RECORDS OF THE FRASER'S SARAWAK DOLPHIN (*LAGENODELPHIS HOSEI*) IN THE WESTERN NORTH PACIFIC

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ABSTRACT

Recently, the dolphins of *Lagenodelphis hosei* Fraser, 1956 have been collected and also sighted sporadically in the certain places of the world. From Kamogawa (JAPAN) and Kaohsiung (TAIWAN) both of which located in the Western North Pacific, each one specimen has been collected and identified as this species as a result of observations on the external character and osteological study.

Considered the places and dates of collection of this species in the Western North Pacific, the dolphin of *Lagenodelphis hosei* might be in the nature of warm water preference. In summer, when the Kuroshio current is dominant, the distribution of the species might be widened to north and may sometimes reach the east coast of Japan to the degree of 35°N.

INTRODUCTION

The Sarawak dolphin (*Lagenodelphis hosei*), was named by F. C. Fraser of the British Museum (Natural History) in 1956. His investigation was on the skeleton found in Lutong River, Borneo, by C. Hose in 1895. However, nothing had been known of the external characters of the whole body of this form until recently. Then this species of dolphins and also sighting records have been collected sporadically in Australia, in South Africa and in the Eastern North Pacific and some other places. Among many dolphin specimens collected from the Western North Pacific since 1969, a few were identified as this species.

KAMOGAWA SPECIMEN

Environmental condition at stranding

This specimen was first found by a local people in passing on the sand beach of Hamaogi, Kamogawa City, on May 25, 1972. The report of the incident was brought to the Kamogawa Seaworld but when one of the attendants reached to the

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scene of stranding an hour later, the animal had already expired. The lower jaw must have bamped with something was broken about 10 cm from its top. Fresh hemorage from the wound told him that the animal had died shortly before. The specimen was thought to be a white sided dolphin (*Lagenorhynchus obliquidens*) at first, though a little difference was recognized in the shape of the dorsal fin and in the body colour. But later, as a result of cooparative study, it was identified as *Lagenodelphis hosei*.

It seems that the animal was carried to the coast of Japan on the Kuroshio current. The northern limit of the current is at around the Boso Peninsula, which located at nearly central part of the Islands of Japan, and Kamogawa City is on the outer coast of the Peninsula. The surface temperature of Boso waters about the

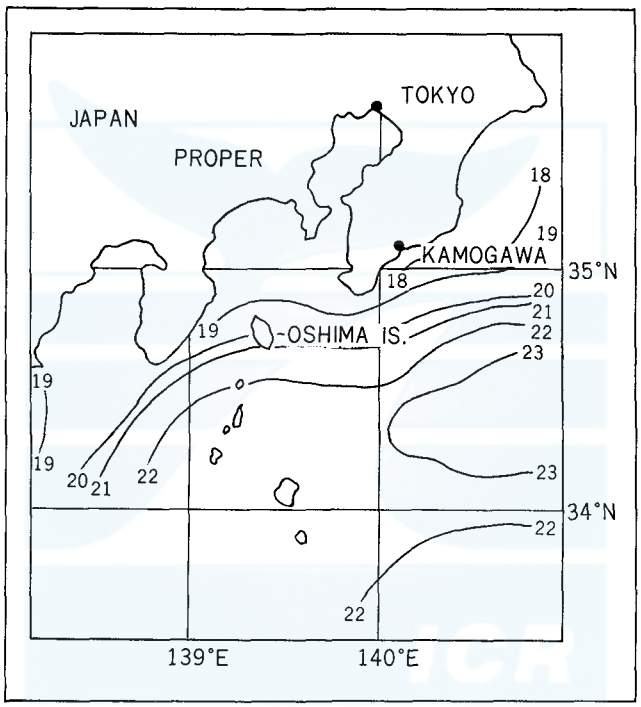


Fig. 1. Distribution of surface water temperature (°C) in 21–27, May 1972.

time of stranding was distinctly higher than usual as shown in Fig. 1. From May 14–20, surface temperature was 16°C–18°C in shallow waters and 19°C–20°C in deep waters. From May 21–27, (the time of stranding), influenced by approach of the Kuroshio current, it was up to be 18°C-23°C in both shallow and deep waters.

