

SOME BIOLOGICAL PARAMETERS FOR STOCK ASSESSMENT OF THE ANTARCTIC SEI WHALE

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INTRODUCTION

The industrial significance of sei whales in the Antarctic has grown considerably in recent years and at the same time whale resource control is emerging as an important problem. However, the knowledge concerning biological parameters which are fundamental to stock assessment is still very limited, so that the knowledge related to age characteristics is practically little.

One biological report on the sei whales in the Southern Hemisphere has been presented by Matthews (1938). He reported on the external characters, food, blubber, parasites, reproduction, growth and migration observed from the 220 whales caught in South Georgia and South Africa.

There has been other reports also by Bannister and Gambell (1965) and by Gambell (1968) on abundance, seasonal cycle and reproduction, but the data for these have been obtained from Antarctic Area II, excluding South Africa.

In this report, specimen obtained by the Japanese expeditions from Area II to IV were used. Examination was made on, sex ratio, size composition, length at sexual maturity, sexual maturity rate, pregnancy rate, number of corpora lutea and, lamination of ear plug and length at recruitment. It is especially importance that the relationship of race between sei whales found in Area V, the Tasman Sea and the eastern waters off New Zealand, and those found in other Areas should be understood, and that operations in that Area by the Japanese expeditions only started in the 1967/68 season.

MATERIAL

Data used were obtained by the Japanese expeditions in the Antarctic whaling seasons in 1963/64, 1964/65, 1967/68, and 1968/69. In Table 1 N indicates northern area of 50°S and S does southern one of 50°S.

SURFACE OCEANOGRAPHIC CONDITION IN RELATION TO THE DISTRIBUTION OF SEI WHALES CAUGHT

Fig. 1 indicates the number of sei whales caught in the area of every 5 degree of longitude and latitude by the Japanese expeditions in the whaling season extending from 1963/64 to 1968/69.

Fig. 2 and 3 indicate the number of whales caught in the area of every degree of latitude and longitude in Areas II, part of V and VI; and the distribution of surface temperature obtained by the Japanese expeditions. The main whaling ground in the low latitude of Area IIW consists of a warm water mass which is

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considered to be an extension of the Brazil Current. If the Antarctic Convergence is considered to be at surface temperature of 4.5°C , the favourable ground for sei whales in Area II W is located in the north of the Antarctic Convergence.

According to Fig. 3 heavy catch area in the eastern waters of Tasman Sea is adjacent to the surface temperature of 15°C , but in the western waters it is adjacent to the 12°C , which is equivalent to the north of Subtropical Convergence. In Area VI, favourable ground is located in the region of the surface temperature of $8^{\circ}\text{--}10^{\circ}\text{C}$.

In this area warm water mass generally extends southwards and the latitudinal position of the Antarctic Convergence extends toward the south as in Area I and II. These are features particular to the oceanographic environment of Area VI.

