Japanese whale marking in the North Pacific, 1963–1972 *

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The marking for large whales has been conducted by Canada, Japan, USA and USSR in the North Pacific. Japanese whale marking began in 1949 (NISHIMOTO, 1951), and has been continuing since then (Appendix Table II). The results of Japanese whale marking have been reported in the annual meetings of the Scientific Committee, the International Whaling Commission, through the series of Progress Reports on Whale Research in Japan. The detailed lists of release and recovery of whale marks have been published domestically in Japan, and the marking cruises were reported also in the newsletters "Geiken Tsushin" from the Whales Research Institute.

OMURA and OHSUMI (1964) reviewed the Japanese whale marking in the North Pacific for the period from 1949 to 1962. However, ten years have already past since their review, and many materials and informations have been accumulated in Japan during the years. We would like to review here on the Japanese whale marking in the North Pacific during the ten years from 1963 to 1972 as a progress report subsequent to the previous paper by OMURA and OHSUMI (1964).

WHALE MARK RELEASE

Marking cruises

The managing agency of whale marking in Japan changed from the Whales Research Institute to the Tokai Regional Fisheries Research Laboratory in 1966, and it then moved to the Far Seas Fisheries Research Laboratory in the next year.

Japanese whale marking cruises are listed in Appendix Table I. Most of the cruises were made by whaling catcher boats. They consumed 2,980 whale marks (99.0% of the total 3,010 marks consumed during the years). In addition, whale marking was also made by two research vessels, Tanseimaru of the Ocean Research Institute, University of Tokyo, in 1965 (NEMOTO, OHSUMI, ICHIHARA and NASU, 1966) and 1966 (NISHIWAKI, 1967) and Shunyomaru of the Far Seas Fisheries Research Laboratory in 1967. However, both vessels have some weak points for the whale marking. They have not good efficiencies to find and chase the whales. Then, such types of research vessels have not been used for the whale marking cruises recently.

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The catcher boats used for whale marking are classified into three categories. The first is the catcher boats under operation. But it is actually very difficult for the catcher boats to engage in whale marking during their operation. They consumed only 11 marks (0.4%). The second is the scouting boats which are accompanied with whaling expeditions. Japanese Government has been obliging to carry out whale marking to whaling companies as a matter of the terms of operative license for the pelagic whaling. Scouting boats consumed 2,548 marks (84.7%), and so they have occupied the principal part of the Japanese whale marking. However, the marking ground and season are both limited within the whaling ground and season in the case of scouting boats, for they ought to work under the full control of the manager of whaling expedition. The third is the catcher boats which are chartered by the Government. This kind of whale marking cruise had discontinued from 1956, but reopened in the North Pacific in 1968 for the strengthening of whale research. Chartered vessels can work for whale marking outside the whaling ground and whaling season. A chartered catcher boat made whale marking cruise in Okhotsk Sea and northern part of the Sea of Japan in April, 1968 (NASU and MACHIDA, 1969). During the season from August to October in 1969 and 1970, whale marking was conducted in the waters off Sanriku area by two chartered catcher boats (MASAKI, 1970; SHIMADZU, 1971). This project has developed to conduct ecological research of whales in lower latitudinal waters in winter season since 1972 (OHSUMI and MASAKI, 1973), and the first cruise was made in the waters around Bonin Is. and Maliana Is. in January and February, 1972 (MASAKI, 1972). Chartered catcher boats consumed 421 whale marks (14.0%).

Marking results

The same type of whale mark has been used since 1955 (OMURA and OHSUMI, 1964). It is a 240 mm long Discovery-type stainless-steel tube with flat-topped head, and charged to 12-bore shot-gun.

Japanese whale marks which were consumed during years from 1963 to 1972 amounted to 3,010, 3,001 marks were actually shot to whales and other nine were used for test-firing or miss-fired.

Table 1 shows the results of whale marking by species. "Hit" marks were 1,279 or 42.6% of total marks shot. This ratio is less than the previous result (47.5%) reported by OMURA and OHSUMI (1964). The reason is mainly due to the change in composition of target whale species. More marks were used for the sei whales which were more difficult to be hit in recent ten years, and less marks were consumed for fin and humback whales of which hit rates were relatively high in previous years.

The hit rate is the highest (53.4%) in the sperm whale, and the lowest (29.1%) in the blue whale. However, in latter case, the rates of "possible hit" and "no

Table 1. Results of Japanese whale marking in the North Pacific, 1963-1972.

Species	Hit	Hit, but protruding	Possible hit	No verdict	Ricochet	Miss	Marks shot	Whales marked
Actual number								
Blue	16	—	9	7	1	22	55	16
Fin	191	9	46	26	10	323	605	181
Sei, Bryde's	329(13)	3	47(2)	52(1)	15	465(13)	911(29)	232(8)
Humpback	53	1	8	2	3	67	134	51
Sperm	675	29	56	22	38	443	1,263	643
Others	15*	—	1	—	2	15	33	14**
Total	1,279	42	167	109	69	1,335	3,001***	1,192
Per cent								
Blue	29.1	—	16.4	12.7	1.8	40.0	100.0	29.1
Fin	31.6	1.5	7.6	4.3	1.7	53.4	100.0	29.9
Sei, Bryde's	36.1	0.3	5.2	5.7	1.6	51.0	100.0	31.0
Humpback	39.6	0.7	6.0	1.5	2.2	50.0	100.0	38.1
Sperm	53.4	2.3	4.4	1.7	3.0	35.1	100.0	51.3
Others	45.5	—	3.0	—	6.1	45.5	100.0	42.4
Total	42.6	1.4	5.6	3.6	2.3	44.5	100.0	39.7

Remarks: Numeral in parenthesis indicates number of whales identified as Bryde's whale, *: 13 right, one giant beaked and one pilot whales, **: 12 right, one giant beaked and one pilot whales, ***: Excluded trial firing and miss firing.

Table 2. Number of whales marked by Japan in the North Pacific, 1963-1972.

Year	Blue	Fin	Sei & Bryde's	Humpback	Sperm	Right	Others	Total
1963	9	39	26	14	16	3	—	107
1964	1	53	32	—	40	1	—	127
1965	1	22	9	—	31	2	—	65
1966	1	21	33	15	47	—	—	117
1967	—	8	28	2	90	3	—	131
1968	1	11	12	4	111	—	1*	140
1969	—	9	34	—	120	1	—	164
1970	1	16	21	8	57	—	—	103
1971	2	2	18	1	61	2	—	86
1972	—	—	69	7	75	—	1**	152
Total	16	181	282	51	648	12	2	1,192

Remarks: *: Giant beaked whale, **: Pilot whale.

verdict" are very high (16.4% and 12.7%, respectively). It is natural that hit rates are less in rorquals which swim faster than the humpback, right and sperm whales. Although the hit rate increased for the sei whale, those for other whales decreased in recent ten years.

Effectively marked whale is determined as a whale into which one or more marks are hit, excluding the records of "hit, but protruding" or "possible hit".

Then, number of whales marked is in general fewer than number of marks hit. Table 2 shows number of marked whales by species and by years. A total of 1,192 whales were effectively marked by Japan in ten years, 1963–1972. They were 16 blue, 181 fin, 282 sei and Bryde's (eight of them were identified as Bryde's), 51 humpback, 648 sperm, 12 right, one giant beaked and one pilot whales. The legally prohibited whales, such as blue, humback and right whales or middle-sized whales such as minke, killer and pilot whales have been marked as few as possible.

Marked fin whales have decreased in number. On the contrary, those of sei and sperm whales have increased. The main reason is that the main pelagic whaling ground moved southward to the area where sei and sperm whales are more abundantly distributed than the fin whales are. The decline in size of fin whale population is, of cource, another reason.

Marking ground

The number of whales marked in 1963–1972 is shown in Appendix Table III by 10° squares, by whale species and by years. Fig. 1 shows the accumulated numbers of whales marked in each square during years, 1963–1972.

Marking grounds have gradually expanded especially southward. Main marking ground was north of 50°N until 1966, but it moved to the waters of 40°–50°N since then. About two thirds of whales were marked in the waters south of 40°N in 1972. However, whale marking ground has not yet covered whole areas of the North Pacific.

Most fin whales (150 whales, 82.9%) were marked in the waters north of 50°N, and 73.3% of them were marked in the Gulf of Alaska. There were no fin whales marked in the waters south of 40°N. Fin whales were also marked in the Okhotsk Sea and the Sea of Japan. In the case of sei and Bryde's whales, only 37.2% of the whales were marked in the waters north of 50°N. Main whaling ground moved to south of 50°N, and it also expanded longitudinally since 1967. Furthermore, whaling ground developed to south of 40°N, with the change in domestic rule for whaling management in 1972, and a whale marking cruise was made in lower latitudinal waters in winter season of the same year. Then, 63 sei and Bryde's whales (22.3%) were marked in the waters south of 40°N by 1972. The chance to mark Bryde's whales has been increasing recently, and eight Bryde's whales were recorded to be marked in 1972. The sperm whales which were marked in the waters north of 50°N occupied 39.2% (254 whales) of total marked sperm whales in 1963–1972, but main marking ground of the species was the waters between 40°N and 50°N, and 52.2% of the whales were marked in these waters. The ratio of marked sperm whales has been increasing recently in the waters south of 40°N, and 56 whales (8.6%) were marked in these waters.

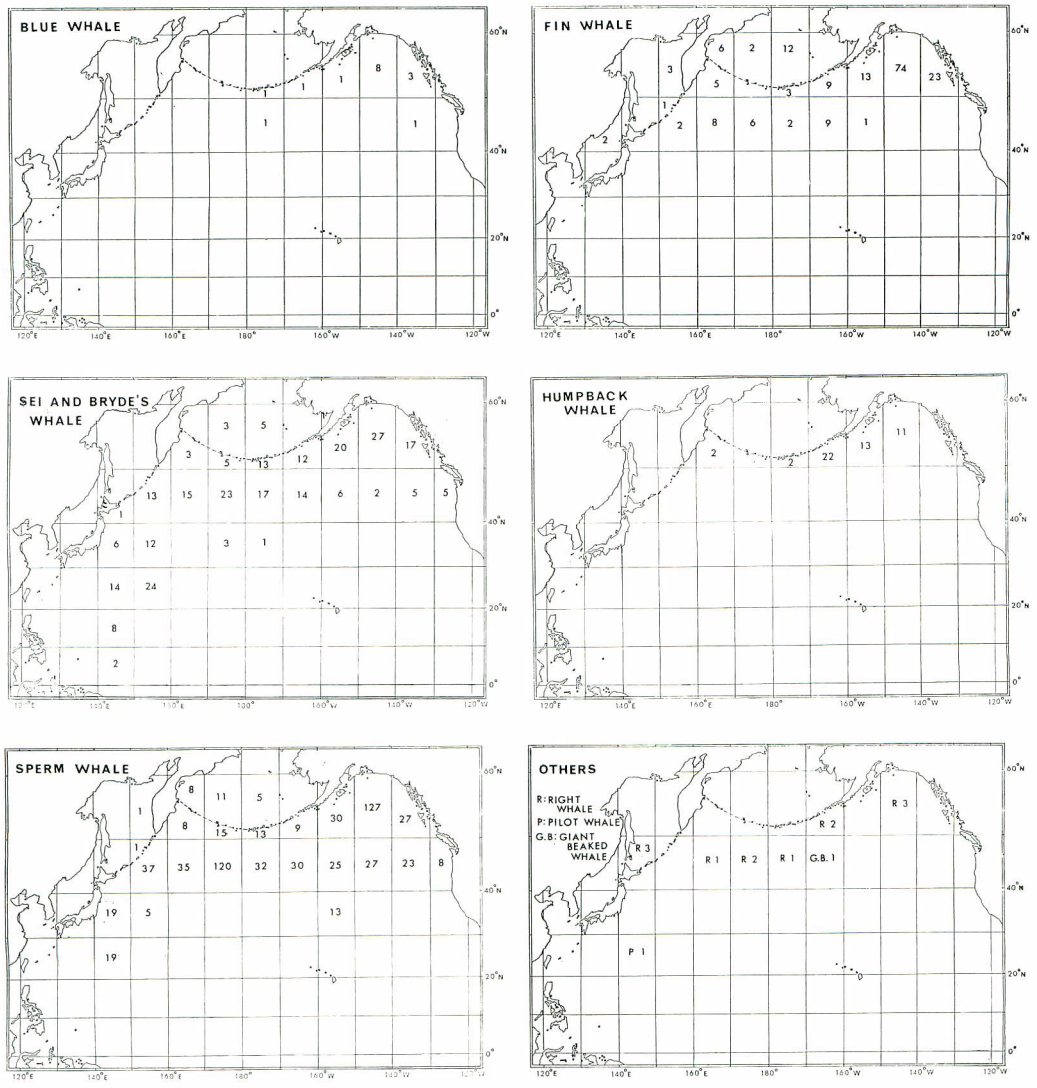


Fig. 1. Distribution of whales marked by Japan in the North Pacific during years, 1963–1972.

RECOVERY OF WHALE MARKS

Number of whales recaptured

During the years 1963–1972, 215 whales marked by Japan were recaptured in the North Pacific. Table 3 shows number of recaptured whales. Twenty nine whales of them were recaptured by foreign countries (27 whales by USSR and two by Canada). Japanese whalers also recaptured 84 foreign marked whales (77 USSR, five USA and two Canadian marked whales) during the same years as shown in Table 4. The marked whales could not be identified their species in cases of two USSR and one

Table 3. Number of recaptured whales which were marked by Japan.

