Whales in the Adjacent Waters of Japan

By Hideo Omura

Introduction

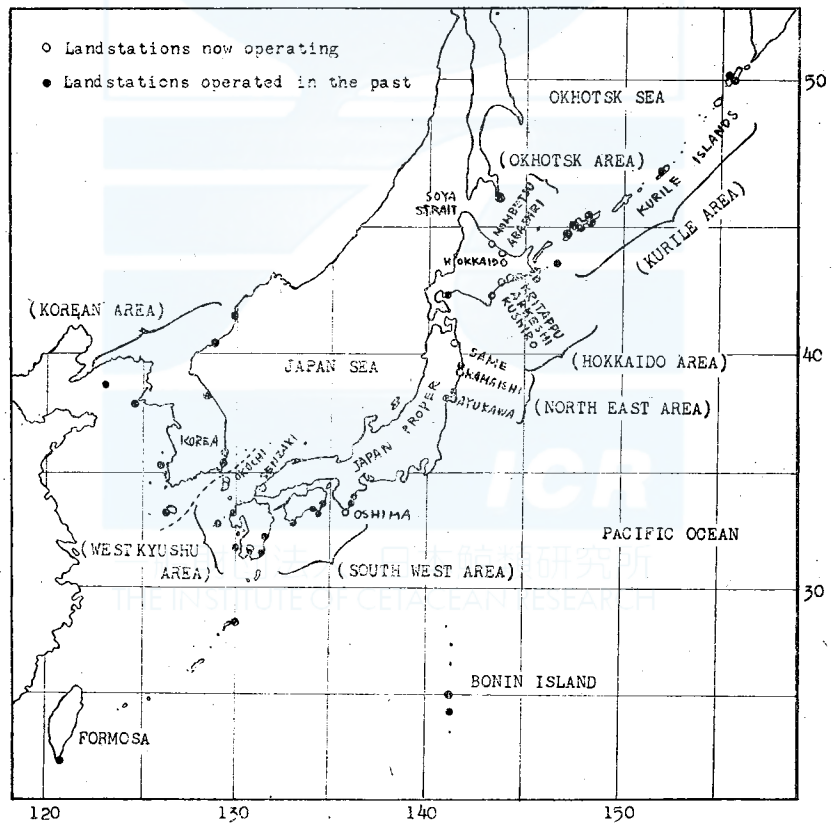
At present, the following two types of whaling are operated in the adjacent waters of Japan.

a. Landstation whaling.

b. Factory ship whaling.

Landstations are located as shown in Fig. 1.

Fig. 1. Locations of landstations in Japan.



Till the end of World War II, whaling industry had been conducted with land stations on Bonin Island. Since the end of the War, small size whaling factory ships have been used there because of the impossibility of

using land. Whaling inspectors are sent by the Japanese Government to every landstation and factory ship. As it is fundamentally important for maintenance of the whale stock to grasp an oecological and resource survey of whales, we decided to carry on the biological investigation by these inspectors for every whale caught with a certain method since 1948. At the end of 1949, the number of whales investigated reached 1,785 in all as shown in Table 1.

Table 1. Number of Whales Observed.

Year	Species	Male	Female	Total
1948	Blue whale	3	7	10
	Fin whale	47	33	80
	Sei whale	222	163	385
	Humpbacks	2	4	6
	Sperm whale	149	212	361
	Total	423	419	842
1949	Blue whale	1	3	4
	Fin whale	39	43	82
	Sei whale	313	333	646
	Humpbacks	2	2	4
	Sperm whale	182	25	207
	Total	537	406	943
Total of both years	Blue whale	4	10	14
	Fin whale	86	76	162
	Sei whale	535	496	1,031
	Humpbacks	4	6	10
	Sperm whale	331	237	568
	Total	960	825	1,785

This report is based on these data as shown in Fig. 1, whaling landstations are scattered all over Japan. To our regret, the investigation could be carried on at only 7 landstations,—Ayukawa, Kamaishi, Kushiro, Akkeshi, Kiritappu, Abashiri, Mombetsu, and Bonin Island. Though extremely few whales are caught around Oshima and west of it, that ground is also an important location for survey of whales' stock and migration. So in the near future the author hopes to be able to carry on the same investigation at these landstations too.

Sincere thanks are expressed to the following men for their cordial cooperation in carrying on the investigations at each landstation.

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Methods.

Excepting various parts of the body measurement was carried on with nearly same method as in Discovery Investigation. Namely, notes on external characters, food, external parasites, condition of genitalia and degree of physical maturity were investigated. However, sometimes not all of them could be investigated on all individuals. Therefore, not all the items were recorded on all the whales shown in Table 1. On some whales only a part of the items was observed.

Details of items observed are as follows:

a. Colour.

Blue whales: Observations were made on the same items as in Discovery Investigation. But there were only 4, so few that no conclusion could be drawn.

Fin whales: There are normally grey but sometimes blackish in back; so classification was made on that point. Distribution of pigment on the side of the body was divided into three groups; (1) normal, (2) those in which the pigmentation did not come down so far as in the normal and (3) those in which the pigmentation extended below the normal. Moreover, there were some whales, of which pigment projected in triangle from a little behind the anus toward the anus, so this was recorded too. Then there were some whales on which the right and left pigments met just in front of the tail flukes on the ventral side of tail; and some on they did not meet. So this was recorded too.

Sei whales: Are generally grey in back, and somewhat lighter on ventral side. Ventral grooves have a large white area. The dark or pigmented area on the side projects into this white area like tongues. It was recorded whether this pigment was very pronounced, normal or not so pronounced, and whether the dark areas on the right and left sides met around the posterior end of ventral grooves. The state of development of white area near the chin was classified into three classes: below normal, normal and

above normal. It was recorded too whether or not the right and left pigments met just in front of the tail flukes. And *Sei whales* have light coloured spots on the flanks and side of the tail, which develop an appearance resembling new galvanized iron. This condition was classified into none, few, moderate, and many for recording.

Humpback whales: though they were very small in number, were recorded under classification of four fundamental and three medium types, according to Lilly.

Sperm whales were divided into 4 classes, for colour recording: black all over, light greyish on lower part of head, light whitish colour all over head, and whitish light colour all over the body.

And there were some sperm whales with light coloured spiral markings at the tip of head. They were recorded under 4 classes: clear, normal, indistinct and none. As some whales had light spotted marks near umbilicus, they were divided into 5 classes: none, rare, normal, abundant and extremely abundant for record. As for distinct white area around umbilicus, it was classified into 3 classes: none, normal and abundant.

b. White scars :

White scars are commonly seen on whales in the Southern hemisphere. The same is true also of whales in the North hemisphere. While open pits were found on whales caught around the Bonin Islands, only healed scars were found on whales caught in the other whaling grounds. These white scars were recorded, dividing into 4 classes : none, extremely rare, many, extremely many. The oldest distinguishable scars were 3 to 4 years old.

c. External parasites :

External parasites of whales in the adjacent waters of Japan are similar to those of whales in the Southern hemisphere. Namely, they are Cyamus sp, Coronula sp, Conchoderma sp, Pennella sp, and diatoms. Where these parasites were found, their species, number and position were recorded.

d. Number of teeth of sperm whales :

The number of functional teeth of lower jaw was counted, separately for right and left sides. Then as there were some teeth in the inner part of the mouth which were not exposed above the gum, these were counted with care. And on the largest of right and left teeth, the length and diameter of its exposed part were measured. The number of rudimental teeth

of upper jaw was also counted, separately for right and left sides.

e. Thickness of blubber.

Thickness of blubber was measured at the following two points:

Point 1, (flank) : the point on a vertical line from the dorsal fin, where it intersects the horizontal cut side of the body.

Point 2, (neck) : the point on the vertical cut near the ear hole where it intersects the mid-dorsal line. In the Discovery Investigation, the thickness of shoulder was measured. But as the measurement of this part was so difficult owing to a different flensing method used in Japan, it was especially measured at Point 2 also. This is not because this point was specially important, but because it was easy for measurement.

f. Thickness of Mammary gland.

The thickness of the thickest part of mammary gland was measured and its colour recorded. But judgment as to its colour was liable to depend upon the observer, so no specially important results were obtained.

g. Stomach Contents.

Kinds, size, quantity and freshness of the first stomach were recorded.

h. Genitalia.

The three dimensions of testis were measured in cms, and multiplied to calculate its volume (Volume 1 was for 1,000 cc). Its weight was recorded in kgs. The weight of ovary and the number of corpus luteum were recorded separately for functional and old. The diameter of the largest Graafian follicle was measured also.

i. Ossification of vertebrae.

At two points, thoracic and lumbar vertebrae, examination was made as to whether or not epiphyses and centra fused. These points were between 7th and 8th bones, both thoracic and lumbar.

Blue whale (*Balaenoptera musculus Linnaeus*)

Blue whales are rarely caught in the adjacent waters of Japan. Even in this investigation, only 4 males and 10 females, 14 whales in all, were examined. And that data are so insufficient through all the items that full discussion cannot be made. Here, only the outline is reported.

a. Color.

Only 4 whales (1 male and 3 females) were recorded for colour. 3 of these whales had many pale spots scattered all over from shoulder to tail. But no mention is made of the 4th whale. As for the clearness of

color, one was not so clear, another clear and the third extremely clear. The one whose color was recorded as "extremely clear" was probably immature. while the other two were mature.

White flecks at the posterior part of ventral grooves were extremely few for 1 whale, few for 2 whales, and normal for 1 whale.

White striation on undersurface of tail flukes was clear on 1 whale, and not very clear on the other 3.

b. White scars.

4 whales were recorded for white scars. The details were : 1 whale with extremely few white scars. 1 with a few scars and 2 with many scars. The first two whales were probably immature and the latter mature.

c. External parasites.

One whale was heavily infected with Cyamus sp. on its head. It was an immature female, 62 feet long, caught at a point 70 miles SE from the Bonins.

d. Thickness of blubber.

Thickness of blubber was measured for 6 whales but no conclusion can be drawn from the results obtained. For reference, the values are shown in Table 2.

Table 2. Blue whale. Thickness of blubber.

Date of Catch	Body length in ft.	Sex	Blubber thickness		Ground	Remarks
			Point I	Point II		
			cm.	cm.		
14 Oct. 1949	72	M	6.0	9.0	Kiritappu	Mature
12 Mar. 1948	62	F	7.5	—	Bonin island	Immature
13 Oct. 1949	67	F	12.0	12.5	Kushiro	〃
27 Jul. 1948	70	F	8.8	7.0	Ayukawa	〃
19 Jun. 1949	70	F	6.5	7.0	〃	〃
6 May. 1948	73	F	11.5	12.5	〃	Pregnant or recently ovulated

e. Food.

Record was made of the stomach contents of 7 whales. In 5 of them the stomach was found to be empty. The other two whales had a small quantity of tiny euphausias. Their species were not identified.

f. Maturity.

As shown in Table 3, the weight (in kgs.) and volume of testis were measured for 4 males. This volume means length, width and thickness in

cms, simply multiplied; and 1,000 cm^3 is given as the unit. According to Mackintosh and Wheeler, Antarctic whales which have a testis volume of more than 5 under this method of calculation are regarded as adults.

Table 3. Blue whale. Weight and volume of testis.

Body length in feet	Weight in kg.	Volume	Maturity
65	(1.9 (2.1	2.4 2.5	Immature
65	(0.5 (0.8	1.0 1.0	〃
72	(17.1 (17.0	19.5 24.6	Mature
74	(12.4 (13.5	18.5 19.7	〃

As table 3 shows, a whale 65 feet long was immature but whales 72 and 74 feet in length were undoubtedly mature. For 10 females, as shown in table 4, ovaries were weighed and number of corpora lutea was counted.

Table 4. Blue whale. Weight of ovaries and number of corpora lutea.

Body length in feet	Weight of ovaries	Number of corpora lutea		Remarks
		Functional	Old	
	kg.			
62	(0.2 (0.3	0 0	0 0	Immature
66	(0.2 (?	0 ?	0 ?	Immature ?
67	(0.2 (0.2	0 0	0 0	Immature
70	(0.3 (0.3	0 0	0 0	〃
70	(0.2 (0.3	0 0	0 0	〃
70	(0.8 (0.9	0 0	0 0	〃
73	(2.0 (3.0	0 1	4 1	Pregnant or recently ovulated.
74	(0.7 (?	0 ?	0 ?	Immature ?
78	(1.5 (1.4	0 0	2 1	Resting
81	(3.7 (3.3	? ?	? ?	Resting ?

In table 4 there is no mention of one of the ovaries of a whale 66 feet long, which was undoubtedly immature.

The same with that of a whale 74 feet long; but in this case the one ovary that was found contained no corpus luteum.

A whale 81 feet long of which only the weight was recorded, was probably in the resting stage.

As mentioned above, there was a male 72 feet long that was mature, and a female 73 feet in length that was mature. For whales located in the Antarctic, such a fact would be exceptional. Matsuura obtained the results shown in table 5, after his investigation on 14 female blue whales which were caught off the east coast of Kamchatka.

Table 5. Blue whale. Number of corpora lutea.
(After Mr. Matsuura)

Body length in feet	Number of corpora lutea (total of both ovaries)								.....		
	1	2	3	4	5	6	7	8	.....	14	Total
71	0										1
72	0										1
73											–
74	△0					□				□	4
75					□						1
76								0			1
77				□							1
78		0		0							2
Total	4	1		2	1	1		1		1	11

0 ..... Pregnant, △ ..... lactating, □ ..... Resting

While Table 5 shows mature whales only, there were 2 other whales of 74 ft. length that were immature.

Though the number of whales investigated was small, Matsuura pointed out on the basis of the above fact and the results of measurement of the various body parts that blue whales located in the Northern Pacific were probably different from those in the Antarctics and that the size at which sexual maturity was attained was smaller in the case of the North Pacific whales.

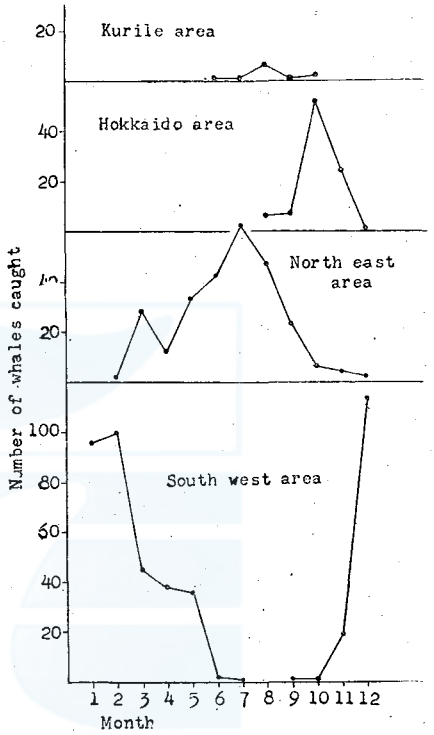
The number of whales investigated this time was even smaller and hence inadequate as a basis for any definite conclusions, but they would seem to endorse Matsuura's opinion.

g. Migration and Stock.

On the basis of the past 18 years' whaling data, number of whales caught monthly in each area (see Fig. 1) is as shown in Fig. 2.

By "past 18 years" means 1910, 1911, 1914, 1919, 1921, 1922, 1926, 1932, 1934, 1940, 1941, 1942, 1943, 1944, 1945, 1946, 1947 and 1948. Data for the other years were lost by fire during the war.

Fig. 2. Blue whale. Monthly catch in different areas.



As seen in Fig. 2, the best season for blue whales in the South-west area, was in Dec. Jan. and Feb. In the Northeast area it is July, and in Hokkaido Oct.

In the Kuriles area, although only a small number of whales are caught, the peak of the season is August. From this fact it can be seen that these whales stay in the warm sea of the South west area during December to February and then gradually migrate northward along the Pacific side of Japan to reach the east side of Kamchatka Peninsula, through the north east area and off Kurile Islands.

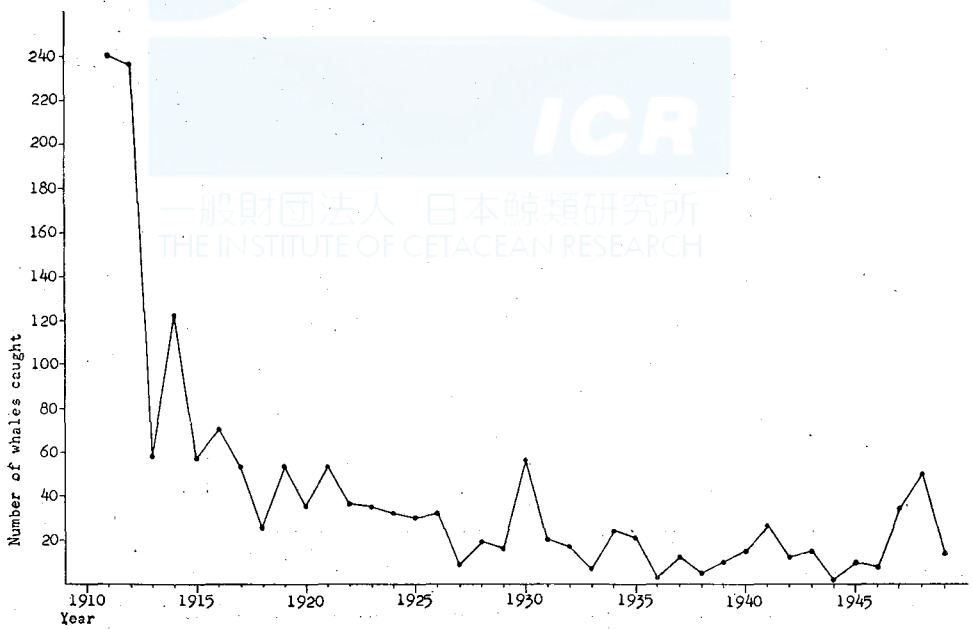
In 1940 and 1941, the whaling factory ship Tonan-maru operated off the east coast of Kamchatka Peninsula and caught 34 blue whales in 1940 and 40 in 1941, the seasons being June and July. It can thus be seen that the whales have already reached this area by that time. In both years, however, there were no blue whales caught north of Lat. 52° N. So it would seem that their northward migration does not extend to such a high latitude, as in the Southern hemisphere. The whales which are caught in the Hokkaido waters are those which, having migrated to the north are on their way southward. The fact that there is almost no catch around Hokkaido before October is indication that the whales when migrating northward follow routes much further off the coast. Both the northward and south-

ward courses, seem to pass through the Northeast area. And in Bonin Island blue whales were caught but very rarely. And as those few catches were during January to May, nothing can be said about the route of the southward migration; but in the northward movement, very few seem to pass through the Bonin area.

In the South west area, Oshima and its neighbouring area were the principal whaling grounds. Off the west coast of Kyushu, whales were rarely caught. Along Korea both east and west sides, whales were caught very rarely. Consequently, it can be said that blue whales seasonally migrate along the east coast of Japan from South to north, and rarely from west coast of Kyushu to Korea. Blue whales have never been caught from Japan sea to Okhotsk sea. Though it is not clear how far south they migrate, no blue whales have been caught around Formosa.

The above is the information bases on whaling data of the past 18 years'. We can see therefrom that there has been a marked decrease blue whale stock, and that notable changes have taken in their whaling grounds. In Fig. 2, it is in the south west area that the most whales were caught. But that was generally the situation before 1920; and today not a single whale is caught around Oshima which was the principal whaling ground in

Fig. 3. Blue whale. Variation of catch.



that area at that time. Though only rarely, it is in the northeast area and the Hokkaido area that they are caught now. Fig. 3 shows the fluctuations in the catch of blue whales from 1911 to 1949.

Though more than 200 blue whales were caught in 1911 and 1912, there was a sudden decrease thereafter; and in no single year since 1917 have more than 60 whales been caught. Comparatively big peaks were seen in 1930 and 1948 but fell again in the following years. The relatively heavy catch in 1948 is to be explained by the fact that more than the usual number of whales migrated to the Hokkaido area on their way from north to south.

As already stated, catch of blue whale in the South west area today is nil but some are caught in the Hokkaido area and the Northwest area. So it would appear that along with the decrease in stock, there has been a change in the migration route of blue whales.

Fig. 4. Blue whale. Size distribution of whales caught in past 18 years.

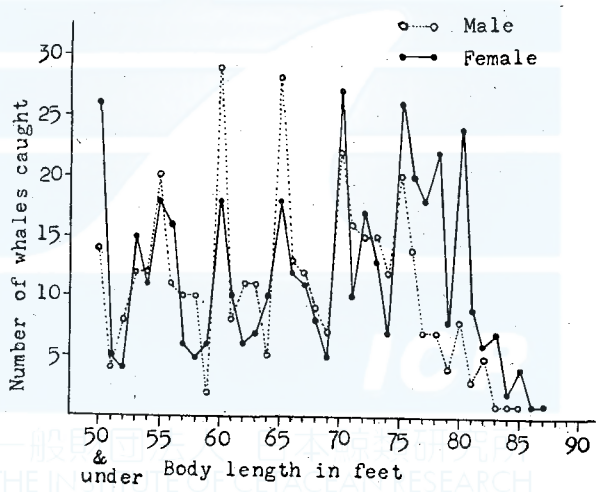


Fig. 4 shows number of blue whales caught in the past 18 years, classified by body length. Even granting that their body length at sexual maturity was not so long as in the case of the Antarctic whales, this chart suffices to show that great many immature whales caught. That this was an important cause of stock depletion can be easily surmised.

Fin Whale (*Balaenoptera physalus Linnaeus*)

a. Colour.

The result of colour observation was summarized as shown in Table 6.

Table 6. Fin whale. Body Colour.

	Actual number			Per cent		
	Male	Female	Total	Male	Female	Total
Body colour, grey	26	25	51	92.9	83.3	87.9
〃 , blackish	2	5	7	7.1	16.7	12.1
Extention of pigment on side, upper	9	10	19	34.6	37.0	35.8
〃 , normal	14	12	26	53.8	44.4	49.1
〃 , lower	3	5	8	11.6	18.6	15.1
Pigment project towards anus	16	16	32	61.5	59.3	60.4
〃 not projects 〃	10	11	21	38.5	40.7	39.6
Pigment of both sides meets in front of tail-flukes.	13	14	27	61.9	51.8	56.3
〃 〃 not meets	8	13	21	38.1	48.2	43.7

No color difference can be noted between male and female. Though this table shows slight difference between male and female this was probably due to the small number of whales observed.

Normal body color is greyish. But blackish whales made up about 10 % of the total. About 50 % of them showed normal color distribution on body side. In about 35 % the pigmentation did not extend so low as in normal distribution, while in about 15 %, it extended below normal distribution.

Whales having a projection toward anus, a little behind anus were more numerous than those without it,—the former being about 60 % and the latter about 40 %.

On slightly more than a half of the whales observed, the color on the right and left sides met just in front of tail flukes (at ventral side).

b. White scars.

White scars were recorded on 31 males, and 30 females, 61 in total. All the whales observed had white scars in varying degrees. Most of them were caught in the adjacent sea of Hokkaido, above all in the Okhotsk sea. Open pits could not be seen on whales caught in this area, but were observed on all whales (3) caught aronund Bonin Island. The number of white scars was classified into 4 classes, very few (up to 10), few (11-20) many (21-40) and numerous (over 41) as shown in Table 7. Most of the whales had less than 20 white scars. The difference was noted between male and female.

Table 7. Fin whale. Number of white scars.

	Male	Female	Total
Very few	16	12	28
Few	12	10	22
Many	2	7	9
Numerous	1	1	2
Total	31	30	61

c. External parasites.

As for external parasites, two whales were infected with a coronula sp. Pennella sp. was seen on 3 whales,—the number on each being 14, 2, and about 50.

The whale which was found with about 50 Pennellas was a female 66 feet long. The number of its corpora lutea was 30 in right and left ovaries and its epiphysis of vertebrae was completely fused into its centrum. So it was a whale which had attained physical maturity. The parasites were found all over body.

Diatom shows much local variety. Excepting one whale which was caught at Ayukawa on 24 June, 1949, there was no whale with parasites caught in any areas outside the Okhotsk Sea.

Table 8. Fin whale. Diatom infection in the Sea of Okhotsk.

	Actual number			Per cent		
	Male	Female	Total	Male	Female	Total
Not infected	4	3	7	14.3	20.0	16.3
with diatoms	19	9	28	67.9	60.0	65.1
with thick film	5	3	8	17.8	20.0	18.6
Total of infected	24	12	36	85.7	80.0	83.7

As seen in Table 8, about 86% of males and 80% of females caught in the Okhotsk Sea were infected with diatomes. It is generally from June to September every year that whales are caught in the Okhotsk Sea. This observation was carried on, in June and July, 1948. In 1949 no investigation was made on whales in this area. Most of the whales caught there were fin whales, and in addition some sperm whales, all of which were mature males,—an indication that so-called "harem" did not migrate to this area.

