Fig. 1. The Movement of Japanese fleets.

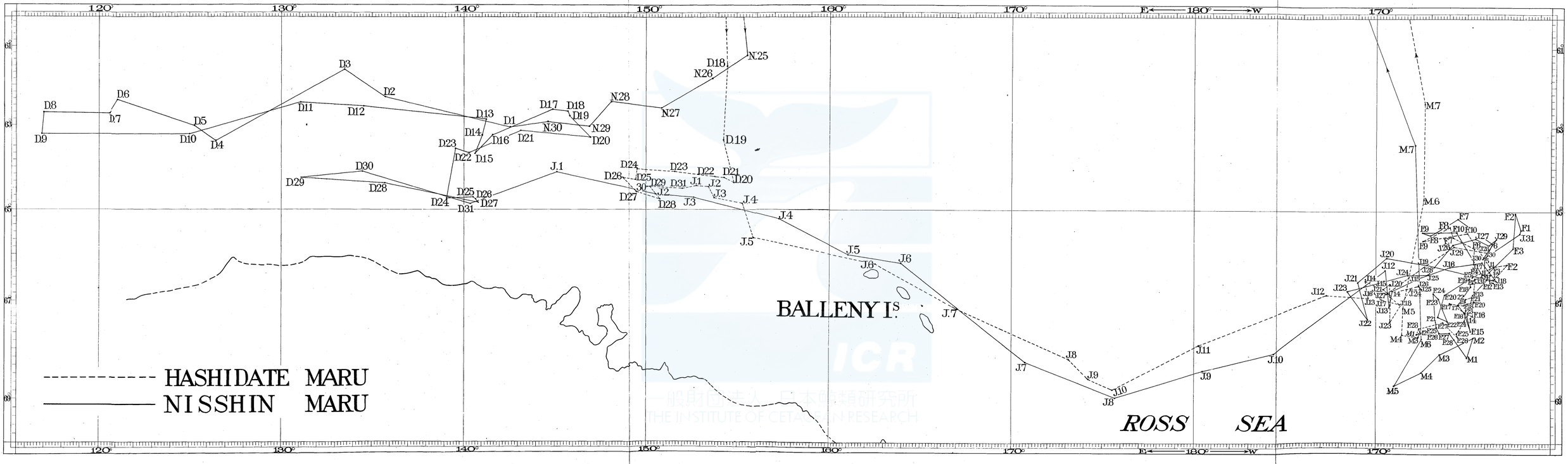
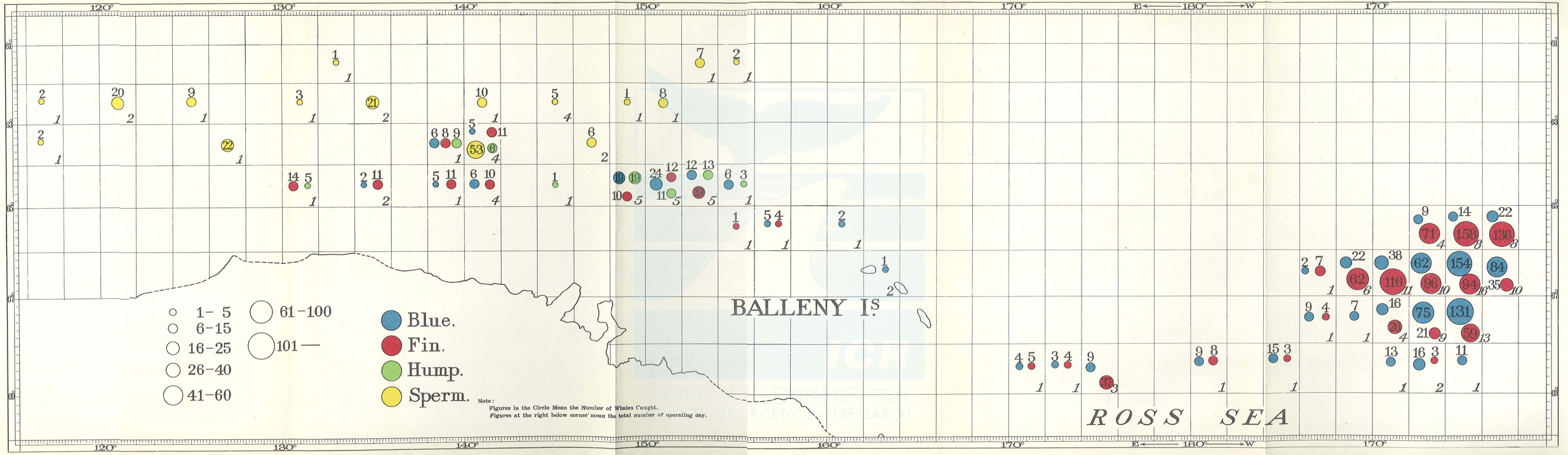


Fig. 2. Locality of Whales Caught by Japanese fleets in the Antarctic for the Season 1949 50.



Biological Investigation on the Whales Caught by the Japanese Antarctic Whaling Fleets Season 1949–50

By
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CONTENTS

Introduction

As in the preceding post-war seasons, Japan participated in the Antarctic whaling expedition in 1949–50 with two whaling fleets, namely the Hashidata Maru fleet and the Nisshin Maru fleet. Each fleet consisted of one floating factory, seven catcher boats and one reconnaissance vessel, and was accompanied by one tanker and several cargo vessels.

The floating factory Hashidate Maru, accompanied by the attached catcher boats, sailed from Yokohama on November 10, 1949 and arrived on the Antarctic whaling grounds on December 19, 1949. The Nisshin Maru and her catcher boats sailed from Yokosuka on November 1, 1949 and arrived on the whaling grounds as early as November 25, 1949. This fleet was engaged in the sperm whaling for the following 25 days until the baleen whaling season was opened. The production from this operation is summarized in Table 1.

The grounds for sperm whales are located to the west of those for baleen whales, or between latitudes 61–64°S and longitudes 116–156°E (Fig. 2).

The baleen whaling of this season, which was commenced just at

Table 1. Catch and processing of sperm whales by Nisshin Maru fleet, 1949

Whales caught	172
Processed products *a/*	(metric tons)
Sperm oil	1,651.0
Liver oil	1.821
Frozen red meat	660.0
Gelatine material	86.4
Leather material	79.4
Flukes	34.7
Total	2,513.321

a/ The amounts of processed products shown are the estimates in the field.

0:00 a.m. on December 22, 1949 by both fleets and closed on March 3 and 5, 1950 respectively by the Hashidate Maru and the Nisshin Maru fleet, have yielded a total production as shown in Table 2. The figures

Table 2. Catch and processing of baleen whales by the two Japanese fleets in the 1949–50 season

	Hashidate Maru	Nisshin Maru	Total
Whales processed:			
Blue	384	433	817
Fin	459	597	1,056
Humpback	49	22	67
Total	888	1,052	1,940
Blue whale units	631.5	740.3	1,371.3
Processed products *a/*:	(metric tons)	(metric tons)	(metric tons)
Whale oil	12,200.0	14,810.0	27,010.0
Red meat, frozen	10,118.7	13,259.0	23,377.7
Other frozen products	344.8	529.0	873.8
Red meat, salted	3,795.3	3,281.4	7,076.7
Ventral grooves, salted	2,924.1	3,143.0	6,067.1
Other salted products	431.6	314.0	745.6
Baleen	113.2	100.2	213.5
Bone meal	102.5	None	102.5
Liver oil	21.601	21.24	42.841
Blood powder and glue	6.443	None	6.443
Total	30,058.244	35,457.84	65,516.684

a/ The amounts of processed products shown are the estimates in the field.

Table 3. Catch and processing of baleen whales by Japanese fleets in the post-war seasons

	Season			
	1946–47	1947–48	1948–49	1949–50
Whales processed:				
Blue	690	710	631	817
Fin	474	608	1,012	1,056
Humpback				67
Total	1,164	1,318	1,643	1,940
Blue whale units	927.0	1,014.0	1,137,0	1,371.8
Processed products *a/*:	(metric tons)			
Whale oil	12,260.0	17,830.0	20,350.0	27,010.0
Frozen and cold-stored products	1,832.9	18,205.3	17,620.1	24,351.5
Salted products	20,385.4	9,048.1	16,535.0	13,889.4
Others *b/*	10.8	301.3	522.7	365.2
Total	34,489.1	45,384.7	55.027.8	65,516.1

a/ The amounts of processed products shown are the estimates in the field.
b/ Includes liver oil, bone meal, blood powder, baleen, etc.

of this table are summarized and shown in Table 3 in comparison with the production in other post-war seasons. Throughout the period covered, the catch, and consequently the production of whale oil as well as the total amount of products have increased year after year, as the equipments of the floating factories and other various conditions of operation have been improved. The output of the salted products has dropped annually, while that of the frozen products risen sharply.

Catch of humpback whales was permitted in the 1949–50 season on condition that the total catch should not exceed 1,250 whales in the whole Antarctic grounds. But it was only for the first fortnight of the season that this permission was really effective, for the ban was again placed on this operation at the beginning of the third week. Japanese fleets caught 67 humpbacks during the two weeks.

In the 1949–50 season the Japanese fleets operated in the waters between parallels 61°S and 69°S from 116°E longitude eastward to 162°W longitude, which is an area much elongated east and west. Both fleets passed a large part of the season in the part east of 180° longitude.

Being assigned to either of the factory vessels in two groups of three, the writers investigated, throughout the season, every whale

carcass when it was hauled up on to the dismembering deck. The main items investigated follow:

Species, sex and length of whale; date and time of capture; date and time of processing.
Body colour.
Scars.
External parasites.
Thickness of blubber.
Kind, amount and degree of digestion of food.
Thickness and colour of mammary glands.
Sex and length of foetuses.
Ovaries (Weight; functional corpora lutea; old corpora lutea; Graafian follicles).
Testes (Weight and volume).
Vertebrae.
Teeth (in the case of sperm whales).

The result of the investigation has been compiled by these items and is presented in this report. In every section of this report, that deals with each of these items, the result is discussed for each species of whales. It should be mentioned here that a satisfactory result has not been reached with humpback whales, because the number caught was so small and their body lengths were limitted to such a small range on account of the short period of operation.

The writers would like to acknowledge most gratefully the matchless cooperations of the Japan Marine Products Co., Ltd. and the Taiyo Fishing Co., Ltd. in the present investigation as well as in the preparation of this report. Hearty thanks are due to Dr. Hideo Omura, who has kindly helped and guided the writers all through the course of this study. They are also much grateful to Miss Hisako Jimbo for her assistance in the compilation of the data. A particular mention should be made of the exertions of Mr. Hiroshi Ando and Mr. Atae Ihara, who cooperated as the assistants in the laborious measurement of whale carcasses on board the factory vessels.

Catch

In Fig. 2 are shown the localities where the stated number of whales were caught by the Japanese fleets during the 1949-50 season. This chart indicates that far more whales were taken in the eastern half of the waters where these fleets operated than in the western

half, and that such a large catch as 674 blue and 877 fin whales were made in a period of 51 days from January 12–March 4, 1950 in that relatively small area of the eastern waters bounded by 65°S and 68° 30′S latitudes and by 162°W and 172°W longitudes. This catch accounts for 82.5% and 83.0% of the total catch of the respective species in the present season, and corresponds to an average catch of 1.04 blue whale units per catcher day. In comparison, the same average for other grounds was 0.45 blue whale units in this expedition. Furthermore, a higher average would have been recorded for this particular area, unless the catching operation had been curtailed, in order to meet the processing capacity of the factory ships, so frequently as was in this season. Though this area was found to be a good whaling ground by the Japanese fleets during the previous expedition, the catch was not so great in that season as in the present season, because the operations were confined to the part east of 170°W and not continued for so many days.

The length frequency of the catch in this season is graphed in Figs. 3–8 for each species of whales, in comparison with the catch in the preceding three post-war seasons. The two sexes of blue and fin whales are shown in separate figures.

In the length frequency of either sex of the blue whale, the mode for this season has slightly shifted towards large from those for the other seasons. But the length frequencies have remained

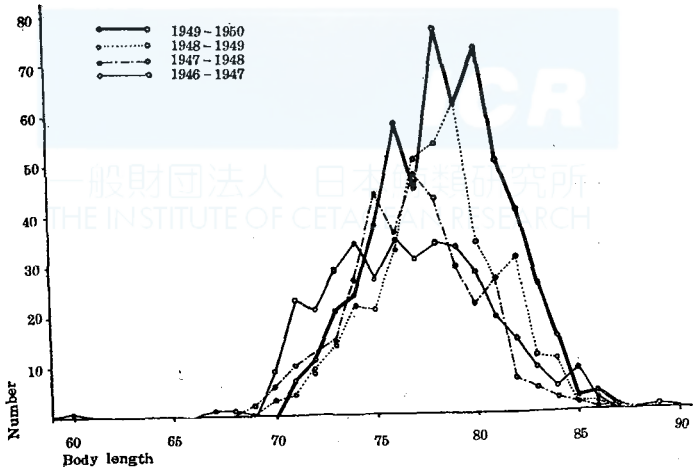

Fig. 3a. Blue whale. Male.

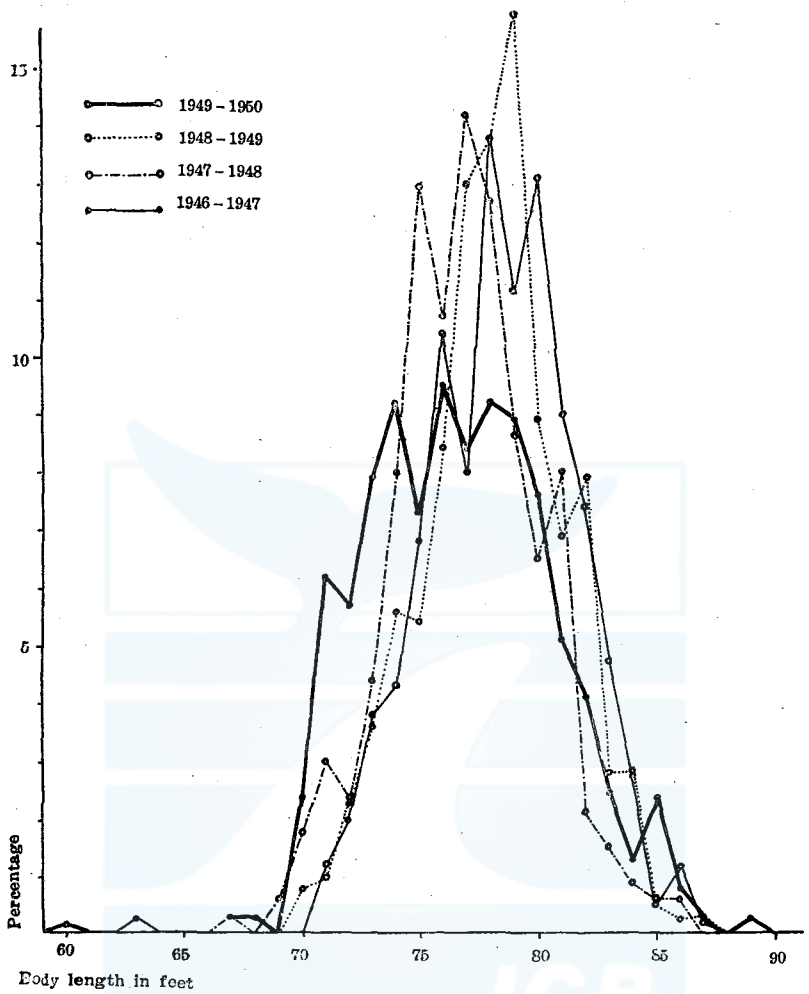

Fig. 3b. Blue whale. Male.

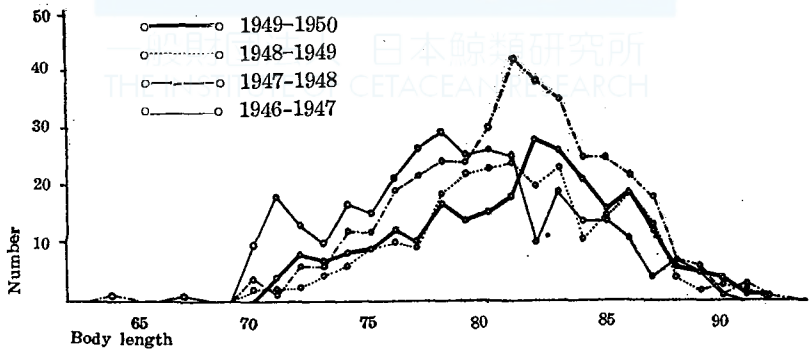

Fig. 4a. Blue whale. Female.