External appearance

The external measurements are as indicated in Table 1. The body shape of this species is a close resemblance to that of the *Lagenorhynchus obliquidens*, though relative differences are in the short snout, the equilateral triangular shaped dorsal

TABLE 1. EXTERNAL MEASUREMENT OF KAMOGAWA SPECIMEN

Sex Male

Number of teeth $\frac{36 \mid 36}{34 \mid 36}$

	Measurement		mm	%
1.	Length, total		2350	100.0
2.	Length, tip of upper jaw to apex of melon		30	1.3
3.	Length, tip of upper jaw to center of eye		280	11.9
4.	Length of gape		240	10.2
5.	Length, tip of upper jaw to external auditory meatus		335	14.2
6.	Length, tip of upper jaw to blowhole		310	13.2
7.	Length, tip of upper jaw to anterior insertion of flipper		410	17.4
8.	Length, tip of upper jaw to tip of dorsal fin		1033	43.9
9.	Length, tip of upper jaw to midpoint of umbilicus		1080	45.9
10.	Length, tip of upper jaw to midpoint of genital aperture		1565	66.5
11.	Length, tip of upper jaw to center of anus		1695	72.1
12.	Projection of upper jaw beyond the lower		10	0.4
13.	Girth, at anterior insertion of flipper		963	41.0
14.	Girth, at axilla		1069	45.4
15.	Girth, at anterior insertion of dorsal fin (maximum)		1163	49.5
16.	Girth, at anus		742	31.5
17.	Maximum height of body, including dorsal fin		565	24.0
18.	Length of eye		27	1.1
19.	Width of blowhole		25	1.1
20.	Length of flipper, anterior insertion to tip	L.	260	11.1
		R.	255	10.9
21.	Length of flipper, axilla to tip	L.	175	7.4
		R.	180	7.7
22.	Width of flipper, maximum	L.	84	3.6
		R.	82	3.5
23.	Dorsal fin, height		175	7.4
24.	Dorsal fin, length of base		300	12.8
25.	Width of tail flukes, tip to tip		530	22.6
26.	Anterior insertion of tail fluke to notch	L.	152	6.5
		R.	155	6.6
27.	Anterior insertion of tail fluke to tip	L.	325	13.8
		R.	322	13.7
28.	Distance, tip of tail fluke to notch	L.	270	11.5
		R.	270	11.5

fin, the smaller flippers located at a little anteriorer parts and the smaller tail flukes.

The whole dorsal surface is slate black while the ventral surface is white. Between these distinct divisions, complicated patterns decorate the sides. A black band extends from the upper base of the snout to meet with another black band which begins at the central part of lower jaw, at the angle of gape. The joint widened black band run through the eye to branch off at a little anteriorer part than the base of flipper. One of the branches ends at the base of flipper, while the other extends further to draw a gentle curve with a little narrower band to the anus. Then the band widened once again and extends to the swelling at a posteriorer