The number of caught whales fluctuates much from year to year.

Humpback whales were rarely caught there. Sperm whales obviously migrate from the Pacific to the Okhotsk Sea through the Channels between Kurile Islands, while other whales in the Japan Sea probably migrate through the Soya channel. They are fin whales which follow the cold current of the Japan Sea along the Russian coast. That is probably the reason why they show such high diatom infection. Species of diatoms have not been studied yet.

d. Thickness of blubber.

The actual measurements of thickness of blubber, classified by body

Fig. 5. Fin whale. Thickness of blubber. 1. Male Point 1.

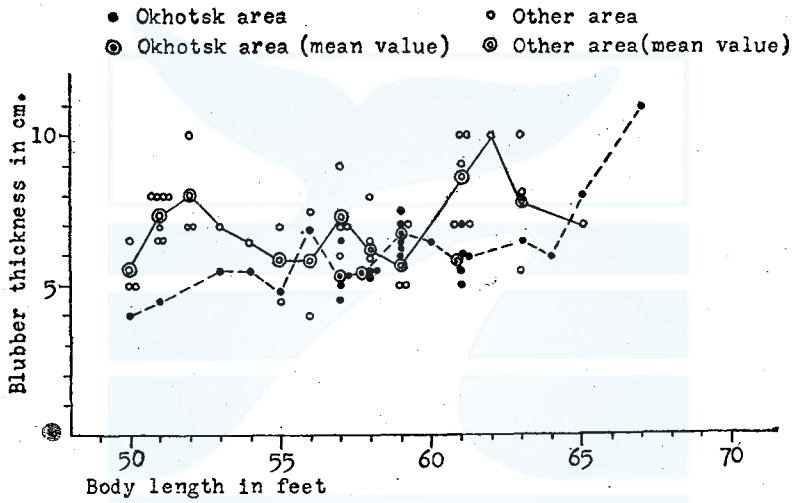


Fig. 6. Fin whale. Thickness of blubber. 2. Female. Point 1.

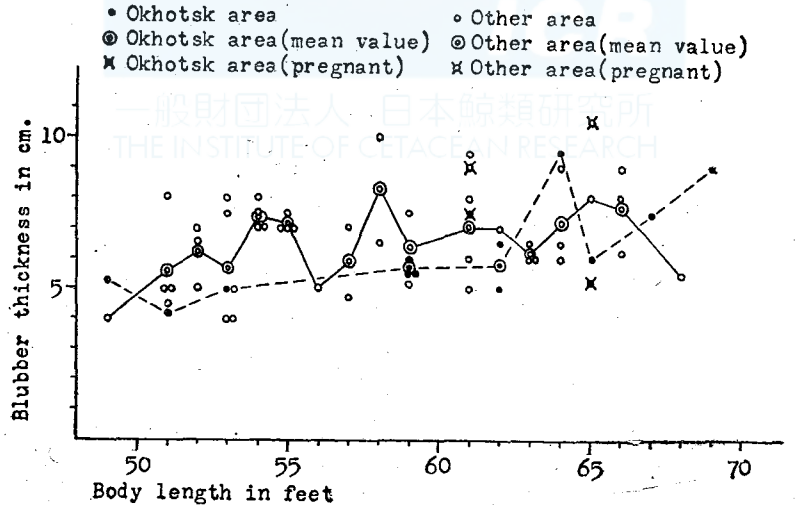


Fig. 7. Fin whale. Thickness of blubber. 3. Male. Point 2.

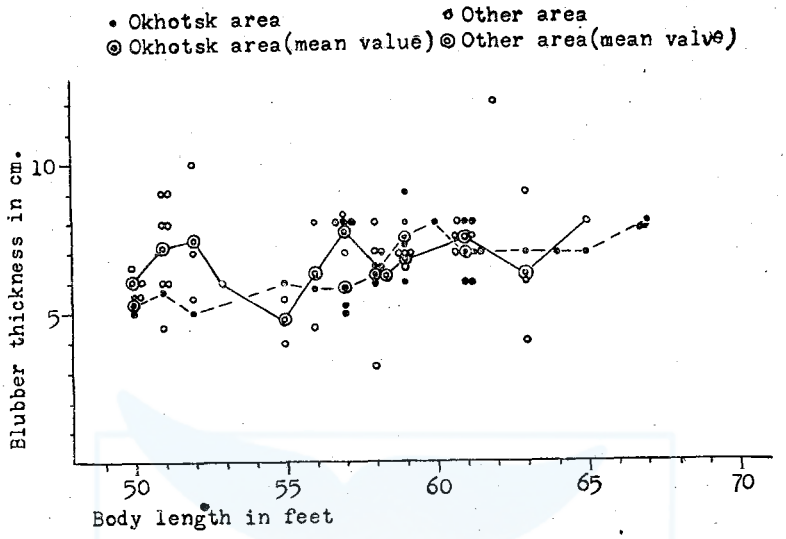
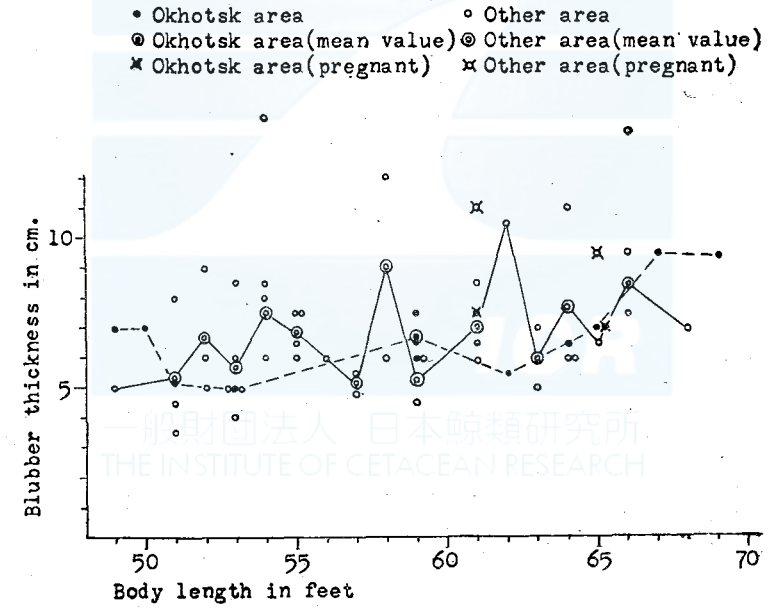


Fig. 8. Fin whale. Thickness of blubber. 4. Female. Point 2.



length, are as shown in Figs. 5 to 8. Figs. 5 and 6 concern Point 1, and Figs. 7 and 8, Point 2. Figs. 5 and 7 are for males, and Figs. 6 and 8 are for females. In all of the above figures, main division is made by two whaling grounds. The one is the Okhotsk Area, and the other is the Hokkaido and North east areas totalled (Ayukawa-Kiritappu). Although a few fin whales were caught in the

Bonins also, and blubber thickness was measured on three whales, the results were not included here because of the different whaling ground and the small number studied. Figs. 5 to 8, though based on insufficient data, show that blubber increases in thickness in proportion to the increase in body length, and that blubber of whales in the Okhotsk sea tends to be thinner than in other areas. As mentioned above, 86 % of fin male whales and 80 % of fin female whales in the Okhotsk area were infected with diatoms. In other areas, however, whales were rarely infected. The fact that whales in the Antarctic are infected with diatom is indicative of their long stay there and hence of thick blubber. Figs. 5 to 8 show that the trend in the adjacent waters of Japan is just the reverse. This means that in the adjacent seas of Japan the relation between the amount of krill as food for whales and diatoms — though their species are still unknown — is reverse to that of the Antarctic.

Fig. 9. Fin whale. Mature.
Mean blubber thickness by months.

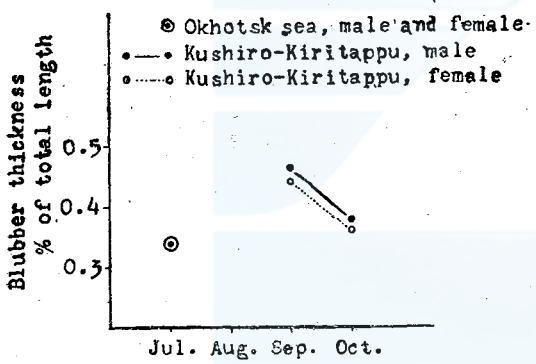
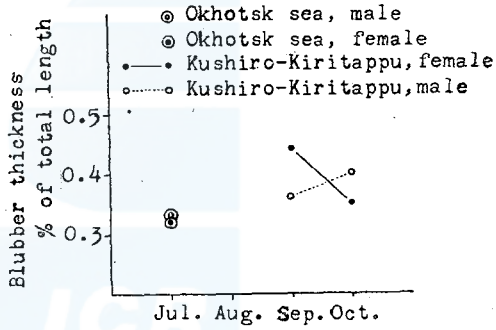


Fig. 10. Fin whale. Immature.
Mean blubber thickness by months.



Figs. 9 and 10 show the percent of blubber thickness to body length by months. Months in which few whales were investigated were omitted. These figures clearly show that blubber of whales in the Okhotsk sea is thinner than that in the Hokkaido area (Kushiro-Kiritappu). It is further shown that in the Kushiro-Kiritappu area blubber of whales, with the exception of immature females, becomes thicker in September and thinner in October. This fact of the blubber which was thick in September becoming thin in October probably has a close bearing on the migration. Namely, fin whales in this area are whales which have migrated southwards from off the Kurile Islands or further north. Owing to the abundant food, their

blubber would become thicker there; but during their stay in the Hokkaido area it probably becomes thinner because of the poorer food supply there. This is the same with Sei whale which is mentioned later.

e. Food.

There is a record on food for 153 whales, of which 57 whales had no food in their stomach. This is about 37 % of the total. Food was almost all Krill (Euphausidae),— there being only one whale that had eaten calanus and another that had eaten sardine. The principal Euphausidae in the adjacent waters of Japan is Euphausia pellucida Dana. As food is most closely related to thickness of blubber, the details are shown in table 9, classified into the Okhotsk and the Ayukawa areas. In the Bonin Island area, all of the 3 whales investigated were found to have empty stomachs. Table 9 is confined to Krill.

Table 9. Fin whale. Quantity of stomach contents.

	Sea of Okhotsk		Ayukawa-Kiritappu	
Number observed	54	%	94	%
None	11	20.4	43	45.7
Few	29	53.7	19	20.2
Moderate	10	18.5	15	16.0
Rich	3	5.6	16	17.0
Full	1	1.8	1	1.1

As seen in Table 9, there were far more whales with empty stomachs in the Ayukawa-Kiritappu than in the Okhotsk Sea. While whales with empty stomachs were 40 % of the total in this area, they were only about 20 % in the Okhotsk area. While a larger percentage of whales in the Okhotsk Sea thus had food in their stomachs than the whales in the Ayukawa-Kiritappu area, the quantity of food found in the former was generally smaller than in the latter.

It may therefore be said that owing to scarcity of food in the Okhotsk sea, the blubber does not get thick while the whales are staying in that area. And that fact would further support the view that as feeding chance for whales is scarce in the Hokkaido area, the blubber that had thickened in northern waters becomes thin during stay around Hokkaido.

f. Genitalia and Maturity.

Ovaries were investigated for 62 females. It was recorded whether they had corpus luteum or not and, when they had, the number of corpus

luteum was classified into "functional" and "old".

It is true that whales have attained sexual maturity when either the right or left ovary has 1 or more corpus luteum.

Table 10. Fin whale. Females classified according to maturity.

Body length in feet	49	50	51	52	53	54	55	56	57	58	59
Mature	0	0	0	0	0	0	0	1	0	1	1
Immature	2	1	4	1	6	2	5	2	2	2	5
Total	2	1	4	1	6	2	5	3	2	3	6

Body length in feet	60	61	62	63	64	65	66	67	68	69	Total
Mature	0	5	2	3	2	5	3	2	1	1	27
Immature	0	1	1	0	1	0	0	0	0	0	35
Total	0	6	3	3	3	5	3	2	1	1	62

In Table 10 the 62 whales investigated are classified by body length into mature and immature, — the mature being those having at least 1 corpus luteum, and immature being those without any.

The shortest mature was 56 feet long, and the longest immature was 64 ft. While no whale exactly 60 feet in length came under observation, most whales up to and including 59 feet in length were immature, there being only three exceptions: 56 ft., 58 ft. and 59 ft. each. On the other hand, most whales—61 ft. long and over were mature, with only three exceptions: 61 ft., 62 ft. and 64 ft. each. Consequently we may regard whales over 61 feet as mature. From this Table we cannot tell whether the border between mature and immature is 60 ft. or 61 ft. It can at least be said, however, that they were smaller than those of the Antarctic. According to Mackintosh & Wheeler, female fin whales located in the Antarctic attain sexual maturity when 20.0 m. (65′ 7″) long. So female fin whales in the adjacent waters of Japan come to maturity when about 5 ft. shorter. Matsuura too reported that female fin whales came to maturity when 61 ft. long, after observation of whales off coast of Kamchatka in 1941. Our present investigation also endorses this fact.

Number of corpora lutea of mature female fin whales is shown in Table 11.

Table 11. Fin whale. Number of corpora lutea in the ovaries.

Body length in feet	Number of corpora lutea (Total of both ovaries)															Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14……30		
56			*													1
57																0
58		*														1
59		*														1
60																0
61		**	○	○		*										5
62	0	*														2
63	0			*										*		3
64		*									0					2
65	*○					0○		*								5
66					*			*							*	3
67					0							*				2
68						*										1
69										*						1
Total	4	6	2	2	2	4	0	2	0	1	1	1	0	1	1	27

○ .... Pregnant. * .... Resting. 0 .... Pregnant or recently ovulated.

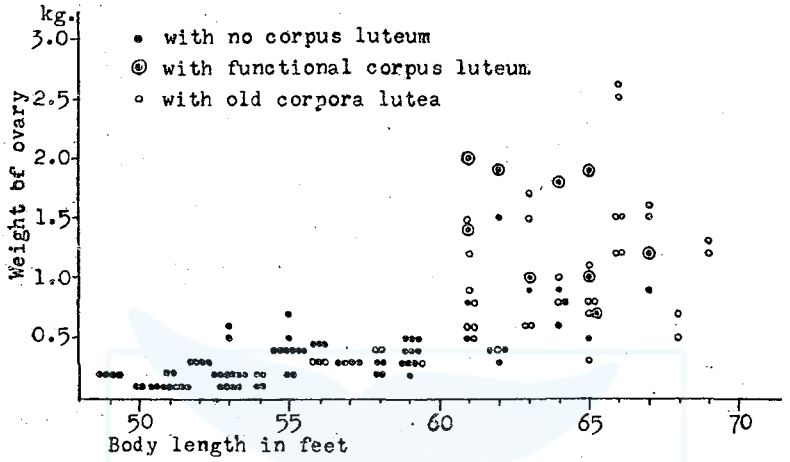
Only one whale was found to have 30, which was the largest number found. All the others had 14 or less. Those with Functional corpus luteum but without fetus were indicated with 0, as in the following three cases.

1) Mere ovulation followed by no pregnancy.
2) In the extremely early stage of pregnancy, when presence of fetus was not confirmed.
3) Though there was a fetus, it was lost while the whale was being towed to landstation.

The case mentioned in (3) seems to take place quite often in Japan. That is because the ventral blubber is cut and internal organs are exposed to the sea water in order to preserve the freshness of meat which is used as food. This is commonly called "blood removing". Owing to this "blood removing", foetuses are often lost. In table 11, there are considerable number of whales with functional corporus luteum and yet no fetus. Most of them were probably lost in that way. Though in those cases careful observation could have determined the existence or absence of foetus, unfortunately such record was not made.

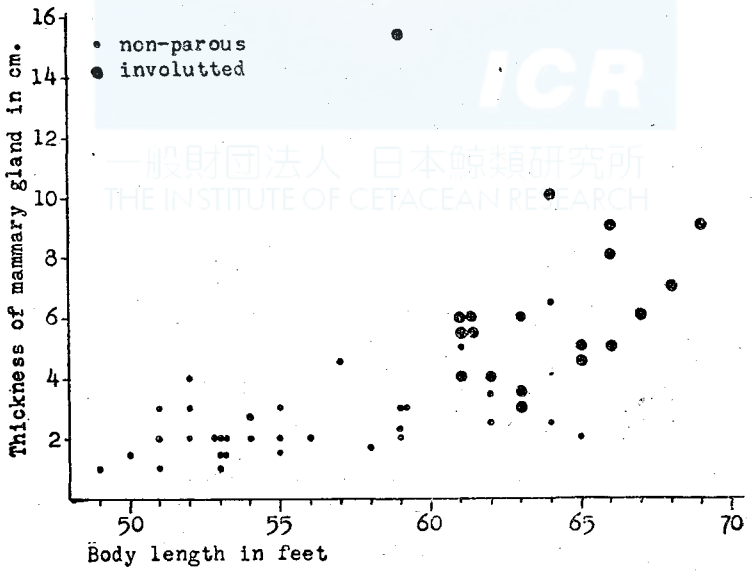
Weight of ovary is as shown in Fig. 11.

Fig. 11. Fin whale. Weight of ovary.



Excepting 2 instances, all whales up to 59 ft. long had ovaries 0.5 kg. or under in weight. The same with whales with old corpora lutea. But in whales 61 ft. or more in length, with a few exceptions, the weight of ovaries was 0.6 kg. or over. And most of them had corpora lutea. Whales with body length of 61 ft. or more which had no corpus leteum in neither ovary were confined to the 3 set forth in Table 10, — their lengths

Fig. 12. Fin whale. Thickness of mammary gland.



being 61 ft., 62 ft. and 63 ft. All the others had corpus luteum in either one or both ovaries. Where only one of the ovaries had corpus luteum, it was usually found that even the ovary which had no corpus luteum was heavier than that of immature whales. We may say from Fig. 11, that female fin whales are immature up to 59 ft. in body length and mature from 61 ft. long, and that the ovary weighs more than 0.6 kg.

Fig. 12 shows thickness of mammary gland. It was generally under 4 cm. in non parous glands. The mature ones, including even those involuted, were mostly more than 4 cm. thick. No lactating whale was observed. For males, weight and volume of their testis were measured. They are shown in Fig. 13 & 14.

Weight and volume of testis show the same general trend, though

Fig. 13. Fin whale. Weight of testis.

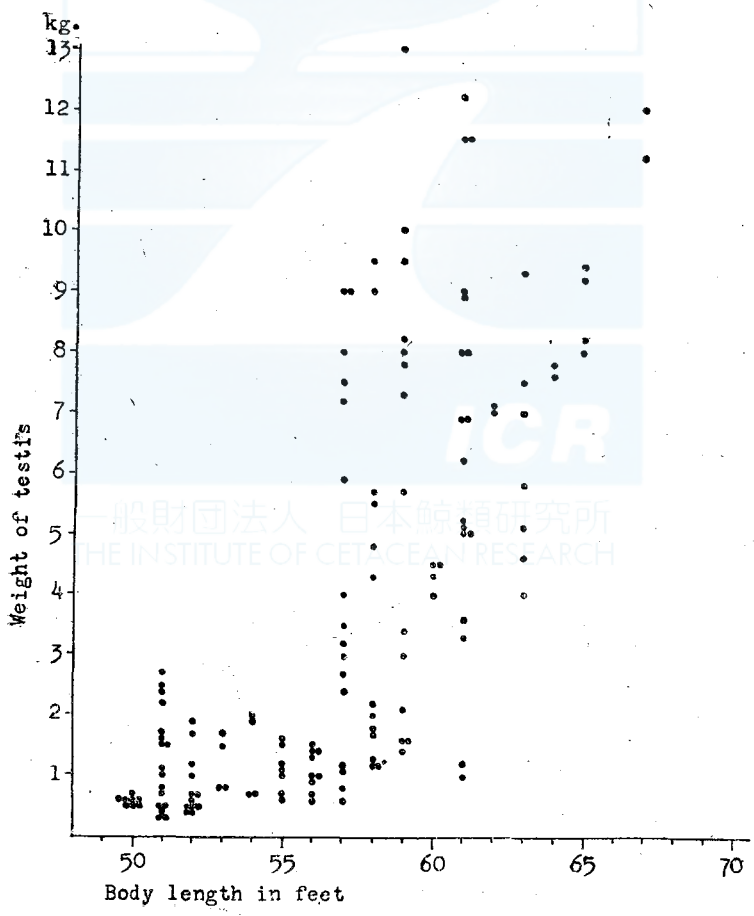
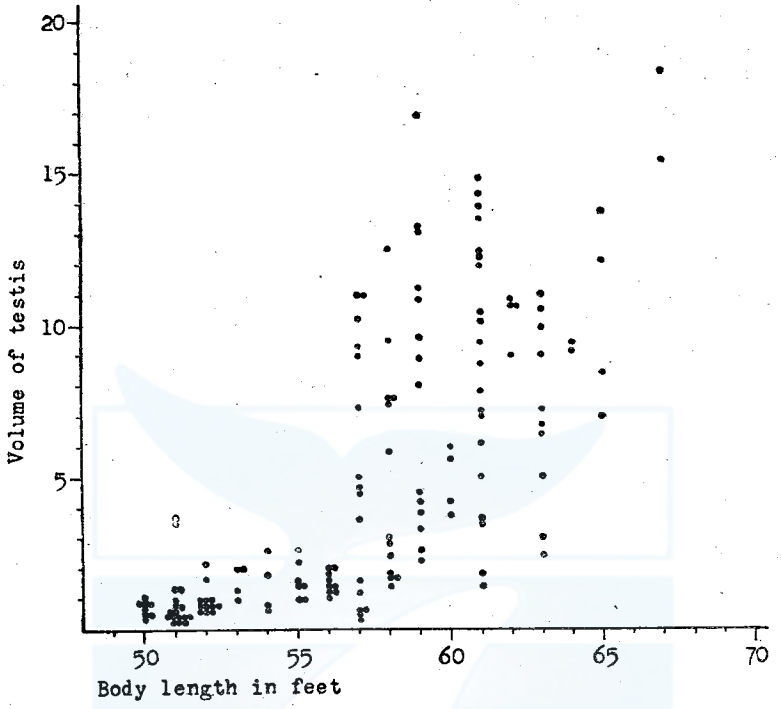


Fig. 14. Fin whale. Volume of testis.



there is some discrepancy as to details. Both in Figs. 13 and 14, a sharp line of demarcation may be drawn between whales of 56 feet and less and those 57 feet and over. According to Mackintosh & Wheeler, male fin whales located in the Southern hemisphere, whose testis has a volume of 4 or more may be regarded as adult. In case of whales in the adjacent seas of Japan, borderline between immature and mature is probably 3 in volume and 2.5 kg. in weight. Taking volume 4 as the standard, however, all male whales studied have been classified into mature and immature by body length, as shown in Table 12.

Table 12. Fin whale. Male classified according to maturity.

Body length in feet	50	51	52	53	54	55	56	57	58	59	60
Mature	0	0	0	0	0	0	1?	5	3	5	2
Immature	4	8	6	2	2	3	3	3	3	2	0
Total	4	8	6	2	2	3	4	8	6	7	2

Body length in feet	61	62	63	64	65	66	67	Total
Mature	9	2	4	1	2	0	1	35
Immature	2	0	0	0	0	0	0	38
Total	11	2	4	1	2	0	1	73

Where only one testis of a whale could be investigated, such whale was regarded as mature if the testis volume was 4 or more. But where the volume was less than 4, such whales were excluded from this Table because of the possibility of the other testis having a volume of 4 or more. From Table 12, it is appropriate in the case of male fin whales to treat whales 58 ft. or 59 ft. and over as mature and whales under it as immature. According to Mackintosh & Wheeler, male fin whales in the Southern hemisphere reach sexual maturity at 19.5 meters (63′ 8″). So compared with them, male fin whales in the adjacent seas of Japan are shorter by 5 feet at sexual maturity. So what was said regarding females may also be said for the males. The constitution of fin whales observed may be summarized as shown in Table 13.

Table 13. Fin whale. Constitution of whales observed.

