PRELIMINARY REPORT ON MORPHOLOGICAL STUDY OF PELVIC BONES OF THE MINKE WHALE FROM THE ANTARCTIC

HIDEO OMURA

Whales Research Institute, Tokyo

ABSTRACT

In the 1976-77 season a total of 51 pairs of the pelvic bone of the minke whale from the Antarctic has been collected for morphological study. These suggested some doubt on sexual dimorphism of bones, which was affirmed in the North Atlantic population. The size of bones is thought to be smaller than in the North Atlantic. The most interesting point, however, is the presence of ossified remnant of the femur in some specimens. Final conclusion is defered for future, because more samples have been collected in the 1977-78 season and these are still in the course of study.

INTRODUCTION

Pelvic bones of baleen whales are two slender elongated bones embedded in muscle on either side of the genital aperture and nearly parallel to the body axis. In studying skull and postcranial bones of the minke whale from the Antarctic I noticed some morphological difference of pelvic bones between whales from the Antarctic and those from the North Pacific (Omura, 1975). This difference was in the position of the lateral tubercle or promontory, and in the former specimen the tubercle situated towards the middle of the bone, whereas in the latter specimen in more posterior position. In these two specimens bones are nearly straight, but in the third specimen which was examined in the following year pelvic bones are curved inwards and in this specimen the lateral tubercles situated posteriorly (Omura, 1976).

In order to investigate the scope of variation in shape of pelvic bones I have asked Kyodo Hogei Co., a whaling company operating pelagic whaling, to collect pelvic bones from the minke whale in the 1976–77 Antarctic season, from each 10 whales from different areas of operation. Thus a total of 51 pairs of pelvic bones were collected from different five areas and these samples are the basis of this report. Almost all of the samples are from males and samples from femeles have been collected in the 1977–78 season, though they are not included in this study.

Concerning the name of this bone Arvy (1976) feels that it is time to discard the ' pelves ', the ' pelvic bones ', the ' ischia ' and ' ilia ' of the cetacea for the only logical appellation of abdominal bones. But I have still sticked to the traditional name ' pelvic bones ' in this paper.

Sci. Rep. Whales Res. Inst.,
No. 30, 1978, 271-279

MATERIAL

Pelvic bones were collected by *Nisshin Maru No. 3* and *Tonan Maru No. 2* expeditions, by crew of the factory ships during treating of whales, and they were stored in refrigeration chamber, attached with identification tag of the whale. Catch position and other particulars of whales from which pelvic bones were collected are shown in Appendix Table in detail, together with measurements of bones.

As shown in Fig. 1 pelvic benes were collected from five different areas of operation, defined by the International Whaling Commission. Further in each area collections were made within a short period of several days (see Appendix Table) and in small squares shown by hatched lines in Fig. 1. Accordingly it may be assumed that pelvic bones collected from the same square represent the same population of the minke whale, though it is not known yet how many populations of the minke whale exist in the whole Antarctic.

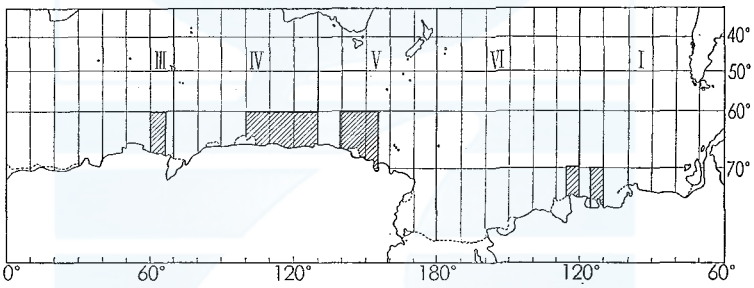

Fig. 1. Chart showing postitions where pelvic bones were collected in the 1976–77 season. Roman numerals denote whaling statistical areas, and hatched small squares in each area show locality where samples were collected.

After arriving our laboratory these bones were boiled for several hours, after each pair was contained in a small bag made of cotton cloth in order to secure remnant of femur, if any. Then each bag was opened and all of the surrounding tissues were removed, and then bones were boiled again. Finally these bones were dried by direct sun.

