

Bryde's whales, *Balaenoptera edeni*, observed in the Azores: a new species record for the region

Lisa Steiner^{*§}, Monica A. Silva[†], Jasmine Zereba[‡] and Maria João Leal[§]

^{*}Whale Watch Azores, c/o 1b Museum Square, Keswick, Cumbria, CA12 5DZ, UK. [†]Departamento de Oceanografia e Pescas, Universidade dos Açores, 9901-862 Horta, Azores, Portugal. [‡]Peter Cafe Sport, Rua Tenente Valadim, 9, Horta, 9900-027, Azores, Portugal. Present address: Norberto Diver, Rua do Paiol, 12, Horta, 9900-026, Azores, Portugal. [§]Espaço Talassa Lda., Rua dos Baleeros, 9930 Lajes do Pico, Pico, Portugal.

[§]Corresponding author, e-mail: wwa2@yahoo.com

Bryde's whales, *Balaenoptera edeni*, were observed during the summer of 2004. The first sighting was of a mother and calf pair on 3 July. This pair was seen on several other occasions during the summer. In addition five other individuals were observed separately from the mother–calf pair. These observations represent the first appearance of this species in the Azorean Archipelago.

INTRODUCTION

Bryde's whales are the least known of the large baleen whales (Kato, 2002). Their occurrence has been reported from all tropical and warm temperate waters between 40°N and 40°S and the animals in the North Atlantic are the least well known of all the Bryde's whale populations (Kato, 2002). In the eastern Atlantic they are thought to range from the Strait of Gibraltar south past the Cape of Good Hope and from Virginia south to Brazil in the west, including the Gulf of Mexico, Caribbean and off Venezuela (Kato, 2002).

In past times they have often been confused with sei whales, distinguished by only three longitudinal ridges along the rostrum (Reeves et al., 2002). Bryde's whales were routinely recorded as part of the sei whale catch as late as the 1970s (Cummings, 1985). There has been whaling in Chile since the 1880s, with most of the whales caught in the area identified as sei whales, but following a research cruise in February 1982, it was discovered that in all probability, these were actually Bryde's whales (Gallardo et al., 1983). After talking to the local whalers and looking at baleen samples, it was discovered that the baleen of the whales killed was much coarser than the baleen found in sei whales, consistent with Bryde's whales (Gallardo et al., 1983).

There are thought to be at least two different forms of Bryde's whale off the coast of South Africa, as well as a small or dwarf form around the Gulf of Thailand, Burma, New Guinea and the Solomon Islands (Kato, 2002), that appears to be restricted to coastal and shelf waters. The 'ordinary' (*Balaenoptera brydei*) and 'pygmy' (*B. edeni*) forms have been distinguished on the basis of morphological and genetic data (mitochondrial DNA and cytochrome b gene) (Dizon et al., 1996; Yoshida & Kato, 1999). In South Africa the inshore form is usually within 20 miles of the coast and the offshore form is generally more than 50 miles offshore. The inshore form is slightly smaller than the offshore form and does not exhibit oval scarring on its sides; they often have scrapes on the underside of the flukes from contact with the bottom (Best, 1977). As the taxonomy of Bryde's whales is still being reviewed with no conclusions yet reached for the North Atlantic, we use *Balaenoptera edeni* as the standard form, although in future Bryde's whales may be separated into two species with one form changing to *Balaenoptera brydei* (Kato, 2002).

Bryde's whales are opportunistic feeders and will feed on schooling pelagic fish such as sardines, mackerel and herring as well as others. They will also eat euphausiids, copepods, cephalopods and pelagic crabs (Kato, 2002). Bryde's whales have been observed in south-east Brazil feeding on sardines on several occasions, most likely following them inshore as they move towards the coast for spawning (Siciliano et al., 2004).

Bryde's whales do not exhibit the normal migration patterns of baleen whales. There is no marked north–south migration, although there may be slight seasonal movements in some populations. Calving for the pelagic type is thought to occur in winter (Kato, 2002), although in the inshore form off the Cape Province, South Africa breeding appears to be unrestricted (Best, 1977). Bryde's whales have the least well defined populations and their distribution is not completely known but appears to be composed of relatively localized sub-populations in tropical and sub-tropical regions, which carry out only limited migrations (Gaskin, 1977).

