Review of current knowledge on *Indopacetus pacificus* including identification of knowledge gaps and suggestions for future research

TADASU K. YAMADA[1], YUKO TAJIMA[1], AKIKO YATABE[2], R. PITMAN[2] AND R. L. BROWNELL, JR. [3]

[1]National Museum of Nature and Science, Tsukuba, Ibaraki, JAPAN

[2]Tokyo University of Marine Science and Technology, Minato-ku, Tokyo, JAPAN

[3]Southwest Fisheries Science Center, U.S. National Marine Fisheries Service, NOAA, La Jolla, California, USA

Contact e-mail address: yamada@kahaku.go.jp

1 INTRODUCTION

Indopacetus pacificus was first described by Longman (1926) as *Mesoplodon pacificus*, based on a skull specimen long preserved in Queensland Museum since 1882 and has been known only by two beach-worn skull specimens until fairly recently (Azzaroli 1968). External morphology was introduced to science by Dalebout et al (2003) describing various cryptic specimens of the species in several institutions. In 2002, a washed-up specimen of probably an elderly female in Kagoshima Japan revealed external morphology of the species (Yamada et al, 2004). Nearly ten more specimens have been collected thereafter.

Brief introduction and summary of what is to come.

2 TAXONOMY, NOMENCLATURE AND SPECIES IDENTIFICATION

Taxonomy and Nomenclature – The species was first described as *Mesoplodon pacificus* by Longman (1926). Moore (1968), however, based on the observations on the type and the second specimens proposed a new genus *Indopacetus.* Dalebout et al (2003) also confirmed the validity of the genus both by morphology and molecular biology. At present there are more than 15 specimens of the species but external morphology and various characters including the maximum body length of the neonates and adult male are not yet known. Possibility of the existence of bottlenose whale in the tropical Indo-Pacific has been discussed and this was attributed to *Indopacetus* (Pitman et al, 1999). The external morphology of full adult male of *Indopacetus* will give this question the final answer to this question.

Species identification – *I. pacificus* can be identified with less difficulty compared to most of the *Mesoplodon* species. However, in the case of sightings in the sea could be very difficult depending on the condition (Anderson et al, 2006). Sometimes eyewitness states that it was like a “gigantic bottlenose dolphin (*Tursiops* sp.)”, which express the essential cue for the identification. Distinct melon and beak, although the boundary between them is less marked than those of most of the delphinid species, is one of the very effective identification characters. Fairly large adult body size around 6m or larger is also an important character. A young might bear some similarity with *Hyperoodon planifrons* (See Fig. 3-I, in Dalebout et al, 2003), however close examination can differentiate the two. The dorsal fin is distinctively high. Pitman et al (1999) described its body color has been variously described as tan, light brown, acorn brown, gray-brown, or just gray.

In most of the cases the body surface of adult is covered with fairly heavy cookie cutter shark bites. Often they carry whale lice, some of them could be not described yet. Researches on the external parasites such as whale lice could yield considering the history of co-evolution of the host and parasite (Kaliszewska et al, 2005). Density of the cookie-cutter shark bites or *Pennela* infestation may also be useful for the identification of the different geographical populations.

3 DISTRIBUTION, POPULATION STRUCTURE AND MOVEMENTS

All the specimens hitherto collected were stranded animals (Table 1). Specimens collected are from South Africa (2), Somalia (1), Kenya (1), Maldives (1), Australia (1), The Philippines (1), Taiwan (2) , China (1), Japan (2) and Hawaii (1). There are two reports of stranding without specimen one is a 5.97m individual from Myanmar, near Rangoon River mouth found in August 2005. The other was a live stranding of an individual of unknown sex and size in Taidon, Taiwan, this animal was released by the local people. In summary, the species is known from the tropical to template zone in the Indian and Pacific Oceans. PEM 292 collected in Natal South Africa (29°39'S, 31°36'E) is the most western and southern individual (Dalebout et al, 2003). The most northern example was NSMT36311 and stranded in Hakodate, Hokkaido, Japan (41°45'N, 140°53'E), and the most eastern individual was stranded in Maui (22°43'N, 155°59'W) (Jensen et al, 2011).

Probably the oldest sighting report of *I. pacificus* was made by Mörzer Bruyns (1971) in the western Indian Ocean. Anderson et al (2006) reported sightings of *I. pacificus* in the western Indian Ocean, summarizing the four sighting surveys and the result of comparison of then existing data (Keller et al, 1982; Anonymous, 1991; Pitman et al, 1999; Flower, 1882; Mead, 1989). Sighting records collected by South West Fisheries Science Center indicate that the species ranges far eastern compared to the stranding data (Table.2).