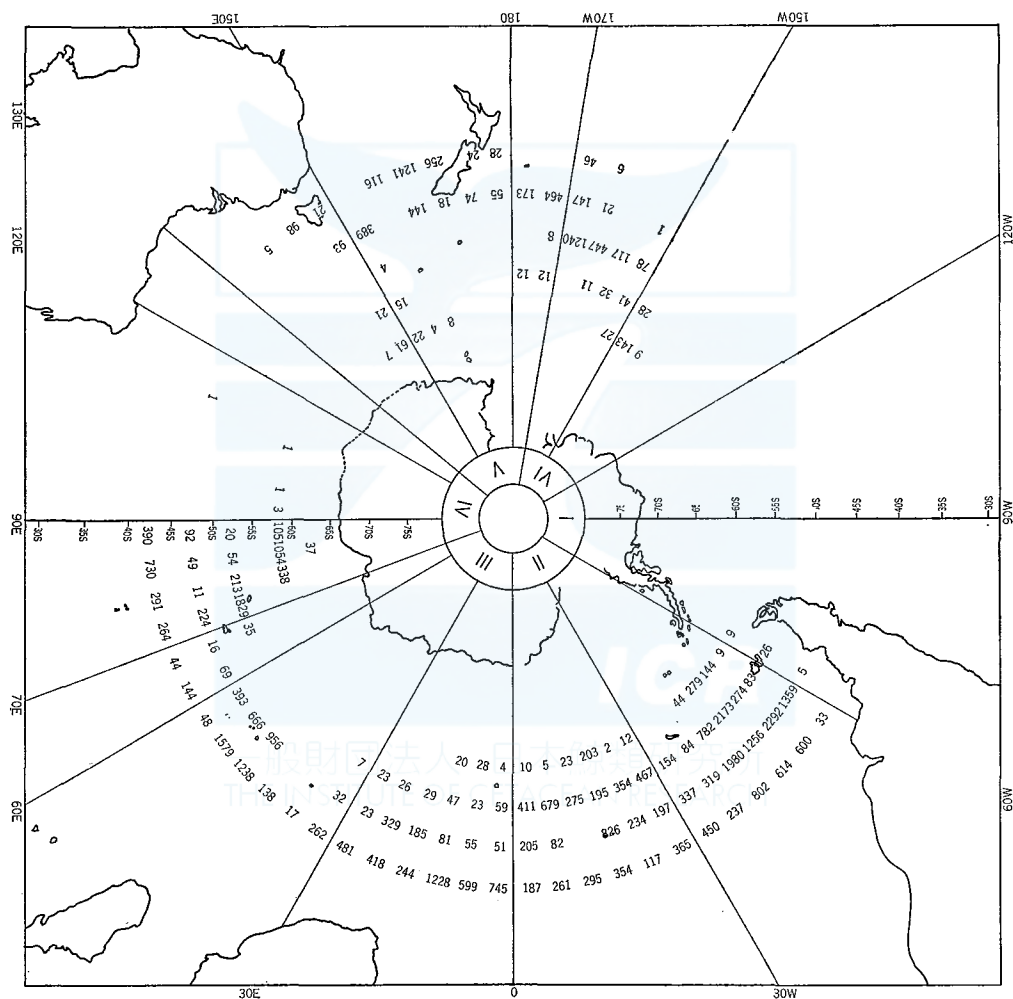


Fig. 1. Number of sei whales caught in the area of every 5 degree of longitude and latitude by the Japanese expeditions in the Antarctic whaling seasons from 1963/64 to 1968/69.

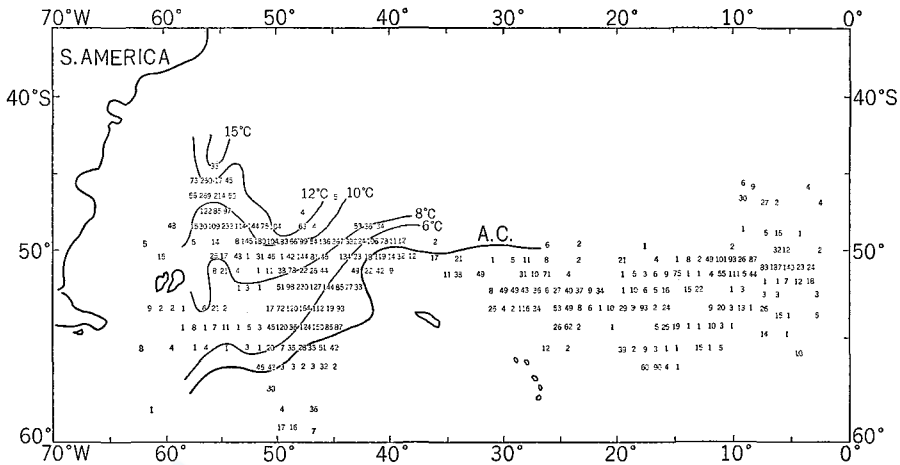


Fig. 2. The distribution of sei whales caught by Japanese expeditions in the Antarctic season 1962/63 to 1964/65 and the surface temperature.

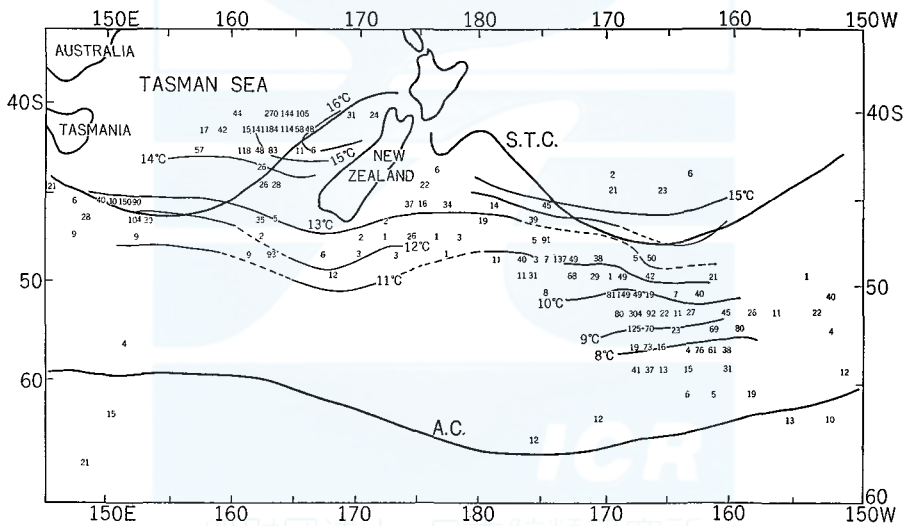


Fig. 3. The distribution of sei whales caught by the Japanese expeditions in the Antarctic season 1967/68 to 1968/69 and the surface temperature.

