

Sei Whales in the Adjacent Waters of Japan.

II. Further Studies on the External Characters.

By

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Introduction

Omura, Nishimoto and Fujino (1952) stated, after investigating the body proportions and other characters of the sei whales taken in the waters adjacent to Japan, that two types of sei whales, namely the northern and the southern types, are both found in the adjacent waters of Japan. They concluded further that the former belong to the ordinary sei whales (*Balaenoptera borealis*) but the latter are more related to the bryde's whales (*B. brydei*) than the ordinary sei whales. As the most distinct differences between the two types in the external characters are (1) the shape and the quality of the baleen plates and (2) the extent of the ventral grooves, the present authors made further investigations mostly on these two points, results of which are reported in the present account.

We are much indebted to the Japanese government whaling inspectors and the staff of the whaling companies who cooperated in the present investigations. Our sincere thanks are due to Dr. F. C. Fraser of the British Museum (Natural History), who kindly gave Omura a chance to read some literatures kept in that museum while the latter stayed in London.

Material

We made the following scheme of investigation prior to the commencement of the whaling season for baleen whales 1952 in the adjacent seas of Japan.

1. A biggest baleen plate should be taken from right or left row of each sei whale captured and such baleen plates should be sent to the laboratory with the particulars of the said whale for the identification of the two types and for the measurement of their length and breadth.
2. The extent of the ventral grooves of each whale should be observed, classifying the following three classes.

The ventral grooves end

- (a) anterior to the umbilicus,
- (b) at the umbilicus, and
- (c) posterior to the umbilicus.

Baleen plates were taken for the investigation from almost all sei whales caught by the pelagic whaling in the waters around Bonin Island and in the northern Pacific. However, regarding those of sei whales processed at the various land stations only about forty per cent of the total catch were sent to the laboratory. Furthermore, some plates were broken in their inner parts in the course of transportation, especially in those taken in the Bonin Island waters. Besides, in some plates the margin line of the gum were not clear because of the carelessness at the time of sampling. Such baleen plates were of course available for the identification of the two types, but were not of use for the measurements. Table I shows the total number of sei whales taken in 1952 and those of which baleen plates were measured.

Table 1. Number of Sei Whales taken and Number of Baleen Plates measured in 1952.

Geographical Areas	Number of Sei Whales taken			Number of Baleen Plates measured		
	Males	Females	Total	Males	Females	Total
Bonin Island (Pelagic)	270	141	411	164	101	265
Coastal	275	390	665	94	141	235
Northern Pacific (Pelagic)	8	6	14	4	4	8
Total	553	537	1,090	262	246	508

As shown in this table, about a half of the total sei whales catch in the waters of Japan, Bonin Island and northern Pacific (pelagic) were measured of their baleen plates.

Observations on the extent of the ventral grooves were made by Mr. K. Ozaki and Mr. I. Hasegawa, whaling inspectors of the Japanese Government on the factory ship which operated in the Bonin waters. In the northern Pacific (pelagic), such observations were made by Fujino. We were not able, however, to send any biologist for a long period to any land stations, so we asked to the staff of the each land station to make such observation.

Analysing these data obtained, we classified at first the sei whales into two types based on the observation of the baleen plates, because this character was deemed as first essential, and then we investigated the extent of the ventral grooves. We rejected such data of the ventral grooves of whale which was not observed firstly by ourselves for identification of the two types according to baleen plate, in the course

of the analysing. We only used, therefore, such data of whales of which baleen plates were observed by ourselves and sometime the observation of the ventral grooves were available. Table 2 shows the number of sei whales on which the both observation were made.

As shown in tables 1 and 2, only 14 per cent of the total sei whales processed at the whaling land stations were observed on the both characters, while almost all sei whales were investigated in the Bonin Island waters and in the northern Pacific (pelagic).

Table 2. Number of Sei Whales of which Baleen Plates and the Extent of the Ventral Grooves were observed in 1952.

Geographical Areas	Males	Females	Total
Bonin Island (Pelagic)	268	139	407
Coastal	43	49	92
Northern Pacific (Pelagic)	8	6	14
Total	319	194	513

Baleen Plates

Omura, Nishimoto and Fujino (1952) describe that the baleen plates of sei whales taken in the Bonin Island waters are shorter in length, coarse in texture, greyish black in colour and with thick bristles as compared with those of ordinary sei whales. It was thought at that time that there might appear some intermediate type of baleen plates if we conduct further investigation in future. While investigating, however, the material of 1952, we could not find any of such intermediate type. All baleen plates were identified clearly as northern type (sei whale type) or southern type (bryde's whale type) without any exception. No hesitation was felt while identifying the both types.