Pitman et al. (1999) reported the mean sizes of the sighted groups as; 8.6 individuals (n = 17) in the eastern Pacific, 29.2 individuals in the western Pacific (n = 15), and 18.5 individuals in the Indo-Pacific (n = 41). Anderson et al (2006) discussed the estimates of mean group size (4.2 individuals for our new sighting data; 7.2 individuals for all western Indian Ocean sightings together) are less than those reported previously. These differences may resulted from observer differences and will be settled to a certain range of values to show whether the group sizes are different in different geographical areas. No data describing the movement of *I. pacificus* is published.

Genetic differences within the species are not discussed yet, because of the small sample number available (Dalebout et al, 2003)

Anderson at al (2006) stated that *I. pacificus* tends to have short (11 to 18 min.) and long (20 to 33 min) dives. This can be said because they have more opportunities to observe the dives, compared to the prior reports simply describe the dive time of one each observation in Gallo-Reynoso and Figueroa-Carranza (1995) and Pitman et al (1999).

4 LIFE HISTORY PARAMETERS

Because sample number is so limited, data to estimate even the body size range are far from enough. The largest male was 5.73m and was not physically mature (Acebes et al, 2005). The largest female was 6.5m (Yamada et al, 2004). The smallest male was 2.91m (PE292, Dalebout et al, 2003). According to Anderson et al (2006), three bycaught animals of 2.7 to 3.3m in body length originally identified by Dayaratne and Joseph (1993) as *Hyperoodon planifrons* were *I. pacificus*. Data on the smaller individuals that may make us estimate the neonate size is not sufficient, and we can only say that the neonate size could be smaller than 3m. It is difficult for us to summarize the range of body size for both sexes. Maximum body size of females could be 6 to 6.5m, whereas we are still not sure about the maximum size of males.

Food habit – Stomach contents were studied at least of two individuals). From Kagoshima specimen, *Taonius pavo*, *Onychoteuthis borealijaponica*, *loennbergi*, *Chiroteuthis picteti*, *Histioteuthis inermis and Histioteuthis* sp. (Yatabe et al, 2010). A subadult male stranded in the Philippines had beakes of *Taonius* sp. and *Histioteuthis* sp. (Acebes, personal communication). Longman's beaked whales seem to prefer to forage in epipelagic to mesopelagic waters, which is similar to other beaked whale species (MacLeod et al, 2003; Ohizumi and Kishiro, 2003). In two of the individuals examined both had some plastic debris in the stomach (Yatabe et al, 2010; Acebes, personal communication).

5 ABUNDANCE AND TRENDS

5.1 Abundance

Anderson et al (2006) discussed the relative abundances of *I. pacificus* in The Western Indian Ocean and the Pacific Ocean and concluded *I. pacificus* could be more common in the Western Indian Ocean, especially arounfd the Maldives. No data was published on abundance of *I. pacificus.*

5.2 Trends

No data was published on trends of *I. pacificus.*

6 DIRECT REMOVALS

6.1 Directed takes

No direct take of *I. pacificus* was recorded.

6.2 Incidental takes

Dayaratne and Joseph (1993) reported three incidental catch of *Hyperoodon planifrons* in Sri Lanka. Anderson et al (2006) reidentified the species as *I. pacificus* and suspects possibility of more incidental catches of the species.

7 OTHER ACTUAL AND POTENTIAL THREATS

In addition to the incidental catch in fishing activity (Dayaratne and Joseph, 1993), Yang et al (2008) pointed out the possible influence of military active SONAR. Seismic threats of this kind are not necessarily military but also various industrial or constructional activity could become serious harracements. Ship strikes especially of the high speed boats and other human activitie are also problematic. Jensen et al (2011) confirmed morbillivirus infection in a subadult male stranded in Hawaii with . probable pathological changes in various organs. Plastic debris found from the stomach of two *I. pacificus* were not serious in volume, however, as was suggested in *M. stejnegeri*, this could sometimes be even fatal Yamada et al (2012).

In the event of strandings or any deaths of the species prompt necropsy should be carried out to clearly reveal the cause of death and the results should be compiled somewhere as a publickly accessible database.

Actual/ Potential Threat	Anthropogenic activity/ies	Evidence	Possible impact
Bycatch	*Commercial and recreational gillnets, wreck nets, tangle nets, bottom trawls*	*possible*	*Not believed to be high*
Serious injury/death (not direct take or bycatch)	*Ship strikes from commercial and recreational vessels*	*Weak. Indications could be obtained from strandings programmes, photographs*	*Not believed to be high*
Mechanical destruction of habitat	*Bottom trawls, infrastructure construction, oil and gas development*	*Not evident*	
Prey depletion	*Overfishing, habitat degradation due to pollution, climate change*	*Not evident*	
Acoustic pollution/harassment	*Fishing vessels, general maritime traffic, acoustic harassment devices at fish farms, pingers, military activities, infrastructure construction, oil and gas development (incl seismic surveys) recreational activities*	*Active SONAR (Yang et al, 2008)*	*Can be serious*
Chemical pollution	*Terrestrial industrial development, terrestrial run-off harbours, ships, aquaculture, sewer discharges, aerial transport.*	*Possible but no evidence*	
Debris	*Various debris*	*Possible but no evidence*	*Can be serious*

8 STATUS

Because the virtual recognition of the species was fairly recent comparison of the present status with the past is almost impossible.