SEX RATIO

Table 1 shows the male sex ratio by Area, north and south of 50°S. No particular difference by Area can be observed but some differences can be noticed in the south and north of 50°S. It indicates that in the region excluded Areas II W and V male whales are seen in greater numbers in the high latitude sea region of 50°S. The average value for the total Area extending from Area II W to VI is 55.5% in the north and 57.7% in the south with difference of 2.2%. The male foetus

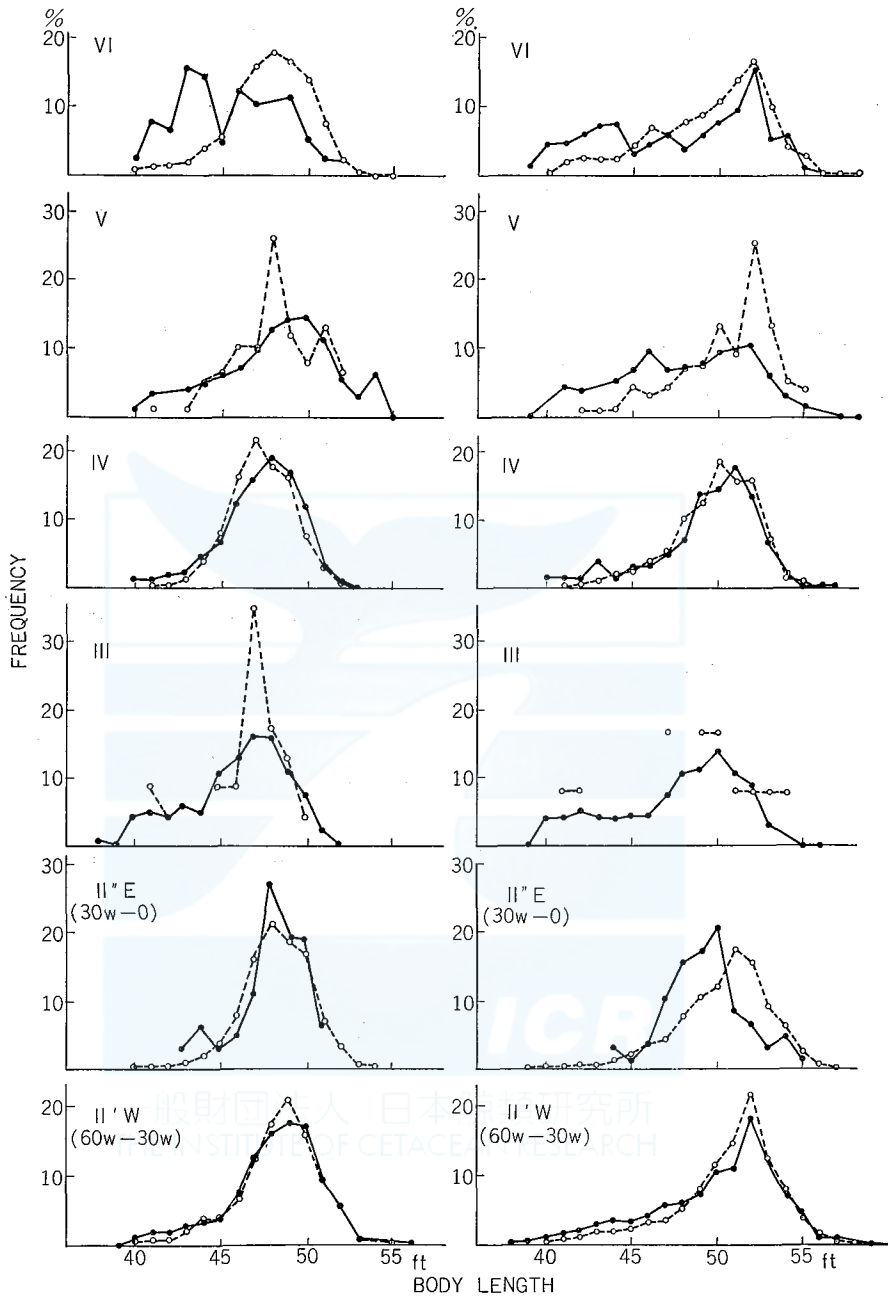


Fig. 4. The size composition by sex of sei whales caught by the Japanese expeditions by Area, north and south of 50°S.