Year	Blue	Fin	Sei	Bryde's	Hump.	Sperm	Total
1963	1	9(2)	1	2	4(3)	8	23(5)
1964	2(1)	17(3)	8(1)	—	3(3)	7	37(8)
1965	1	20(2)	4	—	2(1)	9(2)	36(5)
1966	—	6	8	—	—	5	19
1967	—	1	8	—	—	8(4)	17(4)
1968	—	5(1)	5	—	—	8(3)	18(4)
1969	—	3	2	—	—	4	9
1970	—	6	3	—	—	2	11
1971	—	5	8	1	—	6	20
1972	—	3	14	—	—	6(3)	23(3)
Total	4(1)	75(8)	61(1)	3	9(7)	63(12)	215(29)

Remarks: Figures in parentheses are whales recaptured by foreign countries.

Table 4. Number of whales marked by foreign countries and recaptured by Japan.

Year	USSR marks						USA marks				Canadian marks		
	Blue	Fin	Sei	Sperm	Unkn.	Total	Fin	Sei	Sperm	Total	Sperm	Unkn.*	Total
1963	—	1	1	4	1	7	—	—	—	—	—	—	—
1964	1	1	—	4	—	6	—	—	—	—	—	—	—
1965	—	2	—	9	—	11	1	—	—	1	—	—	—
1966	—	2	—	9	—	11	—	—	—	—	1	1	2
1967	—	1	1	6	—	8	—	—	—	—	—	—	—
1968	—	—	2	7	—	9	—	—	—	—	—	—	—
1969	—	—	1	7	1	9	—	1	—	1	—	—	—
1970	—	—	—	4	—	4	—	—	—	—	—	—	—
1971	—	2	—	8	—	10	2	—	1	3	—	—	—
1972	—	—	—	2	—	2	—	—	—	—	—	—	—
Total	1	9	5	60	2	77	3	1	1	5	1	1	2

Remarks: *: Fin or sei whale

Canadian marks, because they were found from cookers or refrigerator vessels, and furthermore there were unfortunately no records on the marks at the time of release. There was no example of mark recovery in the North Pacific on the whales which has been marked outside of the North Pacific. The foreign marked whales recaptured by Japanese whalers are listed up in Appendix Table V.

As shown in Table 3, 4 blue, 75 fin, 61 sei, 3 Bryde's, 9 humpback and 63 sperm whales were recaptured in the ten years, 1963-1972. Catching of blue and humpback whales was prohibited in 1966, so that there is no record of recapture of these two whale species since then. Recapture of marked sei whales has been increasing accompanied with the increments of mark release and commercial catches; on the contrary, the recapture of marked fin whales has been decreasing. Recapture of marked sperm whales is almost constant in number in recent years.

Table 5. Accumulated recovery ratio of Japanese marked whales in the North Pacific, 1949-1972.

Years	Blue	Fin	Sei & Bryde's	Humpback	Sperm	Total
Release (A)						
1949-1962	48	685	233	343	2,030	3,339
1963-1972	16	181	282	51	648	1,178
1949-1972	64	866	515	394	2,678	4,517
Recapture (B)						
1949-1962	10	118	33	13	108	282
1963-1972	4	75	64	9	63	215
1949-1972	14	193	97	22	171	497
Accumulated recovery ratio (B/A,%)						
1949-1962	20.8	17.2	14.2	3.8	5.3	8.4
1949-1972	21.9	22.3	18.8	5.6	6.4	11.0

Table 5 shows the accumulated recapture ratios of Japanese marked whales from 1949 to 1972. It is notable that these figures do not directly represent the rates of exploitation.

Processing conditions at the time of finding mark

Table 6 shows the carcass processing conditions in which Japanese whale marks were found by Japanese whalers. Only one third of marks were recovered at carcass flensing. A similar trend of mark recovery was obtained in the previous report (OMURA and OHSUMI, 1964), but mark recovery from refrigerator vessels increased in recent years.

Comparison of processing conditions at the time of finding of marks among countries is interesting in evaluating the efficiency of mark recovery, but these data are not available from foreign countries.

It is important to confirm information on an individual whale from which a mark is recovered in order to obtain better and more biological informations from the whale. However, 143 whales (76.9%) out of 186 ones recaptured by Japan during the years, 1963–1972, were identified each individual, but other 43 whales could not, because those marks were recovered from cookers, refrigerator vessels, etc.

Table 6. Processing conditions at the time of finding of mark, 1963–1972*.

Process	Factory ship	Land-station	Total	Blue	Fin	Sei	Bryde's	Hump.	Sperm
Pulling carcass	1	1	2	—	—	2	—	—	—
Flensing	52	19	71	1	19	30	2	—	19
Cutting meat	35	21	56	1	21	14	2	1	17
Cutting blubber	—	4	4	—	—	—	—	—	4
Cutting bone	4	5	9	—	3	1	—	—	5
Treating internal organ	—	1	1	—	—	—	—	—	1
Refrigerator vessel	41	—	41	—	16	25	—	—	—
Cooker	16	4	20	1	12	4	—	—	3
On deck	8	1	9	—	4	—	—	1	4
Total	157	56	213	3	75	76	4	2	53
			Per cent						
Pulling carcass	0.6	1.8	0.9	—	—	2.6	—	—	—
Flensing	33.1	33.9	33.3	33.3	25.3	39.5	50.0	—	35.8
Cutting meat	22.3	37.5	26.3	33.3	28.0	18.4	50.0	50.0	32.1
Cutting blubber	—	7.1	1.9	—	—	—	—	—	7.5
Cutting bone	2.5	8.9	4.2	—	4.0	1.3	—	—	9.4
Treating internal organ	—	1.8	0.5	—	—	—	—	—	1.9
Refrigerator vessel	26.1	—	19.3	—	21.3	32.9	—	—	—
Cooker	10.2	7.1	9.4	33.3	16.0	5.3	—	—	5.7
On deck	5.1	1.8	4.2	—	5.3	—	—	50.0	7.5

Remarks: *: Excluding the marks which were recovered by foreign countries.

Spot of finding marks in whale body

Table 7 shows the body parts from which marks were recovered by Japanese whalers. The frequency of recovering by position in which marks were inserted are different somewhat by whale species. A half of whale marks (51.7%) were found in back muscle, and 15.4% of marks, near the vertebral column. Some of them were inserted into bone tissue. About 7% of marks were found in blubber in average, but the frequency is about twice in the case of the sperm whale. About 2% of marks were found in internal organs. It is uncertain whether all whales of which marks

Table 7. Position of marks found in whale body, 1949–1972.

Body part*	Blue	Fin	Sei	Bryde's	Hump.	Sperm	Total
Blubber	1	3	5	—	—	19	28
Midway of blubber and muscle	2	8	7	—	1	7	25
Back muscle	8	90	47	7	2	64	218
Tail muscle	—	3	5	1	—	3	12
Ventral muscle	—	8	8	—	1	6	23
Near vertebral column	1	31	11	1	1	20	65
Near ribs	—	15	6	—	—	13	34
Near skull	—	3	4	—	—	3	10
Internal organs	—	1	—	—	2	4	7
Total	12	162	93	9	7	139	422
Per cent							
Blubber	8.3	1.9	5.4	—	—	13.7	6.6
Midway of blubber and muscle	16.7	4.9	7.5	—	14.3	5.1	5.9
Back muscle	66.7	55.6	50.5	77.8	28.6	46.0	51.7
Tail muscle	—	1.9	5.4	11.1	—	2.2	2.8
Ventral muscle	—	4.9	8.6	—	14.3	4.3	5.5
Near vertebral column	8.3	19.1	11.8	11.1	14.3	14.4	15.4
Near ribs	—	9.3	6.5	—	—	9.4	8.1
Near skull	—	1.9	4.3	—	—	2.1	2.4
Internal organs	—	0.6	—	—	28.6	2.9	1.7

*: Excluded unknown data.

Table 8. Healing of tissue surrounding mark in whale body, 1949–1972 (Japanese marks).

Species	condition	Elapsed years										
		1	2	3	4–	6–	8–	10–	13–	16–	19–	Total
Blue	Suppurated	1	1	—	2	—	—	—	—	—	—	4
	Healed	—	—	—	2	—	—	1	—	—	—	3
Fin	Suppurated	14	10	20	18	5	2	3	1	—	—	73
	Healed	9	6	5	7	5	5	2	2	2	—	43
Sei	Suppurated	5	10	4	4	3	1	2	—	—	—	29
	Healed	3	5	4	5	1	3	3	—	—	—	24
Bryde's	Suppurated	—	—	—	—	—	—	2	—	—	1	3
	Healed	—	—	—	—	1	—	2	—	—	—	3
Hump.	Suppurated	—	1	—	—	—	1	—	—	—	—	2
	Healed	1	—	1	—	—	—	—	—	—	—	2
Sperm	Suppurated	1	3	—	5	5	6	3	1	2	—	26
	Healed	5	5	2	6	7	9	6	7	8	1	56
Total	Suppurated	22	24	24	29	13	11	8	2	2	1	136
	Healed	15	16	12	19	15	17	15	9	11	1	130
	Total	37	40	36	48	28	28	23	11	13	2	266

inserted into the internal organs are healthy or not. Three marked sperm whales were found by fishermen as "dauhvals" in 1949, and two whales of them had marks in their internal organs (OMURA and OHSUMI, 1964), but there has been no such records since then.

When a whale mark is inserted into a whale body, the tissue surrounding the mark begins to suppurate in three to ten days, and connective tissue encircles the mark at length. The suppuration of tissue surrounding the mark heals in most cases after six years from the time of marking, but there are some records that the tissue was still suppurating within the connective tissue of the whales which were recaptured after the elapse of 16 years and over from the time of mark release (Table 8).

EXAMINATION OF ACCURACY OF MARKING RECORDS

Whale species identification

For the purpose of checking the accuracy of whale species identification at the mark times of release and recovery, the discrepancy of numbers of whales identified to a certain species was made, and results were compared among species in Table 9. In the case of the blue whale, both records coincide completely between release and recovery. All of 139 marked whales which were identified as fin whales at the time of release were reported as the same species at the time of recovery by Japan. On the other hand, of 11 whales which were recorded as fin whales at marking, only six were reported as the same species at recovery by a foreign country. One was reported as a sei whale. This record may be due to the reason that a small fin whale is sometimes confused with a sei or Bryde's whale, when it is identified in swimming. Other four individuals were reported as humpback or sperm whales at recovery. Mark No. 6789 whale was recorded as a fin whale by Japan, but was reported as a humpback whale from USSR. Examining the field note at the time of release of this particular whale, a couple of humpback whales was tried unsuccessfully to be marked at 0900 by use of two marks (Nos. 6790 and 6793) before mark No. 6789 was shot for a fin whale at 1525 on the same day. Then, there is a possibility to make a mistake in recording of mark number of these three marks, so we concluded that this whale was regarded as a humpback whale instead of a fin whale. Mark No. 5990 whale was also recorded as a fin whale at the time of marking, but it was reported as a humpback whale at recovery by a foreign country. Re-examining the field note, we could not find a possibility of misrecording. It is easy for whalers to identify a fin whale from a humpback whale. Therefore, we conclude that No. 5990 is a fin whale in this paper, though we have no exact data at recovery on this whale. Mark No. 7030 whale was recorded as a fin whale at release, but reported

as a sperm whale at recovery. On the same day when this mark was shot, eight fin, two humpback and four sperm whales were marked by using 32 whale marks. Then, there is a possibility to confuse the mark number with others at recording. No. 7741 whale is also in a similar case. Then, we decide these two marked whales are regarded as sperm whales in the present study.

Table 9. Check of whale species identification at marking (Japanese marks, 1949–1972).

Record at marking	Record at recovery*										
	Japan						USSR				
	Blue	Fin	Sei	Bryde's	Hump.	Sperm	Blue	Fin	Sei	Hump.	Sperm
Blue	12	—	—	—	—	—	1	—	—	—	—
Fin	—	139	—	—	—	—	—	6	1	2	2
Sei	—	4	63	13	—	—	—	—	2	—	—
Humpback	—	—	—	—	8	—	—	—	—	12	—
Sperm	—	1	1	—	—	136	—	—	—	—	13

*: Excluded the unknown data caused by the recovery from cooker, etc.

Of 82 whales which were recorded as sei whales at the time of mark release, 65 were sei whales, 13 were Bryde's whales and four were fin whales in the reports of recapture. As mentioned above, sei, Bryde's and small fin whales are rather difficult to be identified each other in the swimming condition, and the Bryde's whale was included into the sei whale in Japan in past time. The present result represents the difficulty in identification of these three species. Some of the whales which were recorded as the sei whales at the time of marking may be actually Bryde's whales.

All of 20 marked whales which were recorded as humpback whales were reported as the same whale species at recovery.

Excluding two individuals, 149 whales which were recorded as sperm whales were also reported as the same species at recovery. One marked whale, No. 4615, was recorded as a sperm whale at marking, but reported as a fin whale at recovery. According to the field note, whale marking of 20 fin and one sperm whales was conducted in close time of a day. Then, it is possible to mistake the record of mark number. In the case of No. 1271 whale the marking record denoted the sperm whale, but in its recovery record it was a sei whale. It is reported that the mark of this whale was found in back muscle at meat cutting of carcasses in a coastal whaling station. Through our experiences, there may be a possibility to misidentification of species at the time of recovery. On the other hand, there was no record of marking of a sei whale in the day when the mark No. 1271 was shot. In conclusion, the identification of whale species at the time of mark release is accurate in most cases,

though there are some difficulties in identification of the species among fin, sei and Bryde's whales. Out of total 416 cases, five (1.2 %) may be mistaken in the record of mark serial number at mark release.

