

**Two Longman's beaked whales (*Indopacetus pacificus*) from Taiwan**

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**Abstract**

Two specimens of Longman's beaked whale, *Indopacetus pacificus*, stranded on the northeastern coast of Taiwan on 22 July 2005. These are the ninth and tenth confirmed specimens of this species. One specimen was a mature female, 565 cm in total length, and the other was a juvenile male, 420 cm in length. The external appearance, color pattern, and external measurements for these two specimens closely match the diagnostic morphological features of *I. pacificus* described in previous reports. The discovery of these two new specimens has extended the known distribution of this species. This apparent northwestern shift in range may be related to the warming trend and changes of the Kuroshio Current. This is the first report on the genetic and external morphological description of *I. pacificus* in the western Pacific.

**INTRODUCTION**

Little is known about the distribution and less about the biology of the Longman's beaked whale, *Indopacetus pacificus*, compared with many of the other 20 plus

species in the Family Ziphiidae. It is known from the tropical and warm-temperate waters of the Indian and Pacific Ocean (Pitman *et al.* 1999), and may be more common in the western Indian Ocean than in the Pacific (Anderson *et al.* 2006). This species is sometimes tentatively identified as a species of *Hyperoodon*, “tropical bottlenose whale”, by field researchers in the tropical Pacific and Indian Oceans because they look very much like Southern bottlenose whales (*Hyperoodon planifrons*), which are 7~8 m long, with a general grayish brown body color pattern, a falcate pointed dorsal fin, a bulbous pale melon, and a moderately long beak (Pitman *et al.* 1999). A group of about 20 whales belonging to this species but referred to as tropical bottlenose whales in Huatung Basin off eastern Taiwan (Yeh 2001), where the water depth is about 4,500-5,000 m.

Before the two Taiwan specimens reported here were discovered, the species was known from only eight specimens: five from the Indian Ocean (Somalia, Kenya, South Africa (two), and the Republic of Maldives), one from Australia (Queensland; the holotype specimen) and one each from Japan and the Philippines in the western Pacific (Pitman 2009). Here we present information on two new specimens: a mature female and a juvenile male that stranded together on the northeastern coast of Taiwan. Watson *et al.* (2008) reported on the osteology of the distal flipper bones from these specimens, and Yang *et al.* (2008) reported on the pathology of these specimens.

On 22 July 2005, local residents reported two whales in the surf at Su-Ao, of Ilan County, northeastern Taiwan (24 ° 36' 49.6 " N, 121° 51' 39.9" E) (Fig. 1). Before Taiwan Cetacean Society staff arrived, Coast Guard members and volunteers attempted to push the whales back into the surf several times without success. . The next evening, Ilan County governmental officers decided to transport the whales to an emergency medical pool at the Animal and Plant Disease Control Center of Ilan County for rehabilitation. However, both whales died on the truck before they reached the pool. Based on their general appearance, they were suspected to be a mother-calf pair of Longman’s beaked whale. The carcasses were then transported to the Taipei City Zoo for necropsy. The adult female was measured and dissected on 24 July and the juvenile male was examined on 25 July. Both female and male skeletons were deposited in the National Museum of Natural Science, Taichung (NMNS 011169) and Taiwan Museum, Taipei (TMMA 0419), respectively.

## **RESULTS AND DISCUSSION**

### *Morphological description*

*External appearance:* The total body lengths of the adult female and juvenile male were 564 and 420 cm, respectively. The dorsal fin was set far back on the body. The anterior edge of the fin sloped rearwards with a markedly falcate trailing edge. The melon was well-rounded in profile and sloped evenly to meet the rostrum at  $\sim 75^\circ$ . The melon was larger and more pronounced than that of *Mesoplodon* spp. The beak was moderately long and slender (slightly shorter in the juvenile than in the female). The adult female appeared robust. No tooth eruption was noticed. There was no notch in the tail fluke and the small pectoral fins tucked into well-defined depressions in the body wall. External measurements for both specimens are given in Table 1. Comparison of external measurements suggested that the two whales were very similar in overall structure to the juvenile male from South Africa (Dalebout *et al.* 2003). However, the Taiwanese specimens were distinctly longer than the South African specimen in several measurements: length of genital slit, anterior flipper length, and length of dorsal fin base (Table 1, measurements 15, 27, 34). It is possible that these differences reflect geographic variation.

