin.

The necropsy revealed that the main pathological findings were related to septicaemia. Lesions in the form of active ulcers in the mouth cavity, especially on the palate, were observed. The stomach was empty, except for two pieces of plastic within the glandular stomach. The body was strongly compressed laterally, with a keel that extended from the posterior margin of the dorsal fin to the flukes. External measurements of this specimen are given in Table 1.

The melon was relatively small and not bulbous, defined posteriorly by the blowhole indentation. The beak was long and narrow with a mouth line slightly sinusoid distally. The back corners of the mouth each possessed only 8 cm of extensible tissue and, based on manual manipulation, we found that the anterior point of the mouth could not be opened further than 15 cm. The throat grooves were long and relatively deep. The abdomen showed a deep furrow on the ventral midline, some centimetres before the genital slit—an effect presumably caused by the extreme thinness of the whale. We also observed the presence of a pair of vestigial mammary nipples (Clarke, 2005) anterior to the anal opening. The overall colour pattern was completely dark grey, which was slightly lighter on the

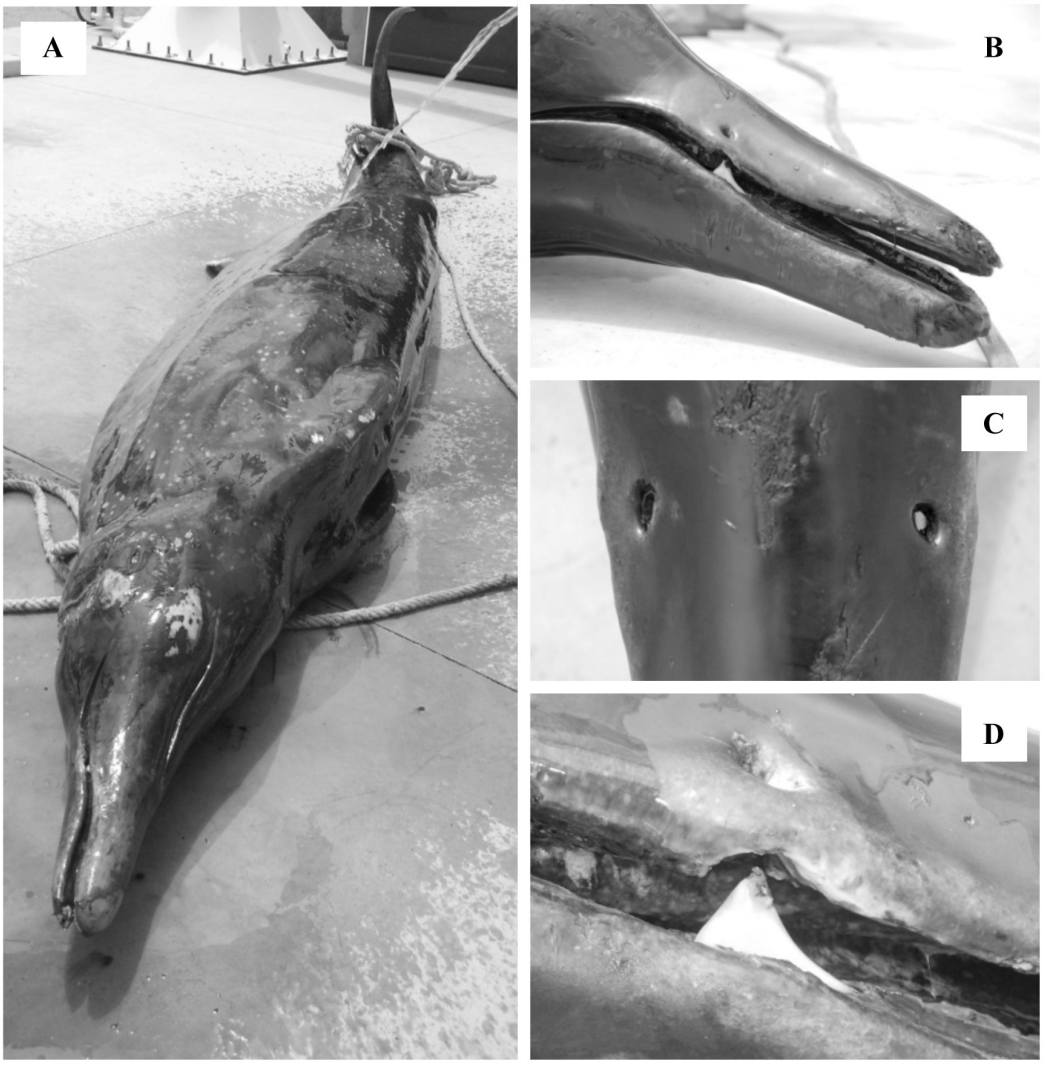


Figure 1. External appearance of the adult Sowerby's beaked whale stranded in Lanzarote, Canary Islands: (A) antero-lateral view of body; (B) lateral view of the head; (C) dorsal view of the snout with the holes; and (D) tooth and holes in the right snout detail.