Marking results

Detailed validity on release have been recorded since 1954 in Japanese whale marking. Validity of marking is classified into six grades through eye measurements, when a mark is shot to a whales. Sometimes two gunners shoot marks to the same whale at the same time. In such a case, the judgements of marking results are actually very difficult to be measured. In some case, many whale marks are shot in a short time. It is possible for crew to mistake in recording mark serial number and validity of marking in such cases. Here, we checked the accuracy of these results by use of records on recapture.

Table 10. Marking results of whale marks recovered during years 1963–1972, on the marked whales released since 1954.

Marking result	Blue	Fin	Sei	Hump.	Sperm	Total	%	1954–1972, total				
								Release (A)	Recovery (B)	C	D	Effective mark
Hit	2	64	54	7	35	162	78.3	2,461	297	12.1	100.0	2,461
Hit, but protruding	1	2	—	—	—	3	1.4	83	5	6.0	49.6	41
Possible hit	—	4	3	1	—	8	3.9	282	11	3.9	32.2	91
No verdict	—	2	4	—	1	7	3.4	150	8	5.3	43.8	66
Ricochet	—	1	1	—	—	2	1.0	99	2	2.0	16.5	16
Miss	—	8	13	—	4	25	12.1	2,474	31	1.3	10.7	265
Total	3	81	75	8	40	207		5,549	354	6.4		2,940
Whales hit	2	59	47	7	33	139	80.8					
Whales not hit	1	14	32	1	5	33	19.2					

Remarks: C: B/A×100, D(Efficiency rate): C/12.1×100

As shown in Table 10, the mark recovery occurs over the all grades of marking validity. Records of "hit" occupy 78.3% of all marks recovered. At the same time, the recovery of "miss" marks also occupy 12.1% of total marks recovered. The ratio of recovery from this grade of marking validity is especially high in the sei whale. About 19% of recaptured whales were recorded as "not hit" at the time of release, though the ratio differs among whale species.

The accurate number of whales marked is a basis to estimate fishing rate by means of the marking method. And we have regarded only hit whales as the effectively marked whale. However, as shown in Table 10, some of the whales which were regarded as "not effectively hit" were actually marked and recaptured. Then, it becomes needful to correct the recorded figures in order to obtain the better esti-

mate of number of marked whales. Table 10 also shows the total marking records and total recoveries by each marking validity degree on the marks fired since 1954. In the Table, the recovery rates are calculated by each grade of marking. Some of marks which were recorded as "hit" may be actually "not hit", but we cannot check it. Then, the relative efficiency rates are calculated by each marking validity grade, regarding that the efficiency rate of "hit" marks is 100%. Relative efficiency rate of "miss" marks is 10.7%. This means that 10.7% of marks which were recorded as "miss" are actually hit. Then, actual number of effectively marked whales are probably more than number of the reported as "whales hit", and they can be calculated by use of the efficiency rates and the mark numbers of each grade of marking validity, though the figures may be different in each whale species. The recorded number of marks "hit" was 2,461 in total during the years, 1954-1972. But the actually "hit" marks are estimated to be 2,940, as shown in Table 10. This suggests that the actual number of marks hit is about 20% more than the number of the recorded "hit" marks. In practice, about 19% of whales recaptured were the whales which were recorded as "not hit", as shown in Table 10.

EXAMINATION OF RECOVERY EFFICIENCY

Experiment on recovery of whale marks

OMURA and OHSUMI (1964) reported on the experiment of mark recovery by using whale carcasses in the North Pacific in 1955. Another similar experiment was conducted by one of us (OHSUMI) in 1964. A catcher boat shot 15 marks into 15 sperm whale carcasses in the course of towing them to a factory ship. Although all of the marks were shot a distance of about one meter from the target, eight of which were "hit, but protruding", and only head part of marks inserted into blubber of the carcasses in two extreme cases. This may be caused by hardness of sperm whale blubber and becoming harder in the carcass. Then, six marks were found by workers, when the carcasses were pulled up on slipway or deck before flensing. It is supposed that one mark was lost in course of pulling the whale on slipway. Another mark of "hit, but protruding" was found at the time of blubber cutting, for this mark was estimated to be located between deck and blubber, and so it was not found at the time of flensing. Five marks were inserted into shallow portion of muscle, and recovered at flensing or cutting muscle. Two marks were recovered from cookers, when the cookers were cleaned.

As the result, only one of 15 marks used in this experiment was not recovered. Seven marks completely inserted were all recovered. Estimating from this experiment, the recovery of whale marks is very high. According to OMURA and OHSUMI (1964), 87.5% of marks were recovered from sperm whale carcasses in the previous

experiment in 1955. Another similar experiment was made by Dr. Keiji NASU in the 1962/63 Antarctic season. He shot six marks into sperm whale carcasses, and five of them were recovered. He also threw nine marks into cooker, and eight of them were recovered thereafter.

Table 11. Recovery of whale marks from multiply marked whales (Japanese marks, 1949-1972).

Country	Release	Recovery	Blue	Fin	Sei	Hump.	Sperm	Total
Japan	Double	1	2	12	8	—	4	26
		2	—	10	13	—	5	28
	Triple	1	—	—	—	—	1	1
		2	—	1	—	—	1	2
		3	—	1	1	—	1	3
	Quadruple	1	—	—	—	—	—	—
		2	—	—	—	—	—	—
		3	—	—	—	—	—	—
		4	—	1	—	—	—	1
USSR	Double	1	—	2	—	1	1	4
		2	—	—	—	—	—	—
	Triple	1	—	—	—	—	1	1
		2	—	—	—	—	—	—
		3	—	—	—	—	—	—
Japan	Release(A)		4	54	45	—	27	130
	Recovery(B)		2	41	37	—	20	100
	B/A%		50.0	75.9	82.2	—	74.1	76.9
USSR	Release(A)		—	4	—	2	5	11
	Recovery(B)		—	2	—	1	2	5
	B/A%		—	50.0	—	50.0	40.0	45.5

Summarizing the data which were obtained in this kind of experiments in the North Pacific and Antarctic, the estimated recovery efficiency by Japanese whalers is 69.3% in the baleen whale, and 78.3% in the sperm whale. The pooled recovery efficiency is estimated at 72.9%. It would be too hasty conclusion to apply these figures directly to a general recovery efficiency by Japanese whalers, for the shooting of marks to whale carcasses is different from that of the living whales in the physiology and hit position of whale bodies. As the mark recovery efficiency may change with the difference of whale processing method, it must be consider that this efficiency is different with whaling countries, and also changes year by year even in the same country.

Estimation of recovery efficiency by means of multiple marking

Table 11 shows the recovery of multiply marked whales in the North Pacific. Recovery efficiency can be estimated from these data. Apparent recovery efficiencies are 76.9% in Japan and 45.5% in USSR, respectively. Although the data are small in number especially in USSR, it is estimated that the recovery efficiency by USSR is clearly less than that by Japan. Above figures do not represent the actual values of recovery efficiency, for the data do not include the whales which were multiply

marked, but no marks were recovered from. Therefore, the actual efficiencies must be less than the apparent ones. Estimating from frequency distribution of recovery numbers in Table 11, the actual recovery efficiency by Japan is 60–70%, whereas that by USSR is less than 20%.

Comparison of recovery efficiencies between Japan and USSR

If the two countries are operating in the same whaling ground and season, the number of marked whales is perhaps proportional to the amount of catch in each country, though the figures are different by whale species because of the difference of mark ratios to each population size.

Table 12. Comparison of mark recovery efficiency between Japan and USSR (1949–1972).

Items		Blue	Fin	Sei & Bryde's	Humpback	Sperm	Total
Catch number (A)	Japan*	1,187	24,917	43,019	1,363	90,878	161,364
	USSR	856	14,844	12,231	4,665	110,950	143,546
Number of whales marked		64	866	515	394	2,678	4,517
Number of whales recaptured(B)	Japan	13	186	95	9	150	453
	USSR	1	8	1	13	20	43
1,000B/A	Japan(C)	10.95	7.46	2.20	6.60	1.65	2.80
	USSR(D)	1.16	0.53	0.08	2.78	0.18	0.29
Ratio of recovery efficiency (D/C,%)		10.6	7.1	3.6	42.1	10.9	10.4

Remarks: *: Included the data of Ryukyu whaling.

Table 12 shows the total numbers of whales caught and recaptured by countries and by species in the North Pacific in 1949–1972. If the recovery efficiency is equal between Japan and USSR, the proportion in number of recaptured whales to the catch amounts should be equal in each whale species. However, clearly this is not equal. This means that recovery efficiency is different between Japan and USSR, that is, the recovery efficiency in USSR is only 10% in average of that in Japan.

It is notable that the recovery efficiency in USSR is extremely high (42.1%) for the humpback whale and very low for the sei whale (3.6%), compared with those for other whale species.

CHAPMAN *et al.* (1967) examined the returns of marks by different countries in the Antarctic. According to them, the recovery efficiencies relative to Japan were 29% in U.K., 48% in Norway and 45% in Netherlands, respectively, but they did not show the value in USSR.

If the actual recovery efficiency is 70% in Japan, the efficiency in USSR is estimated to be about 7%. Correction of number of recaptured whales is necessary for calculating fishing rates by means of whale marking.

MOVEMENTS AND BEHAVIOR OF MARKED WHALES

With the same manner of OMURA and OHSUMI (1964), movements of whales marked by Japan during the years, 1949–1972, are summarized in Figs. 2 A–F. The stock identification by means of whale marking will be examined in future, and we here briefly note the movements and the related behavior of marked whales.

Blue whales

Blue whales have been marked only in Areas IIB, IIIB, IVB and VIB. As this species was banned to catch in 1966, new information from only four individuals was added to the previous report. Of 14 whales, 12 were recaptured in the same areas where the marking was conducted, and other two whales moves Area IIIB to Area IVB. Two whales (Mark Nos. 6892 and 6893) were marked in the same school in Area IIIB. Mark No. 6893 was recaptured in Area IVB one year and two months later, and another whale was recaptured in almost same position of release after five years. No evidence of movement between east and west of 180° longitude has been yet obtained by whale marking. Above evidences enable us to estimate that the blue whale migrates in longitudinally restricted areas compared with other whale species.

Fin whales

Whale marking for the fin whale has been conducted mainly in the northern part of the whaling ground. The interminglings are observed among many adjacent areas, but long movement has not yet been shown by recaptured whales. It is noted that fin whales which had been marked in the adjacent waters to Okhotsk Sea side of Kurile Islands were recaptered in Area VB, and one fin whale was marked and recaptured in the Sea of Japan. No evidence of intermingling with other areas has been obtained in the Sea of Japan and in Area VIB (Sanriku and Hokkaido Districts). The movements of six whales show the interchange between Areas IIB and IIIB. One hundred and sixty fin whales were marked and recaptured in east side of the North Pacific, and four whales which were marked in the east side moved to the west side. On the other hand, five whales which were marked in the west side moved to the east side, and 15 whales were marked and recaptured in the west side.

Sei and Bryde's whales

Much new informations have been accumulated on the movement of sei whales accompanied with the development of pelagic whaling and marking in recent years. The interchanges between Areas IIB and IIIB, between IBV and VB and between VC and VIB are shown by the recovery of whale marks in recent 10 years. Nine sei whales which were marked in Area VIC in winter were recaptured in Areas VB

and VC in whaling season. A sei whale marked in Area IVB was recaptured in Area VIB. Three Bryde's whales were recaptured during the years, 1963-1972. One of them was marked and recapturd in Area VIB, and other two were marked in Area VIC and recaptured in Area VIB. Information on the recapture of marked Bryde's whales has not been available in the pelagic whaling ground.

Thirty five sei whales were marked and recaptured in the east side of the North Pacific, and 58 sei and Bryde's whales were marked and recaptured in the west side. Only one sei whale moved from west side to east side, and two sei whales showed a reverse movement. This will mean that the probability of interchange between west and east sides of the North Pacific is relatively low in the sei and Bryde's whales.