*Color pattern:* Most of the following description of the color pattern is based on the photographs taken on the first two days when the specimens were fresh. Posterior to the blowhole, the entire dorsal surface was dark gray, becoming gray laterally prior to merging smoothly with the white of the ventral surface. Posterior to the eye, the dark gray of the dorsum extended ventrally in a broad band towards the anterior insertion of the flipper, before becoming light gray. A dark band of black extended ventrally from the blowhole to join a black patch surrounding the eye. A small lighter patch was embedded in the area of dark pigmentation posterior to the eye. Anterior to the blowhole, dark gray pigment extended along the mid-line as far as the apex of the melon, in an antero-lateral streak over the upper half of the melon and anterior to the eye. Much of the upper jaw and dorsal margin of the lower jaw tip were black, in contrast to the white of the rest of the face, lower jaw, and throat. The outer surface of the flippers of the female was black but only the margin of the male's flippers was black. The inner surfaces of the flippers of both whales were white. The surface around the genital slit and anus that extended dorsally toward the mid trunk was distinctly white with numerous dark gray spots in the female while it was not present in the male. The posterior margin and the anterior third of the dorsal fin were dark gray to black and enclosed a white blaze. In the posterior half of the caudal peduncle, the dark gray of the dorsal margin extended to the peduncle. On the ventral surface, the margins of the flukes were black. On the dorsal surface, the fluke was black, broadened anteriorly as far as the junction of the caudal peduncle. From the anterior margin of the flukes, numerous fine gray streaks radiated across the white background

of the ventral surface as far as the leading edge of the flukes.

*Postcranial osteology:* There were ten ribs on both sides of the female and the first five were double headed and the last five had a single articulation. There were also ten ribs on both sides of the male and the anterior seven pairs of ribs were double-headed. The last three had single articulations. The vertebral count of the male was C:7, T:10, L:11, Ca:19+ = 47+. The larger of lumbar vertebrae in the male probably reflects the young age of this specimen and as a consequent the difficulty in detecting the position of the first chevron bone. The left and right pelvic bones measured 8.5 cm and 9.7 cm, respectively.

### ***Natural history***

*Reproduction:* The right and left ovaries of the adult female measured 7.2 x 3.0 x 0.8 cm and 7.3 x 3.5 x 1.5 cm and weighed 15.38 g and 21.84 g, respectively. The heavier right ovary had two corpora albicantia. She was lactating and the right mammary gland measured 80.5 x 25.5 x 4.3 cm and weighed 2,600 g.

*Body organs:* The length of intestine of the female was 2,640 cm, or 4.7 times the total body length. Organ weights were recorded.

*Feeding Habits:* The stomachs of both specimens were empty.

*Scarring and bite marks:* Linear and oval-shaped scars from cookie-cutter shark, *Isistius* sp., bites were present on both sides of both whales (Fig.A, B), although there were many more scars on the female than on the juvenile male. No linear tooth rake scars potentially inflicted by conspecifics were observed on either animal.

### ***Molecular genetic species identification***

Total DNA was extracted from muscle tissue samples from both whales, following standard procedures. Two partial sequences of the mitochondrial DNA were amplified by the polymerase chain reaction (PCR). Sequences from these specimens were aligned by eye to the sequences in the beaked whale reference database (Dalebout *et al.* 2003). Mitochondrial DNA sequences of the control region (969 bp) and cytochrome b (418 bp) (Chou *et al.*, unpublished) obtained from these two whales were 99%-100% identical to the *Indopacetus* reference sequences (Genbank accession nos: AY162435-AY162439 for the control region; AY16440-16444 for cytochrome b.)

The reference sequences that matched our sequences from the Taiwan specimens were from an adult female *Indopacetus* from the Maldives (Dalebout *et al.* 2003, 2004).

## CONCLUSIONS

Dalebout *et al.* (2003) described the diagnostic morphological features for *I. pacificus*, which distinguish it from *Hyperoodon* and *Mesoplodon*. The two Taiwan *Indopacetus* show these diagnostic characters in their morphology, coloration and genetics.