In the Gulf of California, Bryde's whales feed predominantly at dawn and twilight, whereas fin whales feed throughout the day (Tershy, 1992). Bryde's whales moved less between feeding locations than fin whales, which may be related to the heavier reliance of Bryde's whales on more predictable, although patchy, food resources. Bryde's whales are known to concentrate in areas of predictable biological abundance, such as along the continental shelf break in the north-eastern Gulf of Mexico

(Davis et al., 2000) and in areas of upwelling, such as off the Chilean coast (Gallardo et al., 1983) or in the eastern tropical Pacific (Palacios, 2003).

Until 2004, five species of baleen whales had been encountered in the Azores in recent years: blue, (*Balaenoptera musculus*), fin, (*Balaenoptera physalus*), sei, (*Balaenoptera borealis*), minke, (*Balaenoptera acutorostrata*), and humpback, (*Megaptera novaengliae*). North Atlantic right whales, *Eubaleana glacialis*, are also listed as a species observed in the Azores but have not been seen in recent times. These are in addition to another 20 species that have been observed in the archipelago (Appendix 2). Most observations have been made during the summer months, May–October, although recently observations have taken place as early as March, from whale watching vessels and vessels from the University of the Azores. In this paper we present the first confirmed occurrence of Bryde's whales in the Azores.

MATERIALS AND METHODS

Bryde's whales were seen by various whale watching boats: 'Physeter' a 12 m motor catamaran, 'Baleias Express' a 9 m motor catamaran, 'Gil de Brum' a 9.6 m rigid hull inflatable, and from the University of the Azores, 'Arion', a 5 m rigid hull inflatable all contributing to the sightings mentioned here. The whales were usually located by shore-based lookouts, 'vigias', using 20x binoculars, who then gave directions to the boats. The crews of the vessels also kept a good general lookout for blows and other signs of cetaceans.

Upon approaching the whales, 'Arion', 'Baleias Express' and 'Physeter' recorded the initial time and location (determined by Global Positioning System (GPS)), group size and composition, behaviour and direction of movement of the whales, as well as environmental data (Beaufort sea state, wind and wave direction). GPS readings were not available for the sightings made by 'Gil de Brum'. Surface water temperature was taken on board 'Physeter' using a digital thermometer. Identification photographs of dorsal fins were taken with digital cameras (Canon 10D with a Tamron 28–300 mm lens (f3.5–6.4), Nikon E5700 and a Nikon F-90X auto focus camera equipped with a Nikkor AF 70–300 mm (f4–5.6) zoom lens).

RESULTS

On 3 July a mother and calf Bryde's whale pair was observed off Faial, an island of the central group of the Azores Archipelago which is located around 900 miles east of Lisbon (Figure 1). Sightings of this species continued until the end of August. These represent the first confirmed sightings of this species in the archipelago.

Bryde's whales were observed on 24 occasions (Appendix 1). The mother and calf pair was observed most frequently with the first sighting on 3 July followed by 12 more sightings. There were sightings from all three of the central group islands Faial, Pico and São Jorge (Figure 2).

The mean surface water temperature recorded on 'Physeter' was $22.15 \pm 0.213^\circ\text{C}$, ranging from 21.6 to 23.5°C .

The depth for all sightings ranged from 500 to 1000 m. (Figure 2).

The group size for all sightings was either one or two. Only on one occasion were two adult individuals observed together, all other sightings were of single adults or the mother and calf pair.

On all occasions the whales were milling, making random movements, dives of 3–5 min with 3–5 blows on the surface in between dives, suggesting foraging behaviour, although fish were not actually observed. Another indication of feeding was the presence of Cory's shearwaters, *Calonectris diomedea borealis*, flying above the whales. Lunging was seen several times and breaching was observed three times. The whales were identified as Bryde's whales by three longitudinal ridges along the rostrum (Figure 3). In four cases (in Appendix 1 marked with an asterisk), there was no clear view of the top of

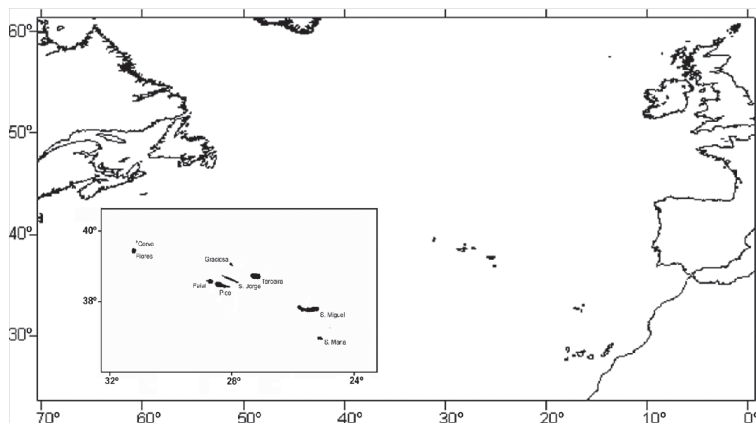


Figure 1. Location of the Azores Archipelago in the North Atlantic.