9 RECOMMENDATIONS

Intensive and extensive sighting surveys are necessary to fill the possible information gaps in geographical density differences.

Rangewide standardaization in necropsy of the dead animals (either natural deaths or human related deaths), and compilation of the database

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Table # – Existing qualitative and quantitative assessment of density of [SPECIES] **of the North Pacific and northern Indian Ocean**										
Species	**Presence (S, St, B)**	**Platform (visual ship or air, acoustic, mark-recapture**	**Month(s)/ Year(s)**	**Surface area (km^2)**	**Qualitative assessment of density**	**Estimation Method**	**Uncorr. Density (n/km^2)**	**Uncorr. estimate of abundance**	**CV (%)**	**Source**
Western North Pacific										
Sub-area if not the whole										1, …
Sub-area if not the whole										
Sub-area if not the whole										
Eastern North Pacific										
Sub-area if not the whole										
Sub-area if not the whole										
Sub-area if not the whole										
Northern Indian Ocean										
Sub-area if not the whole										
Sub-area if not the whole										
Sub-area if not the whole										

Keys/Notes: S: Sightings, ST: Stranding, B: Bycatch.
Source: 1: Brownell *et al*. 2010, ….

NOTES:

- THE COLUMN PRESENCE INDICATES ONLY IF DATA IS AVAILABLE ON SIGHTINGS (WRITE "S"), STRANDINGS (WRITE "St") OR BY-CAUGHT ANIMALS (WRITE "B") FROM A CITABLE SOURCE.
- "SOURCE": USE NUMBERS AND INSERT THE PROPER REFERENCE BELOW THE TABLE. FULL REFERENCES MUST BE PROVIDED IN THE "REFERENCES" SECTION OF YOUR MANUSCRIPT.

Cruise	Date			Latitude		Longitude		School Size
1616	2000	8	15	6.882	N	135.545	W	8
1621	2002	11	6	23.657	N	176.538	W	18
1629	2005	9	18	16.742	N	167.962	W	14
1631	2006	8	12	4.723	N	121.704	W	3
1641	2010	8	31	28.088	N	173.443	W	89
1641	2010	9	11	28.203	N	170.355	W	41
1641	2010	10	31	20.563	N	162.422	W	28
1642	2010	10	14	-		-		4

Table 2

Sighting records of *I. pacificus* in the high seas (Southwest Fisheries Science Center).

ID	Found date			Country	Latitude		Longitude		Sex	BL m	BW kg	Remarks	Specimen	References
QM-J2016	1982			Australia	21°10'	S	149°10'	E	M*			adult*	skull and mandible, Holotype	Longman, 1962; Moore, 1968
MZUF 1956	1955			Somalia	01°52'	N	45°02'	E	F*			subadult*	skull and mandible	Azzaroli, 1968
OM7622	ca 1968			Kenya					U				skull	Dalebout et al, 2003
PEM292	1976	11	7	South Africa	29°39'	S	31°36'	E	M	2.91		neonate?	ribs and vertebrae	Dalebout et al, 2003
PEM1960	1992	8	5	South Africa	27°34'	S	32°41'	E	M	3.63		juvenile	skull, mandible, teeth, earbones and ribs	Dalebout et al, 2003
	2000	1	17	Maldives	3°26'	N	73°26'	E	F	5.96		adult	whole skeleton, foetus	Dalebout et al, 2003
KGA M14	2002	7	26	Japan	31°54'	N	130°13'	E	F	6.5			whole skeleton	Yamada et al, 2004
	2002	9	9	China	29°60'	N	121°40'	E	M	6.08			whole skeleton	Peng et al, 2009
	2004	1	13	Philippines	7°25'	N	125°33'	E	M	5.73	2500	subadult	whole skeleton	Acebes et al, 2005
IL 2005-23-1	2005	7	22	Taiwan	24°37'	N	125°51'	E	F	5.65		adult	whole skeleton	Yang et al, 2008
IL 2005-23-2	2005	7	22	Taiwan	24°37'	N	125°51'	E	M	4.20		juvenile	whole skeleton	Yang et al, 2008
	2010	3	22	USA	22°43’	N	155°59’	W	M	3.71	635	young	whole skeleton	Jensen et al, 2011
NSMT36311	2010	9	25	Japan	41°45’	N	140°53'	E	F	6.3		adult	whole skeleton	
	2011	7	31	Japan					M	ca4		young	whole skeleton	

Table 1