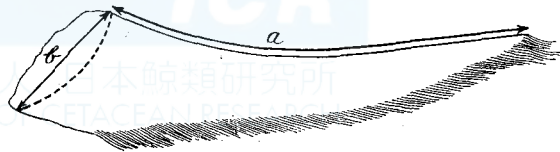


Fig. 1 Measurements of baleen plates. Dotted line shows the margin of gum.
a: length along the outer margin
b: breadth at base

The length and the breadth of each baleen plate was measured in centimeter. As shown in Fig. 1, the length was measured along the outer edge of the baleen plate from the point on the outer edge at the insertion to the gum to the tip of the plate, excluding the length of

the bristles. The breadth was measured by straight line between the two points on the outer and inner edge at the insertion to the gum.

The results of the measurements were dotted in Figs. 2 and 3, separately by sex.

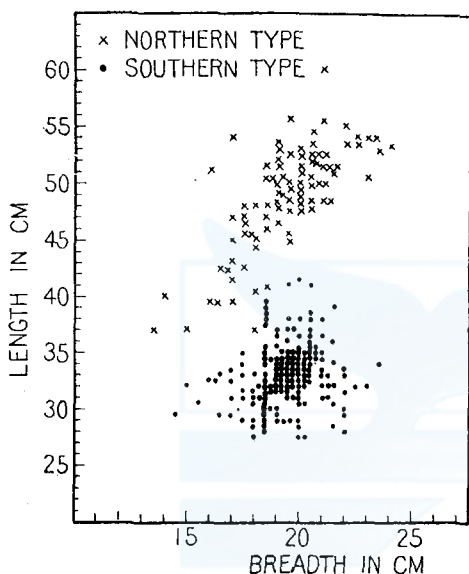


Fig. 2. Relation between length and breadth of baleen plates in sei whales. Males

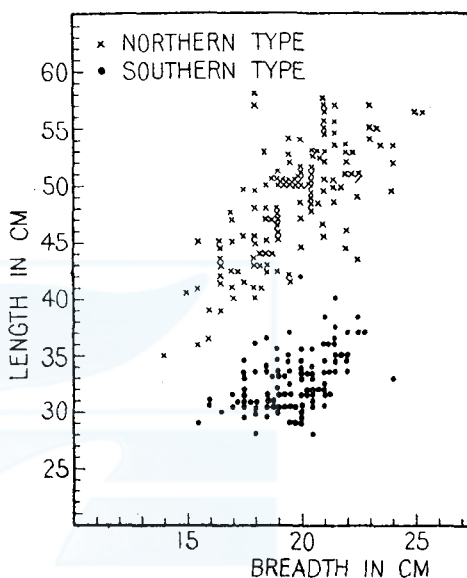


Fig. 3. Relation between length and breadth of baleen plates in sei whales. Females

As shown in these figures, the two types of northern and southern are almost completely separated into different groups in the shape of the baleen plates, both in males and females.

Then we calculated the quotient of the length divided by the breadth in each baleen plate. Table 3 shows the occurrence of each of such quotient (L/B). Figures 4 and 5 were drawn based on the data listed in table 3.

Judged from the above table and figures, the two types of northern and southern are also divided into two different groups nearly completely and we can say in general that the length of the baleen plate is over two times of its breadth in the northern type, while below two times in the southern type. No difference is seen between male and female.

Further, a difference is seen in the shape of the palate between northern and southern types.

As clearly shown in Figures 6 and 7, the breadth of the palate is

broad and slightly concaved inward in the middle part of it in the southern type, but the breadth is very narrow and convexed outward considerably in its posterior part in the northern type sei whale. This

Table 3. Quotient of Length/Breadth of Baleen Plates in Sei Whales.

