A TAXONOMIC STUDY OF THE MINKE WHALE IN THE ANTARCTIC BY MEANS OF HYOID BONE

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ABSTRACT

Hyoid bones of the minke whale in the Antarctic were studied from the standpoint of taxonomy, comparing those in the North Pacific. A distinction was noted in the length and thickness of the stylohyals. Greatest height of the ankylosed bone of basihyal and thyrohyals as well as the height at middle of the right and left wings are greater in the specimens from the Antarctic than in those from the North Pacific. But there is a possibility that this is a difference according to age of the whale. Hence samples from the Antarctic are biased towards older ages and those from the North Pacific towards younger ages, no conclusion was reached in this respect.

INTRODUCTION

The minke whale in the Antarctic, though most closely related to *Balaenoptera acutorostrata*, differs from the latter in having flippers of a uniform pale gray colour instead of showing the characteristic white band of the true minke whale. Furthermore the baleen of *B. acutorostrata* is of a uniform yellowish-white colour whereas the baleen of the minke whale in the Antarctic is white at the front of the series and gray and white at the back (Williamson, 1959, 1961; Utrecht and Spoel, 1962; Kasuya and Ichihara, 1965; Ohsumi *et al.*, 1970).

Williamson (1961) describes that it is uncertain whether they (*B. bonaerensis*) represent a true species, or a subspecies of *B. acutorostrata*, but Utrecht and Spoel (1962) and Ohsumi *et al.* (1970) report that *B. bonaerensis* is a synonym of *B. acutorostrata*, mainly based on studies on the external characteristics.

In this report the hyoid bones of the minke whales in the Antarctic are compared with those of the North Pacific (*B. acutorostrata*) from the taxonomic standpoint, following after the method adopted by Omura (1964).

MATERIAL

In the 1971–72 whaling season Dr. Seiji Ohsumi went to the Antarctic on board Jinyo Maru, a minke whaling expedition. He collected hyoid bones from 25 minke whales and made them at our disposal. These whales were taken in the Antarctic area IV and the sex and body length of each whale are shown in Appendix Table.

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MEASUREMENTS

After extraction of oil and cleaning measurements of various parts were made. These are compared with those from the North Pacific, cited from Omura (1964). There is rather a wide difference in body length of samples between both hemispheres. Samples from the Antarctic range from 710 cm to 980 cm in length, with an average of 850 cm, whereas those from the North Pacific are from 500 cm to 768 cm and in average 624 cm. Thus samples from the Antarctic are biased towards older ages and those from the North Pacific towards younger ages, which should be born in mind in direct comparison.

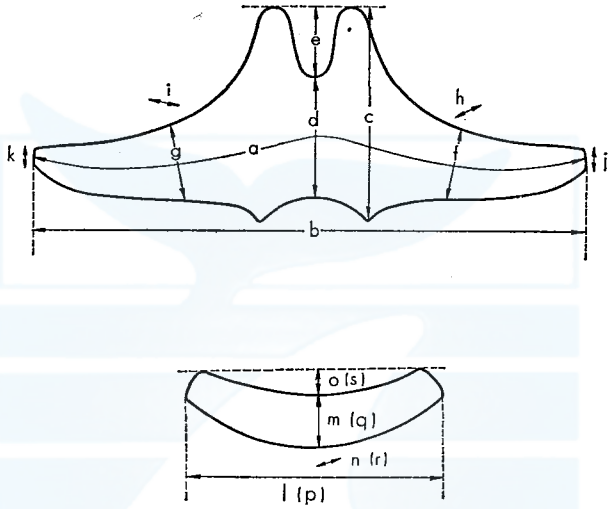

Fig. 1. Showing positions of the measurements.

The following measurements were made on each hyoid bone collected (see Fig. 1).

A. Ankylosed bone of basihyal and thyrohyals.

a. *Overall length.* Curved length measured along the outer surface and passing centers of basihyal and thyrohyals.

b. *Straight length.* Straight length between tips of right and left wings.

c. *Greatest height.* Greatest height between tips of the anterior and posterior projections of the basihyal.

d. *Height at center.* Height measured at the center of the bone.

e. *Forward notch, depth.* Depth of the notch between right and left forward projections of the basihyal.

f. *Height at middle of wing, right.* Height measured at middle between the center of the basihyal and tip of right wing.

g. *Height at middle of wing, left.* Height measured at middle between the center of the basihyal and tip of left wing.

h. *Thickness at middle of wing, right.* Thickness of right thyrohyal on the line of measurement f.

i. *Thickness at middle of wing, left.* Thickness of left thyrohyal on the line of measurement g.

j. *Height at distal end, right.* Height of right thyrohyal at its distal end.

k. *Height at distal end, left.* Height of left thyrohyal at its distal end.

