PAST OCCURRENCE OF *GLOBICEPHALA MELAENA* IN THE WESTERN NORTH PACIFIC

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ABSTRACT

Six skulls of *G. melaena* excavated at the northern Sea of Japan and at the central part of the Pacific coast of Japan indicate that the species was present in the western North Pacific at least untill about 10th century. However, the absence of any indication of the presence of this species in the collection from recent fauna and in the modern Japanese whaling statistics suggests that the species might have been extinct from the North Pacific or that a small population is surviving in some area of western North Pacific which have not been studied by biologist.

INTRODUCTION

The genus *Globicephala* Lesson, 1828, is constituted by two species *G. melaena* (Traill, 1809) and *G. macrorhynchus* Gray, 1846, (Fraser, 1950; Van Bree, 1971). They have been known, except in the North Pacific, to show antitropical distribution, namely the former species in colder waters and the latter in the warmer waters (Davies, 1960, and 1963).

In the North Pacific, *G. scammonii* Cope, 1869, and *G. sieboldii* Gray, 1846, were reported from Mexican waters and from Nagasaki in the southern Japan respectively, which were later concluded by Van Bree (1971) to be the synonyms of *G. macrorhynchus*. Though it was denied recently (Nishiwaki *et al*, 1967), there were published several reports telling the distribution of *G. melaena* in the Japanese coastal waters, and produced a long history of confusion on the zoogeography of globicephalid species. So, it will be worth to have, in the below, a review on this problem for the better understanding of the biological meaning of the present study.

Andrews (1914) is the first scientist who used *G. scammoni* for the pilot whale in the Pacific coast of Japan. This was based on an animal taken at Ayukawa (38° 18′N, 141°30′E), but he gave no biological reason distinguishing it from *G. sieboldii* reported by Gray (1846). Then Nagasawa (1916) used in his list the name *G. scammoni* for the pilot whale in the Japanese waters, considering that *G. sieboldii* should not be trusted because it was based on a drawings of a young pilot whale reported by Temminck and Schlegel (1844). This was followed by Takashima (1931). However, Ogawa (1937) listed *G. melas* in his list of odontoceti in the coastal waters of Japan, and showed a photograph of so-called *G. melas* (236 cm ♂) taken at Shiogama (38°19′N, 141°02′E) on 28, May, 1935. In this list he tentatively considered *G. melas* as the synonym of *G. sieboldii*. Furthermore in the same list, he listed *G. scammoni*, based on two specimens collected at Ayukawa. And he considered the two Japanese names " Naisagoto " and " Magondo " correspond to *G. melas*, and " Shiogoto " and " Tappanaga " to *G. scammoni*. Though he did not give in his report, the reason of the identification, it is written in his another book (Ogawa, 1950). As this is the start of the erroneous story telling the presence of *G. melaena* in the Japanese coastal waters, some important part is translated here.

> [p. 65] I decided to spend the August of this year [i.e. 1935] for the 2nd trip to collect the specimens . . . at Shirahama in Chiba, Taiji in Kii, and Nagasaki in Kyushu. . . . [p. 76] At Taiji I got 2 *Globicephala* (380 cm♀, 470 cm♂), measured their bodies, counted the number of bones, observed the pigmentation, and sent only the skull(s) back. . . . They were commonest at Taiji and colled " Magondo ". . . . They seemed to have no difference from *G. melas* (Traill) . . . and strengthened my belief that " Magondo (or Naisagoto) " indicates this species. One of the reasons for it is . . . [p. 77] the presence of anchor shaped pale area in the chest region. I had been interested in this fact, since I observed this at Shiogama on 2 or 3 *Globicephala*. . . . In the foreign countries the white or pale area of the shape is reported only on *G. melas* (Traill). Though Cuvier and True say that it extends to anus along the midline of the body, that of my specimen ends at the middle of the ventral region and shows slight difference. There are recorded three different names or " Naisa ", " Shio ", and " Onan " for " Goto (or Gondo) " [Pilot Whale] in the Japanese oldest book on cetaceans (Yamase, 1760). . . . Among which the names " Naisa " and " Magondo " now used at Taiji are considered to be synonyms, and " Onan ", which is equal to " Okigondo ", . . . is supposed to indicate *Pseudorca crassidens* (Owen). . . . [p. 78] The still unknown is " Shio ". I was told at Taiji that this species is large in body size, has long flipper, has white area at the posterior of the dorsal fin, and also called by the name of " Tappanaga " [=long flipper]. And it was also told that the number of catch of this species is few, and caught only in the season(s) of equinox. . . . Before this information I had guessed that " Tappanaga " may correspond to *G. scammoni* Cope (Pacific black fish in U.S.). . . . When I arrived at Ayukawa after receiving the news of the catch of " Tappanaga ", the animal had been already processed. So I identified the species only with a part of skeleton. However, Mr. Hasegawa had observed, by my request, the condition of the anchor shaped pale area on the chest and reported that it was absent. He gave me a photo of the dorsal view of other individual (Fig. 22). . . . There was clearly observed a white fleck behind the dorsal fin of which I heard at Taiji. . . . [p. 79] The photo, shown in the journal of the museum, of a *G. scammoni* Cope . . . in the collection made by Andrews in Japan . . . has no pale area on the chest. From these fact I considered that " Shiogoto (Tappanaga) " corresponds to *G. scammoni* Cope.

Above citation shows that Ogawa's misidentification started in the erroneous idea that some of different common names in different localities must indicate different species. Then he overlooked the fact that all of his samples were collected in the area and seasons influenced by the warm Kuroshio current, and the importance of the osteological characteristics and of the external proportions by which the possibility of *G. melaena* might have been eliminated from his samples, but he put the weight on less reliable pigmentation. And he reached the odd conclusion that *G. melaena* is distributed in the south and *G. scammonii* in the north. This conclusion (Ogawa, 1937) was followed without further confirmation by Kuroda (1938, 1953), Noguchi (1946), and Nishiwaki (1957). Then, Nishiwaki *et al* (1967) concluded, based on the specimens collected by themselves in the Pacific coast of Japan in the summer season and on the two of Ogawa's specimens, that there will be distributed only *G. macrorhynchus* in the area in which the distribution of *G. melaena* was expected by former reports. Though Nishiwaki *et al* (1967; and see Nishiwaki, 1967; and Rice and Scheffer, 1968) found no significant difference between *G. macrorhynchus* in the Japanese coastal waters and *G. scammonii*, they retained the conclusion on the taxonomy of these two species. And now it has become a generally accepted idea that *G. melaena* is not distributed in the North Pacific (Rice and Scheffer, 1968; Van Bree, 1971).