L/B	Southern Type			Northern Type		
	Males	Females	Total	Males	Females	Total
1.20-1.29	1	0	1	0	0	0
1.30-1.39	6	2	8	0	0	0
1.40-1.49	9	6	15	0	0	0
1.50-1.59	24	22	46	0	0	0
1.60-1.69	43	30	73	0	0	0
1.70-1.79	40	24	64	0	0	0
1.80-1.89	18	13	31	0	0	0
1.90-1.99	11	7	18	0	1	1
2.00-2.09	10	1	11	1	3	4
2.10-2.19	4	1	5	0	5	5
2.20-2.29	0	0	0	6	14	20
2.30-2.39	0	0	0	13	29	42
2.40-2.49	0	0	0	22	17	39
2.50-2.59	0	0	0	21	30	51
2.60-2.69	0	0	0	17	22	39
2.70-2.79	0	0	0	8	11	19
2.80-2.89	0	0	0	4	2	6
2.90-2.99	0	0	0	0	3	3
3.00-3.09	0	0	0	1	0	1
3.10-3.19	0	0	0	3	2	5
3.20-3.29	0	0	0	0	1	1
Total Number	166	106	272	96	140	236
Geographical areas :—						
Bonin I.	164	101	265	0	0	0
Coastal	2	5	7	92	136	228
N. Pacific	0	0	0	4	4	8

difference is seemed a very essential external character beside others such as the baleen plate and the extent of the ventral grooves, and not the individual difference, though it is not recorded in quantities.

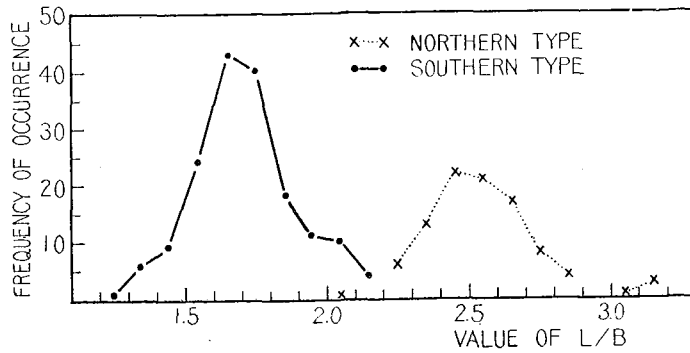


Fig. 4. Value of Length/Breadth of baleen plates in Sei whales. Males.

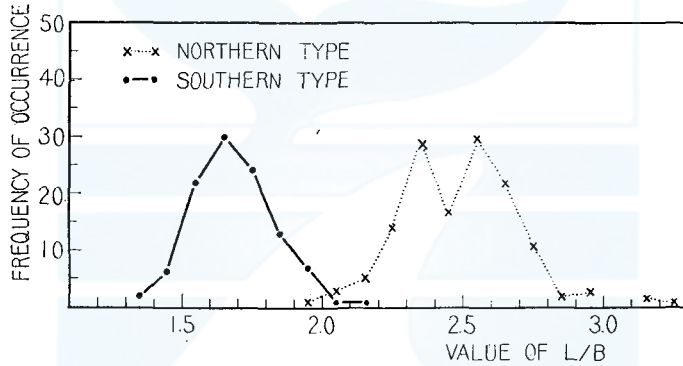


Fig. 5. Value of Length/Breadth of baleen plates in sei whales. Females.

Ventral Grooves

As already stated, we classified at first the sei whales taken in 1952 into two types according to their baleen plates and then we studied the extent of the ventral grooves, classifying in three groups. Table 4 shows its result.

According to table 4, the ventral grooves end anterior to umbilicus in all of the northern type sei whales and no exception is seen. The fact that the ventral grooves end anterior to umbilicus is one character of *Balaenoptera borealis* and our data well agree with those reported by Matthews (1938) concerning the sei whales in the southern hemisphere. Andrews (1916) describes, after investigating the sei whales of Japan, that the ventral furrows of *B. borealis* are present on the throat, breast and abdomen, but instead of extending posteriorly to the umbilicus,



Fig. 6. Palate of a sei whale. Processed at Taiyo Akkeshi land station. Northern Type