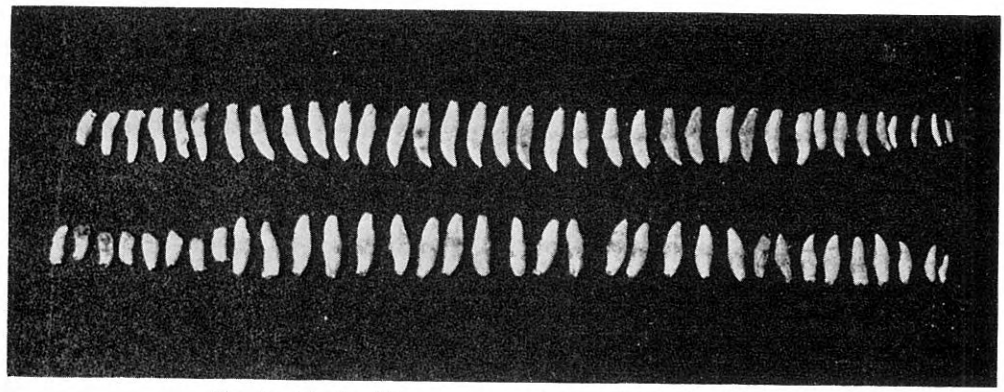
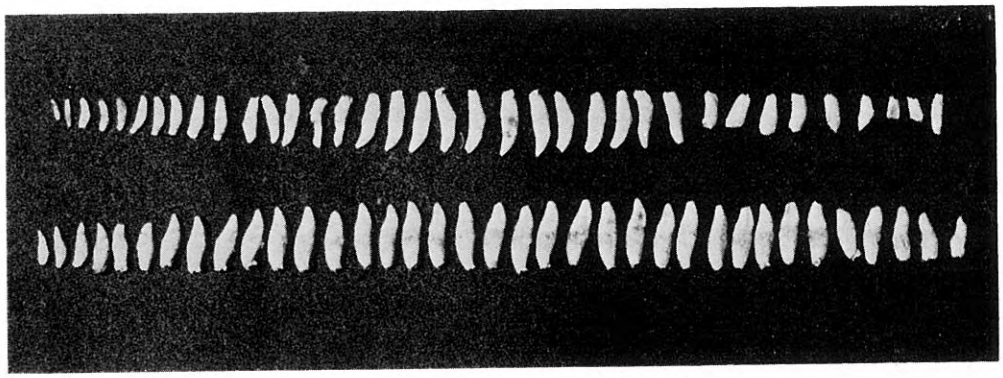


Fig. 2. Teeth of Kamogawa specimen. Top left: Upper right row, Bottom left:

part than the anus. Along with these black band pattern, a gray band from the head to the tail run nearly parallel to it just above, which become wider to the posterior. In addition to these complicated pattern, another, more distinct black band run around the posterior half of the base of flipper, from which a black line extends toward the ventral center. The line is so delicate that it seems as if it were drawn with the tip of a small brush and is fading at the midway between the base and the ventral center and this line does not extend anteriorly than the line between the front of the flipper base. Besides these main bands, there are some detail illustrations. A short black band around the eye extends to the base of rostrum and is joinning into the main black band, so that it is less distinct. Two delicate lines run from the angle of gape to the tip of snout, of which the line along the upper jaw is fading into the dorsal black and that along the lower jaw hemmed the edge which makes clear contrast with the basic white. Ventral view is generally white with two black bands which run along each side, are coming close each other at the anus and are joinning into one to reach to the tail. The flippers and the tail flukes are all black.

Measurements of the skeletons

As it is seen in Table 2 that in comparison of the skull of Kamogawa specimen with the former three, there is no apparent differences except that the parietal width of this specimen is slightly broader and that the maximum width of premaxillae of which is narrower. The snout of Kamogawa specimen is relatively broader than those of former three and the length breadth ratio of it is 1.80 and 1.83. The vertebral formulas are also indecated in Table 2, in which Kamogawa specimen has 15 thoracic vertebrae, while South African specimen has 16. Number of lumber vertebrae is same in all former three, but only in Kamogawa specimen, number is 20. Number of caudal bones vary among the specimens for an example, Kamogawa specimen indicate 39; this number is bigger than any other by 2 to 5. Number of chevrons is 21 in Sarawak specimen and 31 in Kamogawa specimen. (Fig. 3) Difference by 10 is considerable. The first, the second and the 29 to the 31 chevrons



lower right row; Top right: Upper left row, Bottom right: Lower left row.

are being separated into two pieces. (X-ray photos of caudal vertebrae and chevron bones had been taken before dissection.) The phalaengial formula of Kamogawa specimen is I: 2, II: 9, III: 6, IV: 3 and V: 2. The number is same in both flippers, but in the Sarawak flippers, different number is in I, III and V. X-ray photo of the flippers is in Plate V.

