JMBA2 - Biodiversity Records
Published on-line

Cuvier's beaked whale, *Ziphius cavirostris*, remains recovered on the Pakistani coast

M.A. Gore*#, E. Ahmad†, Q.M. Ali‡, R.M. Culloch*, S.A. Hasnain†, B. Hussain†, P. Iqbal[ʃ], S. Kiani[ʃ], C.D. MacLeod§, E.C.M. Parsons¶, P.J. Siddiqui[ʃ], R.F. Ormond* and U. Waqas†

*University Marine Biological Station, Millport, KA28 0EG, Scotland. †WWF-Pakistan, Karachi, Pakistan. ‡Marine Reference Collection and Resource Centre, University of Karachi, Pakistan. [ʃ]Centre of Excellence in Marine Biology, University of Karachi, Pakistan. §School of Biological Sciences, University of Aberdeen, Scotland. ¶Department of Environmental Science and Policy, George Mason University, Virginia, USA.
#Corresponding author, e-mail: mauvisgore@netscape.net

Beaked whales are not a commonly encountered species, but Cuvier's beaked whale, *Ziphius cavirostris*, is the most cosmopolitan. Nonetheless, little is known of its distribution in the north-eastern Indian Ocean, particularly along the coasts of India, Pakistan and Iran. Here we present the first confirmed record of the species for Pakistan from a stranded specimen that was found during a routine beach survey. None have been seen during inshore boat surveys to date. Considering the level of naval activity and seismic surveys in the waters off of Pakistan, incorporation of mitigating measures and monitoring surveys are suggested to avoid potential beaked whale mortality. This is the first confirmed record of *Z. cavirostris* on the Pakistani coast and is an important finding for the Pakistan Biodiversity Action Plan and their National Conservation Strategy for marine mammals.

INTRODUCTION

In comparison to other cetacean species, very little is known about the 20 members of the family Ziphiidae or beaked whales and all are listed as 'data deficient' by the IUCN (Culik, 2004; www.iucnredlist.org). Of these 20 beaked whale species, Cuvier's beaked whale, *Ziphius cavirostris* Cuvier 1823, has the most cosmopolitan distribution. It has been widely recorded from tropical to warm temperate, and occasionally even in sub-polar and polar waters (Heyning, 1989; MacLeod et al., 2006). In addition, *Z. cavirostris* is the most common species of beaked whale to strand (Heyning, 1989) and one of the most frequently identified beaked whale species at sea. As a result, it has one of the best defined ranges of any beaked whale species. Despite this, there are still many parts of the world where little is known about the distribution of *Z. cavirostris* and where its occurrence has only been inferred due to its presence in neighbouring areas or similar habitats in other parts of the world. For example, in the north-eastern Indian Ocean (north of the equator and east of the southern tip of India) *Z. cavirostris* is only known from four locations to date. These are strandings off the Maldives (Ballance et al., 2001) and Minicoy Atoll (Sathasivam, 2000). Both strandings and live sightings have been seen for Oman (Alling, 1986) and the Arabian Sea (Balance & Pitman, 1998) in the north-east. Little is known of the distribution of *Z. cavirostris* in other parts of the north-eastern Indian Ocean, and particularly along the coasts of India, Pakistan and Iran.

Here we present the first confirmed record of *Z. cavirostris* from Pakistan. In addition, we will place this new record in context in the north-eastern Indian Ocean and discuss local issues concerning the conservation and management of *Z. cavirostris* and other beaked whale species that may occur in Pakistani waters.

MATERIALS AND METHODS

Ziphius cavirostris can be readily identified to species level from its skull by the relatively high cranial vertex and enlarged nasal bones that extend anteriorly over the upper nares (Heyning, 1989). In addition, the skull of *Z. cavirostris* is strongly sexually dimorphic, allowing information on the maturity status and/or sex to be inferred from the cranial morphology alone (Heyning, 2002). In particular, males reabsorb bone in front of the nasal passages as they mature, producing a cavity or pre-narial basin that is unique to adult males of this species and leads to the specific name of *cavirostris* (Heyning, 2002). Individual *Z. cavirostris* skulls without this sexually dimorphic feature can be identified as adult female, if they are of sufficiently large size to be considered mature, which is greater than about 6 m, or as immature individuals of either sex, if the skull is too small to be from a mature individual.

