Biological Survey of Fin and Blue Whales Taken in the Antarctic Season 1947~48 by the Japanese Fleet

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by
Masaharu Nishiwaki and Kazuo Hayashi

CHAPTER I. Introduction

I. Permission of Whaling for the Season 1947—48.

The whaling in the Antarctic water for the season 1947—48, a second one since the cessation of the War, was granted by the GHQ, SCAP.

II. Objects of the Whaling Survey.

The present investigations were carried out aboard the "Hashidate-maru", a whaler of the Nippon Suisan K. K. (Japan Marine Products Co., Ltd.), and the "Nisshin-maru", a whaler of the Taiyo Gyogyo K. K. (Taiyo Fisheries Co., Ltd.) which went out on the permission of the above during 8 December 1947 to 10 March 1948. The movement of the vessels are shown in Fig. 1. During this season, the whales caught were: 713 fin whales (Balaenoptera physalus), 608 blue whales (Balaenoptera musculus) and 2 Sperm whales (Physeter catodon), of which 3 heads of fin were lost by the Hashidate Maru and were, therfore, not included in the investigation. Sperm whales were also excluded from survey.

The chief object of the present survey was the classification of whales caught in the Antarctic as part of the world-wide investigations on cetaceae. On the other hand, this report was drawn up in order to present numerical appreciation of the Japanese whaling fleet. At the same time, data which would serve as bases for the biological studies of the Cetaceae were collected as much as possible. In short, this is a statistical data and any phenomena which might accompany them have been included in the Appendix. Physiology of various organs of the whales and anatomical studies of the foetuses have been omitted.

III. Method of Work

1) Body colour: Blue whales— Colour of the skin; size, clarity, number and distribution of pale spots on the skin; size, clarity and number of white flecks; location of ventral grooves; clarity of striation; were all observed by naked eyes.

Fin whales— Shading of the skin colour and extension of the pigmentation to the ventral surface from the back were observed by naked eyes.

2) Measuring of the various parts of the body were made by steel tapes on those parts described by Mackintosh and Wheeler in their Discovery Reports, i. e.:

(1) Total length.
(2) Lower jaw; projection beyod tip of snout.
(3) Tip of snout to blow-hole.
(4) Tip of snout to angle of gape.
(5) Tip of snout to center of eye.
(7) Eye to ear (centres).
(8) Notch of flukes to posterior emagination of dorsal fin.
(9) Flukes, width at insertion.
(10) Notch of flukes to anus.
(11) Notch of flukes to umbilicus.
(12) Notch of flukes to end of ventral grooves.
(13) Anus to reproductive aperture (centres).
(14) Dorsal fin, ventral hight.
(15) Dorsal fin, length of base.
(16) Flipper, tip to axilla.
(17) Flipper, tip to anterior end of lower border.
(18) Flipper, length along curves of lower border.
(19) Flipper, greatest width.
(20) Severed head, condyle to tip.
(21) Skull, greatest width.
(22) Skull length, condyle to tip of premaxilla.
(23) Flipper, tip to head of humerus.
(24) Tail, depth at dorsal fin.
(25) Flukes, notch to tip.
(26) Flukes, total spread.

Since (2), (4), (22) and (26) seemed to contain a large amount of measuring errors, these were omitted in the present investigation, and following measurements were added :

(27) Breadth of the body, back to front (at tip of flipper).
(28) Height of the body when lying on its side.
(29) Greatest circumference.

(30) Tail flukes, from tip to tip.

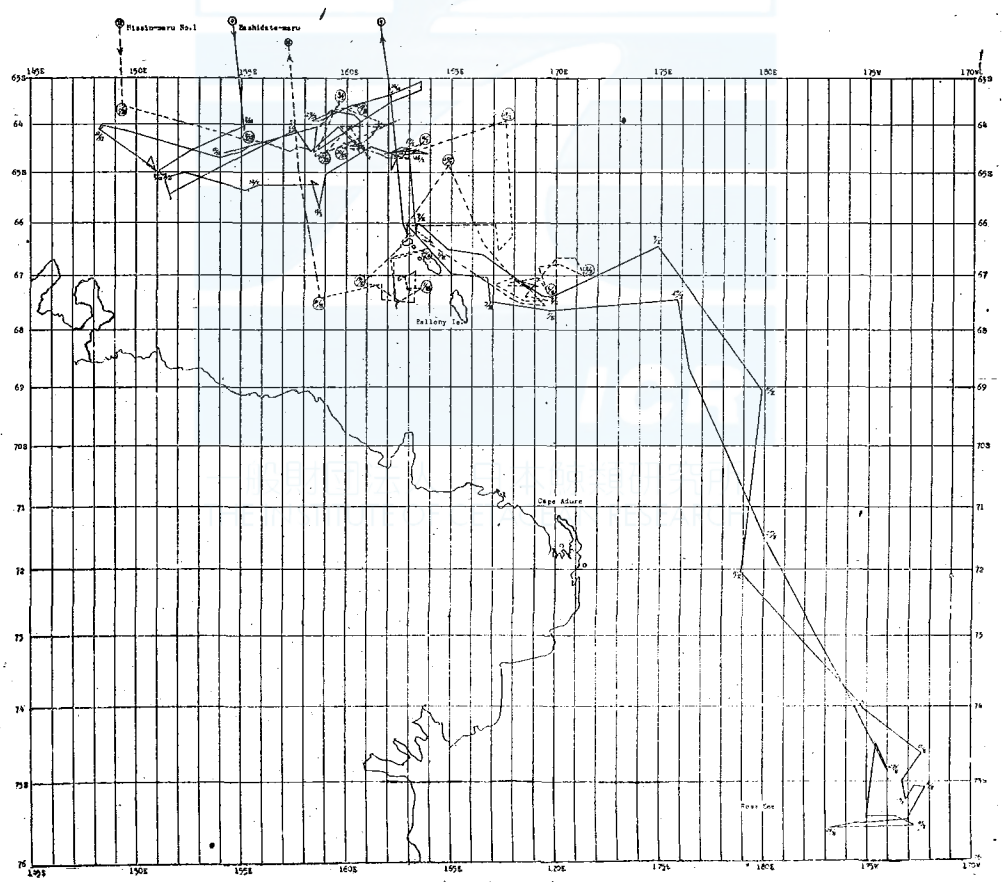
(31) Lower jaw bones, length along curve of border.

3) The determination of the weight of various parts of whale body was carried out with a platform scale, cutting the parts down to the size (about 50 cm^3) to fit the scale and adding up the result. Loss of blood and body fluids had to be tolerated but small pieces sawed off were collected as much as possible and also added up.

Investigations on testes, overies, mammary glands, food, thickness of blubber, etc., were carried out by biologists apointed by the Japanese Government and several men under their guidance so as to eliminate the difference by individual investigation.

IV. Activities of the Japanese Whaling Fleet in the Whaling Ground (South of Lat, 60° S, east of Long, 90° E., and west of Long 170° W,) granted for the Season 1947—48.

Fig. 1. The movement of Japanese fleets in Antarctic ocean (1947~1948 Expedition)



The Hashidate-maru Fleet left on 6 November 1947, and the Nisshin-maru Fleet left Yokosuka on the same date arriving in the ground on 5 and 7 December 1947, respectively. Their activities after those dates are as shown in Fig. 1. The Nisshin-maru confined her activities to an area enclosed by Lat. 63° to 68° S., and Long. 155° to 172° E., but Hashidate-maru went further into the Ross Sea for operation. The present expedition found that the opening to the Ross Sea was not in the direction of the Balleny Is. as usual but far to the east and the fleet found it difficult to find the opening.

V. The Amount of Catch by the Japanese Fleet inside the Whaling Ground granted for Season 1947—1948.

The Amount of whales caught by the expedition, is shown in Figs. 2 and 3 by month. As can be seen from these Figures, both the Hashidate-maru and Nisshin-maru caught many blue whales at the beginning of the season but these animals began to grow less by January and the fleets decided to go after fin whales. Nisshin-maru continued to operate in the same area and encountered the largest catch of fin whales during February. Hashidate-maru, however went into the Ross Sea and operated for blue whales. Fig. 4 shows the amount of whales caught according to different areas which is shown by the same scale as used in the Whaling Ground of the Antarctic Ocean, 6th Series (1) of Whale Resurce Data published by the Japan Association of Whaling Industry.

Fig. 2. Catches of Blue and Fin Whales
Hashidate-maru fleet

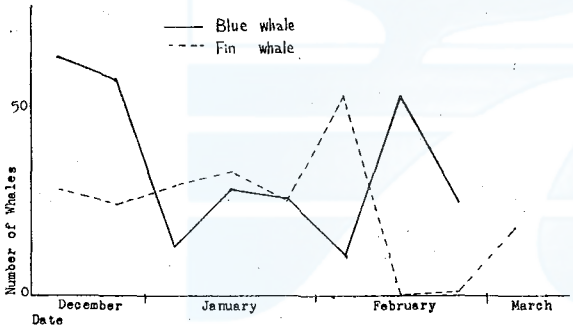


Fig. 3.

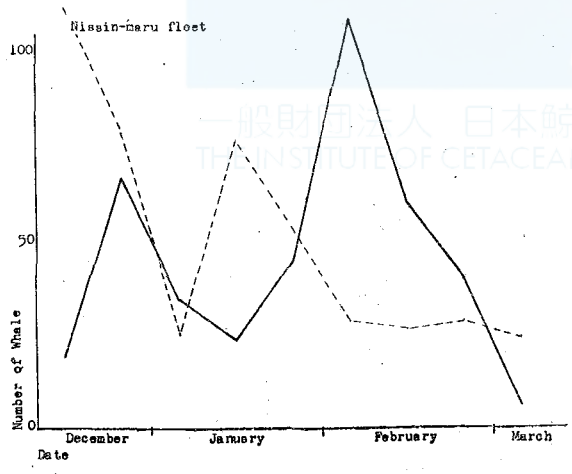
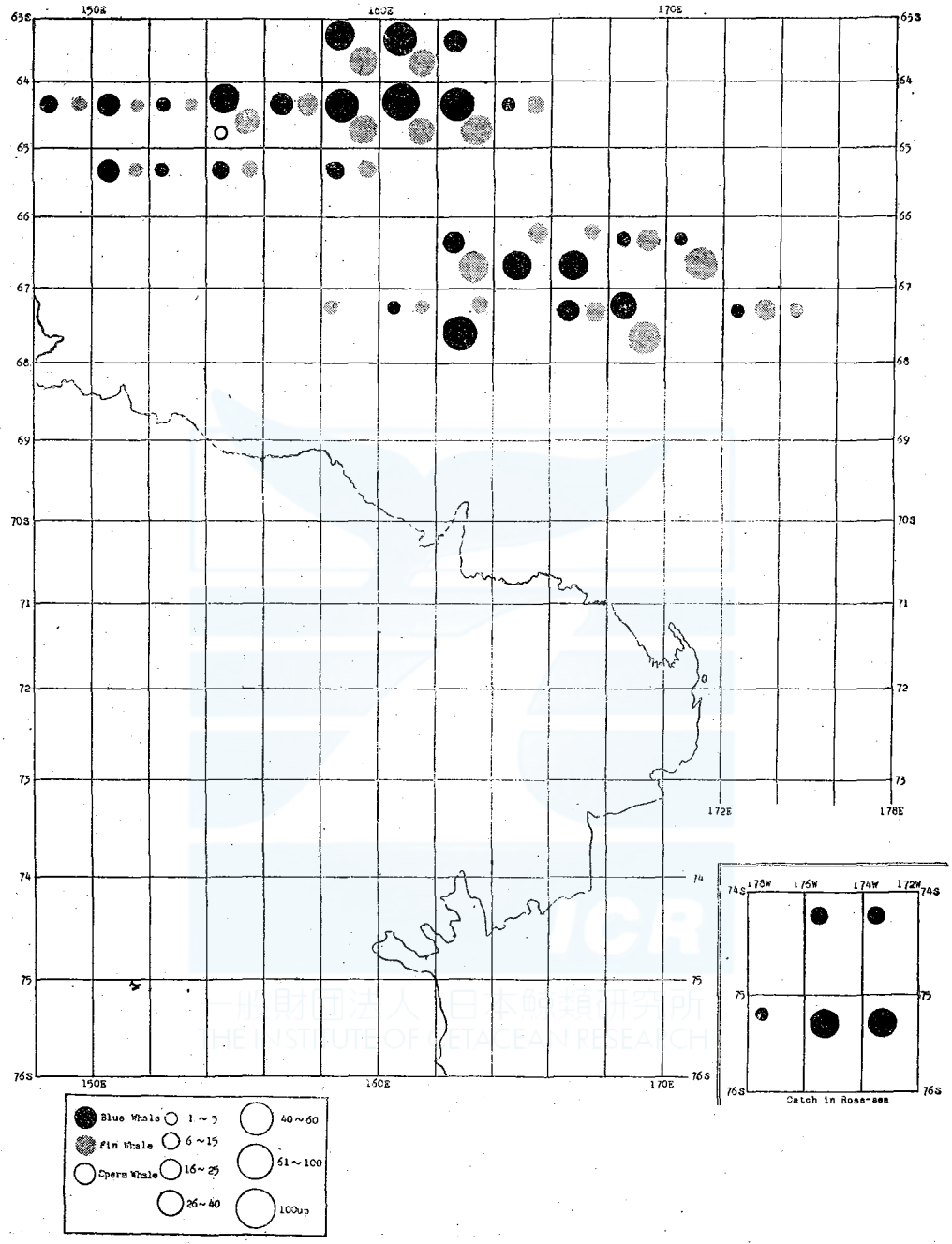


Fig. 4. The map of catch on Japanese fleets (1947~1948 Expedition)



VI. Material and Data.

The number of whales examined during the present investigations on the Hashidate-maru and Nisshin-maru was as follows:

		Hashidate-maru	Nisshin-maru	Total
Blue Whale	Male	138	200	338
	Female	136	236	372
	Total	274	436	710
Fin Whale	Male	87	176	263
	Female	124	221	345
	Total	211	397	608

Grand total of whales caught 1318 (1014 B. W. U.)

Investigation data on individual whales are to be published by the Marine Products Bureau aside from the investigation report.

Average time elapsed between the killing and treating of whales was as follows:

Fleet	Hashidate-maru				Nisshin-maru			
Species	Bule whale		Fin whale		Bule whale		Fin whale	
Sex	Male	Female	Male	Female	Male	Female	Male	Female
Average time interval	7′ 36″	7′ 06″	4′ 57″	5′ 47″	6′ 16″	5′ 51″	3′ 55″	4′ 23″

Unless otherwise stated, all data used in Figures and Tables refer to the total figures and data obtained by both fleet, i. e. results obtained by the Japanese Whaling Fleet.

VII. Abbreviations used.

Abbreviations used in this report and in the appendix are as follows:

In the "Ossification of vertebrae":

1. Number and state of epi. in thoracic (or lumber) refer to the number and state of epiphyses in thoracic series (or in lumber series) of vertebrae.
2. In the column for state, ank. refer to anklosed, those not stated refer to "not ankylosed".

On stomach contents:

1. Size: L=Large, ca. 5.0 cm. and over (from rostrum to tail).
   M=Medium, from ca. 4.0 cm. to 5.0 cm.
   S=Small, up to ca. 4.0 cm.
   X=Mixture of conspicuously different sizes.
   ?=Sizes indistinct due to high degree of digestion.
2. Quantity: 0=Empty.
   r=Very small amount of krill
   rr=Small amount of krill

rrr=Moderate amount of krill
R=Large amount of krill

3. Degree of freshness: f=Almost digested
ff=Half digested
fff=Fresh
F=Very fresh

On the thickness of blubber:

1. Point 1— The point on the horizontal cut side of the body (at the position of lateral line in fish), where it intersects a vertical line from the dorsal fin.
2. Point 2— The point on the vertical cut near the earhole, where it intersects a mid-dorsal line.

External parasites: ###=Much infected or fully developed (diatom)
##=Moderately infected or partially devloped (diatom)
+=Scarcely infected or developed (diatom)
No notation=Not infected in naked eye.

White scar:

Number— 0=None
1=Few
2=Scarce
3=Normal
4=Numerous
5=Very numerous

Colour of the blue whale: Pale spots, whits flecks and striation.

Number— 0=None
1=Few
2=Scarce
3=Normal
4=Numerous
5=Very numerous

State of distinction— I=Indistinct
II=Distinct
III=Very distinct

Colour of the fin whales:

Body colour— N=Normal
B=Blackish

Extension of pigmentation on ventral grooves—
U=Upper
(11—13 stripes of ventral grooves upward from navel line)

N=Normal

L=Lower

Tongue of pigmentation behind anus—

+=Present

−=Absent

Meeting of pigmentation in front of tail flukes—

+=Fused

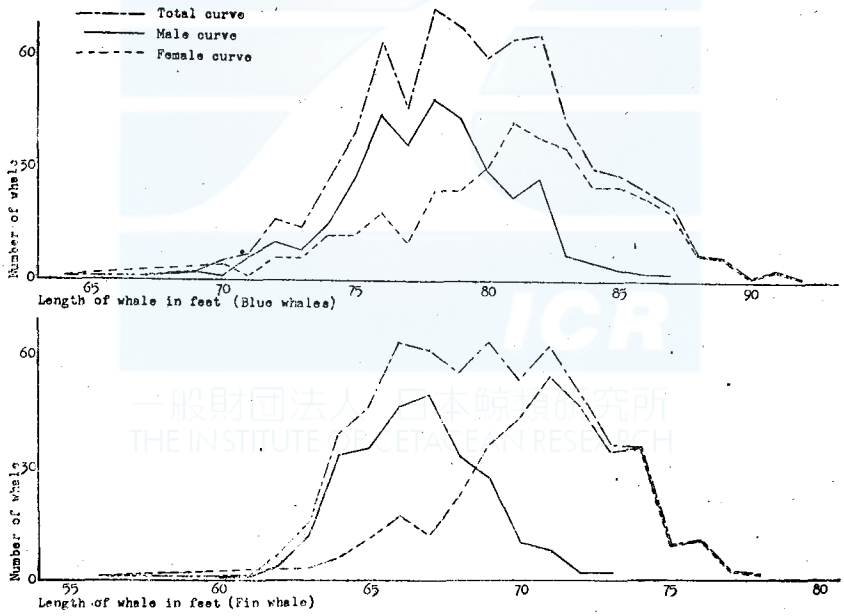
−=Not fused

CHAPTER II. Composition of Whales

I. Composition of Whales Taken.

The formation of whales taken by the present expedition is shown in Fig. 5. The modes of blue whale male are 76, 78 and 82 feet while that of female is 81 feet. Those in fin whale male and female are 67 and 71 feet, respectively.

Fig. 5. Size of whales taken (from all examples of Japanese fleet in 1947~48 expedition)



II. Sex Ratio.

In blue whale, the sex ratio was 47.6% male while that in fin whale was 43.3% male. The sex ratio of the foetuses was 48.8% male in blue whales and 57.4% male in fin whales.

Figs. 6 and 7 show the sex ratio according to body length. In blue whales, there were about 60% of male in whales of under 78 feet whereas there are none in those over 88 feet. In other words, male blue whales do not grow to over 88 feet in length, at least, under the present investigations.

In fin whale, the sex ratio of foetuses was 57.4% male (ca. 60%). About 60% of whales under 69 feet were male, but the number dropped suddenly in those over 70 feet in length.

The reason for this sudden fall in the number of males is that the females normally reach a greater length than the males, as is shown graphically in Fig. 5, in which the number of whales examined is plotted against their length.