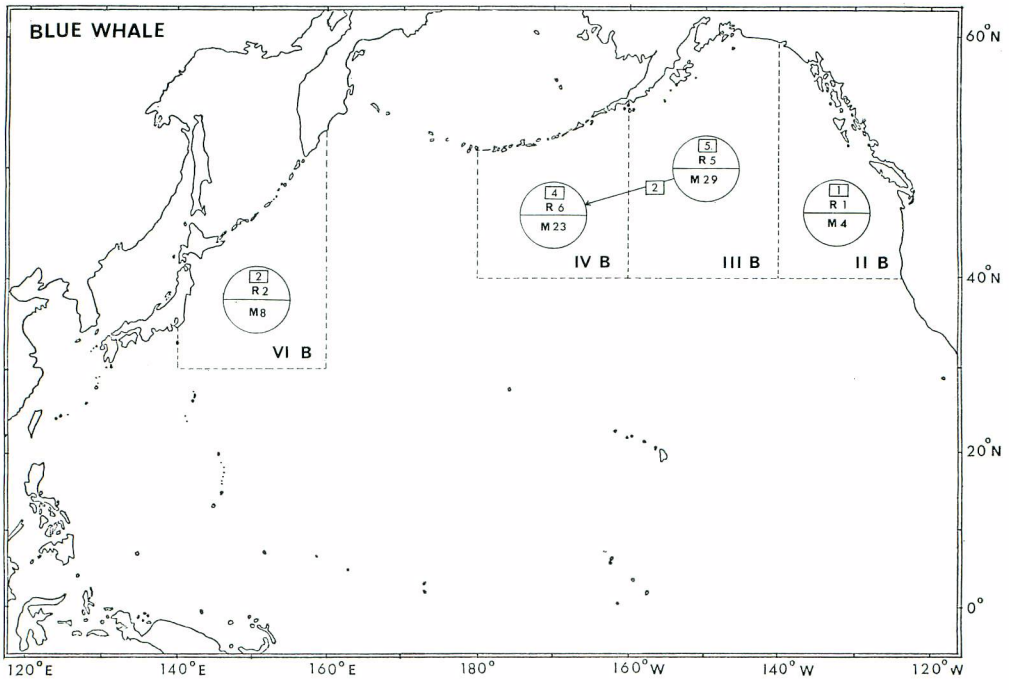
Humpback whales

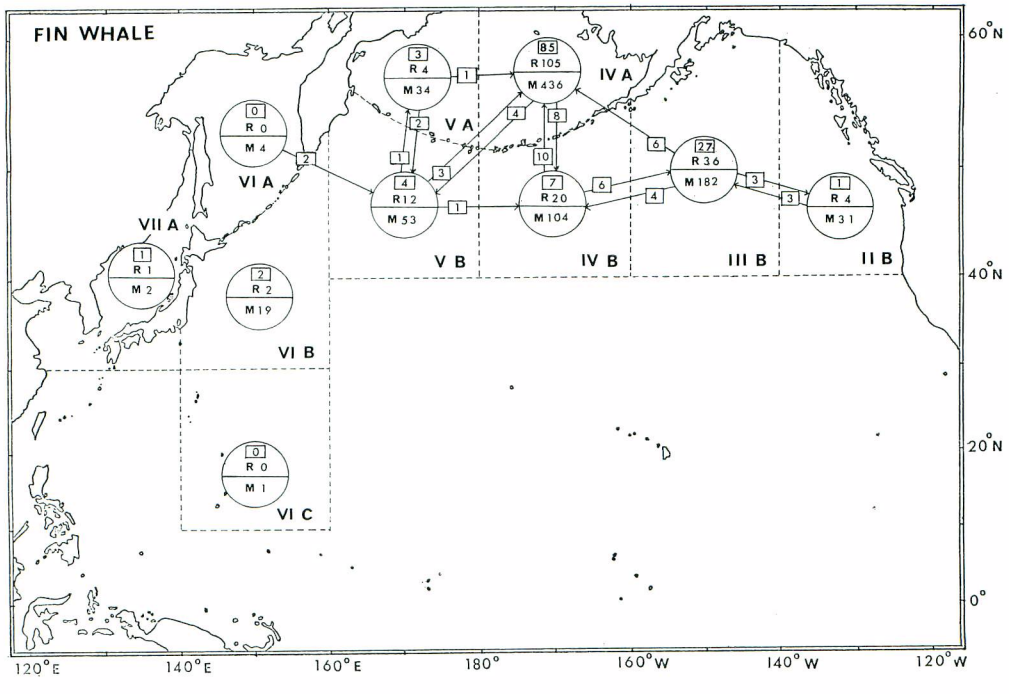
Since this species was banned to catch in 1966 as well as the blue whale was, only nine marked whales generated new information on the movement in recent 10 years. It is interesting to note that three humpback whales which were marked in the waters around Bonin Islands in March were recaptured in Areas VIB and IVA. Comparatively long distant movement was shown in the previous report, that is, six humpback whales which had been marked in the waters near Unalaska Island (Areas IVA and IVB) were recaptured in the waters off Okinawa Island (Area VIIC) in winter. These informations represent that some of the humpback whales which are distributed in Areas IVA and IVB in summer move to at least Areas VIC and VIIC in winter.

Thirteen humpback whales were marked and recaptured in the east side of the North Pacific, and one whale marked and recaptured in the west side. Six whales marked in the east side moved to the west side, and two whales moved from the west side to the east side. Then, the probability of interchange between the east and the west sides is relatively high in this species.

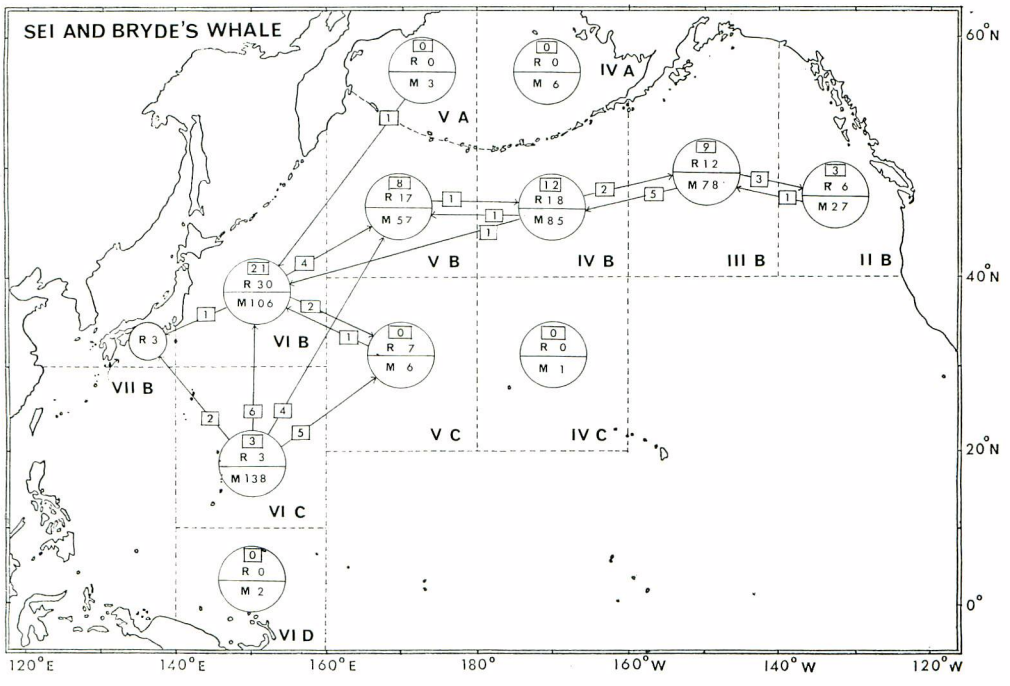
Sperm whales

Considerable long distant movements are shown especially in the male. Seventy female were recaptured during 1949-1972, and 67 of them were marked and recaptured in Area VIB. One exceptional case is that a female (Mark No. 3330) marked in Area VB was recaptured by USSR in the same Area. Mark No. 9729 whale was a female which was recaptured by USSR, and moved from IIIA to IIB. Another female (Mark No. 7741) was also recaptured by USSR, and it moved from Area IVA to Area IIB. Although this individual was recorded as a fin whale at the time of release, it was reported to be a sperm whale at recovery. But it is doubtful to be identified as a female, for sperm whales which were marked on the same day must be all males judging from body lengths and school features. Excluding these females, it is estimated that male sperm whales often move long distance. As new


BLUE WHALE
60°N
40°N
20°N
0°
120°E
140°E
160°E
180°
160°W
140°W
120°W
VI B
IV B
III B
II B
R 2
M 8
R 6
M 23
R 5
M 29
R 1
M 4


FIN WHALE
60°N
40°N
20°N
0°
120°E
140°E
160°E
180°
160°W
140°W
120°W
VI A
VII A
V A
IV A
V B
IV B
III B
II B
VI B
VI C
R 0
M 4
R 1
M 2
R 2
M 19
R 0
M 1
R 4
M 34
R 105
M 436
R 12
M 53
R 20
M 104
R 36
M 182
R 4
M 31

(continued)


SEI AND BRYDE'S WHALE
V A
IV A
V B
IV B
III B
II B
VI B
VII B
V C
IV C
VI C
VI D
60°N
40°N
20°N
0°
120°E
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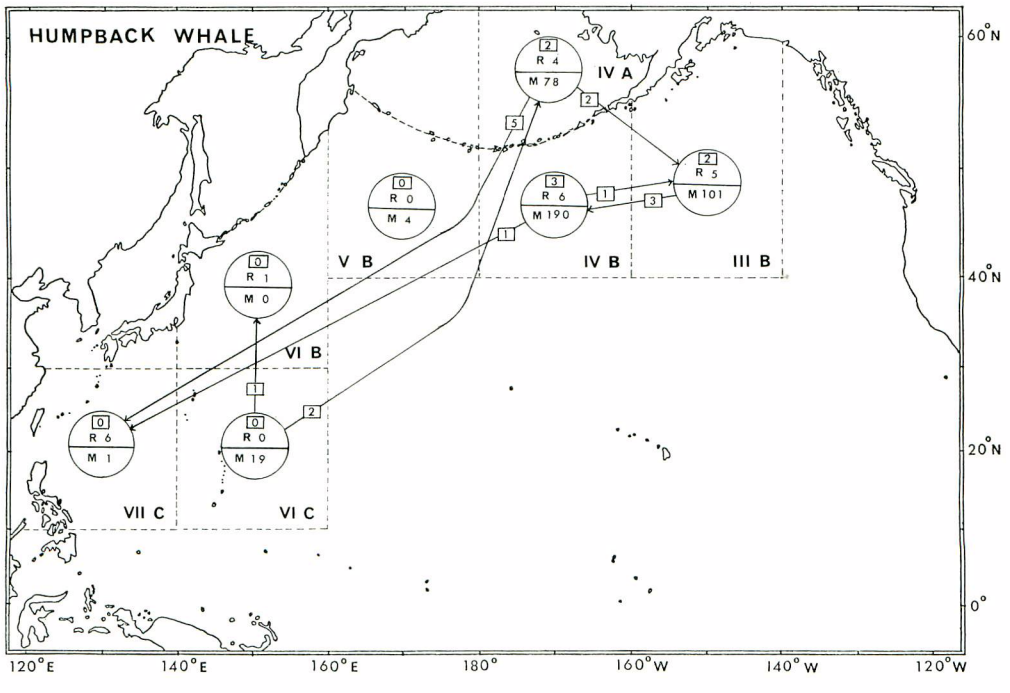
160°E
180°
160°W
140°W
120°W


HUMPBACK WHALE
IV A
V B
IV B
III B
VI B
VII C
VI C
60°N
40°N
20°N
0°
120°E
140°E
160°E
180°
160°W
140°W
120°W

(continued)

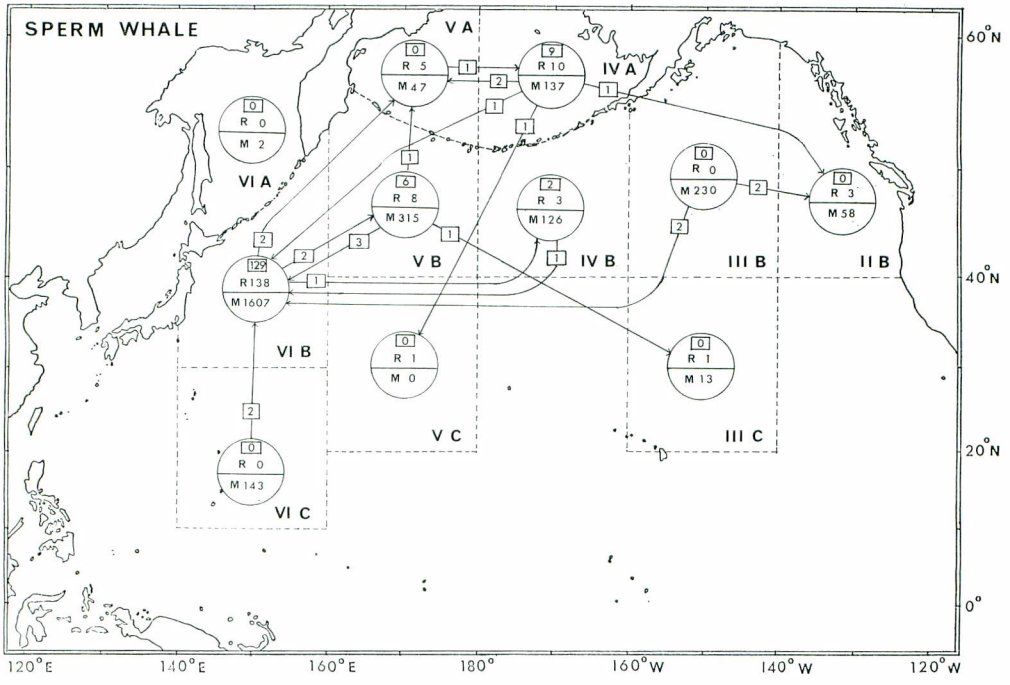


Fig. 2. Summarized results of Japanese marking and recovery for blue, fin, sei, Bryde's, humpback and sperm whales in the North Pacific during years, 1949–1972.
M: number of whales marked, R: total number of whales recaptured in each area, Numeral in square: number of whales recaptured within the marked area, Numeral in square with arrow: number of whales recaptured in different areas.

evidences on long distant movement, there are some examples of interchange between Areas IIB and IIIB, between IVA and VC and between VA and VIB. There is evidence of interchange between the east and the west sides of the North Pacific in females, but in the males 12 were marked and recaptured in the east side, seven moved from the east side to the west side, three moved reversely, and other 67 were marked and recaptured in the west side.

