

# **An account on the beaked-whales (Family: Ziphiidae) and their occurrence in oceanic territories of Sri Lanka**

R.P. Nanayakkara

**BEAR** (Biodiversity Education And Research), 12/2, RajamahaVihara Road, Pita Kotte, Sri Lanka.

Author e-mail address: ranil\_n@hotmail.com

## **Beaked-whales in general**

The mammalian faunal group “beaked-whales” is one of the most distinctive Cetacean representatives in the family Ziphiidae which is represented by a total of 21 described species in six genera. Their common name “beaked-whales” is due to the protrusion of the mouth which gives the impression of a beak. They are one of the most wide-ranging families of Cetacean occurring in all the world’s oceans from the ice edges at both poles to the equator (MacLeod *et al.*, 2006). Though widely distributed, they are the least known family of all marine mammals in the world. Their breeding patterns, habits and localities are presently unknown, as are the exact number of species presently existent. It is not known if they are facing extinction or proliferating. Most of the known information is largely based on stranding records. They are among the few groups of large mammals for which new species continue to be reported (Reyes *et al.*, 1991; Dalebout *et al.*, 2002).

*Habit and habitats:* It is well accepted that the beaked-whales are generally found in deep waters off the continental shelf. Hence, inadequate information either on biology or ecology of this distinctive faunal group exists globally except a little known information on their long dive times, unobtrusive surfacing behavior and pelagic habits (Rommel *et al.*, 2006). Several exclusive studies carried out with modern sophisticated time-depth recorders have shown that they spend most of their time (> 80%) at deep waters usually below 500 m whilst surfacing for short intervals of one hour or less (Hooker & Baird, 1999; Baird *et al.*, 2004). They have shown that certain beaked-whale species dive to 1267 m with up to 70 minutes submergence times which facilitated to shed light on to the previous categorization of them as deep water inhabitants.

*Social behavior:* Beaked-whales often form pods of 5 to 20 individuals, their pods being harems in reality, where one male, several females and juveniles form the pod. According to MacLeod

(2006) group composition of beaked-whales is unique and specific. The genera *Ziphius* and *Mesoplodon* are more commonly met in small groups consisting of a maximum of 20 individuals with an average of 2.5 to 3.5 whereas the genus *Indopacetus* is known to aggregate in large groups of about 100 animals with an average group size of 19-22 individuals in each pod. Therefore, *Indopacetus* spp. occurs more often in large groups compared to *Ziphius* spp. and *Mesoplodon* spp. which predominately occur in relatively small groups. This suggests that there might be at least two different social structures that exist within the family Ziphiidae. Yet, further speculations exists as most of the mature males are seen with scars of scratches and bite marks all over their bodies possibly due to the adult males fighting off their rivals. In addition to these they are known to shun boats or any other objects that are not familiar to them.

*Food and feeding habit:* The qualitative and quantitative studies on the stomach contents of stranded species of beaked-whale have shown that they predominately feed on cephalopods and occasionally on deep sea fish (MacLeod *et al.*, 2003). In 2003, MacLeod *et al.*, stated that there appear to be no obvious bias towards bio-luminescent prey, muscular or neutrally buoyant squid, vertically migrating species or any other ecological characteristics other than water depth. The fish and squid species from beaked whale stomach contents usually differ in one specific way. While squid species recorded are mainly mesopelagic, although they may have been associated with the seabed for part of their lives, the fish species recorded are primarily benthic or benthopelagic. In terms of differences between beaked whale species, *Ziphius*, *Indopacetus* and *Hyperoodon* spp. were found to consume much larger prey than *Mesoplodon* spp., both in general and when individuals from the same location were compared (MacLeod *et al.*, 2003). However other studies have shown that beaked-whales prey on species within a range of 1-5% of their own body length, suggesting that prey size difference between species at the same location may be related to difference in body length (MacLeod, 2006). This disparity in prey size selection among beaked-whale genera is confirmed to some extent by stable isotope analyses, which although it has its own set of limitations and biases, is independent of stomach contents data (Ostrom *et al.*, 1993 and MacLeod, 2005).