The whalers naturally select the largest whale to catch, which so often happens to be a female so that the figures as a whole are not representative of the whale population in that region. However, the sex ratio worked out from data obtained on whales up to 78 feet in total length, which may be expected to show the proportion of males and females more correctly, show that the sex ratio is about 60% of males and not 43.3%, as would appear if the total catch alone is considered.

These figures show the sex ratio among whales of similar length but not necessarily of those of similar age. The proportion of males among those of similar age is probably less than 90%. The males stop growing after reaching a length of about 80 feet and consequently, are removed

Fig. 6. Sex ratio and total length (Blue whale)

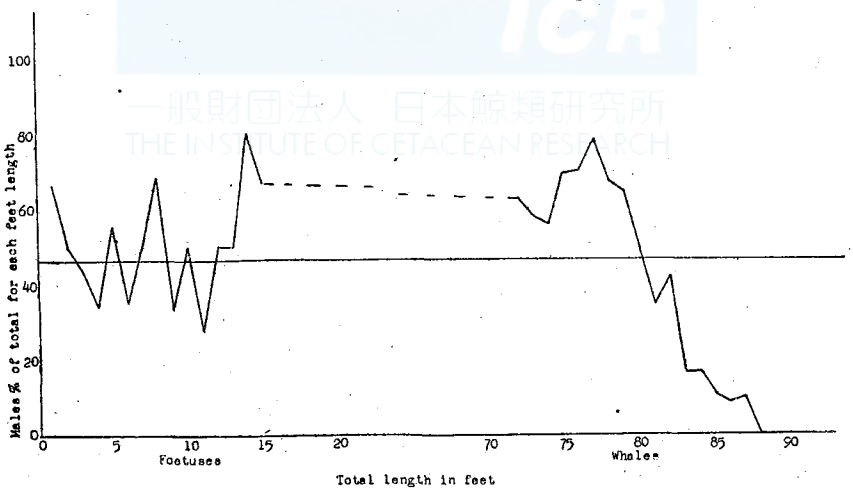
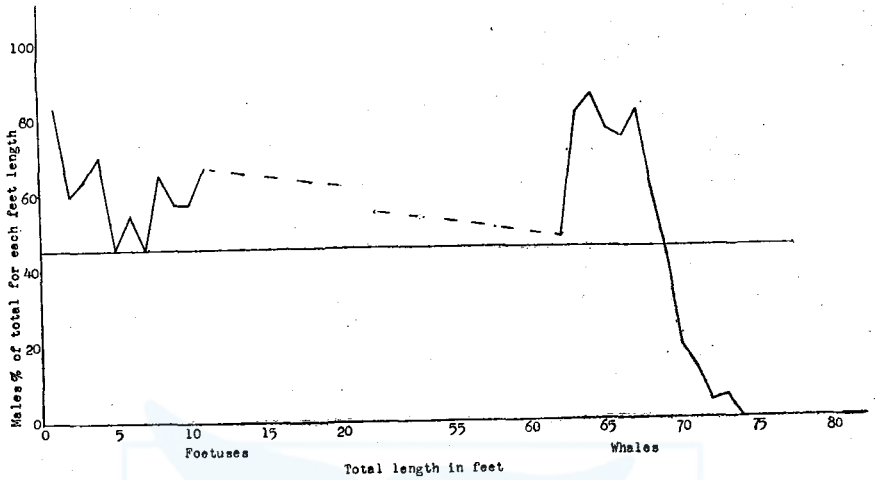


Fig. 7. Sex ratio and total length (Fin whale)



from the length classes of their contemporary females which grows to more than 80 feet. The length classes containing those of 80 feet and less, must, therefore, contain the males of an age equal to that of the females over 80 feet in length. Among whales of similar age, therefore, the primary sex ratio found in the foetuses is probably steadily declining from the high proportion of males to something nearer equality as the whales grow older.

III. Composition of Whales taken as Classified by the "International whaling Statistics Board".

The size of whales when reaching sexual maturity was taken from the works of Mackintosh and Wheeler, the blue and fin whale generally reaching their maturity at the following length:

Blue whale— Male 63 feet, 8 inches (63 feet)
Female 65 feet, 7 inches (65 feet)

Table I. Composition of Blue whales

Classification	Number	Ratio (%)
Group 1 (70 feet and less)	9	1.27
Group 2 (71—85 feet)	639	90.00
Group 3 (86 feet and over)	62	8.73
Total	710	
Immature male	28	8.58
Mature male	310	91.42
Immature female	61	16.40
Mature female	311	83.60
Total No. of immature animal	89	12.54
Total No. of mature animal	621	87.46

Fin whale— Male 74 feet, 2 inches (74 feet)
Female 77 feet, 9 inches (77 feet)

Table II. Composition of Fin whales

Classification	Number	Ratio (%)
Group 1 (55 feet and less)	0	0
Group 2 (56—65 feet)	110	18.09
Group 3 (66 feet and over)	498	81.91
Total	608	
Immature male	6	2.28
Mature male	257	97.72
Immature female	13	3.77
Mature female	332	96.23
Total No. of immature animal	19	3.12
Total No. of mature animal	589	96.88

GHAPTER III. Composition of Male Whales

I. Sexual Maturity of Male Whales.

The sexual maturity of male whales are determined by the following:

1. Size of the penis
2. Size of the testis
3. Weight of the testis
4. Histology of the testis.

The present investigations took the weight of the testis as a chief indication of maturity with additional considerations on other points.

II. Relationship beween the size and weight of testis.

In their Discovery Report, Mackintosh and Weeler classified male whales according to the size of the testis (" the size of the testis represented by a number obtained by multiplying together the length, breadth and depth measured in centimetres ").

In order to obtain the relationship beween the size and weight of the testis of male whales taken by the Nisshin-maru, various parts were plotted against body length and the average values obtained are shown graphically in Figs. 8a, 8b, 9a and 9b. Figs. 10 and 11 show the comparison of their size and weight. Naturally, these Figures show that both weight and size curves have the same tendencies and seem to show that the weight method in which values taken from fresh ones can be used, is much more exact than the size method which necessitates calculations for tabulation.

Fig. 8a Size of testis in different length (Blue whale) on Nisshin-maru No. 1

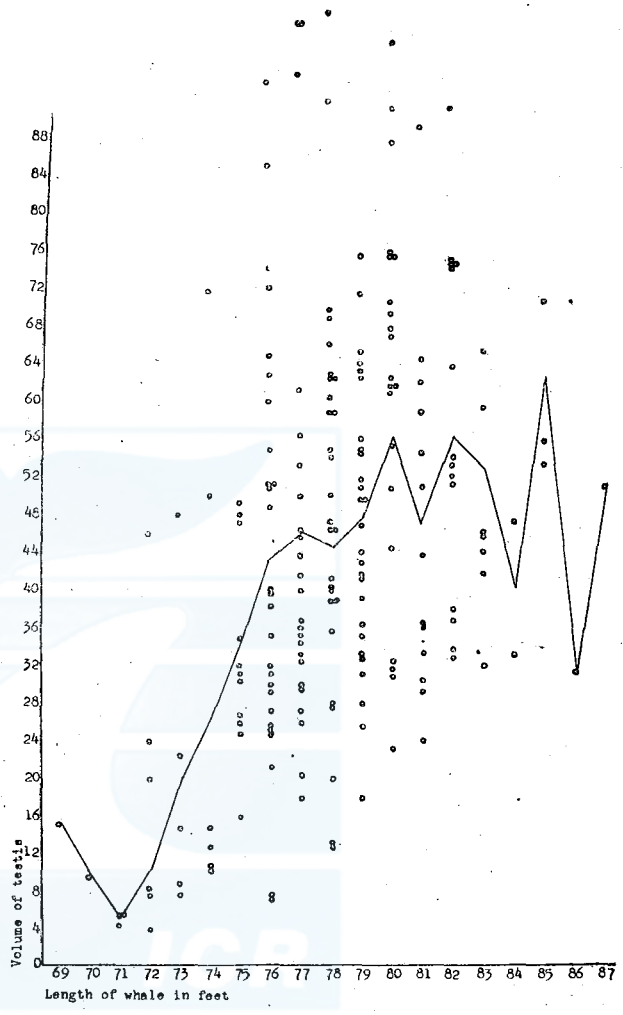


Fig. 8b Size of testis in different length (Fin whale) on Nisshin-maru No. 1

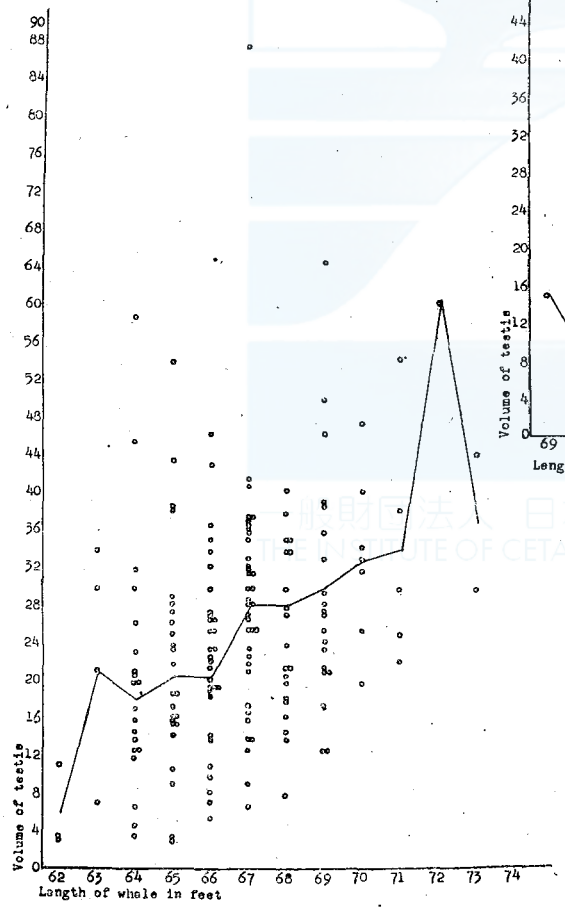
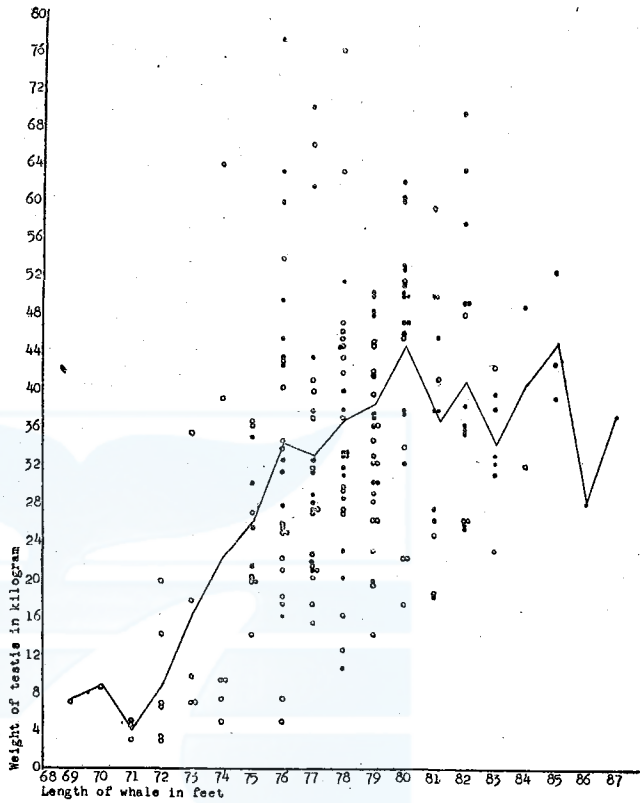


Fig. 9a Weight of testis in different length (Blue whale) on Nisshin-maru No. 1



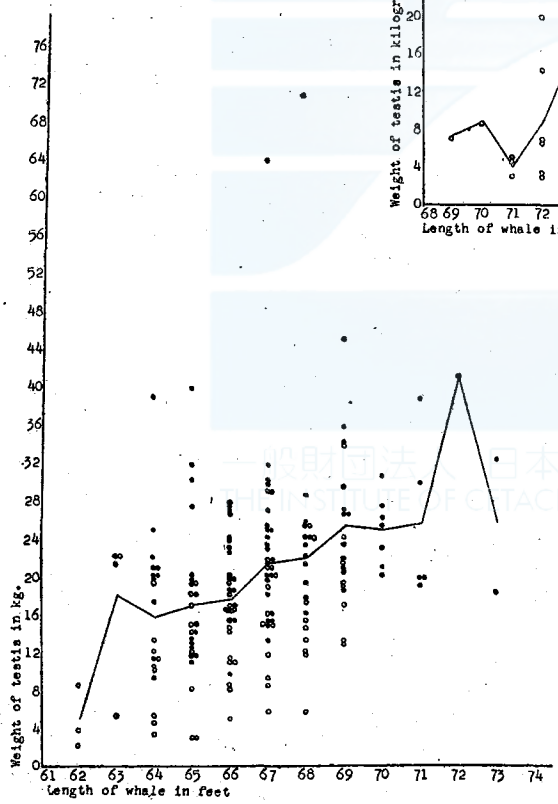


Fig. 9b Weight of testis in different length (Fin whale) on Nisshin-maru No. 1

Fig. 10 Size of testis in different length of whales on Nisshin-maru No. 1
and
Weight of testis in different length of whales

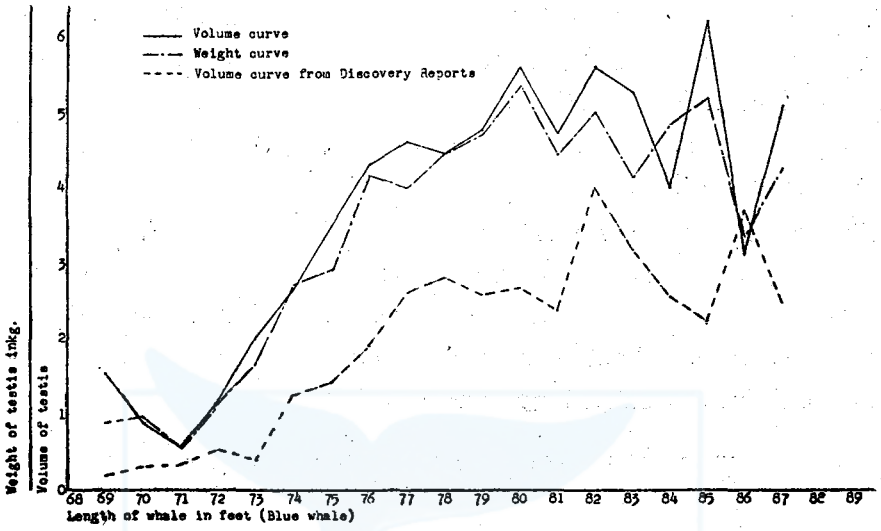
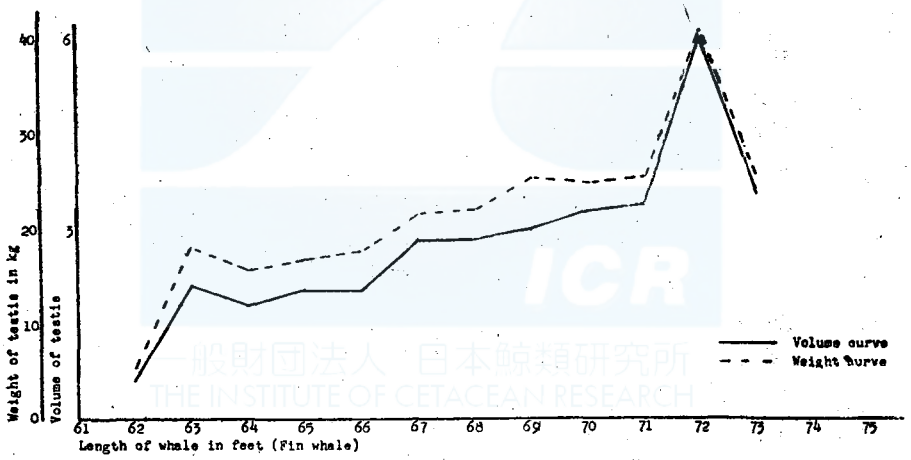


Fig. 11 Size of testis in different length of whales on Nisshin-maru No. 1
and
Weight of testis in different length of whales



III. Weight of the Testis.

The weight of the testis of all whales taken by the Japanese fleet in the present whaling season were taken to observe overall tendencies.

As shown in Fig. 12, the development curve of testis in blue whales is very gradual at first but becomes rapid when the body length reaches 73—75 feet, and again becomes slower thereafter. In male blue whales

of over 83 feet in length, decrease of sexual function can generally be seen. This point constitutes one of the biggest difference from the curve of the number of corpora lutea in female whales. These tendencies observed in the present investigations coincides well with the reports of Makintosh and Wheeler as found in p. 406 of their Discovery Report, Vol. 1. This evidence is shown by the average curve taken from their Fig. 139 (p. 406) plotted on Fig. 10.

The same tendencies can also be seen fin whales. As can be seen from Fig. 13, the develoment curve makes a sudden upturn around a body length of 62 feet and takes a natural course of development thereafter. The fact that a remarkable decrease phenomenon cannot be seen must be due to the failure to catch large, aged whales.

Fig. 12 Weight of testis in different length (Blue whale)

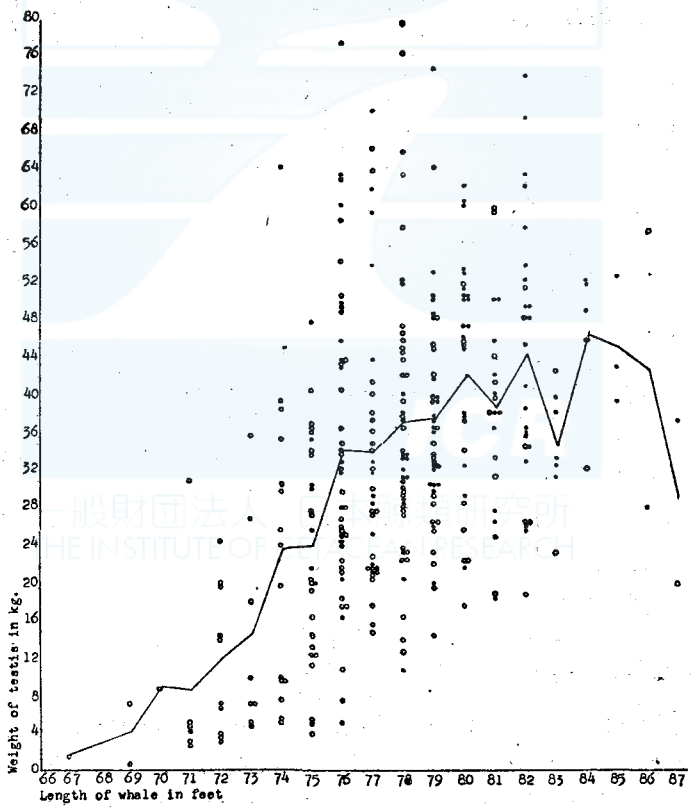
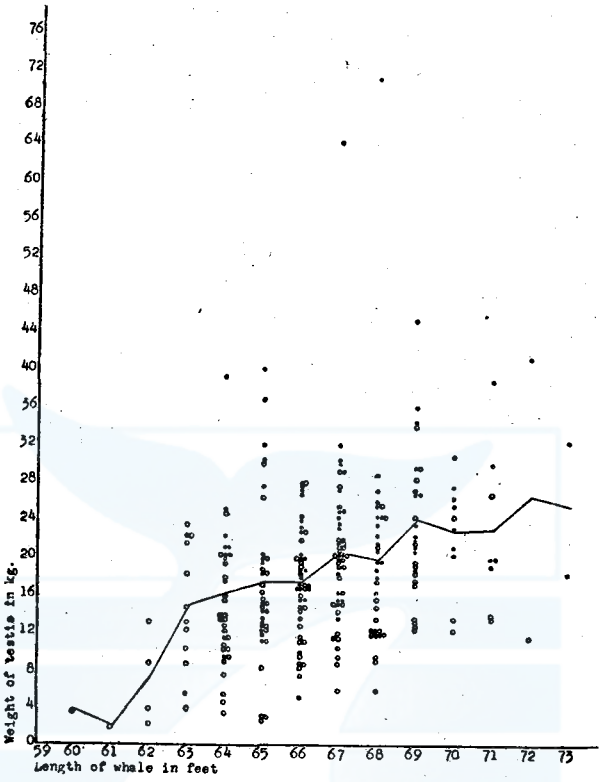


Fig. 13 Weight of testis in different length (Fin whale)



IV. Sexual and Physical Maturity according to Body Length.

The maturity of males according to their body length is shown in Fig. 14. The sexual maturity was classified only by the weight of testis as is done and not by macro- or microscopic observations of the testis. If the combined weight of both testis was less than 10 kg in blue whale and 5 kg in fin whale, they were considered immature.