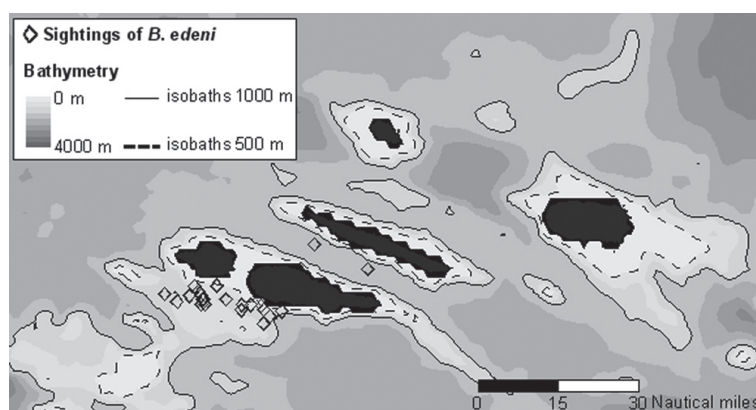


Figure 2. Sightings of Bryde's whales with depth contours.



Figure 3. Breaching Bryde's whale showing the three longitudinal ridges on top of the rostrum.



Figure 4. Cookie cutter scars.

the head and the three ridges were not seen, but the behaviour of the whales was similar to that observed from Bryde's whales on previous occasions and different to that generally observed from sei whales also seen in the Azores.

The whales all had circular depressions along the flanks in the area around the dorsal fin in addition to unhealed white scars (Figure 4). These circular marks were most probably caused by cookie cutter sharks (*Isistius* sp.).

Using photo-identification, seven individual whales were identified: the mother and calf pair, as well as five other animals.

DISCUSSION

Bryde's whales have never been observed in the Azores before. There is much confusion over identification of Bryde's whales as illustrated in Mead (1977); strandings of Bryde's whales along the US eastern coast, Gulf of Mexico and the Caribbean are consistently being misidentified as sei whales. The Bryde's whales observed in the Azores were most likely to be an offshore temperate form based on location, 900 nm off the coast of Portugal. The whales seen had a mix of the offshore and inshore characteristics given for the South African Bryde's whales (Best, 1977). The oval scars along their flanks probably caused by cookie cutter sharks conform to the offshore type described by Best (1977, 2001), although the presence of a calf in summer is not consistent with an autumnal breeding season as described for the offshore form in South Africa (Best, 1977). However, Evans (1987) states that the breeding season of the Bryde's whales is protracted and in some cases year round while Kato (2002) states that peaks for breeding and calving of pelagic stocks are in winter, which would be more consistent with the presence of a calf in summer. The calf observed in these encounters did not appear to have been weaned, although it was probably not that far from it, if as Kato (2002) suggests suckling only lasts for six months. The calf was roughly $\frac{1}{4}$ the size of the adult and several times it was seen in a position just behind the mother's dorsal fin which would be close to a suckling position when submerged. Calves were also observed in the summer of 2005 in the Canary Islands (Ritter & Neumann, 2006).

Water temperature does not appear to play a major role in locations of Bryde's whales. They are found in a wide range of temperatures. Cummings (1985) lists the preferred temperatures as 15–20°C for Bryde's whales. Siciliano et al. (2004) reported Bryde's whales in the upwelling areas off Chile, 15.9–18.6°. Off South Africa, another area of upwelling, Best (1977) found the greatest number of sightings between 12 and 13°C decreasing rapidly after that with increased temperature with a secondary peak in abundance at 18–19°C before again dropping off rapidly. In the Hauraki Gulf in New Zealand, an area without upwelling, Bryde's whales were sighted in water temperatures ranging from 17 to 24.3°C with an average of 19.7°C (O'Callahan & Baker, 2002).