In 1974, however, I had a chance to examine the specimens excavated by Dr. Oba of Hokkaido University and his colleagues from two archaeological sites of Okhotsk culture on Rebun Island in the northern Sea of Japan. Though they are composed of many fragmental bones of odontoceti and mysticeti, the most striking is the presence of skulls of *G. melaena* and the absence of specimens identifiable to *G. macrorhynchus*. This led me to have a discussion on the possibility of existence of *G. melaena* in the western North Pacific.

MATERIALS AND METHOD

Four of 6 skulls of *G. melaena* referred in this study were excavated from the Kabukai A-site on the east coast of Rebun Island (45°20'N, 141°E). Though, ^{14}C dating of charcoal gives 1530±70 B.P. (TK 157) for the lower strata, the date of this site is suspected from known archaeological data to be between 8th century (lowest stratum) and 12th century (upper most stratum) (Oba and Ohyi eds., in press). As shown in Table 1, this site contained the remainings of large whales and of various delphinid species. However, most of them were found in the condition almost completely broken into small pieces. Other than the remains shown in Table 1, there were found 174 vertebrae of *Phocoe noides*, 92 of *Lagenorhychus*, 7 of *Phocoena*, 29 of *Globicephala*, and several vertebrae of large cetaceans. As the excavation was made in a restricted area compared with the expected range of the site, the accurate ratio of the cetacean species consumed by the people is not known at present. But it is safe to say that the delphinid species in the site are, with the exception of *Pseudorca*, composed of the boreal species. Table 1 shows that the number of globicephalid animals found in the upper strata is higher than that in the lower strata. This may suggest the improvement of the fishing technology.

Though the fragments of *Globicephala* skeletons were found in various strata of Kabukai A-site, most of them were unable to be identified the species. Only 4 skulls, RKA 3658, 3983, 3987, and 6054, were identifiable, among which RKA 3983 was young and badly destroyed to measure. The stratum containing the present specimens situates approximately at the middle of upper strata, and had been deposited in a pit representing a ruin of a house of that date. They were found in a stone mound together with 6 skulls of *Globicephala* sp. of various stages of growth and conditions of preservation, 1 *Lagenorhynchus* skull, 1 left tympanic bulla of humpback whale, and a radius of black right whale (?). Further description and interpretation of this site are reported in Oba and Ohyi (eds., in press).

Another skull of *G. melaena* (no. 675) was excavated by Dr. Oba and his colleagues at an archaeological site at Motochi on the west coast of the same island. Though the archaeological study of the site is not finished yet, it is considered to belong to the age between 11th and 13th century (Ohyi, 1972).

The 6th skull of *G. melaena* was found by Mr. M. Yoshimura and offered me for taxomic study. This specimen was excavated from an alluvial silt deposit by

TABLE 1. MINIMUM NUMBER OF CETACEANS REPRESENTED BY BONE FRAGMENTS IN KABUKAI A-SITE[4)]

Strata	Upper strata[1)]	Middle strata[2)]	Lower strata[3)]	Total
Globicephala	13	4	2	19
Lagenorhynchus obliquidens	3	2	4	9
Phocoena phocoena	1	1	1	3
Phocoenoides dalli	+	3	2	5
Pseudorca crassidens	3			3
Physeter catodon			1	1
Ziphiidae sp.	1			1
Megaptera novaeangliae	3	2	1	6
Balaenoptera borealis		1		1
B. acutorostrata	1			1
Eubalaena glacialis	+	1	1	2

1) Erom surface to fish bone stratum II/III, 2) From fish bone stratum III/IV, 3) From fish bone stratum IV to VI, 4) Calculated in each smaller strata. Vertebrae other than cervical, and bones in flipper are not included, but shown by " + ".

the Hekuri River near Tateyama (34°59′N, 139°51′E) at the entrance of Tokyo Bay. This strata belongs to the Numa deposit, and the date of the skull is considered to be equal with the date of fossil coral and of fossil oyster collected at the same stratum of same location (Mr. Yoshimura, pers. comm.). The ^{14}C dating of the coral and of the oyster gives 6,340±140 B.P. and 6,430±130 B.P. respectively (Araki, 1973).

For the osteological comparison, the measurements of 25 skulls of *G. macrorhynchus* collected on the Pacific coast of Japan were used. They are 7 skulls in the collection of National Science Museum (Tokyo), 5 skulls of Ogawa's specimen in the collection of the same museum, 1 skull collected at Ayukawa (no date), 3 skulls collected at Choshi (35°42′N, 135°56′E, Dec. 1966), and 9 skulls collected at Arari on the Pacific Coast of Japan (39°49′N, 137°46′E, June 1965 and 1967). The last

13 skulls are kept in the Ocean Research Institute, University of Tokyo. The skull measurements of 4 *G. scammonii* (=*G. macrorhynchus*) specimens in the collection of Los Angeles County Museum (EDM F 298, WAW 46, WAW 47, WAW 48) and one skull kept in the Smithsonian Inst. (USNM 3076), and the measuremnts of 13 skulls from the North Atlantic in the collection of Smithsonian Inst. (USNM nos. 21572, 257412, 257413, 279366, 257414, 37264, 241182, 37261, 22592, 37263, 395712, 22571, 22570) are used here. The measurements of the type specimen of *G. scammonii* (USNM 9074) were provided by Dr. R. L. Brownell. Measurements of 9 skulls of *G. macrorhynchus* cited from Fraser (1950) and Van Bree (1971, =*G. sieboldii*) were used in Figs. 1 and 2.

The measurements of *G. melaena* were obtained on 21 skulls in the collection of Smithsonian Inst. (USNM nos. 395373, 395365, 395372, 395364, 395363, 395361, 395362, 395360, 395357, 16298, 20981, 21118, 14418, 14360, 20958, 303018, 12098, 12097, 12099, 12100, 20957, and EDM 1000) and on 4 skulls in the collection of Los Angeles County Mus. (four EDM specimens).

The catch statistics of *Globicephala* in the Japanese coastal waters were compiled from Geiryo Geppo [the monthly report of whaling operation] of the period from 1949 to 1952, when most intensive fishing for *Globicephala* was operated because of the social demand for the food. This report was originally presented to the government by the owners of the small whaling boats, but now is kept in the Whales Research Institute in Tokyo. The position of the catch is represented in this study by the position of the whaling station, and the number of the catch is shown in each areas obtained by combining several nearby stations.