Left side : male, Right side: female.

Solid line : North of 50°S

Dotted line: South of 50°S

sex ratio of sei whales in the Antarctic whaling season in 1934/35 to 1965/66 is 49.7% (Gambell 1968), and this ratio is considered to be indicative of natural state, so that in the Southern Hemisphere it can be said that there is a tendency for the male whales to migrate further into higher latitudes than the female ones.

SIZE COMPOSITION

The size composition by sex of sei whales caught by the Japanese expeditions by Area, north and south of 50°S is shown in Fig. 4. The distribution of body length for the total Area extends from 38 to 58 ft. for male and 37–59 ft. for female. The modes for both are 48–49 ft. and 51 ft. respectively. The ratio of smaller male whales under 45 ft. is 21% in the north of 50°S and 12% in the south of 50°S, but the ratio for larger whales over 50 ft. is 27.1% in the south and 26.4% in the north. The difference between north and south of 50°S is found to be slightly greater in the number of male in the north of 50°S, but it shows almost the same

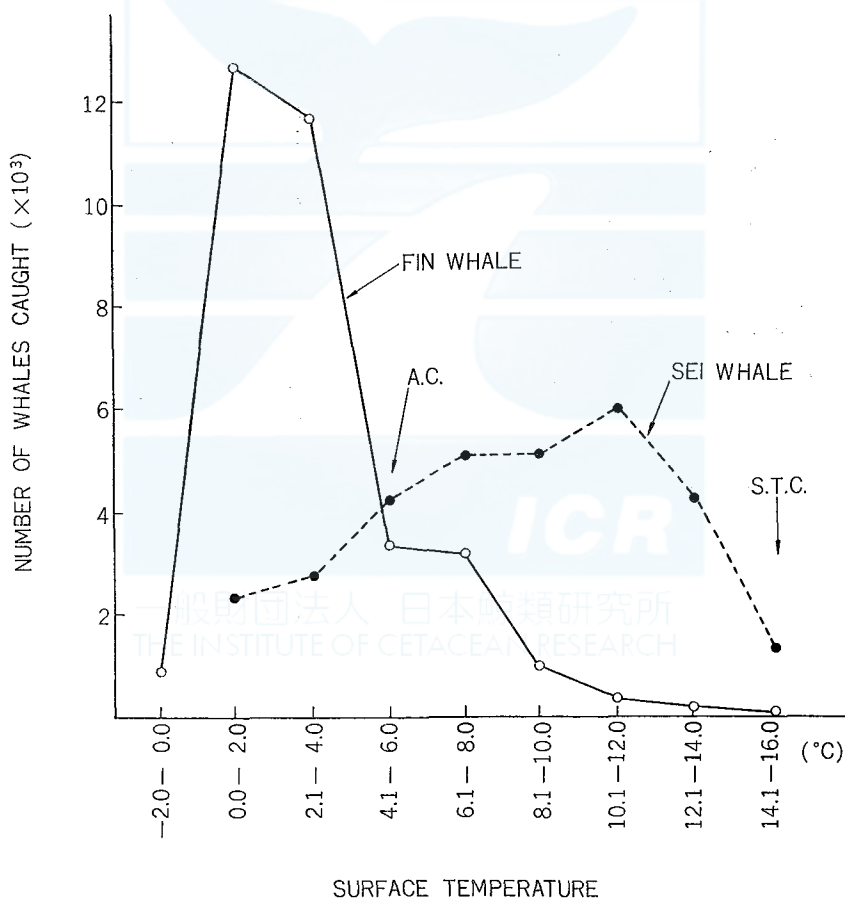


Fig. 5. Relationship between the surface temperature and the number of whales caught by species.