Yet, the hunting/feeding strategies of beaked-whale are unknown, whether they are ambush or pursuit hunters. This may be due to the difficulties of visual observations or any other reliable technique in deep sea areas where the animal concerned often inhabits. However, there are some speculations as to how beak whales hunt. Heyning and Mead (1996) stated that the white areas

inside and around the mouths of beaked-whales may become covered in bioluminescent slime and micro-organisms following successful capture of prey, that then act as bait for the next prey. Such a strategy suggests a fairly passive approach to foraging. However, prey pursuit is the strategy adopted by most other odontocetes and certainly the bodies of beaked-whales are sufficiently hydrodynamic to suggest they are capable of the fast movements and rapid turns required of pursuit predators (Bose *et al.*, 1990). Their prey might be captured via suction feeding. Hence, the presence of expandable throat grooves, a large piston-like tongue and associated large hyoid apparatus and greatly reduced dentition in comparison with many other toothed whales, can be considered as adaptive evolution for their feeding strategy. Conversely, MacLeod and Amico (2006) have stated that suction feeding could form part of both an ambush and a pursuit foraging strategy. Thus it is clear the feeding strategies of this whale group still remain to be established and understood.

#### **Beaked-whale records in Sri Lankan marine territories:**

The oceanic territories of Sri Lanka, a small tropical Island in the Indian Ocean (between 05° 54'N - 09° 52'N and 79° 39'E-81°53'E) have so far recorded a total of four different species of beaked-whales which belong to three genera, namely Cuvier's beaked whale (*Ziphius cavirostris*), Ginkgo-toothed beaked whale (*Mesoplodon ginkgodens*), Blainville's beaked whale (*Mesoplodon densirostris*) and Longman's beaked whale (*Indopacetus pacificus*). Most of the beaked whale records in Sri Lanka come from areas where the continental shelf is close to land. Apart from a few sporadic sighting records while at sea, all other records of beaked whales from the Island are entirely based on stranding and by catch records. It is worth to mention here that the records of the Southern bottle-nosed whale i.e. *Hyperoodon planifrons* in Sri Lankan marine territories quoted in some literature is a case of mistaken identity, as the actual records are of the Longman's beaked-whale *Indopacetus pacificus*(Anderson *et al.*, 2006).

#### **GENUS - *Ziphius***

This genus is represented by a single species globally.

#### ***Ziphius cavirostris* (Cuvier's beaked whale) Cuvier, 1823:**

They grow to about 6.5 meters in length; it has a robust body and a small head, which is about 10% of its body length. The forehead slopes to a poorly defined short beak, and its mouth turns upwards, the males have two large teeth about 2 inches long which protrude from the tip of the

lower jaw (the males use these teeth in fights with each other over females). This is not visible in females, as they are embedded in the gums. This whale has a depression behind the blowholes which ends in a distinct neck; the blow is small and not very noticeable and is projected slightly forward and to the left. The lower jaw extends well beyond the upper jaw like all beaked whales. The Cuvier's has two deep, v-shaped throat grooves.

*Colour:* The colour varies considerably, its back can be rusty-brown, dark grey, or fawn coloured and the underside of the body may be dark brown or black. As the whale ages, first the head and neck and then the body become more lightly coloured. The head of old males become completely white. The back and side, especially in the males, are often covered with double-lined scratches caused by the teeth of other males. Its side and belly has an oval white patch.

*Fins and fluke characters:* The dorsal fin may vary in shape, they may be as high as 15 inches and falcate or less and triangular. The fins are located well behind the mid-section. The flukes are large and rounded at the tips and may or may not be slightly notched in the centre; the flippers are small and rounded at the tips and fold back into little depressions on the side of the body.

### **GENUS *Mesoplodon***

The genus is represented by two species in Sri Lanka.