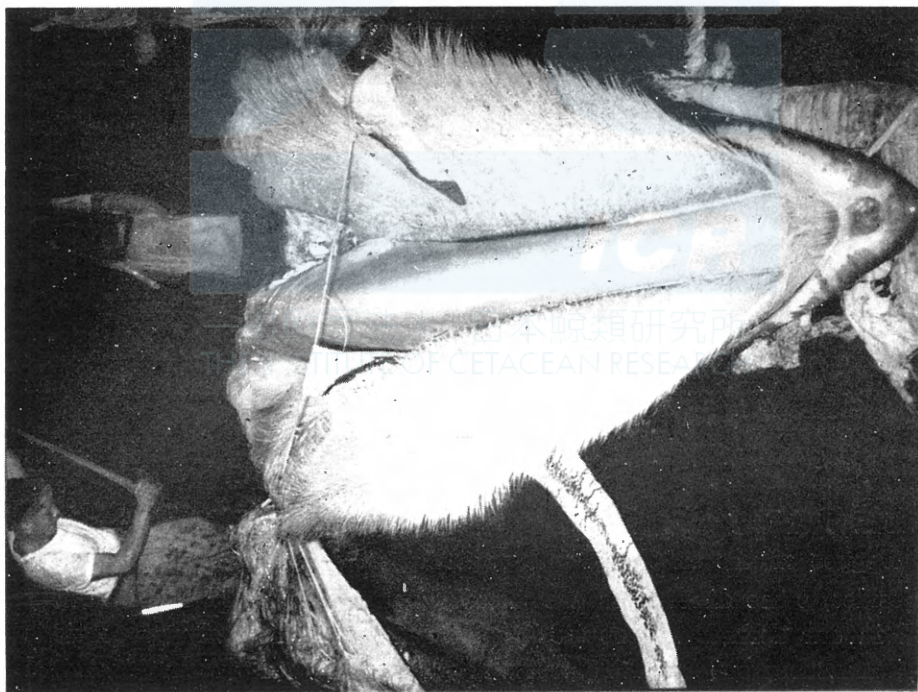


Fig. 7. Palate of a Sei Whale. Processed at Taiyo Ayukawa land station. Southern Type

Table 4. Extent of Ventral Grooves in Sei Whales.

Extent of Ventral Grooves	Northern Type			Southern Type		
	Males	Females	Total	Males	Females	Total
Anterior to the Umbilicus	51	53	104	0	0	0
At the Umbilicus	0	0	0	4	0	4
Posterior to the Umbilicus	0	0	0	264	141	405
Geographical areas:—						
Bonin I.	0	0	0	268	139	407
Coastal	43	47	90	0	2	2
N. Pacific	8	6	14	0	0	0

they end half way between the tip of the pectoral fin laid back and the umbilicus. His observations were confirmed by our present data.

In the southern type sei whales, however, the ventral grooves run posteriorly beyond the umbilicus with only one per cent exceptions, in which the ventral grooves end at the umbilicus. No whale with its ventral grooves end anterior to the umbilicus is observed.

In table 5 of our former report (1952), such point is not so clear, because in that report the whales were only classified according to the geographical areas. When the whales were classified after the observation of their baleen plates, as mentioned above, the relation between the end of the ventral grooves and the umbilicus become so distinct. However, it is thought that there may be some exceptions, in which their ventral grooves end at the umbilicus, in the northern type sei whales in the future investigations as Matthews (1938) reports in the southern hemisphere.

Discussion

The so-called sei whales in the adjacent waters of Japan may be classified into two distinct types in the following three points, as mentioned already:

1. Quality and shape of the baleen plate and the thickness of its bristles
2. Shape of the palate.
3. Degree of the extent of the ventral grooves.

Besides, some differences are seen in the body proportions, as already stated in our former report (1952). However, in the body proportions except measurement No. 12 (Notch of flukes to end of system of ventral

grooves) there exist some individual differences, which make it difficult to identify the two types only by such body proportions. We can conclude that there are such differences between the two types only in group, not in individual. Measurement No. 12 is in other word the extent of the ventral grooves. So we conclude that the most distinct external characters in the two types are above mentioned three points.

Our osteological study has not been completed yet. However, it was made clear that there exist distinct differences in the external characters between the two types of so-called sei whales in the adjacent waters of Japan. And we consider at this stage of the investigation, the two types belong to the different species, and not to the different races in the species *B. borealis*.

The northern type sei whale is, as already stated, identical with *B. borealis*, but the characters of the southern type sei whale are well agree with those which hitherto reported as the identical characters of *B. brydei*. Olsen (1913) states many external characters of *B. brydei* but most important points distinguishing *B. brydei* from *B. borealis* are the extent of the ventral fullows and the character of the baleen, as already pointed out by Andrews (1916). The shape of the plate should be added to these two external characters.

In conclusion of the above statement, it might be concluded that the southern type sei whale is identical with *B. brydei*.