The Bryde's whales observed in the Azores were feeding on unidentified schools of fish. The most likely prey was horse mackerel, *Trachurus trachurus*, which can be found in abundance around the Azores, although other species of fish can also be found there: sardines, *Sardina pilchardus*, blue jack mackerel, *Trachurus picturatus* and chub mackerel, *Scomber japonicus*, are three other possibilities. During night observations off Chile, under artificial lights, large populations of juvenile jack mackerel were observed in the areas of Bryde's whale concentrations and mackerel were also present in many of the specimens caught (Gallardo et al., 1983). Bryde's whales caught in pelagic whaling by the Japanese in the North Pacific had a greater preponderance of euphausiids in their stomachs as opposed to fish (Nemoto & Kawamura, 1977). These differing food preferences confirm that Bryde's whales are opportunistic feeders and it would appear that when observed in the Azores, fish were more abundant than euphausiids. At another time or in a different population, euphausiids may play a more important role in their diet. The group size of 1–2 individuals feeding here is similar to that observed in other regions. Gaskin (1977) reports that Bryde's whales generally feed in singles or mother–calf pairs.

The dorsal fins of Bryde's whales can be used for photo-identification. This method was also used by O'Callahan & Baker (2002) in the Hauraki Gulf in New Zealand and in the Canaries (Ritter & Neumann, 2006). In contrast to the high proportion of marked animals in New Zealand, most of the individuals observed in the Azores did not have markings on the dorsal fin; rather the shape of the fin differed between individuals. This difference may be caused by the different types of habitat involved. The New Zealand whales are found in much shallower water than the Azorean ones. Some individuals had chevron markings, similar to those seen on fin whales, visible on the flank behind the blowhole. The pattern of scars caused by cookie cutter sharks may also be useful for matching individuals.

The Bryde's whales observed here were sighted at depths of between 500 and 1000 m while the mean water depth for Bryde's whales sighted in the Hauraki Gulf was only 43.2 m (O'Callahan & Baker, 2002). In the Gulf of Mexico, Bryde's whales are usually sighted in waters 100 m deep (Davis et al., 1998, 2000). The Bryde's whales were observed in the Gulf foraging 90.9% of encounters and on every occasion they were seen in the Azores they appeared to be feeding.

CONCLUSIONS

Bryde's whales are elusive whales to observe. They do not remain at the surface for long periods of time and do not surface in a predictable manner. This also makes positive species identification difficult. The sightings here may represent a range expansion of the eastern Atlantic Bryde's whale population. If this is the case, in the future this species may become regular visitors to this archipelago, where there is abundant prey during the summer months, or be observed year round due to higher

productivity around the islands than other parts of the eastern Atlantic. Care must be taken to be sure that whales are positively identified as Bryde's whales since they can be confused with some of the other baleen whales passing the islands.

Identification photographs need to be compared with photographs taken in different parts of the eastern Atlantic such as Madeira and the Canaries, to determine if any of the whales observed here have previously been seen elsewhere. This will be feasible through the Europhlukes programme, although currently there are not many Bryde's whale photographs in the database.

The authors wish to thank the crews of all boats involved in these sightings, the lookouts who spotted the whales from the shore and the whale watching clients who made the voyages possible. The authors are very grateful to the Portuguese Science and Technology Foundation (FCT) for funding the CETAMARH project (POCTI/BSE/38991/01, co-participated by the Community Support Framework—FEDER) as well as M.A.S.'s doctoral grant (SFRH/BD/8609/2002). IMAR-DOP/UAç is the R&D Unit no. 531 funded through the pluri-annual and programmatic funding schemes of FCT-MCTES and DRCT-Azores. The authors wish to thank Maria Inês Seabra for generating the GIS maps. This research was conducted under license of the Environment Directorate of the Regional Government of the Azores. Whale watching boats are all licensed by the Department of Tourism.

