

Deraniyagala's beaked whale, *Mesoplodon hotaula*: A review of current status, biology, threats and future research needs

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ABSTRACT

Deraniyagala's beaked whale, *Mesoplodon hotaula*, was described in 1963, but was quickly synonymized with *M. ginkgodens*. Using both morphology and genetics, it was proposed at the 2012 IWC meeting to resurrect *M. hotaula* making it one of the least known cetaceans. It is currently identified from only seven specimens collected from tropical islands in the western (Seychelles [1]) and central (Maldives [1], Sri Lanka [1]) Indian Ocean and central Pacific (Tabiteuea Atoll, Tungaru (Gilbert) Islands, Kiribati [1]; and Palmyra Atoll, Line Islands [3]). It appears to share at least part of its at-sea range with the very similar ginkgo-toothed beaked whale, *M. ginkgodens*. Deraniyagala's beaked whales are found around Palmyra Atoll and Kingman Reef, Line Islands, where they are likely an insular population and occur in small numbers, much like the insular populations of Cuvier's beaked whales, *Ziphius cavirostris*, and Blainville's beaked whales, *M. densirostris*, around other oceanic islands. This insular population is potentially very sensitive to human related mortalities. Almost nothing is known about the appearance and biology of *M. hotaula*, but sightings and acoustic recordings of mesoplodonts around Palmyra Atoll are believed to be of this species.

Also, the stranding rate at Palmyra Atoll is the highest of any beaked whale from other Pacific islands and therefore is of some concern at the population/stock level.

1 INTRODUCTION

The holotype of *Mesoplodon hotaula* was a female that stranded alive at Ratmalana, about five miles south of Colombo, Sri Lanka on 26 January 1963 (Deraniyagala, 1963). The specimen was examined soon after it died by Deraniyagala and photographed by Hans Hofmeister of Berlin. The photographs were reproduced as figures 1-6 of Plate I “Photographs of *Mesoplodon hotaula* and of *Ziphius cavirostris indicus*” in Deraniyagala (1965). It was not until 50 years after the holotype was described, that a second specimen was collected, from a small, isolated atoll in Kiribatian waters. Between 2005 and 2009, five additional specimens were discovered (Dalebout *et al.* 2012, Baker *et al.* in press). The only reports of possible live observations of *M. hotaula* have been from around Palmyra Atoll (Baumann and Yeo 2007, Pitman and Ballance 2008, Baumann-Pickering *et al.* 2010, 2012). Here, we review what little is known about the biology, population status, and potential threats to this species.

2 TAXONOMY AND NOMENCLATURE

Deraniyagala (1963a,b) poorly described a single specimen as the holotype of *M. hotaula*, which was deposited in the National Museum of Sri Lanka in Colombo. Moore and Gilmore (1965) quickly synonymized *M. hotaula* with *M. ginkgodens* Nishiwaki and Kamiya, 1958, after Moore studied the holotype in Sri Lanka (Deraniyagala 1965). Dalebout *et al.* (2012) presented genetic and morphological data supporting the resurrection of *M. hotaula* as either a separate species or subspecies of *M. ginkgodens*. There are no known local names for this whale. At the 2012, IWC Scientific Committee meeting, it was agreed that the common name of *M. hotaula*, if the species

is resurrected, should be Deraniyagala's beaked whale in recognition of the original description. This usage follows the normal pattern within beaked whales to use the name of the person who described the species as the common name. This is the case in most of the world's beaked whales.

3 DISTRIBUTION AND STOCKS

Dalebout *et al.* (2012) reported that, *M. hotaula* is known from seven confirmed specimens. These are: (1) the holotype, from Ratmalana, Sri Lanka (Deraniyagala 1963); (2) Tabiteuea Atoll, Tungaru (Gilbert) Islands, Kiribati (Dalebout *et al.* 2007, Baker *et al.* 2013); (3,4, 5) Palmyra Atoll, Line Islands, US Territory; (6) Hulhudhuffaru, Raa Toll, Maldives (Anderson *et al.* 1999); and (7) Desroches Island, Seychelles (Dalebout *et al.* 2012). Leatherwood and Reeves (1989, figure 21b) illustrated a photograph of a dead whale being examined by Dr. Deraniyagala and the text noted: "and Professor P. E. P. Deraniyagala collecting a specimen of a ginkgo-toothed whale, 1964". The specimen in the photograph is actually the holotype of *M. hotaula* that Deraniyagala examined and collected on 26 January 1963