Concerning the osteology of *B. brydei*, the number of vertebrae is reported as 52-53 (Lönnerberg 1931, Junge 1950). We examined the number of vertebrae of the both type sei whale in 1953, which is shown in Table 5.

The vertebral formula given by Andrews (1916) for *B. borealis* in the Japanese waters is $C7+T14+L13+Ca23=57$ and the total number of vertebrae given by Lönnerberg for *B. borealis* is 56-57. Our data concerning the northern type sei whale agree with those statements, however, those concerning the southern type sei whale does not only agree with those figures, but also with the figures given by Lönnerberg and Junge for *B. brydei*. According to our data the total number of vertebrae is 54-55 in the southern type sei whale, namely two more than those given by Lönnerberg or Junge. However, Junge describes concerning the Pulu Sugi whale, from which his conclusion was drawn, that certainly one, perhaps two of the last caudals have been lost. So his figure of total number of vertebrae cannot be said as accurate. Future investigation on this point is needed for *B. brydei* in all areas concerned. The strong backward inclination of the spinous processes of the dorsal and

Table 5. Number of Vertebrae in Sei Whales of Japan.

Type	Whale No.	Body length	Sex	Date of catch	Position of Catch		Number of Vertebrae				
					N. Lat.	E. Long.	C.	T.	L.	Ca.	Total
S	1) T. 57	42 ft.	♂	7 Jul. '53	37°-41'	142°-28'	7	14	3) 34*		55
	" T. 60	44	♀	11 Jul. '53	36 -54	142 -31	7	14	34*		55
	" T. 63	40	♂	13 Jul. '53	36 -50	142 -32	7	14	34*		55
	" T. 64	41	♂	13 Jul. '53	36 -54	142 -33	7	14	34*		55
	" T. 65	40	♂	13 Jul. '53	36 -52	142 -22	7	14	34*		55
	" T. 66	37	♀	13 Jul. '53	36 -57	142 -25	7	14	33*		54
	" T. 67	43	♂	13 Jul. '53	36 -50	142 -29	7	14	33*		54
	" T. 70	43	♀	20 Jul. '53	36 -07	144 -20	7	14	34*		55
	" T. 71	37	♀	20 Jul. '53	36 -06	144 -18	7	14	33*		54
	" 2) Ki. 32	35	♀	17 Aug. '53	38 -07	144 -00	7	14	14	19	54
	" Ki. 33	42	♀	17 Aug. '53	37 -24	143 -18	7	14	14	20	55
	" Ki. 34	41	♀	17 Aug. '53	37 -21	143 -15	7	14	13	21	55
	" Ki. 35	40	♀	17 Aug. '53	37 -18	143 -18	7	14	13	20	54
	N	T. 69	45	♀	16 Jul. '53	37 -54	145 -38	7	14	35*	
" T. 75		47	♀	11 Aug. '53	38 -02	145 -32	7	14	14	21	56

Remarks. 1) T.Taiyo Ayukawa Land station.

2) Ki.Kinkai Ayukawa Land station.

3) *not distinguished into lumbar and caudal regions

lumbar vertebrae, an important difference which separate *B. brydei* from *B. borealis* according to Junge, is also seen in the southern type sei whale. Our osteological study on the southern type sei whale will be reported in detail in future when the work is completed.

Hitherto *B. brydei* has been reported to inhabit in a narrow area of waters around Cape of Good Hope. However, Kellogg (1931) describes that in the returns made by the Norwegian companies operating off Lower California 34 bryde's whales were caught in 1926. Junge (1950) notes that a whale cast ashore on the coast of Pulu Sugi, near Singapore, and *B. edeni*, as reported by Anderson (1878) are both identical with *B. brydei* and concluded further that this whale occurs in South African waters as well as in the waters of South-eastern Asia. Ruud (1952) reports that 42 sei whales taken in 1952 in the waters of French Equatorial Africa were all bryde's whale after investigating their baleen plates and he further states that we must assume that the bryde's whale has a much wider distribution than previously known and we may expect that this species can be met with in subtropical and tropical waters in all oceans.

In the waters near Japan the bryde's whale inhabit mostly in the Bonin waters. It migrates further north as far as off Sanriku (N-E part of Japan Proper) but we assume at the present stage of our investigation that it never go north beyond the polar front.