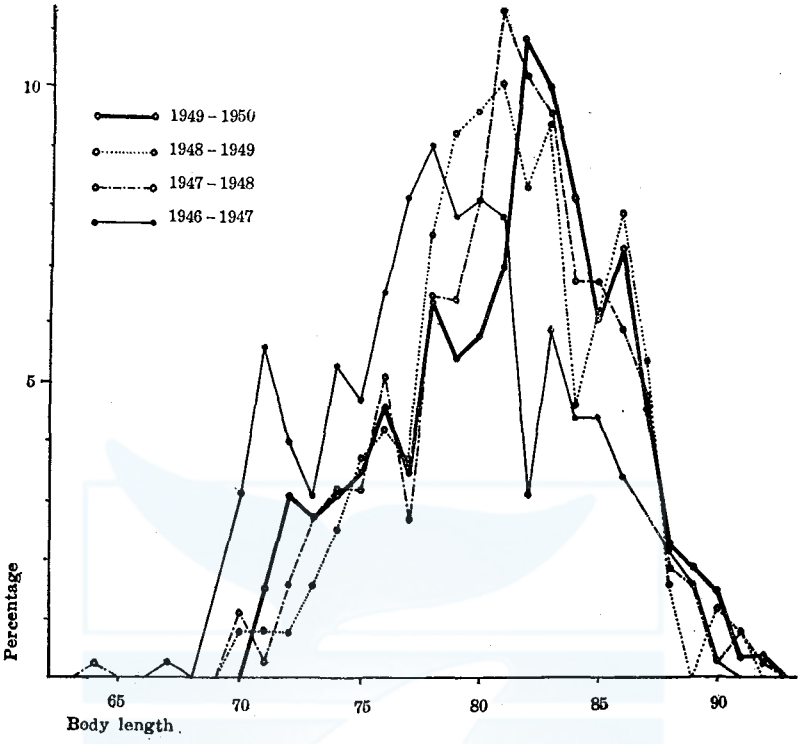

Fig. 4b. Blue whale. Female.

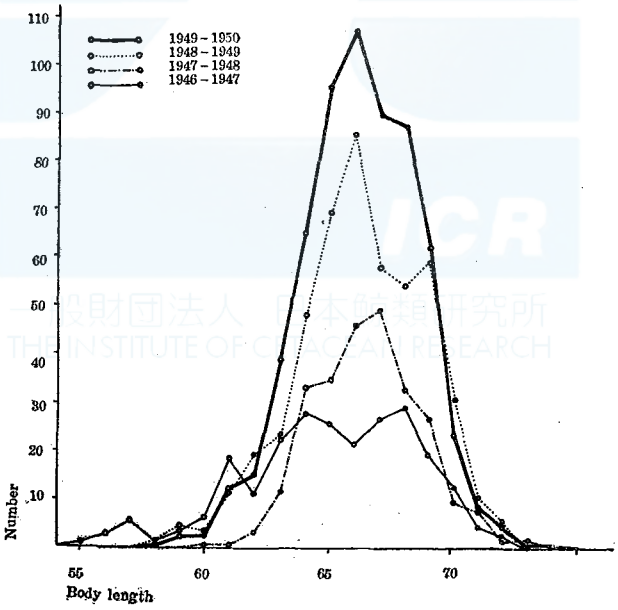

Fig. 5a. Fin whale. Male.

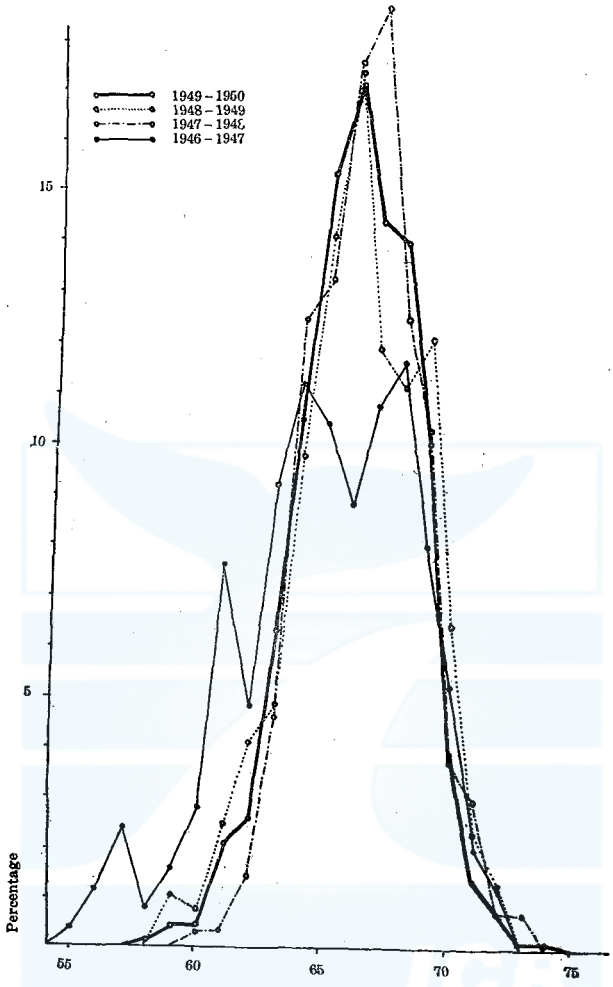

Fig. 5b. Fin whale. Male.

almost unchanged in both sexes of the fin whale throughout the four seasons.

As for the humpback whale, the number caught was so small that any conclusion may not be justified before more data are added through future investigations.

As is obvious from Summary No. 1 through No. 4 (see Appeedixes), in the blue and fin whales the length frequencies of monthly catches show the approximately same tendencies as those in Figs. 3–6. The average lengths of the catch of this season are listed below by species by sexes.

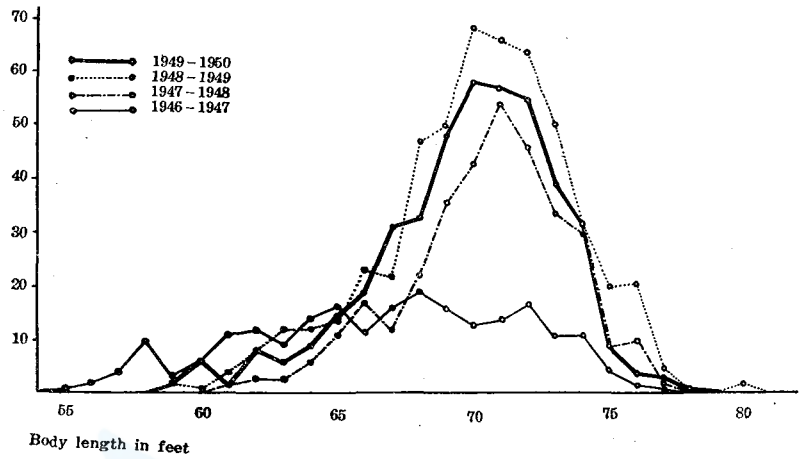

Fig. 6a. Fin whale. Female.

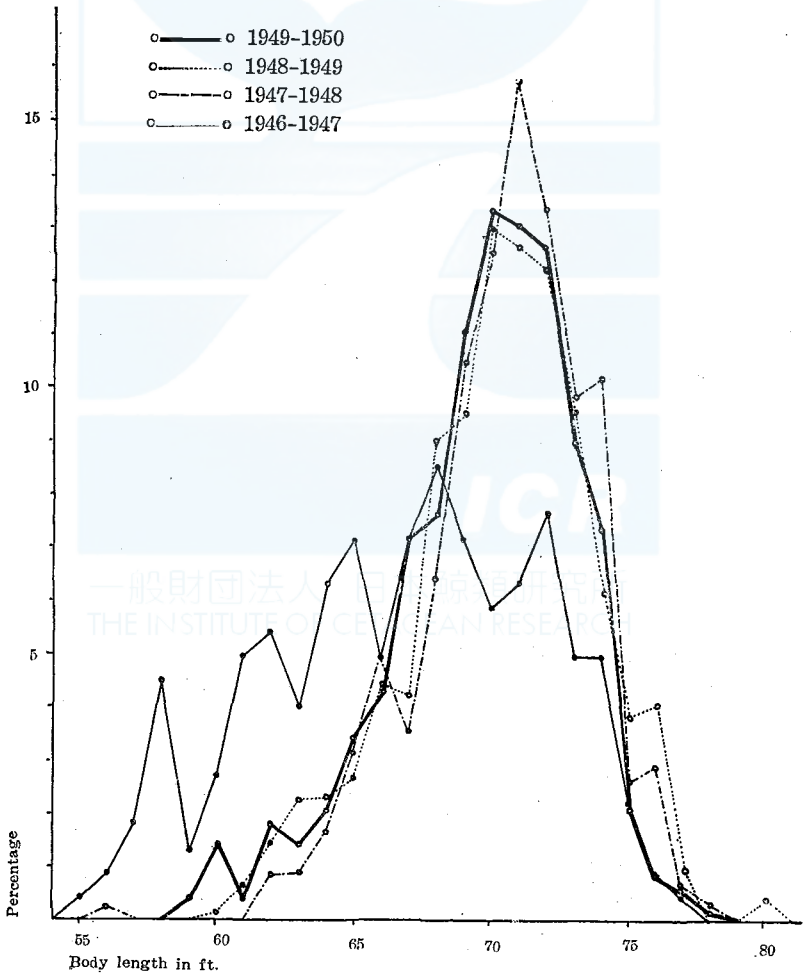

Fig. 6b. Fin whale. Female.

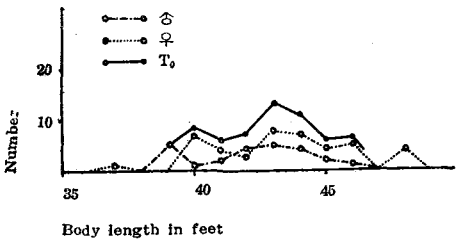

Fig. 7. Humpback whale.

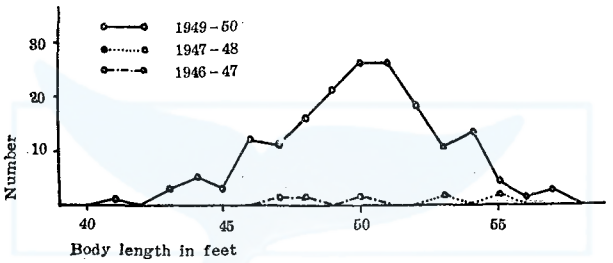

Fig. 8. Sperm whale.

Species	Male	Female
Blue whale	78.4 ft.	81.2 ft.
Fin whale	66.2 ft.	69.8 ft.
Humpback whale	42.2 ft.	43.3 ft.
Sperm whale	49.9 ft.	(No data)

And the average lengths of the monthly catches hardly differ from these (see Summary No. 1 in the Appendix).

These figures for the blue and fin whales are plotted in Figs. 9 and 10 respectively, in comparison with the corresponding averages in other post-war seasons.

Fig. 9 indicates that in either sex of the blue whale the average length has been gradually increasing throughout the period in question. On the contrary, the same of the fin whale seems to have been decreasing gradually in both sexes (Fig. 10).

As for the humpback whale, of either sex, the average length of the catch by the Japanese fleets in this season is far above the averages for the seasons prior to World War II, which were computed for the catch from the entire Antarctic grounds (Table 4).

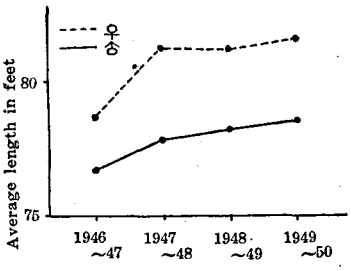

Fig. 9. Blue whale.

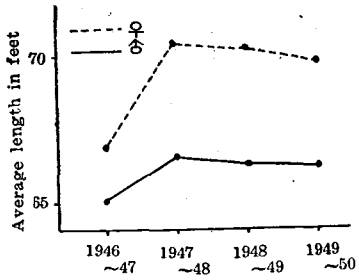

Fig. 10. Fin whale.

Table 4. Average length of humpback whales taken by the floating factory whaling in the Antarctic, 1934-35 through 1938-39

Season	Average length in feet			
	Males		Females	
1934–35	39.43	(900)	42.06	(1,027)
1935–36	40.20	(1,256)	42.26	(1,862)
1936–37	39.77	(2,204)	41.39	(2,256)
1937–38	39.61	(781)	41.97	(1,289)
1938–39	37.69	(266)	40.47	(617)

Note. Numbers of whales are shown in parentheses.
Source: International Whaling Statistics.

Figs. 11 and 12 show the percentage of male whales in the blue and fin whale catches in the post-war seasons. In the both species, and especially in blue whales, the percentage of males is higher in the 1949–50 season than in any other post-war seasons.

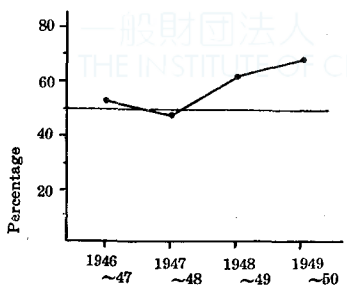

Fig. 11. Percentage of Blue whale male.

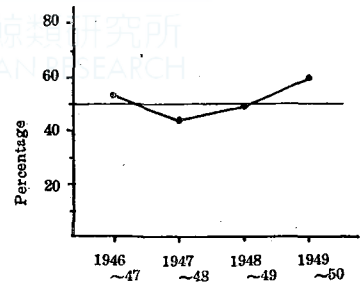

Fig. 12. Percentage of Fin whale male.

The sex ratio in the monthly catches of blue and fin whales are graphed in Figs. 13 and 14 for the post-war seasons. In blue whales (Fig. 13), the percentage of males increase as a season advances. This

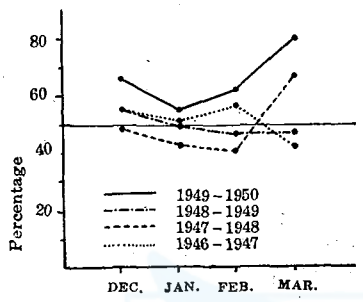

Fig. 13. Percentage of Blue whale male.

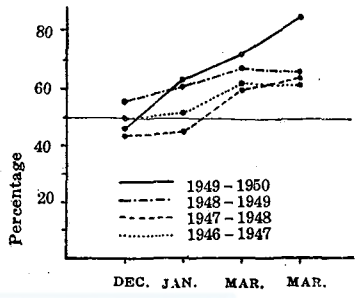

Fig. 14. Percentage of Fin whale male.

tendency is most conspicuous in 1949-50, and 84.7% was reached in March, 1950. Since the Japanese fleets moved toward east with the advance of the season in 1948-49 as well as in 1949-50, this tendency may be regarded as indicating a predominance of males among the blue whales distributed in the eastern grounds. A similar tendency is also observable to some extent in the fin whales caught in this season. In the catch of the humpback whales of this season females exceeded males in number, as was usual in other previous seasons, with the ratio of 64.2% (females) against 35.8% (males). Whether this predominance of females in the catch of humpback whales is caused by chance or is rooted in a preponderance of females in the stock itself, as have been suggested by various authors, is to be decided through the studies in future.

Body Colour

Body colour of the blue whales has been investigated with regard to the following three points:

Abundance and distinctness of the pale spots.

Abundance of the white flecks.

Distinctness of the white striations.

The data have been analyzed to study the correlations of these characteristics with length of the whale, with sex and with whaling grounds. In the last case the grounds have been subdivided into two parts along the 180° longitude. But any of these correlations have

been found. This suggests that these characteristics of the body colour of blue whales vary from individual to individual, independent from the factors listed above.

The result of observations is summarized in Tables 5–8. These observations are, in their nature, subject to a certain size of personal errors of the observers.

Table 5. Abundance of pale spots on blue whales, 1949–50

Class and description	Number of whales	Percentage to total
1 (Very few)	17	2.1
2 (Few)	245	30.1
3 (Normal)	394	48.4
4 (Many)	145	17.8
5 (Very many)	13	1.6
Total	814	100.0

Table 6. Distinctness of pale spots on blue whales, 1949–50

Class and description	Number of whales	Percentage to total
I (Not distinct)	68	8.3
II (Distinct)	507	62.3
III (Very distinct)	239	29.4
Total	814	100.0

Table 7. Abundance of white flecks on blue whales, 1949–50

Class and description	Number of whales	Percentage on total
0 (None)	5	0.6
1 (Very few)	99	12.2
2 (Few)	273	33.5
3 (Normal)	317	38.7
4 (Many)	100	12.3
5 (Very many)	22	2.7
Total	816	100.0

Table 8. Distinctness of white flecks on blue whales, 1949–50

Class and description	Number of whales	Percentage to total
0 (None)	8	1.0
I (Not distinct)	390	44.1
II (Distinct)	372	45.6
III (Very distinct)	76	9.3
Total	816	100.0

Body colour of the fin whales has been investigated with regard to the following five points;

Shade of the dorsal colour.
Which side, right or left, of the lower jaw is black?
Distribution of the dorsal colour over the thoracic body surface.
Presence of the coloured part protruding toward annus.
Unification of the dorsal colour at the base of flukes.

The first item, viz. the shade of the dorsal colour, has been subject to such large personal errors of measurers that the result of the measurements is not presented here.