The physical maturity of males was considered complete when all their epiphyses of vertebral column were fully ankylosed. They were considered immature if thoracic epiphyses were not ankylosed even if caudal and lumber ones were.

Considered from these points, the sexual maturity of Blue whales is reached when the body length is about 74 feet, and the physical maturity at about 80 feet. The sexual maturity in Fin whales is reached at about 63 feet of body length and the phys cal maturity at about 70 feet.

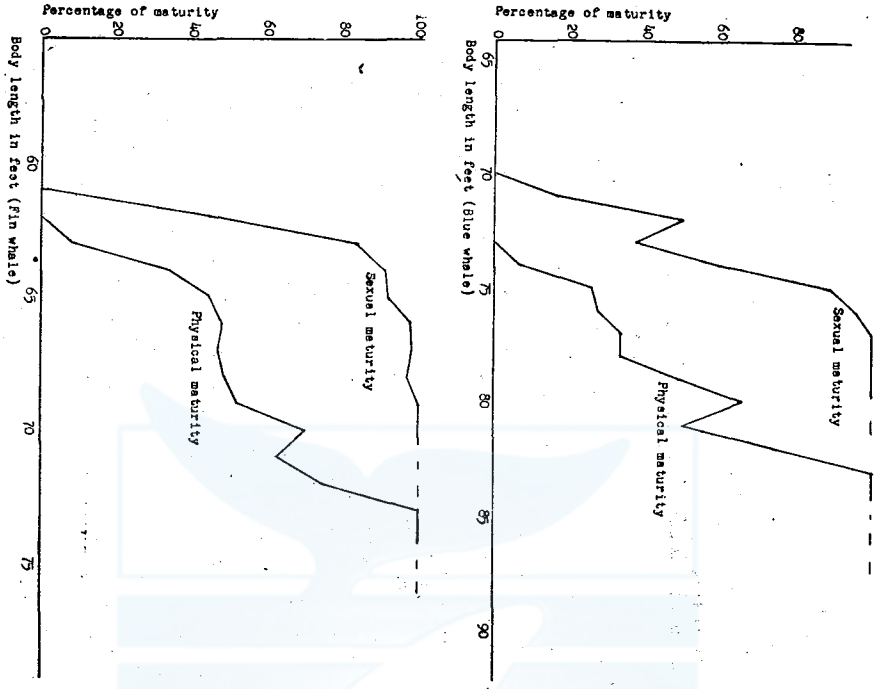


Fig. 14 Maturity curve on different length (Male)

V. Average Length of Whales according to the Weight of Testis.

Fig. 15 and 16 show the average length of whales according to the weight of testis from which it can be seen that in blue whales the body length of whales having 10 kg testis is about 73 feet but the length suddenly increases to 76 feet in those having 12 kg testis. In fin whales,

Fig. 15 Average length of whales in each class of weight of testicles (Blue whale)

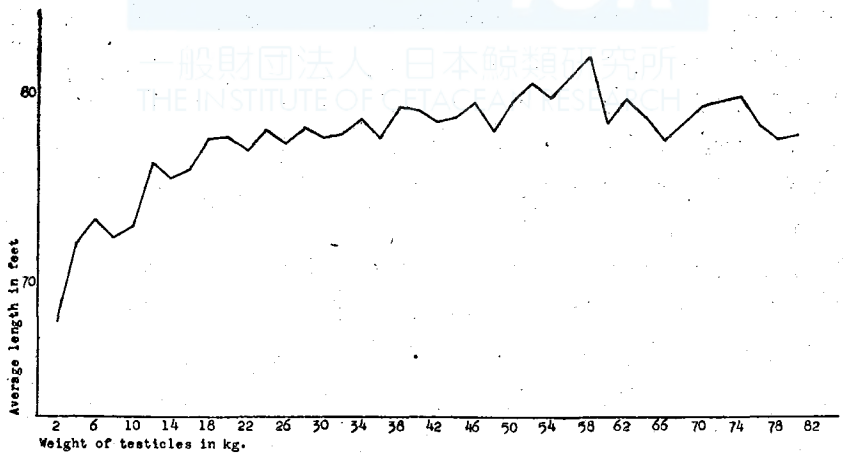
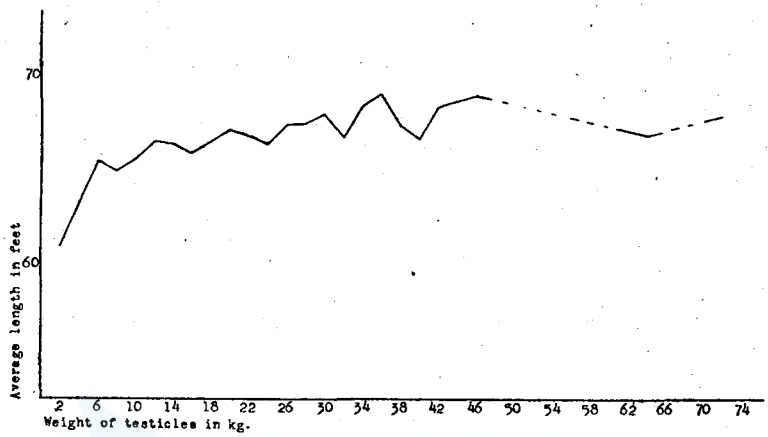


Fig. 16 Average length of whales in each class of weight of testicles (Fin whale)



the curve for whales having testis weighing up to 6 kg take a sudden upward trend which then becomes gradual. The body length of whales having 4 kg testis is about 63 feet, and that of 6 kg testis about 66 feet.

The foregoing is a good evidence that the classification of maturity by body length is based on the classification by testicular weight.

Figs. 17 and 18 show the curves for average testicular weight at different body length according to physical maturity. The physical maturity curve in Fig. 14 thow the ratio of the mature and immature in the former data. These figures also furnish good evidence of the various factors as stated above. It seems correct to observe that the body length of male whales at its maturity, as seen from Fig. 14, is 79 feet in fin whales.

Fig. 17 Average weight of testicles in different length on physical maturity (Blue whale)

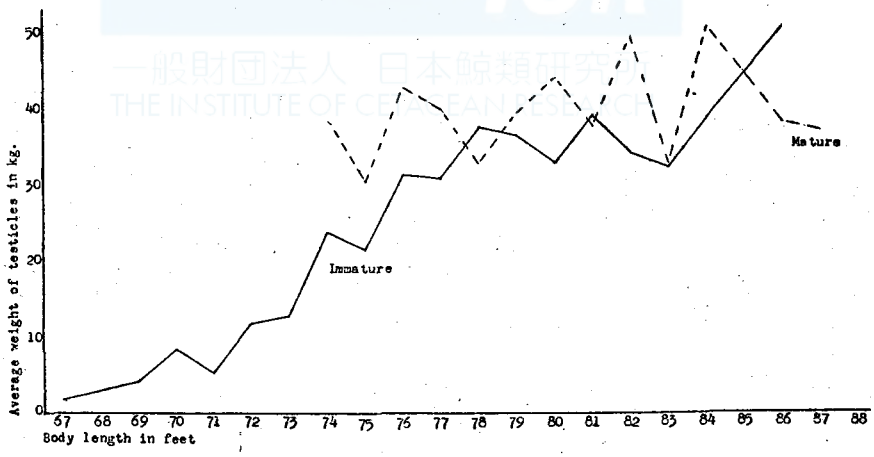
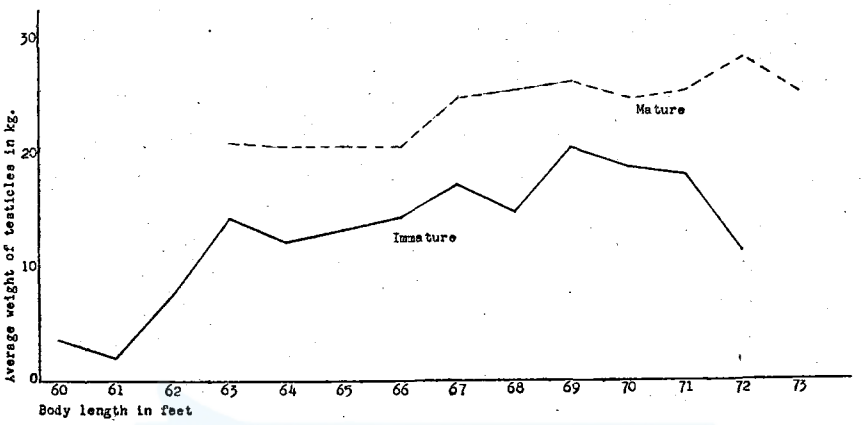


Fig. 18 Average weight of testicles in different length on physical maturity (Fin whale)



CHAPTER IV. Composition of Female Whales

I. Factors decisive in Determining Sexual Maturity of Female Whales.

In order to investigate the sexual maturity in cow whales, following points must be considered:

1. Presence of a foetus
2. Presence of corpora lutea in the ovaries
3. Size of the uterus
4. Size of the ovaries
5. Weight of the ovaries
6. Condition of the ovaries follicle
7. Condition of the mammary glands.

However, the present researches took chief account in the presence of copora lutea in the ovaries with additional considerations on 1, 5, 6 and 7.

II. Relationship between Body Length and the Number of Corpora Lutea.

Figs. 19 and 20 show the distribution of the number of corpora lutea according to body length. In Blue whales, the curve is gradual up to body length of 79 feet (uncer 3 corpora) but takes a sudden upward swing after it reaches 80 feet in length. The same is seen in Fin whales, the curve being gradual up to 65 feet body length (under 2 corpora) but becomes suddenly high at 66 to 67 feet length.

III. Average Length of Whales according to the Number of Corpora lutes.

Figs. 21 and 22 show the curves for average length of whales accor-

ding to the number of corpura lutera observed. In blue whales, the average length of body for those having 3 corpora lutea is 79 feet but those having 4 corpora suddenly goes up to 82 feet. In fin whales, those having 3 corpora lutea is 68 feet and those with 4 corpora, 70 feet. From Figs. 21 and 22 it can be seen that the average body length according to the number of corpora lutea is 84 feet in blue whales and 72 feet in fin whales. In other words, the standard body length in female blue whales is 84 feet and that in fin whales, 72 feet.

IV. Relationship between Sexual Maturity and body Length.

Fig. 23 shows the percentage curve of sexually mature (possessing corpora lutea) animals according to body length from which it can be seen that sexual maturity in blue whales is reached at about 78 feet and that in fin whale females at 67 feet.

Fig. 19 Length of whale and number of corpor lutea (Blue whale)

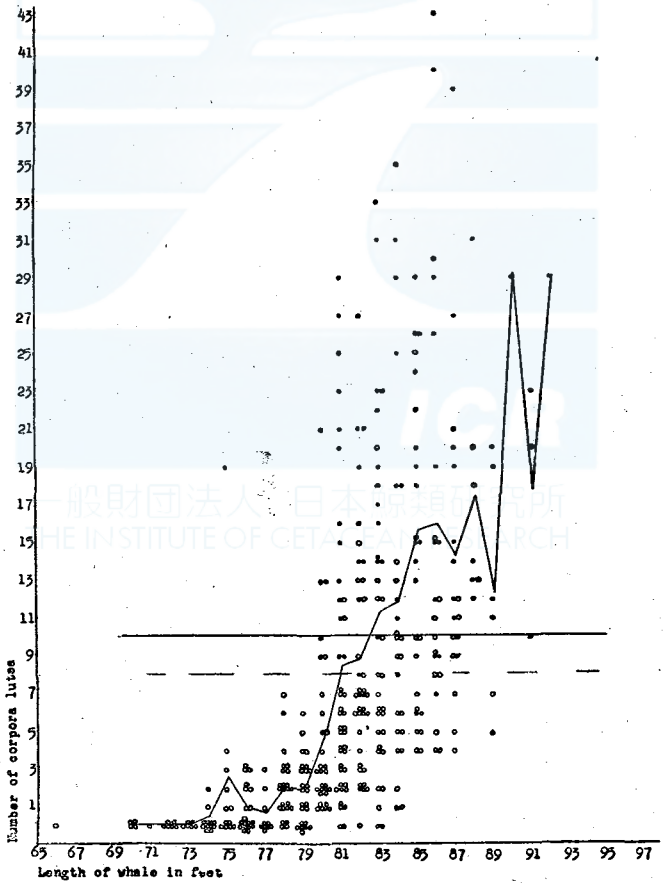


Fig. 20 Length of whale and number of corpora lutea (Fin whale)

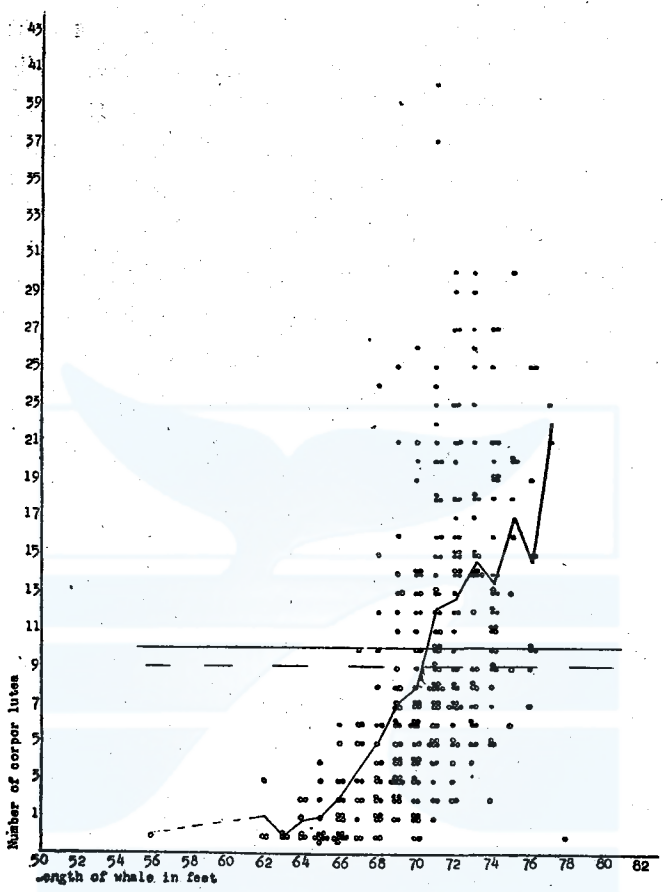


Fig. 21 Average length of whales in each class of corpora lutea numbers (Blue whale)

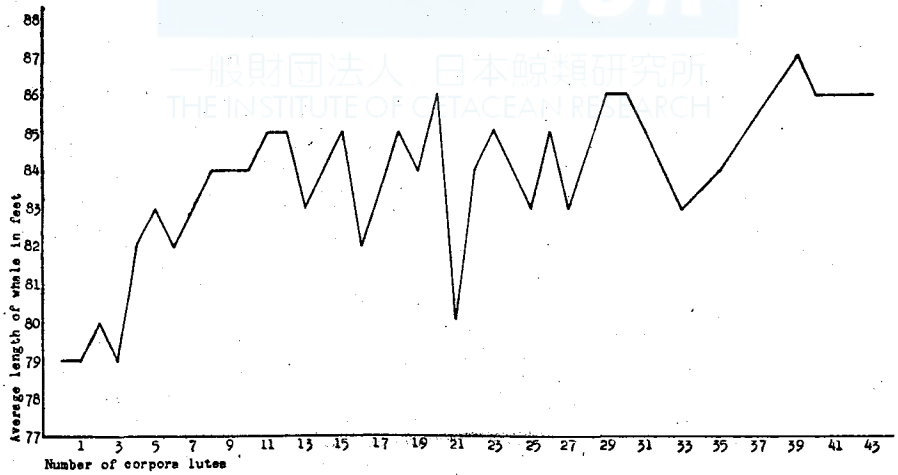


Fig. 22 Average length of whales in each class of corpora lutea numbers (Fin whale)

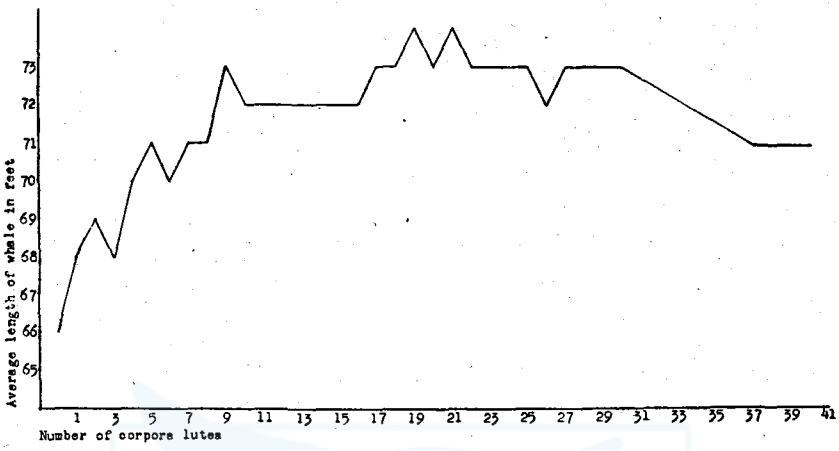


Fig. 23 Maturity curve on different length (Female)

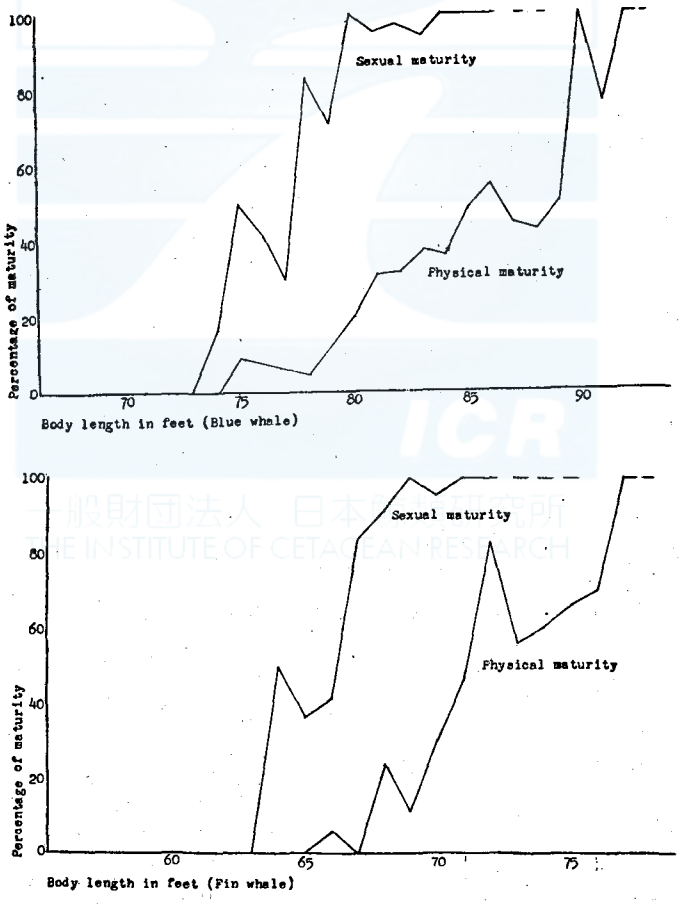
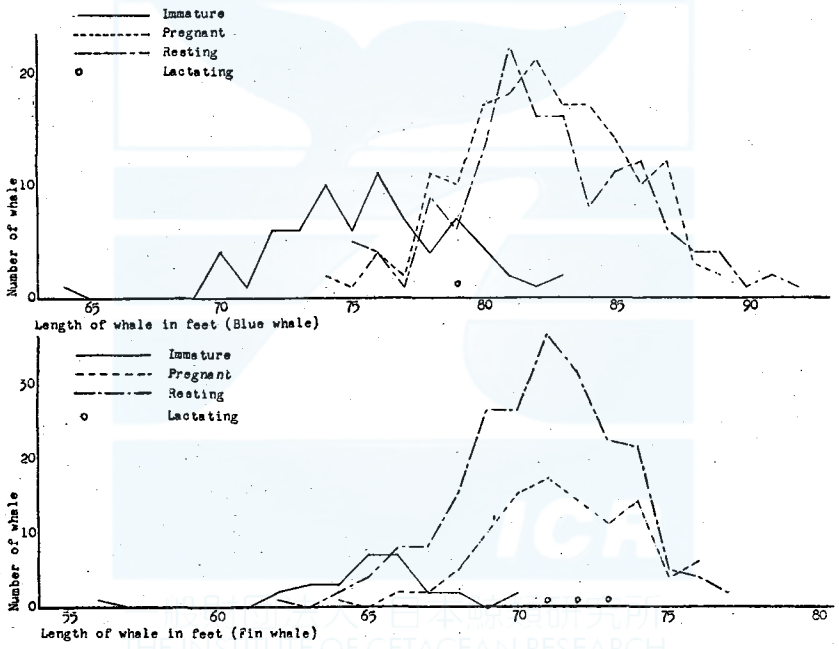


Fig. 24 shows the classification of female whales, indicated in the composition of whales taken, according to sexually immature, pregnant, resting and lactating by their body lengths.