A skull (Figure 1), some vertebrae and ribs of a cetacean were found by S.K. (Cetacean Conservation Pakistan (CCP) team member) at Khobar-Gizri Creek, Sindh Province, Pakistan, at 25°55'36"N 67°31'50"E on 30 June 2006, during a routine survey for beach-cast cetacean specimens. To date

the CCP team has carried out over 75 km of beach surveys and more than 280 hours of boat surveys largely inshore and covering over 3700 km. The team has also conducted surveys in 24 local communities, which involved interviews and discussions with coastal communities and fishers. Only one finding has resulted from this effort and the CCP team have had no sighting or recording of any other beaked whale species.

RESULTS

Species identification was made using Jefferson et al. (1993) and confirmed as *Ziphius cavirostris* by C.D.M. through comparisons with photographs of other specimens of known species identity. The skull was 74 cm at the longest dimension from rostrum to exoccipital and 42 cm at the widest point across the skull from left to right squamosal. In comparison with another specimen of the same species with a body length of 4.26 m and a skull width of 41.6 cm, this skull was most likely an individual of about 4.3 m in body length (C.D.M.). The skull is currently archived at the Centre of Excellence in Marine Biology, University of Karachi.

Evidence of *Z. cavirostris* off Pakistan was previously suggested by Pilleri & Gihr (1972) when they found a vertebra near Dahm, Balochistan Province. They very tentatively identified this as a *Z. cavirostris* bone. However, it is difficult to classify the vertebrae to genera and particularly to species level (C.D.M.). Based on the Pilleri & Gihr (1972) article, both Roberts (1997) and de Boer et al. (2000) included *Z. cavirostris* as a cetacean species recorded in Pakistani waters in their publications. Given the unverifiable evidence presented by Pilleri & Gihr (1972), the current finding presents the first definitive evidence of *Z. cavirostris* in Pakistan.

Figure 1. Skull of a young female beaked whale, *Ziphius cavirostris*, found off the Indus Delta, Pakistan. Note the ballpoint pen for scale. (Photograph: M. Gore.)

DISCUSSION

Ziphius cavirostris are an offshore species capable of deep diving and are thought to spend much of their time at depths below 500 m. They are considered as opportunistic foragers, taking squid and fish (Heyning, 2002). Tamura & Ohsumi (2000) assumed the prey composition, based on percentage weight, was 30% fish, 60% cephalopoda and 10% crustacean. As a result, their distribution is generally restricted to deeper waters away from the continental shelf. The skull found was located at the mouth of the Indus Delta, which adjoins a long stretch of relatively shallow waters, with the continental shelf extending out 150 km from the Sindh coast. This appeared to be an unusual area for a live beaked whale to inhabit. However, beaked whales are known to strand relatively long distances from the nearest deep water (MacLeod et al., 2006). It may be the result of the carcass being carried long distances by prevailing currents and wind, or the live animal straying into shallow waters possibly due to navigational errors or illness and dying before it could return to the usual deep-water habitat.

There have been no previous reports of *Z. cavirostris* in the areas neighbouring Pakistan, which are western India and Iran. In adjacent Oman, however, the Oman Whale and Dolphin Research Group (OWDRG) recorded nine strandings of dead *Z. cavirostris*, all but one identified from skulls, and one freshly stranded juvenile female in 1999 (T. Collins, OWDRG, personal communication). They also recorded three live beaked whales while on effort during boat surveys, two of which were confirmed as *Z. cavirostris*, and two anecdotal records of beaked whales, which included one *Z. cavirostris*.