The second item was studied in the present investigation, though it had been well established in fin whales that the left side of their lower jaw is black and the right side white, because a photograph in a plate of the Discovery Report Vol. I, Plate XXXIV, Fig. 1 had seemed showing a specimen whose lower jaw is black on the right side. Since none of the 1,056 fin whales (619 males and 437 females) examined in this investigation has possessed a white left side of lower jaw, it is most likely that the aforementioned plate shows the negative print of the photograph.

The results of the investigations into the other three items have been analyzed, as in the case of blue whales, respecting their correlations with body length, sex and the whaling grounds as subdivided into two parts along the 180° longitude. Any of these correlations, however, were not found. Consequently, the variation in these characteristics of the body colour of fin whales seems to be nothing more than the individual variation. The results of the observation are summarized in Tables 9–11.

Body colour of humpback whales has been recorded according to Lillie's classification, and the result is summarized in Table 12.

Table 9. Distribution of dorsal colour on the thoracic body surface in fin whales, 1949–50

Type of distribution	Number of whales	Percentage to total
L (Dorsal colour reaching lower than normal)	344	32.6
N (Normal)	392	37.1
U (Dorsal colour confined to regions upper than in normal cases)	320	30.3
Total	1,056	100.0

a/ The "normal" type of distribution is defined as such that the dorsal colour reaches down to the 11th to 13th ventral grooves from the umbilicus.

Table 10. Presence or absence of the protrusion of dorsal colour towards the annus in fin whales, 1949–50

Presence or absence of protrusion	Number of whales	Percentage to total
+ (Present)	819	77.6
− (Absent)	237	22.4
Total	1,056	100.0

Table 11. Unification of dorsal colour at the base of flukes in fin whales, 1949–50

Presence or absence of unification	Number of whales	Percentage to total
+ (Present)	611	57.9
− (Absent)	445	42.1
Total	1,056	100.0

None of the humpback whales dealt with in this investigation belongs to Class 4 (black all over the body), though many individuals of this Class have been reported among the catch from the waters of South Africa and South Georgia. The result of the present investigation almost agrees with the findings made by Matsuura as well as Omura, in their investigations of Area V, for the approximately same waters covered by the present study. Such Agreement seems quite natural, even allowing for the considerably large personal errors which are necessarily connected with the measurements by different investigators.

Table 12. Percentage frequency of body colour classes in humpback whales, 1949-50

Body colour class *a/*	Males	Females	Total
1	12.5	11.6	11.9
Intermediate between 1 and 2	12.5	16.3	14.9
2	16.7	2.3	7.5
Intermediate between 2 and 3	54.2	44.2	47.8
3	4.1	11.6	8.95
Intermediate between 3 and 4	0.0	14.0	8.95
4	0.0	0.0	0.0
Whales examined	24	43	67

a/ According to Lillie's classification. Descriptions of classes follow: "1"-dorsal colour not protruding onto lateral body sides; "2"-dorsal colour protruding onto lateral body sides (The protrusions of dorsal colour generally occur between base of flipper and posterior end of ventral grooves, on the lateral sides opposite the posterior end of dorsal fin, and at the base of flukes; "3"-paired (right and left) protrusions of dorsal colour uniting on the ventral body side; "4"-black all over the body.

On the other hand, the present result is also analogous to Matthews' observations in the New Zealand waters. This fact implies the humpback whales in the latter waters belong to the stock that have been exploited by the Japanese whalers in the Antarctic, and at the same time confirms the northsouth migration of this species which have been established by marking experiments. Body colour of the whale generally have little bearings on the taxonomy of whales. Nevertheless, the body colour of humpback whales seem worth the further investigation, because it may possibly be utilized as a key characteristic in discriminating the races, if any at all, of this species.

Analysis of the data of the present investigation does not show that there is any correlation between the body length and body colour of the humpback whales, but indicates that the intermediates between Class 2 and Class 3 are prevalent in all length classes of both sexes.

Whitish Scars

Whitish scars have been investigated respecting their abundance and their old or new. The result obtained implies nothing but the well established tendency that more scars are found on larger whales than on smaller ones. It is advisable to examine the method now in

use critically before resuming the investigation on this characteristic in next season.

Table 13 shows the abundance of white scars in the heigher and

Table 13 Number of blue and fin whales in each abundance class of whitish scars, 1949-50

a. Blue whales, males.

Length of whale	Abundance class *a/*					
	0	I	II	III	IV	Total
78 feet or under	0	42	139	96	4	281
79 feet or over	0	14	105	153	3	275
Total	0	56	244	249	7	556

b. Blue whales, females.

Length of whale	Abundance class *a/*					
	0	I	II	III	IV	Total
81 feet or under	0	17	82	21	1	121
82 feet or over	0	4	46	81	8	139
Total	0	21	128	102	9	260

c. Fin whales, males.

Length of whale	Abundance class *a/*					
	0	I	II	III	IV	Total
66 feet or under	0	30	163	140	8	341
67 feet or over	0	5	110	149	14	278
Total	0	35	273	289	22	619

d. Fin whales, females.

Length of whale	Abundance class *a/*					
	0	I	II	III	IV	Total
70 feet or under	0	29	149	55	4	237
71 feet or over	0	5	83	103	8	199
Total	0	39	232	158	12	436

a/ The abundance classes of whitish scars are defined as follows: "0"-none; "I" very few; "II"-few; "III"-many; "IV"-very many.

lower length classes of the two sexes of blue and fin whales.

Not so many white scars were found in humpback whales as in blue or fin whales, and they were mostly round in shape, unlike those found on the latter two species.

External Parasites

In Table 14 are shown, by species of whales, the number and percentage of the whales which have been recorded in the present

Table 14. Infection with Pennella spp., 1949–50

Species of whale	Whales examined	Infected	
		Number of whales	Percent
Blue	817	5	0.6
Fin	1,056	6	0.6
Humpback	67	0	0.0
Sperm	172	3	1.7

investigation as being infected by the copepod, *Pennella balaenopterae*. The percentage infection in the blue and fin whales has been very small, being slightly exceeded by that of the sperm whales. Percentage infection has been zero in the humpback whales. But the figures in this table are probably somewhat lower than the true figures, for the parasites as small as this species may have been overlooked at night. The shoulder and the back are the major body parts infected by this species. Head was infected in one individual.

A lower percentage infection has been recorded for the blue whales in this season than in Omura's survey over Area V. For the fin whales, however, the percentages are almost same in the two investigations. *Pennella* is commonly found on the whales captured in the temperate waters, but it gradually falls off the host in the Antarctic. Now that this parasite occurs in the Antarctic waters on the schooling sperm whales more frequently than on the old lone bulls as well as on the blue and fin whales, we may conclude that these schooling sperm whales are migrating over a considerable range of waters.

Only one individual infected by this parasite has been reported by Matthews, out of 38 sperm whales which he studied at Durban.

Table 15 shows the number and percentage of the whales infected by the cirripeds, *Coronula* spp. and *Conchoderma* spp. In the hump-

Table 15. Infection with cirripeds, 1949–50

Species of whale	Whales examined	Infected with			
		Coronula spp,		*Conchoderma* spp.	
		Number of whales	Percent	Number of whales	Percent
Blue	817	3	0.4	1	0.1
Fin	1,056	15	1.4	4	0.4
Humpback	67	67	100.0	67	100.0
Sperm	172	0	0.0	4	2.3

back whales, the percentage infection has been 100% for either of the genera. The percentages are much lower in the blue and fin whales, and the blue whales show a little smaller percentages than the fin whales. In sperm whales, the percentage infected by *Coronula* has been zero, while the same by *Conchoderma* 2.3%.

Both of *Coronula diadema* and *C. reginae* have been found on *C. regniae* on blue and fin whales.

Table 16 shows the percentage of the whales infected by the

Table 16. Infection with Cyamus spp., 1949–50

Species of whale	Whales examined	Infected	
		Number of whales	Percent
Blue	817	20	2.4
Fin	1,056	52	4.9
Humpback	67	56	83.6
Serm	172	47	27.4

amphipods, *Cyamus* spp. Though the table gives 38.6% as the percentage infection of humpback whales, it seems most probable that all the humpbacks handled in this study have been infected, for *Cyamus* are very easily overlooked.

For the same reason, it is also very likely that the percentages of infection of blue and fin whales are underestimated in Table 16. In the blue and fin whales, *Cyamus* are hidden so deep in the posterior parts of the ventral grooves that they may be easily left unnoticed, unless these parts are examined closely.

The percentage infection has been 27.4% in the sperm whales.

Various types of *Cyamus*, probably involving a considerable number

of new species, have been collected in this investigation. A detailed report will follow on this subject.

Diatoms, as external parasites upon whales, differ from the foregoing animals particularly in that their attachment properly occurs in the Antarctic waters. The diatoms, once attached on the whale, rapidly multiply to form a yellow-brown "skin film" over the body surface of the host, as long as the host remains in those waters. But "skin film" falls off the whale in the waters of low latitudes. It has been estimated that a period of about one month elapses between the arrival of whales within the Antarctic Zone and the formation of visible diatom film upon them.

Karcher has already reported that the percentage infection with diatoms differs from one area of the Antarctic Ocean to another. The percentage infection for the waters presently covered by the Japanese fleets has been lower than Karcher's figure for Area II, but higher than the same for Area III; and it resembles the former figure in the general trend. Karcher's data indicate the percentage infection is higher in the adult whales than in the immature. His result also shows, in agreement with the present investigation, that the fin whales are more liable to infection with diatom film than the blue whales.

We may conclude from these evidences that male whales arrive in the Antarctic Zone earlier than females, and the mature whales earlier than the immature.

The very low percentage infection in the humpback whales is probably due to the fact that this species was fished for only in the earlier part of the season. It is noteworthy, however, that an infection as high as 75.5% has been recorded for the sperm whales, in spite that the operations for this species was confined within the period prior to the baleen whaling season, viz. from November 25–December 19, 1949.

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Table 17. Infection with the diatom film, 1949-50

Species of whale	Whale examined	Infected		Males		Females	
		Number of whales	Percent	Whales examined	Percent infected	Whales examined	Percent infected
Blue	816	370	45.3	557	47.6	259	40.5
Fin	1,055	528	50.0	619	54.6	436	43.6
Humpback	67	1	1.5	24	0.0	43	2.3
Sperm	172	129	75.5	172	75.5	—	—

Now, assume the blue and fin whales caught in December and sperm whales caught in November showing thick diatom film on their bodies to have remained in the Antarctic all the previous winter. Table 18 gives, by species of whales, the number and percentage of such whales in the catch of this season.

Table 18. Occurrence of the whales which have spent the 1949's southern winter in the Antarctic a/ in the catch in December b/, 1949

Species of whale	Whales examined	Whales spending 1949's winter in the Antarctic	
		Number	Percent
Blue	66	2	3.0
Fin	101	5	5.0
Humpback	57	0	0.0
Sperm *b/*	22	2	9.1

a/ The definition appears in the text.
b/ In the case of sperm whales, the catch in November. 1949 was examined in stead of that in December, 1949.

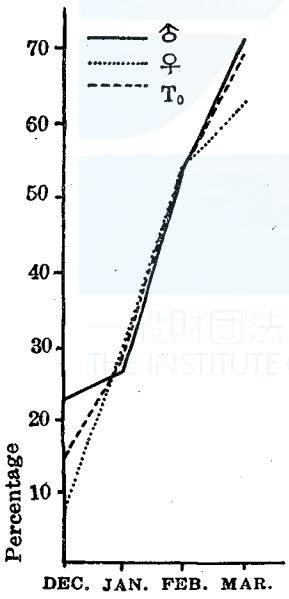

Fig. 15. Monthly infection rate of Diatom on Blue whales

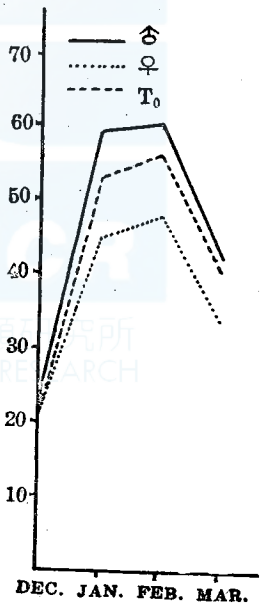

Fig. 16. Monthly infection rate of Diatom on Fin whales

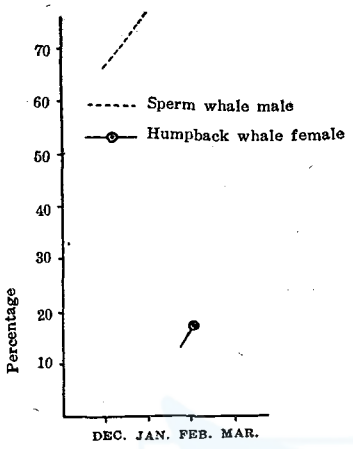

Fig. 17. Monthly infection rate of Diatom on Humpback and Serm whales.

The figures in this table are smaller than Karcher's figures for Area II, but larger than his figures for Area III. Much interesting results will be obtained by investigating the diatomaceous infection on the whales in the Ross Sea, provided that the entrance to that sea is so open as to permit the operations of the whaling fleets therein.

Thickness of Blubber

The thickness of blubber has been measured at the following two parts of the body of every whale caught, viz.:

Point 1; the point on the mid-lateral line, where it intersects the vertical line passing posterior end of dorsal fin.

Point 2; the point on the dorsal line, where it intersects that cross-section of the body passing ears and perpendicular to the body axis.

Since Point 1 can be located in each whale pretty accurately, and the thickness of the blubber around this point is uniform, the measurements at this point are well comparable among the whales. On the contrary, a slight deviation from Point 2 will result in a fairly large error of the measurement; this is especially true in the sperm whales. Once the whale carcass is laid upon its back on the dismembering deck, it is hardly possible to measure the thickness of blubber at Point 2 accurately. So that, it seems advisable to discontinue the measurement at this point.

In Figs. 18–21 are shown, by species, the average thicknesses of the blubber at Point 1 and 2 of male whales of stated body lengths. In blue and fin whales, the thickness of blubber at Point 1 is larger than the same at Point 2, and both are increasing gradually with body length (Figs. 18 and 19). Data on the humpback whales have not been many enough to justify any conclusions (Fig. 20). The increase in thickness of blubber, which is associated with the increase in length of the whale, is not so conspicuous in the sperm whales as in the foregoing species (Fig. 21). In Fig. 21 the measurements at Point 1 show an increase, though slight, with increasing body length,

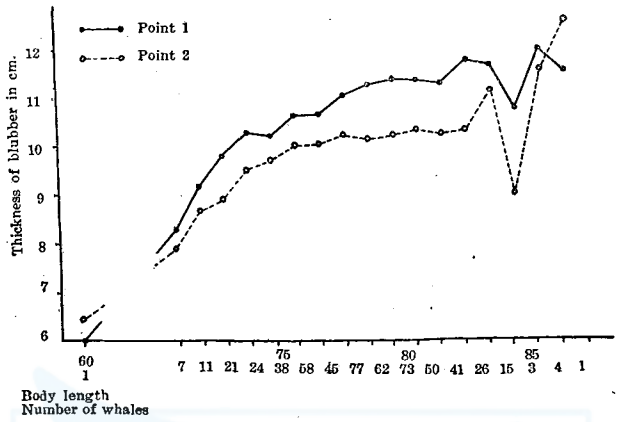

Fig. 18. Average blubber thickness in Blue male whales.

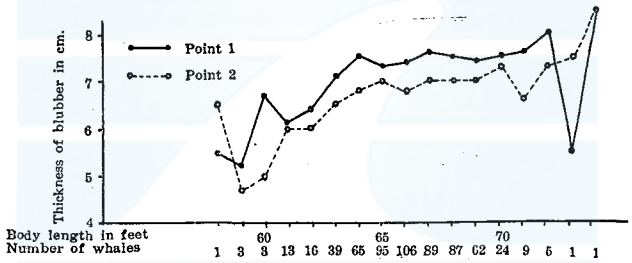

Fig. 19. Average blubber thickness in Fin male whales.

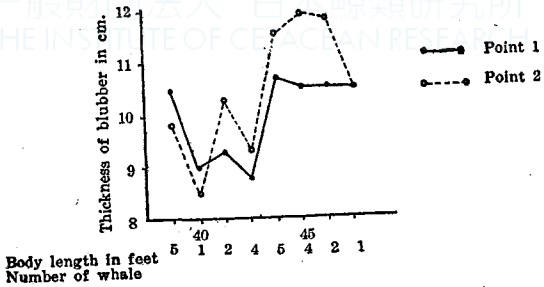

Fig. 20. Average blubber thickness in male Humpback whales,

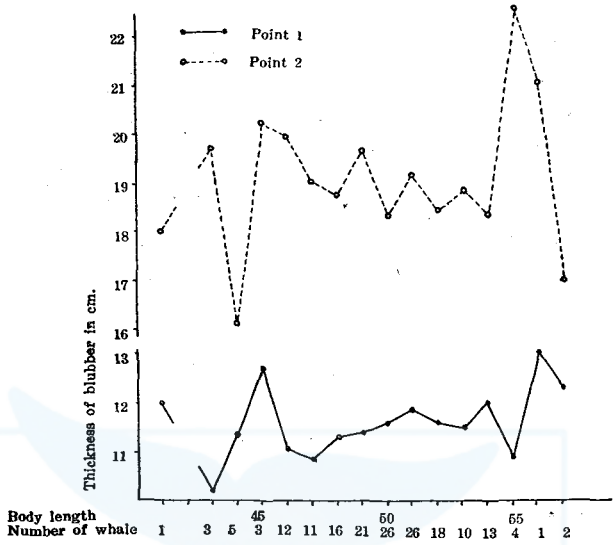

Fig. 21. Average blubber thickness in Sperm whales.

but the values at Point 2 appear to decrease toward larger body lengths, though the result regarding Point 2 are not always reliable on account of the large errors of the measurements. In general, the thickness of the blubber in the Antarctic male sperm whales does not increase with the length of the whale so conspicuously as in the baleen whales.