RESULTS AND DISCUSSION

Heyerdahl jr. (1973) found sexual dimorphism in pelvic bones of the minke whale from the North Atlantic, those of the female having the shape of a knife while those of the male look like drum sticks. Among 51 pairs of pelvic bones collected from the minke whale from the Antarctic only one pair was reported as sampled from a female and all others from male, as seen in Appendix Table. All photographs of these bones are shown in Plates I–V. This female is 76T0193 and 9.0 m in length and the pelvic bones are shown in Pl. III Fig. 10. As seen from this

photograph these bones are short and wide, and lateral promontories are well developed. Both bones are very flat and the ratio of thickness of bones against their width across the promontory are 0.20 and 0.21 respectively. These values are somewhat smaller than those obtained by Heyerdahl jr. (1973), though the general shape resembles to his female specimen.

In other specimens there are rather wide range of variation in the shape of pelvic bones. Some are like drum stick, but some are not. These difference in shape are dependent on the development of the lateral promontory. In the typical ' drum stick ' type no promontory is observed (Pl. I, Figs 4, 8, 10 ; Pl. II, Figs 3, 5, 6 ; Pl. III, Figs 2, 5, 6 ; Pl. IV, Figs 7, 9 ; Pl. V, Figs 8, 10). In the most developed specimen of promontory they are Y-shaped in general (Pl. II, Fig. 2 ; Pl. III, Fig. 4 ; Pl. IV, Fig. 1 ; Pl. V, Fig. 5). In these specimens sexual dimorphism can not be noticed in shape alone.

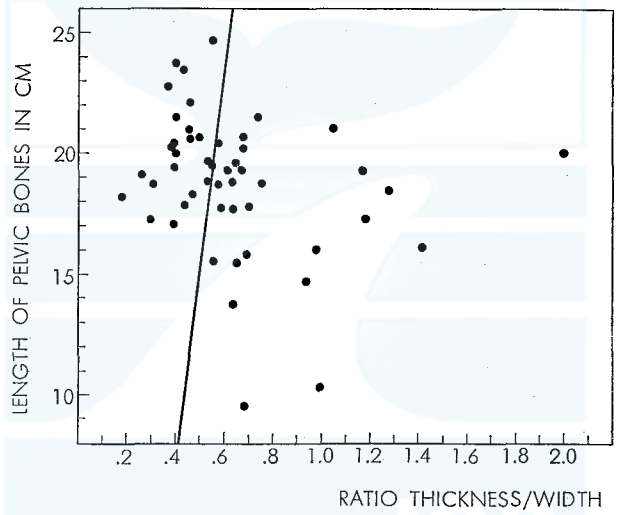

Fig. 2. Relation between lengths of pelvic bones and ratios of thickness/width across the promontory in minke whales from the Antarctic. The straight line in the figure is the regression line obtained by Heyerdahl jr. (1973) for minke whale from the North Atlantic.

As stated already these samples were collected by crew of the factory ships during the course of treatment of whale carcasses. On the flensing deck many carcasses are processed consecutively, and it is rather difficult to identify whale number exactly without special caution. At this moment I can not say any more on this matter and should wait further collection of materials, especially from females.

Among intermediate type of ' drum stick ' and ' Y-shape ' there are also some variations. In Fig. 2 are shown the ratio of thickness/width against their lengths. In this case the average value of measurements within each pair have been used.

The straight line in the figure is the regression line obtained by Heyerdahl jr. (1973) from pelvic bones of the male minke whales from the North Atlantic. His conclusion is that the female bones tend to maintain their proportions while the male bones diverge towards a rounder shape (with growth of the body). In Fig. 2 no such regression line be drawn, because dotts are scattered very widely. I haven't collected pelvic bones from whales shorter than 8 m in length. This is because that in immature animals ossification of bone is not completed and cartilages are remaining towards both ends. In order to simplify the matter I have asked crew of the expeditions to collect bones from animals of 8 m or over in length, because average body length at which sexual maturity is attained is 7.2 m for males and 8.0 m for females (Ohsumi and Masaki, 1975). I haven't measured the degree of ossification of the pelvic bones on the X-ray photographs, and in fact I have noticed while boiling the bones that cartilages are still remaining in some specimens at their extremities, but they are short and do not affect greatly.