Behavior of schools

Two fin whales (Mark Nos. 8793 and 8797) were marked in a school, and they were recaptured from a school 23 days later. They were both males. These two fin whales might move in the same school at least during 23 days in the feeding ground. Another example was that two whales were marked in a school of three fin whales, and they were recaptured in the same day after five days from marking. Unfortunately No. 8232 mark was recovered from a refrigerator vessel, and we could not confirm the situation of the whale at recovery, but both marks were recovered by the same expedition. Then, it may be natural to consider that these whales moved with tight contact each other. Similar features are also observed in the

recaptured sei whales. They are a pair of sei whales (Mark Nos. 10376 and 10378) and another pair (Mark Nos. 12066, '73, '74 and 12076). The former pair was marked in a school of four sei whales, and they were recaptured from close localities each other after 35 and 29 days from marking date. The latter pair was marked in the breeding ground, and recaptured near feeding ground in different days after the elapse of three months. However, according to the recovery report of Mark No. 12066, this whale was a lone and immature female, and swam fast northward, though the school was composed of four sei whales at the time of marking. Then, it is considerable that the school broke into at least two small schools on the course of migration to the feeding ground, but these small schools might have some contact each other.

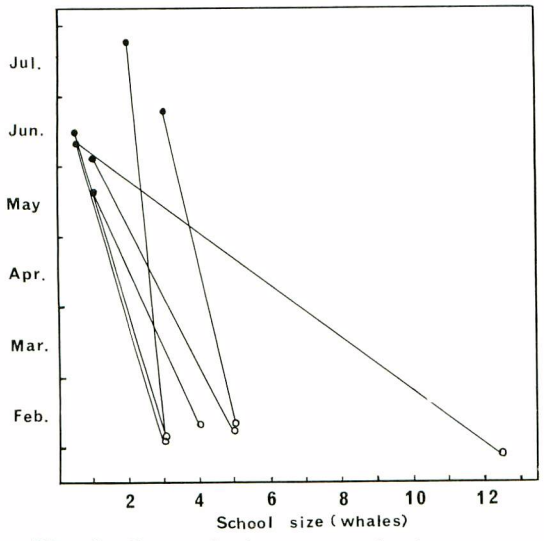


Fig. 3. Seasonal change in school sizes of marked sei whales in the North Pacific. Open circle: Mark release, Colsed circle: Mark recovery.

There are seven records of sei whales which were marked in breeding ground and recaptured in feeding ground three to five months later, and the school sizes were recorded both at the marked and recaptured times. As shown in Fig. 3, all cases show that school size in feeding ground become smaller than that in breeding ground. It may be probable that the school size of the sei whale break down on the course of migration from breeding to feeding grounds. NEMOTO (1964) describes that the size of fin whale school varies, and the break up of the school is observed in the feeding ground.

The continuation of nursery school of the sperm whale was discussed by OHSUMI (1971) by means of whale marking. There is here an observation on behavior of a bachelor school. Three male sperm whales (Mark Nos. 11813, 11814 and 11815) were marked in a school of 40 sperm whales. Estimating from distribution of body lengths, this school appeared to be a bachelor school. These three whales were recaptured near each other two days after marking, but the records at the time of recapture showed that the school sizes of Mark Nos. 11813, 11814 and 11815 were 10, 5 and 2, respectively. It is considerable from these evidences that sperm whale bachelors move in a loose school which sometime breaks down into smallers schools.

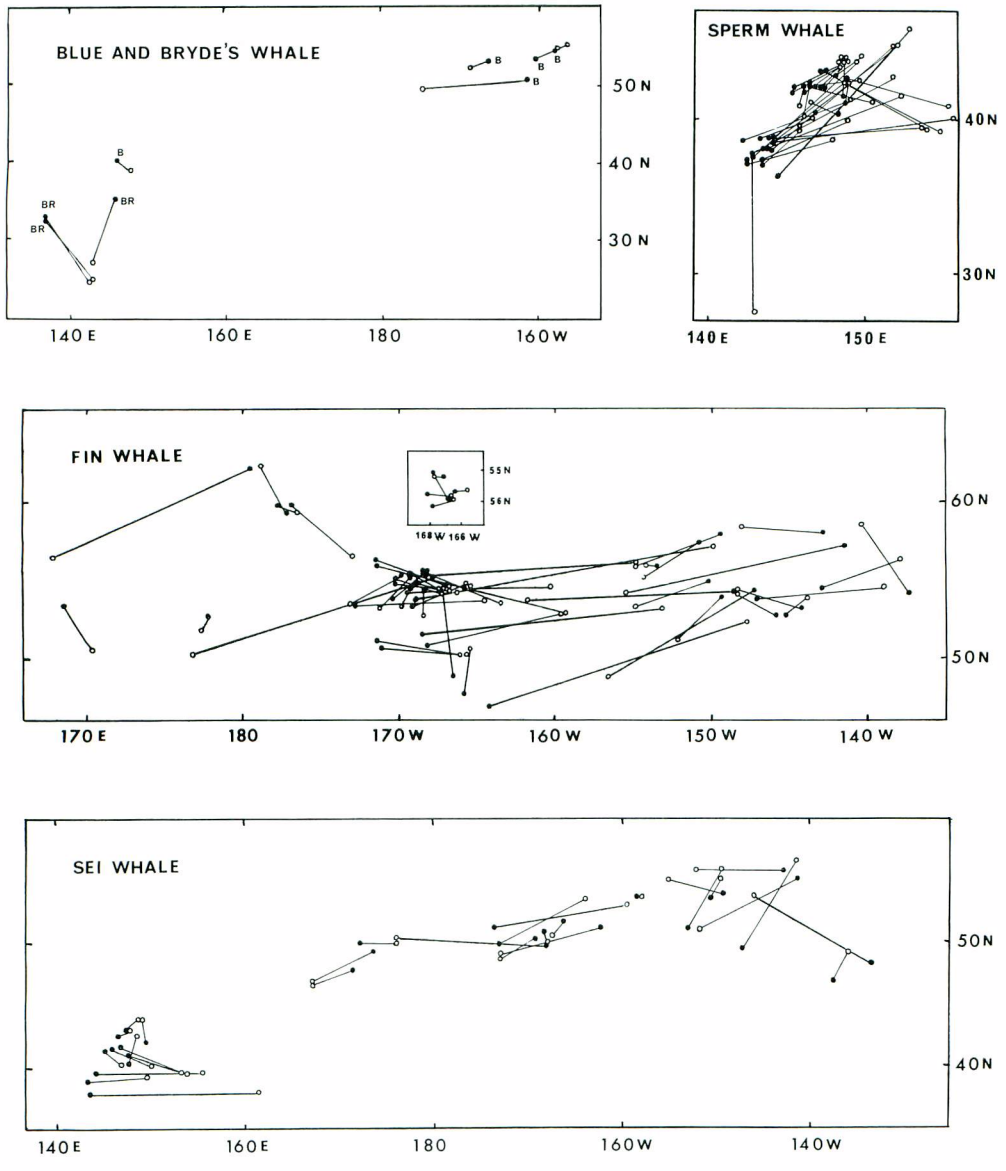


Fig. 4. Movements of marked whales which were recaptured over one winter after the time of marking but deviation of months between marking and recapture was within one month. Open circle: Position marked, Closed circle: Position recovered.

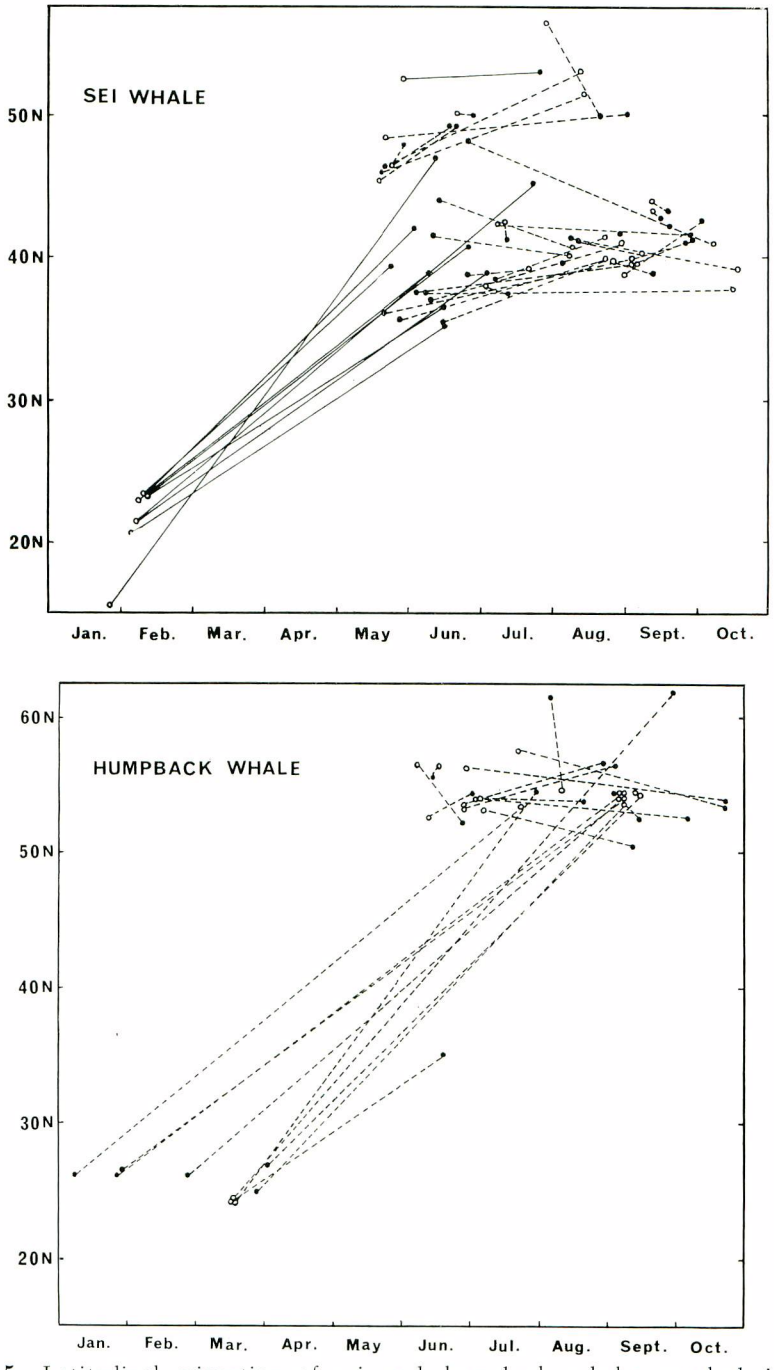


Fig. 5. Latitudinal migration of sei and humpback whales marked in the North Pacific during 1950–1972. Open circle: marking position, solid circle: recapturing position, Solid line: recaptured within the same season, Dotted line: recaptured after one years and over.

Regularity of migration

Fig. 4 shows the positions of the marking and recapture of whales which were free at sea at leat one winter since marking but the deviation of months between marking and recapture was within one month. Although some whales disperse widely, most whales seem to go back to almost the same areas in the same month of year. This will mean that whales have a tendency to migrate regularly at least toward the feeding ground every year.

Migration between feeding and breeding grounds

Most whales were marked and recaptured in feeding ground, but there have been some evidences to show the migration between feeding and breeding grounds on the sei and humpback whales in the North Pacific.

Fig. 5 shows the relation between seasons and latitudinal positions of recapture of whales. Nine sei whales were marked in the waters of 15°N–23°N in the late January and earlier half of February. These waters are regarded as a part of breeding grounds of the sei whale. And they were recaptured in the waters of 35°N–47°N in May to July. These waters are of course the feeding grounds. After May marked sei whales did not move so long in latitude, and they were recaptured in the feeding ground until October. Six humpback whales which were marked in the waters near Unalaska Island (53°N–55°N) in June and September were recaptured in the waters around Okinawa Island (25°N–27°N) in winter and early spring. The latter waters are a breeding ground of the humpback whale (NISHIWAKI, 1959). Among three humpback whales which were marked in the waters around the Bonin Islands (24°N) in middle of March, two were recaptured in the northern part of the North Pacific (54°N–64°N) in July and September. Some of marked humpback whales in breeding ground have a trend to move southward from September, but others still stay in the ground until October.

BIOLOGICAL MATERIALS OBTAINED FROM MARKED WHALES

Biological materials obtained from recaptured whales are shown in Appendix Tables IV–VI. Sex, body length, weight of testes, number of corpora lutea and albicantia in ovaries, number of growth layers in earplug or tooth and foetus are shown as the biological materials. Few materials were obtained from the whales which were recaptured by land-based whaling or by foreign countries. Some of the materials must be re-examined.

The years of liberty at sea are tabulated in Table 13. The longest years of 19 were obtained from Bryde's and sperm whales. Number of recovery is concerned with amounts of marked whales, amounts of catch, natural mortality rates and recovery efficiencies. As shown in Appendix Table II, Japanese whale marking started

in 1949, and marks were shot mainly for the sperm and sei (including Bryde's) whales in the early several years. Old mark have been still recovered in recent years.

Estimation of some biological parameters and examination of growth and other ecological matters will be studied in future works by use of these biological materials from recaptured whales, but we introduce here an interesting material on the breeding behavior of the sei whale.