Deraniyagala's beaked whale is best known from Palmyra Atoll, Line Islands (05°50'N, 162°06'W) where three stranded specimens have been collected and deposited in the United States National Museum (USNM 593414, 593418, and 593426), and where live mesoplodonts have been observed that were suspected to be *M. hotaula* (Baumann and Yeo 2007, Pitman and Ballance 2008, Baumann-Pickering *et al.* 2010, 2012; Figure 1). Beaked whale acoustic recordings from Palmyra Atoll are also believed to be of *M. hotaula* (Baumann-Pickering *et al.* 2010, 2012) as are the recent acoustic recordings from Kingman Reef (Baumann-Pickering, unpublished data).

The Deraniyagala beaked whale appears to have a more restricted at-sea range than the ginkgo-toothed beaked whale, which is known from several records in the eastern Pacific Ocean from as far north as San Diego, California (Moore and Gilmore 1965), Playa Malarrimo, Baja California Sur, Mexico (Vidal 1991) [recently the specimen was genetically identified as *M. peruvianus*] and south to Isla Genovesa, Galapagos Islands (Palacios 1996). However, the genetic identification of the Galapagos specimen was not confirmed and there are no records of *M. ginkgodens* from the central Pacific, including the Hawaiian Islands to the north of Palmyra Atoll region in the center part of the Pacific, and in New Caledonia, where various cetacean sighting/stranding programs exist. In the western South Pacific a record of *M. ginkgodens* based on a skull from New Zealand (Baker and van Helden 1999), has been reidentified as *M. traversii* (Van Helden *et al.* 2002), and specimens of *M. ginkgodens* from New South Wales and Victoria, Australia (Bannister *et al.* 1996) need to be genetically confirmed. In the western North Pacific, most of the reported strandings of *M. ginkgodens* are from Japan and Taiwan (Yamada *et al.* 2012, Yao *et al.* Ms), and this region appears to be the core habitat for this species and about 50% of the reported strandings are from this area. Specimens and records of *M. ginkgodens* from the northern Indian Ocean and from the broader Indo-Pacific are not confirmed and some of these records may refer to *M. hotaula* (Dalebout *et al.* 2012). In the western Indian Ocean, beaked whale sightings from around the Comoros Archipelago were reported as possible *M. ginkgodens* (Ballance and Pitman 1998, Kiszka *et al.* 2006), and a neonate from Phuket, Thailand was identified as *M. ginkgodens* (Chantrapornsy *et al.* 1996).

Dalebout *et al.* (2012) noted that confirmed specimens of *M. hotaula* occur in both the Indian Ocean and Pacific Oceans, and confirmed *M. ginkgodens* specimens are now known only from the Pacific Ocean, and mainly “from the temperate and cold-temperate waters such as Japan,

Taiwan, and New Zealand". However, *M. ginkgodens* is known from less than 40 records and about half of those are from Taiwan and western [southern] Japan (Yamada *et al.* 2012, Yao *et al.* Ms), and these records are from tropical and warm-temperate waters of the Kuroshiro Current, respectively (Briggs 1974, Spalding *et al.* 2007). Three of the six specimens of *M. ginkgodens* confirmed by Dalebout *et al.* (2012) using DNA were from cold-temperate waters (New Zealand and Australia) and therefore appear to be outside the core range of this species. The other specimen was apparently taken as longline bycatch near Pohnpei, Caroline Islands (06°50'N, 158°15'E) and it is the closest confirmed *M. ginkgodens* (Dalebout *et al.* 2008) to a confirmed specimen of *M. hotaula* from Tabiteuea Atoll (01°07'S, 174°40'E), Kiribati; a distance of 1,100nm. We have obtained photographs of three stranded beaked whales from the Marshall Islands (north of the Tungaru Islands), which appear to be *Mesoplodon*. These specimens are from: (1) Mili Atoll (06°55'N, 171°50'E) in 2003 (Figure 2) two beaked whales were found live and one was pushed off the reef and swam away, Andre Seale pers. comm.; (2) a stranding at Majuro 2008 (Figure 3) reported by Ai Matsumiya via Manabu Echigo, specimen appears to be less than 2 meters in total length; and (3) a partially-butchered adult male *Mesoplodon* found ashore in Dec 2009 by Liz Lange. The latter was apparently a local fishery bycatch and is clearly a *Mesoplodon*, but with a much lower arch in the mandible that is present in adult male *M. densirostris*; presumably this was either *M. ginkgodens* or *M. hotaula*. (Figure 4). Mili Atoll is about 480 miles northwest of Tabiteuea Atoll where *M. hotaula* has been confirmed (Baker *et al.* 2013). Figure 5 shows photographs of assumed live *M. hotaula* off Palmyra Atoll.