In Fig. 3 are shown the relationship between the length of the pelvic bones and length of the whales from which bones were extracted. The straight line shown in the figure is the regression line obtained by Heyerdahl jr. (1973), and

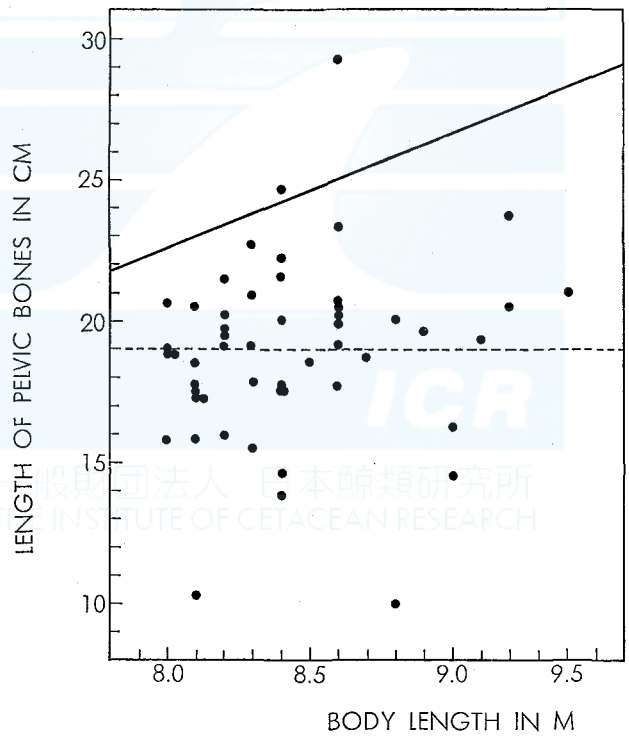

Fig. 3. Relation between lengths of pelvic bones and body lengths in minke whales from the Antarctic. The straight line in the figure is the regression line obtained by Hyerdahl jr. (1973) for minke whale from the North Atlantic and the dotted line 19 cm or minimum length of mature animals in the North Atlantic.

the dotted line was drawn at 19 cm. There is a discrepancy in measuring the length of the bone, because Heyerdahl jr. measured the total length, including those of cartilages, but I have only measured the ossified bones. But this difference in length is not great in the matured animals. Even taking into consideration of this fact it seems that the pelvic bones are shorter in the minke whale in the Antarctic than in the North Atlantic. In the matured minke whales from the North Atlantic pelvic bones are 19 cm or more (Fig. 9 of Heyerdahl jr., 1973), but this does not apply to minke whales from the Antarctic, and they are below the regression line drawn by Heyerdahl jr., with only two exceptions.

The most interesting point in this study is the presence of the remnants of femur in 13 specimens or 25% of the total animals investigated. These are ossified small bones and they are generally like candies or bulbs in shape. Measurements of these bones are also shown in Appendix Table. Burmeister (1867) described the pelvis of his specimen of *Balaenoptera bonaerensis* ' No vestige of an attachment of another bone to any part of its surface is visible ; and it is the same with the European species, according to the observation of Eschricht and Reinhardt '. The existence of the femur in the minke whale had long been denied by other authors too (e.g. Hosokawa 1951), but Heyerdahl jr. (1973) discovered a nodule of cartilage anterior and lateral to the promontory in one of the 32 X-ray photographs. This specimen is from a 25-foot (7.5 m) female, possibly an immature whale judged from Fig. 4 of his paper.