OSTEOLOGY

The difference between *G. melaena* and *G. macrorhynchus* is found, on the skull, in the shape of premaxillae on the dorsal surface of the rostrum (Fraser, 1950). In the latter species the lateral margins of the premaxillae expand widely at the anterior region of the rostrum to cover, entirely on adult individuals, the maxillae of that part. However, on *G. melaena* this expansion is very weak and the maxillae are widely exposed, even on the adult animal, on the dorsal surface of the anterior part of rostrum. Though Van Bree (1971) says that rostrum is elongated in *G. melaena* than in *G. macrorhynchus*, there was found no difference in the length of rostrum between the two species (Fig. 2.). The number of teeth is fewer and the size of tooth larger in *G. macrorhynchus*.

The five *Globicephala* skulls from Rebun Island and Tateyama are, except one juvenile, those of adult individuals, and the lateral margins of the maxillae and of premaxillae of the 5 skulls are almost intact to allow the accurate comparison. And their feature coincides with that of *G. melaena* in the above characteristics (PLATES). The number and size of alveoli are also rather close to that of *G. melaena* (Table 2). As shown in Fig. 1, the measurements of rostral region show the difference between the two species, and *G. macrorhynchus* from the Pacific coast of Japan shows the perfect coincidence with those of the same species in other areas. However the measurements of 5 measureable skulls from Rebun Island and Tateyama come in the range of *G. melaena* in the North Atlantic. From these reasons the present *Globicephala* skulls are classified into *G. melaena*, and it is concluded that *G. me-*

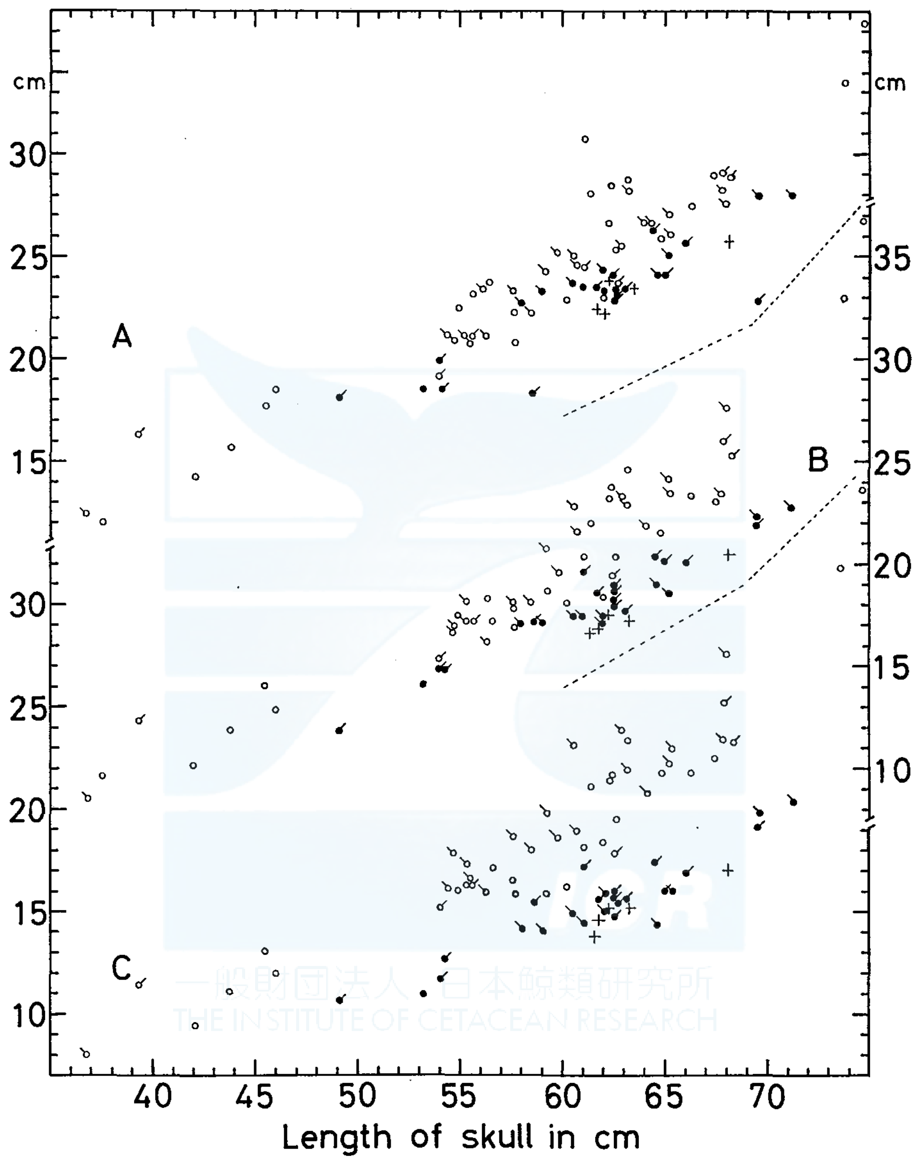

Fig. 1. Scatter diagram of the measurements of rostral region of *Globicephala*. A: Rostrum basal width. B: Rostrum width at middle. C: Premaxillae width at middle of rostrum. Open circle: *G. macrorhynchus* (Without bar indicates animal from Japanese coast, bar at right that from California coast, and bar at left that from other seas). Closed circle: *G. melaena* (Bar at right indicates animal from Chili, bar at left that from North Atlantic, and no bar no history). Cross mark: *G. melaena* from Japanese coast.

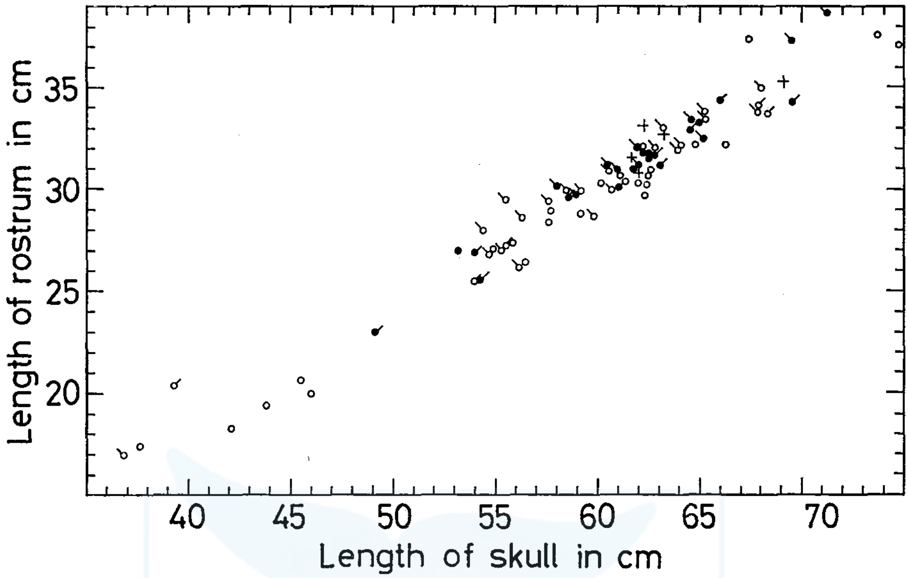

Fig. 2. Scatter diagram showing the relationship between length of skull and length of rostrum. For marks see Fig. 1.