TABLE 1. BIOLOGICAL PARAMETERS OF SEI WHALES IN THE ANTARCTIC BASED ON JAPANESE EXPEDITIONS

Area	II W		II E		III		IV		V		VI		Total	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Sex ratio of male	58.0*	57.2*	52.5*	61.7*	52.2	65.7	53.3	56.7	54.2	44.3	52.3	57.1	55.5	57.7
Mean	48.1*	48.3	49.8*	48.3*	46.2	46.6	47.4	47.3	47.8	48.1	45.7	47.7	47.6	48.0
body length	50.0	50.7	49.3	50.3	47.8	48.8	49.3	49.7	48.1	50.5	47.8	49.6	48.9	50.2
Sexual			95.3**		85.2	100.0	92.5	97.9	84.4	90.9	67.9	92.0	85.9	94.3
maturity rate			96.0**		71.2	75.0	83.6	92.9	58.4	86.6	64.6	76.3	68.1	83.0
Body length at			—		43.4		42.3		43.5		43.5		43.5	
sexual maturity			—		45.6		45.4		46.8		47.4		46.0	
Pregnancy rate			65.0**		53.3	44.4	55.3	63.2	61.2	73.8	63.4	53.6	57.2	58.9
Mean number of			—		4.60	7.33	6.41	7.19	5.42	7.41	4.72	5.94	5.43	6.52
corpola lutea														

* 1964/65

** 1963/64

No mark 1967/68, 1968/69.

TABLE 2. AGE AND BODY LENGTH AT RECRUITMENT OF SEI WHALES BY AREA

Age at recruitment	III		IV		V		VI		Total					
	Total	50%	Total	50%	Total	50%	Total	50%	Total	50%				
Recruitment	20.0	14.9	22.0	16.3	22.0	12.6	20.0	13.8	22.0	15.0				
Male	18.0	13.5	20.0	14.4	19.0	14.5	23.0	16.9	20.0	15.4				
Body length at recruitment														
Area	II W		II E		III		IV		V		VI		Total	
	Total	50%	Total	50%	Total	50%	Total	50%	Total	50%	Total	50%	Total	50%
Recruitment	49.0	38.1	48.0	47.7	47.0	45.7	47.5	46.5	49.5	47.1	48.0	46.1	48.0	46.9
Male	52.0	50.6	51.0	50.5	50.0	47.8	51.0	49.7	52.0	48.3	52.0	49.8	52.0	49.6