TABLE 1. PRESENCE OF FEMUR IN THE PELVIC BONE OF THE MINKE WHALE FROM THE ANTARCTIC

Area	III	IV	V	VI	I	Total
Total number collected	11	10	10	10	10	51
in which femur attached	6	2	2	2	1	13
% femur attached	55	20	20	20	10	25

In the present samples the occurrence of the femur is biassed according to areas where they were sampled, as shown in Table 1. From this table it is suggested that there is difference in occurrence of the femur bone according to different populations, those in the area III showing big value than others. But I hesitate to draw any conclusion at this moment on this and other problems. Also in the 1977–78 season a number of pelvic bones of the minke whale has been collected, mostly from females, but they arrived the laboratory quite recently and now in the course of preparation for study.

ACKNOWLEDGMENTS

Sincere thanks are due to the crew of *Nisshin Maru No. 3* and *Tonan Maru No. 2*, who collected samples of the pelvic bone with much care and trouble.

REFERENCES

ARVY, L., 1976. Some critical remarks on the subject of the cetacean ' Girdles '. *In*: G. Pilleri (ed.) *Investigations on cetacea* VII: 179–186.

BURMEISTER, H., 1867. Preliminary description of a new finner whale (*Balaenoptera bonaerensis*). *Proc. Zool. Soc. Lond.*, XLVI: 707–713.

HEYERDAHL JR., T., 1973. Sexual dimorphism and age criteria in the pelvic bones of the minke whale *Balaenoptera acutorostrata* Lacépède. *Norwegian J. Zoology*, 21 (1): 39–43.

HOSOKAWA, H., 1951. On the pelvic cartilages of the Balaenoptera-foetuses, with remarks on the specifical and sexual difference. *Sci. Rep. Whales Res. Inst.*, 5: 5–11.

OHSUMI, S. and Y. MASAKI, 1975. Biological parameters of the Antarctic minke whale at the virginal population level. *J. Fish. Res. Board Can.*, 32: 995–1004.

OMURA, H., 1975. Osteological study of the minke whale from the Antarctic. *Sci. Rep. Whales Res. Inst.*, 27: 1–36.

OMURA, H., 1976. Additional information on skeleton of the minke whale from the Antarctic. *Sci. Rep. Whales Res. Inst.*, 28: 57–68.

APPENDIX TABLE. CATCH PARTICULARS OF THE MINKE WHALE FROM WHICH PELVIC BONES WERE SAMPLED AND MEASUREMENTS OF BONES (1976–77 SEASON)