Considering the cosmopolitan distribution of *Z. cavirostris*, its occurrence in Pakistani waters is not surprising. The discovery does mean, however, that the species should be included in Pakistan's Biodiversity Action Plan and their National Conservation Strategy for marine mammals, as there are implications for its conservation, particularly with ongoing military activity and seismic surveys in Pakistani waters. In March 2000, the stranding of 16 beaked whales in the Bahamas (Balcomb & Claridge, 2001) drew attention to the threat posed by mid-frequency (2.5–3.5 kHz) naval sonar to this group of cetaceans. A subsequent enquiry determined that sonar-using naval activities were the most likely cause of these strandings (Anonymous, 2001). Although the first multiple strandings of beaked whales coincident with naval exercises had been reported years before in the Canary

Islands and Greece (Simmonds & Lopez-Jurado, 1991; Frantzis, 1998, 2004; Frantzis & Cebrian, 1999), the Bahamas event drew attention to, and research on, the issue. A number of later beaked whale mass stranding events have been associated and coincident with naval activities in Corsica and the Lesser Antilles, the Canary Islands (1985, 1986, 1987, 1988, 1989, 1991, 2002 and 2004), the US Virgin Islands (1998, 1999), Madeira (2000), Spain (2000, 2004) and Taiwan (2004, 2005) (Freitas, 2004; Martin et al., 2004; Taylor et al., 2004; Hildebrand, 2005; ICES, 2005; Fernández, 2006; Podesta et al., 2006; Wang & Yang, 2006). The exact mechanism that causes these stranding events is currently unknown, but it has been suggested that it could be the result of a behavioural reaction to sonar or a physical property of the high intensity sonar sound source (Cox et al., 2006). These stranding events are often associated with lesions in the cetacean, similar to those caused by decompression sickness as seen in humans, and beaked whales appear to be particularly vulnerable to this syndrome (Fernández et al., 2004, 2005; Cox et al., 2006). Seismic surveys, which produce high intensity sound pulses to detect sub-seabed oil and gas deposits (see Parsons et al., 2003), are conducted in the waters of Pakistan and it is feasible that these activities occur within the beaked whale habitat.

The discovery of *Z. cavirostris* in Pakistan is a result of dedicated surveys being carried out along the beaches, at sea and in local communities by the Cetacean Conservation Pakistan team. The confirmed presence of *Z. cavirostris* in this area has implications for management of military exercises, seismic surveys and other human activities such as shipping (Aguilar Soto et al., 2006) with a commitment to consider environmental impacts. This would involve considering the incorporation of mitigating measures and monitoring surveys to avoid causing beaked whale mortalities during exercises. The record of the beaked whale on the Pakistani coast is an important find for both the Pakistan Biodiversity Action Plan and their National Conservation Strategy for marine mammals.

We would like to thank the Darwin Initiative Grant for funding the Cetacean Conservation Pakistan Project, with support from the Pakistan Wetlands Programme, the British Council-HEC Link and the Ocean Park Conservation Foundation. We would also like to thank Tim Collins for sharing the OWDRG sightings.

REFERENCES

Alling, A., 1986. Records of odontocetes in the northern Indian Ocean (1981–1982) and off the coast of Sri Lanka (1982–1984). *Journal of the Bombay Natural History Society*, **83**, 376–394.

Aguilar Soto, N., Johnson, N., Madsen, P.T., Tyack, P.L., Bocconcelli, A. & Borsani, J.F., 2006. Does intense ship noise disrupt foraging in deep-diving Cuvier's beaked whales (*Ziphius cavirostris*)? *Marine Mammal Science*, **22**, 690–699.

Anonymous, 2001. Joint interim report of the Bahamas marine mammal stranding event of 14–16 March 2000. National Oceanic and Atmospheric Administration, Washington DC. http://www.nmfs.noaa.gov/prot_res/PR2/Health_and_Stranding_Response_Program/Interim_Bahamas_Report.pdf

Balcomb, K.C. & Claridge, D.E., 2001. A mass stranding of cetaceans caused by naval sonar in the Bahamas. *Bahamas Journal of Science*, **8**, 1–12.