TABLE 2. SKULL MEASUREMENTS OF *G. MELAENA* FROM JAPANESE COAST (MM)

Specimen no. and Locality	KRA3658 Kabukai	675 Motochi	RKA6054 Kabukai	Awa Mus. Tateyama	RKA3987 Kabukai
Measurements					
1. Condylo-basal length	617	619	623	633	681
2. Rostrum length	315	310	331	329	352
3. Rostrum basal width	224	223	119×2	235	257
4. Rostrum width at middle	167	166	87×2	171	200
5. Premaxillae width at same point	138	146	76×2	151	170
6. Maximum width of premaxillae distally	140	148	146	151	172
7. Maximum width of premaxillae proximally	148	156	—	158	174
8. Width of rostrum at the level of no. 6	168	170	90×2	171	205
9. Width across preorbital angles of supraorbitals	175×2	352	178×2	375	399
10. Width across postorbital angles of supraorbitals	—	384	—	415	440
11. Width of skull at orbits	359	349	—	371	405
12. Zygomatic breadth	—	375	—	416	—
13. Width of braincase across parietals	288	285	—	273	299
14. End of rostrum to blowhole	407	394	401	—	466
15. Length of upper tooth row (to end of pmx.)	L168, R166	L163, R154	L201	L175	L190, R205
16. Number of upper teeth	L10, R10	—	L9	L11*	—

* Last alveolus rudimental.

TABLE 3. COMPARISON OF SOME IMPORTANT SKULL MEASUREMENTS OF TWO SPECIES OF *GLOBICEPHALA*

		G. melaena Japan	*G. melaena* Chili	*G. melaena* N. Atlantic	*G. macrorhynchus* N. Atlantic	*G. macrorhynchus* N. Pacific
1. Condylo-basal length (mm)[1)]	sample size	5	10	14	13	24
	range	617–681	580–712	590–695	544–680	540–748
	mean	634.6	633.1	619.9	611.8	621.6
	standard error	11.92	13.76	11.80	12.79	11.35
2. Rostrum length (%)	sample size	5	10	14	13	24
	range	50.1–53.1	49.8–54.4	47.2–51.2	48.0–52.2	47.2–51.0
	mean	51.6	51.7	50.2	50.4	49.2
	standard error	0.50	0.46	0.31	0.35	0.21
3. Rostrum basal width (%)	sample size	5	10	14	13	24
	range	36.0–38.2	37.3–40.1	31.2–40.2	37.6–44.6	35.6–48.6
	mean	37.1	38.8	36.9	40.4	41.3
	standard error	0.42	0.28	0.71	0.53	0.76
4. Rostrum width at middle (%)	sample size	5	10	14	13	24
	range	26.8–29.4	27.4–31.9	27.3–33.0	30.5–40.4	28.3–49.0
	mean	27.6	29.2	29.8	34.8	34.1
	standard error	0.45	0.49	0.45	0.86	1.03
5. Premaxillae width at same point (%)	sample size	5	10	14	13	24
	range	22.4–25.0	22.1–28.5	21.5–28.2	29.6–40.4	26.7–47.2
	mean	23.9	24.9	25.2	33.8	32.3
	standard error	0.44	0.65	0.48	0.92	1.02
11. Orbital width (%)	sample size	4	10	10	12	21
	range	56.4–59.5	61.1–65.7	59.2–66.7	62.5–68.6	62.2–78.5
	mean	58.2	62.9	63.1	65.8	68.7
	standard error	0.65	0.76	0.73	0.63	1.02
16. Number of upper teeth	sample size[2)]	4	14	16	26	48
	range	9–11	9–11	9–12	7–10	6–9
	mean	10.0	9.9	10.3	8.0	7.8
	standard error	0.41	0.20	0.24	0.20	0.14

1) Skulls more than 540 mm are selected. 2) Both sides are dealt separately.

laena was present at the approximate 10th century in the northern part of the Sea of Japan.

SEASONAL FLUCTUATION OF THE RECENT CATCH

Fig. 2 shows the seasonal fluctuation of the catch of *Globicephala* in the coastal waters of Japan, compiled from the monthly report of the catch in the years from 1949 to 1952. In these years many small whaling boats operated in the Japanese coastal waters for minke whale, ziphioid whales, killer whale, and pilot whale. The fish-