Whale no.	Date of catch	Sex	Body length m	Position of catch		Area	Measurements in mm							
							One side				Another side			
				Lat.	Long.		Length	Width*	Thick-ness*	Femur**	Length	Width*	Thick-ness*	Femur**
76N0026	18 Nov. '76	♂	8.2	61°-56′S	106°-21′E	IV	202	27	19	none	202	27	19	none
76N0027	,, ,, ,,	,,	8.1	,, ,, S	,, ,, E	,,	172	46	13	41, 18, 19	173	43	41	41, 18, 17
76N0029	19 ,, ,,	,,	8.6	61°-43′S	110°-07′E	,,	193	37	21	none	202	43	21	none
76N0075	,, ,, ,,	,,	8.6	,, ,, S	,, ,, E	,,	290	21	29	none	296	23	22	none
76N0119	21 ,, ,,	,,	8.4	62°-43′S	115°-56′E	,,	221	40	17	none	222	35	17	none
76N0378	25 ,, ,,	,,	8.6	64°-01′S	125°-53′E	,,	199	42	17	none	205	43	16	none
76N0390	26 ,, ,,	,,	8.4	63°-59′S	122°-39′E	,,	199	47	19	none	201	43	17	none
76N0391	,, ,, ,,	,,	8.8	,, ,, S	,, ,, E	,,	194	13	27	none	205	15	29	none
76N0692	30 ,, ,,	,,	8.6	64°-19′S	126°-11′E	,,	206	53	20	24, 18, 13	202	53	21	missed?
76N0727	2 Dec. ,,	,,	9.0	64°-09′S	127°-29′E	,,	161	24	30	none	162	21	33	none
76N0974	8 Feb. '77	,,	8.2	66°-44′S	61°-17′E	III	156	25	28	none	163	24	20	none
76N0980	,, ,, ,,	,,	8.4	,, ,, S	,, ,, E	,,	166	45	18	32, 22, 18	184	52	20	34, 23, 19
76N0983	,, ,, ,,	,,	8.8	,, ,, S	,, ,, E	,,	104	20	13	none	94	19	13	none
76N0984	,, ,, ,,	,,	8.1	,, ,, S	,, ,, E	,,	174	28	36	none	172	29	31	none
76N0987	,, ,, ,,	,,	8.0	,, ,, S	,, ,, E	,,	163	27	18	none	153	24	17	none
76N0988	,, ,, ,,	,,	8.1	,, ,, S	,, ,, E	,,	158	25	14	none	150	24	17	none
76N0993	,, ,, ,,	,,	8.4	,, ,, S	,, ,, E	,,	256	37	20	34, 22, 22	236	35	20	53, 22, 20
76N1424	13 ,, ,,	,,	8.4	66°-55′S	62°-05′E	,,	143	39	28	21, 19, 14	132	36	20	22, 21, 15
76N1425	,, ,, ,,	,,	8.6	,, ,, S	,, ,, E	,,	170	36	22	34, 22, 19	185	33	19	35, 23, 18
76N1427	,, ,, ,,	,,	8.3	,, ,, S	,, ,, E	,,	232	38	15	26, 16, 12	222	41	14	34, 18, 17
76N1433	,, ,, ,,	,,	8.6	,, ,, S	,, ,, E	,,	206	50	23	33, 22, 19	209	52	24	32, 24, 18
76T0025	15 Nov. '76	,,	9.1	63°-19′S	153°-04′E	V	196	28	20	none	190	33	21	none
76T0081	16 ,, ,,	,,	8.2	63°-26′S	151°-17′E	,,	194	30	18	none	189	29	18	none
76T0082	,, ,, ,,	,,	8.4	,, ,, S	,, ,, E	,,	196	40	15	29, 20, 18	236	38	16	26, 22, 17
76T0083	,, ,, ,,	,,	8.7	,, ,, S	,, ,, E	,,	187	62	20	46, 29, 26	187	64	20	45, 29, 26
76T0128	17 ,, ,,	,,	9.4	63°-47′S	148°-47′E	,,	212	30	28	none	207	25	29	none
76T0193	18 ,, ,,	♀	9.0	64°-06′S	147°-01′E	,,	145	56	12	none	145	60	12	none
76T0221	19 ,, ,,	♂	8.4	64°-13′S	141°-48′E	,,	153	23	22	none	140	21	19	none

Continued . . .

APPENDIX TABLE. Continued.