In contrast with blue and fin whales, the sperm whales show larger thickness of blubber at Point 2 than at Point 1; and the humpbacks, too, show the same tendency.

The thickness of the blubber of female whales differs considerably according to whether the whale is pregnant or not. In Figs. 22-24 are shown the average thicknesses of the blubber of female blue, fin, and humpback whales of stated body lengths, and distinction is made between pregnant and not pregnant females.

These figures clearly indicate that the blubber of female whales, like that of males, adds in thickness as the length of the whale increases.

Humpback whales of the two sexes are well matched with blue whales of the corresponding sexes in the thickness of blubber. In the females of blue and fin whales, like in their males, the blubber is thicker at Point 1 than at Point 2.

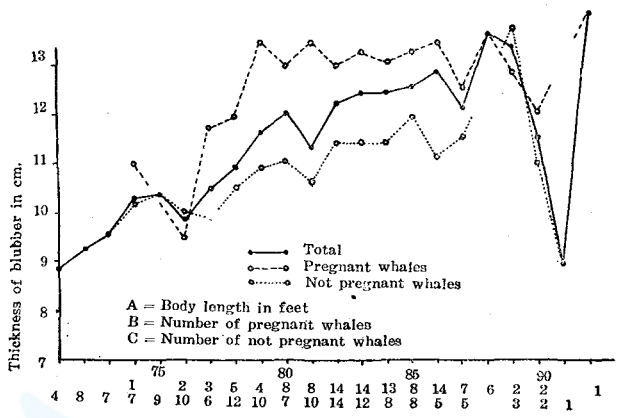

Fig. 22 a. Point 1. Average blubber thickness at Point 1, Blue female whales.

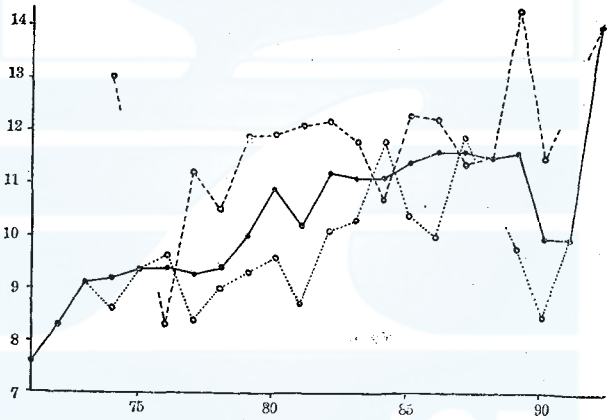

Fig. 22 b. Point 2.

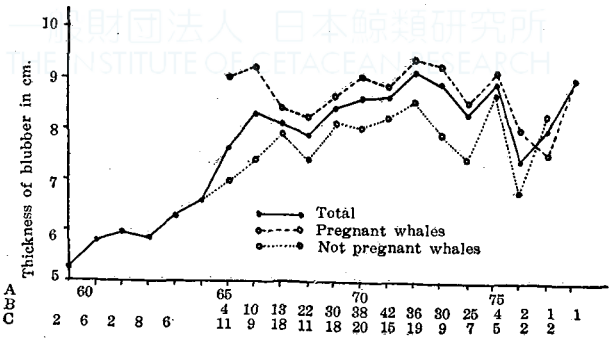

Fig. 23 a. Average blubber thickness at Point 1, Fin female whales.

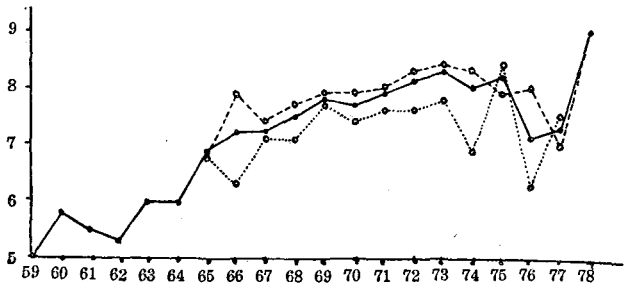

Fig. 23 b. Point 2.

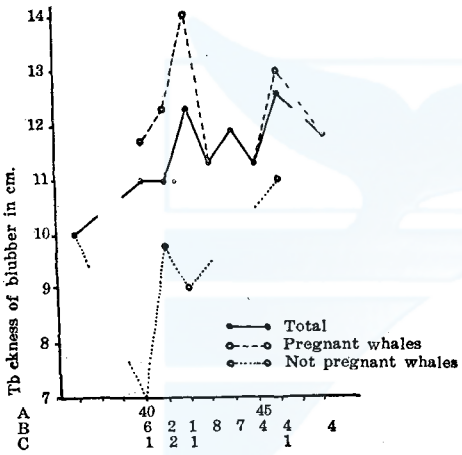

Fig. 24 a. Average blubber thickness at Point 1, Humpback female whales.

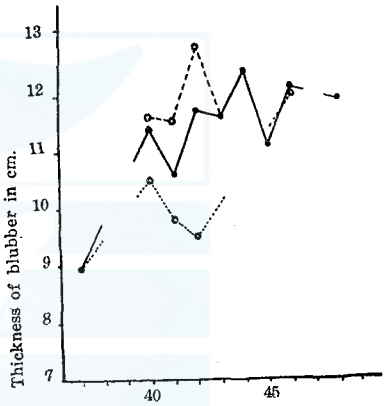

Fig. 24 b. Average blubber thickness at Point 2, Humpback female whales.

In Fig. 25 is shown the change in the relative thickness of blubber during the season, for different species of whales. The relative thickness of blubber has been calculated for each week by species, and is defined as the ratio, (average thickness of blubber for the weekly catch)/(average body length for the same catch), expressed in percentage. The first week as shown in this figure corresponds to the period from December 22–24, 1949.

Every curve in Fig. 25, though not smooth on account of the small samples, generally tends upwards as the season advances.

Most of the curves in the figure show a decline in January, and tend upwards thereafter. The same tendency has been pointed out in the preceding investigations, though the cause of the decline in January has not been explained.

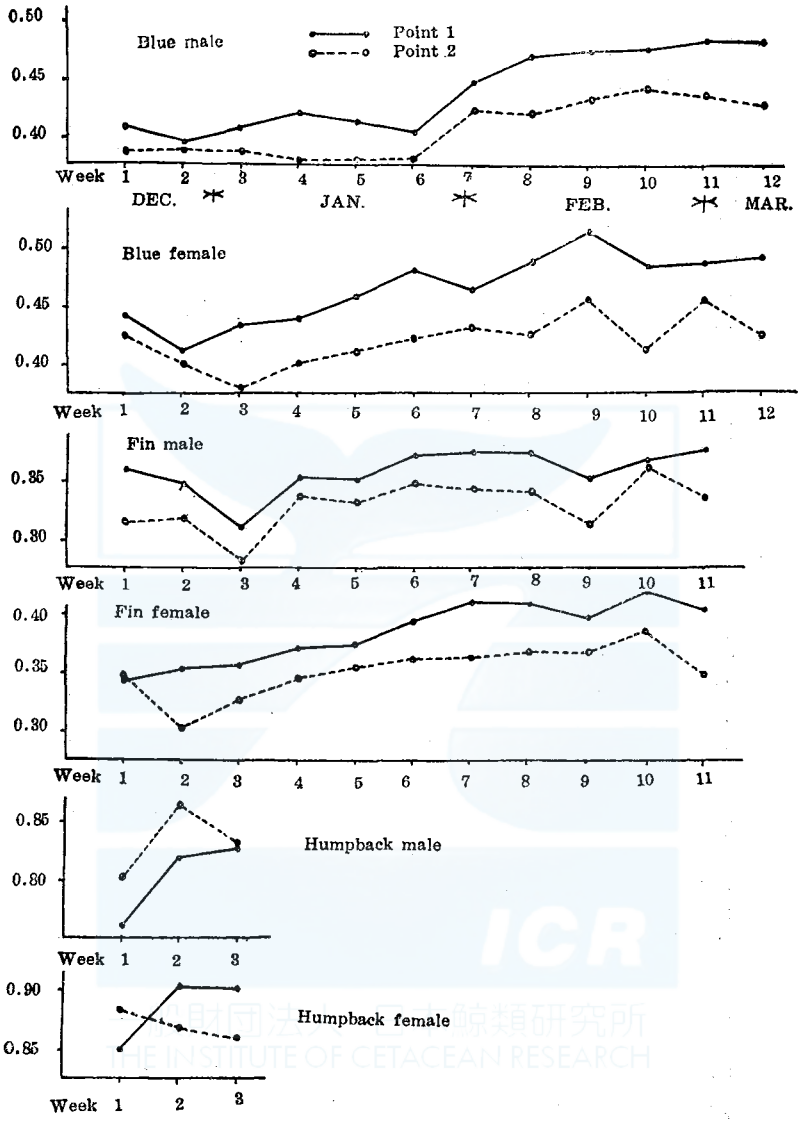

Fig. 25. Weekly fluctuation of blubber thickness (in % of body length).

Fig. 25 also indicates that, in every species, the blubber is thicker in females than in males.

Thickness of blubber, as expressed in the percentage to the length of whale, is larger in blue whales than in fin whales.

Humpback whales have thick blubbers for their body lengths.

Table 19. Feeding condition of the captured whales by semi-monthly periods, 1949–50

Semi-monthly period	Blue whales						Fin whales						Humpback whales					
	Whales examined	0	r	rr	rrr	R	Whales examined	0	r	rr	rrr	R	Whales examined	0	r	rr	rrr	R
2nd half, December	68	36.8	13.2	20.6	19.1	10.3	94	54.3	14.9	13.8	12.8	4.2	56	12.5	16.1	28.6	21.4	21.4
1st half, January	112	58.9	16.1	11.6	10.7	2.7	191	55.5	20.9	14.1	8.4	1.1	10	20.0	10.0	50.0	20.0	0.0
2nd half, January	92	32.9	21.7	19.6	15.2	10.9	390	62.6	16.7	8.7	8.0	4.1	—	—	—	—	—	—
1st half, February	179	33.0	18.4	25.1	11.2	12.3	284	66.2	14.4	10.6	3.5	5.3	—	—	—	—	—	—
2nd half, February	293	28.3	12.3	19.4	17.1	22.9	82	20.7	12.2	19.5	20.7	26.9	—	—	—	—	—	—
1st half, March	72	37.5	8.3	18.1	11.1	25.0	15	13.3	13.3	20.0	26.7	26.7	—	—	—	—	—	—
Total	816	35.5	15.0	19.6	14.3	15.9	1,056	57.6	16.3	11.6	8.5	6.0	66	13.6	15.2	31.8	21.2	18.2

Note. Except for the columns "Whales examined", the figure in this table represents the percentage of whales showing the indicated feeding condition to the indicated semi-monthly or total catch. The feeding condition (i. e., empty or filled of the stomach) is classified as follows: R – stomach being full to the utmost (about 75–100% filled); rrr – stomach containing large quantity of food, i. e., about 60–75% filled; rr – stomach containing moderate quantity of food, i. e., 25–50% filled; r – stomach containing small quantity of food, i. e., less than 25% filled; 0 – stomach being empty.

Stomach Contents

In the Antarctic Ocean the baleen whales are feeding almost exclusively upon *Euphausia superba*, and are not polyphagous as they are in the Japanese waters. Fish were found in the stomachs of some baleen whales handled in this investigation, but such were very rare cases. In Table 19 is summarized the feeding conditions of the whales which were caught by Japanese fleets during this season.

This table refers only to the conditions of the first stomach. Though this table lists a considerable number of whales which showed empty first stomach, many of these whales had food in their second and or further posterior stomachs. And the intestine was filled with faeces in every whale.

Table 19 also shows that the feeding condition of whales improved as the season advanced.

Notes were made on the size of *E. superba* found in the first stomach, and the data are summarized in Table 20. It is seen from

Table 20. Size of Euphausia superba contained in whale stomachs, 1949–50

Species of whale	Whales examined	Size class of *Euphausia superba* a/			
		L	M	S	X
Blue	524	2.5	88.9	6.5	2.1
Fin	441	5.0	73.2	18.1	3.6
Humback	56	5.3	66.1	26.8	1.8

Note. Figures in the last four columns represent the percentages of those whales to the whales examined, whose stomachs have contained *E. superba* of stated size classes. a/ L=over 5 cm.; M=4~5 cm.; S=under 4 cm.; X=all of L, M and S mixed.

this table that in most of the cases *E. superba* in the first stomach belonged to Size Class M (4 to 5 cm. in length). Further analysis of the data shows that relative occurrences of various size classes of *E. superba* were not correlated with the advance of the season.

From late December through January most of the larger females of *E. superba* were seen carrying eggs.

Spermatophores had gone from the thelyca of females by early February.

As was mentioned before, fish were contained in whale stomachs in rare occasions, besides *E. superba*.

In the stomachs of 11 blue and 8 fin whales were found the fish which Japanese whalers call "Mizu-tengu", which means the "watery long-nose" in Japanese. This species, which is slender in shape and less than one feet in length, has not been described in the Discovery Reports.

Six blue and 7 fin whales had *Myctophum* sp. in their stomachs, besides *Euphausia*.

Fishes of Family Nototheniidae were found, together the *Euphausia*, in the stomachs of 3 blue whales.

The fish called "Kori-tengu" (which means the "icy long-nose") by our whalers was found in the stomachs of one blue and one fin whale. This species hardly exceeds 2 feet in length, and the Japanese whalers have learned nothing of its scientific name.

Apart from the fishes, *Paratemisto gaudichaudi* was found in one occasion.

These food animals other than *Euphausia*, are usually less than 10 in number per whale, if they happen to be present in the whale stomach. Therefore, their bearing on the nutrition of whales is almost negligible.

However, their occurrence may have been underestimated in the foregoing descriptions, for a considerable number of them has probably passed unnoticed when they came out of the dissected whale stomach mingled in a mass of *Euphausia*.

Thickness and Colour of Mammary Glands

In the female whales mammary glands were examined respecting their thickness and colour. The thickness was measured at the thickest part of the organ. Colour of the mammary glands was determined by assigning it to one of the colour ranks listed in Tables 21–23, in

Table 21. Colour of mammary glands in sexually immature whales, 1949–50

Colour of mammary glands	Number of whales		
	Blue	Fin	Humpback
Light pink	50	34	1
Greyish yellow *a*/	9	10	0
Reddish yellow	4	3	0
Brownish yellow	2	2	0

a/ The commonest colour in the mammary glands of sexually mature whales.

the investigator's judgement. As this method of determining the colour was considerably subjective, the result may have been biassed to a considerable extent. Consequently, the observations by different investigators do not seem readily comparable with one another, though they are all combined and presented in this section.

Mammary glands are very thin in the sexually immature females. 65 female blue and 49 female fin whales before sexual maturity were examined. The thicknesses of their mammary glands have averaged 2.8 cm. and 2.4 cm. respectively. Maxima of the thickness were 5.5 cm. and 3.5 cm., and minima were 1.5 cm. and 1.0 cm., respectively. There was no sign that the thickness of the mammary glands increases with body length in these sexually immature females. As for colour, the mammary glands of these females were mostly light pink (Table 21). Only one of the female humpbacks caught was sexually immature, whose mammary glands measured 3.0 cm. in thickness.

Sexually mature females were divided into two groups, the pregnant females and those being not pregnant. In the pregnant females of the blue and fin whales, there was observed a definite increase of the thickness of mammary glands with increasing body length (Fig. 26). But such correlations were not studied in the sexually immature females of the humpback whales, since the data had been scarce for this group.

The averge thickness of mammary gland in the pregnant females of each species was as follows:

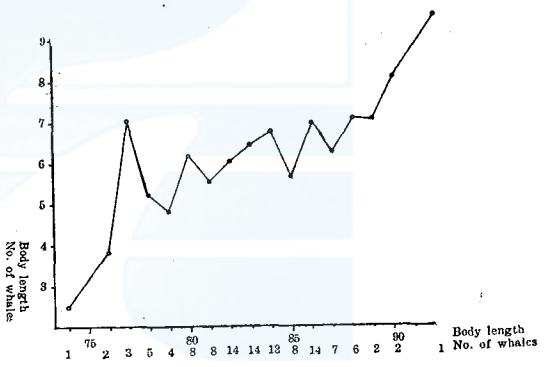

Fig. 26 a. Average thickness of mammary gland of pregnant whales in Blue whale.