Stocks –Oleson *et al.* (2013) reviewed available evidence for island-associated stocks of small cetaceans around the Hawaiian Islands and suggested that Blainville's and Cuvier's beaked

whales are ones where there is some evidence of insular and pelagic stocks. If this turns out to be the case for *M. hotaula* around Palmyra Atoll and Kingman Reef, this will have important management implications as is the case for other insular island populations of small cetaceans.

4 LIFE HISTORY PARAMETERS AND ECOLOGY

Life History – Of the seven known specimens of *M. hotaula*, three were assumed to be adult males, two were adult females, and two were of unknown sex. Total lengths are available from the two female specimens: (1) 450 cm from Sri Lanka and 480 cm (USNM 593418) from Palmyra Atoll. In *M. ginkgodens*, total lengths for the largest known male and female specimens are 495 cm and 490 cm, respectively (Yamada *et al.* 2012). The total length of a purported *M. ginkgodens* neonate from Phuket, Thailand, was 208 cm (Chantrapornsyl *et al.* 1996), but the species identification of this specimen was not confirmed and it could have been *M. hotaula*.

Feeding Habits – Nothing is known about feeding habits, but it can be assumed this species feeds on squid and deep water fish, like other mesoplodonts.

Acoustics — Baumann-Pickering *et al.* (2010) reported that “The echolocation signals of the mesoplodont beaked whale at Palmyra Atoll were spectrally and temporally different to previously published frequency-modulated (FM) pulse beaked whale signals. The use of regularly spaced FM pulses and the switch to broadband clicks for the buzz (probably indicating prey capture), is a signal structural strategy already known for another beaked whale, *Mesoplodon densirostris*.”

School size –The mean school size of mesoplodonts at Palmyra was 2.2 individuals (n=8) ranging from 2 – 3 (all but one of the sightings were of paired animals, including at least 2

cow/calf pairs); no biopsy samples were collected. Four of the sightings were definitely *Mesoplodon* sp.; another 4 were unidentified ziphiids and probably mesoplodonts also.

Behavior – During two of the sightings, animals were seen in the distance to leap completely out of the water. In one sighting seen closely (a female with a calf), the cow was covered with healed cookiecutter shark (*Isistius* spp.) bites. Pitman and Ballance (2008) noted that the *Mesoplodon* observed at Palmyra did not show the characteristic white scars of healed cookiecutter shark bites that *M. densirostris* does, and therefore they assumed that the Palmyra sightings were referable to *M. hotaula* and that it is distinguishable in the field, at least from *M. densirostris*.

5 ABUNDANCE AND TRENDS

5.1 Abundance

No quantitative information exists for this species. However, passive acoustic detections of *M. hotaula* echolocation signals were made every day during four months of monitoring at Kingman Reef, Line Islands, always many times each day. This is the highest rate of acoustic encounters observed at 24 sites across the North Pacific (Baumann-Pickering, unpublished data), indicating a larger aggregation within the detection range of the autonomous recorder.

5.2 Trends

No information exists.

6 DIRECT REMOVALS

6.1 Directed takes

The only known direct takes, which may be rare, are by local people on at least one of the 32 atolls in Kiribatian waters (Tabiteuea Atoll; Baker *et al.* 2013).