In blue whales, the height of curves for the immature and the mature (resting and pregnant) are at different places. The trend of the curves for resting and pregnant match well and show that approximately half of the mature whales are pregnant.

In fin whales, there are a very small number of immature females due, probably, to the fact that whalers generally aim to catch large sizes. Approximately one-third of the mature females are pregnant and the trend of the curve by their body lengths is similar to the above.

Fig. 24 Maturity of female in all Japanese fleet



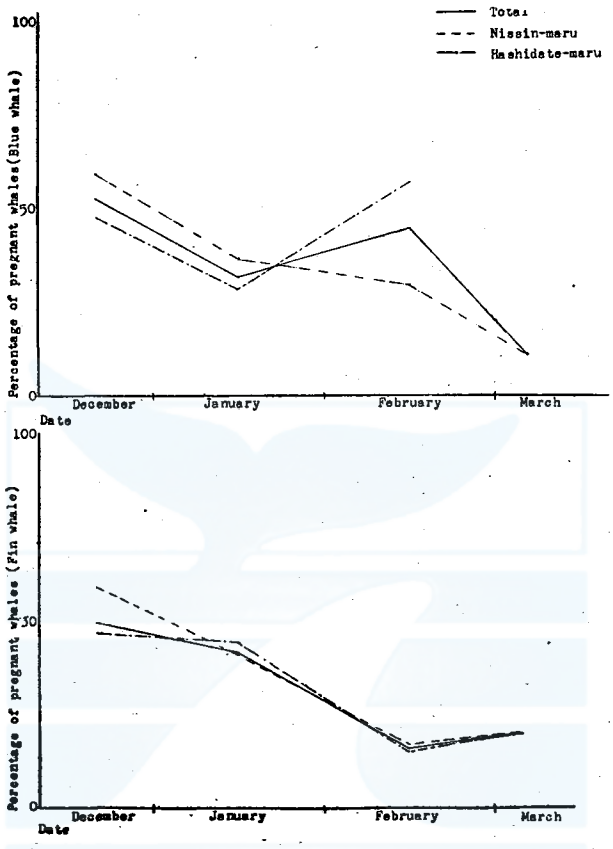
V. Monthly Ratio of Pregnant Whales.

Fig. 25 shows the monthly ratio of pregnant whales and endorses the views of previous workers in the pregnancy rate decreases monthly from December to March. Following figures show the pregnancy rate as a whole:

Table III

Whale speces	Pregnant	Resting	Lactating	Total Mature Female
Blue whales	162 53.29%	131 46.38%	1 0.33%	304
Fin whales	101 32.17%	210 66.88%	3 0.95%	314

Fig. 25 Percentage of pregnant whales in the catch by month
(contain the whale, which has function corpora lutea & no foetus)



VI. Relationship between the Number of Corpora Lutea and the Largest Graafian Follicles.

Figs. 26 to 31 show the results of observations on the relationship between the largest Graafian follicles and the number of corpora lutea. Due to the time allowed for handling, this work was carried out on 236 heads of blue whales and 221 heads of fin whales taken by Nisshin-maru.

Figs. 26 and 29 show the diameter of the largest Graafian follicle in each animal and the average in each body length class. Figs. 27 and 30 give the relation of the number of corpora lutea according to the body length (same as Figs. 19 and 20 but only on data from those taken by the Nisshin-maru). Althogh they fail to show, at first glance, any presence of a relationship between them, their average curve alone plotted on the same diagram show, as in Figs. 28 and 31, that there is a tendency of coinci-

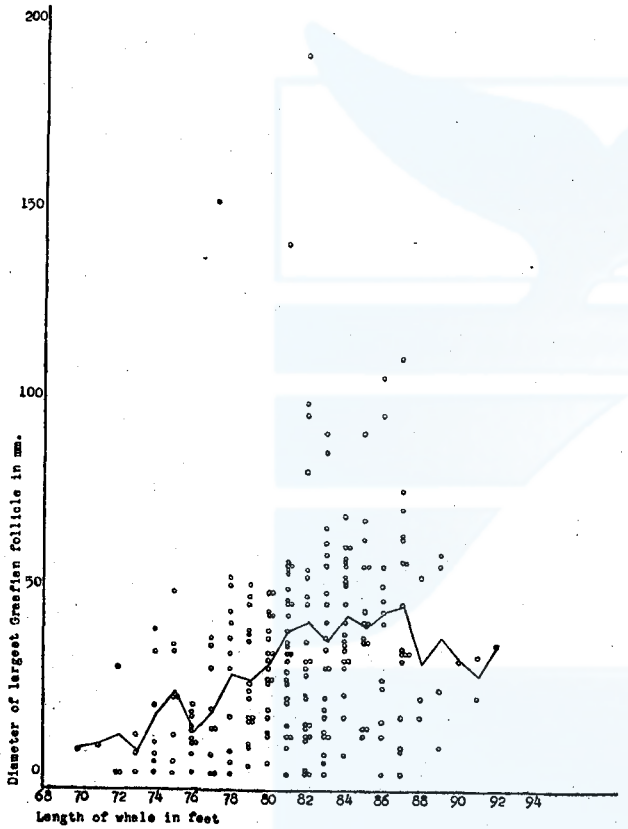


Fig. 26 Diameter of largest Graafian follicle (Blue whale) on Nisshin-maru No. 1.

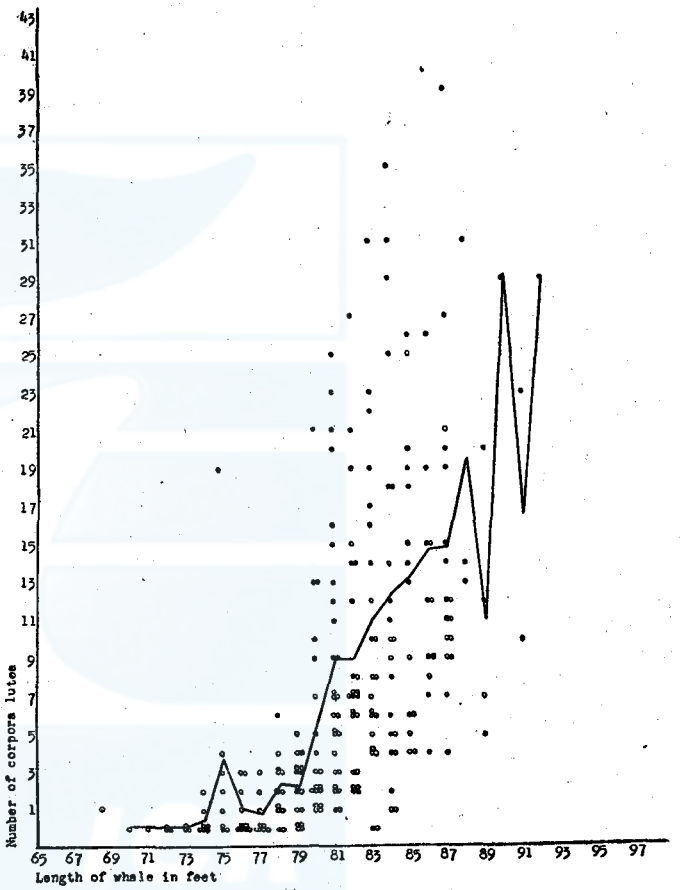


Fig. 27 Length of whale and number of corpora lutea (Blue whale) on Nisshin-maru No. 1.

Fig. 28 Average diameter of largest Graafian follicle and
Average number of corpora lutea on Nisshin-maru No. 1. (Blue whale)

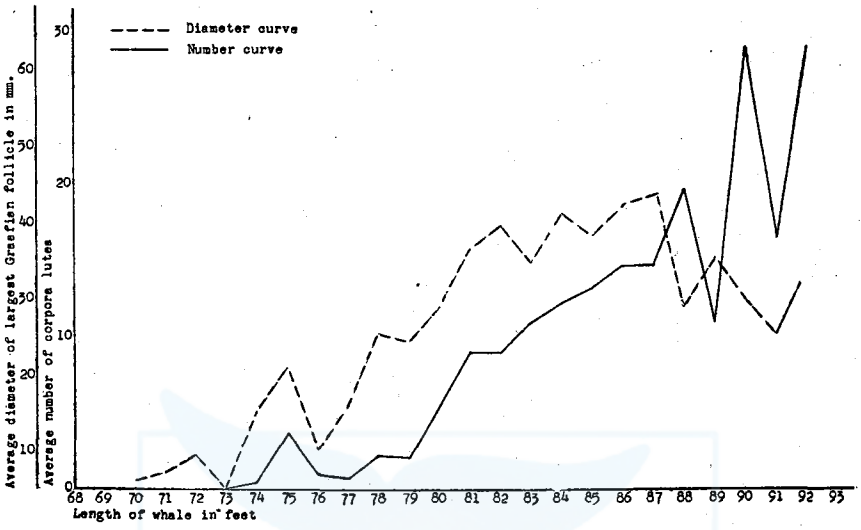


Fig. 29 Length of whales and Number of corpora lutea (Fin whale on Nisshin-maru No. 1.

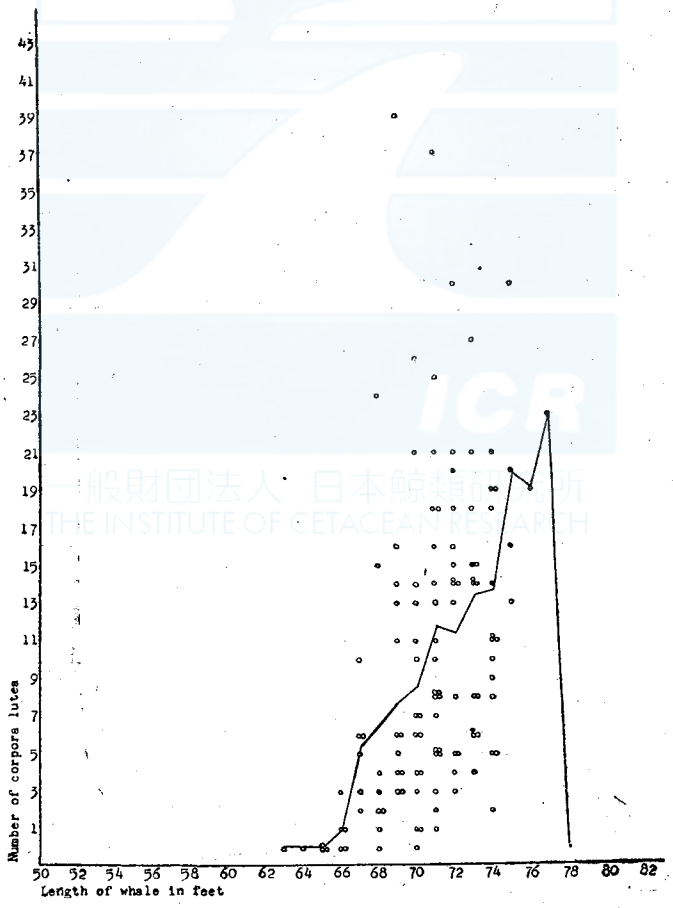


Fig. 30 Diameter of largest Graafian follicle (Fin whale) on Nisshin-maru No. 1.

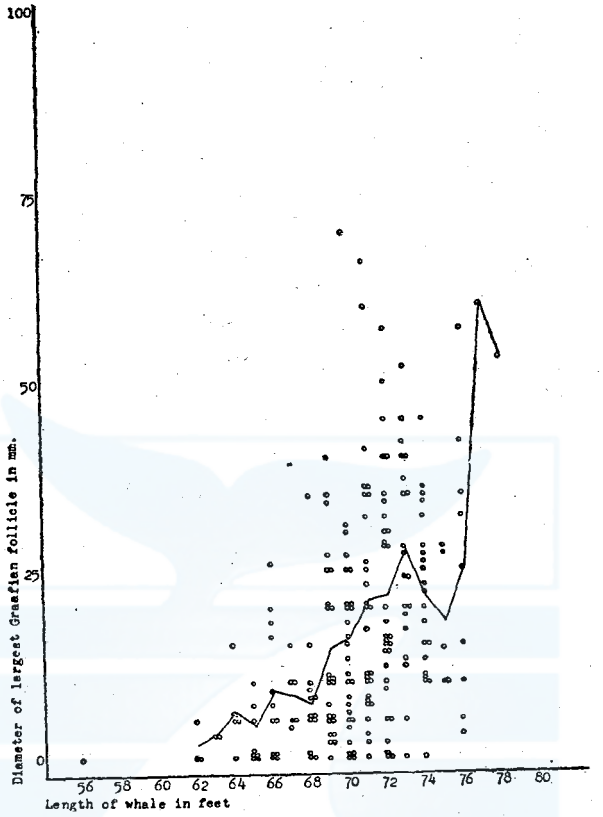
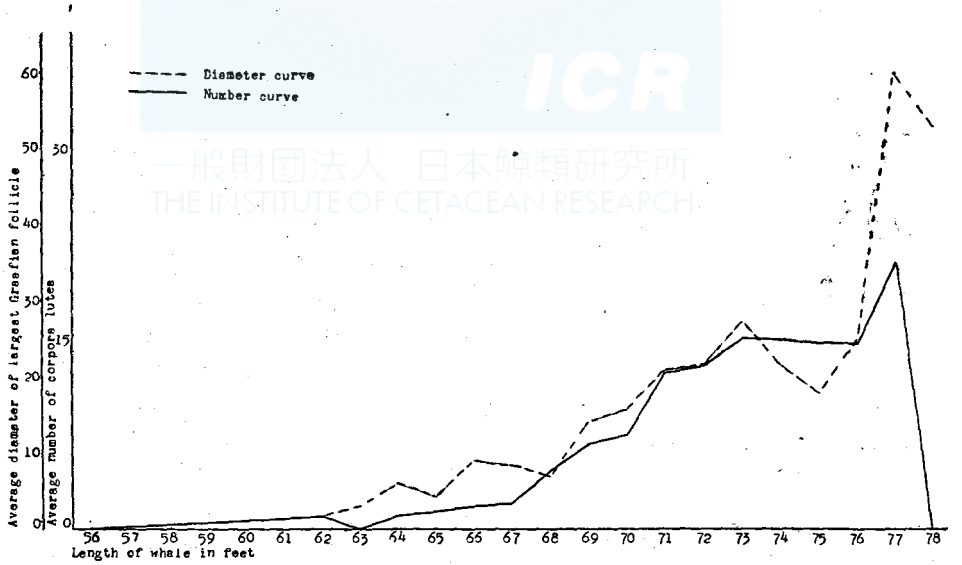


Fig. 31 Average diameter of largest Graafian follicle and Average number of corpora lutea on Nisshin-marn No. 1. (Fin whale)



dence. In other words, the appearance of the largest diameter in Graafian follicles appear with the increase in the number of corpora lutea, i. e. with advancing age.

VII. Frequency Curve for the Number of Corpora Lutea.

Figs. 32 and 33 show the frequency curve for the number of corpora lutea the peaks for wihch in blue whales occur at 2, 6, 9, 12, 15 and 19 (dotted lines show the value given in the Discovery Report). These peaks in fin whales occur at 2,, 5 7, 10, 14, 18 and 21, which coincide well with the peaks for fin whales of 1, 5, 7, 10, 13 and 15 obtained by summari-

Fig. 32 Frequency of numbers of corpora lutea (Blue whale)

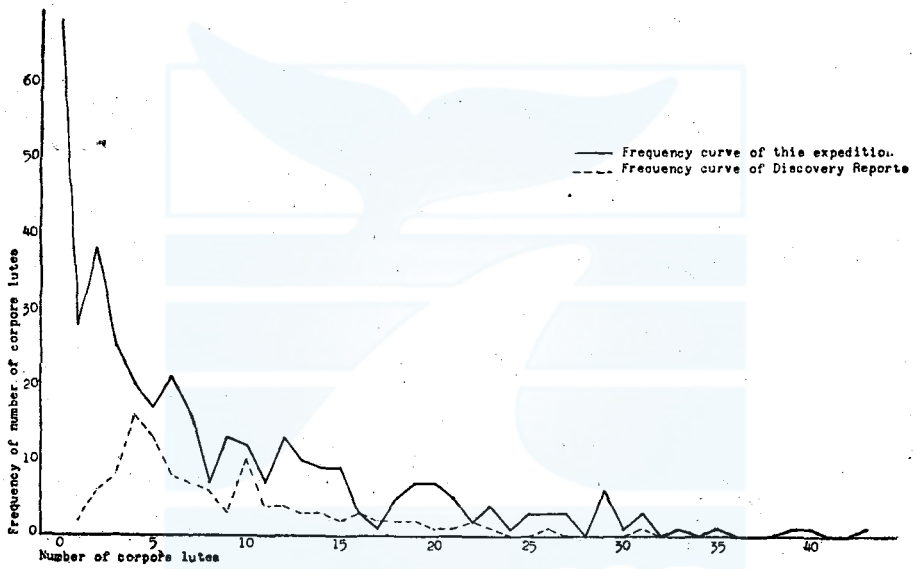
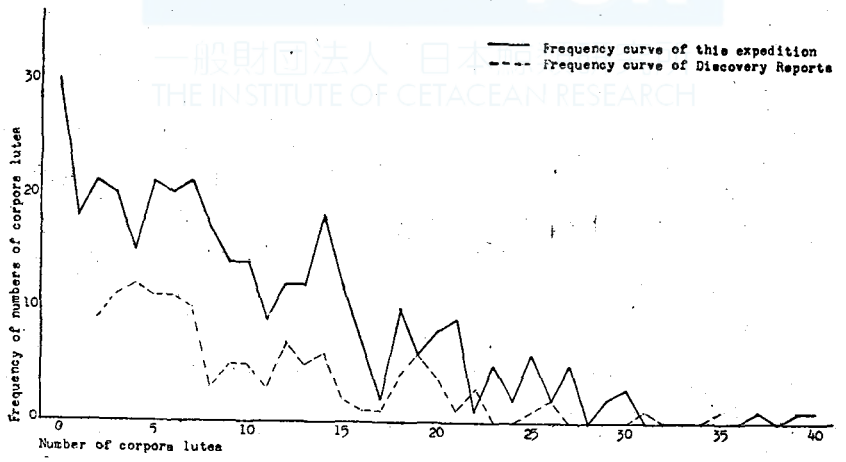


Fig. 33 Frequency of numbers of corpora lutea (Fin whale)



zation of various values obtained for Antarctic fin whales. These curves for fin and blue whales show that, especially in fin whales, there are small number of comparatively aged whales with over 13 corpora lutea. On the whale, there are more number of aged animals which seems to indicate the fact that the whaler go after larger animals when the composition of whales in general is getting younger.