The measurements of vertebrae is shown in Table 3. Among cervical vertebrae, the first and the second bones are inherently fused together and these joint two and the third and the fourth are fixed in order under the vertebral corps, and the neural arch of the fifth and the sixth are fixed. These fusion of the bones are supposed to be a phenomenon of ageing. In the picture of the vertebral column, shown in the Plate IV, the projects of neural spine are short in the 12th to the 15th caudal vertebrae. However, the shape was modified during the process of treatment, not a transformation of the bones. The shape of rib cage is shown in Plate V and the measurements of ribs are in Table 4. The photographs of the hyoid bones are in Fig. 4, and the measurements of them are in Table 5. The sternum is divided into three pieces and the dimentions of it is in Table 6. The left pelvic bone was broken at the time of collection, straight length of the right one is 106 mm and its breadth at the middle is 11 mm, the shape of it is in Fig. 5. The scapulae is shown in Fig. 6 and dimensions of it is in Table 7. The measurements of humerus, radius, ulna, phalaengial and chevron bones are not indicated here on account of limited space.

Other results

1. Weight of the internal organs is shown in Table 8. Compare the internal organs of this specimen with those in other species, apparent differences are in the lower lobe of lung which is more squarely built in the others and in the testes of it that, size of testis is quite different in each other.

2. Examination on the contents of stomach revealed only beaks of squid and otoliths of fish as seen in Table 9. Considered that almost all squids and fish are deep water trait, this species of dolphins might eat food in the night and the species which they feed on are equal with those which the dolphins of *Stenella caeruleoalba*

TABLE 2. SKELETAL MEASUREMENTS AND MERISTICS OF FIVE SPECIMENS OF *LAGENODELPHIS HOSEI* FRASER 1956, INCLUDING THE HOLOTYPE.

Measurement or count	Sarawak specimen* (BMNH 1895.5.9.1 physically mature)	South African** female PBB 71/3 (SAM 36323) physically mature	South African** male PBB 71/4 (SAM 36323) physically mature	Western Pacific*** male KSW 72/5 (TKO 3—) physically mature	Western Pacific*** sex unknown HCY 69/10 (TKO 310) calf
Condylobasal length	413 mm (100%)	429 mm (100%)	440 mm (100%)	423 mm (100%)	415 mm (100%)
Length of rostrum	226 (54.7)	240 (55.9)	241 (54.8)	235 (55.5)	232 (56.1)
Width of rostrum at base	121 (28.3) (53.5% of rost. ln.)	119 (27.7) (40.6% of rost. ln.)	130 (29.5) (53.9% of rost. ln.)	128 (30.2) (54.5% of rost. ln.)	113 (27.0) (48.7% of rost. ln.)
Width of rostrum at midlength	71 (17.2)	71 (16.6)	80 (18.2)	77 (18.2)	62 (14.9)
Width of rostrum 60 mm anterior to antorbital notches	85 (20.5)	86 (20.0)	101 (23.0)	91 (21.5)	78 (18.8)
Least supraorbital width	202 (48.8)	202 (47.1)	218 (49.5)	209 (49.4)	195 (47.0)
Preorbital width	207 (50.1)	207 (48.3)	223 (50.7)	213 (50.3)	197 (47.5)
Postorbital width	230 (55.7)	229 (53.4)	247 (56.1)	234 (55.3)	210 (50.0)
Zygomatic width	225 (54.5)	225 (52.4)	240 (54.5)	229 (54.1)	broken
Parietal width	170 (41.2)	161 (37.5)	177 (40.2)	190 (44.9)	161 (38.8)
Maximum width of premaxillae	82 (19.9)	78 (18.2)	83 (18.9)	70 (16.5)	74 (17.8)
Length of upper right toothrow	194 (46.9)			201 (47.5)	207 (49.9)
Length of upper left toothrow	194 (46.9)	193 (45.0)	213 (48.4)	199 (47.0)	203 (48.9)
Length of lower right toothrow	194 (46.9)			195 (46.0)	207 (49.9)
Length of lower left toothrow	193 (46.7)	198 (46.2)	207 (47.0)	192 (45.3)	208 (50.1)
Length of right ramus	349 (84.5)			356 (84.1)	355 (85.5)
Length of left ramus	350 (84.7)	367 (85.5)	375 (85.2)	broken	357 (86.0)
Coronoid height of left ramus	70 (16.9)	65 (15.2)	71 (16.1)	70 (16.5)	66 (15.9)
Length of symphysis	36 (8.7)	37 (8.6)	31 (7.0)	32 (7.5)	65 (15.6)
					41 (9.9)
Number of teeth	43 | 44 ca. 40 | 42	40 | 42 39 | 39	42 | 42 41 | 40	40 | 42 37+ | 40	41 | 39 41 | 42
Total number of vertebrae	80+2	78	78+1	81	
Vertebral formula	C7 T15 L21 C37±2	C7 T16 L21 C34	C7 T16 L+C55±1	C7 T15 L20 C39	