6.2 Incidental takes

Although no bycatch of this species has been reported in areas where it has been confirmed to occur (Seyehelles, Maldives, Tungaru [Gilbert] Islands, and Palmyra Atoll), unidentified beaked whales are known as bycatch in some of these same locations. For example, Dayaratne and Joseph (1993) reported three beaked whales identified as juvenile “southern beaked whales” from a study of cetacean bycatch in Sri Lanka during the early 1990s. Those specimens were reported to range in total length from 2.7 to 3.3 m, but there were no photographs, specimens or DNA samples to confirm identifications. However, it is likely they were Longman’s beaked whales (Ilangakoon 2002). Leatherwood and Reeves (1989) also reported beaked whales taken as bycatch around Sri Lanka. There are no known fisheries in the EEZ of Palmyra Atoll and Kingman Reef, and since 2009, commercial fishing has been prohibited within 50 nm of the atoll after it became part of the Pacific Remote Islands Marine National Monument. However, Palmyra Atoll and Kingman Reef are located at the northern end of the Line Islands and the southern Line Islands are all under the jurisdiction of the Republic of Kiribati with an EEZ extending from 8°N to 14°S. Currently, the main fishery in the Line Islands appears to be a nearshore small-scale tuna operation using longlines. The long-term goals of the Kiribati Fisheries Ministry appears to be middle- and larger-scale longline fishing and increased participation in purse seining. Kiribati (Christmas Island) in the northern Line Islands), which is about 400 miles southeast of Palmyra Atoll/Kingman Reef, has one of the only two fish processing plants in Kiribati, and it is expected that commercial fisheries will expand in this region..

7 OTHER ACTUAL AND POTENTIAL THREATS

As with all of the beaked whales, this whale may be subject to mortality inflicted by anthropogenic noise produced by military sonar and geological surveys (Cox *et al.* 2006). In a marine mammal stranding report filed at Palmyra on 19 July 2006, William Smith wrote: “It may

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be important to note: This is the third Mesoplodon stranding on Palmyra Atoll in less than a year. Additionally, in early July 2006 we were in radio and visual contact with the Navy vessel USS Sumner. They reported their mission as bathymetry measurements.” The Scientific Committee of the IWC (in press) noted that “Deraniyagala’s beaked whales are probably vulnerable to sound from naval sonar and seismic research, similar to other beaked whales.”

8 STATUS

The status of this species throughout its range is unknown. Around Palmyra Atoll, the Scientific Committee of the IWC (in press) “express concern about the apparently high numbers of strandings [of beaked whales] around Palmyra Atoll in recent years.” Remains of five dead beaked whales were reported from Palmyra or Kingman Reef between 2001 and 2006. This is a high number compared to other Pacific Islands. For example, there were only five strandings of beaked whales reported from Midway Atoll from 1961 and 2006 where there have been many more visitors and scientists than at Palmyra Atoll.

9 RECOMMENDATIONS

Below are our prioritised recommendations for the conservation and management of this species:

In order to better understand the distribution and population status of this species, the most important priority will be to learn to identify it in the field, both visually and to verify our acoustic identification. This will require collecting further concurrent acoustic data, biopsy samples and photographs of individual animals (especially adult males) to confirm field and acoustic characteristics. Highly useful would be improvements on automatic acoustic classification and localization of beaked whale calls presumed to be from *M. hotaula* so that

when an animal(s) surfaces after a dive, a launch can quickly locate the individuals for sampling and photography.

- a. Improve understanding taxonomic between *M. hotaula* and *M. ginkgodens* as recommended by Dalebout et al. (2012). However, aside from the basic morphology and genetic work, additional work to discover possible differences between these species and other *Mesoplodon* species should include the following:

1. Acoustics: Beaked whales produce frequency modulated (FM) pulses to echolocate (e.g. Zimmer et al. 2005, Johnson et al. 2006, McDonald et al. 2009, Gillespie et al. 2009, Rankin et al. 2011, Baumann-Pickering et al. 2010, 2012), which appear to be species specific in their spectral and temporal parameters. FM pulses of presumed *M. hotaula* have been described (Baumann-Pickering et al. 2010) but it is unknown what signals *M. ginkgodens* produce and if they can be differentiated from each other. McDonald et al. (2009) described a signal type of unknown origin from Cross Seamount, south of Hawai'i. Geographic occurrence of this signal type in the North Pacific indicates *M. ginkgodens* as a possible candidate to produce this FM pulse type (Baumann-Pickering et al. 2012). Dedicated fieldwork at Cross Seamount would shed light on this question and could potentially lead to the first confirmed live sighting of *M. ginkgodens*. Data on echolocation rates collected through acoustic tags would provide better understanding of variability in echolocation behaviour, together with source level measurements from towed arrays, to estimate detection radius from an autonomous recorder. This would provide the means for density estimation based on long-term acoustic data. More autonomous acoustic data at a variety of sites would give an understanding about phylogeography.