VIII. Relationship between Sexual Maturity and the Weight of Ovaries.

Fig. 34 Average weight of ovaries on different length of whales (Blue whale)

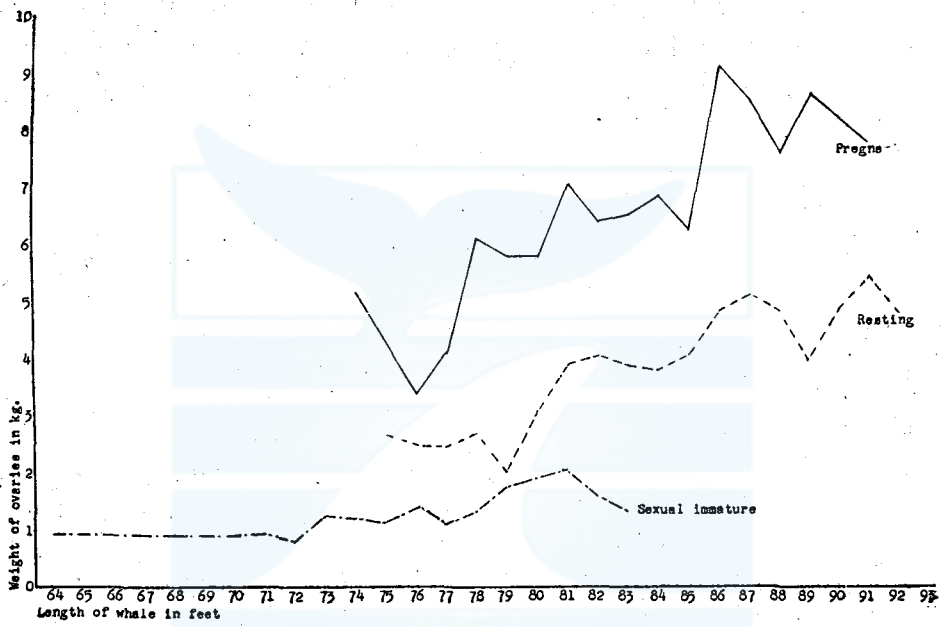
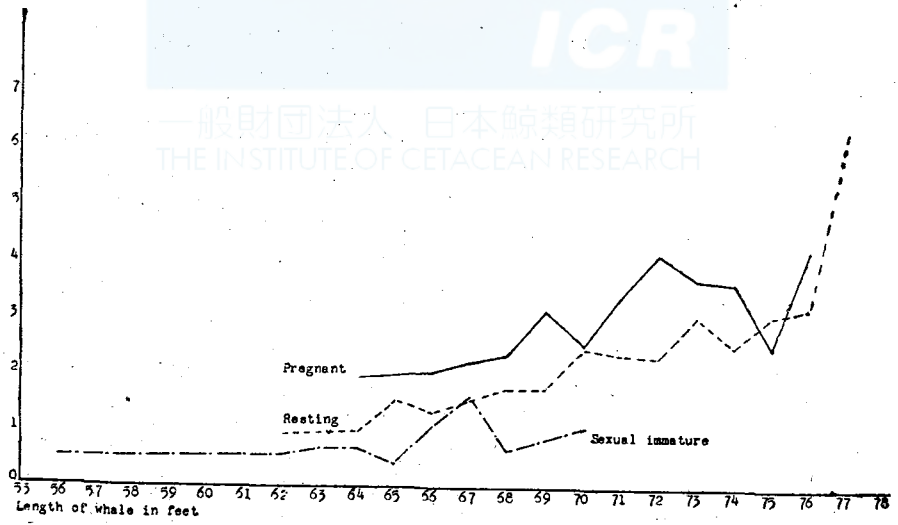


Fig. 35 Average weight of ovaries on different length of whales (Fin whale)



Figs. 34 and 35 indicate the weight of ovaries in sexually immature, resting and pregnant whales classified according to their body lengths. This coincides will data funrnished in the Discovery Report and needs no further comment.

IX. Average Number of corpora lutea according to Body length.

The number of corpora lutea averaged by body length in physically mature whales is shown in Figs. 36 and 37 (Cf. Figs. 19 and 20), Fig. 25 shows the physical maturity curve given by the percentages of the above. From these figures, it can be said that the body length of physically mature animals is about 85 feet for blue whales and about 71 feet for fin whales.

Fig. 36 Average number lutea indifferent length on physical maturity

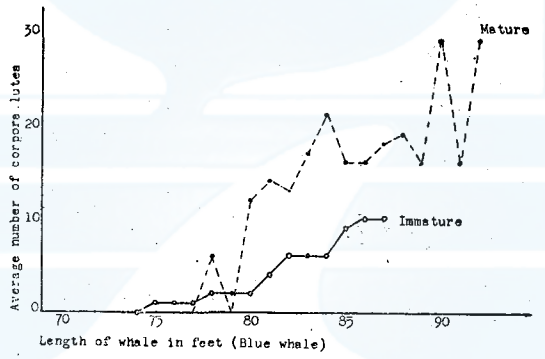
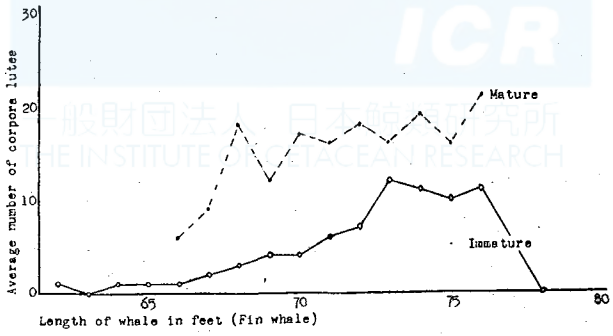


Fig. 37 Average number lutea indifferent length on physical maturity



X. Mammary Glands.

The present investigations were carried out on the colour and thickness of mammary glands on 372 heads of blue whales and 345 heads of Fin whales, values taken being the average of them all. Those classified as

lactating are animals from which even a drop of milk was observed during treatment, others being classified as "not lactating." The latter was again divided into pregnant, resting and immature according to the condition of the ovaries; e. g. those possessing functional corpora lutea classed as the "pregnant" (functional corpora lutea of pregnancy and of ovulation were

Fig. 38 a Average thickness of mammary glands in different length (Blue whale)

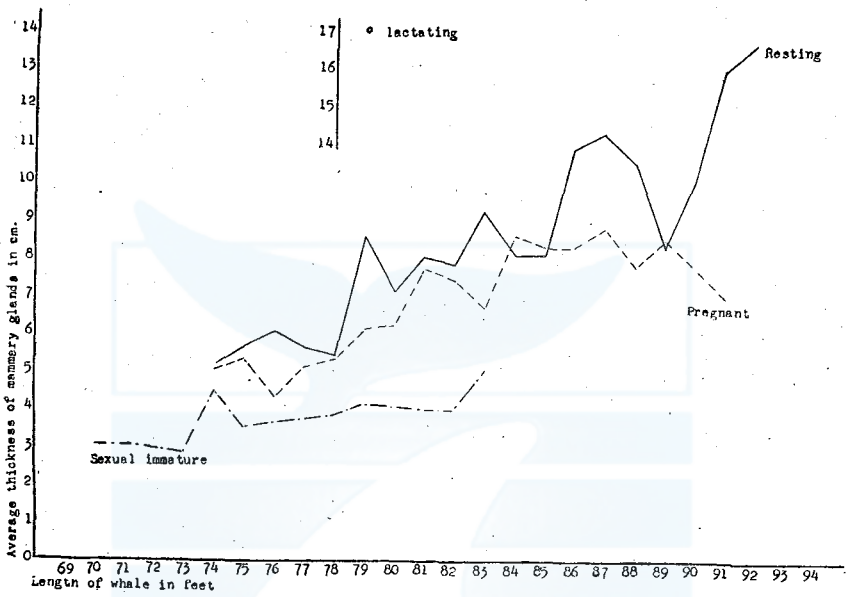
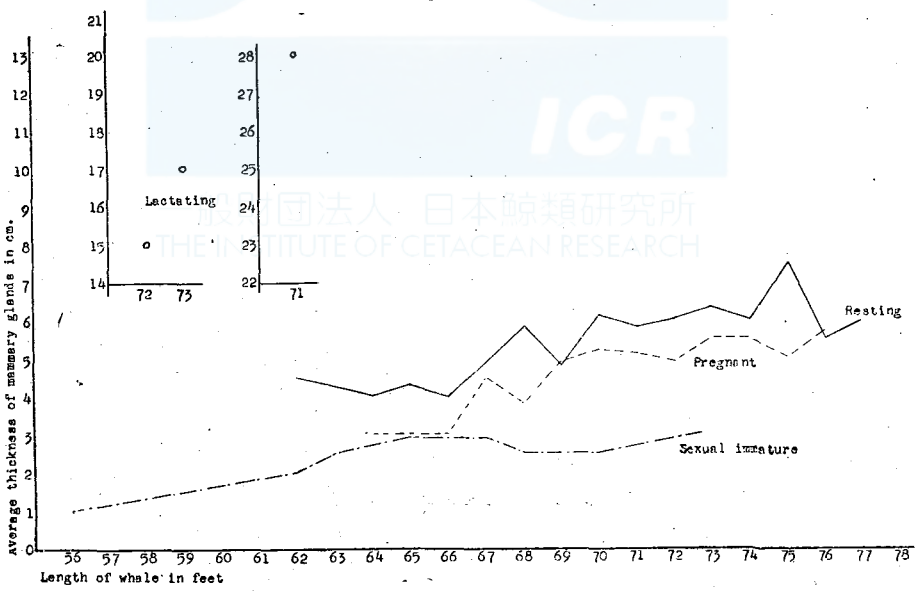


Fig. 38 b Average thickness of mammary glands in different length (Fin whale)



not classified), those possessing no corpora lutea in the ovaries as the "immature" and others as "resting". Figs. 38 and 39 show these averages according to body length. It is noted that both the immature and other curves increase with the increase in body length while that for lactating is in a place by itself with no relation to the former.

There are always a great variations in colour of mammary glands but they have been averaged as follows:

As a whole, the colour of mammary glands in young whales is pale which increases in tone as the whales grow older. In aged animals, the colour becomes deep brown. The colour of mammary glands in lactating whales is orange tinted, irrespective of their age. This tendency is in keeping with the fact that the thickness of mammary glands and that of blubber always change irrespective of the age of whales.

Following table shows the percentage rate in colour of mammary glands in blue whales.

Table IV. Colour of mammary glands in blue whales

Nisshin-maru

		White	Pink	Ivory	Cinnamon	Reddish Yellow	Tawny	Brown
Immature	No.	10	7	7	6	3	2	
	%	28.6	20.0	20.0	17.1	8.6	5.7	
Resting	No.	2	3	3	22	25	34	7
	%	2.1	3.1	3.1	22.9	26.1	35.4	7.3
Pregnant	No.	2	2	5	23	22	38	5
	%	2.1	2.1	5.2	23.7	22.7	39.2	5.2
Lactating	No.						1	
	%						100	

Hashidate-maru

		White	Pink	Cinnamon	Tawny	Brown
Immature	No.	14	3	15	1	
	%	42.4	9.1	45.5	3.1	
Resting	No.	1	4		9	3
	%	5.9	23.3		52.9	17.3
Pregnant	No.	2	10	29	11	14
	%	3.0	15.2	42.9	16.7	21.2
Lactating	No.					
	%					

Following table shows the percentage reate in colour of mammary gland in fin whales.

Table V. Colour of mammary glands in Fin whales

Nisshin-maru

		White	Pink	Ivory	Cinnamon	Reddish Yellow	Tawny	Brown
Immature	No.	13	4		4			
	%	62.0	19.0		19.0			
Resting	No.	5	4	3	46	40	31	4
	%	3.8	3.0	2.3	34.6	30.2	23.3	3.0
Pregnant	No.	1	2	1	26	17	15	2
	%	1.6	3.1	1.6	42.6	26.6	23.5	3.1
Lactating	No.						1	
	%						100.0	

Hashidate-maru

		White	Ivory	Cinnamon	Tawny	Brown
Immature	No.	4	1	4		
	%	44.5	11.0	44.5		
Resting	No.	2	9	35	14	10
	%	2.9	12.9	50.0	20.0	14.2
Pregnant	No.	2	6	14	10	6
	%	5.3	15.8	36.8	26.3	15.8
Lactating	No.				2	
	%				100.0	

CHAPTER V. Foetuses

Main growth curves for 162 heads of blue whale foetus and 101 heads of fin whale foetus, classified according to the date their mothers were caught and by body length, were taken. There were nothing new to be learned from them, only endorsing the data contained in the Discovery Report. The monthly mean body length on the curves, especially, coincided with the older data.

The sex ratio of the foetuses is as described in previous chapter. On the whole, there were 48.8% male in blue whales and 57.4% male in fin whales and 57.4% male in fin whales. The smallest foetus was that measuring 10.6 inches in the blue whale and 7.9 inches in the fin whale, while the largest obtained was 22′ 2″ in the blue whales and 15′ 3″ in fin whales.

Fig. 39a Mean growth curve of foetuses (Blue whale)

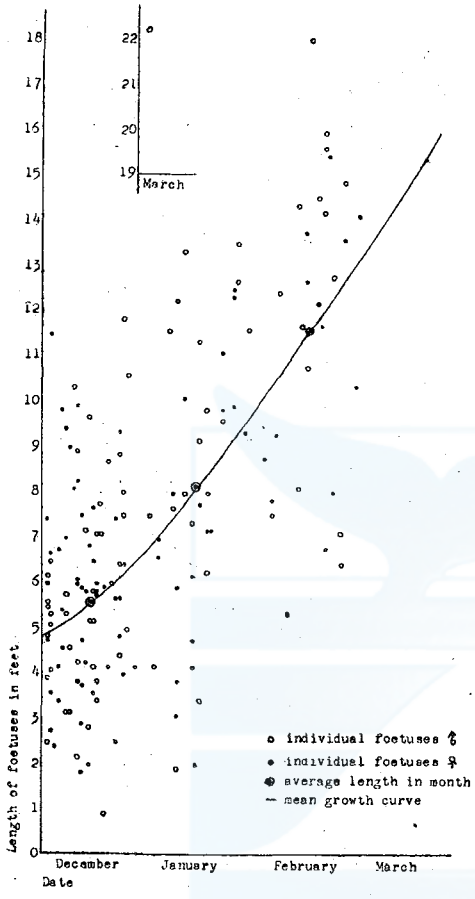
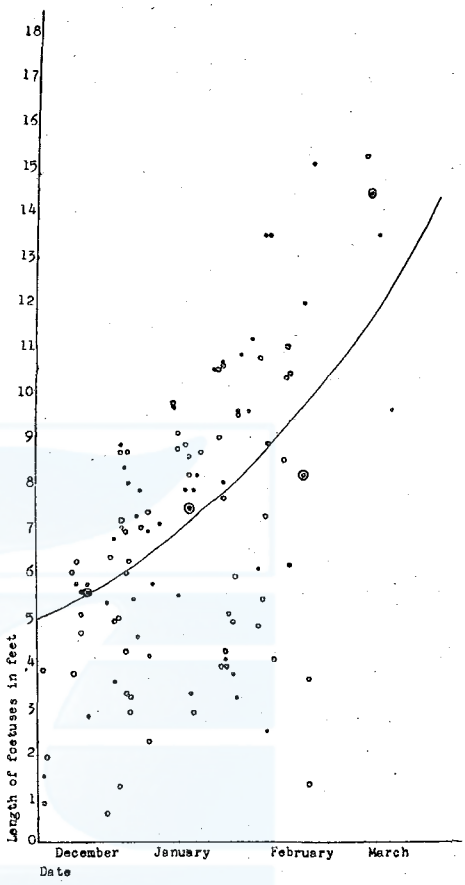


Fig. 39b Mean growth curve of foetuses (Fin whale)



CHAPTER VI. External Characters

I. Colour.

There are many reports on the colour of whales. Observations on the colour of blue whales during the present expeditions followed the notations made by Mackintosh and Wheeler on pale spots, i. e. "most of the body is covered with a pale mottling which consists of small, roughly oval marks of colour which is similar to, but lighter than the blue-grey background", on their clarity and number, and on white flecks on which the two authors say that "those pale spots may also be seen here and there on the ventral grooves". The clarity on the appearance of striation on the ventral surface of tail flukes was also shown by percentages. These results are shown in Table VI. The name of the fleet was noted in because of the fear that

personal view may differ in individual cases.

Table VI.

Pale sport

Sex	MALE				FEMALE			
Fleet	Hashidate-maru		Nisshin-maru		Hashidate-maru		Nisshin-maru	
Grading of Nos.	No.	%	No.	%	No.	%	No.	%
0	0	—	0	—	0	—	0	—
1	7	52.0	39	19.5	4	3.1	40	18.1
2	17	12.6	2	1.0	26	19.8	8	3.4
3	58	43.0	40	20.0	52	39.7	45	19.2
4	44	32.6	84	42.0	43	32.8	93	39.8
5	9	6.6	35	17.5	6	4.6	48	20.5
Clarity								
0	0	—	0	—	0	—	0	—
I	19	16.1	40	20.0	10	8.3	29	12.4
II	34	28.8	139	69.5	24	19.8	177	75.6
III	15	55.1	21	10.5	87	71.9	28	12.0
White Flecks								
0	0	—	1	0.5	0	—	4	1.7
1	17	12.7	71	35.5	20	15.1	63	26.8
2	39	29.1	13	8.5	26	19.7	15	6.4
3	48	35.8	35	17.5	53	40.2	64	27.2
4	27	20.1	55	27.5	24	18.2	48	20.4
5	3	2.3	25	12.5	9	6.8	41	17.5
Striation								
0	0	—	3	1.5	0	—	4	1.7
I	36	26.9	64	32.0	42	31.3	75	31.0
II	43	32.1	102	51.0	39	29.1	115	48.9
III	55	41.0	31	15.5	53	36.6	41	17.5

On the colour of fin whales, Mackintosh and Wheeler says in their Discovery Report, that "the most obvious feature is that pigment covers the whole of the back and flanks, while the ventral surface remains unpigmented". This shading of body colour over the back and flanks (not darkened due to light and air), extention of pigment over the ventral surface, as follows, were examined:

i) Extention of the blackened area of the back over the ventral groove as though by brush;

ii) Extention of the blackened area of the back and flanks in tongue-like form towards anus from the tail; and

iii) Whether the blackened area of back and flanks meet form either

side just in front of the tail flukes.