Table 1. External measurements (cm) of *Mesoplodon bidens* specimen from Lanzarote, Canary Islands, according to Norris (1961); %TL = percentage of total length.

Measurement/count	cm	%TL
Total length	456.0	100.0
Beak tip to centre of blowhole	56.0	12.3
Beak tip to anterior insertion of dorsal fin	280.0	61.4
Beak tip to tip of dorsal fin	308.0	67.5
Beak tip to angle of mouth	45.0	9.9
Beak tip to centre of eye	61.0	13.4
Beak tip to anterior insertion of flipper	106.5	23.4
Beak tip to centre of umbilicus	219.0	48.0
Beak tip to genital slit (centre)	298.0	65.4
Beak tip to anus	336.0	73.7
Flipper length, anterior	45.0	9.9
Flipper length, posterior	33.4	7.3
Flipper width, maximum	17.5	3.8
Dorsal fin height	18.0	3.9
Length dorsal fin base	34.0	7.5
Fluke width	98.0	21.5
Fluke depth	30.0	6.6
Depth of fluke notch	0.0	0.0
Blowhole width	10.0	2.2
Length of eye opening	2.5	0.5
Centre of eye to centre of blowhole	25.5	5.6
Centre of eye to angle of mouth	16.6	3.6
Girth at axilla	170.0	37.3
Girth at anterior insertion of dorsal fin	180.0	39.5
Girth at anus	134.0	29.4
Length of anal opening	9.0	2.0
Length of genital slit	20.0	4.4
Length of left throat groove	29.0	6.4
Length of right throat groove	28.0	6.1

flanks, the abdomen, the lips, and the lower portion of the beak (Figure 1). We counted 14 linear scars ranging between 14 and 57 cm in length, most of these located on the flanks and likely the result of tooth rakes inflicted by other adult males during intraspecific fighting (Mead et al., 1982; Heyning, 1984).

We found a pseudostalked barnacle (*Xenobalanus globicipitis*) on the edges of the flukes and stalked barnacles (*Conchoderma auritum*), in an early development stage, on both teeth. Although only three specimens of the copepod *Penella* sp. were found, the flanks showed several punctiform scars likely due to a past occurrence of these parasites. Cookie-cutter shark (*Isistius* spp.) oval scars were not found. The skull was measured according to Moore (1972) and Ross (1984). The condylobasal length was 782 mm. Skull measurements of this specimen are given in Table 2 and mandibular and tooth measurements in Table 3. In relation to the post-cranial skeleton, the vertebral counts were C7+T10+L11+Ca19, with a total of 47 vertebrae. The first four cervical vertebrae were fused, and there were ten chevron bones in the caudal portion of the caudal vertebrae. The disappearance of the epiphyseal suture of a mid-thoracic vertebra showed that it was a physically (and sexually) mature animal. The rib count was ten pairs, eight of which were double-healed. The three sternal elements were not fused together.

Although the teeth were erupted, they were not exposed outside the jaw in the usual manner of mature ziphiid males. Instead, they were hidden by the lips of the upper jaw when the animal had its mouth closed, with the tips emerging through two holes of 0.5 cm diameter on both sides of the upper snout (Figures 1B, C & D). The internal edges of these holes were hemorrhagic. This unusual feature seems to be an acquired malformation as a result of an active chronic process caused by the mechanical erosion of the extremely sharp teeth tips on the upper lip. This circumstance could probably be influenced by the limited angle outwards of the tusks, leaving them covered by the lip margins. This anomaly, to our knowledge not previously described in the literature, likely had major implications in the life of this animal;

Table 2. Cranial measurements (mm) of *M. bidens* specimen from Lanzarote, Canary Islands, following Moore (1972) and Ross (1984); %CBL = percentage of condylobasal length.