Percentage of condylobasal length in parentheses. * British Museum (Natural History, London, holotype).
** South African Museum, Capetown. *** Ocean Research Institute, University of Tokyo.

TABLE 3. DIMENSIONS OF VERTEBRAE (mm)

	Vertebra No.	A	B	C	D	E	F	G
C	1		37	81	94	165	22	37
	2	17[1]				81		
	3				65	52		
	4				70	44		
	5	7[1]			68	49		
	6				67	53		
	7	4	30	37	63	51	21	32
D	1	10	32	40	81	112	23	37
	2	14			95	125		
	3	19			96	129		
	4	24			98	127		
	5	27			106	131		
	6	32			107	138		
	7	33	31	32	116	148	28	32
	8	33			118	152		
	9	34			125	164		
	10	35			133	174		
	11	35			133	188		
	12	36			139	194		
	13	36			145	210		
	14	34			149	244		
	15	34			151	256		
L	1	32	35	37	148	247	25	18
	2	30			153	241		
	3	30			156	240		
	4	29			161	233		
	5	29			164	233		
	6	27			164	230		
	7	27			163	227		
	8	26			165	223		
	9	25			165	218		
	10	25			166	216		
	11	25	37	39	162	215	27	13
	12	24			161	206		
	13	24			157	205		
	14	24			153	204		
	15	23			152	195		
	16	23			150	193		
	17	23			145	188		
	18	23			143	185[2]		
	19	24			138	188		
	20	23			136	181		

	Vertebra No.	A	B	C	D	E	F	G
Ca	1	23	40	41	133	172	20	9
	2	23			132	165		
	3	23			129	159		
	4	23			125	157		
	5	23			122	149[2]		
	6	23			119	151		
	7	23			117	149		
	8	23			115	150		
	9	23			113	146		
	10	23			109	139		
	11	23	42	45	106	137	10	6
	12	23			97[2]	135		
	13	24			88[2]	126		
	14	24			84[2]	117		
	15	24			80[2]	108		
	16	25			90	96		
	17	25			86	80		
	18	26			84	60		
	19	27			78	49		
	20	28	42	41	76	45	4	4
	21	29			72	39		
	22	29			66	35		
	23	28			62	33		
	24	27			53	32		
	25	25	39		44	33	1	1
	26	25			35	32		
	27	15			28	33		
	28	12			22	32		
	29	10			18	32		
	30	10			17	32		
	31	10			16	29		
	32	9			14	27		
	33	8			13	25		
	34	8			11	23		
	35	7			9	20		
	36	7			8	17		
	37	6			6	14		
	38	4			5	9		
	39	2			2	3		

A: Length of body at ventro-laterally below the transverse process. B: Height of body at front end. C: Breadth of body at front end. D: Total height from anterior bottom. E: Bilateral breadth of transverse processes. F: Greatest height of neural canal. G: Greatest breadth of neural canal.