Regarding to the distribution of the sei and bryde's whales of Japan we found recently some unpublished data concerning the measurements of body proportions. These data were collected during the period from November 1935 to July 1936 at the various

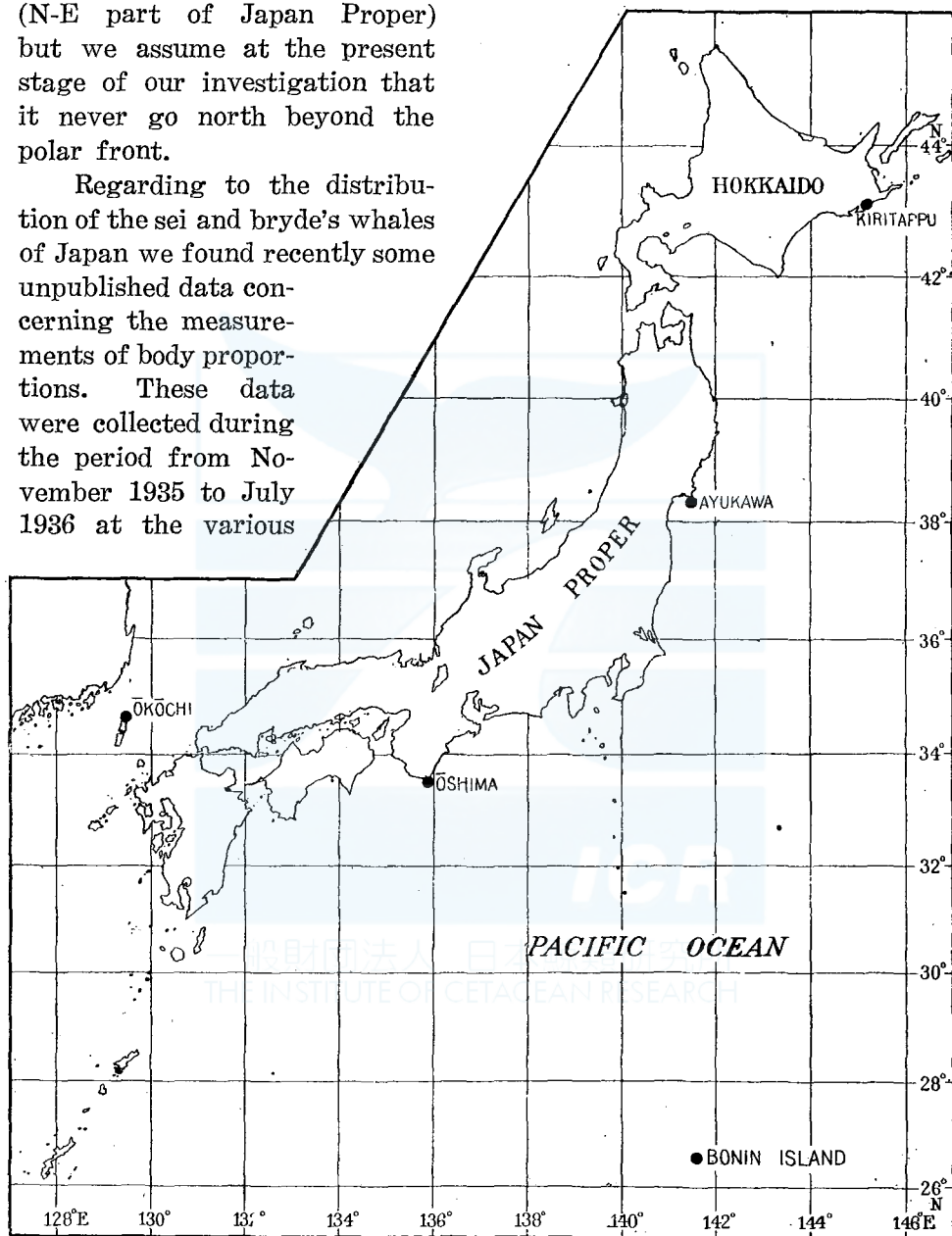


Fig. 8. Location of the Whaling land stations of Okochi, Oshima, Bonin Is., Ayukawa and Kiritappu.

land stations of Japan, of which location are shown in Fig. 8. Some body proportions of the so-called sei whales processed at these land stations were measured.