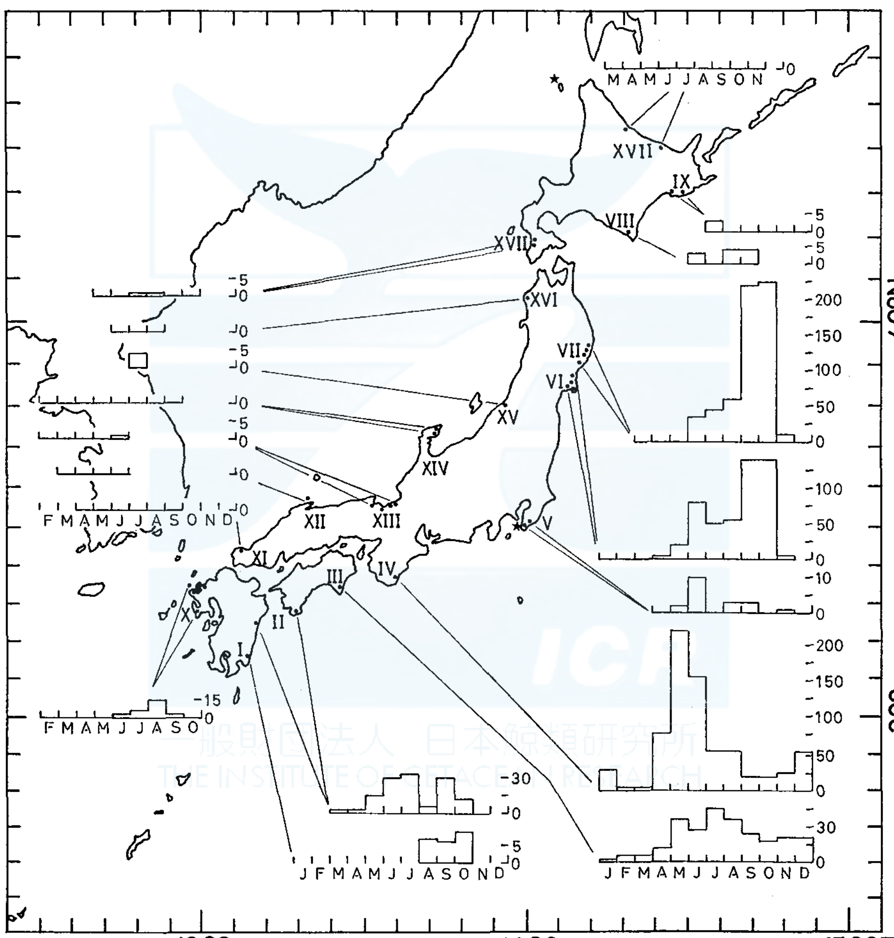

Fig. 3. Seasonal fluctuation of the catch of *Globicephala* in the years from 1949 to 1952. The number of catch is shown by squares, and the months of whaling operation by holizontal line. Closed circle indicates whaling station, and star the position of the occurrence of *G. melaena*. Whaling area is shown by Roman numerals.

ing ground was approximately within the range of 50 nautidcal miles (90 km) from the coast (Omura and Sakiura, 1956). Though they prefered minke whale, they caught other species also, because the demand of whale meat for human consumption was high. Accordingly the seasonal and geographical fluctuation of the catch of *Globicephala* in these years is considered to reflects the abundance of this species. The total number of whaling boats of this type operated was 74 (1949), 66 (1950), 68 (1951) and 69 (1952). And the annual number of *Globicephala* catch was 760 1949), 667 (1950), 591 (1951), and 307 (1952). It is not analyzed yet whether the decrease of the annual catch is the reflection of the depletion of the population or the reflection of economical factors. Probably both of the factors will have influenced on it.

As shown in Fig. 3, the catch in the central and northwest regions (except areas VII to IX) shows, in general, the two peaks one in the autumn and the other in early summer. And the interval between the two peaks is shorter in the northern areas. Though the peak of early summer is inconspicuous in the areas VI and VII, this seems to be the influence of the catch of minke whale. According to Omura and Sakiura (1956), these area is a good whaling ground of minke whale and the season is from January to July with a peak in May. This will have a effect to lower the peak of *Globicephala* in early summer.

However, in the areas VIII and IX, the catch of *Globicephala* shows only one peak. In these areas the season of minke whale is between June and October with a peak in July (Omura and Sakiura, 1956). Accordingly the season of the peak of catch of *Globicephala* in these areas will not be biased, even if the total number of catch is smaller compared with the number of migrating animals.

This fact suggests that the area where *Globicephala* densely distributes moves from the south to the north in the early summer, and after arriving at the latitude of 43°N in July and August, it again moves to the south to arrive at Kii and Shikoku area (32°N to 34°N) in November and December. Possibly this seasonal movement of the whaling ground reflects the migration of one species of *Globicephala* in the Pacific coast of Japan. But as suggested by Fig. 3, some *Globicephala* individuals seem to stay in all seasons in the Pacific coast of the south west region of Japan (areas I to IV).

The catch of *Globicephala* in the sea of Japan and in the northern coast of Kyushu is too scarce to discuss the seasonal fluctuation. But it is safe to say that the catch is restricted to the summer season in spite of the longer operation of whaling in this region. As the number of the catch of *Globicephala* is so few, there may arise a question if the *Globicephala* reported by the fishermen from the Sea of Japan represent real *Globicephala*. However, there is no doubt in the existence of the genus in the Sea of Japan, because a school of *Globicephala* was sighted by myself on 28, August, 1971 at the center of the Sea of Japan (39°04′N, 134°36′E). The surface water temperature at the spot was 24.5°C.

In the Okhotsk Sea, the Japanese whaling boats for small whales operated in the seasons from March to November. But there are no catch of *Globicephala* recorded in the statistics I analyzed. Omura and Sakiura (1956) showed that the season of minke whale in this region lasts from March to July with a peak in May, and the same result was obtained even from my data. After the season of minke whale, they caught *Berardius* and *Orcinus* in the Okhotsk Sea. As the capture of *Globicephala* is not considered to be more difficult than that of *Berardius* or *Orcinus* even if the size is slightly smaller than the latter, they must have captured *Globicephala* if it had been distributed in the sea in that season. According to the personal communication of Mr. S. Miyoshi who has been operating the whaling for more than 20 years mainly in the Okhotsk Sea, he have sighted no *Glogicephala* in the Okhotsk Sea.

These informations strongly suggest that *Globicephala* does not migrate, in the seasons from March to November, to the southern part of Okhotsk Sea where the Japanese whaling boats for small whales operate.

DISCUSSION

On the species of *Globicephala* constituting the catch in the Pacific coast of Japan, the specimens of known locality give the information. All the known records of *Globicephala* in this area, i.e. 6 specimens collected at Arari in June 1967 (Nishiwaki *et al*, 1967), external measurements of 16 animals and 13 skulls collected at Taiji 33°38′N, 135°56′E) in July and August 1969, 1 Ogawa's specimen caught at Shirahama (34°54′N, 137°53′E), 3 animals in a school stranded at Choshi (35°42′N, 140°52′E) in December 1966, 2 Ogawa's specimens presumably collected at Shiogama in May 1932 and 1935 (Ogawa, 1937; Ogawa, 1932 cited in Kuroda 1938), 2 Ogawa's specimens presumably collected at Ayukawa (Ogawa, 1937), and 1 skull and skeleton in National Science Museum in Tokyo killed at 39°28′N, 142°19′E in October 1953, are represented by *G. macrorhynchus*. These animals were collected from the animals representing both the early summer and the autumn-winter peaks.

The comparison of fishing season and oceanographical condition gives another support on the identity of the species. The boundary of the front of warm Kuroshio Current is indicated by the 17°C surface isotherm (Uda, 1954), and in August the boundary go up to the latitude of 43°N (Uda and Nasu, 1956; Miyazaki *et al*, 1974) or to the northern limit of the whaling ground of *Globicephala* analysed here, and retreats in March to 35°N (Miyazaki *et al*, 1974) or to the approximate northern limit of *Globicephala* ground in winter season. From these informations it is concluded that all the catch of *Globicephala* in the Pacific coast of Japan is constituted by *G. macrorhynchus*, and that the species lives in the Kuroshio watermass and moves north and south in accordance with the seasonal movement of the boundary of Kuroshio front. Accordingly the range of normal distribution of *G. macrorhynchus* is expected not to extend into the cold watermass.