	Female	Male	Total
Total number observed	62	73	135
Immature	35(56.5%)	38(52.1%)	73(54.1%)
Mature	27(43.5%)	35(47.9%)	62(45.9%)
in which Resting	18		
Pregnant	4		
Pregnant or recently ovulated	5		
Lactating	0		

As seen in Table 13, more than half of the whales observed were immature. This, however, is hardly indicative of the composition of fin whales caught in the adjacent waters of Japan. So a study has been undertaken here, on the basis of the body length, on all fin whales which were lately caught in the adjacent seas of Japan.

Table 14 shows the result on whales caught from 1946 to 1948. When, based on the above mentioned body length, they were classified into mature and immature, the result was as shown in Table 15.

Table 14. Size of fin whales caught in the adjacent waters of Japan during the year 1946/48.

	Males				Females			
	1946	1947	1948	Total	1946	1947	1948	Total
50 & under	20	14	4	38	15	13	5	33
51	9	5	6	20	6	8	10	24
52	6	5	11	22	9	8	8	25
53	7	6	4	17	5	4	4	13
54	4	3	6	13	5	6	4	15
55	12	6	5	23	8	5	3	16
56	7	9	10	26	9	11	5	25
57	5	4	7	16	9	7	3	19
58	6	10	5	21	4	2	5	11
59	9	9	8	26	3	3	5	11
60	8	14	6	28	4	6	3	13
61	2	13	12	27	3	3	3	9
62	4	10	2	16	9	6	5	20
63	3	9	2	14	6	11	2	19
64	2	5	1	8	5	10	5	20
65	2	5	1	8	6	5	5	16
66		1	1	2	6	7	3	16
67					5	5	4	14
68					2	4	1	7
69					4	2	2	8
70					3	1		4
71						1		1
72						1		1
Total	106	128	91	325	126	129	85	340

Table 15. Fin whale. Mature and immature whales caught in the adjacent waters of Japan during the year 1946/48.

	Females		Males		Total	
	Number	Percent	Number	Percent	Number	Percent
Immature	205	60.3	175	53.8	380	57.1
Mature	135	39.7	150	46.2	285	42.9
Total	340	100.0	325	100.0	665	100.0

Table 15 also shows the immature were over 50 % of the total caught, and that that preponderance is especially high for females. It must therefore be said that that is a very high percentage as compared with situation in the Antarctic where only about 15 % of the fin whales caught

are immature.

g. Migration.

Relative to the migration of fin whales in the adjacent waters of Japan, there are 2 groups. One migrates from South to north along the Pacific side of Japan; and the other, along the Japan sea side. These two groups probably mingle with each other in the south seas during winter, but not so while in the north sea during summer. Figs. 15 and 16 show monthly catch by area, on the basis of the last 18 years' whaling statistics. Fig. 15 shows the Pacific side group and Fig. 16 the Japan Sea group.

Fig. 15. Fin whale. Monthly catch in different areas. I. East side.

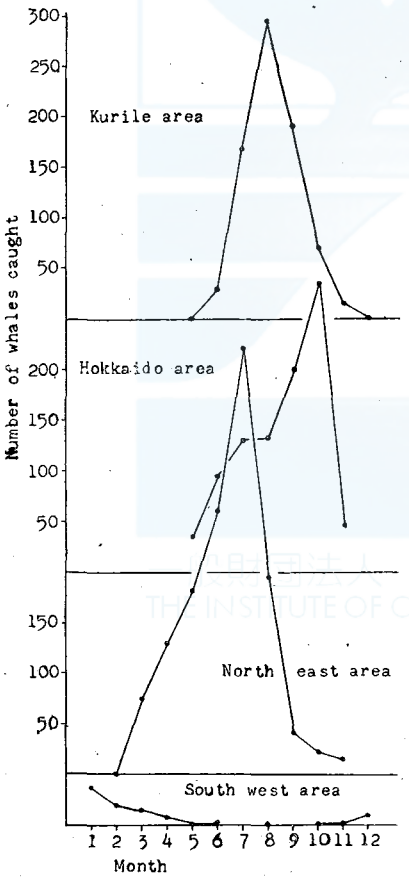
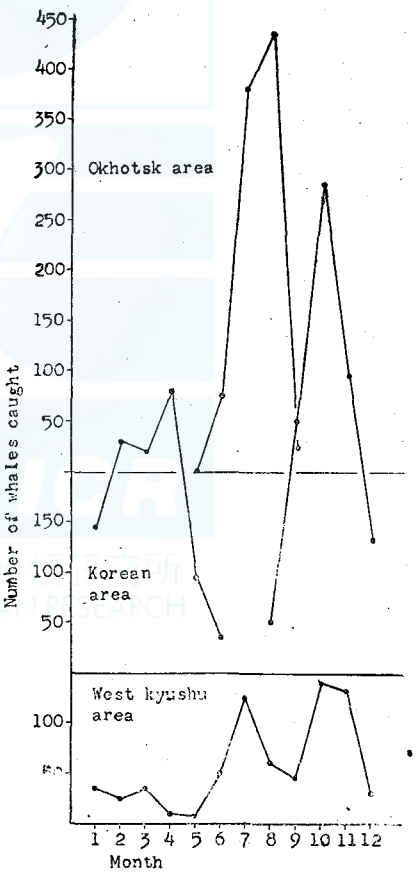


Fig. 16. Fin whale. Monthly catch in different areas. II. West side.



As seen in Fig. 15, the former group was caught in the South West area in winter. The best season was Jan., although the number caught

was not very large. In the northeast area, the peak was in July; and in the Kurile area, August. When the Tonan-maru operated in the Arctic, it caught 221 fin whales in 1940 and 370 fin whales in 1941. The season was from June to August. In 1941, most of the catch was made southeast off Paramushir island, only a few being in the waters from Commander Island to Olyutorsk Cape. In 1940, however, out of 221, 74 whales were caught in the Arctic, north of the Behring Strait. While it is not clear whether these fin whales belong to the same group as whales in the adjacent waters of Japan or to a group on the American side, the chances are that the two groups mingle in the waters around there.

In the Hokkaido area, whales caught from June to August are probably those migrating northwards, while those caught after that are probably whales migrating southwards. As October is the best whaling season, it must mean that more whales migrate through this area in their southward course than in the northward course.

In the Bonin Island area, fin whales are rarely caught, — probably because not so many enter that area. Fig. 16 is concerned with the west side group. In the West Kyushu area, the best catch is seen in October and November. Strange to say, a big peak is sometimes seen in July, although confined to only Tsushima and that mostly in 1911 and 1914. With this one exception the best catch in this area is also seen in winter. The following two causes are conceivable:

1. There is a group which does not migrate north even in summer but stays around Tsushima.
2. There was a group which for some reason stayed in that area in summer of 1911 and 1914.

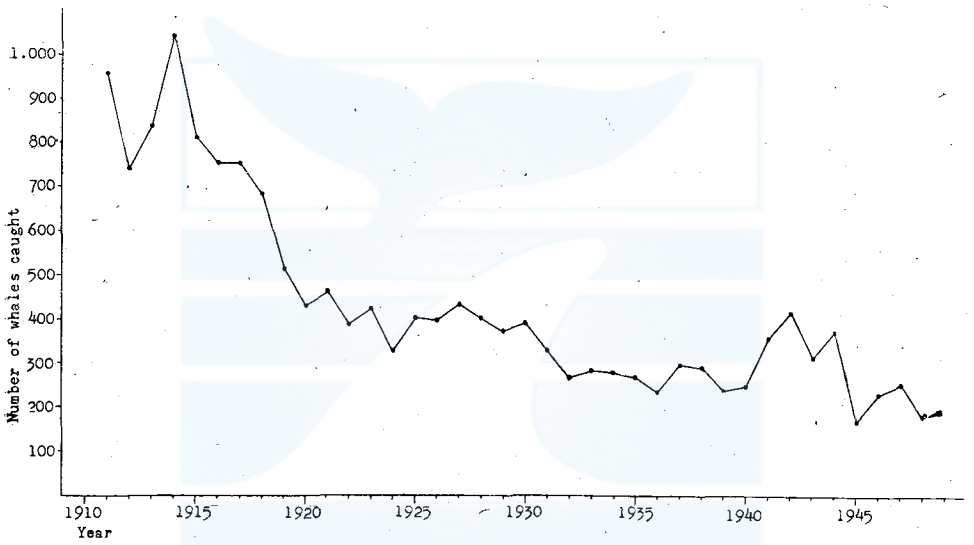
It is not clear which is the correct explanation. It suffices for the present to say that very few fin are being caught there now.

In the Korean area, two peaks can be found. One is in April and the other in October. The former is southward migration and the latter is northward migration. Catches in Korean waters take place off the south coasts. Off west coast, fin whales are mainly caught from January to May, and a few from October to December. This is probably due to southward migration through the West Kyushu area by a part of them and migration to the Yellow Sea round the south coast of Korea by another part.

Fin whales which have entered the Yellow Sea would stay there dur-

ing winter and migrate northwards through the Japan sea in May or June. These whales seem to enter in Okhotsk Sea through the Soya strait. The whaling season in the Okhotsk sea is July and August. As mentioned in the paragraph on "Blubber", the thickness of blubber differs between whales in the Okhotsk area and those in the Hokkaido area. And when considered from the standpoint of diatom infection, there appears to be little likelihood of both groups migrating through the Straits between the Kurile Islands.

Fig. 17. Fin whale. Variation of catch.



h. Stock.

Fig. 17 shows number of fin whales caught annually since 1911. The maximum catch was in 1914, when 1,043 fin whales were caught; and after that there was a sudden decrease. Though in 1942 some increase was seen, it has been on the decline again. After the War, Japan does not operate off Korea, the main whaling ground of fin whales. So the catch since 1946 can not directly be compared with that before it but it is an undeniable fact that fin whale stock tends to decrease. The number of catchers in the adjacent seas of Japan was limited to 30 till 1934, and to 25 since then. (As some substitute ships operate, total number may exceed this. But the number in actual operation is within the limit.) The size and H. P. of the catchers increased, especially since 1935; and the

present total tonnage is two times and total H. P. is over 2.5 times the figures for 1910. Therefore the whaling effort must have increased remarkably. Taking this point into consideration, we cannot help thinking that fin whale stock must have decreased as markedly as blue whale stock.

As mentioned in the paragraph on "Maturity" more than 50% of whales caught from 1946 to 1948 were immature.

Fig. 18. Fin whale. Size distribution of whales caught in past 18 years.

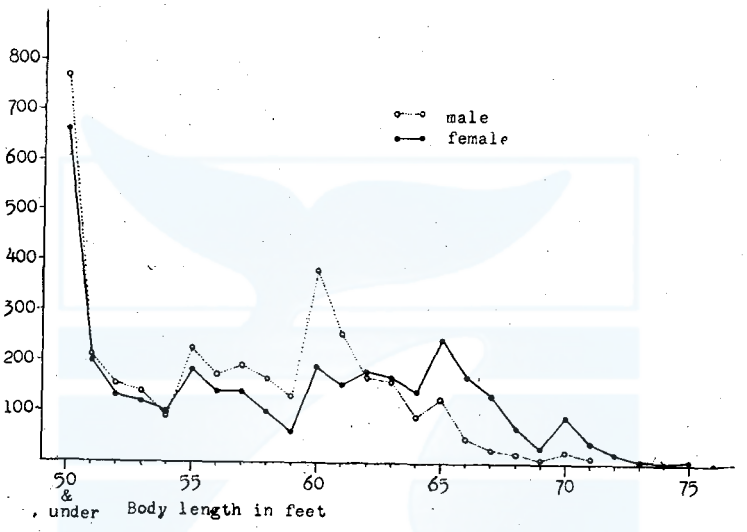


Fig. 18 which shows the total whaling catch for the last 18 years clearly shows how many immature fin whales were caught. This is probably one of the important reasons for the decrease of fin whale stock.

The latest whaling grounds for fin whales are the Okhotsk area, the Hokkaido area and the Northeast area, — catches in other areas being extremely rare.

Humpback Whales. (*Megaptera nodosa Bonnaterre*)

Only 4 males and 6 females, 10 humpback whales in all, were observed. That is but natural, for humpback whale catch is extremely rare in the adjacent seas of Japan. Body color was observed for 7 humpback whales. The details are: 2 whales in group 1, 1 each in groups 2 and 3, and 3 in group 4. Of 7 whales observed for white scars, 3 had "very few" 2 "few", and 2 had "many". As for external parasites, they were infected with Coronula and Chonchoderma as in the case of humpback

whales in other seas. According to the record, 4 humpback whales out of ten were infected with cyamus sp. Thickness of their blubber is as shown in Table 16.

Table 16. Humpback whale. Thickness of blubber.

Date of catch	Body length in ft.	Sex	Thickness of blubber		Ground	Remarks
			Point I	Point II		
			cm.	cm.		
21 Mar. 1949	39	M	12.5	12.0	Bonin island	
25 Feb. 1948	41	M	13.0	11.0	〃	
23 Feb. 1948	45	M	13.5	——	〃	
6 Mar. 1949	45	M	12.0	12.5	〃	
22 Mar. 1949	35	F	11.0	12.0	〃	Immature
8 May, 1948	36	F	3.5	7.5	Ayukawa	Immature ?
13 May, 1948	36	F	7.5	9.5	〃	Immature
21 Mar. 1949	43	F	12.0	13.0	Bonin island	Pregnant or recently ovulated.
26 Jan. 1948	44	F	15.0	13.0	Mombetsu	Pregnant
4 Apr. 1948	45	F	8.0	9.5	Bonin island	Lactating

As for food, out of 10 humpback whales, 7 whales had empty stomachs and 2 had krill in their stomachs and of 1 there is no record. Out of the above 2 whales found with krill in stomach, one had a small amount of krill and the other had a large amount.

As for genitalia, weight and volume of testis of males were measured. The results are as shown in Table 17.

Table 17. Humpback whale. Weight and volume of testis.

Body length in feet	Weight in kg.	Volume in 1,000 cc	Maturity
41	10.5 ?	6.3 ?	Mature
45	5.5 5.5	6.2 6.3	〃
45	9.5 9.4	14.0 15.8	〃

They were all mature. In addition, there was 1 male 39 ft. long; but it is unknown whether it was mature or immature because no observation seems to have been made of it. Ovary of 4 females was observed. The results are as shown in Table 18.

Table 18. Humpback whale. Weight and condition of ovaries.

Body length in feet	Weight of ovaries	Number of corpora lutea		Sexual condition
		Functional	Old	
35	0.1 kg.	0	0	Immature
	0.1	0	0	
43	0.3	0	1	Pregnant or recently ovulated
	0.2	1	0	
44	4.0	1	3	Pregnant
	2.5	0	1	
45	1.6	1	2	No fetus Lactating
	0.9	0	3	

Among the whales indicated in Table 18, a whale 45 feet long was in an extremely early stage of pregnant or of recent ovulation, for it had one functional corpus luteum. Nevertheless, it was lactating. Such instances are sometimes observed even in the Antarctic. Humpback whales that are lactating and pregnant are probably found more often than among other baleen whales.

Fig. 19. Humpback Whale. Monthly catch in different areas. I. East side.

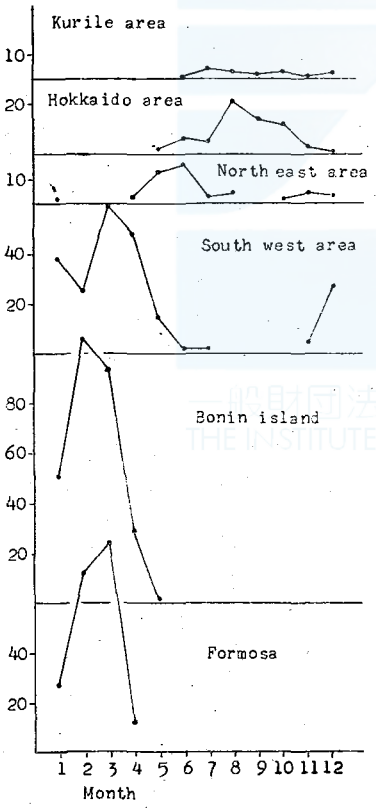
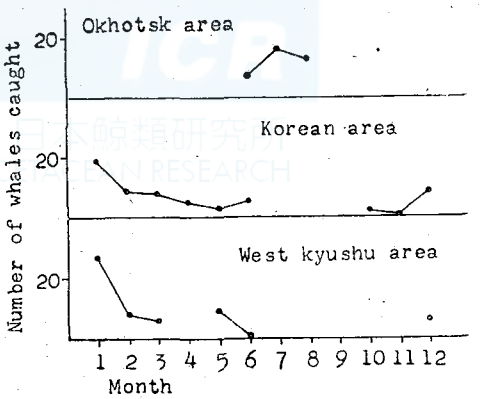


Fig. 20. Humpback Whale. Monthly catch in different areas. II. West side.



Figs. 19 and 20 show monthly catch of Humpback whales in each area for the past 18 years. Fig. 19 concerns whales in the east side of Japan and Fig. 20 with those in the west side of Japan.

As seen in Fig. 19, the best season is in February and March in Formosa and the Bonin Island area, and in June in the South west area. In this order, therefore, they probably migrate from south to north. In the Kurile area very few were caught; and same with the east side of Kamchatka Peninsula when the Tonan-maru operated there in 1940 and 1941 (7 humpback whales in 1940 and 6 in 1941). In addition, however, 101 whales were caught in the Arctic in 1940. Whether these belong to Japanese group or American group is not known; but since it is known that a considerable number of whales migrate along the Alaskan coast, these probably belong to the American group.

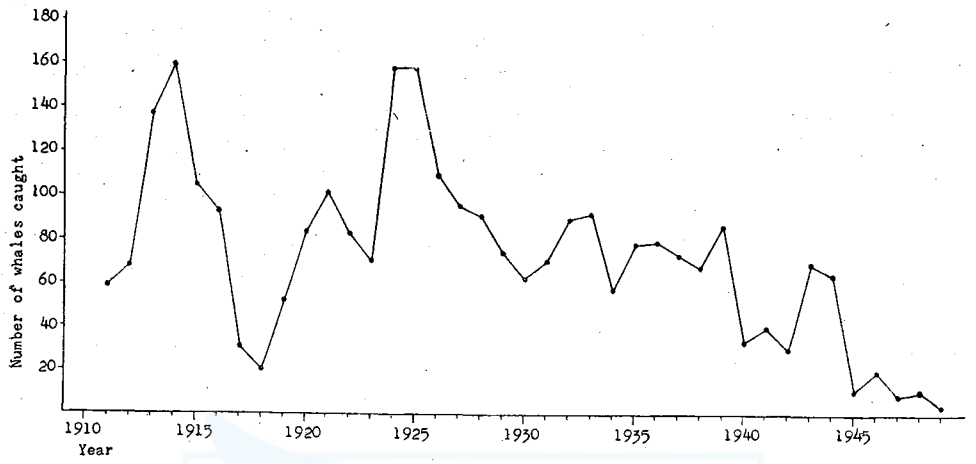
The fact that they were mostly caught in the east side of the Kamchatka Peninsula in July, means they migrate that far north in this season. In the Hokkaido area they were mainly caught beginning in August, indicating that they were probably on their way from North to South. The same is true with other baleen whales such as blue, fin and sei whales.

As shown in Fig. 19, Bonin Island, Formosa and South west area were the principal whaling ground. But Japanese whaling no longer operates in Formosa, and the catches in the other two grounds are virtually nil.

As Fig. 20 shows, extremely few whales were caught in any west side area. In both the West Kyushu and the Korean areas, the catches were made in winter, and in the Okhotsk area, they were caught in summer, from June to August. In the Korean area, some whales were caught off all the coasts, — east, west and south. Consequently, migration from the west Kyushu area and the Korean area to the Okhotsk sea through the Japan sea appears plausible. Their number, however, was very small. It may be that the east side group and the west side group mingled in the south seas in winter, though there is no positive proof of it. Nor is it clear whether whales around Formosa migrate northeast-wards to the east side or northward to west side. But since the Formosa and Bonin island seasons are generally the same, the chances are that the two belong to different groups.

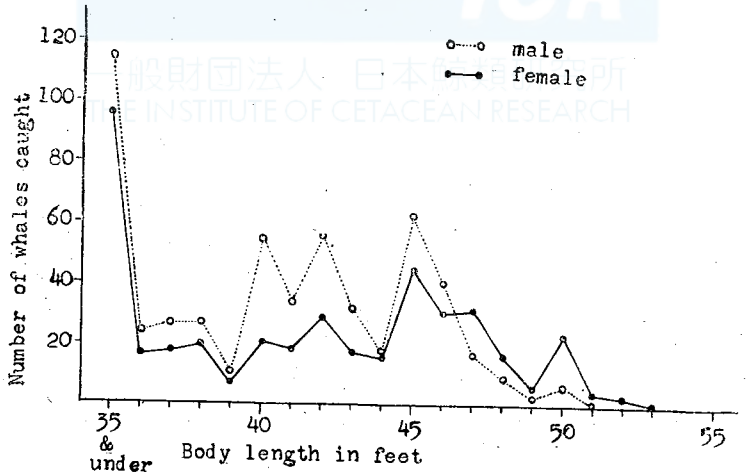
Fig. 21 shows fluctuations in the annual number of Humpback whales caught since 1911. There are two big peaks, —in 1914 and 1924 (or 1925).

Fig. 21. Humpback whale. Variation of catch.



The 2nd peak in 1924 (or 1925) was due to a sudden increase of catch as a result of commencement of whaling in Formosa and Bonin Islands, the principal whaling grounds for Humpback whales. But they have decreased since then. Thus, Humpback whale catch in the adjacent waters of Japan increased sharply and reached the maximum in 1914, and then decreased suddenly. Some years later, however, the newly begun whaling in Formosa and the Bonin Islands area, made Humpback whale catch increase again as high as the 1914 peak. There has since been a gradual decrease, and the present annual catch is probably only 10 whales or so. Another reason for sudden decrease since the end of war is of course the fact that

Fig. 22. Humpback whale. Size distribution of whales caught in past 18 years.



there is no operation in Formosa.

Fig. 22 shows size distribution of total Humpback whales caught in the last 18 years. It is true that considerable number of small sized Humpback whales were caught, though not to such an extent as in the case of blue whales and fin whales.

Sei Whales (*Balaenoptera borealis Lesson*)

Sei whale, like sperm whale, is a species which is caught in large numbers in the adjacent sea of Japan. Accordingly, the number of whales observed was also large, — it being 1031, as Table 1 shows.

a. Colour.

As mentioned earlier sei whale is usually of grey colour on the back and of somewhat lighter colour on the ventral side. And they have large spots on their ventral grooves. On the back, the dark or pigmented areas extend in tongue-like shape toward ventral grooves, and in the extreme cases the right and left pigmented areas meet at the posterior end of the ventral grooves. The state of pigmentation was classified under 3 heads: "not developed," "normal," "well developed". The number of whales observed was 300 males and 284 females, or a total of 584. The results are shown in Table 19.

Table 19. Sei whale. Degree of pigmentation towards posterior end of ventral grooves.

Degree of Pigmentation	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
Not developed	84	28.0	76	26.7	160	27.4
Normal	139	46.3	149	52.5	288	49.3
Well developed	77	25.7	59	20.8	136	23.3
Total	300	100.0	284	100.0	584	100.0

Although this table shows some difference between the sexes, that difference is probably not an essential one. For an observation of this kind may sometimes differ according to the observers engaged in it, and at times even when the observer is the same. So it may be safely said that Table 19 shows the same general trend for male and female. White areas of ventral grooves of 428 whales were also classified as "not developed", "normal" and "well developed". The results, set down in Table 20,

show no great difference by sex on that point.

Table 20. Sei whale. Development of white area on the ventral grooves.

Degree of development	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
Not developed	40	20.2	57	24.8	97	22.7
Normal	94	47.5	112	48.7	206	48.1
Well developed	64	32.3	61	26.5	125	29.2
Total	198	100.0	230	100.0	428	100.0

"Not developed" is about 20% of the total and "well developed" is about 30%.

According to Matthews's observation on 96 Antarctic Sei whales, about 20% had a well developed white area and about 3% only slightly developed. So the reverse result is seen for Sei whales in the adjacent seas of Japan.

As to whether the right side and left side pigmented area met just in front of tail flukes below the tail or not, 425 whales were observed. The results are as shown in Table 21. Those that met slightly outnumbered those that did not. There was no difference between sexes on that point.

Table 21. Sei whale. Meeting of pigments just in front of the tail flukes.