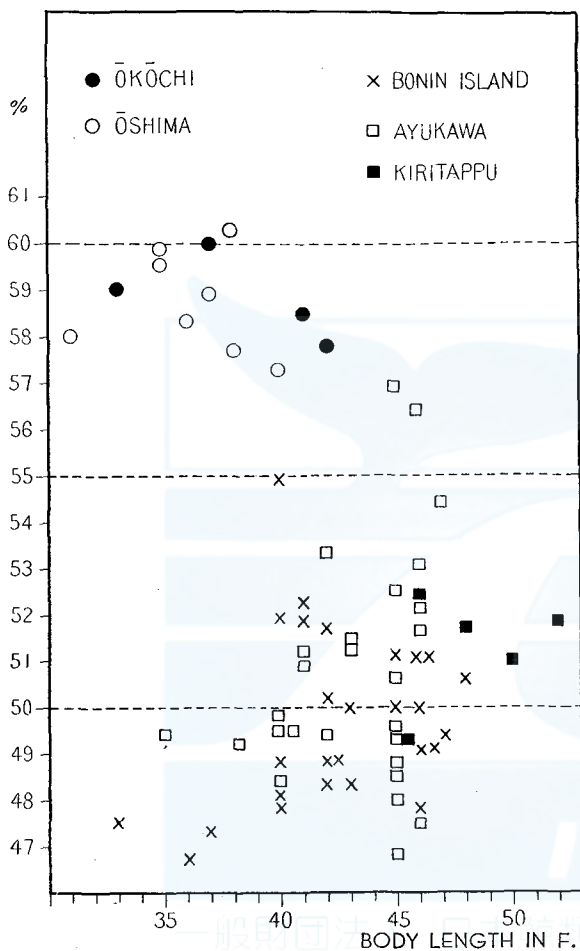


Fig. 9. From tip of lower jaw to posterior end of the system of ventral grooves (shown as percentages of body length)

means the whales, of which ventral grooves extend posteriorly far beyond the middle of the body, which is one important character of the bryde's whale. The latter means that whale belongs the ordinal sei whale. All whales processed at Okochi and Oshima land stations belong to the bryde's whale and those processed at Bonin Island, Ayukawa, and Kiritappu land stations belong to the ordinal sei whales with some exceptions.

Seven measurements were made to each sei whales processed, but most important one in this connection is the length from the tip of the lower jaw to the end of the system of the ventral grooves. Though the measurement cannot be said as accurate, because this was done by the staff of the each land stations, instead of the biologist, however, we can assume that these data are still available to get rough idea of the distribution of the both species.

In Fig. 9 the length from the tip of the lower jaw to the end of the system of the ventral grooves are shown in percentage against the total body length, separately according to each land station. We can see two groups in this figure, one being over 55-56 per cent and another one is below this figure. The former

Andrews (1916) observed some sei whales at Oshima land station, but no record of measurements was given by him. So we cannot conclude which type of sei whale he observed there.

As shown in table 3 and 4, all sei whales taken in the Bonin waters belong to the southern type, namely *B. brydei*. Also in our former account (1952), all whales were southern type with a few exceptions. However, our present data show that all sei whales processed in 1935-36 belong to the northern type with only one exception, which we cannot conclude to which type it belongs.

How can be occur such difference? We should assume that is because the difference of the seasons. The seasons of the Bonin Island whaling in the post-war days are quite different as compared with those in the pre-war days. In the pre-war days the whaling was mainly operated in the period of January to April. In the post-war days the seasons were commenced later and later, and now it has been designated by the Japanese Government that no baleen whales should be taken prior 1st May. Consequently, now the season is quite different from that in the pre-war days.

Table 6 shows the monthly catch in 1935-36 and 1952. The whaling was commenced from 1st May in 1952, but it was ended on 8th April in 1935-36.

Judged from the above fact, we assume that a herd of *B. borealis* comes near to Bonin Island in the period from December to the middle of April, and after the herd passed north another herd of *B. brydei* approaches to the island from the middle or end of April. This herd of *B. brydei* seems also go north towards the end of June as far as off Sanriku, but one part of that seems to remain longer in the Bonin waters. According to the Japanese Fisheries Agency (1953), a whale marking trip was conducted in the Bonin waters from 27th June to 10th July 1952 and 74 sei whales were sighted in this period.

As mentioned above, many *B. brydei* have been taken yearly in the seas around Bonin Island, but it is the fact in the post-war days. Namely, it can be said that it was made clear that a new herd of

Table 6. Monthly catch of Sei Whales in the Bonin Waters in the Seasons 1935-36 and 1952.