B. Stylohyal.

l. *Total length, right.* Straight length between tips of right stylohyal.

m. *Height at middle, right.* Height at middle of right stylohyal.

n. *Thickness at middle, right.* Thickness of right stylohyal on the line of measurement m.

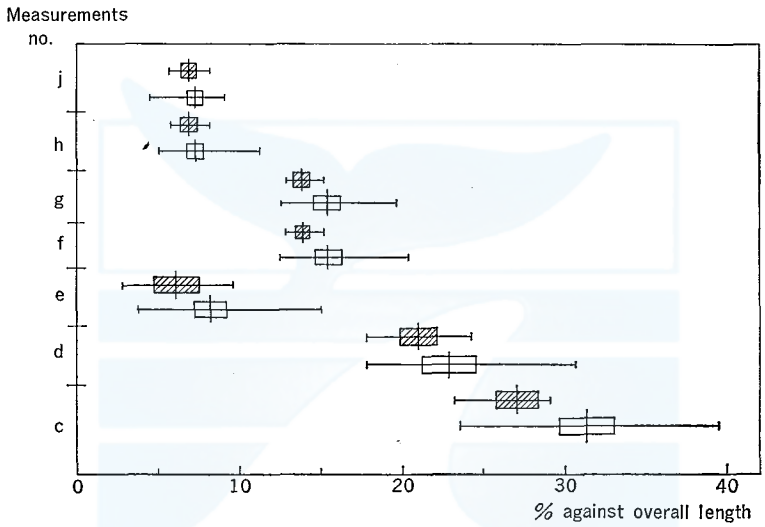

Fig. 2. Measurements of various parts of the ankylosed bone of basihyal and thyrohyals of the minke whale, expressed as percentages against its overall length. For measurements no. see text. Horizontal line indicates ranges of measurements, vertical midline the arithmetic mean, square the 95% confident limits of the mean. Square with hatched lines denotes samples from the minke whale from the North Pacific and white square those from the Antarctic.

o. *Degree of curvature, right.* Greastest distance between the straight line passing the most prominent parts of right stylohyal and its forward surface.

p. *Total length, left.* Straight length between tips of left stylohyal.

q. *Height at middle, left.* Height at middle of left stylohyal.

r. *Thickness at middle, left.* Thickness of left stylohyal on the line of measurement q.

s. *Degree of curvature, left.* Greatest distance between the straight line passing the most prominent parts of left stylohyal and its forward surface.

Results of these measurements are shown in Appendix Table, together with the serial number of the whale, sex, and body length.

These measurements were then calculated of their percentages against overall length in the case of the ankylosed bones of the basihyal and thyrohyals. For the stylohyals also percentages against overall length were calculated for total length, but in other measurements percentages against the length of stylohyals were calculated. Further for each measurement the arithmetic mean, its standard deviation and 95% confident limits of the mean were calculated.

DISCUSSION

The results of the calculations are shown in Figs. 2–4, comparing with those from the North Pacific. As seen in these figures differences are noted between the minke whales from the different oceans in the following measurements:

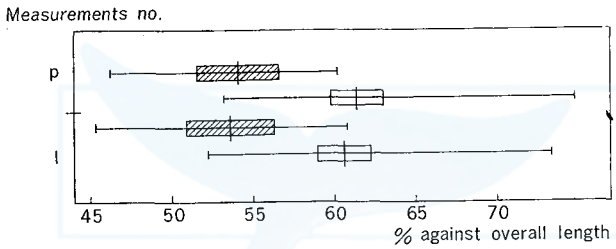

Fig. 3. Measurements of stylohyal of the minke whale, expressed as percentages against the overall length of the ankylosed bone of basihyal and thyrohyals. For explanation see Fig. 2.