There is obtained no data directly indicating the species of *Globicephala* caught by recent whaling in the Sea of Japan. However, the existence of the skull of *G. sieboldii* [=*G. macrorhynchus*] caught at Nagasaki in western Kyushu, the fact that *Globicephala* was caught in the same season with that of *Pseudorca* (areas XI, XII and XVI), one sighting record mentioned in the former section, and the presence of warm Tsushima Current in the Sea of Japan (Uda, 1954) strongly suggest that there is distributed *G. macrorhynchus* in the summer season. So I consider that all the *Globicephala* appeared in the statistics is represented by *G. macrorhynchus*.

As the northern extension of Tsushima current is faint in the north western and northern coast of Hokkaido, there will be expected no migration of *G. macrorhynchus*. Though the water in the eastern part of northern coast of Hokkaido is high in the summer season (Uda and Nasu, 1956), it is restricted to a small locality and will not result in the migration of *G. macrorhynchus*.

From the above discussions it is supposed that G. *melaena* found on the Rebun Island must have been caught in the seasons from late autumn to winter.

Though at present there is no data to have a discussion on the present status of population or on the migration of *G. melaena* in the North Pacific. There can be two possible hypotheses on that problem. The first is to consider that *G. melaena* is extinct in the Okhotsk and in the Sea of Japan. Judging from the carvings excavated at Sakhalin and at Nemuro in eastern Hokkaido (Tsuboi, 1908 and 1909; Yahata, 1943), it is sure that the natives of the Okhotsk coast including the people on the Rebun Island of that date had the techniques to catch even some mysticeti. However, as they seems to have used only hand harpoon and small canoe for the whaling, it is difficult to consider that the *G. melaena* population was exterminated only by the whaling of that date. If the population have been exterminated, we should expect the interspecific competition between *G. melaena* and other organisms. One of the possible competitative mammal species other than man seems to be *Phocoenoides dalli* (True, 1885). On this hypothesis, a possibly small population of *G. melaena* which might have immigrated to the North Pacific is considered to have failed in establishing its niche obstacled by the dominant population of *Phocoenoides*. On the date and the route of the immigration of *G. melaena*, there can be two possibilities. The first is, as suggested by Davies (1962), through the eastern equatorial Pacific in the Würm glacier stage. The second is from the North Atlantic through the Arctic Ocean in more recent age. The vegetation detected by the pollen analysis and the Alpine timberline show that the climate of all the northern hemisphere was warmer in the age between 8,000 B.P. and 2,000 B.P. (Atlantic and Sub-boreal periods) than the present (Deevey and Flint, 1957), and the air temperature at Oslo was suggested to have been higher by 3°–4°C (Tsukada, 1974). The similar result was obtained by Emilliani (1964) by the oxigen isotopic analysis of the Caribbean Sea deposit. Though the exact change of water temperature in the Arctic Ocean of that date is not known, above climatic change seems to have provided the passages for *G. melaena* to North Pacific.

The other hypothesis is to consider that *G. melaena* is surviving at least in the western North Pacific and its adjacent seas, and that it lives in the areas and seasons when the Japanese whaling operation or scientific study was not conducted. For this hypothesis the presence of the peak of density of globicephalid species in November in the southern coast of Hokkaido (Kasuya, 1971) will give some suggestion. As *Orcinus* is recorded separately in his aerial sighting records and the water is too cold to expect *Pseudorca*, the possible species recorded there can be *Globicephala* especially *G. melaena*. According to the personal communication of Mr. K. Sasaki, who is one of the fishermen operating the *Phocoenoides* hunting in January to March in the coast of Iwate and Miyagi prefectures (Pacific coast, 38°N to 40°N in latitude), they sometimes find *Globicephala* while they are operating *Phocoenoides* hunting. The surface water temperature at those positions is told to be 7°C to 8°C. As *Phocoenoides* is mostly found in the water colder than 16°C and above this temperature all of my sightings of *Globicephala* and other temperate or tropical species (e.g. *Pseudorca*, *Tursiops*, and *Stenella*) have occurred (Kasuya, umpublished, Miyazaki *et al*, 1974), the sighting of *Globicephala* mensioned in the above can represent *G. melaena*. But this problem is left to be confirmed. Though the information on the globicephalid founa on the Russian coast is desirable, there seems to be no reliable study (Dr. Yablokov, pers. comm.).

Though it is not the purpose of this study to have a discussion on the Japanese common names indicating *Globicephala*, some comments are added here. At first we must remind that Japanese fishermen can use different names for the animals of various growth stages as usually found in some species of fish, and that the name can be modified even by the fishing season. Ui (1942) reported a case that the pilot whale caught at Taiji in the calm season of November and December is called " Nagi [=calm]-gondo ". It is, of course, expected that the fishermen at different places use different common names. However, it will be easily concluded that " Magondo [=common pilot whale] " used by the whalers at Taiji for *Globicephala* caught at Taiji indicate *G. macrorhynchus* which were formerly misidentified as *G. melaena*. The whalers at Taiji have another name " Tappanaga " indicating so-called another *Globicephala* species. According to a former whaler Mr. Mizutani (pers. comm.), " Tappanaga " is rare at Taiji but commonly caught in the summer season in the northern part of the Pacific coast of Japan. He tells that " Tappanaga " has, as the name indicates, longer flipper than that of " Magondo ", and the size of the body of " Tappanaga " is usually larger and the content of oil is fewer. The distinction of the two is told to be difficult. However, as the relative length of flipper of *G. macrorhynchus* can be expected to increase accompanied with the growth of the animal (Sergeant, 1962), the above distinction is not reliable. Furthermore, the fishing season of " Tappanaga " in northern Japan corresponds to the season of *G. macrorhynchus* mentioned above. Accordingly it is concluded that the name " Tappanaga " does not indicate *G. melaena* but may indicate old individual of *G. macrorhynchus*. I have no new information on " Naisa " or " Naisagoto " and on " Shio " or " Shiogoto " which had been considered to be the synonyms of " Magondo " and " Tappanaga " respectively (Ogawa, 1937). But I suppose that they also indicate *G. macrorhynchus* because they were reported to be found near Taiji and the body length and the swelling of the head is larger in " Shio " than " Naisa " (Yamase, 1760), which is considered to be male secondary sexual character..