Table VII shows the number of whales in percentage on above points.

Table VII

Sex		MALE				FEMALE			
Fleet		Hashidate-maru		Nisshin-maru		Hashidate-maru		Nisshin-maru	
Classification		No. of whales	%	No. of whales	%	No. of whales	%	No. of whales	%
Normal colour		67	81.7	154	87.5	83	68.6	205	92.7
Blackened colour		15	18.3	22	12.5	38	31.4	16	7.3
Extention of Pigm.	High	13	15.1	49	27.8	25	20.2	36	16.3
	Norm.	50	58.1	102	58.0	61	49.2	130	58.8
	Low	23	26.8	25	14.2	38	30.6	55	24.9
Tongue of Pigmentation beh. anus	+	70	81.4	102	92.0	89	72.9	183	82.8
	−	16	18.6	14	8.0	33	27.1	38	17.2
Meeting of Pigmentation in front of flukes	+	73	85.9	99	56.3	90	73.8	110	49.8
	−	12	14.1	77	43.7	32	26.2	111	50.2

As a result of foregoing data, the normal body colour of whales can be summarized as follows:

In blue whales, pale spots do not appear collectively but is dispersed; there are 6 or 7 spots, normally, of a size about (4×6) cm 2 in an area of 1 m^2. The clarity of these spots is distinct. The white flecks are also dispersed in an area about 1/3 behind the ventral grooves. The striation is normally distinct and there can be seen no difference between sexes.

In fin whales, the normal body colour is slate-gray, and the extention of pigmentation to the ventral groove is on the 11th or 13th from the navel line, neither higher nor lower. The tongue of pigmentation behind anus is normally present. The pigmentation also normally meets in front of the tail flukes. Here, also, it is hard to distinguish the sexes according to body colour.

Although the distinct white flecks seen in blue whales seem to be due to old age, the difference in body colour due to age is very slight.

II. Proportion of Body Length.

At the time of the weighing of whales on the Hashidate-maru, measurement of body proportion was also carried out (Cf. Table IX). According to Mackintosh and Wheeler, the proportion of anterior part of the body becomes larger with the increse of body length, both in blue and fin whales. However, since the measurements made were small and the range

narrow in the present investigations, no calculations were made on the mean values and their distribution according to body length group. There were evidence, however, of the proportional increase of anterior portion of the body and decrease in the posterior portion with the increase in age, not necessary with body length. From what measurements that were made during this expedition, no distinctive relationship can be seen between the body length and its proportions.

From the relationship between the number of corpora lutea and body proportion in female whales, as shown in Fig. 40, it can be seen in Nos. 3, 5 and 6, especially in 3 and 5, that the proportionate percentages of anterior portion increase with the increase in the number of corpora lutea. In the measurement of posterior portion, as in Nos. 8, 10, 11 and 12, the proportionate percentage apparently decrease with the increase in the number of corpora lutea. (Numbers used here refer to the investigation Nos. as explained in the "Method of work" in the Introduction).

III. Proportions of Body Weights.

Total weight of foetus was measured on 30 heads of blue whales and 16 heads of fin whales. Foetuses were cut into blocks of about 30 to 50 kg. each and weighted on a platform scale of 200 kg. capacity. Some of the body fluid has naturally been lost during the process so that the weight cannot be taken as the true weight.

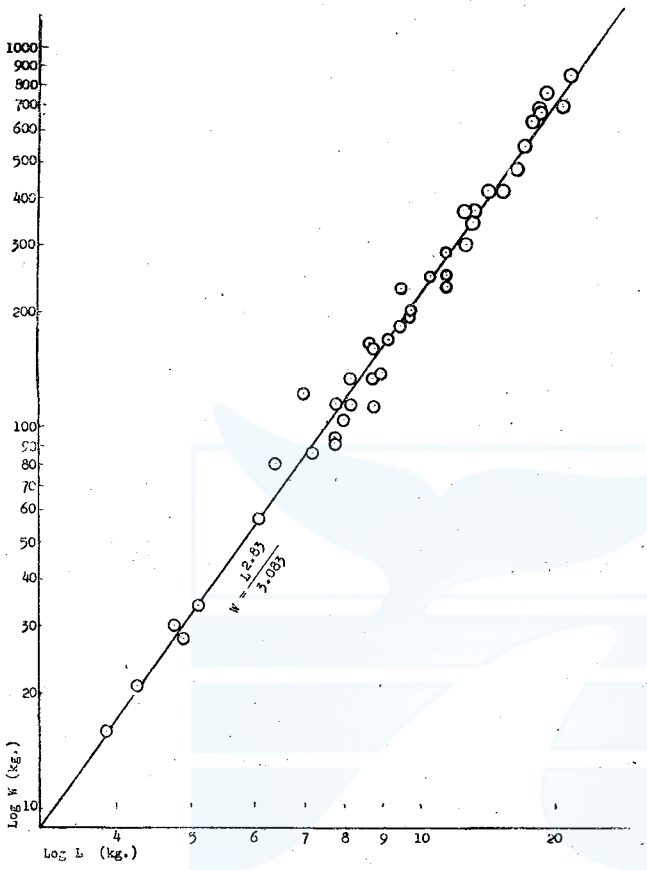
The relationship between body length, L (ft.), and body weight, W (kg.), obtained by the least squares, from all the measured, values on blue and fin whales, is as shown in Fig. 40a, the regression line in these samples being

$$W=\frac{L^{2.83}}{3.083} \quad \cdots\cdots(1)$$

for the foetusess of blue and fin whales.

Weight of variously dissected parts were weighed in a box placed on the said platform scale on 4 heads of male and 10 heads of female blue whales and 2 heads of male and 3 heads of female fin whales on the Nisshin-maru, and on 7 heads of male and 9 heads of female blue whales, and 4 heads of male and 7 heads of female fin whales on the Hashidate-maru (Cf. Table X). At the same time, oil production of these various parts were measured by the readings on oil tank gauge from part of these material. Since the total weight of various parts could not be obtained

Fig. 40a Weight-length relation of foetuses (Blue & Fin whale)



due to loss of body fluids, excreta, urine and stomach contents, overall weight of a whale could not be taken. If on the other hand, the proportion of were the same in whales, their relationship to each other would be similar to the total body weight. Fig. 40 b shows the total weight plotted according to body length.

Although the process of dissection of the two fleets differed slightly, there would be no effect on the measured values with the exception of one or two points. In grand total, especially, same items have been inculuded on values from both fleet.

Total weight: Measurements were made on 30 heads of blue and 16 heads of fin whales. Their regression line, measured as for foetus, obtained from the specimens by the least squares, are

$$\text{Blue Whales} \cdots\cdots W = \frac{L^{3.5}}{5.27 \times 10^4} \cdots\cdots (2)$$

$$\text{Fin whales} \cdots\cdots W = \frac{L^{2.9}}{4.30 \times 10^2} \cdots\cdots (3)$$

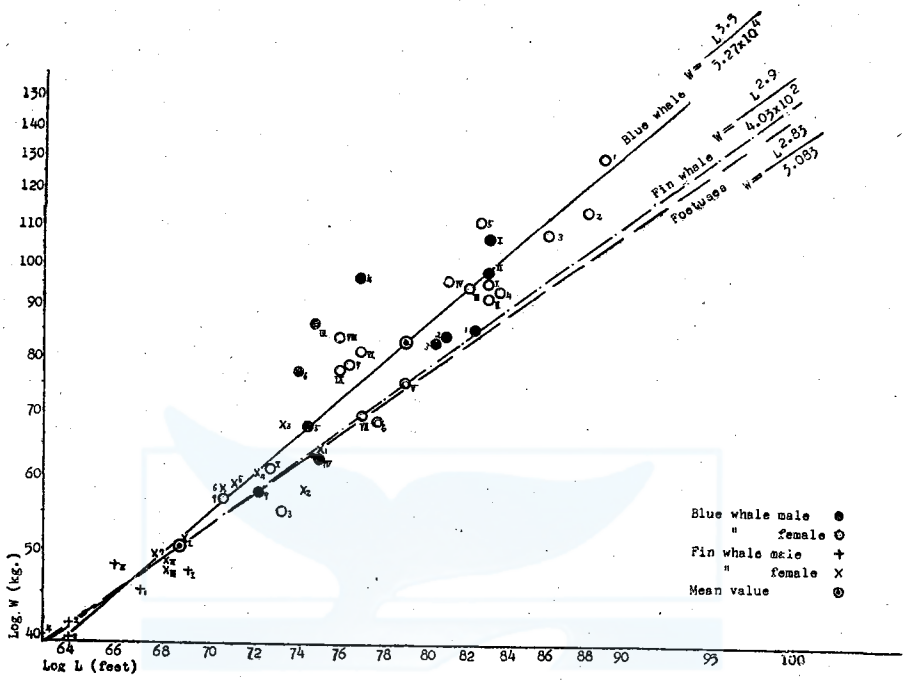
CHAPTER VII. Thickness of Blubber

I. Sites of Measurement

Thickness of blubber was measured in following places:

Point 1-- The point on the horizontal cut side of the body (at the

Fig. 40b Weight-length relation of whales (Blue & Fin whale)



position of lateral line in fish), where it intersects a vertical line from the dorsal fin.

Point 2— The point on the vertical cut near the earhole, where it intersects a mid-dorsal line.

II. Average Thickness of Blubber according to Sexes and Body Length measured on the Nisshin-maru Fleet.

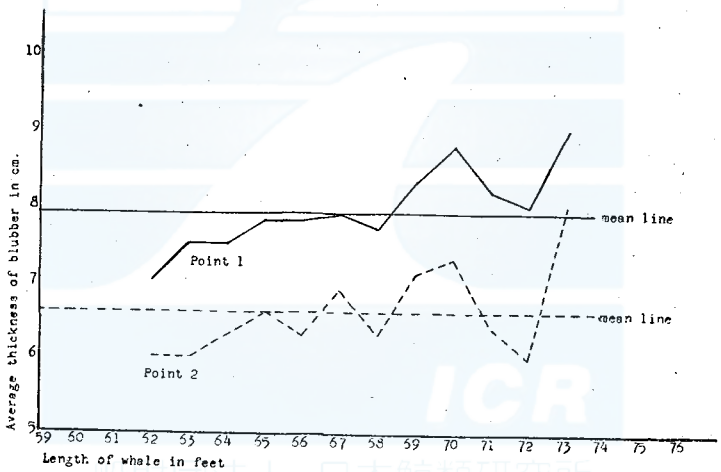
Figs. 41 to 44 show mean values measured by the Nisshin-maru Fleet on the thickness of blubber according to sexes and body length. Figs. 41 and 42 show curves for male whales and indicate that the thickness approximately increases in proportion to body length. It is interesting that in blue whales, thickness becomes less with age when the animals attain sexual maturity. Curves in Figs. 43 and 44 represent those for females which peculiar modes appear every 3 feet in blue whales and every 4 feet in fin whales.

III. Monthly Change in the Thickness of Blubber.

Average percentage monthly change of the thickness of blubber by body length are shown in Figs. 45 and 46. From these Figures, it can be seen that the thickness of the blubber increases during December to March,

Fig. 41 Variations of thickness of blubber in length of whales (Male Blue whale)

Fig. 42 Variations of thickness of blubber in length of whales (Male Fin whale)



i. e. the summer months in the Antarctic, irrespective of the sexual state of the whales. In other words, the state of nutrition of the whales become better during these months. This is particularly remarkable in blue whales.

Due to the lack of whales in lactating stage, no curve for such animals was obtained but this has been noted in places. As can be seen from the Figures, the thickness is remarcably small which seems to have a relative connection with the fact that the thickness of mammary glands in lactating whales is conspicuously thick.

Fig. 43 Variations of thickness of blubber in length of whales (Female Blue whale)

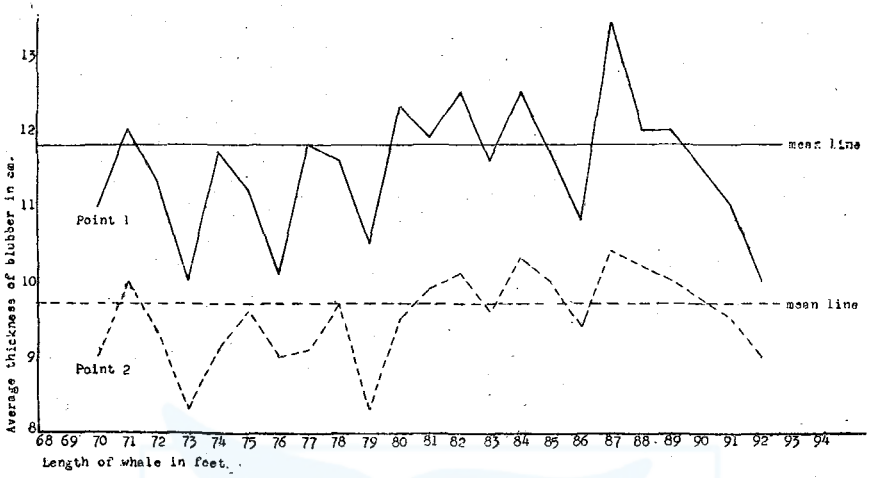
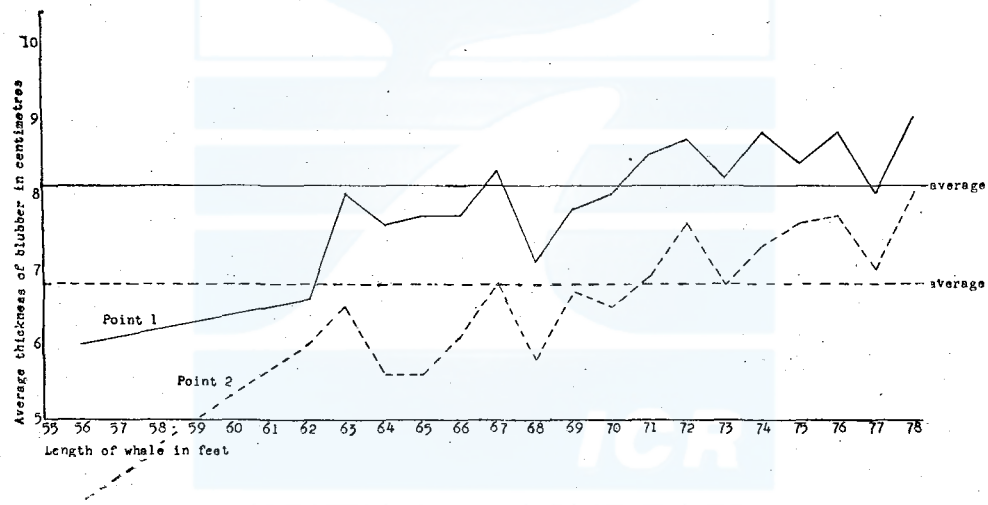


Fig. 44 Variations of thickness of blubber in length of whales (Female Fin whale)



IV. Relationship between the Thickness of the Blubber and Body Length as measured on the Hashidate-maru Fleet.

The coeficient of the thickness of blubber is shown by $D/L \times 10$ where D denotes the thickness of blubber in cm., and L, the body length in feet. Distribution of its mean value at Point 1 (at the side of the body) is shown in Figs. 47 and 48. In general, both the male and female blue whales coefficient of from 0.09 to 2.0, the peaks being presentat 3 points between 1.1—1.5. In Fin whales, the coefficient is distributed between 0.7 to 1.5, peaks being present in 1 to 3 places between 0.9 and 1.3.

V. Relationship between the Thickness of Blubber and Body Length by

Fig. 45 Monthly average thickness of blubber (Blue whale)

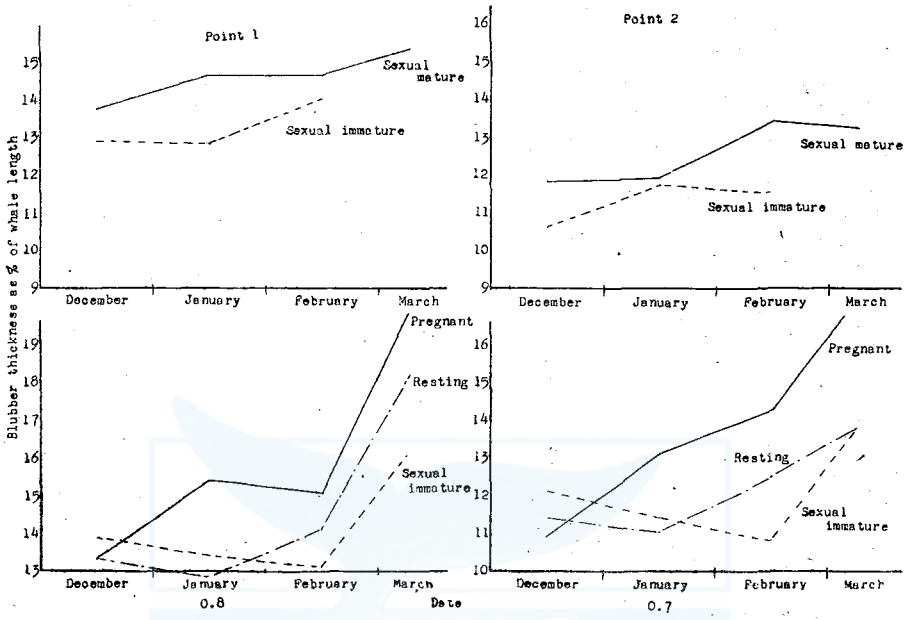
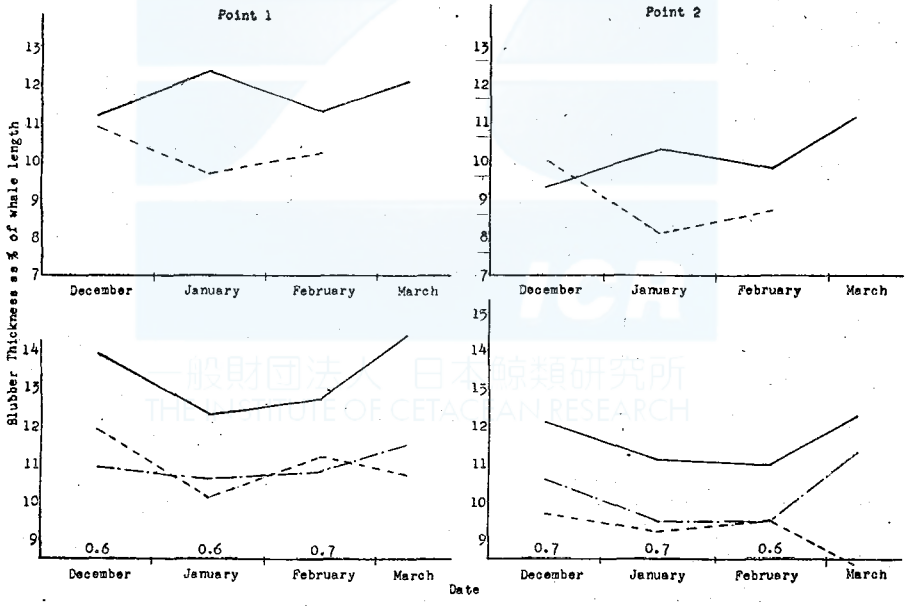


Fig. 46 Monthly average thickness of blubber (Fin whale)



the Degree of Sexual Maturity, as measured on the Hashidate-maru.