[1] Each vertebra is united.

[2] Broken.

TABLE 4. DIMENSIONS OF RIBS OF KAMOGAWA SPECIMEN (mm)

No. of ribs		A		B		C	
		L.	R.	L.	R.	L.	R.
Vertebral ribs	1	180	185	23	22	19	19
	2	281	288	15	16	25	26
	3	360	360	10	10	32	32
	4	400	402	9	8	37	37
	5	414	418	8	8	39	38
	6	380	380	8	8	—	—
	7	371	376	8	12*	—	—
	8	369	375	8	7	—	—
	9	371	375	8	8	—	—
	10	365	365	8	7	—	—
	11	345	345	7	7	—	—
	12	315	315	7	7	—	—
	13	307	312	7	7	—	—
	14	284	284	4	5	—	—
	15	196	192	4	4	—	—
Sternal ribs	1	81	82	14	14		
	2	89	89	13	13		
	3	110	111	9	9		
	4	122	121	8	7		
	5	130	128	6	6		
	6	138	137	6	6		
	7	144	145	6	7		
	8	154	146	6	6		
	9	133	**	6	**		
	10	92	93	4	4		

A: Length along visceral border. B: Breadth at middle. C: Distance between two heads.
* Deformed
** Lost

Fig. 3. Chevron bones of Kamogawa specimen.

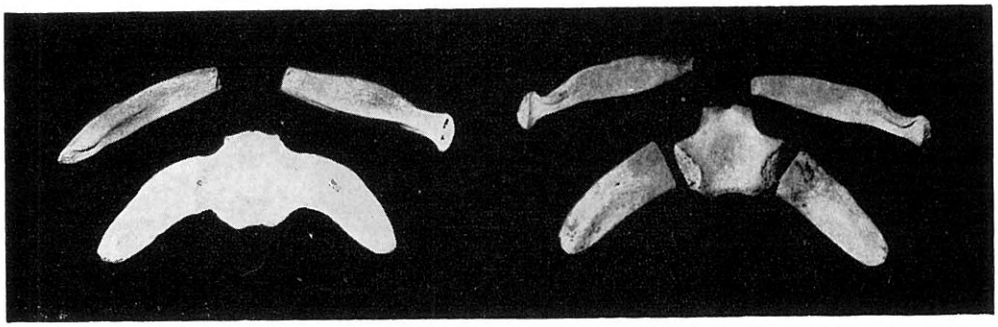
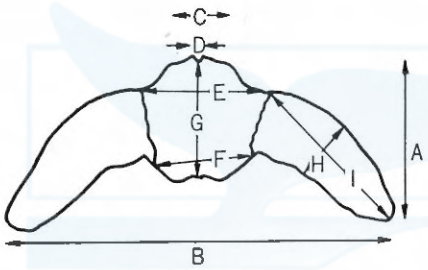


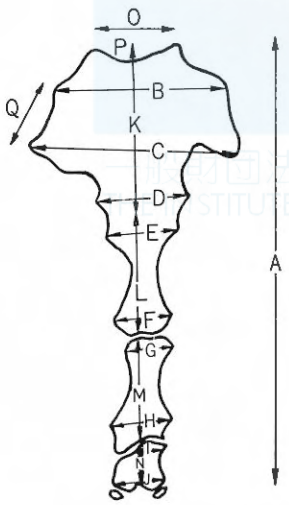
Fig. 4 Hyoid bones of Kamogawa specimen (left) and Kaohsiung specimen (right)

TABLE 5. DIMENSIONS OF HYOID BONES OF KAMOGAWA SPECIMEN (mm)



A		69
B		138
C		26
D		1
E		49
F		29
G		47
H	L.	25
	R.	25
I	L.	73
	R.	71
Thyrohyals straight length	L.	89
	R.	91
Thyrohyals breadth at middle	L.	19
	R.	20