REFERENCES

- Barreiros, J.P., Teves, M. & Rodeia, J., 2006. First record of the harbour porpoise, *Phocoena phocoena*, (Cetacea: Phocoenidae) in the Azores (NE Atlantic). *Aqua Journal of Ichthyology and Aquatic Biology*, **11**(2), 45–46.
- Best, P., 1977. Two allopatric forms of Bryde's Whale off South Africa. *Report of the International Whaling Commission, Special Issue 1*, 10–38.
- Best, P., 2001. Distribution and Population separation of Bryde's Whales, *Balaenoptera edeni*, off South Africa. *Marine Ecology Progress Series*, **220**, 277–289.
- Cummings, W.C., 1985. Bryde's Whale, *Balaenoptera edeni*, Anderson. In *Handbook of marine mammals*, vol. 3 (ed. S.H. Ridgway and R.J. Harrison), pp. 137–154. London: Academic Press.
- Davis, R.W., Fargion, G.S., May, N., Leming, T.D., Baumgartner, M., Evans, W.E., Hansen, L.J. & Mullin, K.D., 1998. Physical habitat of cetaceans along the continental slope in the north-central and western Gulf of Mexico. *Marine Mammal Science*, **14**, 490–507.
- Davis, R.W., Evans, W.E. & Würsig, B., eds., 2000. *Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: distribution, abundance and habitat associations*. Vol. II. Technical Report. Prepared by Texas A&M University at Galveston and the National Marine Fisheries Service. US Department of the Interior, Geological Survey, Biological Resources Division, USGS/BRD/CR-1999-0006 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA, OCS Study MMS 2000-003, 346 pp.
- Dizon, A.E., Lux, C.A., LeDuc, R.G., Urban, R.J., Henshaw, M., Baker, C.S., Cipriano, F. & Brownell Jr, R.L., 1996. *Molecular phylogeny of the Bryde's/sei whale complex: separate species status for the pygmy Bryde's Form?* Cambridge, UK: International Whaling Commission, Scientific Committee Document SC/48/O27.
- Evans, P.E., 1987. *The natural history of whales and dolphins*. Bromley, Kent: Christopher Helm (Publishers) Ltd.
- Gallardo, V.A., Arcos, D., Salamanca, M. & Pastene, L., 1983. On the occurrence of Bryde's Whales (*Balaenoptera edeni* Anderson, 1878) in an upwelling area off central Chile. *Report of the International Whaling Commission*, **33**, 481–488.
- Gaskin, D.E., 1977. Sei and Bryde's Whales in waters around New Zealand. *Report of the International Whaling Commission, Special Issue 1*, 50–52.
- Gonçalves, J.M., Barreiros, J.P., Azevedo, J.M.N. & Norberto, R., 1996. Cetaceans stranded in the Azores during 1992–96. *Arquipélago. Ciências Biológicas e Marinhas*, **14A**, 57–65.
- Gordon, J.C.D., Steiner, L. & Gonçalves, J., 1990. Sei whales (*Balaenoptera borealis*) encountered in the Azores: a new record for the region. *Arquipélago. Life and Earth Sciences*, **8**, 97–100.
- Kato, H., 2002. Bryde's Whales *Balaenoptera edeni* and *B. brydei*. In *Encyclopedia of marine mammals* (ed. W.F. Perrin et al.), pp. 171–177. San Diego: Academic Press.
- Mead, J.G., 1977. Records of sei and Bryde's Whales from the Atlantic coast of the United States, Gulf of Mexico, and the Caribbean. *Report of the International Whaling Commission, Special Issue 1*, 113–116.
- Nemoto, K. & Kawamura, K., 1977. Characteristics and food habits of baleen whales with special reference to the abundance of North Pacific sei and Bryde's Whales. *Report of the International Whaling Commission, Special Issue 1*, 80–87.
- O'Callahan, T.M. & Baker, C.S., 2002. *Summer cetacean community, with special reference to Bryde's Whales in the Hauraki Gulf, New Zealand*. Wellington: DOC Science Internal Series 55. Department of Conservation.
- Palacios, D.M., 2003. *Oceanographic conditions around the Galapagos Archipelago and their influence on cetacean community structure*. PhD thesis, Oregon State University, Corvallis, Oregon, USA.
- Reeves, R.R., Smith, B.D., Crespo, E.A. & Notarbartolo di Sciarra, G. (compilers), 2003. *Dolphins, whales and porpoises: 2002–2010 Conservation Action Plan for the World's Cetaceans*. Gland, Switzerland and Cambridge, UK: IUCN/SSC Cetacean Specialist Group.
- Reeves, R.R., Stewart, B.S., Clapham, P.J. & Powell, J.A., 2002. *National Audubon Society guide to marine mammals of the world*. New York: Chanticleer Press Inc.
- Reiner, F., 1986. First record of Sowerby's beaked whale from Azores. *Scientific Reports of the Whales Research Institute*, **37**, 103–170.