#### ***Mesoplodon ginkgodens* (Ginkgo-toothed beaked whale) Nishiwaki & Kamiya 1958:**

They grow to about 5 m in length; the head slopes down to a prominent beak, there is no crease separating the beak from the head. The line of the mouth takes an abrupt upward turn about halfway through and continues towards the eye. The teeth in the lower jaw are found towards the middle of the beak, posterior to the mandibular symphysis and barely break the gum line (which erupts through the gum line only in mature males, the teeth resemble the leaf of a ginkgo tree, hence the name) in mature males the upper jaw is narrow and pointed at the tip. The covering v-shape grooves on the ventral surface of the lower jaw are present as in other species of beaked whale.

*Colour:* Adult males are dark grey, but females are lighter with a pale underside and have white spots on the back and ventral surface.

*Fins and fluke characters:* The dorsal fin is set well behind the midpoint of the body and is falcate. The flippers are small. The fluke lacks the median notch.

***Mesoplodon densirostris* (Blainville's beaked whale) de Blainville, 1817:**

They grow to about 4.5m-5.0m in length; this spindle-shaped whale has a low, non bulging forehead that gently slopes onto a long, prominent beak. The area in front of the blowhole is marked by a slight depression, which gives the rostrum a flattened appearance. The long mouth line has a distinctive shape, marked as it is by a prominent arch towards the corners, beginning well before the angle of the gape on each side. These rises, which bear the two laterally compressed teeth, one on each side, give a peculiar high, arching contour to the mouth, particularly in adult males.

*Colour:* They are grey on the back, lightening towards the abdomen. Males in particular have grayish-white or pink blotches over much of the body. Both sexes usually possess scratches and scars. However males appear to be more heavily scarred than females, and they often have large white or reddish patches on the head.

*Fins and fluke characters:* The flippers are small (about one-tenth of body length); shape of the dorsal varies from small and triangular to moderately falcate and pointed on the tip. The dorsal fin is situated behind the midpoint of the back. Fluke is about one-sixth of the body length; sometimes there is a slight median convexity on the rear margin but almost never a notch.

**GENUS *Indopacetus***

This genus is represented by a single species globally.

***Indopacetus pacificus* (Longman's beaked whale) Longman, 1926:**

They grow to about 6m-7m in length, however some specimens have been reported to be over 7 m in length; the forehead is extremely bulbous, sloping steeply in adults to a long beak (the bulbous forehead is less pronounced in females and juveniles). The tip of the lower jaw reaches slightly anterior to that of the upper jaw.

*Colour:* Anderson *et al.*, 2006 say: The dorsal colour of live animals varies according to the weather conditions. In good sunlight, most animals appear a rich coffee brown colour. Under grey skies, most appear dull grey-brown. Secondly, the dark band behind the blowhole is highly variable and sometimes indistinct. Thirdly, the lower jaw is normally pale brown or grey, but it is sometimes pink.

The pale colour of the forehead only extends up to the blow hole. They possess circular and linear scars all over their body.

*Fins and fluke characters:* The flippers are small (about one-tenth of the body length). The dorsal fin is relatively large and slightly falcate and situated behind the middle of the back (it is distinctly larger and taller than the dorsal fins of most, if not all *Mesoplodon* spp., but appears only slightly larger than that of *Z. cavirostris*. (Anderson *et al.*, 2006). The fluke is one-sixth of the body length, with no median notch.

### **Significant features of the beaked-whale records in Sri Lanka**

The information on beaked-whales in Sri Lankan oceanic territories is by far and largely based on strandings and by-catch records, with sporadic records of sightings (table 1). A simple consideration of this table suggests that the majority of beaked-whale records were from the west coast, south coast and the east coast of the island (figure 1). These areas, unlike the northern part of the country, do not have a continental land mass near it, especially the southern coast, where the next land fall is Antarctica. These areas also happen to be the major fish landing sites in the country, where a number of multi-day fishing crafts operate. Thus the studies carried out in early 1990's (Dayaratne and Joseph) showed that the majority of beaked-whale catches both direct and indirect have come from multi-day fishing crafts that are of 9-10m in length. These crafts usually operate beyond 60 nautical miles out to sea. Hence, the chances are high that the encounters/bycatch is of foreign territorial waters. As such, the site of landing does not necessarily indicate a direct bearing on the location of encounter/capture.