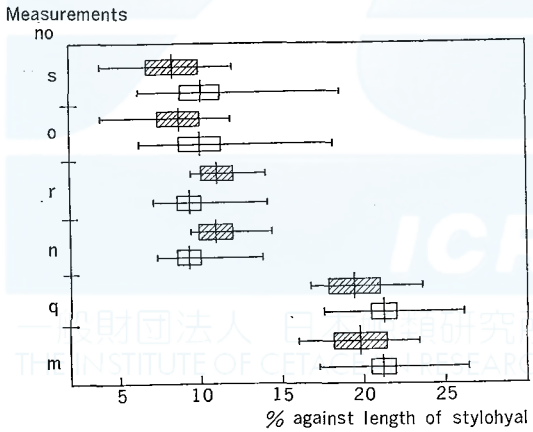

Fig. 4. Measurements of various parts of the stylohyal of the minke whale, expressed as percentages against its total length. For explanation see Fig. 2.

A. Ankylosed bone of basihyal and thyrohyals (Fig. 2).
   c. Greatest height.
   f. Height at middle of wing, right.
   g. Height at middle of wing, left.

B. Stylohyal (Fig. 3, Fig. 4).
   l. Total length, right.
   p. Total length, left.
   n. Thickness at middle, right.
   r. Thickness at middle, left.

In the other measurements 95 % confident limits are overlapping each other and they cannot be said as distinct. In conclusion above the minke whales in the Antarctic have more higher combined bone and larger and thicker stylohyals, hence more massive hyoid bones than those in the North Pacific.

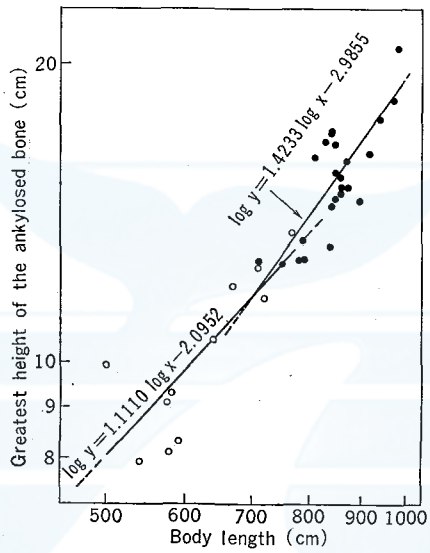

Fig. 5. Relative growth of the greatest height of the ankylosed bone of basihyal and thyrohyals and body length of the minke whale. Circles indicate minke whales in the North Pacific and black dots those from the Antarctic.

As already stated average body lengths of the sample whales are widely different between the two oceans. More larger or older whales were sampled from the Antarctic than from the North Pacific. The reason for such discrepancy in body length should be sought in the segregation of the minke whales according to the size or age. Samples from the North Pacific were collected at Ayukawa on the east coast of Japan where sexually mature animals are far less than in the waters of higher latitudes (Omura and Sakiura, 1956). Also in the Antarctic similar segregation by age groups was noted in males (Ohsumi *et al.*, 1970). Consequently there is a possibility that the above noted differences in hyoid bones are in fact due to differences according to age.

In Fig. 5 the greatest heights of the ankylosed bone of basihyal and thyrohyals have been plotted logarithmically against body length of whales. In the figure different symbols were used for the minke whales from both hemispheres. This

figure shows that there are significantly different gradients for regressions of log height of the bone on log length between whales from the different oceans, and the lines of regression intersect at the body length of 709 cm.

In Figs. 6 and 7 relative growth of the height at middle of wing of the combined bones and body length are shown. In these cases two regression lines in

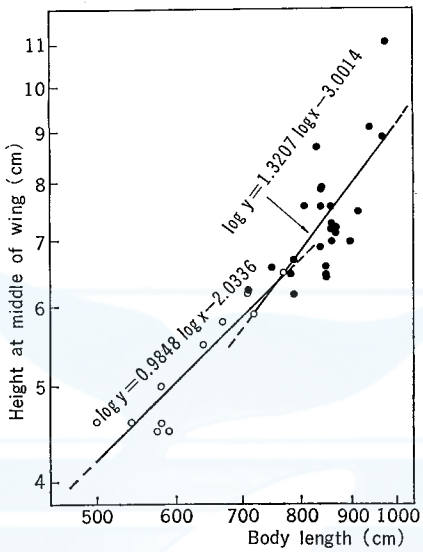

Fig. 6. Relative growth of height at middle of right wing of the ankylosed bone and body length of the minke whale. For symboles see Fig. 5.