Pigments of both sides	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
Meet	111	56.1	131	57.7	242	56.9
Not meet	87	43.9	96	42.3	183	43.1
Total	198	100.0	227	100.0	425	100.0

Table 22. Sei whale. Presence of light-coloured Spots on the flanks and side of the tail.

Light-coloured spots	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
None	115	41.8	97	33.6	212	37.6
Few	48	17.5	65	22.5	113	20.0
Moderate	95	34.5	87	30.1	182	32.2
Many	17	6.2	40	13.8	57	10.1
Total	275	100.0	289	100.0	564	100.0

Light coloured spots and white scars: There are some sei whales which have light coloured spots on the flanks and the side of the tail which have

an appearance resembling new galvanized iron. The density of these scars was recorded as "none", "few" "moderate" and "many". The results are as shown in Table 22.

Females with light coloured spots were slightly more numerous than males. These spots, however, are probably not original coloration, but secondary, with sei whales. These "white scars" are found also on blue and fin whales almost exception in both the South and the Northern hemispheres. The cause for these white scars is still unknown, but according to Mackintosh & Wheeler, they are probably due to the infection of ciliated protozoas. Though Mackintosh & Wheeler says "The open pits seem never to have been described in whales of the Northern hemisphere", such open pits have often been found on whales in the Bonin Island area. (See Fig. 23) and open pits in the healing stage have also been found. (See Fig. 24). But they have rarely been found in Japanese whaling grounds other than Bonin Island. So in the northern hemisphere, as in the Southern hemisphere, open pits probably develop while the whales are in the warm sea and appear as white scars on the skin when they have healed. The white scars are usually found on flank and tail, as in the southern hemisphere. "New galvanized appearance" of sei whales is probably due to these white scars accumulated year after year.

Fig. 23. Sei whale. Open pit.

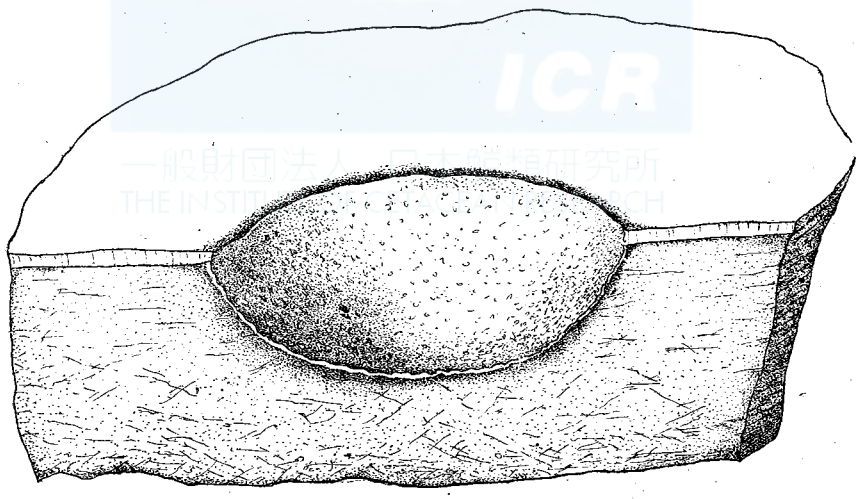


Fig. 25 shows the so-called "new galvanized appearance" of Sei whale,

Fig. 24. Sei whale. Healed pit.

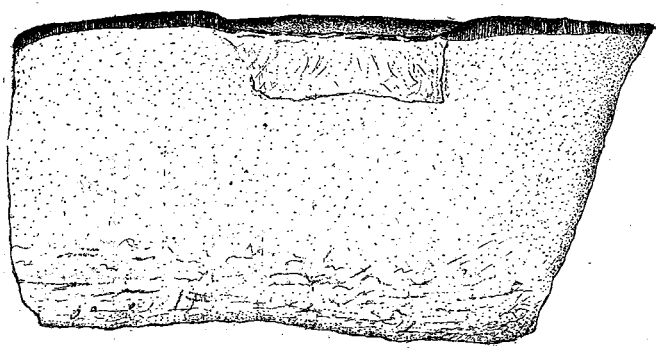
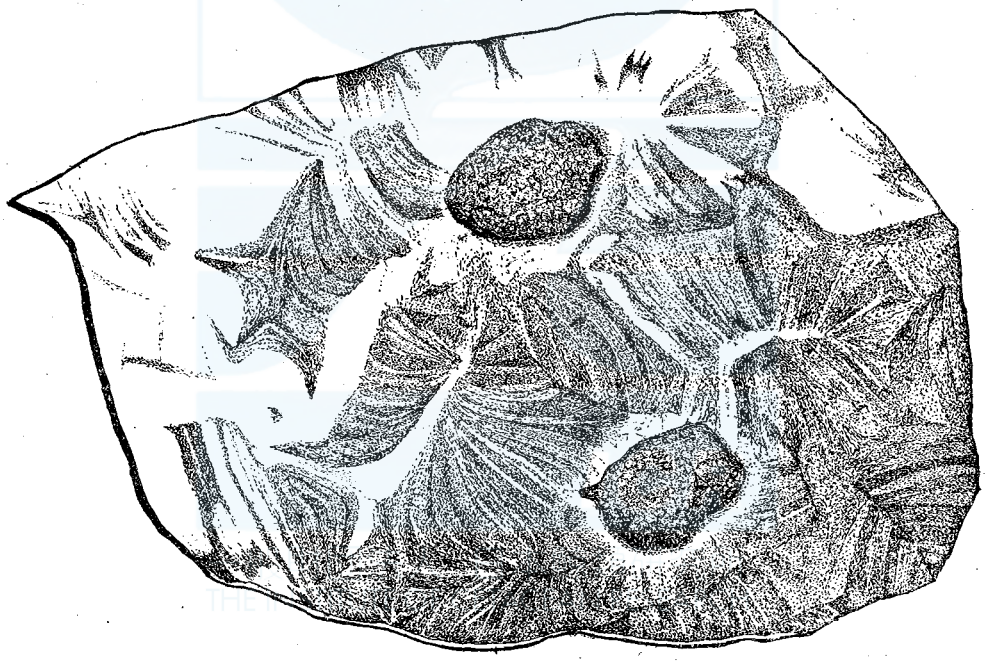


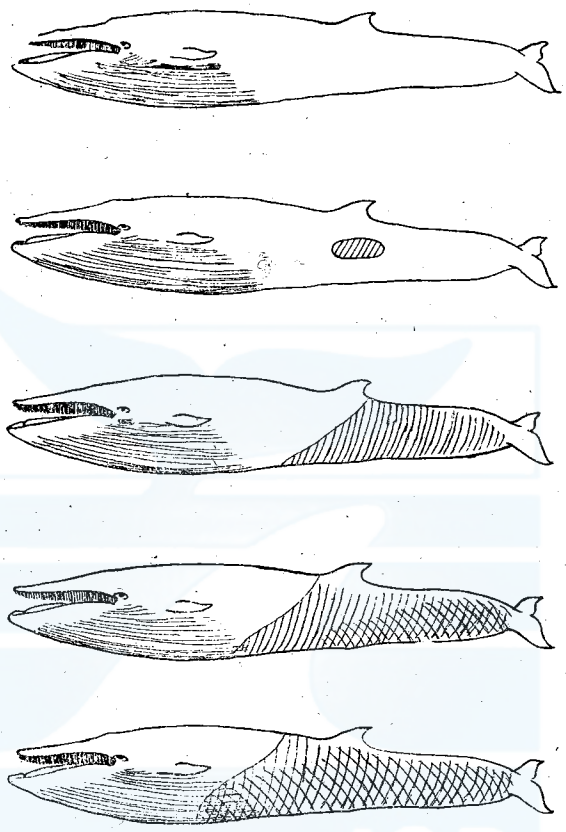
Fig. 25. Sei whale. Light coloured spots.
O. P. .....Open pit



male 46 ft., which was caught in the adjacent sea of Bonin Island on 29 March, 1948. Its location was just below the dorsal fin. The two ellipses shown in the Figure are open pits, which look as though blubber were scooped out with a spoon. The other marks are the so-called "new galvanized appearance"; without any doubt these are older white scars. Generally speaking, therefore, it would be reasonable to say that a whale with many light-coloured spots is one of considerable age.

The stages in the development of light coloured spots are shown in Fig. 26.

Fig. 26. Sei whale. Development of light-coloured spots.



Briefly stated, these spots seemed to be caused by the white scars which develop and change the original skin colour, and finally give a different appearance to the whale. Though white scars are seen on almost all sei whales such is not always the case with light coloured spots. It would therefore seem that the formation of light coloured spots depends upon a certain external condition, — probably water temperature, and hence closely connected with their migration.

Table 23 shows development of light coloured spots classified according to maturity and sex. As seen in Table 23, there is some difference between male and female, and that in both sexes there are fewer and less developed spots in the immature than in the mature. When male and fe-

Table 23. Sei whale. Difference of light-coloured spots presence by sex and maturity. Shown in percentage.

	Immature			Mature		
	Male	Female	Total	Male	Female	Total
Number observed	100	109	209	159	160	319
None	51.0	42.2	46.4	38.4	27.5	32.9
Few	22.0	24.8	23.4	14.5	20.0	17.2
Moderate	26.0	26.6	26.3	37.1	32.5	34.8
Many	1.0	6.4	3.9	10.0	20.0	15.1

male are totalled, "none" and "few" are about 7% of total immature and about 50% of total mature. Whales with well developed spots constitute only about 4% of total immature, and 15% of total mature, indicating that light coloured spots develop with increase in age. As compared with female, male has better developed spots. That is true of both immature and mature. It probably means that the females stay in the southern warm seas for a longer period than the males. For spots are due to white scars, and scars are attributable to open pits which have been formed while in warm seas. Could this fact have some relation to the nurturing of calves? In any case, there may be some difference of migration between male and female.

The details by area are as shown in Table 24.

Table 24. Sei whale. Difference of light-coloured spots presence by ground. Shown in the percentage figure.

	Bonin Island			Ayukawa-Kamaishi			Kushiro-Kiritappu		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Number observed	98	96	194	103	91	194	74	102	176
None	23.5	15.6	19.6	76.7	74.7	75.8	17.6	13.7	15.3
Few	19.4	21.9	20.6	1.0	6.6	3.6	37.8	37.3	37.5
Moderate	45.9	44.8	45.4	19.4	16.5	18.0	35.1	28.4	31.3
Much	11.2	17.7	14.4	2.9	2.2	2.6	9.5	20.6	15.9

The number of whales with light coloured spots varies greatly by area. They are extremely rare in the Ayukawa-Kamaishi area and most numerous in the Kushiro-Kiritappu area, with the Bonin Islands coming in between. But when the Kushiro-Kiritappu area is compared with the Bonin Island area, we find more "few" in the former and more "moderate" in the

latter. This phenomenon is probably closely related to their migration. The development of spots is due primarily to the existence of many open pits. But it is thought that their development into light coloured spots through the intermediate state of white scars requires their stay in low temperature area. That is probably the reason why there are more whales with spots in the Kushiro-Kiritappu area. The whales in this area, however, stay in the warm sea for so short a time and hence have so few chances for the formation of many open pits, that there may be many whales for which the stage of developement must be classified as "few" notwithstanding that the percentage having light coloured spots is high. The difference between Ayukawa-Kamaishi and Kushiro-Kiritappu may be partly due to the fact that in the latter area the whales are caught while migrating southward from off Kurile Islands, while in the Ayukawa-Kamaishi area they are caught while migrating northward as well as when returning southward.

In the Bonin Island area, more whales with spots are caught than in Ayukawa-Kamaishi area. The explanation is that more mature whales are caught around Bonin Islands. In the Bonin Island area, the minimum size permitted to be caught is 40 ft. in length because of operation with factory-ship; and in other areas 35 ft. As will be mentioned later, however, whales at sexual maturity are considerably shorter in the Bonin area than elsewhere. That explains why in the Bonin area the percentage of immature caught is low. The fact that there are more whales with light-colored spots in the Bonin Island is probably due to the fact that light colored spots are more often found on mature whales than on the immature.

The number of white scars not developed to the stage of light coloured spots was recorded by area in Table 25.

Table 25. Sei whale. Number of white scars. Shown in the percentage figure.

	Bonin Island			Ayukawa-Kamaishi			Kushiro-Kiritappu		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Number observed	109	100	209	185	137	322	96	141	237
None	13.8	7.0	10.5	0	2.9	1.2	2.1	0.8	1.2
Few	16.5	8.0	12.4	25.9	22.6	24.5	42.7	26.2	32.9
Moderate	21.1	23.0	22.0	28.6	32.1	30.1	32.3	39.0	36.3
Many	43.1	57.0	49.8	40.0	35.8	38.2	14.6	24.1	20.3
Numerous	5.5	5.0	5.3	5.5	6.6	6.0	8.3	9.9	9.3

In the Bonin Island area about 10 % of the total have "None"; and in other areas the percentage is much lower. Those with "Many" constitute about 50 % of the total in the Bonin Island area, and somewhat less in other areas. The presence of more whales with many white scars in the Bonin Island area may be explained by the fact that Bonin Island whales do not migrate very far north; but it is not so easy to explain the reason for the relative abundance there of whales with "none".

In the Ayukawa-Kamaishi area, whales with no scars are about as many as in the Kushiro-Kiritappu area, being a little less than 1 per cent of Total. In the former area, there are more whales with "many" scars and in the latter area, there are more "few" and "moderate". This agrees with the fact mentioned in paragraph "light-coloured spots". Namely, more whales with spots are captured in the Kushiro-Kiritappu area, but the spots are not highly developed, probably due to the abundance of whales with few white scars. If the number of white scars is in proportion to the length of period which whales stay in the warm seas, it must mean that the Kushiro-Kiritappu whales do not migrate to such low latitudes or, even if they do, their stay there is short.

c. External parasites.

External parasites were not so often recorded for Sei whales. Pennella sp. was found on 7 males and 8 females in the Bonin Island area and on 5 males and 4 famales in the Ayukawa area. The number found per whale was normally from 1 to 5, and the highest was 19. The place of infection varied. As for other parasites, there were only 1 instance of coronula sp. infection and 2 of conchoderma infection. A female which was captured in the Ayukawa area was infected with many coronula sp. on its tail flukes. This female was found to be infected with conchoderma sp. also. The other instance of conchoderma sp. infection was found on the baleen plate of a female which was caught in the Akkeshi area.

d. Thickness of blubber.

Regarding thickness of blubber, as shown in Table 26, 900 Sei whales were measured at Point 1 and 870 at Point 2.

The results were as shwon in Figs. 27 to 30, by area and body length. In preparing these figures, whales whose blubber thickness measurement was less than 3 were excluded, as were pregnant females. As can be seen from

Fig. 27. Sei whale. Average thickness of blubber. Male. Point 1.

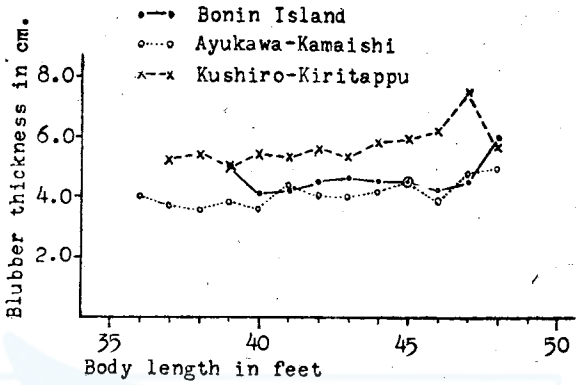


Fig. 28. Sei whale. Average thickness of blubber. Male. Point 2.

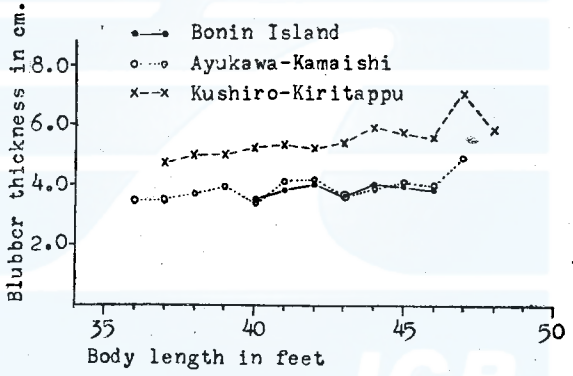


Fig. 29. Sei whale. Average thickness of blubber. Female. Point 1.

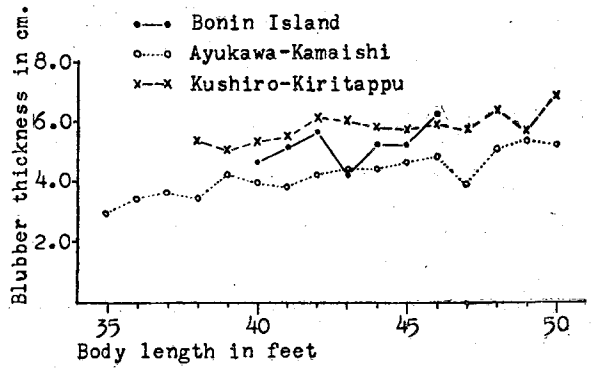


Fig. 30. Sei whale. Average thickness of blubber. Female. Point 2.

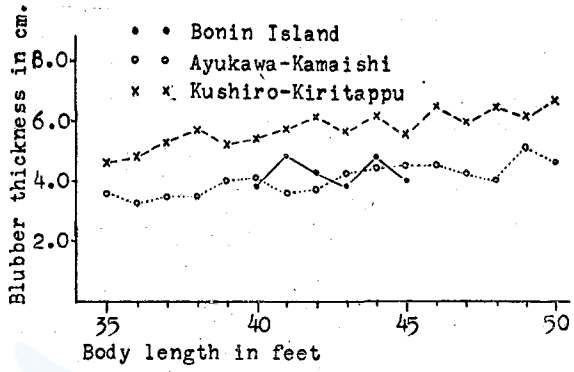


Table 26. Sei whale. Number of measurements of blubber thickness.

	Point 1			Point 2		
	Male	Female	Total	Male	Female	Total
Bonin Island	61	101	162	73	70	143
Ayukawa-Kamaishi	262	193	455	254	185	439
Kushiro-Kiritappu	122	161	283	122	166	288
Total	445	455	900	449	421	870

these tables, thickness of blubber increases in proportion to the increase of body length for both male and female, although with considerable differences according to areas. Points 1 and 2 show the same general trend. The thickest blubber is seen in the Kushiro-Kiritappu area and the thinnest in the Ayukawa-Kamaishi area. Though in Fig. 28, the whales in the Bonin Island are seen to have the thinnest blubber, we may safely say it is nearly as thick as in Ayukawa-Kamaishi area. From the latitudinal point of view, the Kushiro-Kiritappu area is located the farthest north, followed by Ayukawa-Kamaishi area; and the Bonin Island area is the farthest south. And the best season in the Bonin Islands, moreover, is from winter to spring. Consequently, one might well expect the blubber to be the thinnest there. So the explanation must be that although the Bonin area is located the farthest south, this area, unlike the Ayukawa-Kamaishi area, has such favorable oceanographical conditions that there is more abundant food for sei whales.

Various parts of sei whales which were caught in the Bonin Island area and the Kamaishi area in 1948 and 1949, were weighed. From this result

too, blubber of sei whales in the Bonin Island was found to be heavier than those in the Kamaishi area.

The blubber weight of whales in the Bonin Island area was 25.4 % of the total body weight on the average, and only 17% in the Kamaishi area.

For a further study of this relationship, calculation was made of the relation of thickness of blubber to body length in terms of percent by months, for the 3 areas, as shown in Figs. 31 to 34.

Fig. 31. Sei whale. Blubber thickness expressed as percentage of total length, by months.
Male. Mature.

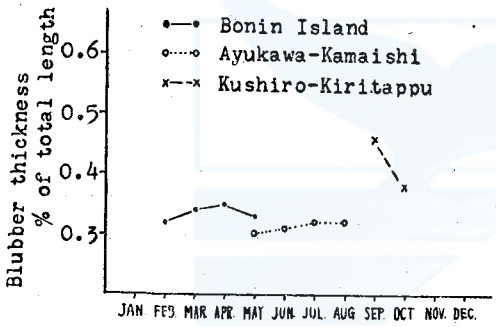


Fig. 32. Sei whale. Blubber thickness expressed as percentage of total length, by months.
Male. Immature.

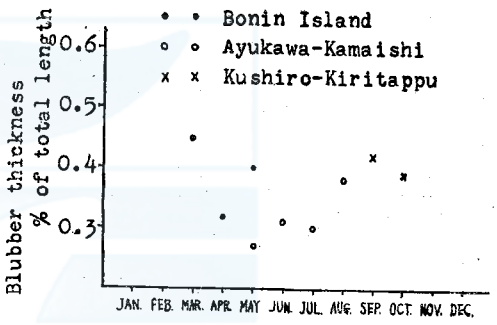


Fig. 33. Sei whale. Blubber thickness expressed as percentage of total length, by months.
Female. Mature.

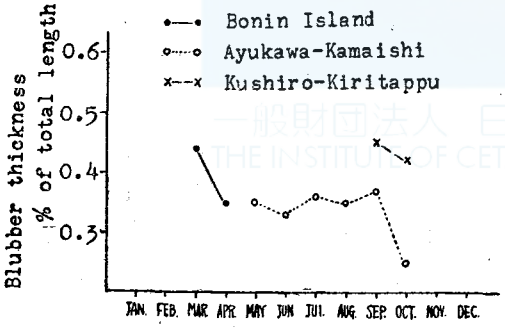
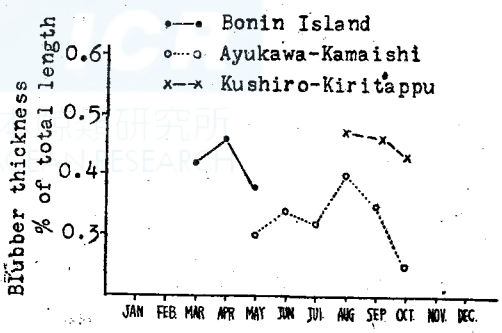


Fig. 34. Sei whale. Blubber thickness expressed as percentage of total length, by months.
Female. Immature.



Since nearly the same trend is seen at Points 1 and 2, only the former was indicated in these Figures by maturity and sex. In these figures, as in Figs. 27 to 30, pregnant females were omitted. In the Bonin Island area, excepting the immature males, blubber is thin in the early parts of

the whaling season and becomes thick in mid-season, then becomes thin again towards the end.

The trend is the same in the Ayukawa-Kamaishi area, — the blubber being thin around May, becoming thicker till August, and then suddenly thin. In the Kushiro-Kiritappu area, the blubber is thickest early in the season (Aug. to Sept), and thins rapidly by October. Generally speaking, blubber is the thickest in the Kushiro-Kiritappu, and next, in the Bonin Island area, and the thinnest in the Ayukawa-Kamaishi area. The tendency of blubber setting thicker as the season advances in the Kushiro-Kiritappu area is closely related to migration. Sei whales caught in this area are those which had stopped there on their way south from the Kurile Islands to which they had earlier migrated. Owing to abundant food off the Kurile Islands, they grow fat while staying there. But as food is less abundant off Kushiro-Kiritappu, the blubber gets thin there.

e. Food.

In regard to stomach contents, 215 Sei whales were recorded in the Bonin Island area, 475 whales, in the Ayukawa-Kamaishi area and 344 whales, in the Kushiro-Kiritappu area. The results by area are as shown in Table 27.

Table 27. Sei whale. Stomach content.

	Bonin Island	Ayukawa-Kamaishi	Kushiro-Kiritappu
Number of whales observed	215	475	344
Empty	71 (33.0)	223 (46.9)	211 (61.3)
Few	35 (16.3)	119 (25.0)	65 (18.9)
Moderate	52 (24.2)	92 (19.4)	37 (10.8)
Rich	33 (15.3)	27 (5.7)	22 (16.4)
Full	24 (11.2)	14 (3.0)	9 (2.6)

Note : Figures in parenthesis show the percentage.

Those with empty stomachs were most numerous in Kushiro-Kiritappu, followed by Ayukawa-Kamaishi and the Bonins in that order. Those whose stomach contents are designated as "few" were also most numerous in Ayukawa-Kamaishi and Kushiro-Kiritappu, while in the Bonin Island area the "moderate" were the most numerous, and the "Rich" and "Full", too, were far more numerous in the Bonin Island than in other areas. This means that the Bonin Island area is the richest in food for sei whales. It was explained in paragraph (d) "Thickness of blubber" that blubber of

whales in Bonin Island is thicker than that of whales in the Ayukawa-Kamaishi area. It can now be understood that that was due to the more abundant food, and it was mentioned that blubber becomes thinner with the advance of the whaling season in the Kushiro-Kiritappu area. From this table, it can be seen that that is due to the less abundant food. The variation in stomach contents by months in each whaling ground is shown in Tables 28 to 30.