Cranial measurement description	mm	%CBL
1. Condylobasal length	779.0	100.0
2. Length of rostrum; tip of beak to line connecting apices of antorbital notches	518.0	66.5
3. Tip of rostrum to posterior margin of pterygoid near midline	631.0	81.0
4. Tip of rostrum to most posterior extension of wing of pterygoid	654.0	84.0
5. Tip of rostrum to most anterior extension of pterygoid	445.0	57.1
6. Tip of rostrum to most posterior extension of maxillaries between pterygoids on the palate	533.0	68.4
7. Tip of rostrum to most posterior extension of maxillary plate	714.0	91.7
8. Tip of rostrum to anterior margin of superior nares	568.0	72.9
9. Tip of rostrum to most anterior point on premaxillary crest	573.0	73.6
10. Tip of rostrum to most posterior extension of temporal fossa	728.0	93.5
11. Tip of rostrum to most posterior extension of lateral tip of premaxillary crest	621.0	79.7
12. Tip of rostrum to most anterior extension of pterygoid sinus	495.0	63.5
13. Length of temporal fossa (L/R)	98.9	12.7
14. Length of orbit (L/R)	83.0	10.7
15. Length of right nasal on vertex of skull	36.1	4.6
16. Length of nasal suture	36.6	4.7
17. Breadth of skull across postorbital process of frontals	296.0	38.0
18. Breadth of skull across zygomatic processes of squamosals	293.0	37.6
19. Breadth of skull across centres of orbits	279.0	35.8
20. Least breadth of skull across posterior margins of temporal fossae	197.0	25.3
21. Greatest span of occipital condyles	111.0	14.2
22. Greatest width of an occipital condyle (left)	42.0	5.4
23. Greatest length of an occipital condyle (left)	73.0	9.4
24. Greatest breadth of foramen magnum	36.0	4.6
25. Breadth of skull across exoccipitals	244.0	31.3
26. Breadth of nasals on vertex	42.5	5.5
27. Least distance between premaxillary crests	33.6	4.3
28. Greatest extension of right premaxillary posterior of right nasal on vertex of skull	8.8	1.1
29. Greatest span of premaxillary crests	121.7	15.6
30. Least width (strictly transverse) of premaxillae where they narrow opposite superior nares	103.9	13.3
31. Greatest width of premaxillae anterior to place of previous measurement	104.3	13.4
32. Width of premaxillae at mid-length of rostrum	30.7	3.9
33. Width of rostrum in apices of antorbital notches	188.0	24.1
34. Width of rostrum in apices of prominential notches	138.0	17.7
35. Greatest width of rostrum at mid-length of rostrum	50.2	6.4
36. Greatest depth of rostrum at mid-length of rostrum	39.0	5.0
37. Greatest transverse width of superior nares	48.7	6.3
38. Greatest inside width of inferior nares; at apices of pterygoid notches, on the pterygoids	77.6	10.0
39. Height of skull; distance between vertex of skull and most ventral point of pterygoids	277.0	35.6
40. Greatest width of temporal fossa approximately at right angles to greatest length	50.8	6.5
41. Least distance between (main or anterior) maxillary foramina	87.6	11.2
42. Least distance between premaxillary foramina	46.1	5.9
43. Distance; posterior margin of left maxillary foramen to anterior extension of left maxillary prominence	54.1	6.9
44. Greatest length of vomer visible at surface of palate	136.9	17.6

as the teeth, largely hidden by the lips, would not have been able to be used as effective weapons in aggressive encounters with other males (Heyning, 1984).

In some species of the genus *Mesoplodon*, the teeth can slightly raise the lips or fit into depressions of the upper lips. The first case showing this formation was observed in a Gervais' beaked whale, a mature male of 4.53 m, that had stranded in Giniginamar in the southeast Fuerteventura Island in February 1985, and in another specimen observed alive at sea (V. Martín, unpub. data). Varona (1970) noticed in a Gervais' beaked whale stranded in Arroyo Bermejo, Cuba, that when

Table 3. Mandibular and tooth measurements (mm) of *M. bidens* specimen from Lanzarote, Canary Islands, following Moore (1972) and Ross (1984); %CBL = percentage of condylobasal length.