The distribution of mean values as shown in Figs. 47 and 48 can be divided into several groups by the mature and immature in males, and inmmature, pregnant and resting in females. These are as shown in Figs.

Fig. 47 Tickness of Blubber (Blue whale)

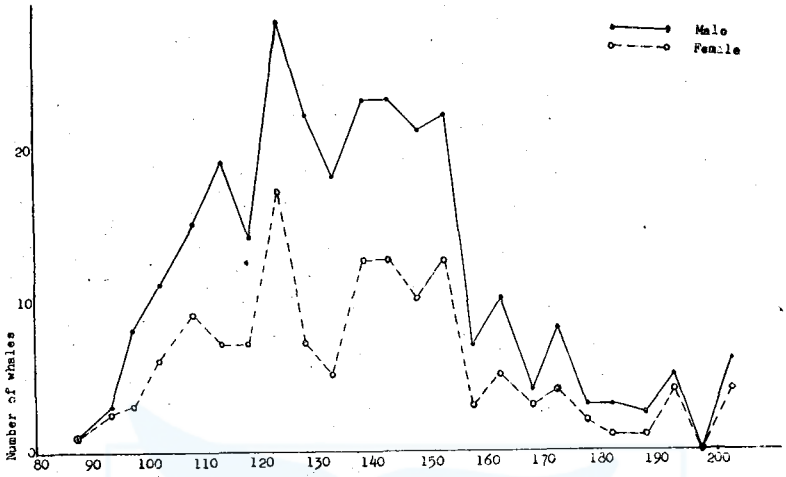
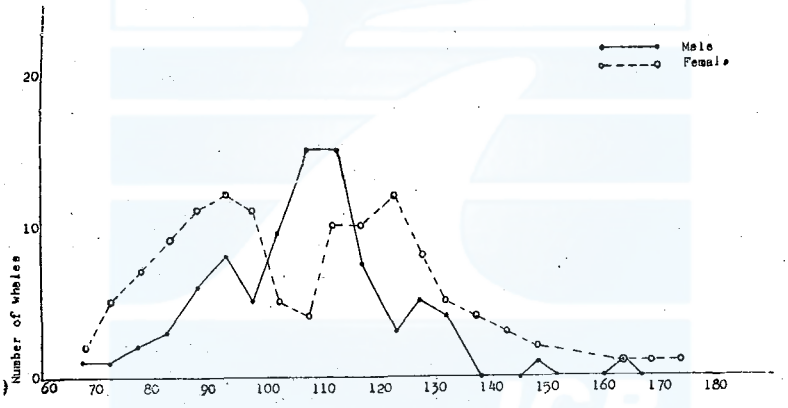


Fig. 48 Tickness of Blubber (Fin whale)



49 and 50 which indicate that in immature whales both male and female, the average value is distributed between 1.0–1.4 and seems to have a uniform mode, although the trend is not remarkable probably due to the small number of whales measured. The mode in mature males is at 1.3, especially that in whales from the Ross Sea being at 1.5, showing clearly the difference in the thickness of blubber. The distribution is broader both in the pregnant and resting, although the distribution in the pregnant whales is slightly higher. In both cases, whales from the Rose Sea contains larger proportion of higher coefficients.

The coefficient for immature fin whale males is situated around 0.9—1.0. There is no remarkable difference in females according to month, but

Fig. 49 Tickness of Blubber (Blue whale)

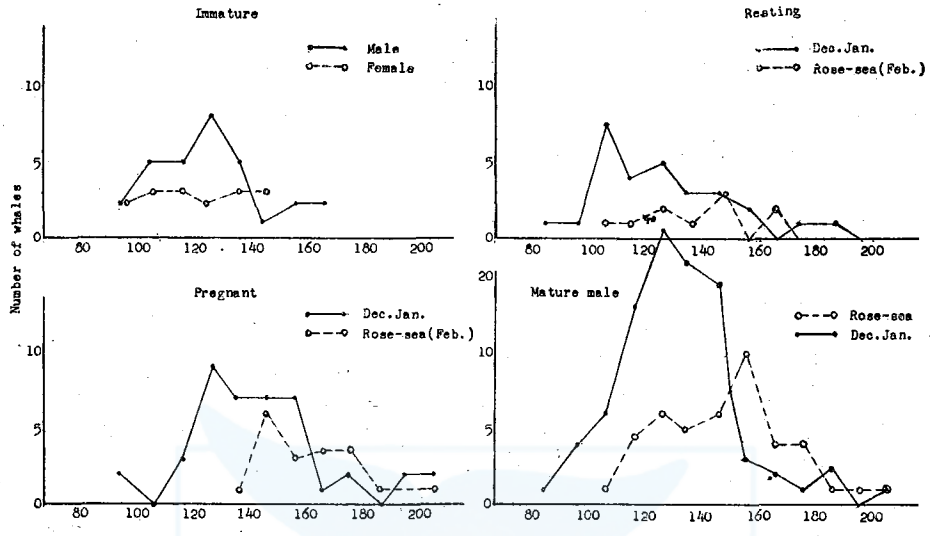
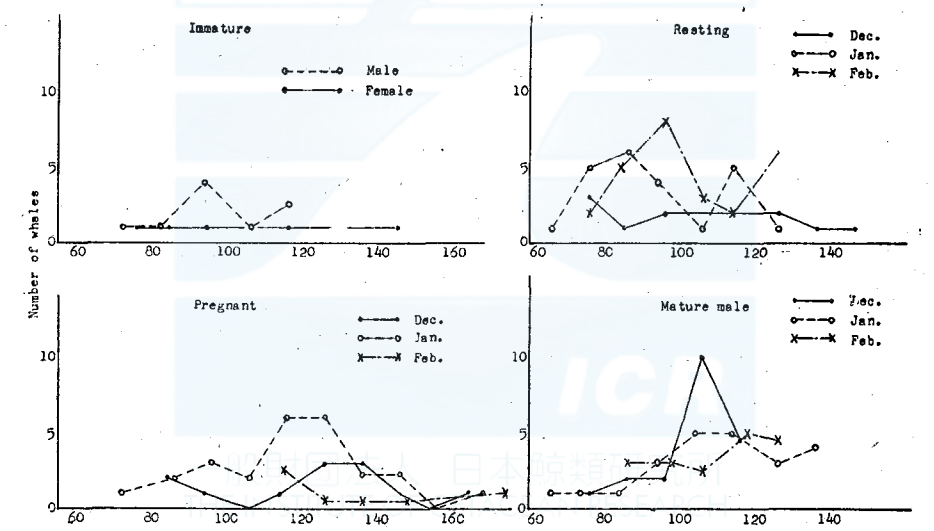


Fig. 50 Tickness of Blubber (Fin whale)



in the pregnant and resting whales larger coeficients increase as the month advances. On the whole the difference in the coefficients between blue and fin whales seem to be essential.

CHAPTER VIII. Food

I. Krills and Other Fish

The present investigation also disclosed the fact that the chief food of the blue and fin whales in the Antarctic Ocean is the krill. Of the 710

heads of blue and 608 heads of fin whales examined, fish other than krill found in their stomach were as follows:

Fish of large Harpodontidae: 2 cases (1 in blue whale, 1 in fin whale)

Squids: 4 cases (1 in blue whale, 3 in fin whale)

Small type of Harpodontidae: 24 cases (10 in blue whale, 14 in fin whales)

Kind of Iniomi: 1 case in blue whale.

Jelly fish: 3 cases in fin whale.

II. Euphausia as Whale Food

Results of investigations on Euphausia, especially E. superba, are shown Tables VIII and IX, in which the empty spaces are mostly those in which the krill was found almost digested as reddish-brown colour in the intestines. It is interesting to note that the semi-monthly percentage rate of stomachs with krill coincide wholly with the catch curves as shown in the foregoing Figs. 2 and 3. In other words, this shows how the whales move their positions according to the presence of krill or that the investigation of krill would enable judgement on condition of the catch.

Table VIII. Stomach contente (Blue whale)

Name of fleet	Half-months	No. of stomach examined	No. of stomach with krill	No. of stomach empty	% of stomach with krill	No. with much krill (R)	No. with mod krill (rrr)	No. with little krill (rr)	No. with very little krill (r)	Type of krill				
										L	M	S	X	?
Hashidate-maru fleet	December	41	26	15	63	7	3	2	14	5	14	1	5	1
		79	53	26	66	3	15	17	18	—	21	3	26	3
	January	27	12	15	44	0	1	4	7	—	8	—	4	—
		39	11	28	28	0	3	3	5	—	8	1	2	—
	Feburary	36	23	13	64	1	10	10	2	2	10	—	9	2
		52	31	21	60	3	9	7	12	8	14	—	8	1
	March	—	—	—	—	—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	—	—	—	—	—	—	—
Nisshin-maru fleet	December	112	99	13	88	44	24	14	17	24	41	31	3	—
		78	58	20	74	27	10	11	10	5	19	33	1	—
	January	66	83	33	50	3	9	9	12	1	8	24	—	—
		87	51	36	59	10	11	17	13	5	11	35	—	—
	Feburary	31	16	15	51	1	7	2	6	1	6	9	—	—
		38	13	25	34	3	6	2	2	—	1	17	—	—
	March	24	9	15	37	1	4	3	1	—	4	5	—	—
		—	—	—	—	—	—	—	—	—	—	—	—	—

Table IX. Stomach contente (Fin whale)

Name of fleet	Half-months	No. of stomach examined	No. of stomach with krill	No. of stomach empty	% of stomach with krill	No. with much krill (R)	No. with mod krill (rrr)	No. with little krill (rr)	No. with very little krill (r)	Type of krill				
										L	M	S	X	?
Hashidate-maru fleet	December	5	2	3	40	—	—	—	2	—	1	—	1	—
		47	22	25	47	1	5	7	9	2	8	3	7	2
	January	44	19	25	43	—	3	6	10	1	8	1	7	2
		43	23	20	54	4	4	5	10	1	9	2	10	1
	Feburary	53	25	28	47	4	1	6	14	4	8	1	11	1
		1	0	1	0	—	—	—	—	—	—	—	—	—
	March	13	4	14	22	—	2	—	2	—	2	—	2	—
		—	—	—	—	—	—	—	—	—	—	—	—	—
Nisshin-maru fleet	December	18	16	2	89	4	4	5	3	5	5	5	1	—
		67	38	29	57	15	5	8	10	14	11	12	1	—
	January	44	28	16	64	10	6	6	6	2	6	20	—	—
		56	28	28	50	9	8	9	2	4	9	15	—	—
	Feburary	143	85	58	59	20	25	26	14	6	22	56	1	—
		63	35	28	56	9	11	10	5	—	14	21	—	—
	March	6	5	1	83	3	1	1	—	—	2	2	1	—
		—	—	—	—	—	—	—	—	—	—	—	—	—

Symbols used in tables are as follows:

L=E. superba. Large, 5.0 cm. and over (from rostrum to tail).

M=E. superba. Medium, from ca. 4.0—5.0 cm.

S=E. superba. Small, up to ca. 4.0 cm.

X=E. superba. Mixture of conspicuously different sizes.

?=E. superba. Sizes unknown due to high degree of digestion.

R=Stomach with large amount of krill.

rrr=Stomach with moderate amount of krill.

rr=Stomach with small amount of krill.

r=Stomach with very small amount of krill.

CHAPTER IX. Prasites

I. External Parasites

Following external parasites have been collected from blue and fin whales apart from certain more or less minutes form found on the baleen:

Cirripediae— Coronula sp. (C. regina)

Conchoderma sp.

Coppepodae— Pennella sp.
Anphipodae— Cyamus sp.
Diatomes— Cocconeis sp.

The incidence of these parasites are shown in Tables X. and XI. Seasonally, there is no great change according to whaling seaosn with Cirripediae, but Pennela is found more in the earlier part of the whaling season, one example being a clue whale on which about 30 full grown specimen had been found hanging. Cyamus was found in the latter part of the whaling season. Almost all of the diatomes found were of the Cocconeis sp., which began to increase, both in incidence and density, as the whaling season advanced.

Table X. Percentage Incidence of External Parasites in Blue Whales.

	Infected		Not Infected		Percentage of Infection	
	Hashidate Maru	Nisshin Maru	Hashidate Maru	Nisshin Maru	Hashidate Maru	Nisshin Maru
Whale lice (Cyamus Sp.)	17	32	176	402	6.32%	7.37%
Barnacles (Coronula Sp.)	7	17	262	417	2.60%	3.92%
Conchoderma Sp.	1	4	268	430	0.37%	0.92%
Parasitic coppepedae (Pennella Sp.)	2	8	267	426	0.74%	1.84%
Diatomes	72	109	197	325	26.76%	25.12%

Condition unknown: 2 whales used as fenders in the Nisshin-maru Fleet.
5 whales missed from the Hashidate-maru Fleet.

Table XI. Percentage Incidence of External Parasites in Fin Whales.

	Infected		Not Infected		Percentage of Infection	
	Hashidate Maru	Nisshin Maru	Hashidate Maru	Nisshin Maru	Hashidate Maru	Nisshin Maru
Whale lice (Cyamus Sp.)	24	19	184	378	11.53%	4.79%
Barnacles (Coronula Sp.)	24	30	184	367	11.53%	7.56%
Conchoderma Sp.	1	4	207	393	0.48%	1.01%
Parasitic coppepedae (Pennella Sp.)	1	4	207	393	0.48%	1.01%
Diatomes	77	131	131	266	37.02%	33.00%

Conditions unknown: 3 whales missed from the Hashidate-maru Fleet.

The incidence of white scars was as shown in Table XII which indicates that no whale is free from it.

The proportion of scars obtained in the previous year and prior to it were found to be, in the maiority of cases, more numerous for the older one, the values being:

About 92% had more scars obtained earlier than the previous year; about 2% had equal number of scars obtained in the previous year and earlier, about 6% had more scars obtained during the previous year.

There were no difference between male and female, or between blue and fin whales.

It was thought possible to tell the age of whales by the white scars but there are some remarkable exceptions that they would not constitute a very good facter in assuming age. There is a tendency, however, of larger number of scars in aged animals.

Table XII. White scars on Blue Whales.

Sex	Male				Female			
Name of fleet	Hashidate-maru		Nisshin-maru		Hashidate-maru		Nisshin-maru	
Classification	Number of whale	%	Number of whale	%	Number of whale	%	Number of whale	%
none	0	0.0	0	0.0	0	0.0	0	0.0
few	5	3.8	39	19.5	6	4.5	70	29.8
scarce	40	30.0	2	1.0	46	34.3	8	3.4
normal	25	18.8	40	20.0	27	20.2	26	11.1
numerous	57	42.9	84	42.0	51	38.0	90	38.3
very numerous	6	4.5	35	17.5	4	3.0	41	17.4

Table XIII. White scars on Fin Whales.

Sex	Male				Female			
Name of fleet	Hashidate-maru		Nisshin-maru		Hashidate-maru		Nisshin-maru	
Classification	Number of whale	%	Number of whale	%	Number of whale	%	Number of whale	%
none	0	0.0	0	0.0	2	0.0	0	0.0
few	0	0.0	58	33.0	5	4.1	63	26.8
scarce	36	42.4	5	2.8	26	21.5	9	3.9
normal	13	15.3	14	8.0	30	24.8	27	11.5
numerous	32	37.6	81	46.0	45	37.2	108	45.9
very numerous	4	4.7	18	10.2	15	12.4	28	11.9

II. Internal Parasites

Internal parasites are found more commonly than the external Crustaceae and they are often present in great number in whales. However, since not all of the intestines were cut open, no percentage of incidence were obtained. The species found were tapeworms (Tetrabothrius sp.?) or Acanthocephala.

Numerous encysted tissues, due probably to nematode worms, were fuond near the body cavity, especially in the ventral muscles. Since calcu-

lation of its incidence would be difficult, no attempt was made to obtain percentage rates.

CHAPTER X. Summary

The results of various observations made the catch by the Japanese fleet during the season 1948—1949 can be summarized as follows:

1) Composition of Whales Taken

There is no denying that the body length of whales taken is decreasing year by year. However, as far as the present expedition is concerned, the results showed a slight tendency to improve in this respect. This is an evidence that the Japanese whalers have come to recognize the fact and are taking great care to catch large-sized whales. It is regrettable that four of the blue whales taken were under-sized and is therefore in violation of the international law. However, it is hoped that everyone will recognize the fact that the Japanese whalers are doing their best to comply with the international code of ethics. Average body length were as follows:

	Male	Female	Animal
Blue whale—	77.86 ft.	81.09 ft.	79.55 ft.
Fin whale—	66.52 ft.	70.53 ft.	68.80 ft.

2) Body length of mature whales according to their sexes came out as follows:

	Male	Female
At sexual maturity:		
Blue whale—	74 ft.	78 ft.
Fin whale—	63 ft.	68 ft.
At physical maturity:	Male	Female
Blue whale—	79 ft.	85 ft.
Fin whale—	68 ft.	74 ft.

3) Pregnancy rate, especially in fin whales, during the present expedition seemed to be lower than the pre-war records, values being:

Blue whale— 53.29% of total mature animals.

Fin whale— 32.17% of total mature animals.

4) It has been found that it is impossible to tell the sex of a whale from its body colour and that only a very inaccurate data can be obtained in telling the age of whales from their body colour.

5) Although it is still uncertain, judging of age from the condition of white scars and the amount of parasites on whales would be a good

subject of study in knowing migratory habit of whales.

6) It is to be regretted that no investigations were made on the baleens.

APPENDIX I.