Table 28. Sei whale. Monthly variation of Stomach content. Bonin island.

	February	March	April	May
Number of whales observed	11	58	93	53
Empty	9 (81.8)	17 (29.3)	30 (32.3)	15 (28.3)
Few	2 (18.2)	6 (10.4)	13 (14.0)	14 (26.4)
Moderate	0	9 (15.5)	32 (34.4)	11 (20.8)
Rich	0	14 (24.1)	11 (11.8)	8 (15.1)
Full	0	12 (20.7)	7 (7.5)	5 (9.4)

Note : Figures in parenthesis show the percentage.

Table 29. Sei whale. Monthly variation of Stomach content. Ayukawa-Kamaishi

	May	June	July	August	September	October
Number of whales observed	55	164	142	95	10	9
Empty	32 (58.2)	51 (31.1)	82 (57.7)	52 (54.7)	4 (40.0)	4 (44.4)
Few	12 (21.8)	52 (31.7)	26 (18.3)	23 (24.2)	1 (10.0)	1 (11.2)
Moderate	10 (18.2)	44 (26.8)	21 (14.8)	13 (13.7)	2 (20.0)	4 (44.4)
Rich	0	13 (7.9)	9 (6.3)	4 (4.2)	1 (10.0)	0
Full	1 (1.8)	4 (2.5)	4 (2.9)	3 (3.2)	2 (20.0)	0 0

Note : Figures in parenthesis show the percentage.

As these tables show, there are some months for which there are very few data. No comparison is possible between such months and other months for which there is abundant data. The percentages, however, have been calculated. For all of the areas, no great difference by month could be discerned, with the one exception that in the Ayukawa-Kamaishi area,

Table 30. Sei whale. Monthly variation of Stomach Content. Kushiro-Kiritappu.

	August	September	October
Number of whales observed	10	192	142
Empty	2 (20.0)	119 (62.0)	90 (63.4)
Few	1 (10.0)	37 (19.3)	27 (19.0)
Moderate	1 (10.0)	21 (10.9)	15 (10.6)
Rich	4 (40.0)	10 (5.2)	8 (5.6)
Full	2 (20.0)	5 (2.6)	2 (1.4)

Note : Figures in parenthesis show the percentage.

there was more abundant food in June than in other months.

As for kinds of food, plankton was Euphausia and Copepoda and fish were principally sardines. In some cases mackerel, herring and saurypike were found. Squid was sometimes seen also. In the Bonin Island area, there was 1 instance of Decapoda.

Kinds of foods by area are as shown in Table 31.

Table 31. Sei whale. Kind of food.

	Bonin Island	Ayukawa-Kamaishi	Kushiro-Kiritappu
Euphausia or Copepoda	70	76	118
Sardine	72	59	3
Mackerel	0	8	2
Herring	0	0	3
Saury	0	0	2
Squid	0	9	5
Decapoda	1	0	0
Other	1	0	0

As Euphausia and copepoda were recorded in some cases separately and together in others, they are not treated separately here. Since these investigations are being continued. In the future reports they are to be classified separately. Where several kinds of foods were mixed, they were all recorded under the kind which was largest in quantity.

As seen in Table 31, in the Bonin Island area and the Ayukawa-Kamaishi area sardine, as well as Euphausia or Copepoda, are the principal food while in the Kushiro-Kiritappu area food was nearly all Euphausia or Copepoda. Other kinds of foods were also found, but only rarely. "Other" in the column "Bonin-Island" are fish eyes; and although it is not clear from the record, the other parts were probably digested in some stomach,

other than the first stomach, leaving only the eyes there.

Table 32. Sei whale. Difference of food by month.

Ground	Month	Euphausia or copepoda	Sardine	Mackerel	Herring	Saury	Squid	Decapeda	Other
Bonin Island	Feb.	2	0	0	0	0	0	0	0
	Mar.	25	15	0	0	0	0	1	1
	Apr.	25	37	0	0	0	0	0	0
	May	18	20	0	0	0	0	0	0
Ayukawa-Kamaishi	May	23	1	0	0	0	0	0	0
	June	110	0	3	0	0	1	0	0
	July	30	21	5	0	0	4	0	0
	Aug.	11	28	0	0	0	4	0	0
	Sept.	0	6	0	0	0	0	0	0
	Oct.	2	3	0	0	0	0	0	0
Kushiro-Kiritappu	Aug.	7	0	1	0	0	0	0	0
	Sept.	68	0	1	1	0	4	0	0
	Oct.	43	3	0	2	2	1	0	0

Table 32 shows the variation of kinds of foods by month. There were more Euphausia or Copepoda than sardines in the Bonin Island till March. From April, sardines were the more numerous. The same was true of the Ayukawa-Kamaishi area, with some time-lag. Namely, almost all the food was Euphausia or Copepoda in May and June; sardines were found in considerable numbers in July; and from August on, sardines were the principal food.

In the Kushiro-Kiritappu area, other foods were found in all the months, but principal food was Euphausia or Copepoda.

As mentioned above, there is a monthly variety in kinds of foods. That probably is not because the sei whale chooses from among the kinds available, but probably because there are more chances for the whale to eat the kind of food that is most abundant.

f. Genitalia and Maturity.

For 95 females in the Bonin Island area, 185 females in the Ayukawa-Kamaishi area and 159 females in the Kushiro-Kiritappu area, it was observed whether their ovaries had corpus luteum or not; and, if they had, the number of corpus luteum was counted and the weight of ovaries measured. In addition, there were some whales for which observation could be made of only one of the ovaries by reason of the other ovary having

gotten lost while the whale was being towed or in process of dissection. But when such data could be effectively utilized, such as for weight of ovary alone, they were used with the above data. On the basis of the above data, whales with 1 or more corpora lutea in their ovary were regarded as mature and those without any corpora luteum, as immature.

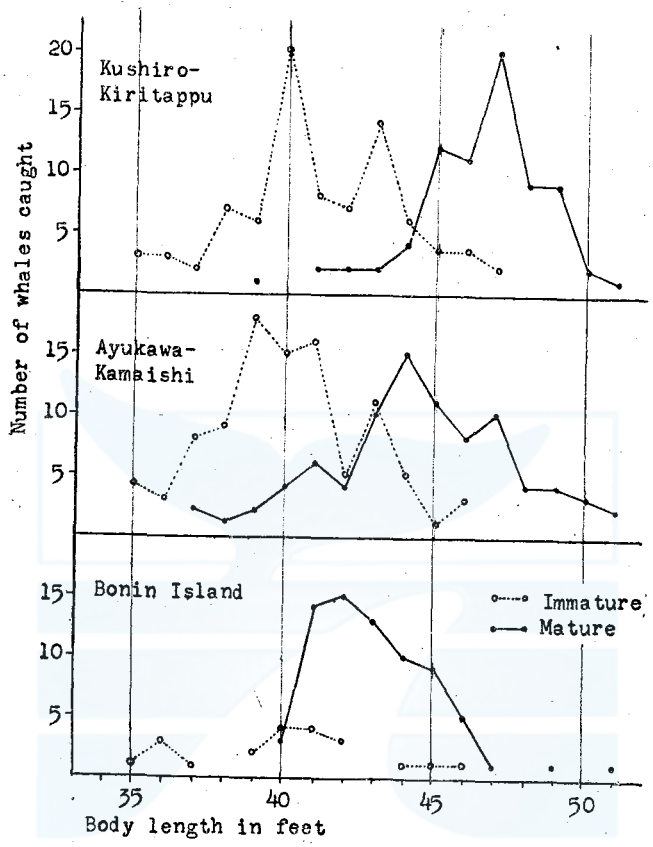
Table 33. Sei whale. Number of immature and Mature female whales in each length.

Body length in ft.	Bonin island			Ayukawa-Kamaishi			Kushiro-Kiritappu		
	Immature	Mature	Total	Immature	Mature	Total	Immature	Mature	Total
33	0	0	0	1	0	1	0	0	0
34	0	0	0	0	0	0	0	0	0
35	1	0	1	4	0	4	3	0	3
36	3	0	3	3	0	3	3	0	3
37	1	0	1	8	2	10	2	0	2
38	0	0	0	9	1	10	7	0	7
39	2	0	2	18	2	20	6	1	7
40	4	3	7	15	4	19	20	0	20
41	4	14	18	16	6	22	8	2	10
42	3	15	18	5	4	9	7	2	9
43	0	13	13	11	10	21	41	2	16
44	1	10	11	5	15	20	6	4	10
45	1	9	10	1	11	12	3	12	15
46	1	5	6	3	8	11	3	11	14
47	0	1	1	0	10	10	2	20	22
48	0	0	0	0	4	4	0	9	9
49	0	1	1	0	4	4	0	9	9
50	0	0	0	0	3	3	0	2	2
51	0	1	1	0	2	2	0	1	1
52	0	0	0	0	0	0	0	0	0
Total	21	72	93	99	86	185	84	75	159
%	22.6	77.4	100.0	53.5	46.5	100.0	52.8	47.2	100.0

Table 33 shows the results classified by body length. The body length at which maturity is reached shows a considerable difference according to locality. For instance, in the Bonin Island area, whales 41 ft. or longer may be regarded as mature. In the Ayukawa-Kamaishi and the Kushiro-Kiritappu areas, however, whales of 41 ft. length that are still immature far outnumber those of the same length that are mature. 41 feet in the Bonin Island area corresponds to 44 ft. in the Ayukawa-Kamaishi area, and 45 ft. in the Kushiro-Kiritappu area. This relation can be seen more clearly in Fig. 35, in which table 33 has been reduced to chart form.

In the 1937 International Agreement for the Regulation of Whaling, there was no restriction as to body length for sei whales. But the Japanese Regulation prohibited the catching of whales less than 35 ft. long, both for

Fig. 35. Sei whale. Mature and immature females observed in three areas.

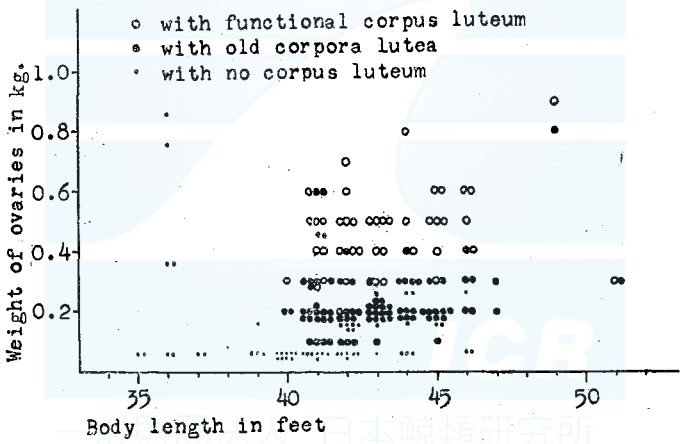


landstations and factory ships. The International Convention for the Regulation of Whaling which was signed at Washington on Dec. 2, 1946 fixed the limit at 40 ft, but allowed catches down to 35 ft. in case of landstation whaling. As this convention took effect in October, 1948, the limited body length of sei whales in the Bonin Island area which was 35 ft. in 1948 was raised to 40 ft. from 1949. As compared with other areas, therefore, there is less material available on sei whales of less than 40 ft. for the Bonin Island area. But that fact does not have any effect upon the decision to set 41 ft. and over as the body length at which sexual maturity is attained in the Bonins. In any case, from Fig. 35 we may consider 41 ft. and over in the Bonin Island area, 44 ft. and over in the Ayukawa-Kamaishi area and 45 ft. and over in the Kushiro-Kiritappu area as body length at which sexual maturity is reached. According to Matthews, female sei

whales located in the Antarctic come to sexual maturity at the length of 14.5 meters: (47 ft. 7 inches) this is 48 ft. under the measuring method provided for in the Present Convention. As compared with this length, all sei whales located in the adjacent seas of Japan are smaller, — the difference for the Bonin Islands being about 7 ft. Of the sei whales caught in the Bonins, only 2 were 48 ft. or over; that number is but 2.15% of the total caught in that area.

Table 33 shows the ratio between mature and immature in each area. Immature is 22.6% in the Bonin Island Area and about 53% in both Ayukawa-Kamaishi and Kushiro-Kiritappu areas. This is due to the fact that though sei whales in the Bonin Island area become adult at smaller size than those in other areas, the minimum body length is fixed at 40 ft. for the Bonin Island area (because of factory ship operation) and 35 ft. for other areas. This is an illogical situation which should be corrected soon.

Fig. 36. Sei whale. Weight of Bonin island.



Figs. 36 to 38 show weight of ovary by areas. In this respect, too, the Bonin Island area show a different trend from other areas. In the Bonin Island area, the weight of ovary of immature (with no corpus luteum in ovary) was 0.3 kg. or less, with a few exceptions. Those of 0.1 kg. or even lighter were most numerous. In the Ayukawa-Kamaishi and Kushiro-Kiritappu areas, the weight was generally less than 0.5 kg. and most often under 0.2 kg. The heaviest ones were about 0.6 kg. in the Bonin Island, with a few exceeding that. In other areas there were a

Fig. 37. Sei whale. Weight of ovaries. Ayukwa-Kamaishi.

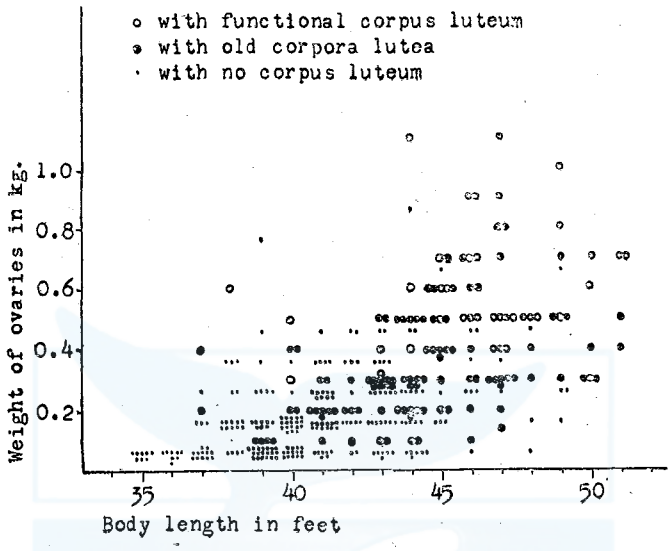
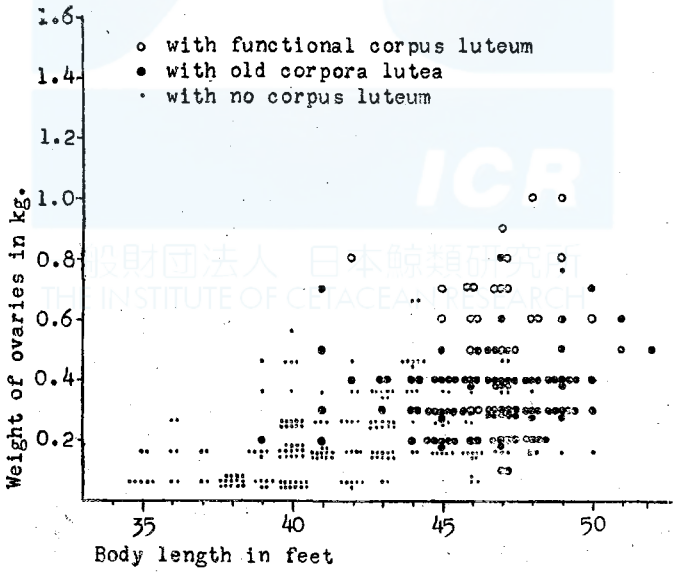


Fig. 38. Sei whale. Weight of ovaries. Kushiro-Kiritappu



considerable number of ovaries over that figure, and the heaviest one was 1.6 kg. which was seen in the Kushiro-Kiritappu area.

Figs. 39 to 41. show the number of Corpora lutea by body length and area. The maximum far all the areas was 20, with Kushiro-Kiritappu area alone having exceptions of 21 and 22.

In the Bonin Island area, there were comparatively few whales with small number of corpora lutea, but great many in the other two areas.

This relation can be seen more clearly in Fig. 42. Namely, in the Ayukawa-Kamaishi and Kushiro-Kiritappu areas those with only 1 corpora

Fig. 39. Sei whale. Female. Number of corpora lutea. Bonin island.

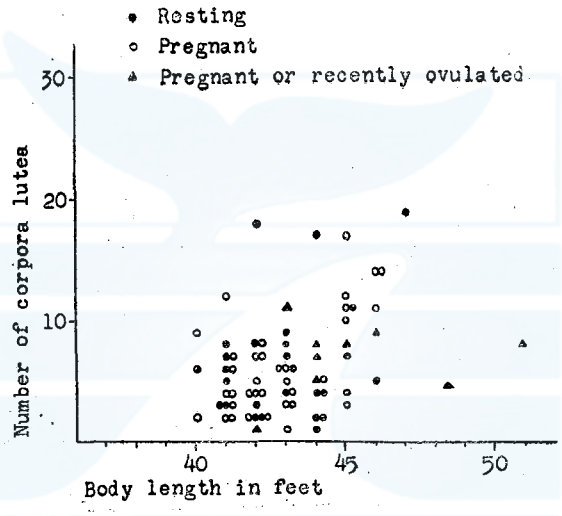
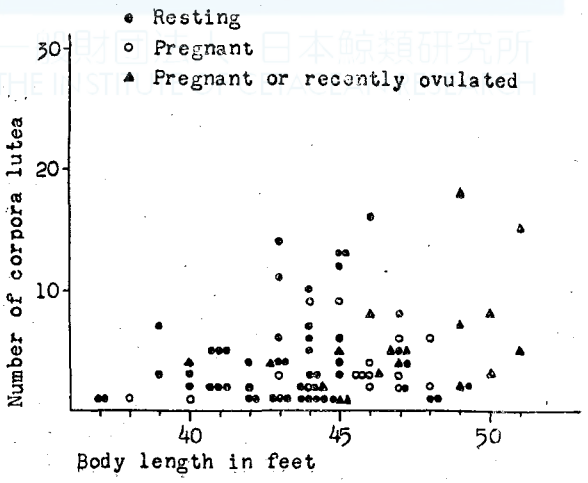


Fig. 40. Sei whale. Female. Number of corpora lutea. Ayukawa-Kamaishi.



lutea were the most numerous, followed by those having 2 and 3; while in the Bonin Island area the maximum was 4, and those with only 1 were far fewer than in the other 2 areas.

Fig. 41. Sei whale. Female. Number of corpora lutea. Kushiro-Kiritappu.

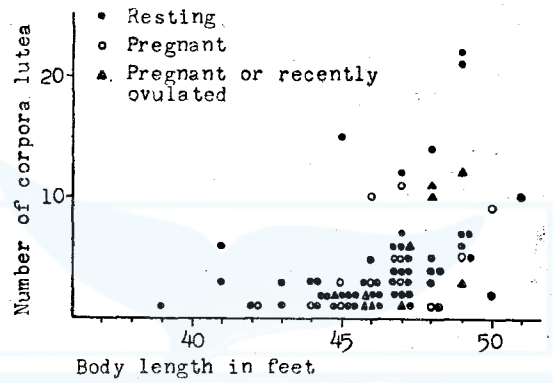
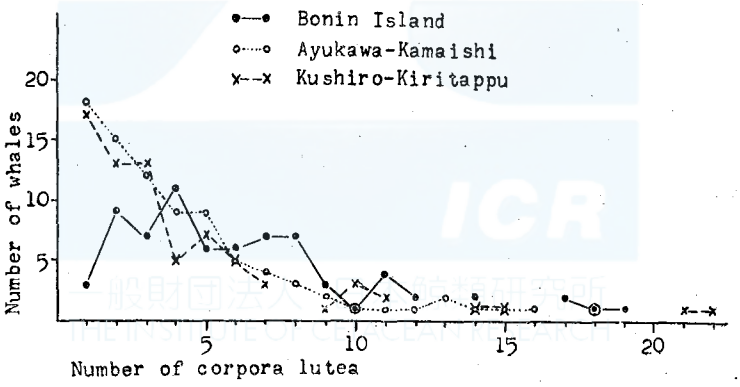


Fig. 42. Sei whale. Female. Number of corpora lutea.



Figs. 43 to 45 show the thickness of mammary gland. The small number of no-parous glands measured for the Bonin Island area made it impossible to compare the thickness of mammary gland of the 3 areas. There does, however, seem to be some difference in that respect between the Ayukawa-Kamaishi area and the Kushiro-Kiritappu area. The thickest of non-parous glands was about 3 cm. thick in the latter area but about 4 cm. in the former area. Involuted glands were generally thicker in the Bonin

Fig. 43. Sei whale. Thickness of mammary gland. Bonin island

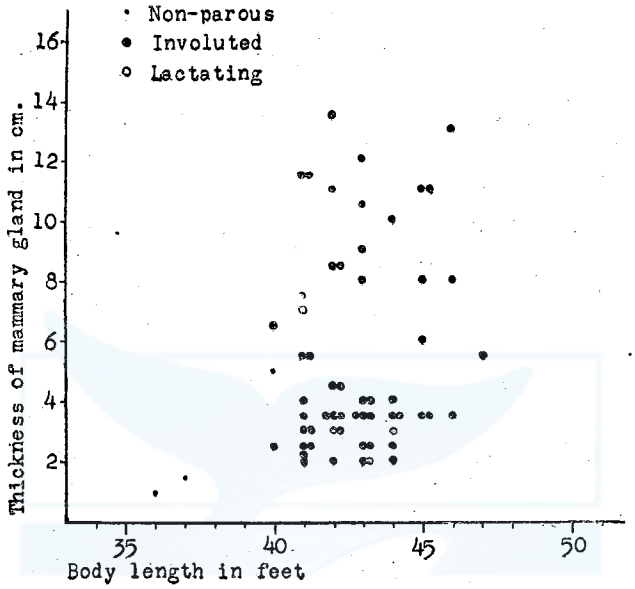


Fig. 44. Sei whale. Thickness of mammary gland. Ayukawa-Kamaishi

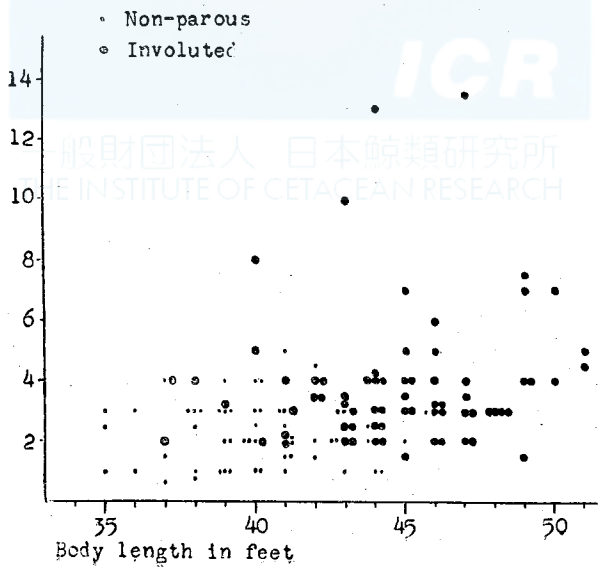
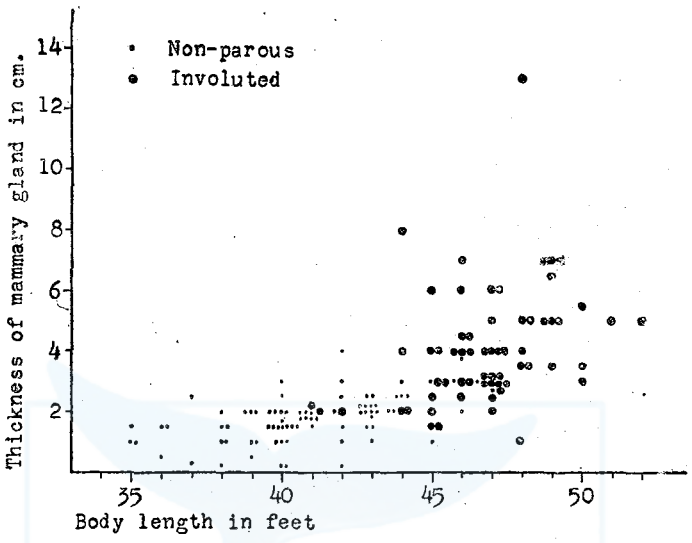


Fig. 45. Sei whale. Thickness of mammary gland. Kushiro-Kiritappu.