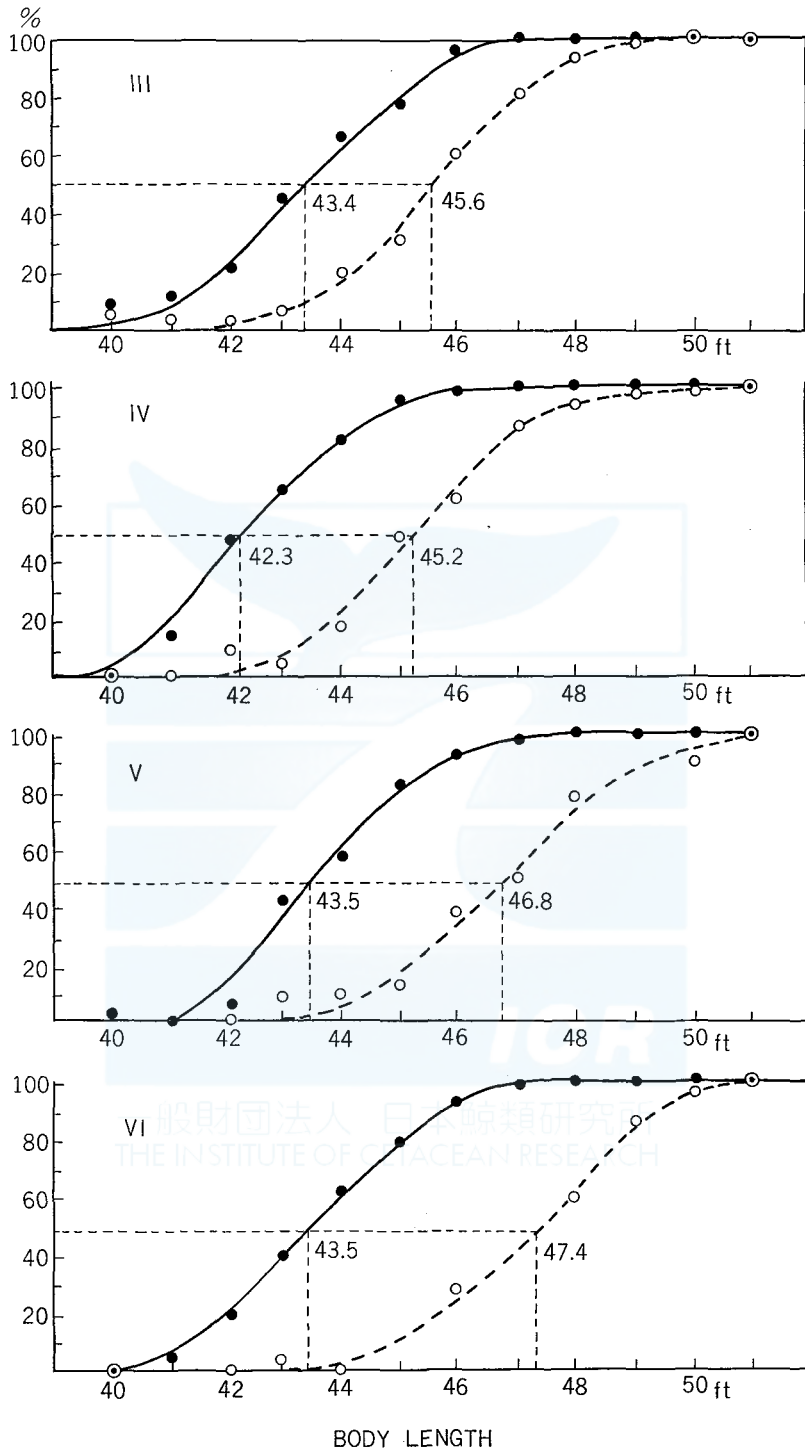


Fig. 6. Body length at sexual maturity

ratio. The ratio of medium size whales of 45 to 50 ft. is large in the south of 50°S.

The small size whales under 47 ft. are 32 % in the north of 50°S and 22 % in the south of 50°S and show a larger concentration in low latitudes. Medium size whales are found in greater numbers in the south of 50°S and larger whales show figures of 31 % in the north of 50°S and 29 % in the south of 50°S respectively. They fairly uniformly distribute regardless of latitude.

In summarizing the latitudinal distribution of sei whales in the Antarctic can generally be explained that smaller whales distribute in low latitude, medium whales are in high latitude and larger whales evenly distribute in low and high latitude. The difference of mean body length between the low and high latitude is summarized in Table 1.

Based on the size composition in Fig. 4 examination of the composition by Area shows that in Area II W and VI small group found in the south of 50°S. This phenomena may be considered to arise from oceanographic conditions.

This means that according to data obtained by Japanese expeditions, as seen in Fig. 5, sei whales are distributed in the north of the Antarctic Convergence, and the Antarctic Convergence in Area II W and VI is found in higher latitudes than in other Areas.

When the forementioned tendency in the latitudinal distribution of body length is taken into consideration, a heavy distribution of small group in higher latitudes can be thought to be derived from the fact that there is a water mass which possesses low latitude features extending southward into high latitudes.

Mean length by Area in Table 1 shows that in the whole of Area II to VI male is 47.6 ft. and female is 48.9 ft. in the north of 50°S and, in the south of 50°S those are 48.0 ft (male) and 50.2 ft (female) respectively. On the mean there are higher values in high latitudes as shown in Fig. 4.

In the north of 50°S in Areas III and VI the body length is short for male with figures of 46.2 ft. and 45.7 ft. This derives from the fact that the ratio of small group is higher as shown in Fig. 4. The mean length for female in Areas III, V and VI is short because of the same reason.

SEXUAL MATURITY

a) *Sexual maturity rate*

As shown in Table 1, the sexual maturity rate in the north of 50°S is both male and female larger than that in the south of 50°S. Those maturity rates by Area show the largest in the Antarctic Areas II and IV, which it may be considered that the old year group are more than other Area.

b) *Mean length at sexual maturity*

The analysis on this problem was done using data resulting from examination of testis and ovary material sampled in 1963/64, 1964/65, 1967/68, and 1968/69. As the index of sexual maturity were used, the animals with 1 Kg. or more testis weight in male and one or more corpora in ovaries of female were sexual mature.

The percentage of mature animal at each length for male and female sei whales was plotted as shown in Fig. 6. From Fig. 6 the length at which 50 % of whales are

mature, and which is taken as the mean length at sexual maturity, is obtained. These length are shown in Table 1. The mean length in Area IV shows both male and female had the minimum value with 42.3 ft. and 45.2 ft., respectively. The mean length in Tasman Sea and east sea region of New Zealand corresponding to Area V and VI are higher than the figures in Areas III and IV.

Consequently, it must be caused by large length at sexual maturity that the figures of mean length in Tasman Sea and east sea region of New Zealand are small.