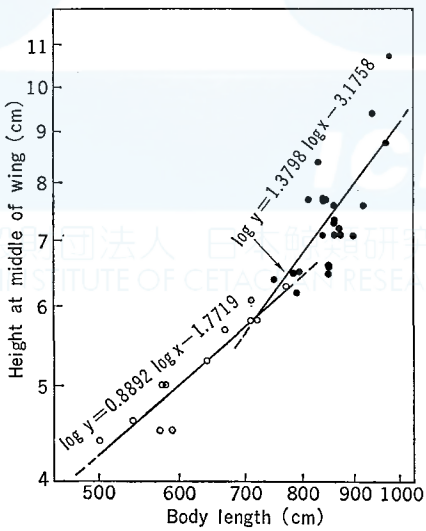

Fig. 7. Relative growth of height at middle of left wing of the ankylosed bone and body length of the minke whale. For symbols see Fig. 5.

each figure intersect at a body length of 761 cm (right side, Fig. 6) and 727 cm (left side, Fig. 7) respectively. Ohsumi *et al.* describe that the sexual maturity of the minke whale in the Antarctic is attained at a body length of 710 cm in male and 790 cm in female. According to Omura and Sakiura (1956) in the minkes on the coast of Japan these lengths at sexual maturity of male and female are 660–690 cm and 720 cm respectively.

One possibility, therefore, is that the antero-posterior growth of the combined bone becomes greater proportionally after the attainment of the sexual maturity. But this cannot be concluded at present due to lack of sufficient materials. More materials, i.e. in the case of the minke whale in the Antarctic samples from immature animals and in that in the North Pacific more samples from mature animals, are needed.

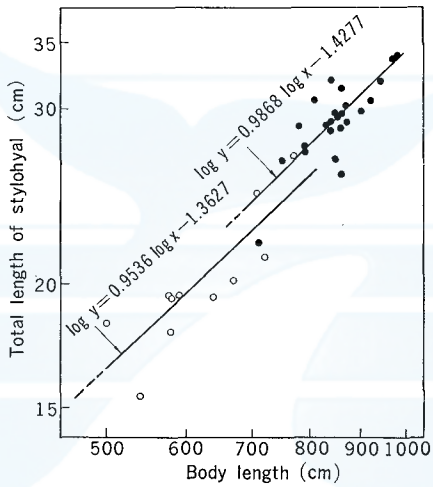

Fig. 8. Relative growth in length of right stylohyal and body length of the minke whale. For symbols see Fig. 5.

In Figs. 8 and 9 relative growth of the stylohyal and body length are shown. As clearly seen in these figures two lines of regression are nearly parallel and we may safely conclude that the minke whale in the Antarctic has more longer stylohyals than the minke in the North Pacific, though there is rather a wide individual variation.

We are not in a position, however, to conclude at present whether the minke whale in the Antarctic, *Balaenoptera bonaerensis*, represent a true species, or a subspecies of *B. acutorostrata*, as stated by Williamson (1961). Further studies especially on the skull and other postcranial bones are needed in order to reach a more definite conclusion.

Omura (1964) made a key to the genera and species of mystacoceti by means of hyoid bone. In the key he separates *B. acutorostrata* from *B. borealis* and *B. edeni* by percentage of the greatest height of the combined bone against its overall length.

The critical proportion is 29 percent and those less than this value was assigned to *B. acutorostrata* and others to *B. borealis* and *B. edeni*. *B. bonaerensis* has more greater value than this and the key should be or should not be revised in this respect, depending upon the final conclusion.

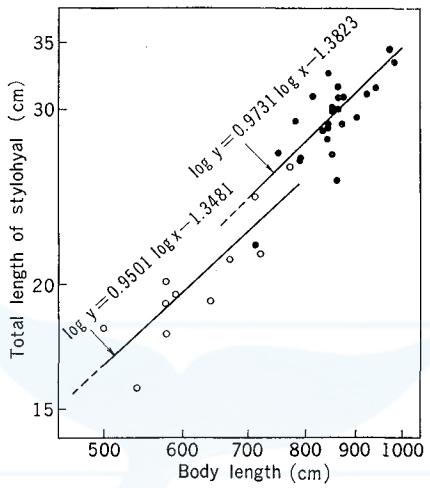

Fig. 9. Relative growth in length of left stylohyal and body length of the minke whale. For symbols see Fig. 5.