The Taiwan specimen, a 565 cm lactating female, is the smallest known adult female of this species. The largest known female *Indopacetus* is the 648 cm specimen from Sendi-shi, Kyushu, Japan (Yatable *et al.* 2010) and the next largest female is the 619 cm specimen from Hakodate, Hokkaido, Japan (T. K. Yamada, pers. comm.) The only other known adult female is a specimen from Felidhu Atoll, Maldives with a total length of 596 cm but this length was a curvilinear measurement (Anderson *et al.* 2006). The mean size of the three correctly measured adult females is 610 cm.

The Taiwan male specimen was the offspring of the Taiwan female, but its total length (420 cm) is 74% of the length of its mother and 69% larger than the 291 cm male from Natal, South Africa that was considered to be a neonate (Ross 1984, Dalebout *et al.* 2003). No other *Indopacetus* specimens have been examined with total lengths in the range of 400–565 cm, but even with the Taiwan specimens, the +sample size of known+ length individuals is only ten individuals.

The Natal, South Africa specimen was believed to be a neonate. Using the mean size, 610 cm, of the three adult females, a neonatal length of about 275 cm is obtained from Ohsumi's (1966) equation for the allometric relationship between the mean length of females at sexual maturity and neonatal length. Therefore, even the smallest known *Indopacetus* with a total length of 291 cm is much larger than the estimated neonatal length of 275 cm.

The stranding of the Taiwan specimens in 2005 represented the most northwestern record for this species at that time. Previously, the species was only known from the waters mainly to the east and southeast of Taiwan (Pitman *et al.* 1999). More recently, two single *Indopacetus* stranded to the northeast in Japan (Yatabe *et al.* 2010 and T. K. Yamada, pers. comm.). The reason for this apparent westward shift in range is

unknown, but western boundary currents (WBC), like the Kuroshio Current, are known for their transport of heat poleward and these WBC are warming 2-3X faster than the global mean surface ocean warming rate (Wu *et al.* 2012). This may enable important prey items like squids (Yatabe *et al.* 2010) to move west and this in turn will cause the tropical predators like Indo-Pacific beaked whales also to move with their prey.

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Table 1. External measurements of the two *Indopacetus pacificus* specimens stranded at Su-Au Taiwan, on 22 July 2005 compared with a juvenile from Natal, South Africa .

		Taiwan		Taiwan		South Africa	
		IL20050723-1		IL20050723-2		PEM 1960*	
		cm	% TL	cm	% TL	cm	% TL
1	Sex/age class	Female/adult		Male/juvenile		Male/juvenile	
2	Total length	565	100	420	100	363	100
3	Beak tip to center of blowhole	75	13	58	14	50	14
4	Beak tip to center of eye	80	14	63	15	54.5	15
5	Beak tip to apex of melon	27	5	15	4		
6	Beak tip to angle of mouth	52	9	41	10	34	9
7	Beak tip to anterior insertion of flipper	131	23	109	26		
8	Beak tip to center of umbilicus	265	47	196	47	175	48
9	Beak tip to genital slit (center)	351	62	246	59	220	61
10	Beak tip to anus	393	70	287	68	258	71
11	Beak tip to tip of dorsal fin	380	67	287	68	249	69
12	Beak tip to anterior insertion of dorsal fin					224	62
13	Beak tip to ante. end of pelvic vestige	374	66	280	67		
14	Beak tip to post. end of throat creases					48	13
15	Length of genital slit			31	7	15	4
16	Length of mammary slits	15	3	6	1		
17	Length of anal opening					10	3
18	Girth at axilla	244	43	200	48		
19	Maximum girth	268	47	212	50		
20	Girth at anus	205	36	162	39		
21	Projection of lower jaw beyond rostrum tip	27	5	16	4		
22	Length of eye opening						
23	Center of eye to angle of mouth	28	5	22	5		
24	Center of eye to center of blowhole	5	1	5	1		
25	Blowhole width	16	3	13	3		
26	Length of throat grooves	39.5	7			29	8
27	Flipper length, anterior	55	10	44	10	26	7
28	Flipper length, posterior	32	6	28	7	22	6
29	Flipper width, maximum	15	3	12.5	3	9	2
30	Fluke width	136	24	92.5	22	78	21

31	Fluke depth					22	6
32	Depth of fluke notch						
33	Dorsal fin height	31	5	20	5	18	5
34	Length of dorsal fin base	58	10	36	9	24	7

\* Dalebout *et al.*, Marine Mammal Science 19(3), 2003



Male



Male



Female



Female



Female





Female