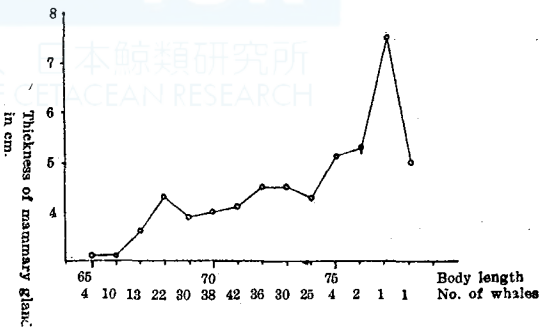

Fig. 26 b. Average thickness of mammary gland of pregnant whales in Fin whale.

Species of Whale	Average Thickness of Mammary Glands	Number of Individuals Examined
Blue whale	6.2 cm.	112
Fin whale	4.1 cm.	258
Humpback whale	5.1 cm.	87

It is noteworthy that the average thickness for pregnant humpbacks was larger than that for pregnant fin whales. Maximum thickness was 12.0 cm. in these blue whales, 9.5 cm. in these fin whales, and 9.0 cm. in these humpback whales. Minimum was 1.5 cm., 1.5 cm. and 1.0 cm. respectively. The result of observations on the colour of the mammary glands of these pregnant females is given in Table 22.

Table 22. Colour of mammary glands in pregnant whales, 1949–50

Colour of mammary glands	Number of whales		
	Blue	Fin	Humpback
Light pink	6	32	3
Greyish yellow *a/*	52	123	30
Reddish yellow	41	74	4
Brownish yellow	5	12	0
Brown	7	17	0
Red	1	0	0

a/ The commest colour in the mammary glands of sexually mature whales.

The table shows that greyish yellow and reddish yellow were the most prevalent among the colours. Pink was almost exclusively associated with the female whales in their first pregnancy.

The data were analized to determine the correlations of the thickness and colour of the mammary glands of pregnant female whales with the size of their foetuses, i. e., with the time of pregnancy, but such correlations have not been established.

Sexually mature but not pregnant female whales have comprised two physiologically different groups, namely the resting females and the females having weaned recently. On account of this heterogeneous composition, possible correlations of the thickness and colour of mammary glands with body length and the time of pregnancy have not been adequately represented for these not pregnant females.

Average thicknesses of mammary glands in these not pregnant females are listed below by species. These figures are larger than those for the pregnant females.

Species of Whale	Average Thickness of Mammary glands	Number of Individuals Examined
Blue whale	8.1 cm.	83
Fin whale	5.1 cm.	127
Humback whale	7.4 cm.	4

In these not pregnant females, the maximum thickness of mammary glands was 25.0 cm. (measured on a lactating female) for blue, 13.0 cm. for fin and 15.0 cm. (measured on a lactating female) for humpback whales. The minima were 2.0 cm., 1.5 cm. and 3.5 cm. for the respective species.

The observations on the colour of mammary glands of the not pregnant females are summarized in Table 23. The tendency illustrated

Table 23. Colour of mammary glands in not pregnant a/ whales, 1949–50

Colour of mammary glands	Number of whales		
	Blue	Fin	Humpback
Light pink	6	17	0
Greyish yellow b/	43	56	3
Reddish yellow	21	39	1
Brownish yellow	5	7	0
Brown	8	8	0

a/ Not includes immature whales.
b/ The commonest colour in the mammary glands of sexually mature whales.

by this table is very similar to the one shown by Table 22 for pregnant females.

It seems that there is some general relationship between colour and thickness in the mammary glands of whales. Light pink is generally associated with thicknesses less than 4 cm. in the blue whales and with those less than 3 cm. in the fin and humpback whales. The mammary glands of this colour and with these thicknesses are found only in such female whales which have not paired, or are in their first pregnancy, or have ovulated but not have conceived.

Greyish yellow and reddish yellow are usually associated with moderate thickness of mammary glands, namely 5–8 cm. in the blue, 4–6 cm. in the fin, and 5–7 cm. in the humpback whale. Mammary glands showing these characteristic colours and thicknesses are found in the major part of pregnant females as well as in the resting females. A considerable portion of the mammary glands which were

reddish yellow in colour showed thicknesses larger than what was stipulated above. These are considered to have referred to those females which had weaned relatively long before their capture.

Such colours as yellowish brown, brown and red generally occurred in the mammary glands of large thickness, sometimes as large as 25 cm. These mammary glands may be regarded as from suckling females or those females which had weaned very recently.

Foetuses

In this section are dealt with the results of observations on the foetuses and on the pregnant female whales.

In Table 24 are shown the frequencies that the foetuses were found in the right and the left cornu uteri.

Table 24. Occurrence of foetuses in the right and the left cornu uteri, 1949-50

Species of whale	Number of cases examined	Left cornu uteri percent	Right cornu uteri percent
Blue	107	59.8	40.2
Fin	250	48.0	52.0
Humpback	32	56.2	43.8

The frequencies that the heads of foetuses were directed toward the vagina and to the reverse direction are given in Table 25.

Table 25. Position of foetuses in cornu uteri, 1949-50

Species of whales	Number of cases examined	Occurrence of foetal positions in percent	
		Foetal head towards vagina	Foetal tail towards vagina
Blue	87	96.6	3.4
Fin	205	91.7	8.3
Humpback	20	85.0	15.0

Table 26 gives the foetal sex ratio for each species of whales.

Table 26. Foetal sex ratio, 1949-50

Species of whale	Males		Females		Sex not determinable (Number)	Total (Number)
	Number	Percent	Number	Percent		
Blue	50	44.6	62	55.4	0	112
Fin	136	52.9	121	47.1	1	258
Humpback	19	52.8	17	47.2	1	37

The lengths of foetuses are plotted against the date of capture of mother whales in Figs. 27–29, espectively for the blue, fin and humpback whales. Average foetus lengths for ten days and monthly periods are also shown in these figures with the marks ○ and ◉ respectively. The tendencies appearing in these figures are similar to those found by Mackintosh and Wheeler.

Maximum foetus length was 19′0″ for the blue, 16′1″ for the fin, and 3′0″ for the humpback whales. The minimum was 2′2″ in blue and 0′3½″ in humpback whales. The smallest fin whale foetus was at the stage immediately after the conception.

Table 27 gives, by body length classes, the proportions of the pregnant and the not pregnant females to the total female catch. Pregnant females have accounted for 43.1%, 59.0% and 86.0% of the female catches of blue, fin and humpback whales respectively.

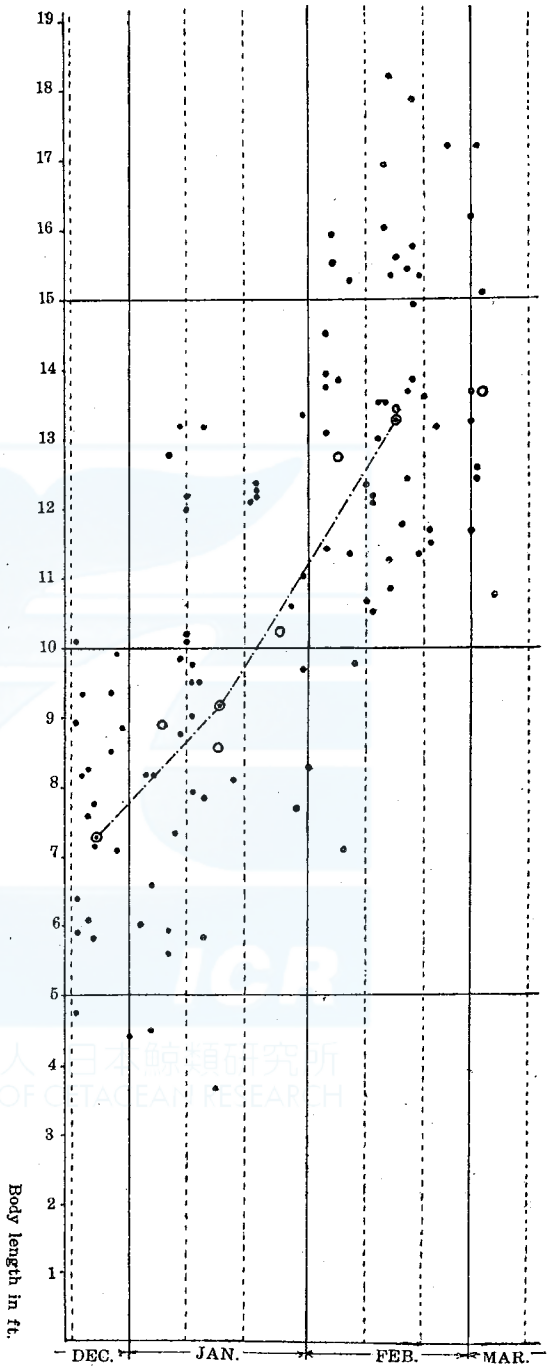

Fig. 27. Growth curve of foetus of Blue whales.

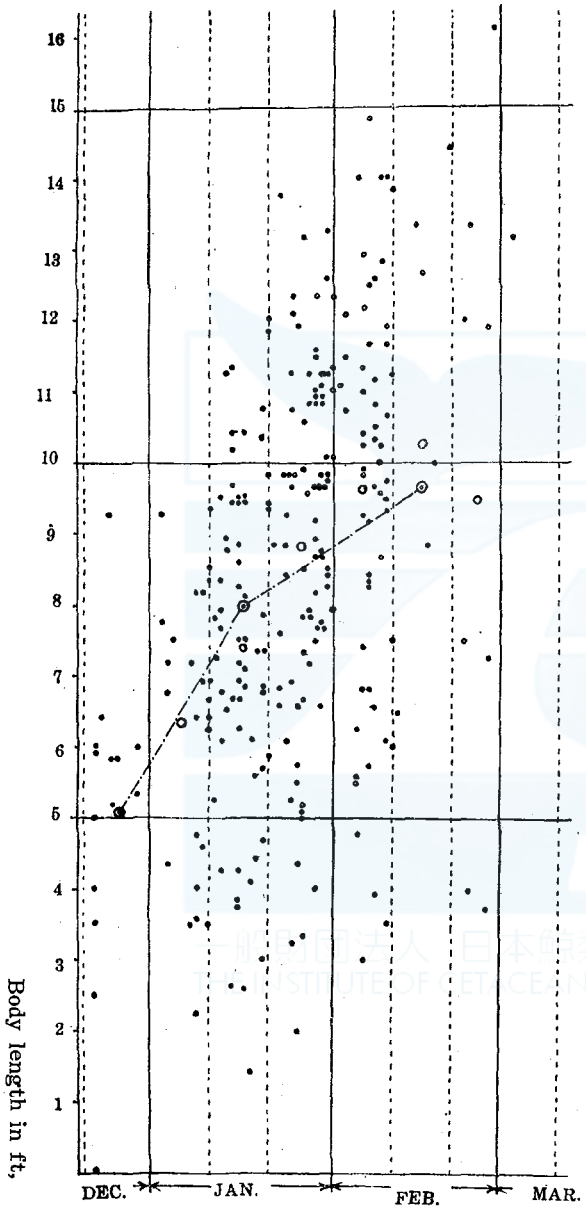

Fig. 28. Growth curve of foetus of Fin whales.

The proportion of the pregnant and the not pregnant females to the catch of the sexually mature females are shown in Table 28. The females showing one or more corpora lutea in their ovaries were considered as being sexually mature. Pregnant females have amounted to 57.7%, 66.8% and 88.1% of the captured sexually mature females of the blue, fin and humpback whales, respectively.

These percentages of pregnant females, which have been derived from the analyses of the catch, are probably overestimating the percentage of the pregnant females in the stock of whales in the sea to a considerable extent, because the mother whales which are accompanied by calves and are seemingly suckling are never hunted, thus preventing the not pregnant females from being represented in the catch as fully as the pregnant individuals.

In both of Tables 27 and 28 the females of blue whales give a higher percentage pregnancy

than those of fin whales. And the percentage pregnancy is very high in humpback whales, implying that this species propagates more rapidly than the other species.

Table 28, which refers to the sexually mature females, gives a relatively constant percentage pregnancy throughout the body length classes of each species. Hence, there are found no such length classes in which the female whales are more liable to pregnancy than in others.

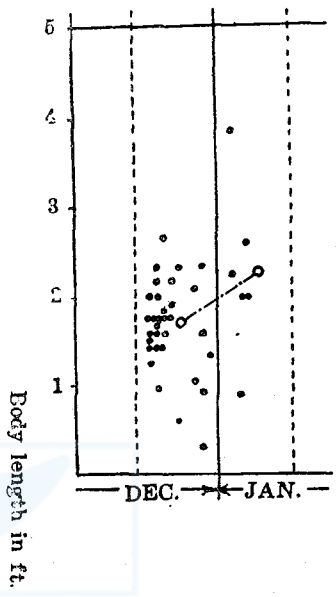

Fig. 29. Growth curve of foetus of Humpbackwhales.

Ovaries

The measurements made on the ovaries of every female have included the weights of the right and left ovary, the number of corpora lutea, and the

Table 27. Pregnant and not pregnant whales in the catch of females a/, by length groups, 1949–50

a. Blue whales.

Length in feet	Pregnant		Not pregnant		Total number
	Number	Percent	Number	Percent	
71	0	0.0	4	100.0	4
72	0	0.0	8	100.0	8
73	0	0.0	7	100.0	7
74	1	12.5	7	87.5	8
75	0	0.0	9	100.0	9
76	2	16.7	10	83.3	12
77	3	33.3	6	66.7	9
78	5	29.4	12	70.6	17
79	4	28.6	10	71.4	14
80	8	53.3	7	46.7	15
81	8	44.4	10	55.6	18
82	14	50.0	14	50.0	28
83	14	53.8	12	46.2	26
84	13	61.9	8	38.1	21

Length in feet	Pregnant		Not pregnant		Total number
	Number	Percent	Number	Percent	
85	8	50.0	8	50.0	16
86	14	73.7	5	26.3	19
87	7	58.3	5	41.7	12
88	6	100.0	0	0.0	6
89	2	40.0	3	60.0	5
90	2	50.0	2	50.0	4
91	0	0.0	1	100.0	1
92	1	100.0	0	0.0	
Total	112	43.1	148	56.9	260

a/ Includes sexually immature whales.

b. Fin whales.

Length in feet	Pregnant		Not pregnant		Total number
	Number	Percent	Number	Percent	
59	0	0.0	2	100.0	2
60	0	0.0	6	100.0	6
61	0	0.0	2	100.0	2
62	0	0.0	8	100.0	8
63	0	0.0	6	100.0	6
64	0	0.0	9	100.0	9
65	4	26.7	11	73.3	15
66	10	52.6	9	47.4	19
67	13	41.9	18	58.1	31
68	22	66.7	11	33.3	33
69	30	62.5	18	37.5	48
70	38	65.5	20	34.5	58
71	42	73.7	15	26.3	57
72	36	65.5	19	34.5	55
73	30	76.9	9	23.1	39
74	25	78.1	7	21.9	32
75	4	44.4	5	55.6	9
76	2	50.0	2	50.0	4
77	1	33.8	2	66.7	3
78	1	100.0	0	0.0	1
Total	258	59.0	179	41.0	437

c. Humpback whales.

Length in feet	Pregnant		Not pregnant		Total number
	Number	Percent	Number	Percent	
37	0	0.0	1	100.0	1
38	0	0.0	0	0.0	0
39	0	0.0	0	0.0	0
40	6	85.7	1	14.3	7
41	2	50.0	2	50.0	4
42	2	66.7	1	33.3	3
43	8	100.0	0	0.0	8
44	7	100.0	0	0.0	7
45	4	100.0	0	0.0	4
46	4	80.0	1	20.0	5
47	0	0.0	0	0.0	0
48	4	100.0	0	0.0	4
Total	37	86.0	6	14.0	43

Table 28. Pregnant and not pregnant whales on the catch of sexually mature females, by length groups, 1949–50

a. Blue whales.

Length in feet	Pregnant		Not pregnant		Total number
	Number	Percent	Number	Percent	
74	1	100.0	0	0.0	1
75	0	0.0	0	0.0	0
76	2	66.7	1	33.3	3
77	3	75.0	1	25.0	4
78	5	45.0	6	54.5	11
79	4	40.0	6	60.0	10
80	8	61.5	5	38.5	13
81	8	50.0	8	50.0	16
82	14	51.9	13	48.1	27
83	14	53.8	12	46.2	26
84	13	65.0	7	35.0	20
85	8	50.0	8	50.0	16
86	14	73.7	5	26.3	19
87	7	58.3	5	41.7	12
88	6	100.0	0	0.0	6
89	2	40.0	3	60.0	5
90	2	50.0	2	50.0	4
91	0	0.0	1	100.0	1
92	1	100.0	0	0.0	1
Total	112	57.4	83	42.6	195

b. Fin whales.

