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

YUKO SATAKE AND HIDEO OMURA

Whales Research Institute, Tokyo

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.

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.

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.

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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.** Greatest 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).
   a. Greatest height.
   f. Height at middle of wing, right.
   g. Height at middle of wing, left.

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B. Stylohyal (Fig. 3, Fig. 4).
   1. Total length, right.
   2. Total length, left.
   3. Thickness at middle, right.
   4. 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.

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 Sakura, 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

**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.
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
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.

![Graph showing relative growth in length of right stylohyal and body length of the minke whale.](image)

**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.

![Graph](image)

**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.

**REFERENCES**


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

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* For measurement number see text.

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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.