TABLE 6. DIMENSIONS OF STERNUMS OF KAMOGAWA SPECIMENS (mm)



A	216	J		27
B	94	K		69
C	113	L		66
D	52	M		54
E	40	N		27
F	39	O		44
G	38	P		9
H	39	Q	L.	29
I	26		R.	32

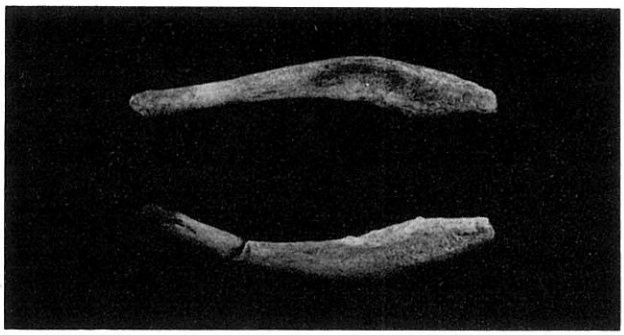


Fig. 5. Pelvic bones of Kamogawa specimen. upper: right (left of the picture is anterior)

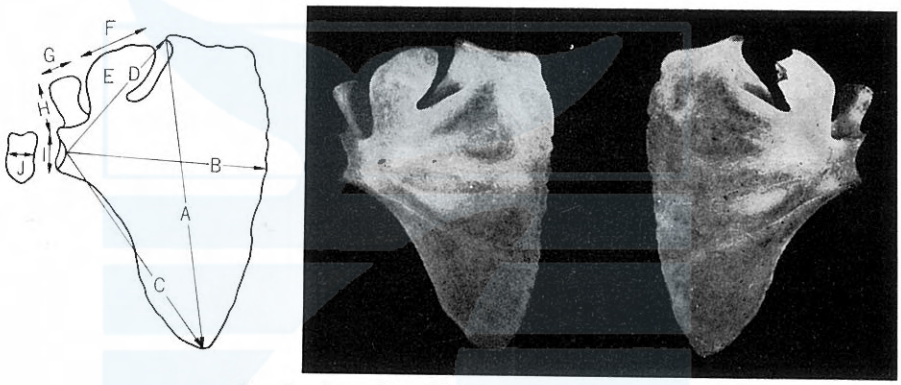


Fig. 6. Scapulae of Kamogawa specimen.

TABLE 7. DIMENSIONS OF SCAPULAE OF KAMOGAWA SPECIMEN (mm)

Measured part	A	B	C	D	E	F	G	H	I	J
Left	193	119	144	84	43	45	19	28	28	18
Right	188	121	146	96	58	49	19	27	28	20

TABLE 8. WEIGHT OF ORGANS IN PROPORTION TO THE BODY WEIGHT

235 cm M

Body weight		129 kg	100%	Kidney	L.	390	0.30
Esophagus		150 g	0.11%		R.	380	0.29
Heart		1010	0.78	Adrenals	L.	7	0.0053
Lung	L.	1720	1.33		R.	8	0.0058
	R.	1540	1.19	Testis	L.	990	0.76
Trachea		150	0.11		R.	260	0.20
Stomach		1200	0.93	Thyroid		17	0.01
Spleen		69	0.05	Tongue		500	0.38
Liver		3160	2.44	Intestine		2660	2.06
Interseptum		1050	0.81	Total weight		16112 g	12.49
Pancreas		140	0.10	Intestine Length		13.3 m	

TABLE 9. NUMBERS AND KINDS OF FISH OTOLITHS, SQUID BEAKS FOUND IN STOMACH AND INTESTINE OF *LAGENODELPHIS HOSEI* COLLECTED AT KAMOGAWA, JAPAN, MAY 1972.