The figure of male in each Area except Area IV agree closely each other, but

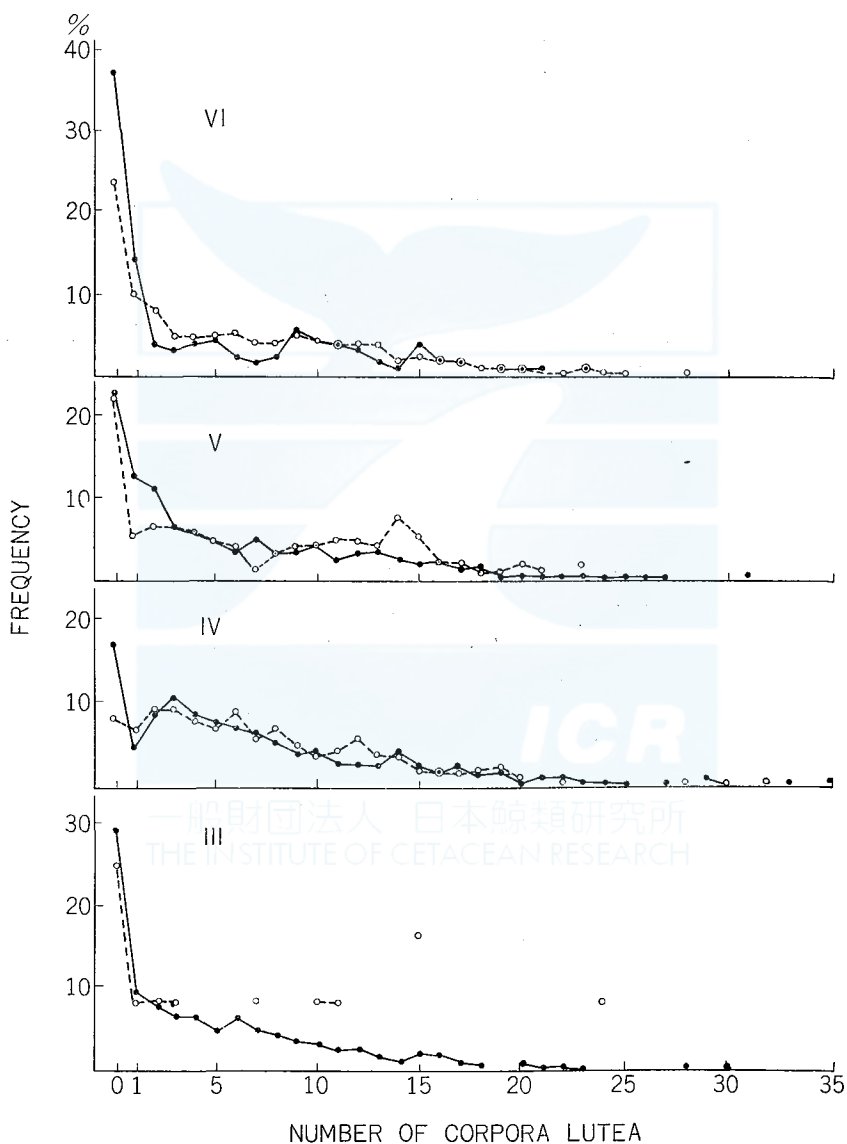


Fig. 7. Frequency of number of corpora lutea.

there are difference between the female in Area III, 45.6 ft. and Area VI, 47.4 ft.

This is one of the cause which occurred with the difference of sexual maturity by Area. The mean length at sexual maturity length of female in Area III agree closely with that from Durban (Bannister and Gambell 1965) and such phenomena may be caused by same race, because these sea regions locate nearly each other. However, the problem on the race between Durban and Area III must be analyzed from other data.

PREGNANCY RATE

Pregnant whales constituted 57.2% and 58.9% respectively of mature females in the north and south regions of 50°S, so we can find that the pregnancy rate in the south region of 50°S is barely higher than that in the north region. The pregnancy rate in all Areas was estimated about 58%, but the pregnant whales have a tendency to leave earlier from Antarctic in the whaling season. From that reason, the figure of pregnancy rate should be discussed from the point of whaling season and Area.

COMPOSITION OF NUMBER OF CORPORA IN THE OVARIES

Table 1 shows the mean number of corpora by Area. Fig. 7 shows the frequency of number of corpora. The proportions of young group derived from the number of corpora in Area III and VI are larger than that in Areas IV and V. It is just similar with the size compositions. The mean number of corpora in the north of 50°S in Areas III and VI are low, and that in the south region of 50°S in Area VI is also low compared with other Areas. The number of corpora in all Area, generally speaking, increase with latitude.

AGE AND LENGTH AT RECRUITMENT

Table 2 shows the age and length at recruitment by Area. The mean age and length at recruitment in all Areas are 22.0 years, 48.0 ft. in male and 20.0 years, 52.0 ft. in female, respectively. Furthermore the age and length at 50% recruitment are 15.0 years, 46.9 ft. in male and 15.4 years, 49.6 ft. in female, respectively.