Length in feet	Pregnant		Not pregnant		Total number
	Number	Percent	Number	Percent	
64	0	0.0	1	100.0	1
65	4	50.0	4	50.0	8
66	10	71.4	4	28.6	14
67	13	46.4	15	53.6	28
68	22	71.0	9	29.0	31
69	39	63.8	17	36.2	47
70	38	66.7	19	33.4	57
71	42	73.7	15	26.3	57
72	36	65.5	19	34.5	55
73	30	76.9	9	23.1	39
74	25	78.1	7	21.9	32
75	4	44.4	5	55.6	9
76	2	50.0	2	50.0	4
77	1	33.3	2	66.7	3
78	1	100.0	0	0.0	1
Total	258	66.8	128	33.2	386

c. Humpback whales.

Length in feet	Pregnant		Not pregnant		Total number
	Number	Percent	Number	Percent	
40	6	85.7	1	14.3	7
41	2	50.0	2	50.0	4
42	2	66.7	1	33.3	3
43	8	100.0	0	0.0	8
44	7	100.0	0	0.0	7
45	4	100.0	0	0.0	4
46	4	80.0	1	20.0	5
47	0	0.0	0	0.0	0
48	4	100.0	0	0.0	4
Total	37	88.1	5	11.9	42

diameters of the largest Graafian follicle and corpus luteum.

The females which showed any corpora lutea on their ovaries were regarded as sexually mature, and those showing no corpus luteum as immature. Figs. 30 to 32 show the percentage of the sexually

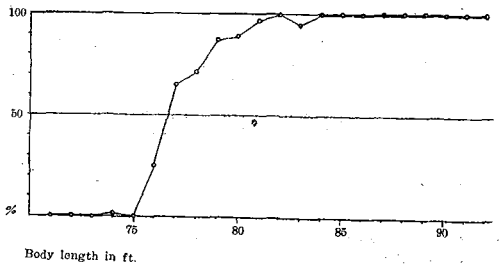

Fig. 30. Maturity of Blue female whales.

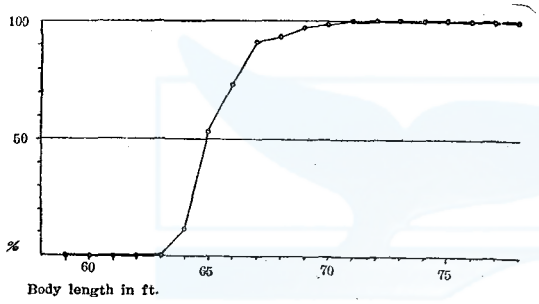

Fig. 31. Maturity of Fin female whales.

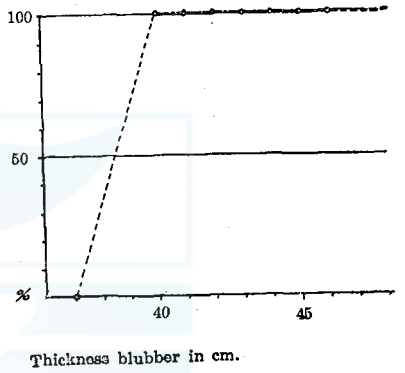

Fig. 32. Maturity of Humback female whales.

mature females to the female catch in each length class, respectively for the blue, fin and humpback whales.

Sexually immature females have accounted for the following percentages of the female catch:

Species of Whale	Percentage of Sexually Immature Females	Total Females Caught
Blue whale	25.0%	260
Fin whale	11.7%	437
Humpback whale	2.4%	42

Table 29. Total number of corpora lutea for all the whales examined, by ovaries, 1949-50

Species of whale	Number of whales examined	Right ovary		Left ovary	
		Total number of c. lutea	Percent	Total number of c. lutea	Percent
Blue	137	750	51.7	701	48.3
Fin	282	1,744	49.5	1,776	50.5
Humpback	26	97	50.5	95	49.5

In Table 29 are shown the total numbers of the corpora lutea which were found on the right and left ovaries of all the female whales examined. Since the totals for the right and the left ovaries are approximately equal in every species, we may well consider that

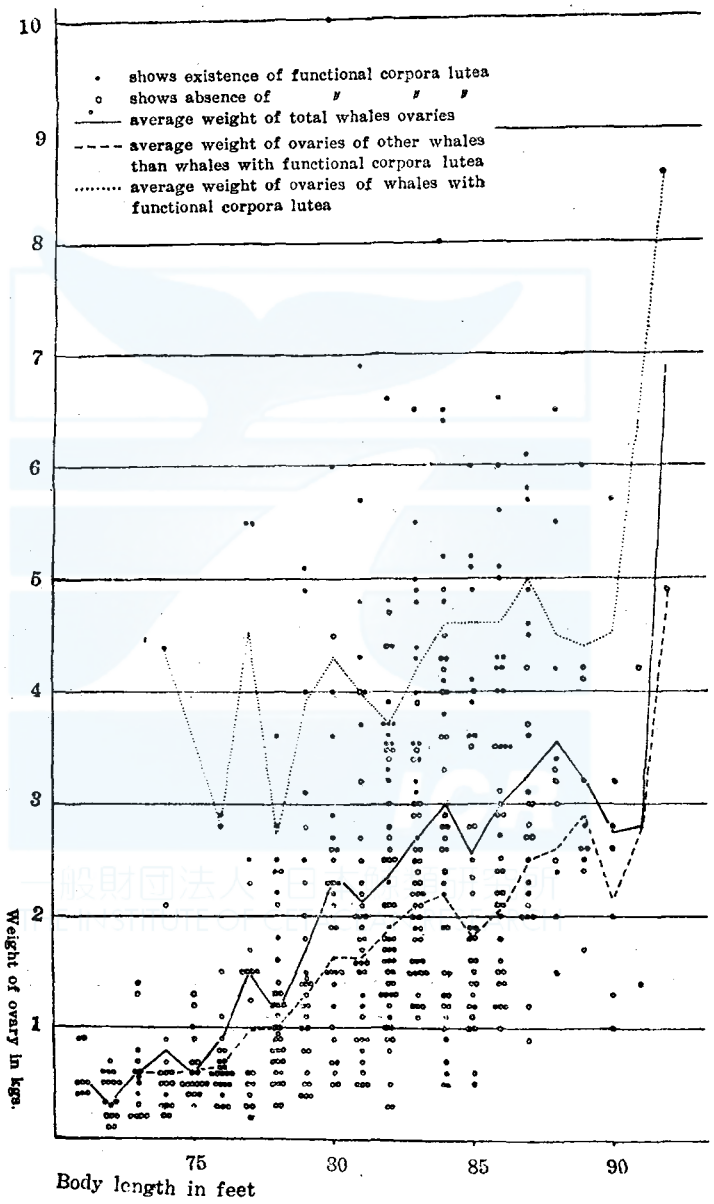

Fig. 33. Relation between weight of ovary and body length of Blue whales.

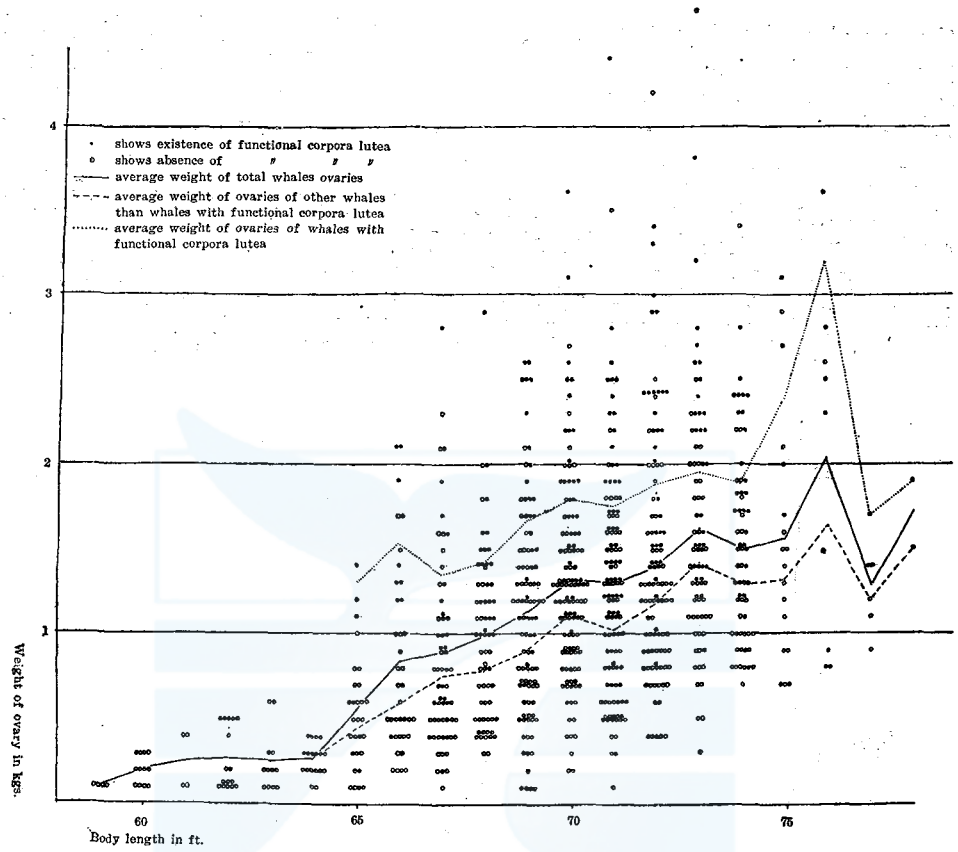

Fig. 34. Relation between weight of ovary and body length of Fin whales.

corpora lutea develop equally on both ovaries, though it does not necessary follow that the right and left ovaries ovulate in exact turns.

In Figs. 33–35 are illustrated the correlation between the weight of the single ovary and the body length in the female blue, fin and humpback whales, respectively. On these figures the weights of the right and left ovary were plotted individually, and the discrimination was made between

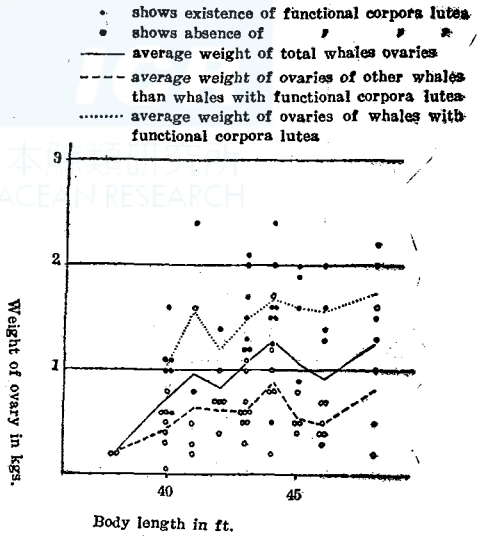

Fig. 35. Relation between weight of ovary and body length of Humpback whales.

the ovaries showing the functional corpus luteum (black dots) and those not showing them (white dots). Though the correlation considered has been obscured in these figures by the occurrences of functional corpus luteum in some ovaries, we can still see the general tendency that the weight of ovary increases with the body length.

In Figs. 36–38 are shown the numbers of corpora lutea in the ovaries of the female whales of stated lengths.

Minimum length in the sexually mature females measured 74 ft. in blue, 64 ft. in fin and 40 ft. in humpback whales. (Measurements were not made so many on the sexually mature female humpbacks.)

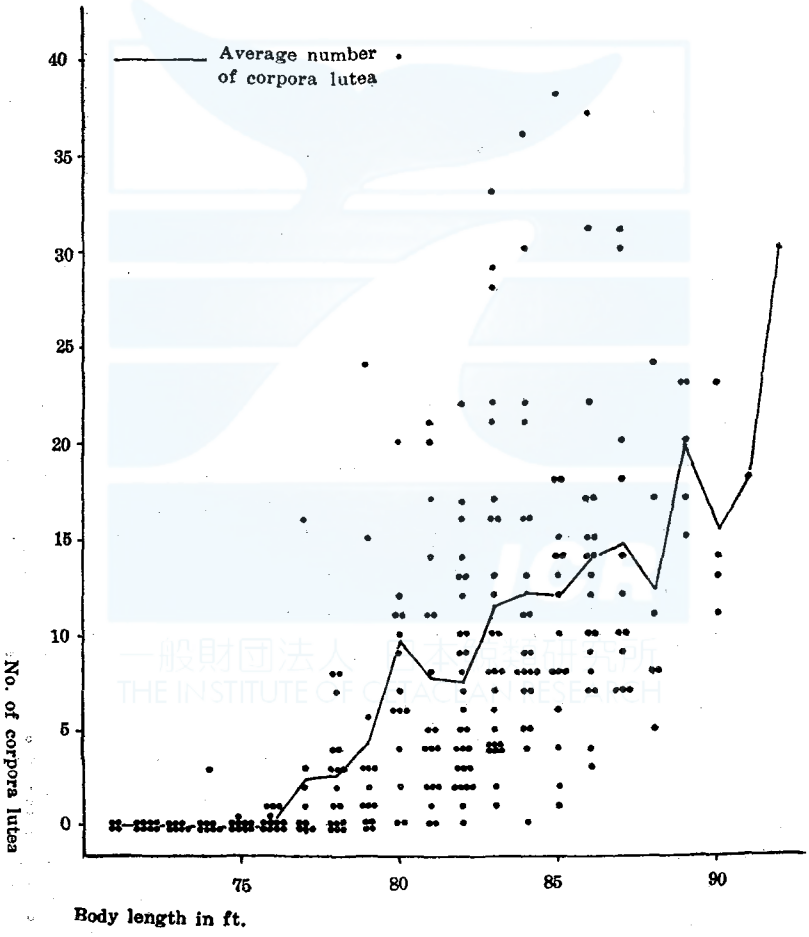

Fig. 36. Relation between body length and number of corpora lutea in Blue whales.

Maximum lengths in the sexually immature females were 84 ft. for the blue, 70 ft. for the fin, and 37 ft. for the humpback whales. (There caught only one immature female humpback whale.)

Figs. 36–38 show that there is a general increase in numbers of corpora lutea with increasing body length, and Figs. 33–35 evidence

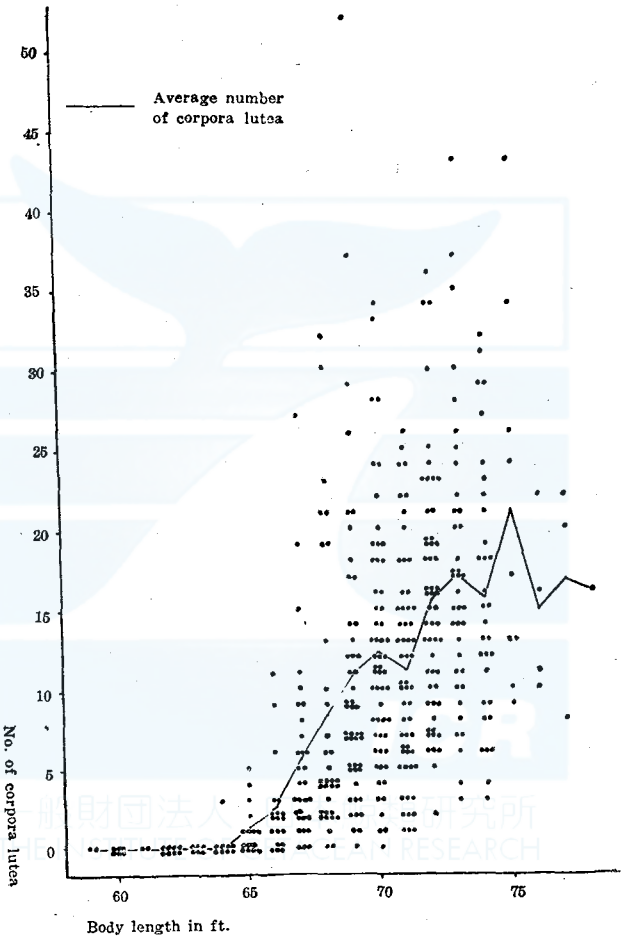

Fig. 37. Relation between body length and number of corpora lutea in Fin whales.

the increase in the weights of ovary with increasing body length. Consequently, we may say that the weights of ovary increases with the numbers of corpora lutea.

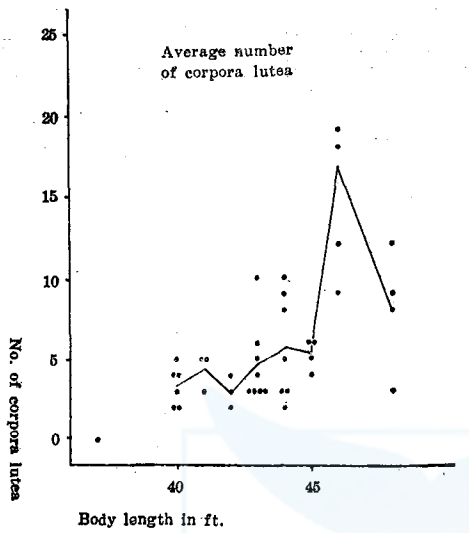

Fig. 38. Relation between body length and number of corpora lutea in Humpback whales.

In Figs. 39–41 are plotted the diameters of the largest Graafian follicle and the functional corpora lutea of the pregnant females against the lengths their foetuses. Since the length of foetus gives an accurate estimate of the time of the last ovulation, we can also study in these graphs the correlations of these diameters with the time that has elapsed since the last ovulation.