- Reiner, F., Gonçalves, J.M. & Santos R.S., 1993. Two new records of Ziphiidae (Cetacea) for the Azores with an updated checklist of cetacean species. *Arquipélago. Life and Marine Sciences*, **11A**, 113–118.
- Ritter, F. & Neumann, K., 2006. *The year of the whale: extraordinary occurrence of Bryde's whales off La Gomera (Canary Islands) in 2005*. Poster presented at the Annual Conference of the European Cetacean Society, Gdynia, Poland, April 2006.
- Siciliano, S., Santos, M.C. d O., Vincente, A.F.C., Alvarenga, F.S., Zampiroli, E., Brito Jr, J.L., Azevedo, A.F. & Pizzorno, J.L.A., 2004. Stranding and feeding records of Bryde's whales, (*Balaenoptera edeni*), in south-eastern Brazil. *Journal of the Marine Biological Association of the United Kingdom*, **84**, 857–859.
- Steiner, L., 1995. Rough-toothed dolphin, *Steno bredanensis*: a new species record for the Azores, with some notes on behaviour. *Arquipélago. Life and Marine Sciences*, **13A**, 125–127.
- Tershy, B.R., 1992. Body size, diet, habitat use, and social behaviour of *Balaenoptera* whales in the Gulf of California. *Journal of Mammalogy*, **73**, 477–486.
- Yoshida, H. & Kato, H., 1999. Phylogenetic relationships of Bryde's whales in the western North Pacific and adjacent waters inferred from mitochondrial DNA sequences. *Marine Mammal Science*, **15**, 1269–1286.

Submitted 19 February 2007. Accepted 22 May 2007.

Appendix 1. Sightings of Bryde's whales.

Date	Time	Latitude (°)	Longitude (°)	No.	Calf	Boat
03/07/2004	1603	38.465	–28.747	2	Y	Physeter
12/07/2004	0929	38.482	–28.762	2	Y	Expresso
12/07/2004	1500	38.485	–28.673	2	Y	Expresso
13/07/2004	0922	38.41	–28.497	2	Y	Expresso
13/07/2004	1143	38.37	–28.458	2	Y	Arion/Gil
13/07/2004	1404	38.388	–28.418	2	Y	Arion
13/07/2004	1630			2	Y	Gil
14/07/2004	1116	38.547	–28.08	1	N	Physeter
17/07/2004	1144	38.638	–28.29	1	N	Physeter
29/07/2004	1130			2	Y	Gil
31/07/2004	1000	38.415	–28.72	2	Y	Expresso
31/07/2004	1100	38.427	–28.83	1	N	Expresso
31/07/2004	1617	38.435	–28.732	2	Y	Expresso
01/08/2004	1530	38.435	–28.725	1	N	Expresso
02/08/2004	1012	38.413	–28.573	2	Y	Physeter
02/08/2004	1508	38.433	–28.637	2	Y	Physeter
08/08/2004	1130			2	Y	Gil
09/08/2004*	1050	38.436	–28.76	1	N	Expresso
11/08/2004	1625	38.39	–28.573	2	Y	Arion
12/08/2004	1820	38.345	–28.49	2	N	Expresso
19/08/2004*	0940	38.45	–28.733	1	N	Expresso
23/08/2004*	0937	38.417	–28.733	1	N	Physeter
26/08/2004*	0950	38.413	–28.538	1	N	Physeter
28/08/2004*	1222	38.447	–28.78	1	N	Physeter
30/08/2004	1700	38.453	–28.878	1	N	Expresso

*, Longitudinal ridges not observed.

Appendix 2. Cetacean species of the Azores.

Blue whale
Fin whale
Sei whale
Minke whale
Humpback whale
Sperm whale
Pygmy sperm whale
Dwarf sperm whale
Right whale (not in recent history)
Northern bottlenose whale
Cuvier's beaked whale
Sowerby's beaked whale
Gervais beaked whale
Blainville's beaked whale
True's beaked whale (L. Steiner personal communication)
Bottlenose dolphin
Risso's dolphin
Common dolphin
Atlantic spotted dolphin
Striped dolphin
Rough-tooth dolphin
Orca
False killer whale
Short-finned pilot whale
Harbour porpoise
Barreiros et al. 2006; Gonçalves et al. 1996; Gordon et al. 1990; Reiner, 1986, 1993; Steiner, 1995.