ACKNOWLEDGEMENTS

Our sincere thanks are due to Dr. Seiji Ohsumi who collected hyoid bones of the minke whale in the Antarctic for the present study. The crew of Jinyo Maru and the staff of Taiyo Gyogyo K.K. are deeply acknowledged for their cooperation in sampling and also in transportation of the material.

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APPENDIX TABLE. MEASUREMENT OF HYOID BONE OF THE MINKE WHALE IN THE ANTARCTIC.

Serial no.	Body length (m)	Sex	Measurement in mm*																	
			a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s
71J2721	7.1	F	364	334	127	98	21	62	61	30	29	34	34	220	46	23	18	219	45	22	19
71J2692	7.5	F	446	404	125	86	38	66	64	32	30	38	38	266	55	21	25	271	56	20	26
71J0188	7.8	F	459	425	127	88	37	65	65	30	30	43	45	288	54	22	35	292	55	22	35
71J2849	7.9	M	489	452	126	87	40	67	65	32	31	35	35	274	62	20	17	276	63	21	18
71J2685	7.9	F	414	399	132	105	24	62	62	29	30	36	33	271	47	23	30	275	48	23	28
71J2727	8.1	F	478	451	161	106	52	76	77	38	36	48	49	306	62	32	25	311	64	31	25
71J2323	8.3	F	450	420	166	138	23	87	84	42	41	41	41	285	63	34	33	286	65	33	30
71J2324	8.4	M	503	435	131	107	19	76	77	32	31	32	32	289	59	23	33	289	62	24	31
71J0157	8.4	F	466	438	171	96	70	79	77	42	41	34	37	275	61	38	50	280	62	37	52
71J0312	8.4	F	433	405	171	129	35	79	77	35	36	33	31	318	64	30	52	324	60	33	55
71J0459	8.4	F	477	425	143	90	43	69	71	34	34	32	32	285	55	29	27	287	57	30	24
71J0174	8.5	M	522	475	164	111	49	65	66	30	29	30	29	294	61	24	37	298	66	26	36
71J2415	8.5	F	502	462	147	94	52	65	65	38	39	39	41	267	62	24	17	272	63	24	18
71J2793	8.5	M	514	491	155	113	40	66	66	31	32	35	39	294	61	30	41	302	60	30	45
71J2322	8.6	F	427	397	153	123	31	73	73	38	37	37	36	257	59	34	22	256	60	36	21
71J0165	8.6	F	506	460	148	97	46	72	73	31	32	29	30	294	67	23	25	299	70	23	26
71J2373	8.6	M	471	438	124	96	27	70	71	24	26	36	37	286	65	25	23	308	65	25	26
71J2667	8.6	M	507	453	150	99	46	76	76	47	46	41	41	315	69	35	23	316	70	36	25
71J2197	8.7	F	505	460	151	105	43	71	72	34	34	44	41	300	67	29	33	307	68	30	34
71J2228	8.7	F	480	435	159	121	38	73	71	31	31	29	30	290	61	20	18	292	64	21	18
71J0145	9.0	F	503	454	145	106	35	70	71	38	41	37	38	297	62	27	24	296	62	27	23
71J0154	9.2	F	511	479	162	104	49	75	76	32	32	39	41	306	63	24	19	312	62	22	20
71J0276	9.4	F	485	433	176	147	22	91	94	39	40	47	44	318	84	29	23	314	82	27	24
71J0458	9.7	F	556	489	184	130	44	89	88	46	46	51	53	335	69	27	43	346	67	28	47
71J2883	9.8	F	543	493	207	157	48	111	107	40	40	38	40	339	63	27	33	336	64	28	39

* For measurement number see text.

EXPLANATION OF PLATES

All the photographs were taken from the ventral side.

PLATE I

The ankylosed bone of basihyal and thyrohyals of the minke whale from the Antarctic.

Fig. 1. specimen 71J2721
Fig. 2. specimen 71J2692
Fig. 3. specimen 71J0188
Fig. 4. specimen 71J2849
Fig. 5. specimen 71J2685
Fig. 6. specimen 71J2727
Fig. 7. specimen 71J2323
Fig. 8. specimen 71J2324
Fig. 9. specimen 71J0157
Fig. 10. specimen 71J0312
Fig. 11. specimen 71J0459
Fig. 12. specimen 71J0174
Fig. 13. specimen 71J2415
Fig. 14. specimen 71J2793

PLATE II

The ankylosed bone of basihyal and thyrohyals of the minke whale from the Antarctic.