It is noteworthy from the information given in table 1 that the data pertaining to beaked whale landing records of either direct or indirect fisheries are of juvenile specimens. This could perhaps be due to the fact that Sri Lankan boats tend not to land the largest cetaceans caught, because of the difficulties of taking them on board and the excessive amount of hold space that

would be required for storage. Large cetaceans are cut free or cut-up and used as long-line bait for sharks (Leatherwood & Reeves, 1989). Therefore, the sizes of the juveniles landed are unlikely to be representative of the total catch. It should be also noted that if the beaked whales were caught in Sri Lankan waters, given the high occurrence of juveniles, it could be surmised that calving occurs in the territorial waters of Sri Lanka. Unfortunately there is a dearth of information on their reproduction and biology in Sri Lankan marine territories to establish such a situation, conclusively and definitively. Since any form of research into beaked whales found in and around Sri Lankan territorial water has not been undertaken, there is an imperative need to carry out extensive consequential studies, to establish a better understanding of their ecology and biology. Thus, further research would provide strong enough evidences to justify such a notion.

Table 1 Records of beak whales in Sri Lanka (ZC: *Ziphius cavirostris*, IP: *Indopacetus pacificus*, MG: *Mesoplodon ginkgodens*, MD: *Mesoplodon densirostris*, UN: Unidentified, SP: Southern Province, WP: Western Province, EP: Eastern Province, NR: No record, FL Female, M: Male, J: Juvenile and NMDSL: National Museums Department of Sri Lanka).

Date of record	Species	Location	Type of records	Sex (# of individuals)	Length in m	Source
20/08/1936	ZC	Goiyapana in SP	Stranding	NR (01)	4.3	NMDSL
10/01/1939	ZC	Dodanduwa in SP	Stranding	NR (01)	NR	NMDSL
24/06/1939	IP	Colombo in WP	Harbor Stranding	NR (01)	5.6	NMDSL
30/07/1940	ZC	Rathmalana in WP	By catch	NR (01)	NR	NMDSL
26/01/1963	MG	Rathmalana in WP	Stranding	F (01)	4.5	NMDSL
01/07/1963	ZC	Telwatte in SP	Stranding	NR (01)	NR	NMDSL
-/06/1967	ZC	Matara in SP	Stranding	NR (01)	5.6	NMDSL
15/03/1983	ZC	Trincomalee in EP	Harpooned	F/J (01)	2.7	Alling 1988
11/03/1983	IP	Off east coast	Sighting	NR (40)	NR	Alling 1986
23/04/1983	IP	Off east coast	Sighting	NR (02)	NR	Alling 1986
14/04/1983	UN	Trincomalee in EP	Harpooned	F (01)	3.5	Alling 1988
-/ -/1983	ZC	Trincomalee in EP	Sighting	NR (01)	NR	Alling 1983
-/ -/1983	ZC	Beruwala in WP	Harpooned		NR	Alling 1983
-/ -/1986	ZC	Negombo in WP	By catch	NR (01)	NR	Leatherwood & Reeves 1989
-/04/1986	MD	Beruwala in WP	By catch	NR (01)	NR	Ilangakoon 2003
1991-1992	IP	Beruwala in WP	By catch	M/J (01)	NR	Dayaratne& Joseph 1993
1991-1992	IP	Beruwala in WP	By catch	M/J (01)	NR	Dayaratne& Joseph 1993
1991-1992	IP	In SP	By catch	F/J (01)	NR	Dayaratne& Joseph 1993
21/05/2010	IP	Trincomalee in EP	Sighting	NR (05)	NR	Author record
1/03/2011	UN	Mirissa in SP	Sighting	NR (02)	NR	Author record
23/01/2011	ZC	Batticaloa in EP	Stranding	F (01)	4.5	Author record