Island area than those in other areas. But it is not known whether this difference is due to group or seasonal differences. From what has been explained above, it may be said that female sei whales in different areas belong to different groups. The Ayukawa-Kamaishi area and the Kushiro-Kiritappu area have much in common, but the Bonin Island area plainly differs on the various points above mentioned. So, it would appear that the sei whales in the adjacent waters of Japan consist of at least 2 local races, northern and southern. But as it is necessary for this question to be studied for males also, and it has some relation to migration, it will be further discussed later.

The volume and weight of testis were measured for 99 males in the Bonin Island area, 226 males in the Ayukawa-Kamaishi area and 121 males in the Kushiro-Kiritappu area. There were, in addition, some whales of which only the right or the left testis was measured; but those data were also used whenever possible.

In Figs. 46 to 48, volume of testis of male sei whales in each area was plotted by body length. As shown in these Figures, the farther north the area is, the greater the volume of testis of immature whales seems to be even in the mature whales, the volume of testis is definitely greater in the Kushiro-Kiritappu area than in the Bonin Islands.

Fig. 46. Sei whale. Volume of testis. Bonin island.

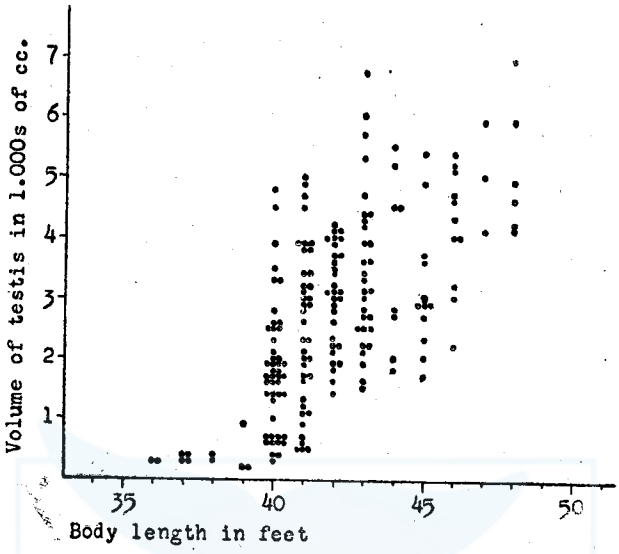


Fig. 47. Sei whale. Volume of testis. Ayukawa-Kamaishi

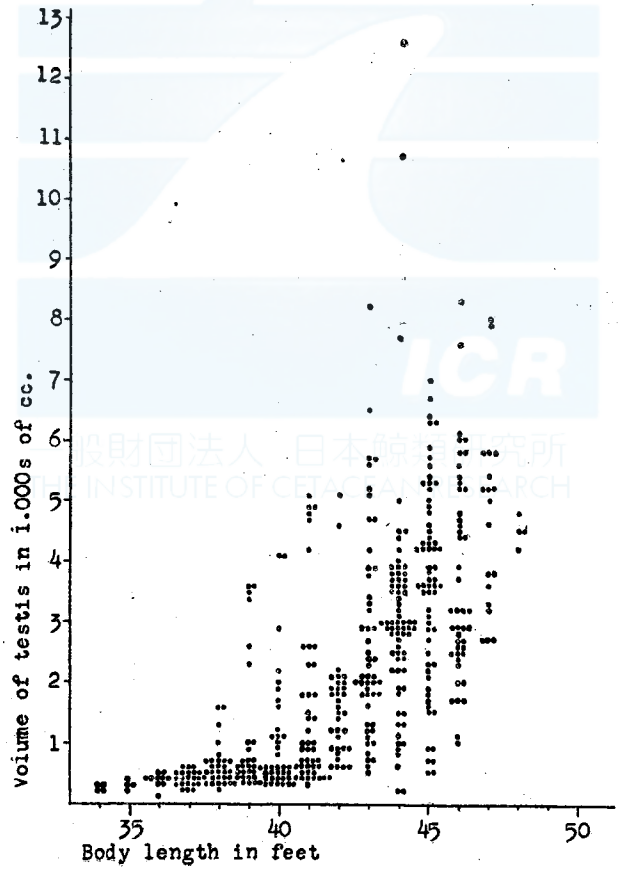


Fig. 48. Sei whale. Volume of testis. Kushiro-Kiritappu

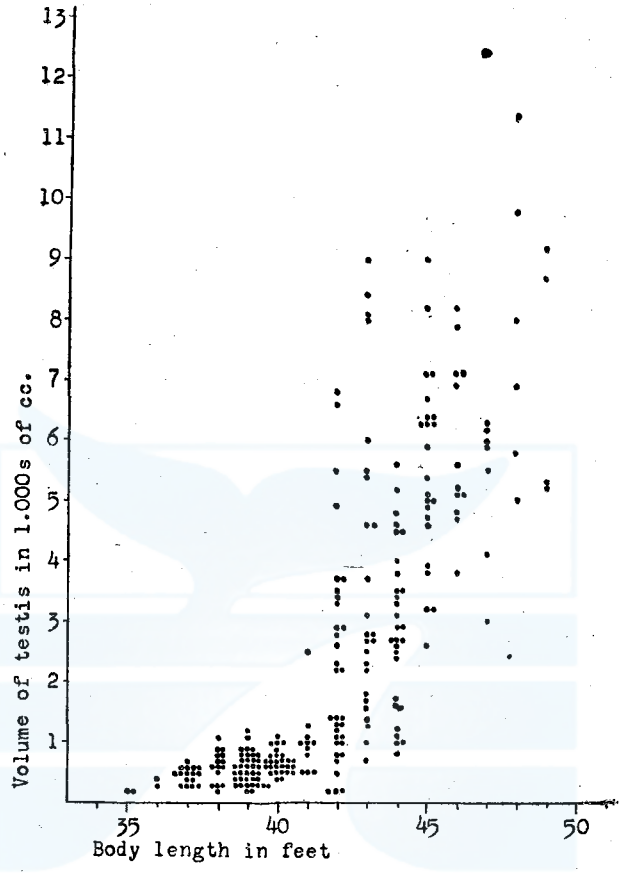
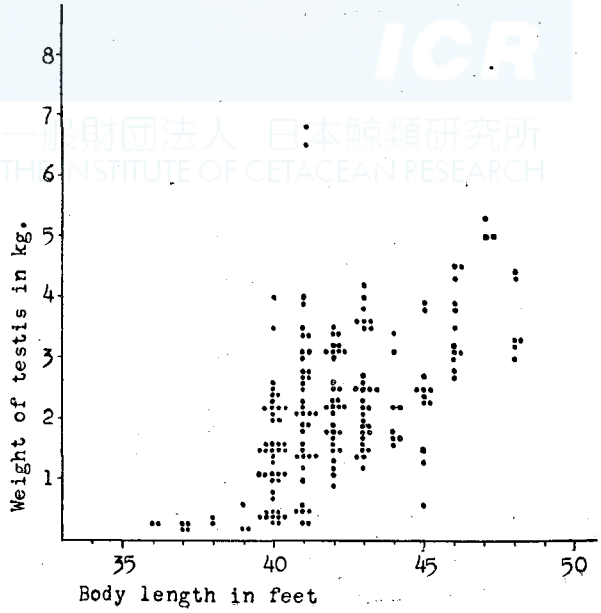


Fig. 49. Sei whale. Weight of testis. Bonin island.



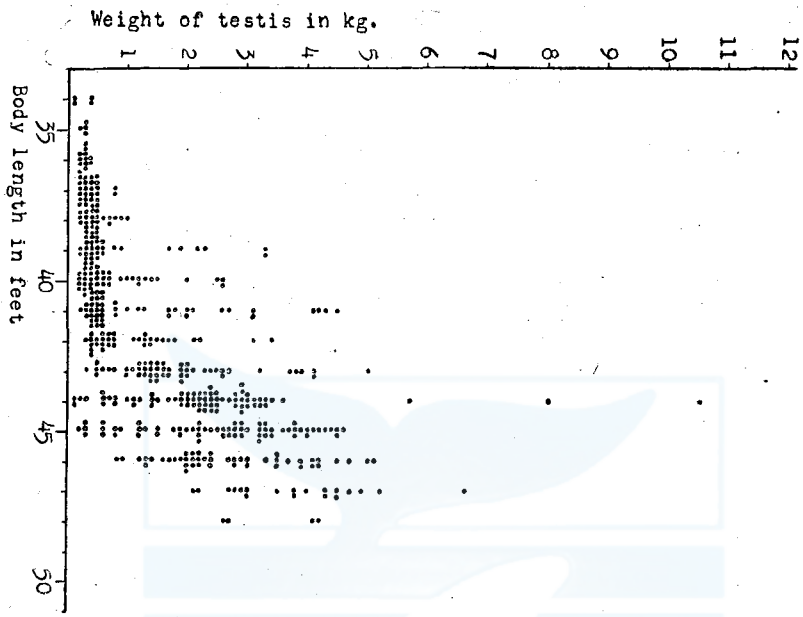


Fig. 50. Sei whale. Weight of testis. Ayukawa-Kamaishi

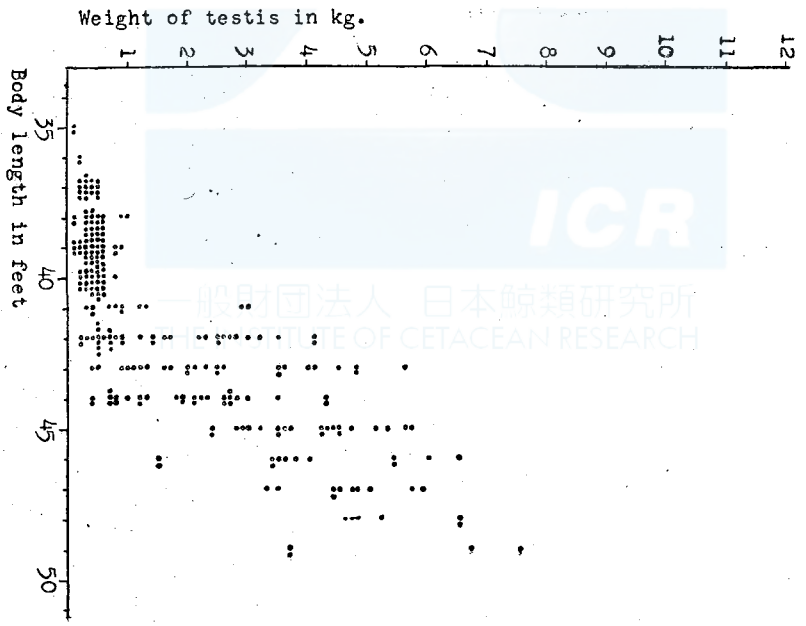


Fig. 51. Sei whale. Weight of testis. Kushiro-Kiritappu

In Figs. 49 to 51, the weight of testis was plotted by body length. Regarding weight also, the same thing can be said as was said regarding volume for these 3 areas. From tne above Figures on volume and weight, male sei whales in the adjacent seas of Japan whose testis is 1.5 or less in volume and 1 kg. or less in weight can be regarded as immature, and those over those figures, as mature.

Table 34. Sei whale. Number of immature and mature male whales in each length.

Body length in ft.	Bonin Island			Ayukawa-Kamaishi			Kushiro-Kiritappu		
	Immature	Mature	Total	Immature	Mature	Total	Immature	Mature	Total
34	0	0	0	2	0	2	0	0	0
35	0	0	0	2	0	2	1	0	1
36	1	0	1	3	0	3	1	0	1
37	2	0	2	9	0	9	7	0	7
38	1	0	1	11	1	12	6	0	6
39	1	0	1	9	3	12	17	0	17
40	8	15	23	13	4	17	14	0	14
41	2	15	17	12	8	20	4	1	5
42	0	16	16	6	10	16	9	9	18
43	0	15	15	4	21	25	1	11	12
44	0	5	5	4	31	35	2	12	14
45	0	6	6	3	32	35	0	11	11
46	0	7	7	1	25	26	0	6	6
47	0	2	2	0	10	10	0	4	4
48	0	3	3	0	2	2	0	3	3
49	0	0	0	0	0	0	0	2	2
Total	15	84	99	79	147	226	62	59	121
%	15.2	84.8	100.0	35.0	65.0	100.0	51.2	48.8	100.0

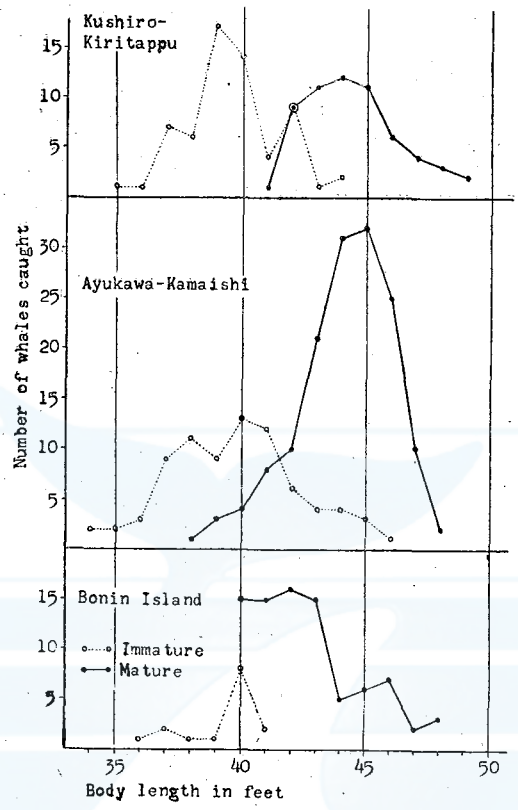
Table 34 shows all the males studied classified into mature and immature on the basis of volume of testis.

As seen there, it may be said that male sei whales reach sexual maturity at 40 ft. length in the Bonin Island area, 42 ft. in the Ayukawa-Kamaishi area, and, 43 ft. in the Kushiro-Kiritappu areas. These is, in other words, difference by locality in males as in females.

Fig. 52, which was prepared on the basis of Table 34, shows this relation even more clearly. According to Matthews, Sei whales located in the Antarctic, come to sexual maturity at the body length of 13.5 meters (45 ft. 3 inches). As compared with those, male sei whales in the adjacent seas of Japan area of smaller size, as in the case of females; — the difference in the Bonins being as much as 5 ft.

Table 34 shows the percentage of mature and immature in each area

Fig. 52. Sei whale. Mature and immature males observed in three areas.



as in the case of females, comparatively few immature males were caught in the Bonin Island area; but the number was far greater in the other two areas. Only in the Ayukawa-Kamaishi area was the percentage of immature males lower than in the case of females; it being 35% of total male. At any rate, the high ratio of immature whales in the whaling grounds other than Bonin Island area is noteworthy.

Table 35 shows the constitution of total sei whales observed.

Table 35. Sei whale. Constitution of total whales observed.

	Female	Male	Total
Total number observed.	437	446	883
Immature	204 (46.7%)	156 (35.0%)	360 (40.8%)
Mature	233 (53.3%)	290 (65.0%)	523 (59.3%)
Resting	131		
Pregnant	64		
Pregnant or recently ovulated	37		
Lactating	1		

g. Conclusion on sexual maturity and migration.

As mentioned above, the body length at which sei whales in the adjacent seas of Japan come to sexual maturity, is as follows :—

In Bonin Island area

Female	41 ft. long
male	40 ft. long

In Ayukawa-Kamaishi area

female	44 ft. long
male	42 ft. long

In Kushiro-Kiritappu area

female	45 ft. long
male	43 ft. long

It may be that such a conclusion cannot be drawn regarding male whales in the "Bonin Island area, where their catch is poor there. It may be smaller by 1 foot. Thus, the above 3 areas show different body lengths; but there still remaines the question as to the situation in Oshima and areas west of it. Oh that, no investigations have been made.

However, from the past whaling statistics, the body length was examined for pregnant whales caught in these areas. The result is as follows:

Body length	Number of pregnant whales
40 ft.	4
41 ft.	1
42	3
43	1
44	0
45	5
46	0
47	2
48	1

It can thus be seen that there were recorded 4 pregnant whales 40 ft. long, which number is more than for whales of other body lengths. But the body lengths recorded are not always correct, because there is a tendency to exaggerate the size recorded because of the bonus involved. The temptation to stretch a 39 ft. whale to 40 ft. for the record is probably especially strong.

In view of such circumstances, it is quite possible that whales of only

39 ft, or some even smaller, may be included among those recorded as 40 ft. But in any case, it can be said that in these areas there are whales approximately 40 ft. long that are pregnant, and that the percentage of those pregnant at that size is not much lower than in whales of larger size.

From these facts, it appears possible that sei whales in Oshima and west of it, come to sexual maturity at least at the same body length as those in the Bonin Island area.

Although there are some very slight differences between the Ayukawa-Kamaishi area and the Kushiro-Kiritappu area, their points of similarity are considerable. It is therefore conceivable that Sei whales in the adjacent waters of Japan consist of two local races, northern and southern types. And the southern type whales migrate mainly to the Bonin Island, Oshima, and further west, and partly to the Ayukawa-Kamaishi area, and a few even to the Kushiro-Kiritappu area. The northern type whales, on the other hand, probably migrate up to Kurile Islands through the Ayukawa-Kamaishi area and off Kushiro-Kiritappu; and from there most of them probably migrate southward, while a very few continue their migration as far as to the east side of Kamchatka Peninsula. The question is how far they migrate southward. Judging from the fact that there are white scars on the body and that in the Ayukawa-Kamaishi area open pits which are the cause of scars are not found, it must be that they migrate to the warmer seas of low latitudes, but to areas other than the Bonin Islands. For if they migrated to the Bonin Island area, they would be caught there and thus alter the constitution of whales caught in the Bonins. Consequently the number migrating to the neighborhood of Bonin Islands must be very few, if any. And as stated in the paragraph "white scars", the northern type whales probably do not migrate so south as the southern type, and even if they did, their stay in the south must be shorter.

Fig. 53 was made on the basis of 6,939 Sei whales classified by area and body length which were caught for the past 18 years.

In Fig. 53, grounds I—V mean the following areas.

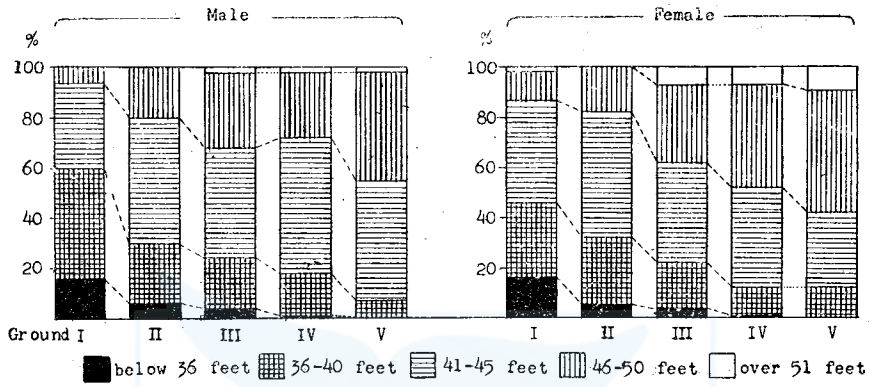
I. Oshima and west of it (Southwest area and West Kyushu area)

II Bonin Islands.

III Ayukawa-Same (North east area)

IV Muroran-Kiritappu (Hokkaido area)
V Kurile Islands (Kurile area).

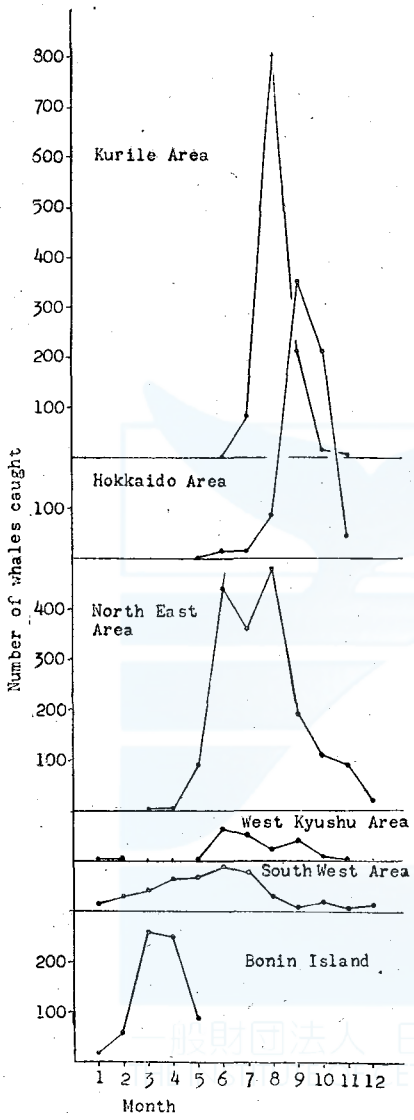
Fig. 53. Size of Sei whale in various grounds.



According to Fig. 53, the body length of Sei whales is smallest in the south west area, becoming larger as it goes north east. From this fact alone, therefore, it seems reasonable to classify them into local races for each area. But as their migrating route seems to differ by body length, that may be too hasty a conclusion. But since, as mentioned already, a clear-cut line can be drawn between the Bonin Island area and the Kushiro-Kiritappu area with regard to the body length at sexual maturity, it is impossible to say that Sei whales in the adjacent seas of Japan all belong to the same group, and that the difference in body length by area is simply due to their migration. That is why the author would like to divide them into 2 local races, northern and southern, and to explain the other details on the basis of migration. But that involves considerable assumption. It is hoped to obtain a more definite conclusion when sufficiently data has been collected through the measurement of the proportions of body parts. For the purpose of studying migration, in the adjacent seas of Japan whale marking have been carried on since 1949. Some data should be obtained from this field.

Fig. 54 shows monthly number of whales caught in each area, on the basis of the past 18 years whaling statistics. In the Bonin Island, the largest catch is seen in March and April. In the north east area, it is from June to August. In the Kurile area, the catch is mostly in August. When the Tonan-maru operated in the northern waters, only 3 Sei whales

Fig. 54. Sei whale. Monthly catch in each area.



were caught in 1940, and 7 in 1941; and the place of catch was generally south of Lat. 50°N. And since few sei whales were caught by the Russian Factory ship "Aleut" also it does not seem that many migrate north of the Kurile Islands. Even in the Kurile Islands, the principal whaling ground was south of middle Kurile Islands. In the Hokkaido area, most of them were caught in Sept. and Oct. These, as stated in the paragraph "thickness of blubber", were caught on their way southward from the Kurile area. Also the whales caught in the North east area after September, were probably southward bound.

It was mentioned in the paragraph "light-coloured spot" that female sei whales probably stayed in the south warm seas for longer time than males. There is also a difference in the sex composition of sei whales which migrate to the Hokkaido area and the Kurile area. On the basis of the past 18 years' data, catch by sex in these two areas is as shown in Table 36.

As seen there, in the Kurile area,

Table 36. Sei whale. Sex ratio of whales caught in Kurile and Hokkaido areas in past 18 years.

	Actual number		Percent	
	Kurile area	Hokkaido area	Kurile area	Hokkaido area
Male	749	420	67.7%	37.4%
Femal	357	702	32.3	62.6
Total	1,106	1,122	100.0	100.0

female was only 32.3 % of total, while in the Hokkaido area it was 62.6%. Consequently, in these areas too, migrating route might differ between male and female; but for the present, their actual route is not known.

In the South west area and the West Kyushu area, the best catch is seen in June and July. In Korea, catches are extremely rare. The same is true of the Okhotsk area. From this fact too, it may be inferred that sei whales in this area do not migrate north but stay in the waters nearly even during the summer. A part of the Sei whales in the Bonin Island area migrate to the North east area, while others may migrate to Oshima (the South west area). For the present, however, there is no data to prove it. It may be clarified in the future by the data of the present whale marking and of measurement of whale body proportion started this year.

h. Stock.

Fig. 55. Sei whale. Variation of catch.