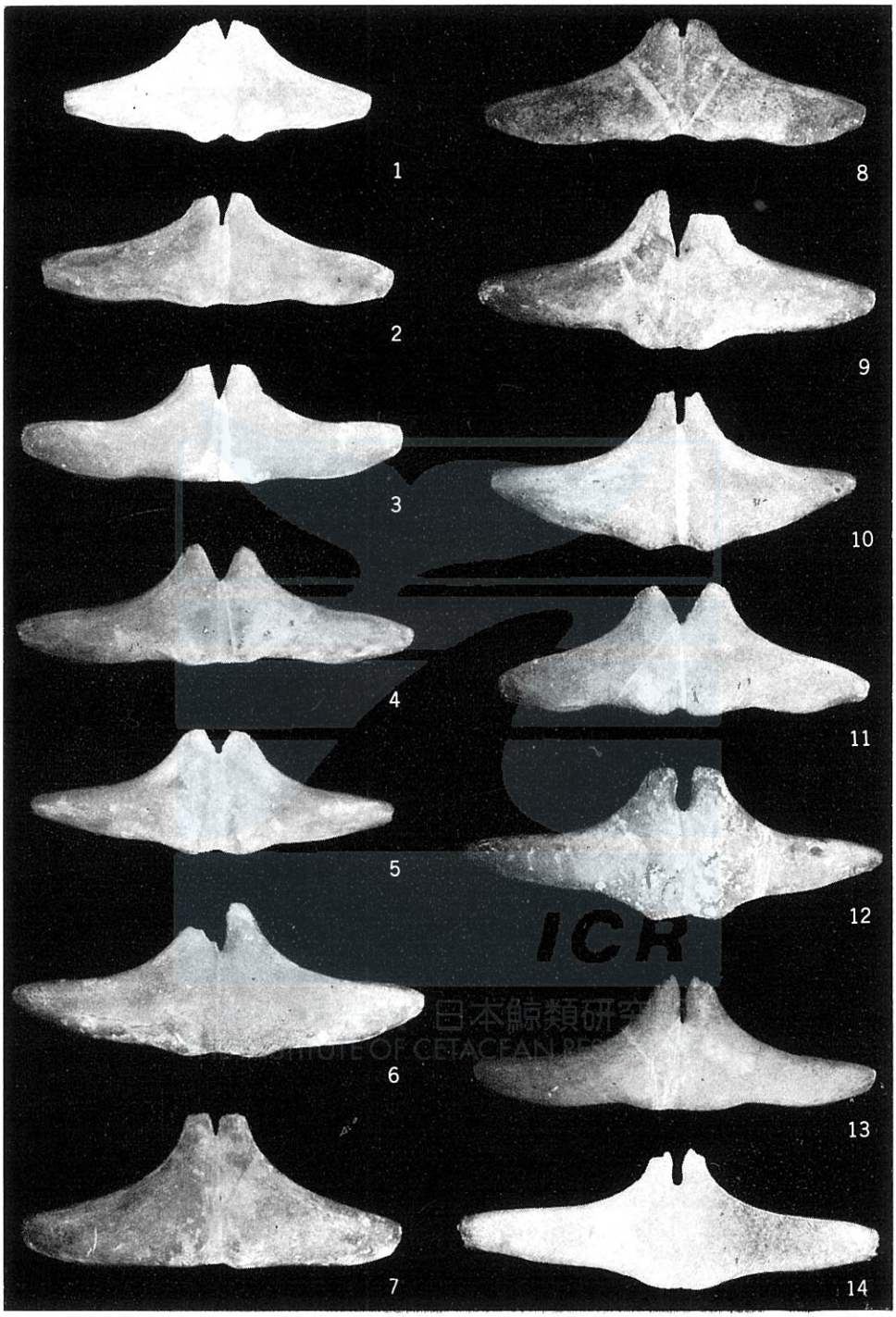
Fig. 15. specimen 71J2322
Fig. 16. specimen 71J0165
Fig. 17. specimen 71J2373
Fig. 18. specimen 71J2667
Fig. 19. specimen 71J2197
Fig. 20. specimen 71J2228
Fig. 21. specimen 71J0145
Fig. 22. specimen 71J0154
Fig. 23. specimen 71J0276
Fig. 24. specimen 71J0458
Fig. 25. specimen 71J2883