These figures illustrate that the diameters of the largest Graafian follicles as well as of the functional corpora lutea remain fairly constant throughout the foetal lengths, that is, irrespective of the time from the last ovulation. In these analyses, the foetal lengths have ranged between 2–19 ft. in blue whales, corresponding to $3^1/_2$–$9^1/_2$ months after ovulation, and from less than 1 ft. to 16 ft. in fin whales, representing the period from immediately after ovulation to 10 months later.

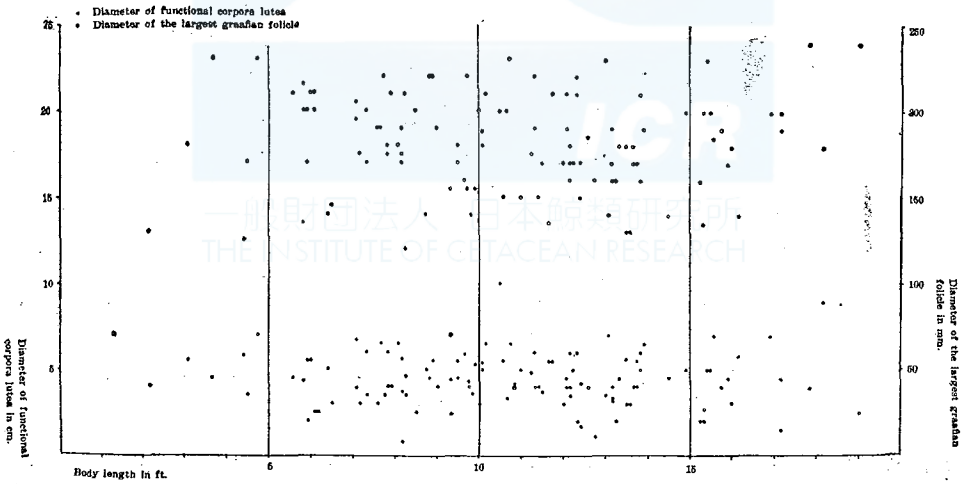

Fig. 39. Relation between body length of foetus and diameters of the largest Graafian follicles and functional corpora lutea in Blue whales.

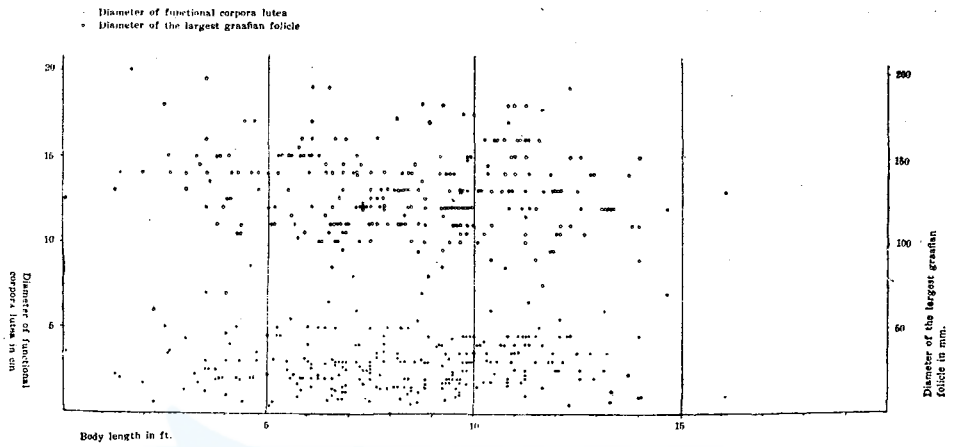

Fig. 40. Relation between body length of foetus and diameters of the largest Graafian follicle and of functional corpora lutea in Fin whales.

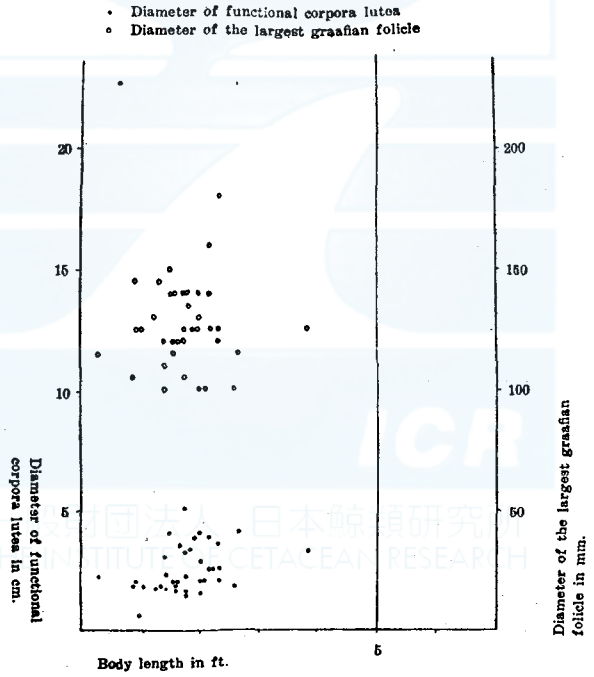

Fig. 41. Relation between body length of foetus and diameters of the largest Graafian follicle and of functional corpora lutea in Humpback whales.

It is likely from the above analyses that the functional corpora lutea and the largest Graafian follicles of the pregnant fin and blue

females remain at constant sizes throughout the period of pregnancy, neither swelling nor shrinking. (The conditions in the pregnant humpback whales have not been confirmed, because the observations were not enough many.)

The diameters of the largest Graafian follicles and the functional corpora lutea of pregnant females have averaged as follows:

Species of Whale	Average Diameter		Number of Individuals Examined
	Functional Corpora Lutea	Largest Graafian Follicles	
Blue whale	17.9 cm.	45.8 mm.	112
Fin whale	12.9 cm.	28.4 mm.	258
Humpback whale	12.6 cm.	25.0 mm.	37

The data for the largest Graafian follicles of the not pregnant whales were analyzed in a similar way, and have led to the almost same conclusion as was reached concerning the pregnant whales. There was found no correlation in the sexually immature females between the diameter of the largest Graafian follicles and the time of capture; in other words, there was no sign that the largest Graafian follicles in these whales had shown smaller diameters in the earlier part of the season than they did in the later part of it. The diameters of the largest Graafian follicles of sexually immature whales have averaged as follows:

Species of Whale	Average Diameter of Largest Graafian Follicles	Number of Immature Females Examined
Blue whale	16.8 mm.	29
Fin whale	5.0 mm.	26
Humpback whale	8.0 mm.	1

In the sexually mature females which were not pregnant, the diameters of the largest old corpora lutea were measured. The data were analyzed to determine the possible correlation of these diameters with the time of the season. But the result shows that there is no such correlation, and that the sizes of the largest old corpora lutea remain fairly constant throughout the season without any sign of shrinkage in the later part of the season. As for the largest Graafian follicles of these whales, their sizes have not changed appreciably all through the season, just as was the case in the same organ in the sexually immature females.

The diameters of the largest Graafian follicles of the sexually mature, not pregnant females have averaged as follows:

Species of Whale	Average Diameter of Largest Graafian Follicles	Number of Not Pregnant, Mature Females Examind
Blue whale	25.0 mm.	37
Fin whale	17.0 mm.	63
Humpback whale	22.0 mm.	2

It should be mentioned here that any analyses of the data that are made in this study with reference to time have much limitations to their scope, because the data used have only covered a single season, or a period of two and a half months. And the conclusions drawn on basis of such analyses are mostly tentative ones; this holds true particularly in the discussions in this section.

One of the pregnant fin whales examined showed two functional corpora lutea in spite of being with a single foetus. Data pertinent to this case follow:

Length of Mother	Location Captured	Date & Time Captured	Sex & Length of Foetus
72 ft.	162°44′W 66°11′S	February 2, 1950. 5:00 a.m.	Male; 12′1″; found in the left cornu uteri.

Functional Corpora Lutea		Number of Old Corpora Lutea	Weight of Ovary
Number	Diameter		
(Left) 2	11.0 cm., 10.5 cm.	8	2.4 kg.
(Right) 0		6	1.3 kg.

The correlation between the numbers of corpora lutea and the ossification of vertebrae was also investigated, with a result as illustrated in Fig. 42. Exactly median vertebrae of the thoracic and lumbar series were examined. The determination of the degrees of ossification was subject to a considerable personal error, and the numbers of corpora lutea were considerably divergent in each ossification class. And so, the average value was taken in each class, and are plotted in Fig. 42.

From this figure we may state that, in both blue and fin whales, the ossification of both thoracic and lumbar series is not completed at corpora lutea numbers less than 20, and the physical maturity begins

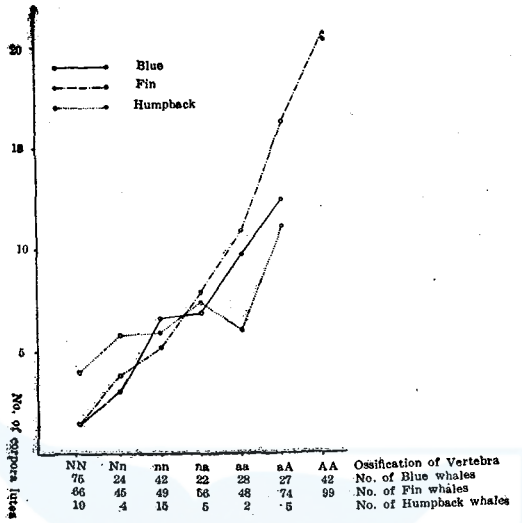

Fig. 42. Relation between number of corpora lutea and ossification of vertebrae.

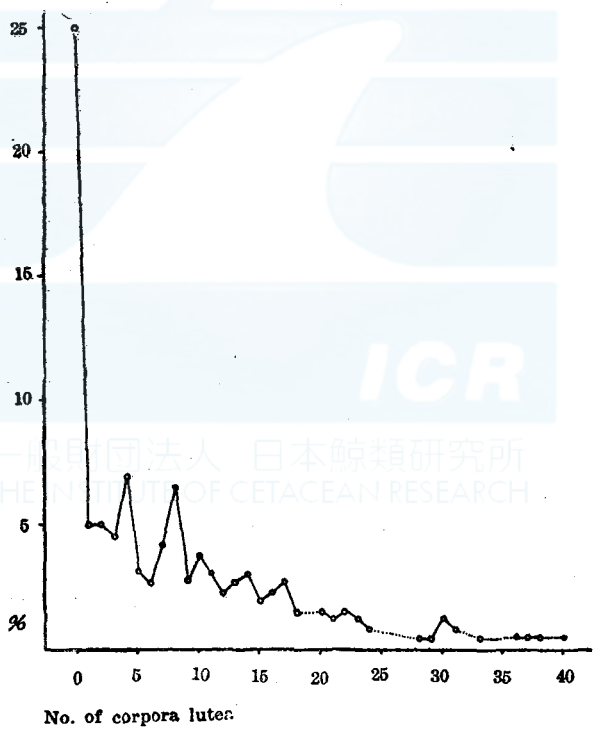

Fig. 43. Frequency curve of number of corpora lutea in Blue whales.

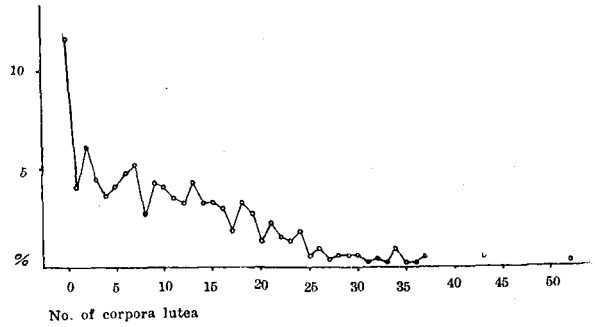

Fig. 44. Frequency curve of corpora lutea in Fin whales.

at corpora lutea number of 3 or 4. The humpback whales examined were so few that the correlation has not been clearly represented for this species.

The percentage frequencies of numbers of corpora lutea are given in Figs. 43–45 for the blue, fin and humpback whales respectively.

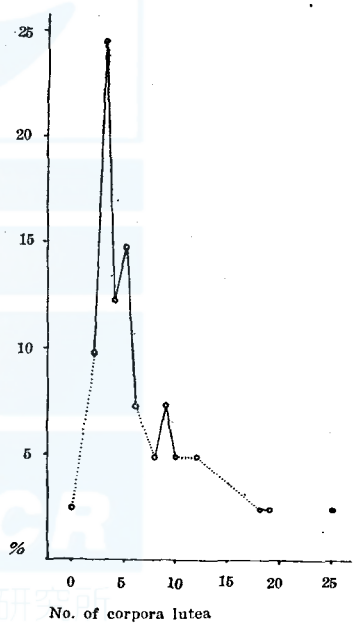

Fig. 45. Frequency curve of number of corpora lutea in Humpback whales.

Testes

The weight and volume of the testes excluding deferent ducts were measured in every male whale captured.

The weights and volumes of the testes of blue whales are plotted against the lengths of whale in Figs. 46 and 47. The distribution of the plots in both these figures generally agree with the records for the usual years. If we consider the male blue whales with the testes weighing 10 kg. upwards as being sexually mature, only 33 whales or 6% of the male blue whales taken were sexually immature.

The data for the fin whales are plotted in Figs. 48 and 49 in same fashions. These figures also give just same features as have been recorded in the preceding seasons. Only 30 or 5% of the male fin whales that were caught in this season were sexually immature, if

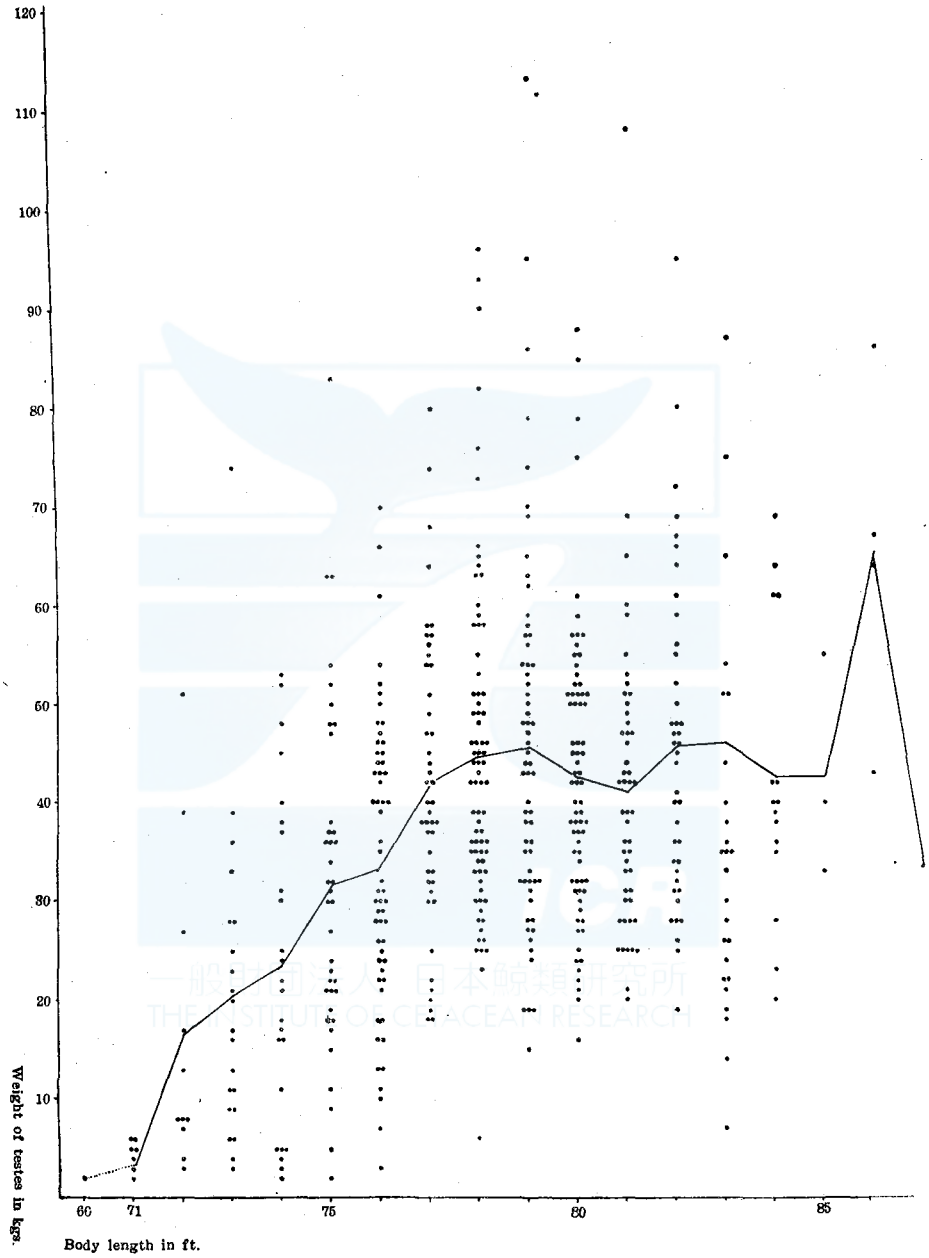

Fig. 46. Relation between total weight of right and left testes and body length in Blue whales.