Ballance, L.T. & Pitman, R.L., 1998. Cetaceans of the western tropical Indian Ocean: distribution, relative abundance, and comparisons with cetacean communities of two other tropical ecosystems. *Marine Mammal Science*, **14**, 429–459.

Ballance, L.T., Anderson, R.C., Pitman, R.L., Stafford, K., Shaan, A., Waheed, Z. & Brownell, R.L., 2001. Cetacean sightings around the Republic of the Maldives, April 1998. *Journal of Cetacean Research and Management*, **3**, 213–218.

Boer, M.N. de, Baldwin, R., Burton, C.L.K., Eyre, E.L., Jenner, K.C.S., Jenner, M-N.M., Keith, S.G., McCabe, K.A., Parsons, E.C.M., Peddemors, V.M., Rosenbaum, H.C., Rudolph, R. & Simmonds, M.P., 2000. *Cetaceans in the Indian Ocean Sanctuary: a review*. Chippenham, UK: WDCS Science Report.

Cox, T.M., Ragen, T.J., Read, A.J., Vos, E., Baird, R.W., Balcomb, K., Barlow, J., Caldwell, J., Cranford, T., Crum, L., D'Amico, A., D'Spain, G., Fernandez, A., Finneran, J., Gentry, R., Gerth, W., Gulland, F., Hildebrand, J., Houser, D., Hullar, T., Jepson, P.D., Ketten, D., MacLeod, C.D., Miller, P., Moore, S., Mountain, D.C., Palka, D., Ponganis, P., Rommel, S., Rowles, T., Taylor, B., Tyack, P., Wartzok, D., Gisner, R., Mead, J. & Benner, L., 2006. Understanding the impacts of acoustic sound on beaked whales. *Journal of Cetacean Research and Management*, **7**, 177–187.

Culik, B. 2004. Review of small cetaceans: distribution, behaviour, migration and threats. *Marine Mammal Action Plan/Regional Seas Reports and Studies*, no. 177, UNEP/CMS, 343 pp.

Fernández, A., 2006. Beaked whale (*Ziphius cavirostris*) mass stranding on Almería's coasts in southern Spain, 26th–27th January 2006. *Report of the University of Las Palmas de Gran Canaria, Canary Islands*.

Fernández, A., Arbelo, M., Deaville, R., Patterson, I.A.P., Castro, P., Baker, J.R., Degollada, E., Ross, H.M., Herráez, P., Pocknell, A.M., Rodríguez, E., Howie, F.E., Espinosa, A., Reid, R.J., Jaber, J.R., Martin, V., Cunningham, A.A. & Jepson, P.D., 2004. Pathology: whales, sonar and decompression sickness. *Nature, London*, **428**, 1–2.

Fernández, A., Edwards, J.F., Rodrigez, F., Espinosa de los Morteros, A., Herraez, P., Casstro, P,. Jaber, J.R., Martin, V. & Arbelo, M., 2005. Gas and fat embolic syndrome involving a mass stranding of beaked whales (Family Ziphiidae) exposed to anthropogenic sonar signals. *Veterinary Pathology*, **42**, 446–457.

Frantzis, A., 1998. Does acoustic testing strand whales? *Nature, London*, **392**, 29.

Frantzis, A., 2004. The first mass stranding that was associated with the use of active sonar (Kyparissiakos Gulf, Greece, 1996). In *Proceedings of the Workshop on Active Sonar & Cetaceans* (ed. P.G.H. Evans and L.A. Miller), pp. 14–20. *ECS Newsletter* no. 42, Special Issue.

Frantzis, A. & Cebrian, D., 1999. A rare mass stranding of Cuvier's beaked whales: cause and implications for the species' biology. *European Research on Cetaceans*, **12**, 332–335.