The age at total recruitment of male in Areas III and IV, 20.0 years is younger than that in Areas IV and V, 22.0 years. This is explained by Fig. 4, in which the mode of size composition shows the large value in Areas IV and V. On the other hand, the age at the youngest and oldest on the female were found in Area III, 18.0 years and in Area VI, 23.0 years, respectively.

The characters on the length at recruitment by Area are as follows;

Male; minimum in Area III, 47.0 ft., maximum in Area V, 49.5 ft.

The case of female also shows a tendency to similar with male. From above mentioned, it can be concluded that the age at recruitment is older than the age at sexual maturity.

The age and length at total, and 50% recruitment were obtained by each composition of age and size. Here the age at total recruitment took the mode *b* in Fig. 8 showed the frequency of age. The age at 50% recruitment was obtained by point *a* which means that the numbers of whale from 0 to 5 years equal to that from *a* to *b*

years.

Furthermore the length at recruitment is obtained by the similar to the case of age.

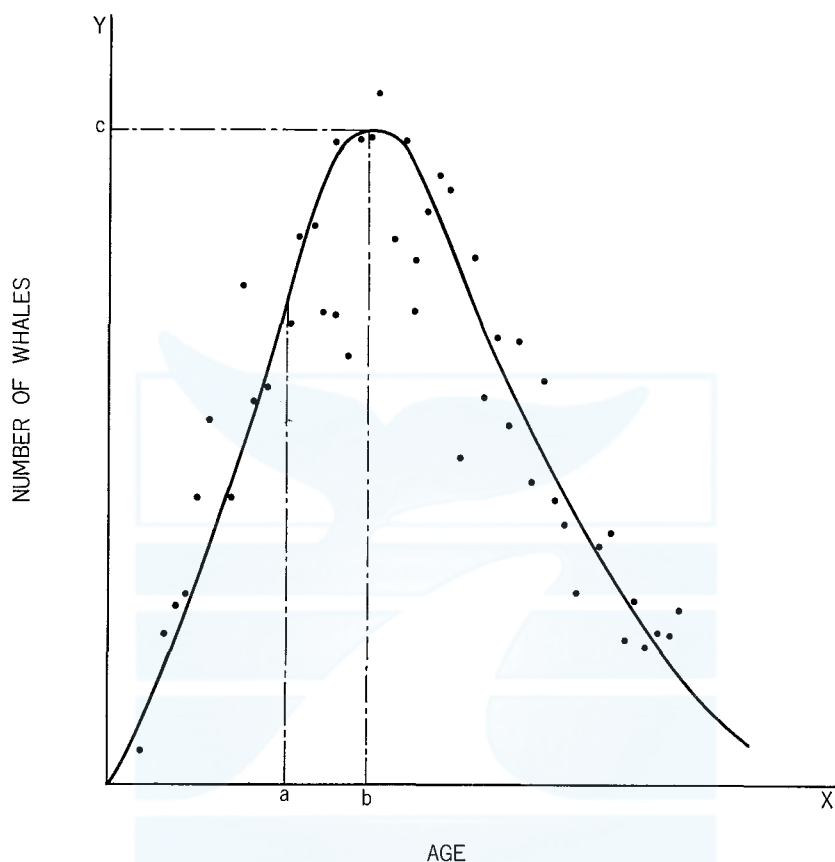


Fig. 8. Age at recruitment

SUMMARY

1) The biological parameters of sei whales in the Antarctic were analyzed based on the data sampled by Japanese expeditions.

2) The favourable ground of sei whales, in general, occurred in the north sea region of Antarctic Convergence.

3) The foetus male sex ratio of sei whales in the Antarctic showed 49.7% (Gambell 1968), but that of whales caught have tendency increases with latitude.

4) The small group less than 45 ft. dominates in the northern region of 50°S, while the large group more than 50 ft. distributes of a uniform both north and south region of 50°S.

5) The sexual maturity rate is both male and female larger than that in the south region of 50°S, and shows the maximum value in Areas II and IV.

The length at sexual maturity is large both male and female in Area IV and small in Area VI

6) The mean pregnancy rate in all Areas was estimated to be about 58%, but the figure should be discussed from the point of whaling season and Area.

7) The proportion of young group derived from the number of corpora in Areas III and VI are larger than that in Areas IV and V. The number of corpora, in generally speaking, increases with latitude.

8) The age and length at total and 50% recruitment are estimated, and those mean values in all Areas are as follows;

		Total	50%
Age	{ male	22.0	15.0
	{ female	20.0	15.4
Length	{ male	48.0	46.9
	{ female	52.0	49.6

Where it was assumed that one lamina in ear plug accumulated a year.

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