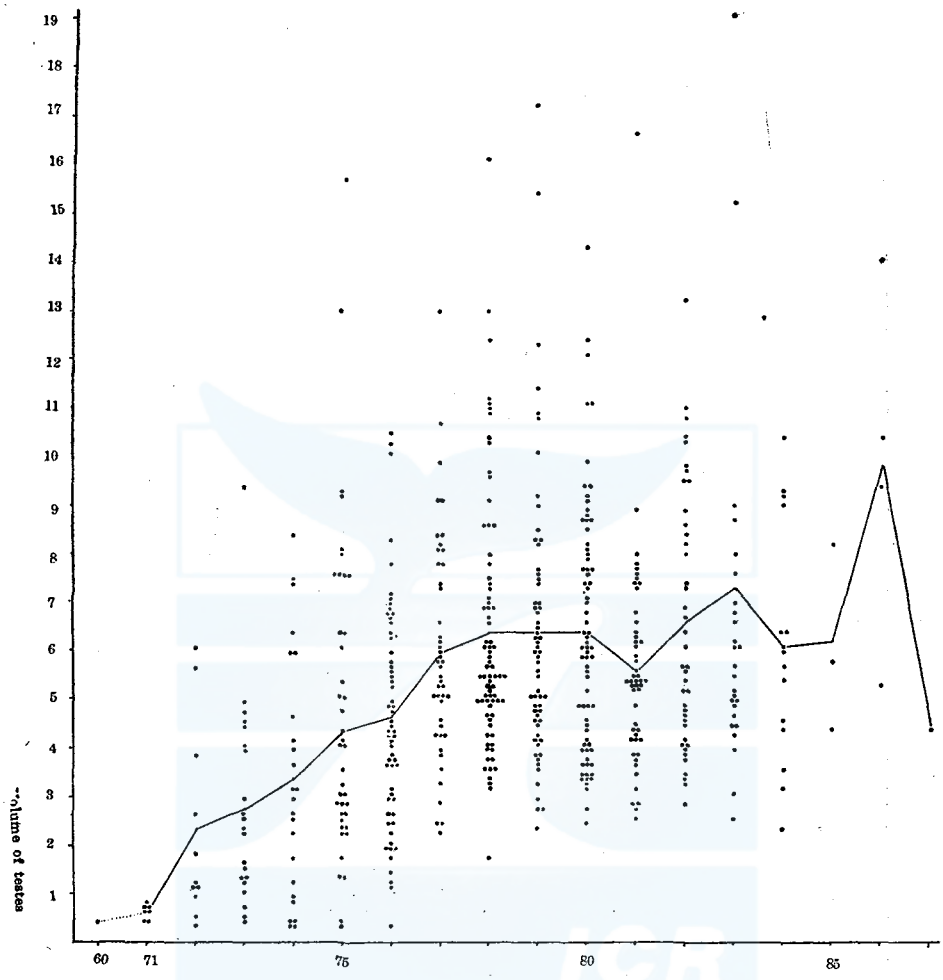

Fig. 47. Relation body length and volume of testes in Blue whales.

5 kg. is taken as the minimum testes weight of the sexually mature fin whales.

The writers are of opinion that both of the weight and the volume of testes need not be measured, as one is to give the same result as the other. And it seems more advisable to choose the weight, for weighing can be done more easily and accurately than measuring the volume, and, in addition, the data of weight are far easier to handle than the volume data.

The measurements on the humpback whales are plotted in Figs. 50 and 51 in same manners. But the data are too scarce to justify

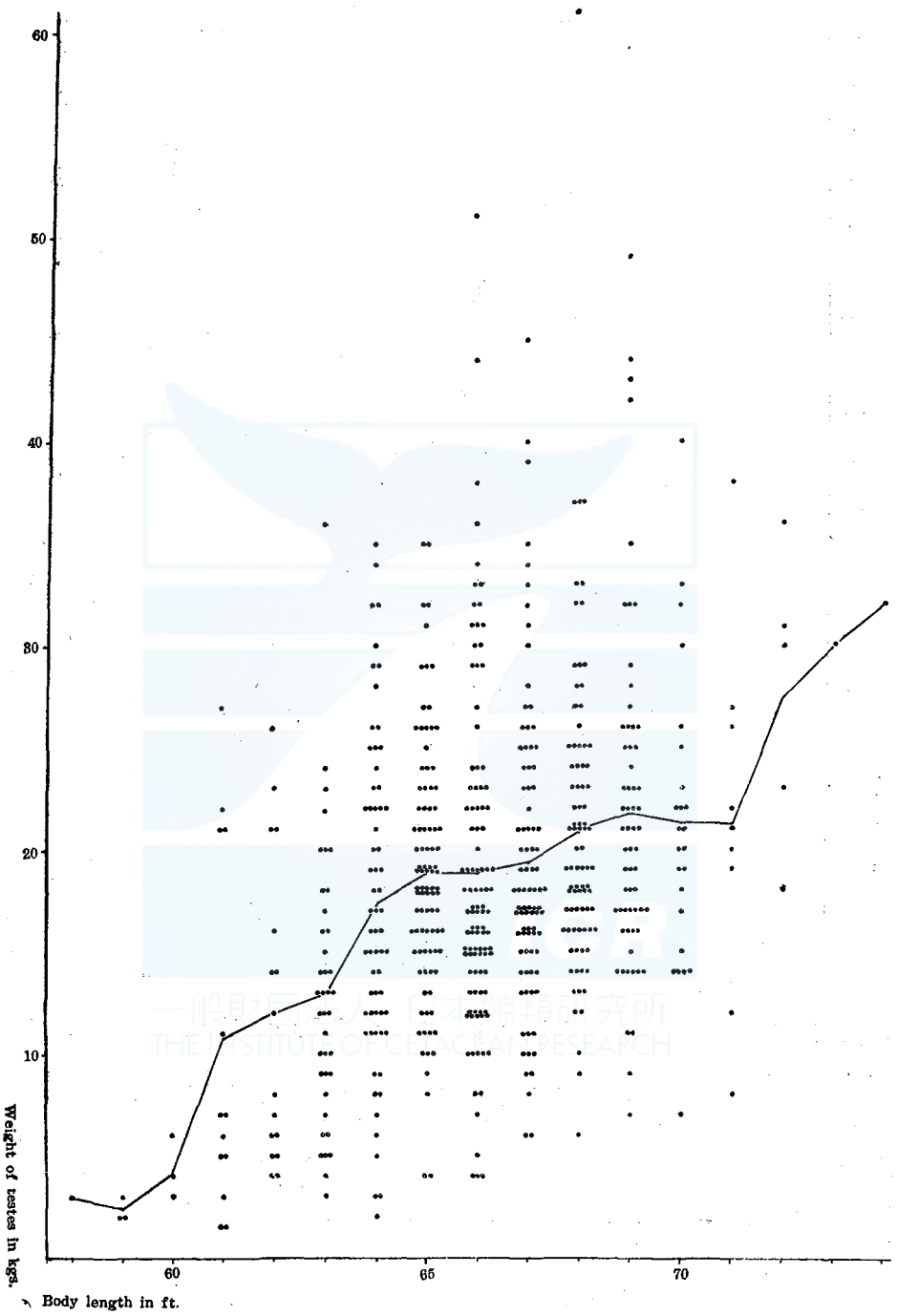

Fig. 48. Relation between weight of testes and body length in Fin whales.

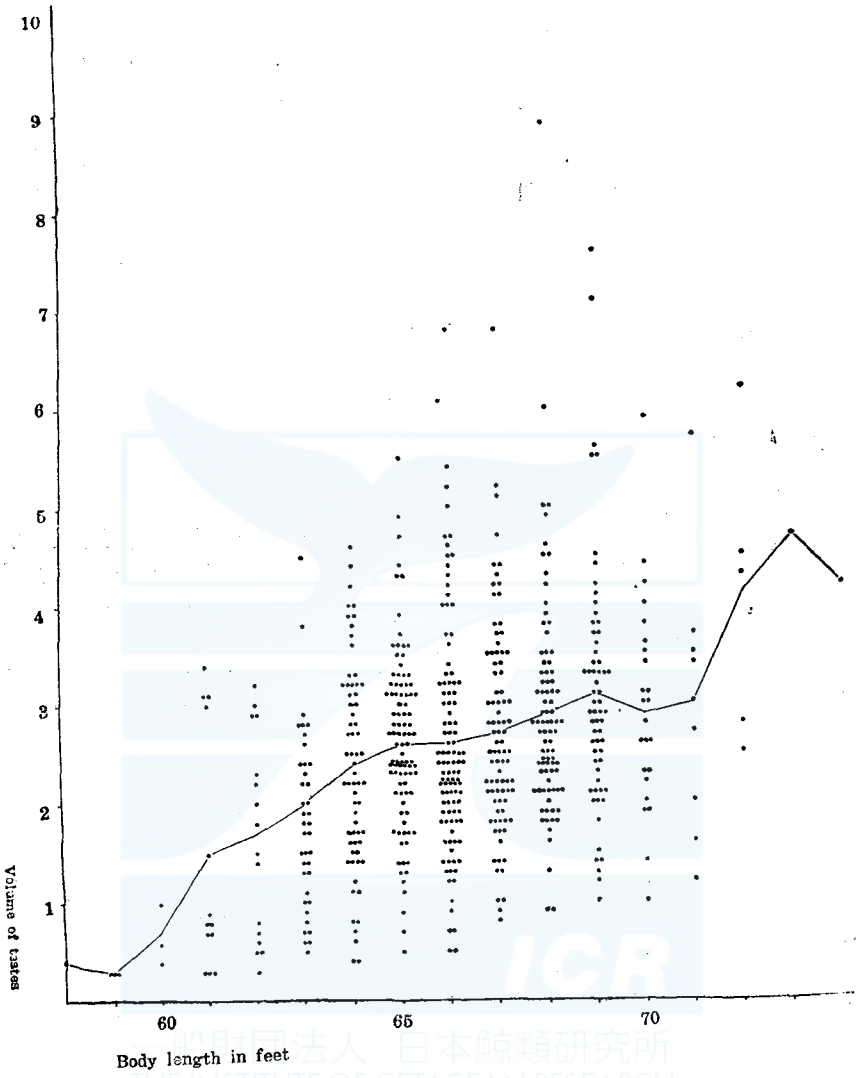

Fig. 49. Relation between body length and volume of testes in Fin whales.

any statement concerning the correlation of these measurements with the length of whale. Such biological characters as the body length at the sexual maturity and others, that have already been clarified in the Antarctic blue and fin whales, remain obscure in the case of humpback whales. It is necessary to throw light upon these problems by repeating the investigations in future.

The correlation of the weight of testes with the ossification of

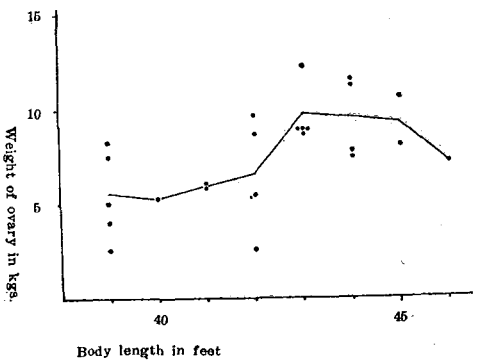

Fig. 50. Relation between body length and weight of testes in Humpback whales.

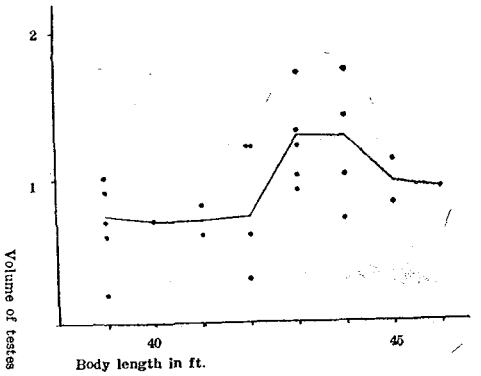

Fig. 51. Relation between body length and volume of testes in Humpback whales.

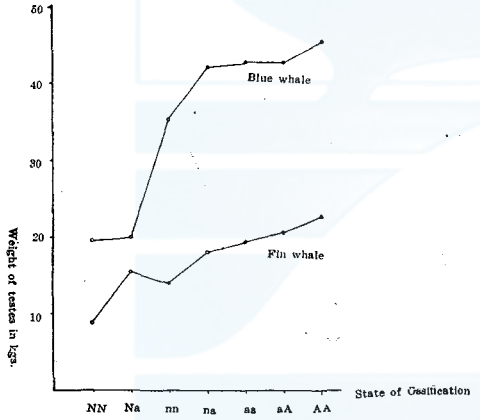

Fig. 52. Relation between state of ossification of vertebrae and weight of testes in Blue and Fin whales.

vertebrae is shown in Fig. 52. Humpback whales are omitted because their number examined are so small.

The weight of testes is so divergent in each ossification class, just as the number of corpora lutea was, that the average weight was calculated for each class, and was plotted in Fig. 52. But the obtained correlation curve is far difficult to interprete, compared with the one or the number of corpora lutea.

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Vertebrae

The ossification of the vertebrae was examined by chipping off the cartilage layer between epiphys and centrum. But it seems somewhat doubtful that the data obtained by different investigators are perfectly comparable with one another.

The correlations of the ossification with the numbers of corpora lutea and with the weights of testes have been dealt with respectively in the sections of "Ovaries" and "Testes". The correlation with body length of the whale will be discussed here. Figs. 53 and 54 show

this correlation in the blue and fin whales. Body lengths are also divergent in each ossification class, just as the numbers of corpora lutea and the weights of testes were. And so, the average length is computed for each class, and is plotted in these figures.

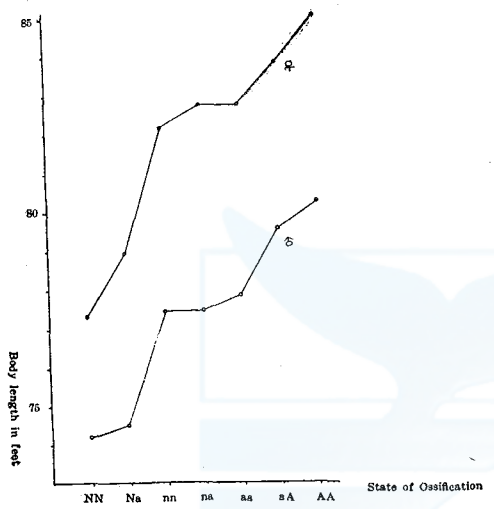

Fig. 53. Relation between state of ossification of vertebrae and body length in Blue whales.

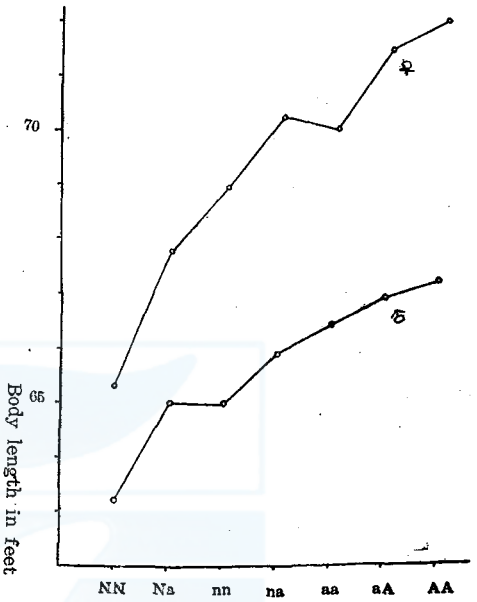

Fig. 54. Relation between state of ankylosis of vertebrae and body length of Fin whales.

According to Figs. 53 and 54 the ankylosis of the vertebrae is completed (i. e. ossification class "AA") at the following body lengths:

Blue whales, males 80 ft.; Blue whales, females 85 ft.
Fin whales, males 67 ft.; Fin whales, females 72 ft.

Then, the body lengths at which the ankylosis of vertebrae is completed differ by 5″ between the two sexes in both of blue and fin whales.

If we regard the whales showing the ossification of vertebrae of "aa" or further as physically mature, such whales have accounted for 58% or 470 whales of the blue whale catch of this season, and 57% or 597 whales of the same fin whale catch.

* * * * * * *

On closing this report, mention should be made of such phases of the present investigation that were not dealt with in this report.

General biological data, as were presented in this report respect-

ing the baleen whales, were also collected on all the sperm whales caught in the expedition. But they had not been finally compiled by the time this report was prepared. They are to be dealt with in another report.

In parallel with the general biological investigation into the whale carcasses, the writers carried out further specialized studies on the biology of the whale. The projects of such studies follow:

Study on the blood-group in the whale.
Study on the whale food.
Study on the lung of the whale.
Identification of the fishes found in the whale stomachs.
Identification of the whale lices.

Until present the writers have not had time to compile and analyse the data of these studies. Results of these studies will be published when the necessary treatments of data are finished.

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