2. compare the skeleton of *M. hotaula* with other species of *Mesoplodon*, especially *M. ginkgodens*, for possible differences
- b. Conduct more visual and acoustic survey in “Hot spots” like Palmyra Atoll and Kingman Reef in the Line Islands and confirm their presence in the southern Line Islands in the Republic of Kiribati, Tungaru (Gilbert) Islands, and Mili and Majuro Atolls in the Marshall Islands.
 - c. Re-examine all specimens reported as *M. ginkgodens* to genetically confirm their identification, as some of these specimens may be *M. hotaula*.
 - d. Collect eDNA in the above “Hot spots” where *M. hotaula* is known to occur and compare with known DNA sequences of *M. hotaula* (see Foote *et al.* 2012).
 - e. If *M. hotaula* can be confirmed in the southern Line Islands, it will then be important to confirm population structure around the islands/atolls and if any fisheries in those waters might capture these beaked whales as bycatch.

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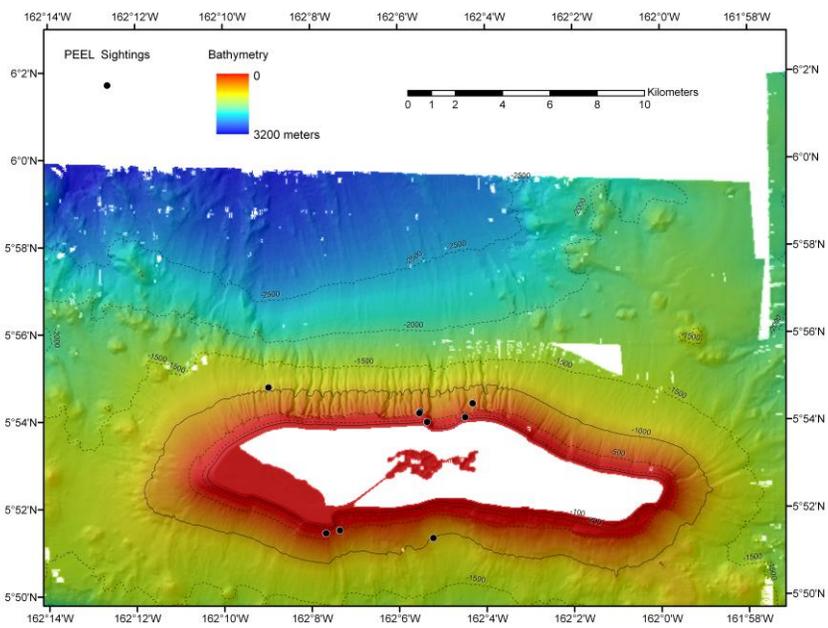


Figure 1. Distribution of beaked whales (*Mesoplodon* sp. or unidentified ziphiids) around Palmyra Atoll, Line Islands. (*Mesoplodon* sp., n = 4, filled circles, or *Mesoplodon* sp. / *Ziphius cavirostris*, n = 4, open circles) around Palmyra Atoll, 25 Aug-19 Sept, 2008.

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Figure 2. Live stranded beaked whale Mili Atoll (06°55'N, 171°50'E) in 2003. Photograph courtesy Andre Seale.



Figure 3. Dead stranded beaked whale, Majuro summer 2008. Total length was probably less than 2 meters. Note foetal folds in front of the dorsal fin and the lateral side of the body. Photograph courtesy Ai Matsumiya.



Figure 4. An adult male *Mesoplodon* sp. found stranded at Majuro, Marshall Islands in 2009. The specimen was estimated to be about 14 feet in total length. The low arch in the lower jaw rules out *M. densirostris* but not *M. hotaula* or *M. ginkgodens*. Photograph courtesy Liz and Matt Lange.

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Figure 5. Mother (right) and calf (left) pair of presumable *M. hotaula* at Palmyra Atoll on 10/11/2007. Notable are the cookie-cutter shark bites healed in dark skin **ea**hercolor, pronounced melon and beak, and large blow hole. Photographs by S. Baumann-Pickering.

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