Number of Whales in the Ross Sea

I. Blue Whales in the Ross Sea

During the present season, the Hashidatemaru operated around the Ross Sea (Lat. 74°—76°S, Long. 172°--178°W) from 11 to 25 February 1948. During this time, 77 heads of blue whales alone (Nos. 393 to 471) were taken and distribution of their body length is shown in Fig. A1. As a result of investigations, there were no immature whale among 47 heads of males and only one immature whale among the 30 heads of females. 19 of the mature females, about 66%, were pregnant, 10 or 34%, resting. This percentage seems to be rather high for February. The ratio of male to female was 100 males to 64 females, incidence of males being remarkably higher than in other waters. Average body length of whales taken in the Ross Sea was 78.66 ft. for males, 82.77 ft. for females, the total average being 80.62 ft. This is slightly above the average but the percentage of aged males was

Fig. A1 Length frequency curve on Hashidate-maru

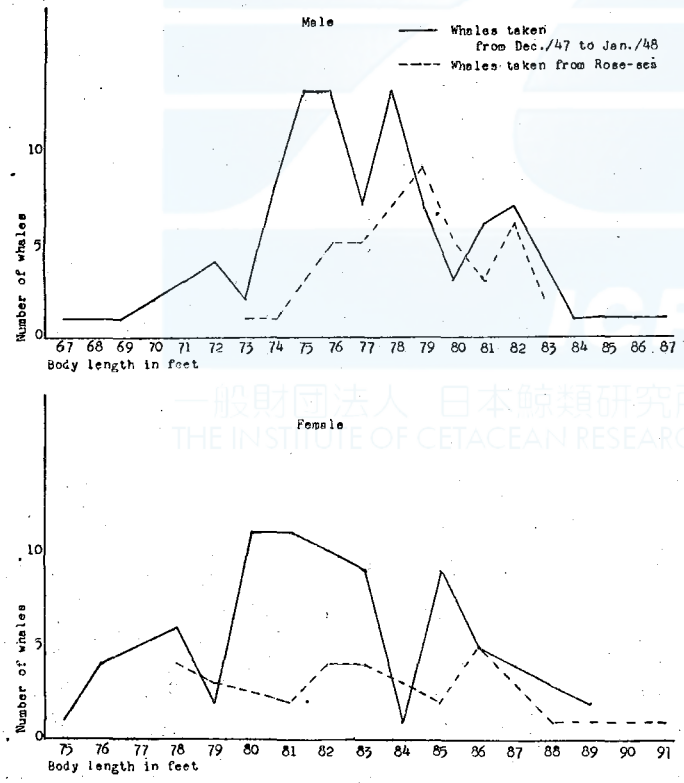
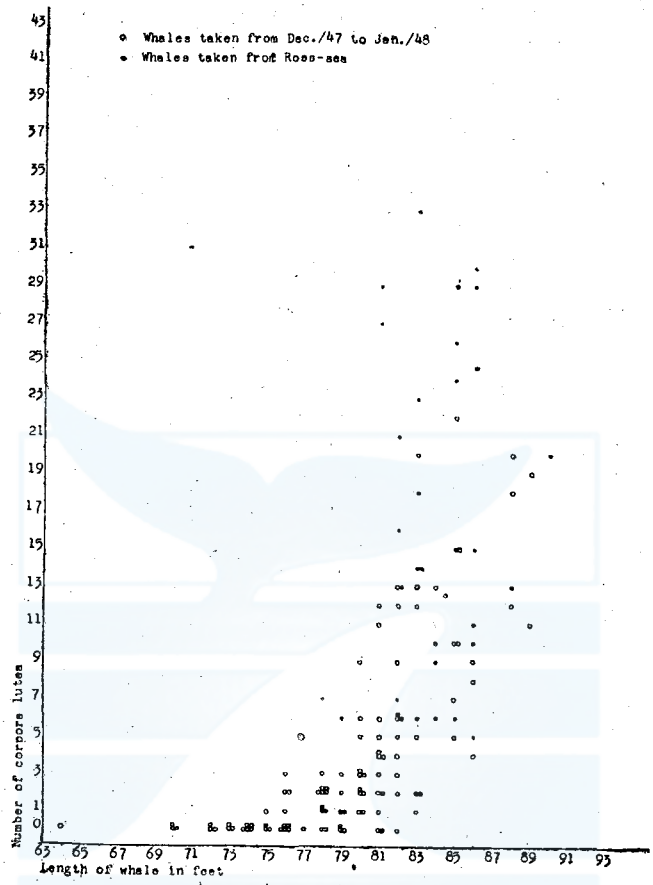


Fig. A2 Length of whales and Number of corpora lutea (Blue whale)



higher than in other water, individuals in which ossification of vertebral column had been ankylosed was 55% in males and 20% in females. Immature animals were few in both male and female. There were also a very low incidence of external parasites, Cyamus being found only in one case each in male and female. There was no evidence of Coronula sp., one each in male and female of Pennela sp. Diatome film infection was found in 15% of the male and 30% of the female. As was explained in the Chapter on the blubber, its thickness per unit body length was larger the whales being fatter. This was not only seen in external appearance but also borne out by the fact that the production of oil per B. W. U. during operation in the Ross Sea was extremely high.

No particular difference from other waters was seen in the relationship

between body length and number of corpora lutea (Cf. Fig. A2). This is an evidence that there were a small number of large-sized whales in the Ross Sea during the present operational season when considering the facts that the average body length of whales taken in the same region by the 2nd Tonan-maru in 1941 were 79 ft. for males and 82 ft. for females, in average, and that a school of quite a large-sized blue whales had been taken in the Kerguolen sector during the season 1923 — 1933 (A. H. Laurie: Discovery Reports. Vol. XV, pp. 223—284). However, due to a lack of biological data, no explanation can at present be given.

APPENDIX II.

Copulation of Humpback whales

There has been many tables told by whalers on the copulation of whales but very few description has been given by biologists. As far as is known by the auther, the only report of such detail is the one by D. C. Lilie published in 1910 (Cf. except at the end of this chapter).

During the present expedition, the auther witnessed following actions by the humpback whales.

On 13 January 1948, at about 21—00, operation was being carried out on the Nisshin-maru drifting about 1 mile off the so-called pack line. There were many cracks and inlets into the pack ice near the ship and many humpback whales (about 15 to 16 heads) were swimming around there.

As though these animals know that the catching of humpback whales in the Antarctic Ocean had been prohibited by the International agreement, they often came very near the ships. Just then, some humpbacks started to come nearer to the Nisshin-maru, making tremendous spashings. At first, one stood watching without any thought but there were something peculiar in their movement and the author began to watch with intent.

There were two heads of humpbacks and, as shown in Fig. A3, they at first swam in single file. Shortly later, as shown in Fig. 4, the two whales began to roll and romp together with each one of their fippers well above the water. At one time, as shown in Fig. A5, one of the whales flipped its peculiar tail flukes above the water and then dived deep into the water, followed immediately by its mate. For a few seconds afterwards, the surface of the water remained calm and then the quiet of the

water was broken by the sudden surfacing of the two whales vertically, as shown in Fig. 6, with their ventral surfaces in close contact and appearing above water almost to the middle of their bodies, just below their flippers. Then the whales fell back into the water, sometimes together, sometimes separately. After that, the same movements started all over again. Although there were some pauses, the romping continued well over three hours from the time it was first noticed until the whales were lost to sight. It may be that the objective had not been attained, but the so-called

Fig. A3 Swimming together

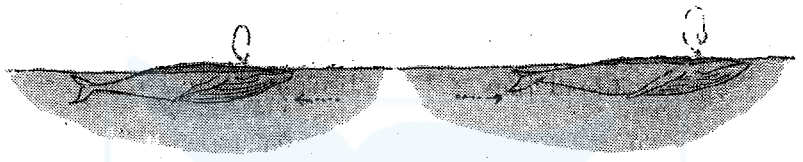


Fig. A4 Female turns one side, then male turns another side and makes several dashes

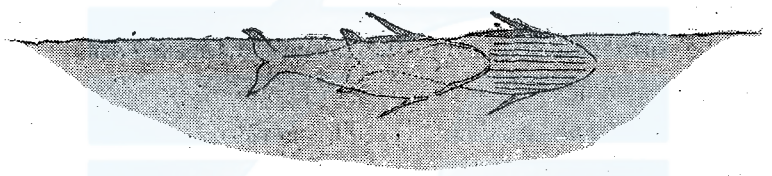


Fig. A5 Dive into the depth

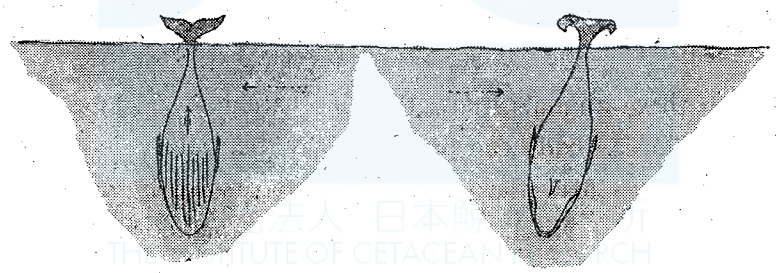
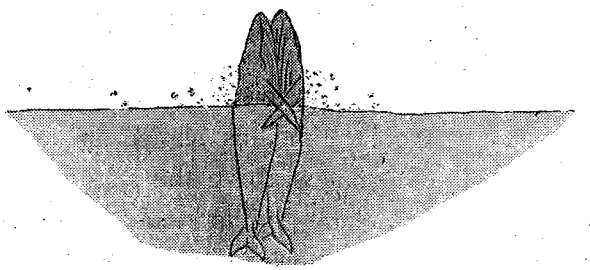


Fig. A6 Refloat vertically they faced their ventral side



"standing up on the flippers", as shown in Fig. A6, were witnessed more than to or three times. The author was of the opinion that this was the copulation of humpback whales, the fact of which was borne out by the experienced crews of the ship. The author had heard previously from a whaler that the whales jumped above the water, their ventral surfaces together, during copulation but was very doubtful if this were feasible. However, the present expedition showed that this is possible although the copulation itself may be performed underwater. The whole scene was a grand s'ght if slightly garish. It was a great pity that the time was at sundown and did not permit photographing. The nearest that whales came to the ship was about 200—300 metres. Some whalers said that the surface of the water became was not witnessed at this time. It seems that the whales moved away before the acts were completed but there were no evidence that the male whale heaved a great sight or become exhausted after the act. Even during copulation, the whales rested a while, sometimes swimming quiently for 15 to 30 minutes.

ABSTRACT

Observations on the Anatomy and General Biology of Some Members of the Larger Cetaceae

by D. G. Lilie, Hutchinson Research Student of St. John's College, Cambridge.

(Taken form the Proceedings of the Zoological Society of London, 1910)

VIII. Miscellaneous Observations

3. Copulation, period of gestation and rate of breeding.

The Balaenoptera are said by whalers to copulate at the surface of the sea. The pair swim towards each other and turn slightly on the sides so that their ventral surfaces face one another. The male makes several dashes at the female to insert the penis. When the pair first rush together, the long axes of their bodies are paralel with the surface of the sea; but they curve up vertically at the end of the act. After copulation, the male is said to be exhausted and easily caugt.

APPENDIX III.

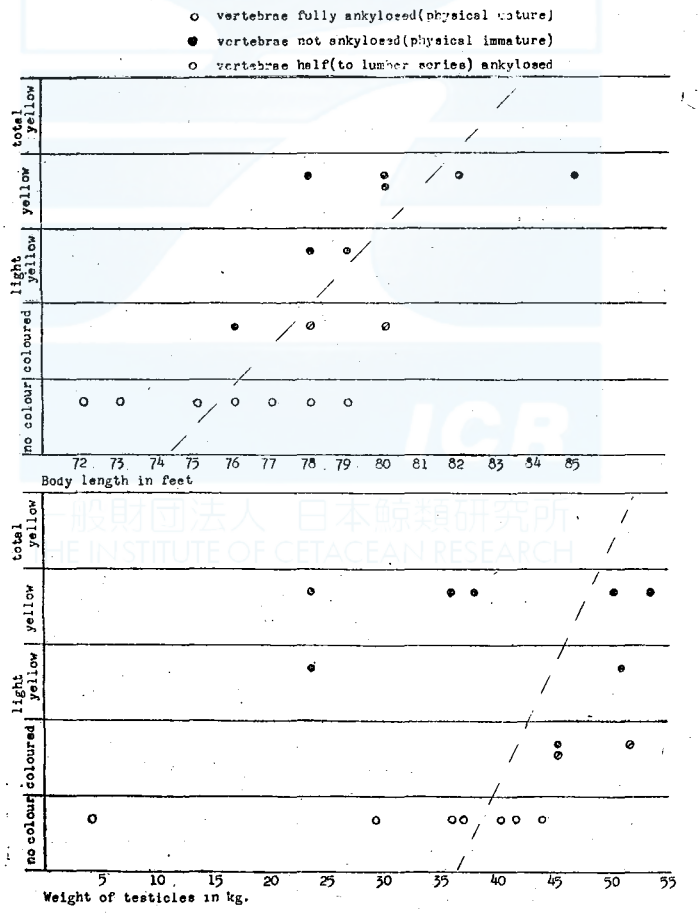
Age of Whales and Colour of Crystalline Lens

Wheeler's statement in his Discovery Report says that "the determination of age on whales is a question of much scientific research and economic importance".

During the expedition, I have stood at the side of the slipway watching the eyes of whales as they came up. Some looked as if they were peacefully sleeping, whilst others had a hunted look. Amongst these, the colour was of a golden shine. But I understand the colours vary.

When I was a boy, I used to be to told that there were witches (an old cat, an old fox or an old badger) who could change themselves into men, then some hero would have to go out and dispose of them. These

Fig. A7 Comparison of body length, Weight of testicles and colour of crystalline lens (Blue whale)



animals (wiches) were always old, I was informed, and their eyes shone a bright golden colour.

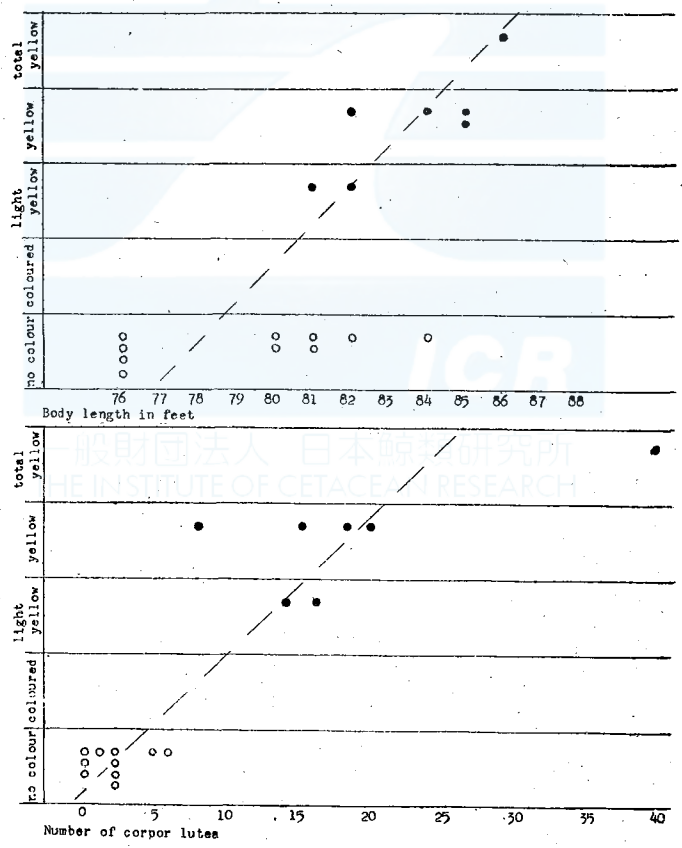
Looking at the eyes of whales, I wondered if this story could not be connected with them.

In dissecting, first, cut the vertex corneae in a V shape manner without scratching the lens and then take the lens out with the corpus vitreum with two fingers. Secondly, wash the corpus vitreum and the iris off with fresh water. It is then ready for observation in the shade. It is best to look at the lens in the shade and not in direct sunshine (though the sun in the Antarctic was not strong).

Lastly, I have found at the crystalline lens, some to be yellow, others light yellow, and still others without colour or transparent.

It was interesting to discover that the colour of the eyes had a very close resemblance to that shown in the chart. There was no colour by

Fig. A8 Comparison of body length, Weight of testes and colour of crystalline lens (Fin whale)



naked eye, in the lens of the eyes especially, if the epiphyses of the lumbar series was not ankylosed. As ankylosis progressed, the colour became yellowish, and when the ovaries had a number of corpora lutea (much as 30) and complete ankylosis had set in, they were found to be completely yellow. Depending upon individual whale, the gradual change of colour was also noticed with the number of corpora lutea or weight of testicles and state of ankylosis.

In order to gauge the change in colour, it would have been an advantage to have used the lovibond tintometer (the British Drughouses pattern) or some electric method, but I came upon this instrument too late to obtain full advantage of its use.

The classified colour of lens in the chart has been done only through my naked eyes. The five colours as classified are no colour (transparent), coloured, light yellow, yellow, total yellow.

Fig. A9 Comparison of body length, Number of corpor lutea and colour of crystalline lens (Blue whale)

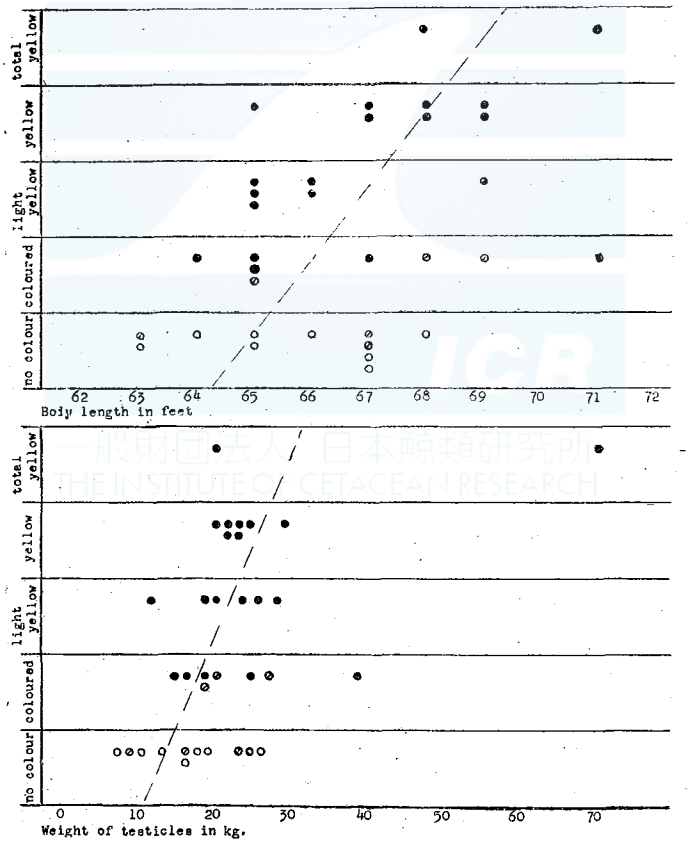
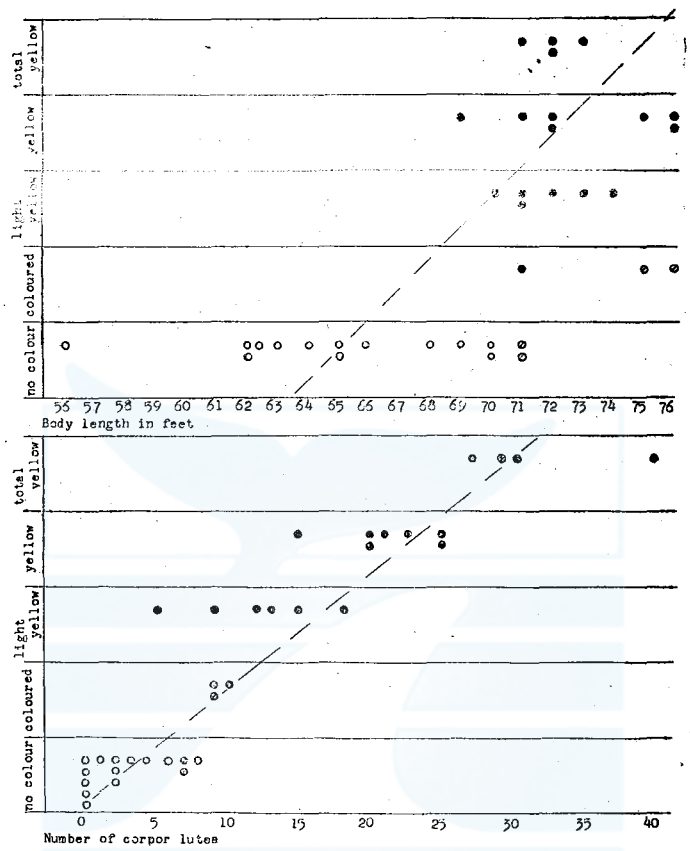


Fig. A10 Comparison of body length, Number of corpor lutea and colour of crystalline lens (Fin whale)



The data gathered in this Report may be of some help in determining the age of whales through the colour of the crystalline lens.

It is hoped to include colourimeter and electric ammeter in the next expedition in order to complete this research but the present report will only suffice by preliminary descriptions. (Cf. Figs. A7—A10).

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