Table 13. Recapture of marked whales during 1963–1972 (Japanese marks).

Species	Elapsed years																			
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Total
Blue	1	1	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—			4
Fin	14	11	7	4	9	1	3	4	4	4	4	3	1	—	1	2	—	2	1	—	75
Sei	20	9	14	6	1	2	1	2	1	1	4	—	—	—	—	—	—	—	—	—	61
Bryde's	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	1	3
Humpback	—	1	3	—	—	—	1	1	1	1	—	1	—	—							9
Sperm	6	3	5	—	—	—	—	1	5	5	3	5	5	6	3	3	3	6	3	1	63
Total	41	25	29	10	10	3	6	8	11	11	11	12	6	6	4	5	3	8	4	2	215

A cow with a 29 feet long calf (Mark Nos. 12012, '38) was marked on 6 February, 1972, and was recaptured on 3 July, 1972. The cow was pregnant at time of recapture, and the foetus was a 147 cm long male. The cow might be conceived in about the beginning of February, for foetus was about five months of gestation at the time of recapture, estimating from its size and growth curve of southern sei whale foetuses by GAMBELL (1968). Then, the whale was marked on a day near conception, and so the position of marking (22°N, 152°E) is clearly a breeding ground. The body length of the calf was about twice of neonatal length at the time of marking, if the estimation of the body length was correct. There are some reports that whales grow at weaning to about twice of the neonatal length (the fin whale, MACKINTOSH and WHEELER, 1929; humpback whale, CHITTLEBOROUGH, 1958; and gray whale, RICE and WOLMAN, 1971). If it is also true in the sei whale, the calf was around the term of weaning at the time of marking. Blubber thickness of the cow was 7.0 cm at recapture. This suggests that lactation ended fairly long time before. When this whale was caught, it swam with another pregnant female (14.3 m long, foetus: 193 cm long female). It is clear that the calf had left its mother before the mother was caught. According to GAMBELL (1968), lactation period of southern sei whale is six months. If the calf was near term of weaning at the time of marking, it might be born in August, 1971. It is a problem whether it is true or not. Anyway, the caw shows an evidence of late-lactating or end-of-lactation oestrus of the sei whale. The calf was marked at that time, but it has not yet been recaptured.

DISCUSSION

Whale marking outside of whaling ground and whaling season has been providing valuable informations on the ecology of whales, as shown in the previous chapter. Whale marking cruise is also useful for the purpose of whale sighting from which we can directly estimate abundance of whales. We have been developing whale marking cruise in lower latitudinal waters in winter season since 1972. However, our cruises are limited to the waters of the west side of the North Pacific owing to the limit of budget and time. We hope to establish the International Whale Marking Scheme in lower latitudinal waters.

The present whale marking method is one of an internal body tagging. The first problem of the method is that whale marking is useless without catch of whale. Then, the whale marking is not so effective for banned whale species such as blue, humpback, gray and right whales, so that, we shoot whale marks as few as possible for these species, even when we have a chance to find them. The second problem is that the mark recovery efficiency is low especially in the foreign countries, as examined in the previous chapter, even when a marked whale is recaptured. Some experiments to estimate the recovery efficiency and to raise the efficiency should be necessary. The third problem is the impossibility of finding and tracking of a swimming marked whale. If they are possible, we can estimate abundance of whale population from a marking ratio which is calculated by means of counting marking and non-marking whales in the sea without catch of whales. And, this kind of marking will also provide very detailed information concerning with exact movement and other behavior. It is considered that the method of whale marking to solve above problems is the external body tagging. Streamer mark was tried for large whales in the North Pacific in past years, but it was not succeeded. Recently, MITCHELL and KOZICKI (1975) developed a streamer mark. Several types of external body tagging have been examined for small cetaceans. According to EVANS *et al.* (1972), button tag, spaghetti tag, radio tag and freeze branding are being tried. Techniques of external body tagging should be developed as soon as possible.

SUMMARY

Japanese whale marking in the North Pacific during the years 1963–1972 was reviewed.

1. Japanese whale marking cruises were conducted by the co-operation of a total of 42 vessels, and 3,010 Japanese whale marks were consumed during the years 1963–1972 (Appendix Table I).
2. A total of 1,192 whales were recorded to be effectively marked by Japan during the years 1963–1972. They are 16 blue, 181 fin, 282 sei and Bryde's, 51 humpback,

648 sperm, 12 right, one giant beaked and one pilot whales (Text Table 2).

3. Whale marking ground has been developing gradually southward, especially in the west side of the North Pacific, but it has not yet covered whole areas of the North Pacific (Figs. 1 and 2, Appendix Table II).
4. During the years 1963–1972, 215 Japanese marked whales were recaptured; 186 whales were reported by Japan and 29 whales by foreign countries. They are consisted of 4 blue, 75 fin, 61 sei, 3 Bryde's, 9 humpback and 63 sperm whales (Text Table 3, Appendix Table IV). Japanese whalers also recaptured 84 whales which were marked by foreign countries during the years (Text Table 4, Appendix Tables V and VI).
5. One third of whale marks were recovered at the time of flensing carcasses. The mark recovery from refrigerator vessels has increased in recent years (Text Table 6). On 76.9% of marks recovered, biological informations on the original animal were available. One half of whale marks recaptured were found in back muscle of whales (Text Table 7).
6. Identification of whale species at the time of release is considered to be accurate in general, though there are some difficulties in identification of species among small fin, sei and Bryde's whales. And 1.2% of cases are estimated to be mistaken on the record of mark serial number at the time of release (Text Table 9).
7. Recovered marks come from each of six grades of marking validity appear. The whale marks which were recorded as "hit" occupy 78.3% of total marks recovered, but the "miss" marks also occupy 12.1% (Text Table 10). It is estimated that number of effectively marked whales is probably by about 20% more than the number which were recorded as hit whales.
8. An experimental release and recovery of whale marks was conducted by use of sperm whale carcasses in 1964. Also, recovery efficiencies were estimated by means of multiple marking. These experiments show that Japanese recovery efficiency of whale marks may be about 70% of whale marks which are actually recaptured by Japanese whalers. On the contrary, the efficiency of USSR is estimated to be around 10% of Japanese one (Text Table 12).
9. New informations on the movement of whales were provided by the recent recapture of marked whales (Text Table 2). Blue, fin, sei and Bryde's whales seem to migrate within longitudinally restricted areas. On the contrary, the migratory ranges of humpback and male sperm whales seem to be relatively wide longitudinally.
10. Some evidences on schooling behavior, migration between feeding and breeding grounds and its regularity were provided through the information on recaptured whales.
11. Biological materials obtained from recaptured whales are shown in Appendix Tables IV–VI.

12. External body tagging techniques should be developed for observation on the marked whales in living conditions, increasement of recovery efficiency and much more detailed informations of behavior.

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北太平洋における日本の鯨類標識調査，1963-1972年

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日本は，1949年から北太平洋において鯨類の標識調査を開始し，現在まで継続して実施している。この中，1962年までの結果は OMURA and OHSUMI（1964）によってすでに報告されている。本報告はその続報として，1963年から1972年までの10年間に行なわれた標識および再捕の結果の概要を取りまとめた。

日本の鯨標識業務は，1966年に鯨類研究所から東海区水産研究所に，ついで1967年からは遠洋水産研究所に移管されて現在に至っている。

北太平洋における日本の鯨標識は北洋捕鯨船団所属の漁場調査船を主体としてなされており，1968年から水産庁用船による鯨標識航海が再開され，その他，海洋調査船，漁業調査船および操業捕鯨船によっても一部の標識が実施されている（附表Ⅰ）。漁場調査船による標識は，捕鯨船団の操業海域および漁期に限られるのに対し，用船による標識調査はそれらに制約されずに実施でき，1972年には冬期における鯨の生態調査を兼ねて，低緯度海域における標識調査航海が用船により行なわれた。標識海域は捕鯨主漁場の移動に伴ない，次第に南に拡大されつつあるものの，いまだに北太平洋の全海域を掩うに至ってはいない（図2．附表Ⅱ）。

北太平洋における鯨標識は同一型の日本製標識銛を鯨体に射入することにより実施されており，1963年からの10年間に3,010本の標識銛が消費され，これによりシロナガスクジラ16頭，ナガスクジラ181頭，イワシクジラ（ニタリクジラを含む）282頭，ザトウクジラ51頭，セミクジラ12頭，マッコウクジラ648頭，ツチクジラ１頭およびゴンドウクジラ１頭，合計1,192頭が標識された（表1,2）。日本により標識された215頭の鯨が，1963年からの10年間に再捕された（表3，附表Ⅳ）。この中，29頭はソ連およびカナダによって再捕されている。一方この間に，日本は84頭の外国によって標識された鯨（ソ連による標識鯨77頭，米国によるもの５頭，およびカナダによるもの２頭）を再捕した（表4，附表Ⅴ）。日本により標識された215頭の再捕鯨の内訳は，シロナガスクジラ４頭，ナガスクジラ75頭，イワシクジラ61頭，ニタリクジラ３頭，ザトウクジラ９頭およびマッコウクジラ63頭であり，シロナガスクジラおよびザトウクジラの捕獲は1966年以来禁止されている。

再捕された標識銛の中で，鯨体の解剖時に回収された銛は３分の１に過ぎず，最近は冷凍船からの標識銛の回収の割合が増加している（表６）。そのため，再捕標識鯨の中，23%が再捕個体を確認できず，体長，性別その他の生物学的情報が得られなかった。回収された標識銛の52%は背肉中に埋没しており，その他脂皮中，脊椎骨附近，内臓腔中などからも標識銛が発見されている（表７）。射入した標識銛の周囲の組織は，標識後 3～10日の中に化膿するが，やがて結締組織が銛の周囲を掩い，大部分は６年以内に治癒する（表８）。

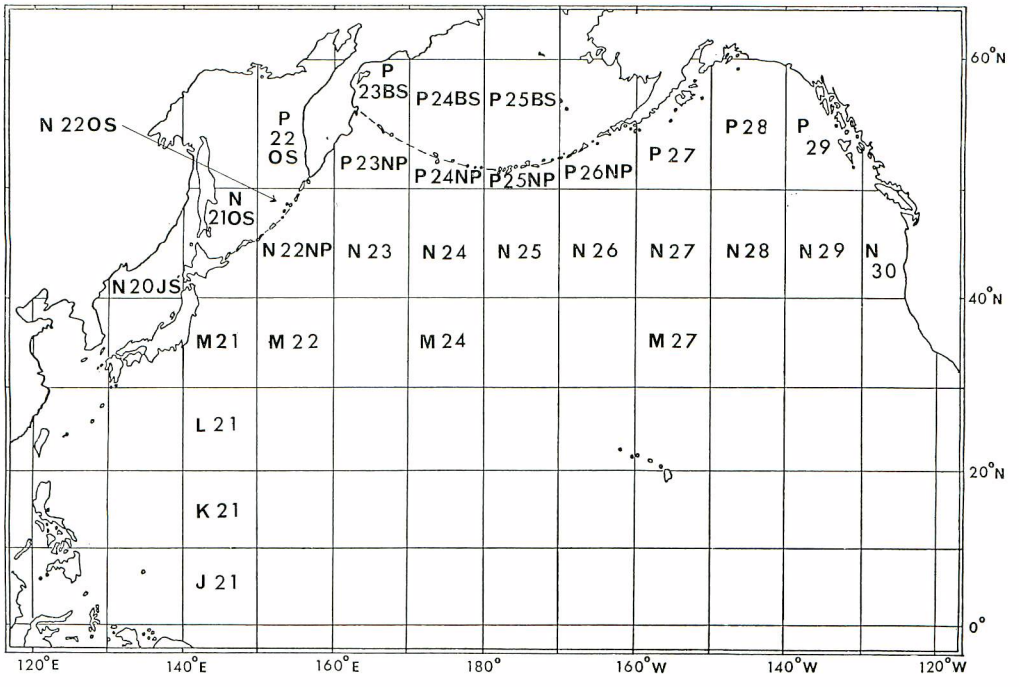
標識時の鯨種の判定はほぼ正しいが，イワシクジラ，ニタリクジラおよび小さいナガスクジラの間の種の判別には時として誤りがみられ，また標識記録の誤記による鯨種の取り違えも１%程度みられる（表９）。従来，１本以上の標識銛が完全に鯨体内に命中したと判定された個体を標識鯨としているが，標識時に〝命中〟と判定されていない標識銛も回収されており，現実に標識された鯨の頭数は，記録上の標識頭数の20%増と推定される（表10）。

捕獲鯨への標識銛の射入による標識回収試験と，重複標識鯨からの標識の回収（表11）から推定した日本の標識銛の発見報告率は約70%であるのに対し，日・ソの捕獲頭数と標識回収頭数とから検討したソ連の標識発見報告率は7%で極めて低率と推定される（表12）。

標識されたシロナガスクジラ，ナガスクジラ，イワシクジラ，ニタリクジラおよび雌マッコウクジラの移動は経度的に比較的限定されているのに対し，ザトウクジラと雄マッコウクジラは移動の範囲が広い（図2）。再捕標識鯨によって，群れの行動（図3），回遊の規則性（図4），繁殖場と索餌場との間の回遊（図5）に関して，いくつかの例証がもたらされた。また年令，成長，繁殖などの生態研究のための生物学的資料が再捕鯨によって蓄積されている（附表Ⅳ-Ⅴ）。

最後に，漁期，漁場外の鯨標識の拡大の必要性，標識銛の発見報告率の向上，体外標識技術の導入の必要性など鯨標識の問題点のいくつかが論議された。

鯨標識資料を用いた系統群の分離，漁獲率の推定などは別に報告する。



Appendix fig. 1. Address of 10° Squares for Appendix Table III. BS: Bering Sea, JS: Sea of Japan, OS: Sea of Okhotsk, NP: North Pacific.