Kind of fishes and squids eaten		Stomach	Intestine	Total
Argentinidae				
Argentina semifascista			1	1
Coryphaenoididae		17		17
Gonostomatidae				
Ichtyococus elongatus		310	37	347
Gonostomatid			3	3
Moridae				
Physiculus sp.?		8	3	11
Myctophidae				
Diaphus elucens?		10	10	20
Lampanyctus jordani			2	2
Sternoptychidae				
Polyipnus asteroides		71	4	75
Unidentified		2	1	3
Total		418	61	479
Gonatidae	upper beak	1		1
	lower beak	1		1
Loliginidae	lower beak		1	1
Ommastrephidae	upper beak	1		1
Onychoteuthidae	upper beak	2		2
	lower beak	1		1
Total		6	1	7

* 6 small stone found in stomach.

are on, so it can be said that they eat food without diving into the depth.

3. Parasitical examination revealed three Nematoda and one *Tetrabothius* sp. from the first stomach and 35 *Bolbosoma* sp. from the intestine, and number of cysts of Cestoda were found in the blubber around the anus about 30 cm^2.

KAOHSIUNG SPECIMEN

This specimen was collected by H. C. Yang at the fishmarket in Kaohsiung City on Oct. 31, 1969.

Precede to this incident, Yang had come across with a male dolphin at the fishmarket on Oct. 24, 1969, length of which was 164 cm and its face was a close resemblance to the present specimen, but he could not be able to collect it. The dental formula of the dolphin was $\frac{39\ \ 40}{40\ \ 40}$ (out of gum).

Unfortunately, Kaohsiung specimen is only a head portion, the body portions had already been sold as lumps of meat when the skull was found. Because of that, we could not collect body length nor identify sex of the animal and can not tell how it had been grown.

Nishiwaki saw the photographs of this specimen while he was passing Kaohsiung on his way home from the expedition on the fresh water river dolphins in East Pakistan (now Bangladesh). The photographs drew his attention and Nishiwaki and Yang, by joint effort, excavated the buried skull, cleaned it by boiling and sent it to the Ocean Research Institute in Tokyo. When Yang came up to Tokyo in Oct. 1970, as a research student of the institute, they again got together and studied on the present specimen. As a result, they identified it as a *Lagenodelphis hosei*. The specimen consists of a skull and a hyoid bones. The measurement on these are shown in Table 2 and Plate VI. The dental formula was counted as $\frac{39\ \ 37}{38\ \ 39}$ at collection but later it was concluded as $\frac{41\ \ 39}{41\ \ 42}$ at measurement.

Compared the measured values of the present specimen with those of the Sarawak specimen (holotype) or other specimens of this species in the South African Museum (by the kindest help of Dr. Perrin), this skull is slenderer in shape and the beak of which is longer than that of the others.

The shape of the hyoid bones are well fit to those of the holotype. It can be said that the present skull is of a young female.

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EXPLANATION OF PLATES

PLATE I

External features of *Lagenodelphis hosei*, Kamogawa specimen.
Top to bottom:
Lateral, ventral and dorsal view.

PLATE II

Skull of *Lagenodelphis hosei*, Kamogawa specimen.
Top to bottom: Dorsal, ventral and lateral view.

PLATE III

Skull and mandible of *Lagenodelphis hosei*, Kamogawa specimen.
Top to bottom:
Posterior view of skull.
Dorsal and lateral view of mandible.

PLATE IV

Vertebrae of *Lagenodelphis hosei*, Kamogawa specimen.
Top to bottom:
Cervical and dorsal, lumbar, caudal (1–19) and caudal (20–39) vertebrae.

PLATE V

Ribs and X-ray photographs of flippers of *Lagenodelphis hosei*, Kamogawa specimen.
Top to bottom:
Rib cage, right and left flipper.

PLATE VI

Head and skull of *Lagenodelphis hosei*, Kaohsiung specimen.
Top to bottom:
Left side; dosal, lateral and ventral view of head.
Right side; dorsal, lateral and ventral view of skull.