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EXPLANATION OF PLATES

PLATE I

Fig. 1. *G. melaena*, ventral view of skull found in the alluvial deposit by the Hekuri River at Tateyama (34°59′N, 139°51′E).

Fig. 2. *G. melaena*, lateral view of the same specimen.

Fig. 3. *G. melaena*, dorsal view of the same specimen.

Fig. 4. *G. melaena*, dorsal view of skull (no. 675) found at Motochi archaeological on the west coast of Rebun Island (45°20′N, 141°00′E).

PLATE II

Fig. 1. *G. melaena*, dorsal view of skull (RKA 6054) found at Kabukai archaeological A-site on the east coast of Rebun Island.

Fig. 2. *G. melaena*, dorsal view of skull (RKA 3658) found at Kabukai A-site.

Fig. 3. *G. melaena*, dorsal view of skull (RKA 3987) found at Kabukai A-site.

Fig. 4. *G. macrorhynchus*, dorsal view of skull, caught at Taiji (33°35′N, 135°43′E) in May 1967.

PLATE III

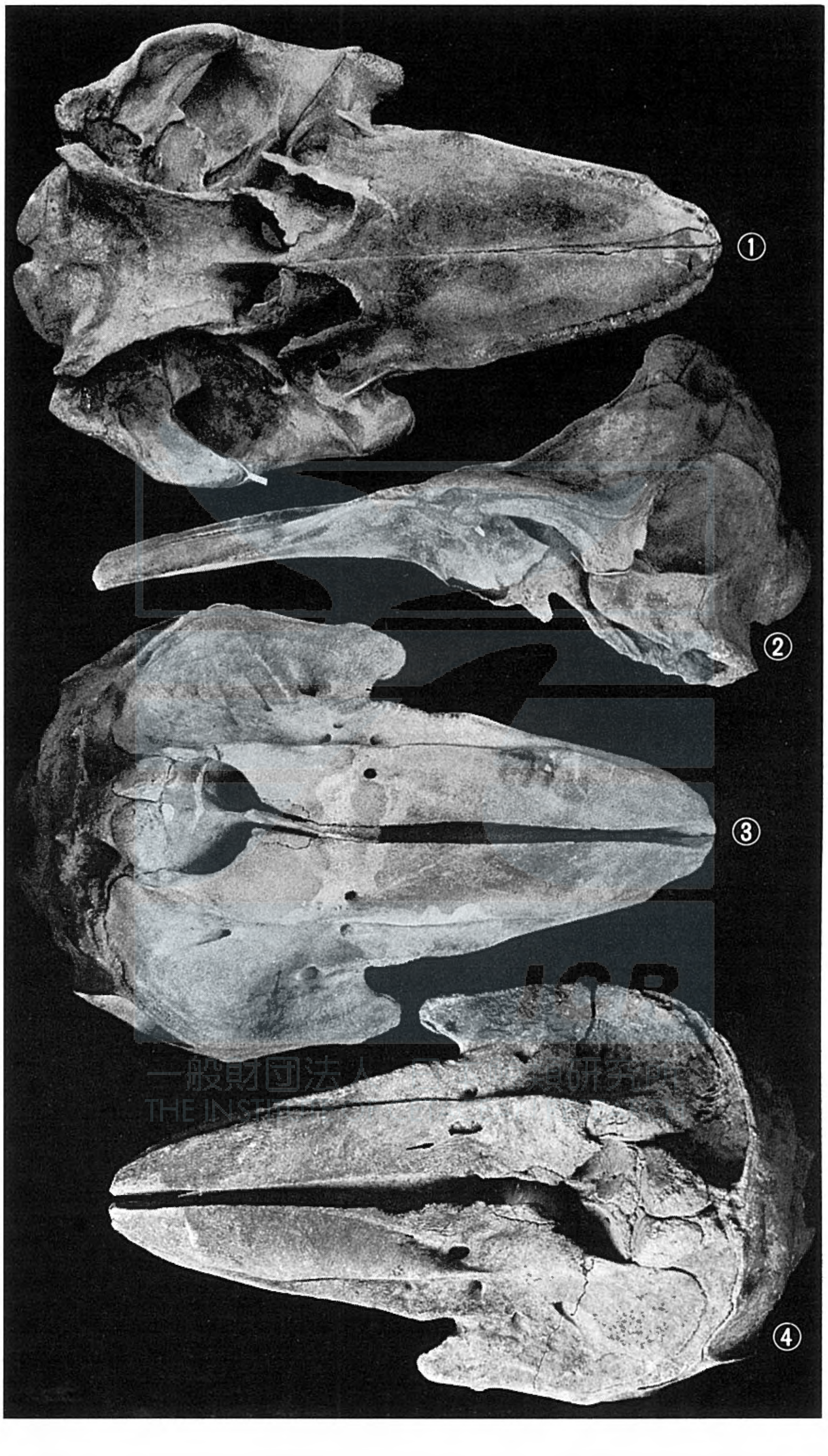
Fig. 1. *G. macrorhynchus*, dorsal view of skull, California coast, USNM 9076 (?).

Fig. 2. *G. macrorhynchus*, ventral view of the same specimen.

Fig. 3. *G. melaena*, dorsal view of skull, Virginia coast, USNM 303018.

Fig. 4. *G. melaena*, ventral view of the same specimen.