Whale no.	Date of catch	Sex	Body length m	Position of catch		Area	Measurements in mm							
							One side				Another side			
				Lat.	Long.		Length	Width*	Thick-ness*	Femur**	Length	Width*	Thick-ness*	Femur**
76T0222	19 Nov. '76	♂	9.2	64°-13′S	141°-48′E	V	236	40	16	none	238	43	17	none
76T0299	21 ,, ,,	,,	8.2	64°-27′S	139°-26′E	,,	213	35	22	none	217	27	23	none
76T0300	,, ,, ,,	,,	8.5	,, ,, S	,, ,, E	,,	190	24	34	none	180	28	32	none
76T0766	16 Feb. '77	,,	8.6	70°-20′S	114°-21′W	I	189	54	15	none	193	53	15	none
76T0767	,, ,, ,,	,,	8.1	,, ,, S	,, ,, W	,,	127	37	30	none	80	27	32	none
76T0774	,, ,, ,,	,,	8.2	,, ,, S	,, ,, W	,,	199	46	18	none	190	45	18	none
76T0819	17 ,, ,,	,,	8.1	70°-18′S	115°-31′W	,,	172	37	18	none	173	38	17	none
76T0827	,, ,, ,,	,,	8.4	,, ,, S	,, ,, W	,,	181	31	14	none	174	33	14	none
76T0863	,, ,, ,,	,,	8.1	,, ,, S	,, ,, W	,,	181	33	21	none	189	40	21	none
76T0871	18 ,, ,,	,,	8.3	71°-01′S	114°-57′W	,,	201	37	18	none	217	36	15	none
76T0907	19 ,, ,,	,,	8.3	70°-54′S	112°-12′W	,,	190	35	27	none	166	42	26	none
76T0908	,, ,, ,,	,,	8.0	,, ,, S	,, ,, W	,,	190	25	15	none	186	23	15	none
76T0914	,, ,, ,,	,,	8.0	,, ,, S	,, ,, W	,,	189	25	20	missed?	186	28	20	18, 11, 9
76T1094	23 ,, ,,	,,	8.0	70°-45′S	121°-21′W	VI	186	41	19	19, 13, 13	190	35	21	19, 11, 10
76T1106	23 Feb. '77	,,	8.3	70°-45′S	121°-21′W	VI	149	29	19	none	161	36	16	none
76T1129	,, ,, ,,	,,	8.2	,, ,, S	,, ,, W	,,	198	34	17	none	193	30	18	none
76T1130	,, ,, ,,	,,	9.2	,, ,, S	,, ,, W	,,	206	40	21	49, 32, 22	203	39	24	50, 37, 24
76T1139	24 ,, ,,	,,	8.3	70°-44′S	124°-36′W	,,	188	68	18	none	194	70	18	none
76T1164	,, ,, ,,	,,	8.9	,, ,, S	,, ,, W	,,	194	34	21	none	199	34	22	none
76T1165	,, ,, ,,	,,	8.5	,, ,, S	,, ,, W	,,	235	38	19	none	231	43	16	none
76T1171	,, ,, ,,	,,	8.1	,, ,, S	,, ,, W	,,	202	32	20	none	209	31	23	none
76T1172	,, ,, ,,	,,	8.0	,, ,, S	,, ,, W	,,	207	33	17	none	205	37	17	none
76T1177	,, ,, ,,	,,	8.1	,, ,, S	,, ,, W	,,	175	31	15	none	180	27	21	none

* Measured across promontory.

** Three dimentions.

EXPLANATION OF PLATES

PLATE I

Pelvic bones of the minke whale collected in area IV.

Fig. 1.	76N0026	Fig. 6.	76N0378
Fig. 2.	76N0027	Fig. 7.	76N0390
Fig. 3.	76N0029	Fig. 8.	76N0391
Fig. 4.	76N0075	Fig. 9.	76N0692
Fig. 5.	76N0119	Fig. 10.	76N0727

PLATE II

Pelvic bones of the minke whale collected in area III.

Fig. 1.	76N0974	Fig. 7.	76N0993
Fig. 2.	76N0980	Fig. 8.	76N1424
Fig. 3.	76N0983	Fig. 9.	76N1425
Fig. 4.	76N0984	Fig. 10.	76N1427
Fig. 5.	76N0987	Fig. 11.	76N1433
Fig. 6.	76N0988		

PLATE III

Pelvic bones of the minke whale collected in area V.

Fig. 1.	76T0025	Fig. 6.	76T0221
Fig. 2.	76T0081	Fig. 7.	76T0222
Fig. 3.	76T0082	Fig. 8.	76T0299
Fig. 4.	76T0083	Fig. 9.	76T0300
Fig. 5.	76T0128	Fig. 10.	76T0193

PLATE IV

Pelvic bones of the minke whale collected in area I.

Fig. 1.	76T0766	Fig. 6.	76T0863
Fig. 2.	76T0767	Fig. 7.	76T0871
Fig. 3.	76T0774	Fig. 8.	76T0907
Fig. 4.	76T0819	Fig. 9.	76T0908
Fig. 5.	76T0827	Fig. 10.	76T0914

PLATE V

Pelvic bones of the minke whale collected in area VI.

Fig. 1.	76T1094	Fig. 6.	76T1164
Fig. 2.	76T1106	Fig. 7.	76T1165
Fig. 3.	76T1129	Fig. 8.	76T1171
Fig. 4.	76T1130	Fig. 9.	76T1172
Fig. 5.	76T1139	Fig. 10.	76T1177