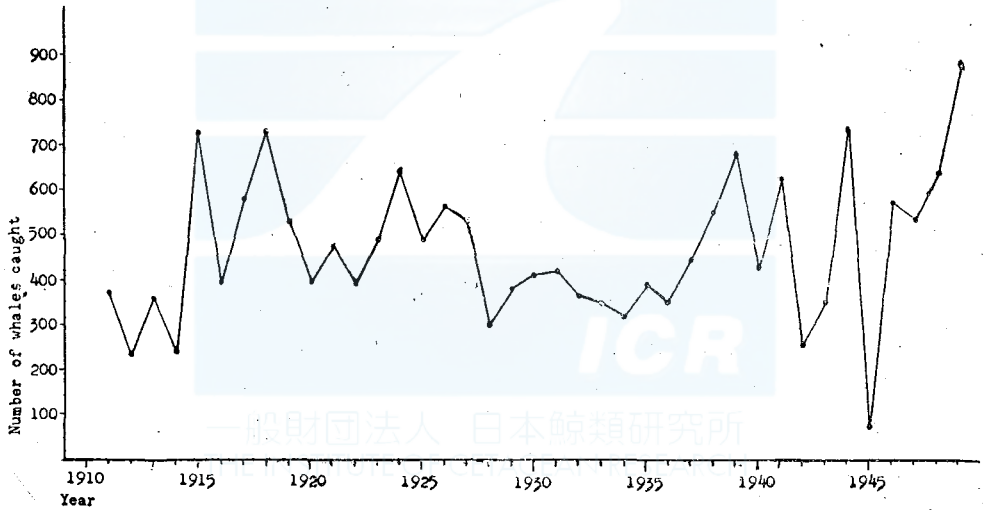


Fig. 55 shows annual variation of Sei whale catch since 1911. Although there is some variation by years, there is no decrease in catch as there is in other baleen whales. The very poor catch in 1945 was due to the War, and was not confined to Sei whales. Consequently, we may say that among baleen whales, sei whale is the most stable in stock. As stated already, however, catch ratio of immature whale is so high especially in the Hokkaido area that there is danger of depleting the stock unless

this point is borne in mind.

From the point of view of stock conservation, therefore, the limit on body length should probably be raised from 35 ft. to 40 ft. in the North east area and the Hokkaido area.

Fig. 56. Sei whale. Size distribution of whales caught in the past 18 years.

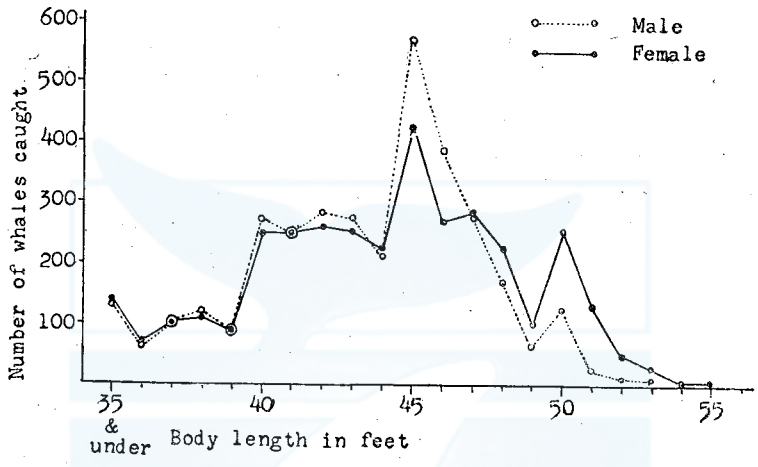


Fig. 56 shows the size distribution of all Sei whales caught in the last 18 years.

Both for males, and females the peak catch were in 45 ft. Being different from other baleen whales, Sei whales under the present limited body length were not caught in such large numbers.

Sperm whale (*Physeter catodon Linnaeus*)

The Sperm whale, like the sei whale, is a specie which is caught in great abundance in the adjacent seas of Japan. Number of sperm whales observed is over 500, as shown in Table 1.

a. Colour :

Sperm whales are generally dark grey all over the body. When studied in detail, sperm whales in the adjacent waters of Japan can be classified into the following 4 classes:

A. Uniform dark greay all over the body.

B. Lighter on the under surface of the head and lower jaw.

C. Light whitish all over the head.

D. Light whitish all over the body.

The results of recording for 283 whales are as shown in Table 37.

Whales light colored over the greater part of the ventral surface had been classified by Matthews, but only in rare instances; more common were whales light colored all over the body, which were included in class "D".

Table 37. Sperm whale. Body colour

	Actual number			Percent		
	Male	Female	Total	Male	Female	Total
Number whales observed	179	104	283	100.0	100.0	100.0
A	121	76	197	67.6	73.1	69.6
B	23	18	41	12.8	17.3	14.5
C	3	2	5	1.7	1.9	1.8
D	32	8	40	17.9	7.7	14.1

As seen in this table, about 70 % of total was nearly uniform dark grey, or about the same percentage as observed by Mathews in sperm whales in the Antarctic. Of the rest according to Matthews 25.7 % were considerably lighter on the under surface of the head and lower jaw, and 4.3 % were conspicuosly lighter over the greater part of the ventral surface. Among sperm whales in the adjacent seas of Japan, however, whales lighter on the under surface of the head were 14.5 % and whales lighter all over the body were about 14 %. Whales lighter all over the head were very few, being only 1.8 % of total. The greatest difference between male and female was seen in "D", lighter all over the body, male being about 18 % and female being not more than 8 %. Next in order came A and B, in both of which there were more females by about 5 %. But such a classification of colouration often differs according to the observers, so that detailed comparative study would not have much significance.

Some sperm whales had light coloured spiral markings on their head, which were classified into 4 classes for observation. The results are as shown in Table 38.

As seen in Table 38, only about 13 % of total had no spiral markings at all, and all the rest had them, though in varying degrees of clarity. Though some difference between male and female, was seen also, it is impossible to discuss it on the base of this table, for the number of females

Table 38. Sperm whale. Colour, Light-coloured spiral marking on head.

	Actual number			Percent		
	Male	Female	Total	Male	Female	Total
Number whales observed	150	23	173	100.0	100.0	100.0
Very clear	10	3	13	6.7	13.0	7.5
Clear	56	9	65	37.3	39.1	37.6
Not clear	64	8	72	42.7	34.8	41.6
None	20	3	23	13.3	13.1	13.3

observed was especially small.

Sperm whales have white markings near umbilicus. There are two kinds. One is light grey flecking, which consists of patches or flecks of light pigment. The other is white splash, which is generally triangular in shape with its apex pointing forward.

The light grey flecking condition of 231 whales was divided into 5 classes: none, few, moderate, many, numerous, for recording. The results are as shown in Table 39.

Table 39. Sperm whale. Colour. Light grey fleching.

	Actual number			Percent		
	Male	Female	Total	Male	Female	Total
Number whales observed	182	49	231	100.0	100.0	100.0
None	27	3	30	14.8	6.1	13.0
Few	67	10	77	36.8	20.4	33.3
Moderate	31	22	53	17.0	44.9	22.9
Much	47	12	59	25.8	24.5	25.5
Numerous	10	2	12	5.6	4.1	5.3

Accoding to Matthews, 67 per cent of sperm whales found in the Antarctic had this light grey flecking. In the adjacent seas of Japan, flecking is seen more often.

As seen in Table 39, male had more "none" and "few" than female. It is doubtful whether such a conclusion is warranted, for the number of females observed was small as in case of table 38.

White splash was observed for 215 whales, and classified into none, normal and remarkable, as shown in Table 40.

As in the case of light grey flecking there were more males than fe-

Table 40. Sperm whale. Colour. White splash

	Actual number			Percent		
	Male	Female	Total	Male	Female	Total
Number whales observed	155	60	215	100.0	100.0	100.0
None	46	9	55	29.7	15.0	25.6
Normal	99	46	145	63.9	76.7	67.4
Remarkable	10	5	15	6.4	8.3	7.0

males that had no white splash at all. About 75% of males and females together had this white splash.

b. White scars.

White scars were observed for 244 males, and 85 females. If these were to be divided into three areas, as in case of sei whales, the number of whales in each area would be so small as to render their comparison meaningless, and it is thought that moreover, sperm whales in the adjacent seas of Japan, unlike the sei whales, belong not to local seas in a narrow sense but to same group for all areas. Therefore they were studied without classification into 3 areas. The results are as shown in table 41.

Table 41. Sperm whale. White scars.

	Actual number			Percent		
	Male	Female	Total	Male	Female	Total
Number of whales observed	244	85	329	100.0	100.0	100.0
None	25	36	61	10.2	42.4	18.5
Very few	124	24	148	50.8	28.1	45.0
Few	62	14	76	25.4	16.5	23.1
Many	30	11	41	12.3	13.0	12.5
Numerous	3	0	3	1.3	0	0.9

In Female "none" was 42 percent of total female; and in male, only about 10% had "none", but "very few" was about 50%. According to Matthews, all sperm whales found in the southern hemisphere have white scars, though in varying degrees. In this respect, therefore, sperm whales in the adjacent seas of Japan are different.

Matthews further stated that sperm whales had fewer white scars than Rorqual. The same seems to be true in the adjacent seas of Japan, for sperm whales generally have fewer white scars than sei or fin whales.

c. External parasites.

As in the case of other whales, Cyamus, Coronula, Conchoderma, Pennela and diatom were found as external parasites on sperm whales. 3 sperm whales in the Bonin Island area, 2 in the Ayukawa-Kamaishi area and 1 in the Kushiro-Kiritappu area, were infected with Cyamus sp.

Only 1 whale caught in the Ayukawa area, was infected with coronula sp. on the lower jaw, the number being 8.

Sometimes the functional teeth of the lower jaw are infected with Conchoderma sp. Such was the case with 3 whales in the Bonin Island area and 1 each in the Ayukawa-Kamaishi area and the Kushiro-Kiritappu area.

Pennella sp. was found to be most numerous, especially in the Bonin Island area, where 18 whales were infected with it. 6 whales were infected with it in the Ayukawa-Kamaishi area and none in the Kushiro-Kiritappu area. The number of Pennella sp. was usually not over 10, but, in the Bonin Island area there was one whale with about 50. Diatoms in the form of small patches were found on only 7 whales in the Ayukawa-Kamaishi area.

d. Number of teeth.

With regard to the functional teeth of lower jaw, their number was recorded separately for right and left side for 266 males and 119 females. The results are as shown in Table 42.

Table 42. Sperm whale. Number of functional teeth.

Number of teeth	Male		Female	
	Right side	Left side	Right side	Left side
17	2 (0.8)	3 (1.1)	0	0
18	3 (1.1)	1 (0.4)	0	1 (0.8)
19	4 (1.5)	7 (2.6)	2 (1.7)	3 (2.5)
20	17 (6.4)	16 (6.0)	12 (10.1)	9 (7.6)
21	28 (10.5)	33 (12.4)	17 (14.3)	21 (17.7)
22	37 (13.9)	35 (13.2)	30 (25.2)	28 (23.5)
23	60 (22.6)	60 (22.6)	28 (23.5)	23 (19.3)
24	53 (19.9)	54 (20.3)	17 (14.3)	21 (17.7)
25	36 (13.5)	29 (10.9)	9 (7.6)	8 (6.7)
26	16 (6.0)	15 (5.6)	2 (1.7)	4 (3.4)
27	8 (3.0)	9 (3.4)	1 (0.8)	0
28	2 (0.8)	3 (1.1)	1 (0.8)	1 (0.8)
29	0	1 (0.4)	0	0
Total	266 (100.0)	266 (100.0)	119 (100.0)	119 (100.0)

Note : Figures in parenthesis show the percentage.

The fewest was 17, and most numerous 29. They are chartred in Figs. 57 to 58.

Fig. 57. Sperm whale. Occurrence of functional teeth. Male.

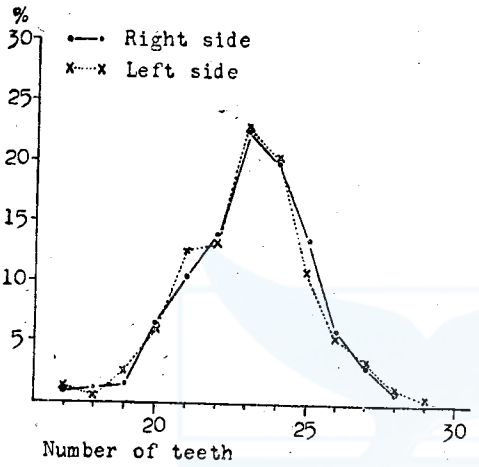
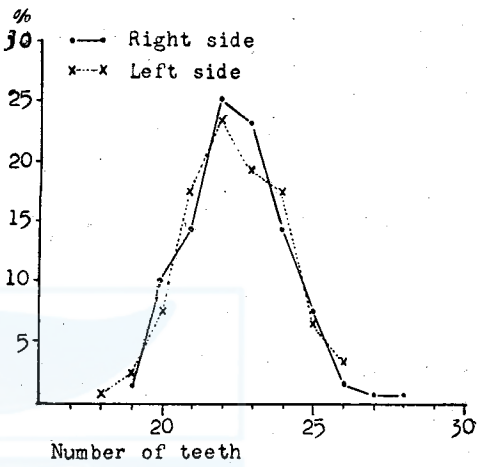


Fig. 58. Sperm whale. Occurrence of functional teeth. Female.



Though there is some difference between right side and left side, that difference is so slight as to be negligible. The males had a few more than the females, the most common for males being 23, and 22 for females, for both the right and left sides.

There were also a greater percentage of males than females that had 25 or more teeth. On the contrary, the percentage of those with 20 or less was greater among the females. Accordingly it can be safely said that in general, the number of functional teeth of sperm whales is larger for male than for female. This is probably related to the fact that males grow larger in length than females. Rudimentary teeth of upper jaw were observed for 263 males and 118 females. The results are as shown in Table 43.

About 80 % of whales observed were formed to have no rudimentary teeth at all.

The number of teeth of sperm whales in the Antarctic Ocean was observed by Matthews, Matsura and Omura. Regarding the functional teeth of male, there was no remarkable difference, but as for rudimentary teeth, the occurrence in the southern hemisphere was nearly 50 %, or far greater than that in the adjacent waters of Japan. In the Antarctic, principally

Table 43. Sperm whale. Number of rudimentary teeth.

Number of teeth	Male		Female	
	Right side	Left side	Right side	Left side
0	200 (76.0)	212 (80.6)	96 (81.4)	97 (82.4)
1	18 (6.8)	16 (6.1)	5 (4.2)	3 (2.5)
2	18 (6.8)	13 (4.9)	3 (2.5)	5 (4.2)
3	10 (3.8)	2 (0.8)	4 (3.5)	4 (3.5)
4	7 (2.7)	8 (3.0)	2 (1.7)	3 (2.5)
5	2 (0.8)	4 (1.6)	4 (3.5)	3 (2.5)
6	1 (0.4)	0	1 (0.8)	1 (0.8)
7	5 (1.9)	3 (1.1)	1 (0.8)	1 (0.8)
8	1 (0.4)	1 (0.4)	1 (0.8)	0
9	0	1 (0.4)	0	0
10	0	0	1 (0.8)	1 (0.8)
11	1 (0.4)	3 (1.1)	0	0
Total	263 (100.0)	263 (100.0)	118 (100.0)	118 (100.0)

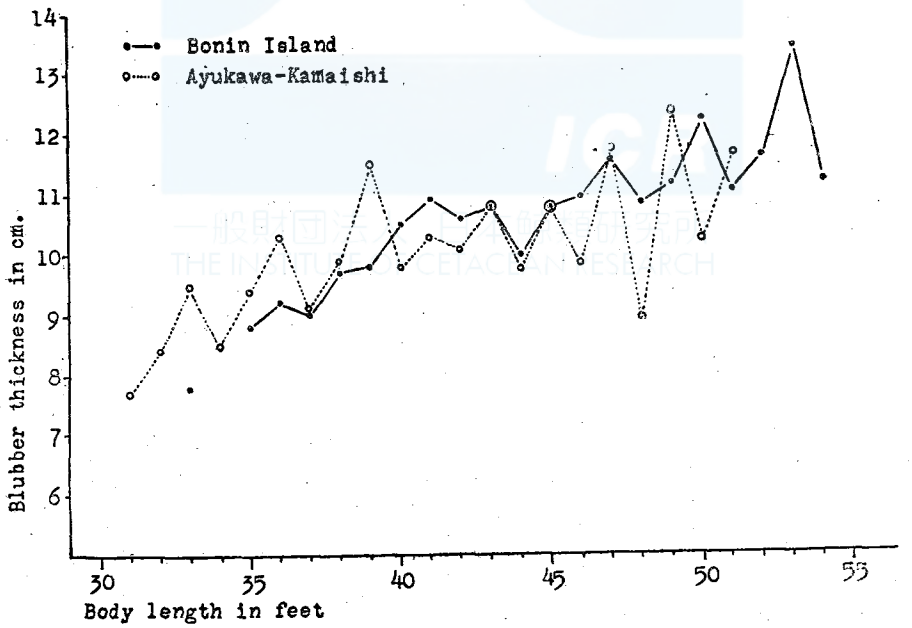
Note : Figures in parenthesis show the percentage.

southern hemisphere, however, extremely few females were observed; so there is little basis for comparison. Rudimentary teeth were usually small in number, both for male and for female. The largest number was 11.

e. Thickness of blubber.

Thickneness of blubber was measured for 349 males, and 181 females. As in the case of other whales, the measurement was taken at two points,

Fig. 59. Sperm whale. Blubber thickness. Male.



1 and 2. In this report, only the thickness at Point 1 is given, for point 2 varied too much by individuals.

The averange thickness for each body length by area was as shown in Fig. 59.

Sperm whales both in the Bonin Island area and in the Ayukawa-Kamaishi area increase thickness of blubber with increase in body length. Bonin area whales less than 40 ft. seem to have thinner blubber and those of 45 ft. or longer seem to have thicker blubber than whales of comparable size in the Ayukawa-Kamaishi area. But whether such is the case is doubtful. The chances are that there is no difference between areas. Fewer females than males were observed, and a considerable number of them were pregnant or lactating. So if these were to be divided into areas, the number of whales of each body length observed would become so small as to render their comparison of little measuring. So instead of dividing into areas, observed values divided into pregnant, lactating and resting and others, were plotted in Fig. 60.

Fig. 60. Sperm whale. Thickness of blubber. Female.

As seen in this figure, blubber was 6 cm and over in thickness, with

only one exception. The thickest was 13 cm; but that was exceptional,—the majority being not more than 10.5 cm. Still, it can be seen that there were considerable individual variations. And it can also be seen that there was no particularly thick or thin blubber in pregnant and lactating whales. In female sperm whales, in other words, thickness of blubber seems to depend less upon whether they are pregnant, lactating or resting, than upon other conditions, e. g. the food situation.

Fig. 61. Sperm whale. Male. Blubber thickness expressed as percentage of total length, by months.

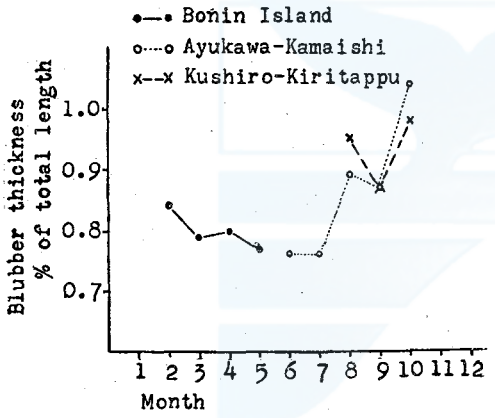
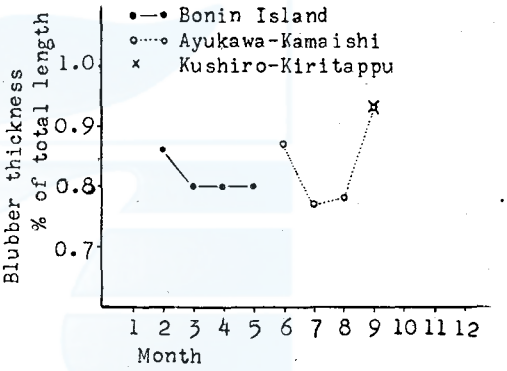


Fig. 62. Sperm whale. Female. Blubber thickness expressed as percentage of total length, by months.



Figs. 61 and 62 show average blubber thickness expressed as percentage of total length by months.

Fig. 61, which is concerned with males, show that blubber tends to get thicker in males after August.

From the point of view of area, the Kushiro-Kiritappu area shows the thickest blubber. Fig. 62 is for female excluding those pregnant and lactating. In the Bonin Island area, nearly same trend as for male is seen,—blubber being the thickest in February and then getting thinner. The different trend from male in the Ayukawa-Kamaishi area is probably due to the small number of whales observed. In the Kushiro-Kiritappu area, blubber was measured only in Sept. It seems the thickest in Sept., as in the case of males.

f. Food.

Food was observed for 215 sperm whales in the Bonin Island area,

302 in the Ayukawa-Kamaishi area and 38 in the Kushiro-Kiritappu area. The results are as shown in Table 44. Sperm whales in the Bonin Island area most often had food in their stomach. The Kushiro-Kiritappu area can not be compared directly with other areas, because of small number of whales observed.

Table 44. Sperm whale. Stomach contents.

	Bonin island	Ayukawa-Kamaishi	Kushiro-Kiritappu
Number of whales observed	215	302	38
Empty	71 (33.0)	125 (41.4)	21 (55.3)
Little	59 (27.4)	113 (37.4)	12 (31.6)
Moderate	51 (23.7)	54 (17.9)	4 (10.5)
Rich	28 (13.0)	9 (3.0)	1 (2.6)
Full	6 (2.9)	1 (0.3)	0

Note : Figures in parenthesis show the percentage.

In the Bonin Island area, whales with empty stomachs were few in number, and among those that contained some food, a few had "little", and those with "moderate" food were the most numerous. In the other areas, on the contrary, there those with little food were the most numerous. In the Bonin Island area, moreover, there were 10 % more whales with rich food than in the other 2 areas.

Stomach contents for each area and month are shown in Tables 45 to 47.

Table 45. Sperm whale. Monthly variation of stomach contents. Bonin island.

	February	March	April	May
Number of whales observed	48	86	43	38
Empty	21 (43.8)	30 (34.9)	8 (18.6)	12 (31.6)
Little	12 (25.0)	28 (32.5)	11 (25.6)	8 (21.1)
Moderate	11 (22.9)	16 (18.6)	15 (34.9)	9 (23.7)
Rich	3 (6.3)	9 (10.5)	8 (18.6)	8 (21.1)
Full	1 (2.0)	3 (3.5)	1 (2.3)	1 (2.5)

Note : Figures in parenthesis show the percentage.

As seen in these tables, when divided into each month, the number of whales observed becomes too small to give an accurate picture of the situation. Especially is that true of the Kushiro-Kiritappu area. From

Table 46. Sperm whale. Monthly variation of stomach contents. Ayukawa-Kamaishi

	June	July	Aug.	Sept.	Oct.
Number of whales observed	67	115	62	38	20
Empty	26 (38.8)	55 (47.8)	23 (37.1)	14 (36.8)	7 (35.0)
Little	20 (29.9)	33 (28.7)	33 (53.2)	20 (52.6)	7 (35.0)
Moderate	16 (23.9)	23 (20.0)	5 (8.1)	4 (10.5)	6 (30.0)
Rich	4 (6.0)	4 (3.5)	1 (1.6)	0	0
Full	1 (1.4)	0	0	0	0

Note : Figures in the parenthesis show the percentage.

Table 47. Sperm whale. Monthly variation of stomach contents. Kushiro-Kiritappu

	August	September	October
Number of whales observed	7	21	10
Empty	1 (14.3)	15 (71.4)	5 (50.0)
Little	3 (42.8)	4 (19.0)	5 (50.0)
Moderate	2 (28.6)	2 (9.6)	0
Rich	1 (14.3)	0	0
Full	0	0	0

Note : Figures in parenthesis show the percentage.

these tables, however, the following may be said:

In the Bonin Island area, though the food is not so abundant in February, it becomes richer till April and decreases again in May.

In the Ayukawa-Kamaishi area, food is most abundant in June. In the Kushiro-Kiritappu area, the number of whales observed was too small to permit of their discussion. Since the above mentioned facts do not agree with the variations of blubber thickness, any definite conclusions will have await the results of future investigations.

In all areas, as shown in Fig. 48, most of the food was squid; and octopus, rock cod, and cod were found only in a few instances. But the

Table 48. Sperm whale. Kind of food.

	Bonin island	Ayukawa-Kamaifhi	Kushiro-Kiritappu
Squid	136	170	170
Octopus	8	2	0
Menuke (Rockcod)	0	4	0
Cod	0	1	0

instances in which these lattey items were found mixed with squids were quite numerous.

g. Genitalia and maturity.