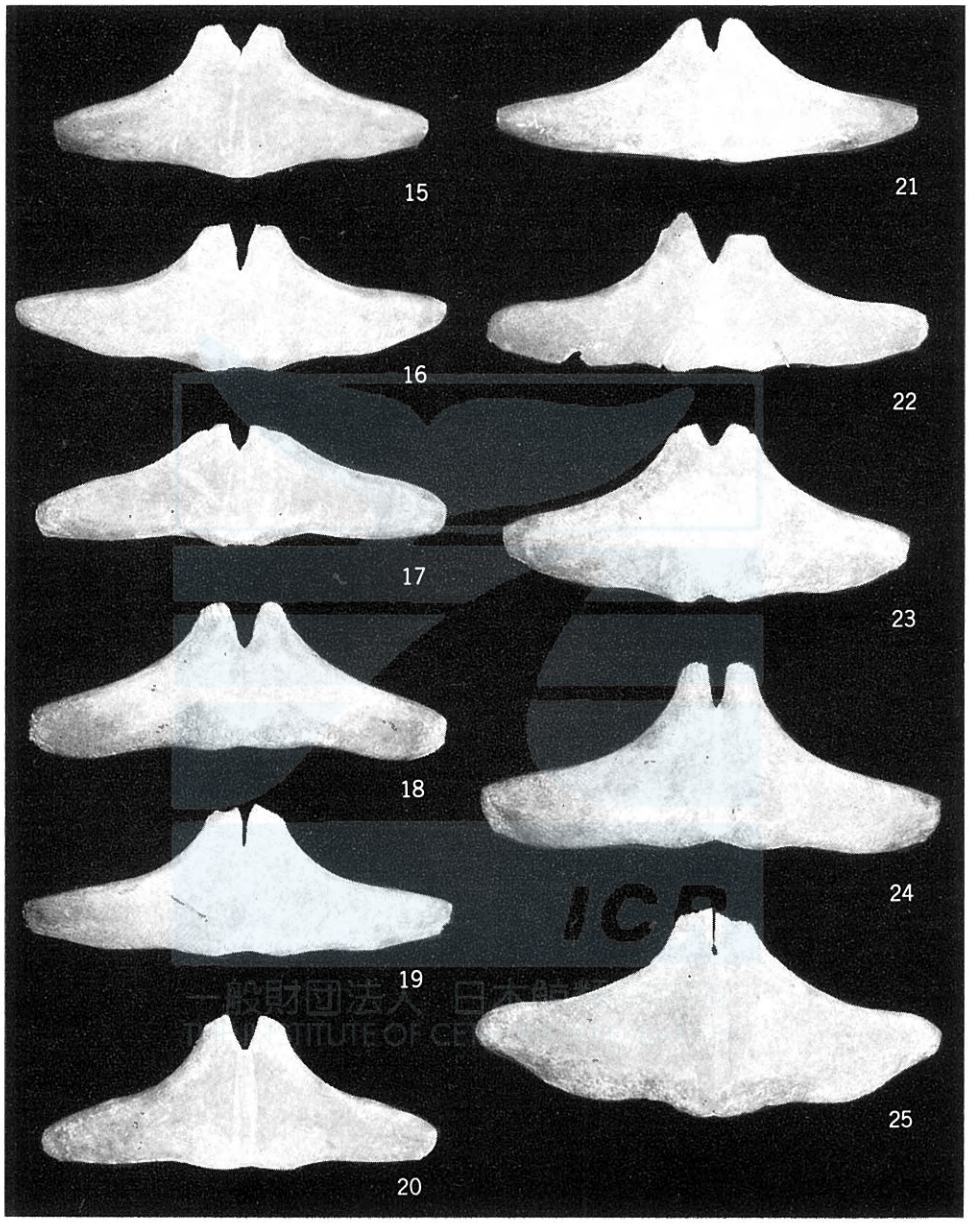
PLATE III

Stylohyals of the minke whale from the Antarctic.
For explanation see PLATE I.

PLATE IV

Stylohyals of the minke whale from the Antarctic.
For explanation see PLATE II.

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