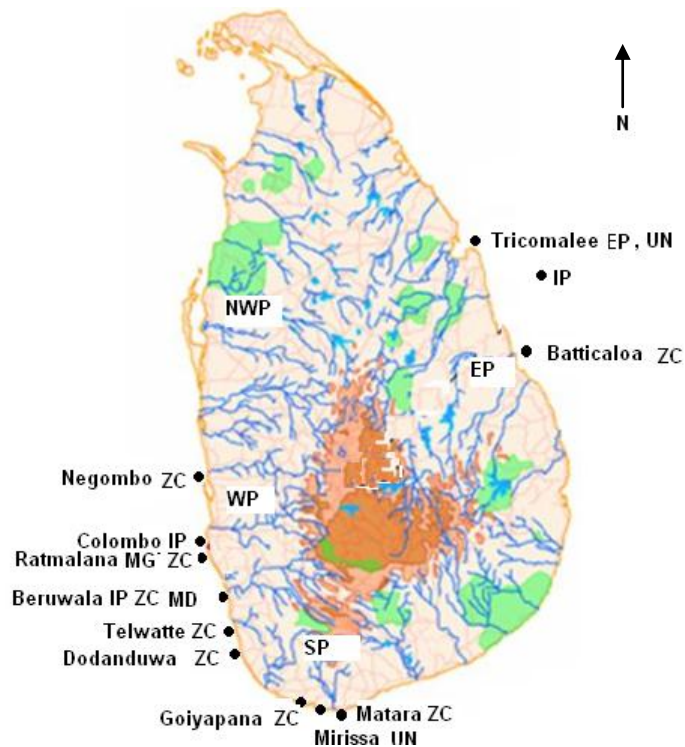


Figure 1 the map of Sri Lanka showing recorded beaked-whale sites in Sri Lankan oceanic territories ( • site, ZC: *Ziphius cavirostris*, IP: *Indopacetus pacificus*, MG: *Mesoplodon ginkgodens*, MD: *Mesoplodon densirostris*, UN: Unidentified, SP: Southern Province, WP: Western Province, EP: Eastern Province).

The data presented here indicate that the majority of stranding records have come from the west coast and the south coast of the island, with an occasional record from the east coast, but none from the north coast of the island, this could be perhaps due to the continental shelf being narrow around the west, south and east coast of the island, whereas in the north coast the continental shelf is broader. However this does not mean that the animals perished in Sri Lankan waters, as stranded animals may have drifted, either incapacitated or as dead carcasses, for long distances before making landfall, meaning that such evidence may not accurately reflect the actual distribution of the species. Taking into consideration that the west and south coast of the island opens on to vast expanses of Open Ocean, there being no land fall for considerable distances, this could well justify the reason why the majority of stranding records are from such areas.

The other interesting feature that there is a noticeable trend in the beaked-whale records in Sri Lanka, the majority of records being clustered into the months from January to August with the peak frequency being from March to August (figure 2). This is coincident with the strong



upwelling that develops between April and July, due to the seasonal reversal in the open ocean currents that flow between the Arabian Sea and Bay of Bengal via Sri Lanka. The elevated nutrients and chlorophyll levels during the southeast monsoon provide evidence of the strong upwellings that are experienced during the stipulated months (per. com. with K. Arulananthan). Further, during the months from January to May the average surface temperature of sea water around Sri Lanka rises with the peak being in May, after which it gradually becomes cooler (per. com. with Mr. Dayananda). This period coincides with the southern hemisphere seasons of fall and winter. Perhaps these climatic conditions influence the beaked whales to migrate to warmer waters around Sri Lanka, as an abundance of prey species occur in the warmer waters. Further studies are needed to understand the exact reasons for this trend. As little is known of the particular factors that cause beaked whales to be found in one area and not in another, it appears, qualitatively at least, in respect of climatic and prey availability, to be the same. However one major factor affecting productivity, and thus indirectly influencing the distribution of marine mammals, is the pattern of major ocean currents. These currents are driven largely by prevailing winds, modified in their effects by the rotation of the earth, which causes major surface currents to move clockwise in the Northern Hemisphere and counterclockwise in the southern Hemisphere. This has different implications for animals on east and west sides of ocean basins. In the northern Hemisphere, warm tropical waters move further north along the east coasts of continental land masses, and warm-water species are often found unexpectedly far to the North. In the Southern Hemisphere, by contrast, cold polar waters move northward along the west coasts of continents, allowing cold-water marine mammals to range closer to the equator. The interplay of these surface currents and subsurface movements of major water masses moves nutrients around by upwelling and indrift. As these nutrients and sunlight are the basic ingredients of productivity, areas of high mixing often are more productive than still areas of little or no mixing. Whenever oceanic conditions promote high nutrient content, it is likely that some species of marine mammal will be present to exploit that richness (Jefferson *et al.*, 1993). Thus the presence of marine mammals and other high order predators and consumers in an area is related primarily to prey, and secondarily to the water conditions supporting that productivity.