Fig. 5. *G. melaena*, dorsal view of skull, Chili, USNM 395365.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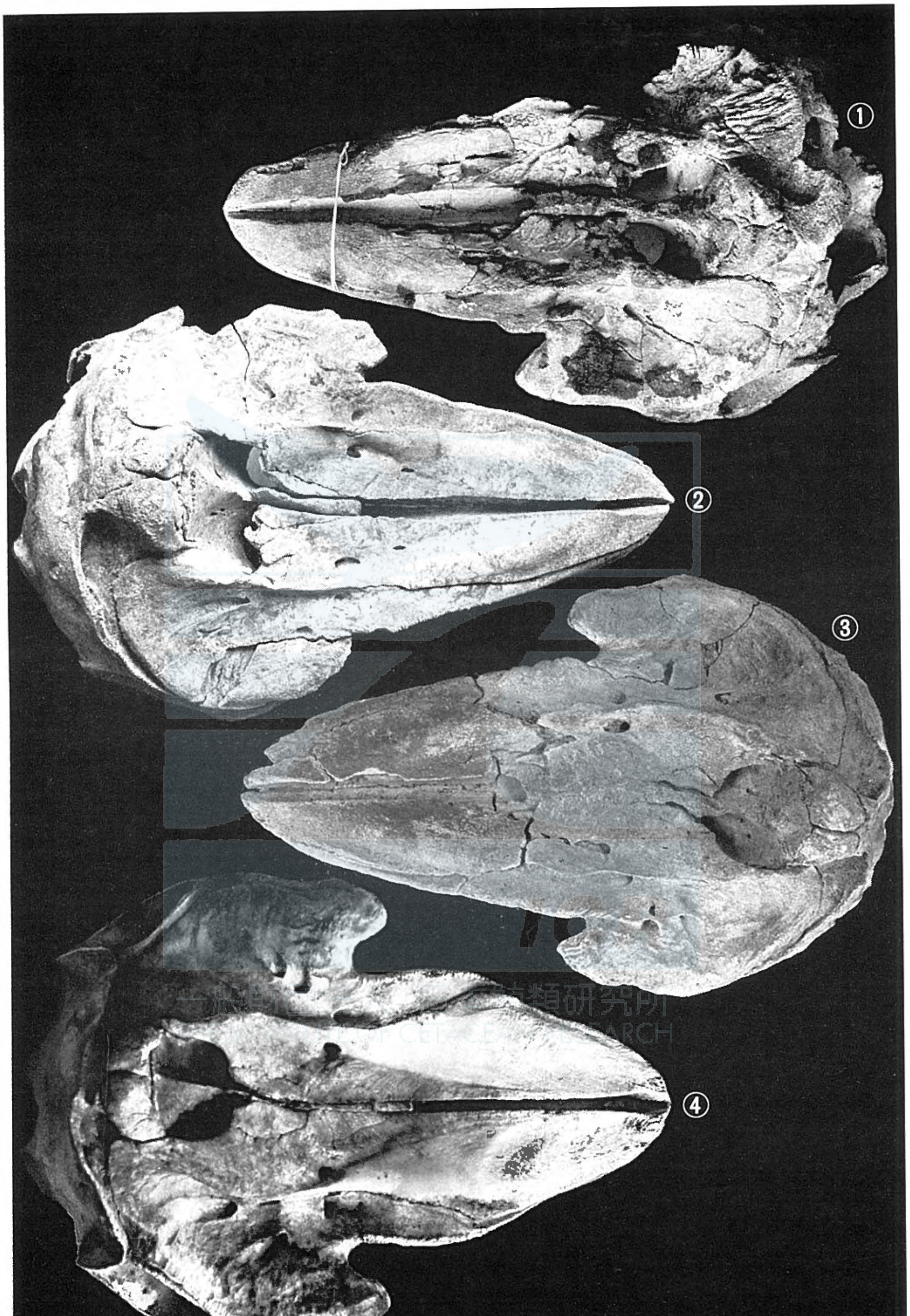
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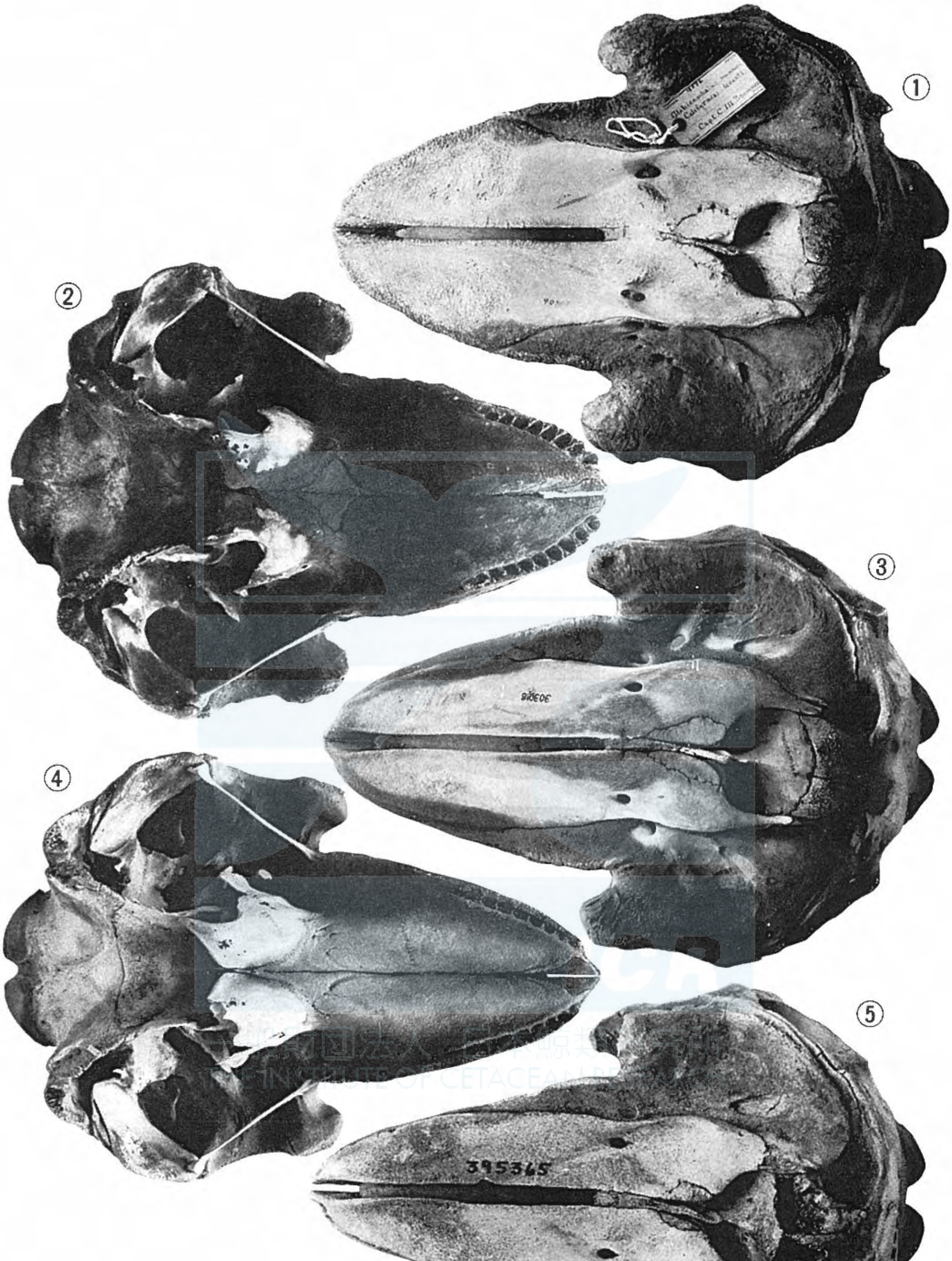
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