Appendix table I. Japanese whale marking cruises in the North Pacific, 1963-1972.

Year	Name of vessel	Type	Gross tonnage	Kind	Research ground	Dates	Mark numbers consumed
1963	Konanmaru No. 21	Catcher	754	Scouting	Pelagic	21 June-15 July	100
	Fumimaru No. 18	〃	650	〃	〃	21 May-31 May	100
	Kyomaru No. 12	〃	728	〃	〃	14 June-26 June	100
1964	Konanmaru No. 21	〃	754	〃	〃	17 June-11 July	100
	Toshimaru No. 15	〃	647	〃	〃	27 May-10 July	100
	Kyomaru No. 12	〃	728	〃	〃	24 May-28 May	1
	Kyomaru No. 15	〃	738	〃	〃	1 June-28 June	97
1965	Konanmaru No. 21	〃	754	〃	〃	23 May-29 June	64
	Toshimaru No. 15	〃	647	〃	〃	13 July-3 Aug.	1
	Toshimaru No. 25	〃	740	〃	〃	5 Aug.-15 Aug.	59
	Kyomaru No. 12	〃	728	〃	〃	21 May-25 June	70
	Tanseimaru	R/V	258	Research	Coastal	4 Sept.-6 Sept.	25
1966	Konanmaru No. 15	Catcher	746	Scouting	Pelagic	27 June-28 Aug.	100
	Katsumaru No. 11	〃	750	〃	〃	15 June-18 Aug.	100
	Kyomaru No. 7	〃	399	〃	〃	14 June	3
	Kyomaru No. 20	〃	725	〃	〃	13 July-27 Aug.	78
	Tanseimaru	R/V	258	Research	Coastal	20 Sept.-28 Sept.	—
1967	Shunyomaru	〃	186	〃	Lower latitude	25 Nov.	5
	Konanmaru No. 21	Catcher	754	Scouting	Pelagic	16 May-22 May	100
	Fumimaru No. 17	〃	648	〃	〃	28 May-24 July	100
	Kyomaru No. 20	〃	725	〃	〃	12 May-27 June	100
	Katsumaru	〃	495	Operating	Coastal	30 July	7
1968	Katsumaru No. 10	〃	395	Chartered	〃	3 April-29 April	38
	Konanmaru No. 22	〃	754	Scouting	Pelagic	14 May-6 Aug.	100
	Sekimaru No. 18	〃	647	〃	〃	8 June-17 Aug.	100
	Kyomaru No. 20	〃	725	〃	〃	16 May-28 May	100
1969	Konanmaru No. 18	〃	751	〃	〃	11 May-14 Aug.	100
	Torhimaru No. 12	〃	647	〃	〃	24 May-27 Aug.	100
	Kyomaru No. 17	〃	754	〃	〃	21 May-21 June	100

(continued)

Year	Name of vessel	Type	Gross tonnage	Kind	Research ground	Dates	Mark numbers consumed
1969	Konanmaru No. 10	Catcher	742	Chartered	Coastal	1 Aug.-30 Aug.	70
1970	Konanmaru No. 17	〃	752	Scouting	Pelagic	6 May-11 July	98
	Toshimaru No. 12	〃	647	〃	〃	21 June-7 Aug.	100
	Kyomaru No. 12	〃	728	〃	〃	6 July	3
	Kyomaru No. 23	〃	701	〃	〃	16 July-7 Aug.	36
	Ryuhomaru	〃	494	Chartered	Coastal	28 Sept.-26 Oct.	83
1971	Konanmaru No. 21	〃	754	Scouting	Pelagic	6 June-8 July	50
	Toshimaru No. 12	〃	647	〃	〃	4 May-26 Aug.	100
	Kyomaru No. 15	〃	738	〃	〃	12 May-14 Aug.	20
1972	Ryuhomaru No. 3	〃	430	Chartered	Lower latitude	16 Jan.-16 Feb.	230
	Konanmaru No. 20	〃	751	Scouting	Pelagic	26 June-11 Sept.	78
	Toshimaru No. 12	〃	647	〃	〃	15 July-2 Sept.	100
	Kyomaru No. 15	〃	738	Operating	〃	19 July-22 Aug.	4

Appendix table II. Number of whales marked and recaptured in the North Pacific (Japanese marks).

Year	Number of whales marked								Number of whales recaptured					
	Blue	Fin	Sei & Br.	Hump.	Sperm	Right	Others	Total	Blue	Fin	Sei & Br.	Humpback	Sperm	Total
1949	1	7	12	—	239	—	—	259	—	—	—	—	3	3
1950	—	—	48	—	195	—	—	243	—	—	3	—	1	4
1951	1	2	17	—	223	—	—	243	—	—	1	—	4	5
1952	—	1	62	—	400	—	—	463	—	—	3	—	4(2)	7(2)
1953	5	24	21	1	310	—	—	361	1	—	3	—	5	9
1954	8	230	13	104	265	—	—	620	—	7	6	—	6	19
1955	7	51	6	23	235	—	1 a)	323	—	11	—	—	6(2)	17(2)
1956	6	74	5	64	14	—	—	163	3	7	—	—	16	26
1957	3	51	7	55	29	—	—	145	—	11	2	—	16(2)	29(2)
1958	—	64	5	7	38	—	—	114	—	14	5	3	15(1)	37(1)
1959	7	25	6	15	9	—	—	62	1	20	3	1	4	29
1960	5	35	10	39	39	—	1 b)	129	4	16	—	1	8(2)	29(2)
1961	2	80	10	24	16	1	—	133	—	22	2	2(1)	10	36(1)
1962	3	41	11	11	18	1	—	85	1	10	5(1)	6(5)	10	32(6)
1963	9	39	26	14	16	3	—	107	1	9(2)	3	4(3)	8	25(5)
1964	1	53	32	—	40	1	—	127	2(1)	17(3)	8(1)	3(3)	7	37(8)
1965	1	22	9	—	31	2	—	65	1	20(2)	4	2(1)	9(2)	36(4)
1966	1	21	33	15	47	—	—	117		6	8		5	19
1967	—	8	28	2	90	3	—	131		1	8		8(4)	17(4)
1968	1	11	12	4	111	—	1 c)	140		5(1)	5		8(3)	18(4)
1969	—	9	34	—	120	1	—	164		3	2		4	9
1970	1	16	21	8	57	—	—	103		6	3		2	11
1971	2	2	18	1	61	2	—	86		5	9		6	20
1972	—	—	69	7	75	—	1 b)	152		3	14		6(3)	23(3)
Total	64	866	515	394	2,678	14	4	4,535	14(1)	193(8)	97(2)	22(13)	171(21)	497(45)

Remarks: a): Gray whale, b): Pilot whale, c): Giant beaked whale.

Figures in parentheses are the marked whales recaptured by foreign countries.

Appendix table III. Number of whales marked by Japan in the North Pacific during the years from 1963 to 1972, by 10° Square and by species (see Appendix Fig. 1 on the address of 10° Squares).

A. 1963

Speciss	M25	N26	P26 NP	P27	P28	P29	Total
Blue	—	—	1	1	5	2	9
Fin	—	—	3	4	26	6	39
Sei & Bryde's	7	—	—	9	10	—	26
Humpback	—	—	4	6	4	—	14
Sperm	—	1	—	5	8	2	16
Right	—	—	2	—	1	—	3
All species	7	1	10	25	54	10	107

B. 1964

Species	N29	M30	P26 NP	P27	P28	P29	P24 BS	Total
Blue	—	—	—	—	1	—	—	1
Fin	—	—	3	4	32	14	—	53
Sei & Bryde's	3	5	2	4	1	17	—	32
Humpback	—	—	—	—	—	—	—	—
Sperm	2	—	3	7	15	12	1	40
Right	—	—	—	—	1	—	—	1
All species	5	5	8	15	50	43	1	127

C. 1965

Species	M21	N25	N26	P25 NP	P26 NP	P27	P28	P29	P25 BS	Total
Blue	—	—	—	—	—	—	1	—	—	1
Fin	—	—	2	—	3	3	8	3	3	22
Sei & Bryde's	—	1	1	—	2	—	4	—	1	9
Sperm	5	5	1	1	1	—	11	3	4	31
Right	—	1	—	—	—	—	1	—	—	2
All species	5	7	4	1	6	3	25	6	8	65

D. 1966

Species	N24	N25	N26	P23 NP	P24 NP	P25 NP	P26 NP	P27	P28	P23 BS	P24 BS	P25 BS	Total
Blue	—	—	—	—	—	—	—	—	1	—	—	—	1
Fin	—	1	1	1	—	1	—	1	1	6	1	8	21
Sei & Bryde's	2	—	3	—	4	8	2	—	7	—	3	4	33
Humpback	—	—	—	—	—	2	11	1	1	—	—	—	15
Sperm	—	1	4	4	3	2	4	5	11	8	5	—	47
All species	2	2	8	5	7	13	17	7	21	14	9	12	117

(continued)

E. 1967

Species	N21 OS	N23	N24	N25	N26	P23 NP	P24 NP	P25 NP	P26 NP	P27	P28	P24 BS	P25 BS	Total
Fin	—	—	3	1	—	—	—	1	—	1	—	1	1	8
Sei & Bryde's	—	7	6	8	—	—	1	5	1	—	—	—	—	28
Humpback	—	—	—	—	—	—	—	—	2	—	—	—	—	2
Sperm	—	4	57	9	4	4	3	—	—	1	2	5	1	90
Right	3	—	—	—	—	—	—	—	—	—	—	—	—	3
All species	3	11	66	18	4	4	4	6	3	2	2	6	2	131

F. 1968

Species	N20 JS	N22 OS	P22 OS	N22 NP	N24	N25	N26	N27	N28	P23 NP	P24 NP	P25 NP	P27	P28	Total
Blue	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1
Fin	2	1	3	—	1	—	—	—	—	4	—	—	—	—	11
Sei & Bryde's	—	—	—	—	3	—	1	1	—	—	—	—	4	3	12
Humpback	—	—	—	—	—	—	—	—	—	2	—	—	2	—	4
Sperm	—	1	1	5	24	4	3	7	4	—	1	—	1	60	111
Giant beaked	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
All species	2	2	4	5	28	4	5	8	4	6	1	1	7	63	140

G. 1969

Species	M21	M22	N21 NP	N22 NP	N23	N24	N25	N26	N27	N28	N29	P24 NP	P25 NP	P27	P28	P29	Total
Fin	—	—	—	—	1	—	—	6	1	—	—	—	1	—	—	—	9
Sei & Bryde's	5	9	1	4	1	5	—	—	3	1	—	—	—	3	2	—	34
Sperm	—	—	—	1	29	39	3	12	7	12	3	1	—	—	6	7	120
Right	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
All species	5	9	1	5	32	44	3	18	11	13	3	1	1	3	8	7	164

H. 1970

Species	M21	M22	N22 NP	N23	N26	N28	N29	P27	P28	P29	Total
Blue	—	—	—	—	—	—	—	—	—	1	1
Fin	—	—	2	7	—	—	—	—	7	—	16
Sei & Bryde's	1	3	9	1	5	—	2	—	—	—	21
Humpback	—	—	—	—	—	—	—	2	6	—	8
Sperm	—	5	21	2	3	2	11	2	8	3	57
All species	1	8	32	10	8	2	13	4	21	4	103

(continued)

I. 1971

Species	N22 NP	N23	N24	N25	N26	N27	N28	N29	N30	P24 NP	P26 NP	P28	Total
Blue	—	—	—	1	—	—	—	1	—	—	—	—	2
Fin	—	—	2	—	—	—	—	—	—	—	—	—	2
Sei & Bryde's	—	6	6	—	4	1	1	—	—	—	—	—	18
Humpback	—	—	—	—	—	—	1	—	—	—	—	—	1
Sperm	10	—	—	8	2	3	9	7	8	7	1	6	61
Right	—	—	2	—	—	—	—	—	—	—	—	—	2
All species	10	6	10	9	6	4	11	8	8	7	1	6	86

J. 1972

Species	J21	K21	L21	L22	M21	M24	M25	M27	N24	N25	N27	P23 NP	P25 NP	P26 NP	P27	Total
Sei	—	8	14	24	—	3	1	—	1	1	1	3	—	5	—	61
Bryde's	2	—	3	—	—	—	—	—	2	1	—	—	—	—	—	8
Humpback	—	—	—	—	—	—	—	—	—	—	—	—	—	5	2	7
Sperm	—	—	19	—	14	—	—	13	—	2	8	—	10	—	9	75
Pilot	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
All species	2	8	37	24	14	3	1	13	3	4	9	3	10	10	11	152

K. 1963–1972, total

Species	J21	K21	L21	L22	M21	M22	M24	M25	M27	N20 JS	N21 OS	N22 OS	N21 NP	N22 NP	N23	N24	N25
Blue	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Fin	—	—	—	—	—	—	—	—	—	2	—	1	—	2	8	6	2
Sei & Bryde's	—	8	14	24	6	12	3	1	—	—	—	—	1	13	15	23	17
Bryde's	2	—	3	—	—	—	—	—	—	—	—	—	—	—	—	2	1
Humpback	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sperm	—	—	19	—	19	5	—	—	13	—	—	1	—	37	35	120	32
Right	—	—	—	—	—	—	—	—	—	—	3	—	—	—	1	2	1
Others	—	—	1*	—	—	—	—	—	—	—	—	—	—	—	—	—	—
All species	2	8	37	24	25	17	3	1	13	2	3	2	1	52	59	153	54

Species	N26	N27	N28	N29	N30	P22 OS	P23 NP	P24 NP	P25 NP	P26 NP	P27	P28	P29	P23 BS	P24 BS	P25 BS	Total
Blue	—	—	—	1	—	—	—	—	1	1	1	8	3	—	—	—	16
Fin	9	1	—	—	—	3	5	—	3	9	13	74	23	6	2	12	181
Sei & Bryde's	14	6	2	5	5	—	3	5	13	12	20	27	17	—	3	5	274
Bryde's	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8
Humpback	—	—	1	—	—	—	2	—	2	22	13	11	—	—	—	—	51
Sperm	30	25	27	23	8	1	8	15	13	9	30	127	27	8	11	5	648
Right	—	—	—	—	—	—	—	—	—	2	—	3	—	—	—	—	12
Others	1**	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
All species	54	32	30	29	13	4	18	20	32	55	77	250	70	14	16	22	1,192

Remarks: *: Pilot whale, **: Giant beaked whale.