Months	1935-36 (N-Type)	1952 (S-Type)
Nov.	1	0
Dec.	1	0
Jan.	0	0
Feb.	2	0
Mar.	11	0
Apr.	12 ¹⁾	0
May	0	235 ²⁾
Jun.	0	176

Notes: 1) Season closed on 8 Apr. 1936.
2) Season opened on 1 May 1952.

B. brydei approaches to that island in the period in which hitherto no whaling had been conducted, and consequently a new whaling for this herd had inaugurated quite recently.

It is very interesting to investigate the ratio of intermingling of the both species in the waters off Sanriku, especially in connection with

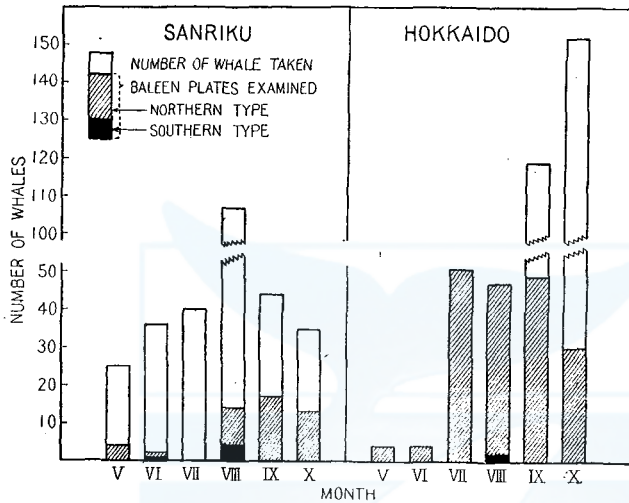


Fig. 10. Number of sei whales taken and number of baleen plates examined in 1952 in Sanriku and Hokkaido.

the oceanographic conditions of the sea water, because the two currents of warm and cold water intermingle in these areas of the sea. We collected some data in 1952, but it was so few to get any conclusion on this point, as shown in Fig. 10.

Many baleen plates have been sent to the laboratory in 1953. They are now under investigation and the result will be published later.

Conclusion

1. The two types of sei whales in the adjacent waters of Japan, as reported in our former account (1952), are separated clearly by the following characters.
 - a. Quality and shape of the baleen plate and the thickness of its bristle.
 - b. Shape of the palate.
 - c. Degree of the extent of the ventral grooves.
2. Though the osteological study has not been completed yet, there are some differences between the two types in the total number of vertebrae, etc.
3. The conclusion from above is that we can consider the southern type and *B. brydei* conspecific and the northern type is identical with *B. borealis*.

Literatures Cited

1. Anderson, J.; Anatomical and Zoological Researches: Comprising an Account of the Zoological Results of the two Expeditions to Western Yunnan in 1868 and 1975. (1878).
2. Andrews, R. C.; Monographs of the Pacific Cetacea. II. The Sei Whale (*Balaenoptera borealis* Lesson). Mem. American Museum Nat. Hist. (1916).
3. Japanese Fisheries Agency; Report on Whale Marking in Japan. No. IV. (1953).
4. Junge, G. C. A.; On a Specimen of the Rare Fin Whales, *Balaenoptera edeni* Anderson Stranded on Pulu Sugi near Singapore. Zoologische Verhandelingen. No. 9. Leiden. (1950.)
5. Kellogg, R.; Whaling Statistics for the Pacific Coast of North America. Journal of Mammalogy. vol. 12, No. 1. (1931).
6. Lönnberg, E.; The Skeleton of *Balaenoptera brydei* Olsen. Arkiv. f. Zoologi. vol. 23A, No. 1, (1931).
7. Matthews, H.; The Sei Whale, *Balaenoptera borealis*. Discovery Reports. vol. XVII, pp. 183-280
8. Olsen, O.; On the External Characters and Biology of Bryde's Whale (*Balaenoptera brydei*), a new Rorqual from the Coast of South Africa. Proc. Zool. Soc. London. (1913).
9. Omura, H., Nishimoto, S. and Fujino, K.: Sei Whale (*Balaenoptera borealis*) in the Adjacent Waters of Japan. Japan Whaling Association. (1952).
10. Ruud, J. T.; Catch of Bryde-Whale off French Equatorial Africa. Norsk Hvalfangst-Tidende. Nr. 12. (1952).

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