In addition to these, the near shore continental shelf and the presence of deep water canyons in the areas where beaked-whales have been recorded in Sri Lanka may be one of the possible reasons for their aggregation. These deep sea canyons have constant up welling, giving rise to myriad of prey species. Records have shown that beaked whales prefer this type of topography.

This statement has been justified by the studies carried out in other parts of the world by MacLeod in 2006. However, this does not necessarily mean that beaked whales the world over prefer this type of habitat. In some parts of the world where studies of beaked whales have indicated that they have different habitat preference from region to region. The studies carried out on the Blainvilles beaked-whale has shown that they prefer near shore water in and around the Bahamas where as in other areas the same species is found in deeper water off the continental shelf (Hazen *et al.*, 2011). As such more studies have to be carried in a global scale to get a better understanding of the biology and ecology of beaked whales.

The information presented, does not necessarily mean that there are only four species of beaked whale found in waters around Sri Lanka. Given their unobtrusive surface behavior and the elusiveness of these cetaceans, there is most probably many more species that haunt the waters around Sri Lanka, perhaps there are many more species yet awaiting to be described. Given the marine ecosystem around Sri Lanka, with near shore continental shelves and deep canyons which have constant upwelling is a suitable place for these elusive cetaceans, but we need to follow suit with other nations and promote extensive research into these little known leviathans.

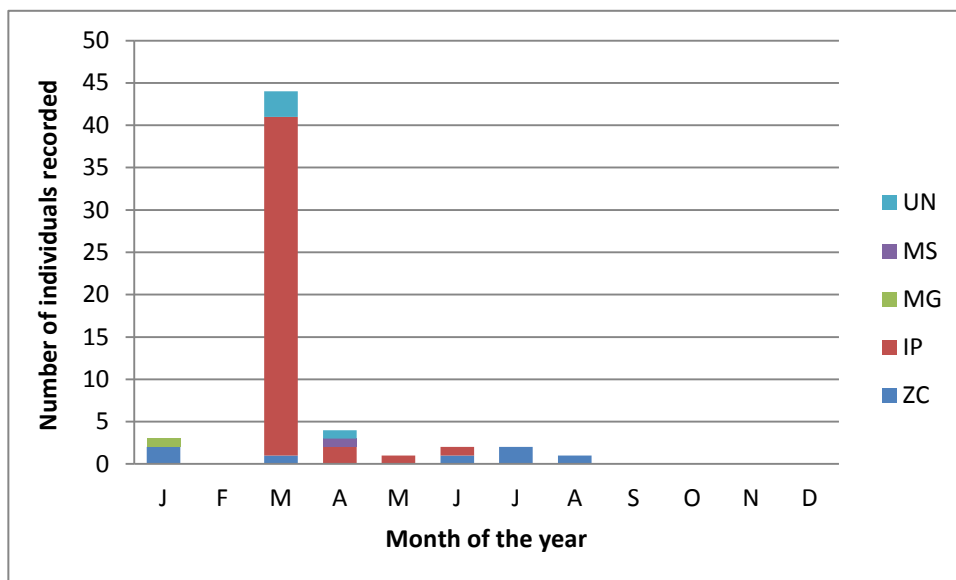


Figure 1 showing monthly variation in different species of beak whale's records in Sri Lanka (ZC: *Ziphius cavirostris*, IP: *Indopacetus pacificus*, MG: *Mesoplodon ginkgodens*, MD: *Mesoplodon densirostris*, UN: Unidentified).

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