Freitas, L., 2004. The stranding of three Cuvier's beaked whales *Ziphius cavirostris* in Madeira archipelago—May 2000. *ECS Newsletter* (Special Issue), **42**, 28–32.

Heyning, J.E., 1989. Cuvier's beaked whale *Ziphius cavirostris* G Cuvier, 1823. In *Handbook of marine mammals*, Vol. 4 (ed. S.H. Ridgway and R.J. Harrison), pp. 289–308. London: Academic Press.

Heyning, J., 2002. Cuvier's beaked whale. In *Encylopedia of marine mammals* (ed. W.F. Perrin et al.), pp. 305–307. London: Academic Press.

Hildebrand, J.A., 2005. Impacts of anthropogenic sound. In *Marine mammal research: conservation beyond crisis* (ed. J.E. Reynolds et al.), pp. 101–124. Baltimore, Maryland: Johns Hopkins University Press.

International Council for the Exploration of the Sea (ICES), 2005. *Report of the ad-hoc group on the impact of sonar on cetaceans and fish (AGISC)*. ICES CM 2005/ACE: 01, 41pp.

Jefferson, T.A., Leatherwood, S. & Webber, M.A., 1993. *FAO species identification guide. Marine mammals of the world*. Rome: FAO.

MacLeod, C.D., Perrin, W.F., Pitman, R., Barlow, J., Ballance, L., D'Amico, A., Gerrodette, T., Joyce, G., Mullin, K.D., Palka, D.L. & Waring, G.T., 2006. Known and inferred distributions of beaked whale species (Cetacea: Ziphiidae). *Journal of Cetacean Research and Management*, **7**, 271–286.

Martin, V., Servidio, A. & Garciua, S., 2004. Mass strandings of beaked whales in the Canary Islands. *ECS Newsletter* (Special Issue), **42**, 33–36.

Parsons, E.C.M., Swift, R. & Dolman, S., 2003. Sources of noise. In *Oceans of noise* (ed. M. Simmonds et al.), pp. 24–43. Chippenham, UK: Whale and Dolphin Conservation Society.

Pilleri, G. & Gihr, M., 1972. Contribution to the knowledge of cetaceans of Pakistan with particular reference to the genera *Neomeris*, *Sousa*, *Delphinus* and *Tursiops* and description of a new Chinese porpoise (*Neomeris asiaeorientalis*). *Investigations on Cetacea*, **4**, 107–162.

Podesta, M., D'Amico, A., Pavan, G., Drougas, A., Komnenou, A. & Portunato, N., 2006. A review of Cuvier's beaked whale strandings in the Mediterranean Sea. *Journal of Cetacean Research and Management*, **7**, 251–261.

Roberts, T., 1997. *The mammals of Pakistan*. Karachi: Karachi University Press.

Sathasivam, K., 2000. A catalogue of Indian marine mammal records. *Blackbuck*, **16**, 23–74.

Simmonds, M. & Lopez-Jurado, L.F., 1991. Whales and the military. *Nature, London*, **337**, 448.

Tamura, T. & Ohsumi, S., 2000. *Regional assessments of prey consumption by marine cetaceans in the world*. International Whaling Commission, SC/52/E6, 42 pp.

Taylor, B., Barlow, J., Pitman, R., Ballance, L., Klinger, T., DeMaster, D., Hildebrand, J., Urban, J., Palacios, D. & Mead, J. G., 2004. A call for research to assess risk of acoustic impact on beaked whale populations. *Paper presented to the Scientific Committee at the 56th Meeting of the International Whaling Commission*, 29 June–10 July 2004, SC46/E36, Sorrento, Italy.

Wang, J.Y. & Yang, S.-C., 2006. Unusual cetacean stranding events off Taiwan in 2004 and 2005. *Journal of Cetacean Research and Management*, **8**, 283–292.

Submitted 9 July 2007. Accepted 11 October 2007.