Mandibular and tooth measurement description	mm	%CBL
1. Length of mandible	655	83.8
2. Length of symphysis (fused length)	231	29.5
3. Length of symphysis (including unfused posterior part)	231	29.5
4. Height mandible at coronoid process	101	12.9
5. Outside height mandible at mid-length of alveolus	44	5.6
6. Inside height mandible at mid-length alveolus	46	5.9
7. Length posterior of condyle to posterior of symphysis	422	54.0
8. Length posterior of condyle to posterior margin of alveolus	400	51.2
9. Length alveolus	59	7.5
10. Width alveolus	13	1.7
11. Tip of mandible to anterior margin of alveolus	185	23.7
12. Greatest (vertical) length of tooth	87	11.1
13. Greatest antero/posterior width of tooth perpendicular to greatest length	36	4.6
14. Greatest breadth of tooth (L)	13	1.7
15. Depth of alveolus (L)	35	4.5

the mouth was closed, the teeth were fitted in skin depressions. This detail was also previously described in a male stranded in Boca Grande, Florida, in April 1959 (Moore, 1960).

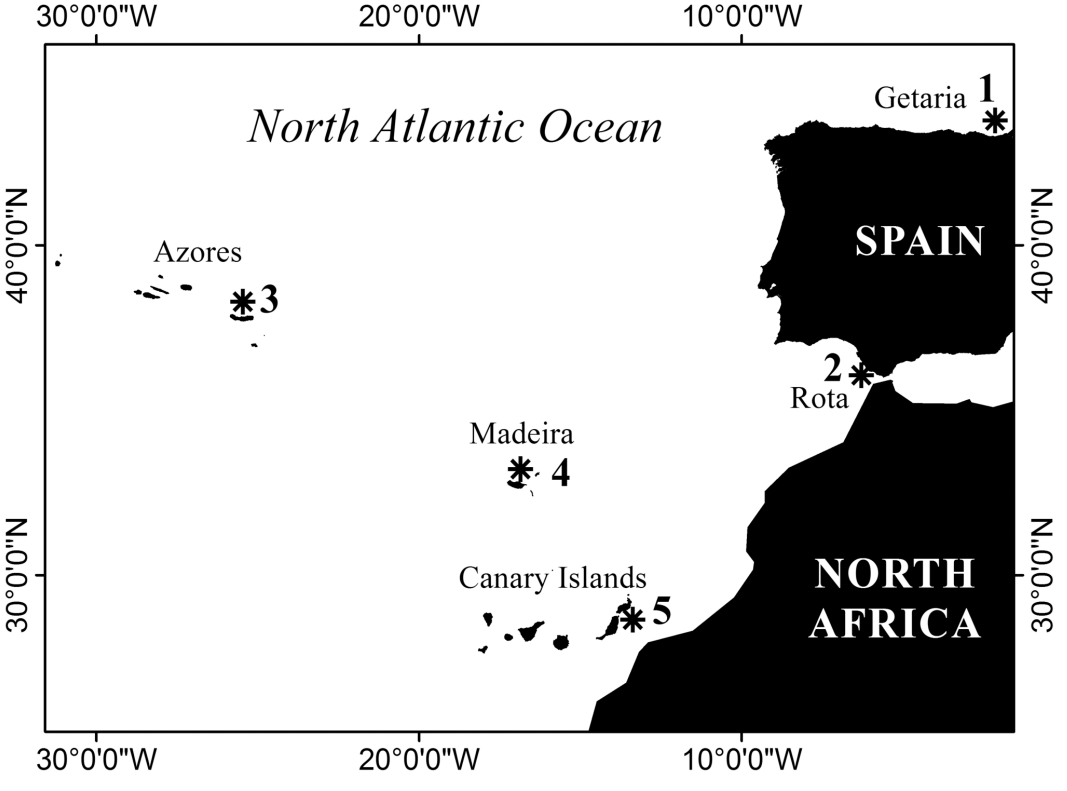
Comparison of mtDNA control regions and cytochrome b sequences to the beaked whale reference database (Dalebout et al., 2004, 2007) confirmed that this animal represented *M. bidens* and was not genetically divergent from other *M. bidens* sampled to date. Over approximately 400 base pairs (bp) of the mtDNA control region, the Canary Islands specimen shared the same haplotype (e.g., same maternal lineage) as one animal from Scotland. The other specimens held (UK, Ireland, France, East Coast USA; N = 15) represented closely related haplotypes that differ from this one by 1 to 5 bp (< 2%). The Canary Islands specimen shared the same haplotype, over approximately 300 bp of the cytochrome b, as two other animals: one from the Atlantic coast of France and one from the East Coast of the U.S. The other *M. bidens* sampled (N = 18) represented haplotypes that differed from this by 1 to 2 bp. Overall, genetic diversity at these mtDNA genes in *M. bidens* was relatively low, following a similar pattern to that observed in other *Mesoplodon* species (Dalebout et al., 2007). In several cases, animals from opposite sides of the North Atlantic shared the same haplotype, suggesting that these animals disperse widely.