Ovary of 152 sperm females was observed. As in baleen whales, sperm whales with more than 1 corpus luteum in their ovary may be regarded as mature and those with none may be regarded as immature. As a result of the investigation, almost all whales were found to be mature, — there being only 3 immature, of which 1 was 30 feet long and 2 31 feet long and 2 31 feet in length. There were, on the other hand, 2 mature whales 30 ft. long and 12 mature whales 31 ft. in length; also of 28 ft. and 2 of 29 ft. which also were mature. Sperm whales, therefore, probably come to sexual maturity at the body length of 30 ft. or under. Under the "International Convention for the Regulation of Whaling", the minimum body length of sperm whales which may be caught in fixed at 35 ft. So, in future, catching of immature whales should almost disappear. It is not exactly known at how many feet female sperm whales come to sexual maturity. According to Matthews, that figure is from 9 meters to 9.5 meters (28′ 6″—31′ 2″). As stated above, of the sperm whales 31 feet long found in the adjacent seas of Japan, there were more mature than immature ones. So it would appear that they reach sexual maturity at 30 ft. or a little under it.

Weight of ovary is shown in Fig. 63. Ovary without functional corpus luteum is generally not more than 0.6 kg. in weight. Ovary with functional corpus luteum was of course heavier, but generally not more than 1.2 kg. There was, however, one exceptional instance of 2.0 kg. In immature whale the ovary was under 0.2 kg. in weight.

Number of corpora lutea (right and left totalled) is shown in Fig. 64.

Among whales 36 ft. or over in body length, there was only 1 instance in which the number of corpora lutea was less than 5. But among whales up to 35 ft. long there were quite a number that had less than 5. This fact means that female, sperm whales grow rapidly to 35 ft. in length after reaching to sexual maturity, but do not grow to 36 ft. or over till a certain period has elapsed after attaining sexual maturity. This "certain period" is the period during which ovulation takes place 5 times; but exactly how many years that covers is not known. But that period can hardly be so short as 1 year, because some whales with 1 or 2 corpora lutea were

Fig. 63. Sperm whale.
Weight of ovary.

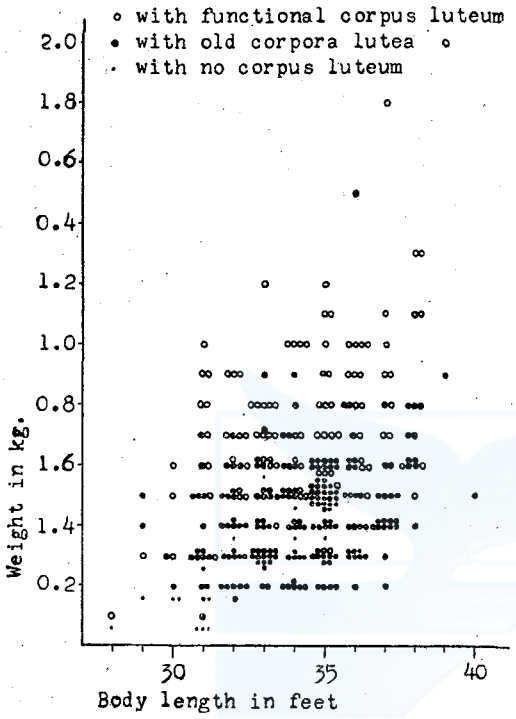
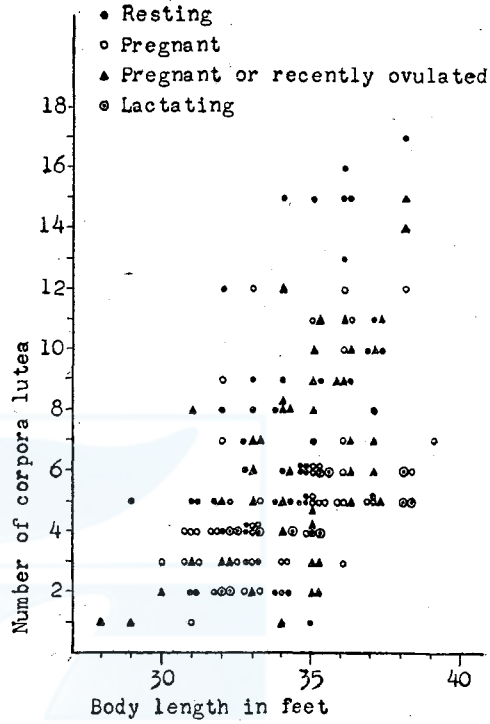


Fig. 64. Sperm whale.
Number of Corpora lutea.



pregnant, and among those with 3 or 4 corpora lutea there were more pregnant or lactating than those resting and pregnant or recently ovulated. In any case, they probably attain a length of 36 ft. and over after several parturitions after a certain period has elapsed subsequent to attainment of sexual maturity. Considered from that point of view, the prohibition on the catching of sperm whale less than 35 ft. is a very effective one.

Fig. 65 shows the frequency of number of corpora lutea.

As seen in this figure, number of whales with only 1 corpora lutea was small and increased gradually up to those with 5, then decreased again. The maximum was 17 in number.

Fig. 66 shows the thickness of mammary gland. The thickness ranges widely from 2 cm to 15 cm. Many lactating whales were found among those with blubber thicker than 10 cm; but there was also a considerable number of whales not lactating whose blubber was 10 cm or more in thickness. From Fig. 66, it would appear that even after the completion of the lactating stage, mammary gland of sperm whales does not contract so ra-

Fig. 65. Sperm whale. Frequency of Number of corpora lutea.

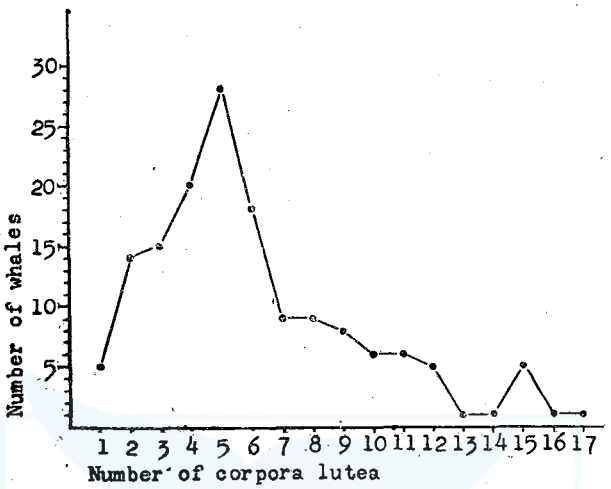
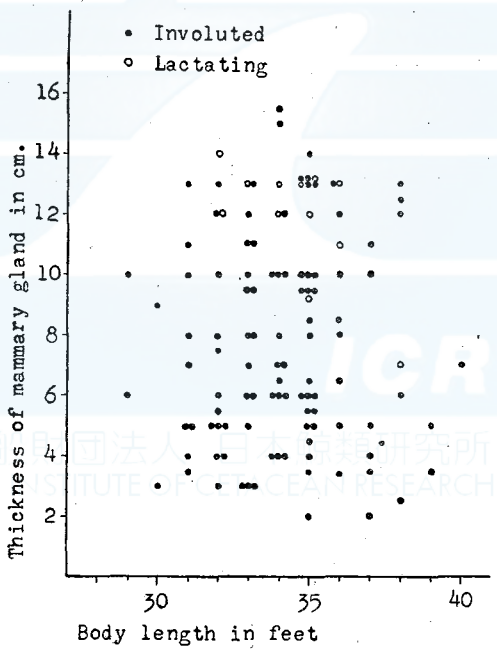


Fig. 66. Sperm whale. Thickness of mammary gland.

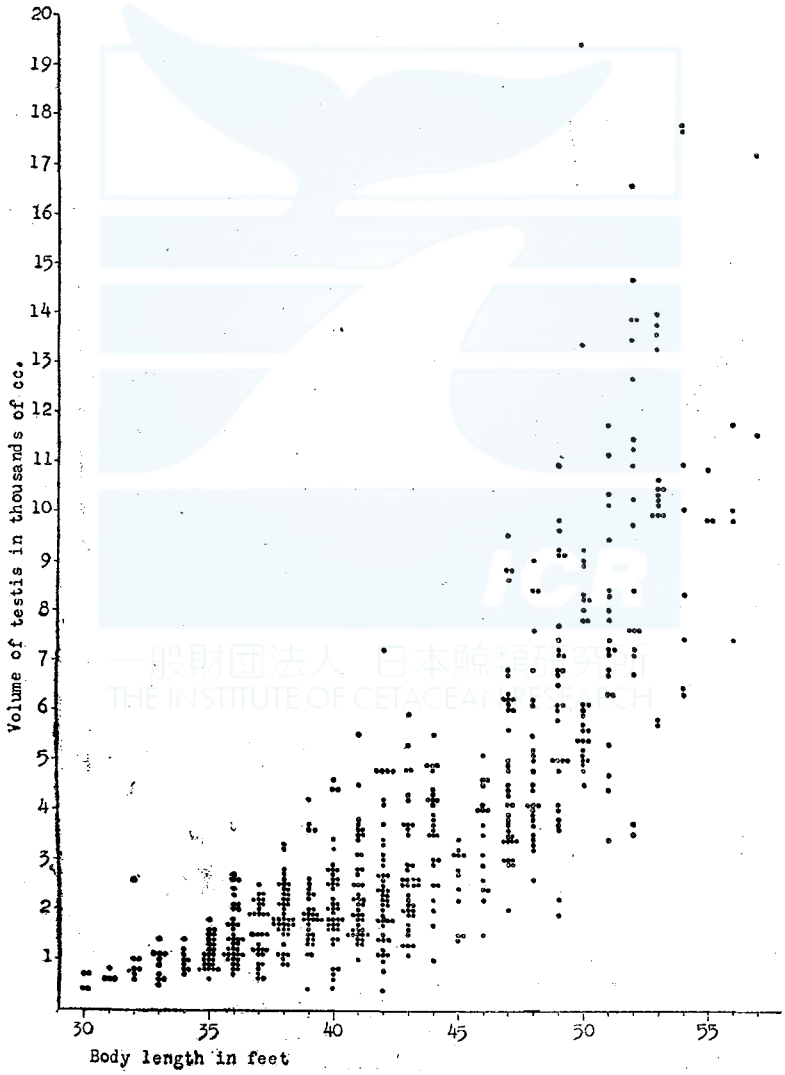


pidly, and that a considerable period elapses before a state of complete involution is reached.

In the case of males, the volume and weight of testis were measured. In Figs. 67 and 68, they were plotted for each body length. Both volume

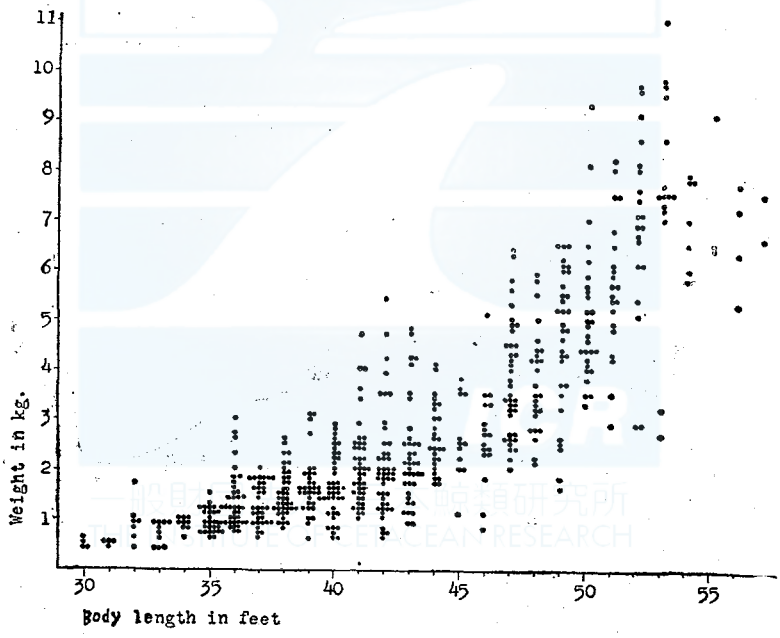
and weight of testis increases with body length, at least up to 53 ft. Among the few of 54 ft. and over that were observed, this tendency was not found. In the other species of whales, the volume and weight of testis increase suddenly at sexual maturity; and after that they have almost no relation to body length. Sperm whales differ on that point, for the volume and weight of testis increased at a certain ratio in proportion to the increase of body length up to 53 ft, instead of increasing suddenly at sexual maturity. Consequently it is impossible to divide sperm whales into mature and immature through measurement of volume or weight of testis alone.

Fig. 67. Sperm whale. Volume of testis.



Microscopic investigation is absolutely necessary for that. Such investigation could not be made in the past for various reasons; but it is hoped to carry out such microscopic study hereafter in order to ascertain that point. According to Matthews, sperm whales found in the Southern hemisphere come to sexual maturity at the length of 11.5 m to 12.5 m (37′ 9″—41′ 0″). As in case of female, the body length at sexual maturity for male whales in the Antarctic is nearly the same as those in the adjacent seas of Japan. According to Matuura's observation for sperm whales caught by the Tonan-maru in the Antarctic Ocean in 1941, males reach sexual maturity at the length of 42 ft. That was based on observations with the naked eye; and the number of whales observed, moreover, was not so large, so that his conclusion can hardly be definite. The chances are, however, that 42 ft. is not very far from the correct figure.

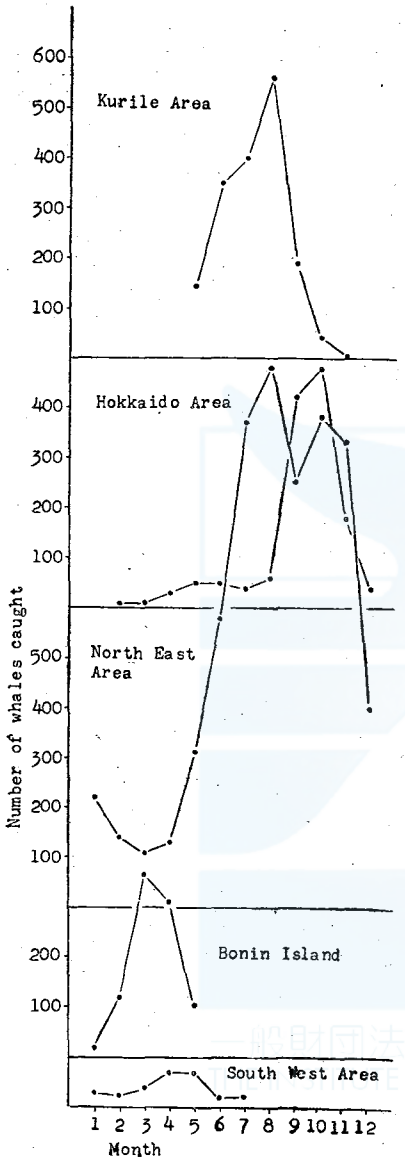
Fig. 68. Sperm whale. Weight of testis.



h. Migration and Stock.

Fig. 69 shows monthly catch in each area on the basis of the past 18 years whaling data. The Bonin Island area has its peak in March. It is regularly about 20 Feb. that the so-called "harems" migrate there. So, no female is caught until that time. The North east area is the area where

Fig. 69. Sperm whale. Monthly catch in different areas.



the most numerous sperm whales are caught, and it is here that harems come together. The best catch is seen from July to November. In the Kurile area the peak is in August. Harems do not migrate there so often. Most of the sperm whales caught are males, — females being only about 10 % of the total. When the Tonan-maru operated in the Northern waters in 1940 and 1941, the most northern area in which sperm whales were caught was Lat 60°-50'N. It therefore appears that sperm whales do not migrate to such high lattitudes in the northern hemisphere as they do in the southern hemisphere. As in the Southern hemisphere, females do not migrate to such high latitudes. In the "Tonan-maru"'s operation, the northern most point at which female sperm whales were caught was Lat. 51° N. Consequently, the northern limit for harems is probably about there. They stay in the Kurile area and north of it till about August, and then most of them migrate south. The fact that the catches in the Hokkaido area are outstandingly large in Sept. and Oct. is indication that sperm whales, like the fin and sei whales, are caught in that area after coming there from waters further north. Sperm whales were caught in some years even in Okhotsk sea; these were all large males. They migrated there through the straits between the Kurile Islands, and were caught in the vicinity of the straits. It is said that these whales do not enter the Okhotsk sea through these straits where whaling operations are being carried on from landstations on the Kurile Islands. The best season in the South west area is April and May, though

the catch is less than in other areas. Some sperm whales are caught in the West Kyushu area, where the best season is May. None are caught around Korea. Also at Senzaki, the entrance to Japan Sea, a few sperm whales are caught. So while it may be said that a few enter Japan Sea via. west coast of Kyushu, the majority of Sperm whales in the adjacent seas of Japan migrate along the Pacific side of Japan from the Bonin Islands to the North East area, Hokkaido, and the east coast of Kamchatka Peninsula, with a part migrating to the south west area also. A few sperm whales have been caught in Formosa also.

Fig. 70. Sperm whale. Variation of catch.

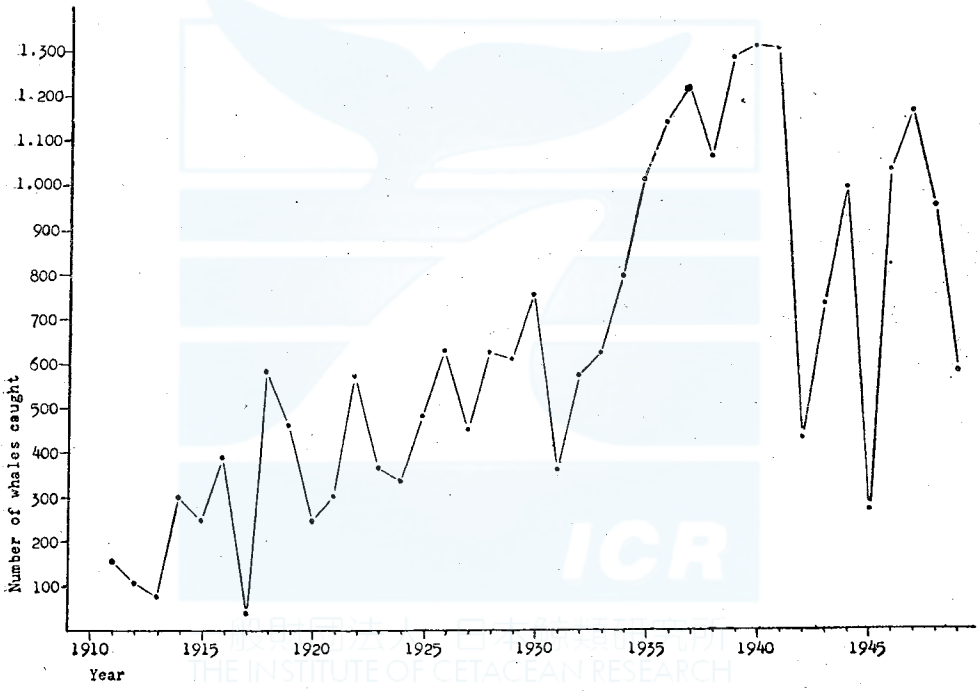
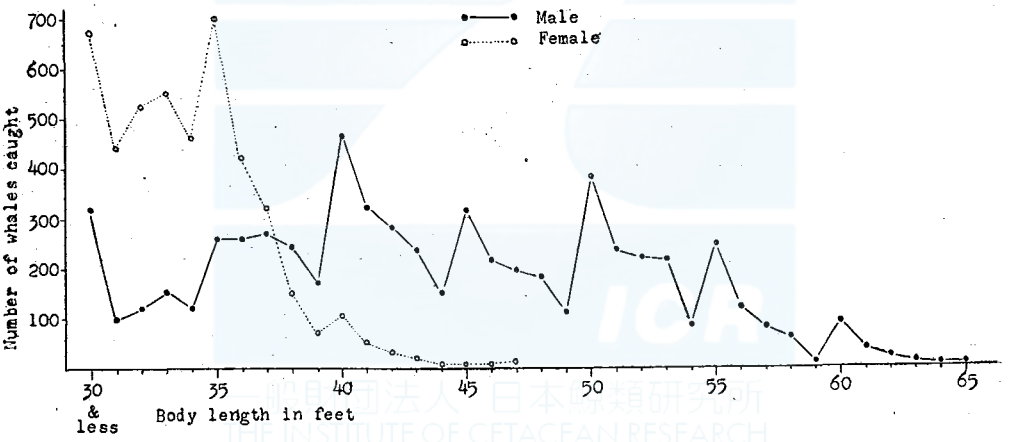


Fig. 70 shows annual number of sperm whales caught since 1911. Unlike in the case of baleen whales, catch of sperm whales increased remarkably during this period, with its maximum in 1939 and 1940. In the years following that peak, there was some drop due to suspension of operations in Kurile Islands after the War. The notable decrease in 1949 is due mainly to the change in the size limit from 30 ft. to 35 ft. Although we have no basic figure at present pertaining to sperm whale stock, there is pro-

bably no fear of a decrease. For while female sperm whales come to maturity at the body length of 30 ft. or under, catching of whales less than 35 ft. long is prohibited. Consequently there is no longer any possibility of immature sperm whales being caught. Moreover, sperm whales, unlike baleen whales, are polygamous. Many harems come into that part of the north east area commonly known as the Kinkazan coast, and females of those harems were often caught there in the past. But, such instances greatly reduced as a result of the raise in the minimum body length to 35 ft. And while this change in the limit on body length should, as already stated, prove immensely beneficial from the standpoint of stock conservation, its effect on the Japanese whaling industry is quite damaging.

On the basis of the last 18 years' whaling data, size distribution is shown separately for males and females in Fig. 71. To be especially noted from this figure is the fact that catches of females under 35 ft. were quite numerous in the past.

Fig. 71. Sperm whale. Size distribution of whales caught in past 18 years.



SUMMARIZED CONCLUSIONS

Biological observation was made for a total of 1,785 whales from among those caught in the adjacent waters of Japan in 1948 and 1949. On the basis of these data, supplemented by past whaling data, the following conclusions were drawn:

1. Body length at sexual maturity.

It is shorter for sei whales of Japan than for those of the Antarctic and shows variation, by localities, as follows.

Area	Male	Female
Bonin Island	40 ft.	41 ft.
Ayukawa-Kamaishi	42	44
Kushiro-Kiritappu	43	45

The whales in the Ayukawa-Kamaishi area and those in the Kushiro-Kiritappu area, although showing a slight difference in body length probably belong to the same stock. But since those in the Bonin Island area are clearly distinguishable, sei whales located in the adjacent seas of Japan should probably be classified into 2 local races, southern and northern. Fin whales of Japan, too, are smaller than those of the Antarctic. Males come to sexual maturity at the length of 58 ft. or 59 ft, and females at 60 ft. or 61 ft.

As for blue whales, it is believed that they are a little smaller than in the Southern hemisphere, although no definite statement can be made on that point because of the small number of whales observed. Sperm whales probably show no difference between the adjacent seas of Japan and the Antarctic.

For humpback whales, no conclusion can be drawn, due to the small number of whales observed.

2. As for migration, there are two routes, viz. east side (Pacific side) and west side (Japan sea side) of Japan. Fin whales migrate through these two routes, but most of the other whales take the east side route only, while a very few migrate from Korean waters to Okhotsk sea through Japan Sea. The southern migration limit is not clear, but the northern limit seems to be :

For blue whales, Lat 52°N.

For fin whales, the Arctic through Behring strait.

Humpback whales are seldom seen along the east coast of Kamchatka Peninsula, but are found in considerable numbers in the Arctics north of Behring strait.

It is unknown whether those that migrate into the Arctics belong to the same group as those of Japan or to the American group.

For sei whales, Lat. 56°N. But as stated already, they can probably be classified into two local races, northern and southern. Most of the

southern race seem to stay around Oshima and areas west of it instead of migrating very far north, though a small part of them seem to migrate to the Ayukawa-Kamaishi area or the Kushiro-Kiritappu area.

For Sperm whales, Lat. 60°-50′ N; but the females do not go much beyond Lat. 51°N.

3. About all that we can know about the stock, on the basis of past whaling statistics is the general trend. But it is clear that Blue, Fin and Humpback whales have decreased. Sei and sperm whales do not show a downward trend. As the present body length limit for sperm whales fixed by "International Convention for the Regulation of Whaling" is 35 ft., the protection of females is nearly perfect. But as many immature sei whales are caught in areas other than the Bonin Islands, some protective measures may be necessary.

4. In other to the above points, body colour, external parasites, food and thickness of blubber were studied. Although nothing has been said regarding growth, that is to be studied in the future.

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