Surprisingly little is known about the color pattern of this species, which is relatively nondescript (Reeves et al., 2002). It has been described as "bluish-grey or slate coloured with the sides lighter and the belly white" (Mead, 1989, p. 374). The present animal stranded overnight (probably alive) and was found at dawn partially covered by water. Given these facts, and given our experience with other stranded beaked whales, the dark coloration of our specimen was not due to *post-mortem* darkening or sun exposure, and, if it were, the effect would have been minimal indeed. A pair of fresh mature males of 4.35 m and 4.89 m, respectively, stranded in Rota, Cadiz Spain (Bellido et al., 2008), and a 4.7-m long fresh mature female accompanied by a calf stranded in France on 19 January 2008 (www.beakedwhaleresource.com/news/20080125_bwdeathseurope.htm; consulted on 5 January 2011) had a similar, all-over dark coloration. On the other hand, according to the literature, all immature individuals are grey on the dorsal side, lighter at the flanks, and white on the ventral side. These findings suggest that either there is a variation of the color pattern of this species or there are ontogenic changes in coloration as is evident in other species of beaked whale (Mead, 1989)—a fact that needs confirmation with further analysis of more fresh stranded individuals.

The Sowerby's beaked whale is an endemic species of the cold and temperate North Atlantic waters where its distribution is partially sympatric with that of True's beaked whale, Gervais' beaked whale, and Blainville's beaked whale, having its centre in the North Sea (Mead, 1989; MacLeod et al., 2006). It is the most frequent mesoplodont in the stranding records from the European coasts, especially in the British Isles (MacLeod, 2000), with the Norwegian Sea as the northern limit of its distribution in the occidental Atlantic (Carlström et al., 1997). In the West Atlantic, Sowerby's beaked whale have also stranded in North America, between New England (Lien & Barry, 1990) and Florida (Mead, 1989). A further record exists from the Gulf of Mexico (Bonde & O'Shea, 1989). In

Spain, there are two records of *M. bidens*: a 4.0-m male stranded on 13 July 2006 in Getaria, Basque country (P. Cermeño, pers. comm., 30 January 2009) and a pair of mature males of 4.35 m and 4.89 m, respectively, stranded in Rota, Cadiz, on 8 September 2007 (Bellido et al., 2008). In the mid-Atlantic archipelagos, *M. bidens* has stranded and been sighted in the Azores (Reiner, 1986; Reiner et al., 1993) and been found beached in Madeira (Maul & Sergeant, 1977). Consequently, the present specimen represents the most southerly record for this species in the eastern North Atlantic margin (see Map 1).

Since the early 1980s, the Society for Study of Cetaceans in the Canary Archipelago (SECAC) has conducted a long-term cetacean strandings programme. To date, 95 beaked whale strandings have been recorded along the coast of the Canary Islands, with a total of 127 animals of six species: Cuvier's beaked whale, Gervais' beaked whale, Blainville's beaked whale, True's beaked whale, Sowerby's beaked whale, and Northern bottlenose whale (V. Martín, unpub. data). These species of beaked whales are regularly recorded in the North Atlantic. True's beaked whale, Sowerby's beaked whale, and Northern bottlenose whale are distributed in colder, more northern waters in the North Atlantic. Sowerby's beaked whale and the Northern bottlenose whale are considered endemic to the North Atlantic, and both are restricted to more northern waters (MacLeod, 2000, 2005). Strandings of Cuvier's beaked whale, Blainville's beaked whale, and Gervais' beaked whale have been registered throughout the whole year in the Canary Islands, indicating year-round presence in this archipelago (V. Martín, unpub. data). Nevertheless, the stranding of the Sowerby's beaked whale in Lanzarote should be considered extralimital, along with the unique records in the Canary Islands of the True's beaked whale (a stranded animal on 31 March 1984 in the north of Lanzarote) and the Northern bottlenose whale (a specimen stranded on 25 November 1998 in the south of Fuerteventura) (Martín & Tejedor, 2009).



Map 1. Records of Sowerby's beaked whale strandings in the meridional waters of the eastern North Atlantic: 1 – Getaria, Spain (P. Cermeño, pers. comm.); 2 – Rota, Spain (Bellido et al., 2008), 3 – Azores (Reiner, 1986; Reiner et al., 1993); 4 – Madeira (Maul & Sergeant, 1977); and 5 – Lanzarote, Canary Islands, Spain (our specimen).

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