Appendix table IV. Japanese whale marks recovered in the North Pacific during the years, 1963-1972.

Mark no.	Date marked	Date recovered	Years	Position marked	Position recovered	Sex	Length (A, m)	Length (B, m)	Testes(kg) Ovaries	Age (Years)	Foetus (cm)	Remarks
Blue whales												
4098	13/7/53	15/6/64	11	39-16N, 147-21E	40-20N, 145-50E	F	20.7	22.5	—	—	—	
7965	12/7/59	16/7/65	6	49-47N, 175-02W	50-53N, 161-19W	F	23.5	24.5	0-5, 0-2	—	None	
9041	9/7/63	10/7/63	0	56-49N, 136-25W	57-14N, 137-00W	F	22.3	23.3	0-3, lost	34	None	
9243	16/6/63	21/6/64	1	52-55N, 159-35W	54-35N, 151-59W	F	22.9	22.0	—	—	—	USSR
Fin whales												
151	25/7/49	2/9/67	18	39-09.5N, 145-43E	44-36N, 147-45E	F	15.2	18.2	—	—	—	
3415	6/8/54	31/8/65	11	53-14N, 171-17W	55-07N, 169-15W	F	20.4	20.4	1-4, 2-7	—	M247	
4203	14/6/54	16/7/64	10	52-53.4N, 165-42W	50-59N, 167-37W	—	21.3	—	—	—		a)
4248} 4252}	4/7/54	11/7/63	9	54-06N, 155-31W	57-04N, 141-29W	F	19.8	20.3	0-1, 0-4	22	None	
4272	7/7/54	20/8/65	11	55-03N, 165-05W	54-26N, 166-33W	F	20.7	20.1	0-5, 0-6	—	None	
4650	10/8/54	30/6/71	17	54-10N, 166-58W	50-16N, 171-20W	M	18.9	19.1	4.5, 4.5	—		
5990	11/8/55	19/6/63	8	52-49N, 175-03W	53-30N, 165-23W	F	16.2	14.0	—	—	—	USSR
6064	12/9/55	9/8/70	15	54-23N, 170-02W	58-46N, 174-33W	M	15.8	18.3	7.9, 7.7	19		
6069	12/9/55	9/8/65	10	54-40N, 170-02W	53-02N, 178-15W	F	18.9	19.5	1-2, 0-4	—	Lost	
6270	4/9/56	13/8/70	14	54-15N, 166-55W	54-53N, 167-53W	F	18.3	18.8	1-5, 0-2	8	F183	
6671	27/6/60	6/8/65	5	53-00N, 153-32W	54-23N, 170-43W	F	18.3	19.5	1-0, 0-0	—	Unknown	
6679	27/6/60	15/6/64	4	53-04N, 153-07W	51-36N, 168-38W	M	18.9	18.6	9.0, 8.2	24		
6702	28/6/60	4/7/64	4	52-46N, 152-02W	53-14N, 148-43W	M	18.9	19.1	—	—		USSR
6713	28/6/60	-/7/63	3	53-37N, 151-55W	(56-05N, 141-02W)	—	18.3	—	—	—		On deck
6781	8/9/57	18/7/64	7	54-13N, 168-09W	54-29N, 171-00W	F	17.1	18.5	—	—		USSR
6915	14/7/55	8/6/64	9	56-45N, 150-14W	53-26N, 164-33W	—	15.2	—	—	—		a)
7043	17/9/55	18/6/72	17	55-34N, 167-40W	53-05N, 163-31E	F	18.3	21.3	0-3, 1-10	44	M250	
7045	17/9/55	11/8/70	15	55-34N, 167-40W	56-42N, 170-21W	F	10.7	19.2	0-4, 0-5	45	None	
7087} 7092}	22/7/56	14/6/64	8	53-29N, 160-12W	54-33N, 149-00W	M	17.4	18.6	12.0, 11.0	—		
7152} 7156}	2/8/56	29/7/68	12	51-42N, 177-15E	52-33N, 174-43W	M	17.7	19.0	8.2, 8.1	8		
7215} 7216}	6/9/56	25/7/65	9	54-16N, 167-29W	54-43N, 168-06W	M	14.6	17.6	4.6, 4.2	—		

(continued)

Mark no.	Date marked	Date recovered	Years	Position marked	Position recovered	Sex	Length (A, m)	Length (B, m)	Testes(kg) Ovaries	Age (Years)	Foetus (cm)	Remarks
Fin whales (continued)												
7281	10/6/57	24/7/65	8	55-25N, 168-50W	54-50N, 167-34W	F	16.8	20.0	0-2, 0-4	—	None	
7286	28/5/57	9/8/65	8	51-40N, 178-50W	52-33N, 177-43W	M	18.3	19.3	14.4, 13.0	—		
7431} 7435}	9/6/57	28/6/64	7	53-11N, 154-50W	54-50N, 150-03W	F	19.0	18.5	0-1, 0-2	—	None	
7618	18/7/58	5/6/68	10	51-11N, 171-54E	46-02N, 166-37E	—	18.9	—	—	—		b)
7623	16/7/58	4/6/69	11	55-47N, 166-32E	43-15N, 171-19E	F	20.1	20.4	0-11, 0-14	38	None	
7740	24/6/58	2/8/65	7	54-29N, 167-14W	53-55N, 170-02W	F	18.9	18.6	1-0, 0-2	—	M310	
7905	4/6/59	14/6/65	6	53-43N, 161-44W	54-09N, 148-05W	—	18.9	—	—	—		a)
8283	28/7/60	30/5/64	4	56-23N, 166-55E	50-10N, 163-29E	F	18.3	19.9	0-0, 0-2	7	None	
8437	20/6/61	13/7/65	4	54-31N, 168-08W	57-00N, 171-40W	M	16.2	18.3	—	—		USSR
8457	12/7/61	13/6/64	3	51-05N, 152-03W	53-58N, 149-22W	—	17.4	—	—	—		a)
8475	12/7/61	5/9/71	10	51-16N, 151-54W	(50-23N, 152-43W)	—	18.3	—	—	—		c)
8497	9/7/61	15/6/65	4	48-49N, 156-27W	54-10N, 147-05W	F	19.2	18.5	—	—	M95	
8562	20/8/61	15/6/64	3	54-56N, 153-50W	55-38N, 152-36W	F	17.7	18.4	0-3, 0-1	—	None	
8575	16/8/61	17/6/65	4	53-48N, 138-15W	(53-56N, 148-52W)	—	18.3	—	—	—		c)
8596	12/8/61	10/7/63	2	56-21N, 147-41W	51-32N, 130-34W	M	18.3	17.4	—	—		Canada
8602	15/8/61	-/-/63	2	55-09N. 138-35W	Pelagic ground	—	18.3	—	—	—		c)
8622	4/8/61	5/7/63	2	58-12N, 148-00W	59-00N, 142-48W	F	17.7	19.4	1-2, 0-4	9	F76	
8635	29/7/61	10/6/65	4	51-15N, 149-21W	53-19N, 154-21W	F	19.2	18.7	—	—	M79	
8682	8/7/62	16/8/65	3	54-22N, 168-26W	52-11N, 178-46W	F	19.2	19.6	1-9, 0-4	—	Unknown	
8785	19/6/62	-/-/68	6	50-42N, 165-27W	Pelagic ground	—	18.9	—	—	—		c)
8791	19/6/62	18/6/69	7	50-38N, 165-23W	47-42N, 165-54W	M	19.2	18.7	6.4, 6.2	22		
8815	28/7/62	15/7/66	4	50-05N, 166-06W	51-04N, 171-25W	—	18.9	—	—	—		a)
8816	28/7/62	20/6/63	1	50-05N, 165-58W	592-0N, 149-07W	F	19.2	18.3	0-0, 0-0	8	None	
8822	28/7/62	30/6/71	9	50-06N, 165-56W	50-30N, 171-04W	—	18.9	—	—	—		a)
9123	30/5/63	30/6/64	1	58-31N, 140-21W	54-03N, 137-12W	F	18.9	18.5	1-1, 0-0	—	M181	
9165	20/6/63	14/7/63	0	59-31N, 147-21W	58-15N, 143-04W	F	18.3	18.1	—	—	None	
9172	20/6/63	23/6/63	0	59-31N, 147-21W	59-22N, 147-22W	F	18.9	17.7	0-0, 0-0	10	None	
9239	16/6/63	24/9/64	1	53-29N, 158-04W	56-43N, 144-45W	M	19.2	17.0	—	—		USSR
9248	16/6/63	15/7/64	1	52-54N, 159-29W	50-43N, 168-01W	M	18.9	18.8	9.0, 9.0	—		
9269	20/6/64	20/6/64	0	59-41N, 147-22W	58-06N, 145-29W	—	19.8	—	—	—		a)

(continued)

Mark no.	Date marked	Date recovered	Years	Posision marked	Position recovered	Sex	Length (A, m)	Length (B, m)	Testes(kg) Ovaries	Age (Years)	Foetus (cm)	Remarks
Fin whales (continued)												
9371	9/6/64	9/7/65	1	57-19N, 144-19W	(54-00N, 141-43W)	—	18.9	—	—	—		c)
9406	24/6/64	26/8/66	2	57-06N, 142-58W	(53-03N, 179-29W)	—	19.2	—	—	—		c)
9429	27/6/64	4/7/66	2	54-06N, 148-18W	53-14N, 144-08W	F	19.8	19.7	0-4, 0-1	—	None	
9455	28/5/64	15/6/65	1	54-32N, 138-59W	53-44N, 147-03W	M	19.8	18.8	—	—		
9456	27/5/64	24/6/64	0	56-26N, 146-55W	56-36N, 143-43W	F	18.9	19.4	1-4, 0-2	25	M130	
9491	2/6/64	30/5/65	1	57-27N, 145-27W	54-48N, 135-33W	F	18.3	18.3	—	—		USSR
9493	17/6/64	13/7/70	6	56-13N, 137-54W	54-30N, 142-57W	F	18.3	18.2	1-0, 0-0	11	Unknown	
9503	17/6/64	21/6/64	0	56-13N, 137-54W	56-06N, 138-32W	M	19.5	17.1	2.0, 1.5	—		
9535	19/6/64	9/8/64	0	57-24N, 142-38W	(53-15N, 179-53W)	—	17.7	—	—	—		c)
9577	26/5/65	24/8/65	0	49-15W, 169-31W	51-29N, 161-34W	F	19.5	18.5	0-0, 0-0	—	None	
9579	26/5/65	7/9/65	0	48-55N, 169-50W	55-26N, 168-54W	M	20.4	17.5	2.1, 2.1	—		
9710	28/5/65	14/6/66	1	54-02N, 148-04W	52-43N, 145-55W	M	19.8	18.8	4.8, 4.8	—		
9717	29/5/65	27/6/66	1	53-57N, 143-49W	52-48N, 145-06W	M	18.3	18.5	7.0, 6.7	—		
9736	29/5/65	26/6/65	0	54-07N, 141-30W	55-30N, 143-03W	M	18.3	19.3	—	—		
9898	2/8/66	20/8/66	0	53-06N, 173-49W	52-58N, 175-00W	F	15.8	16.8	0-0, 0-0	—	None	
10475	13/4/68	30/6/68	0	49-23N, 153-57E	48-57N, 166-10E	F	—	18.2	0-1, 1-0	32	M127	
10463 10481 10482	11/4/68	16/6/72	4	50-31N, 155-19E	50-20N, 170-05E	M	18.3	18.0	8.7, 8.1	11		
10498	23/4/68	29/8/70	2	45-29N, 138-26E	45-15N, 138-58E	M	16.9	17.9	—	—		
10773	12/6/68	8/8/68	0	52-00N, 161-34E	47-12N, 175-38W	M	17.1	20.1	—	—		USSR
11194	1/6/69	-/8/69	0	44-10N, 169-56E	Pelagic ground	—	19.8	—	—	—		c)
11565	23/7/70	15/6/72	2	47-17N, 161-22E	50-16N, 175-16E	M	15.2	18.2	6.4, 5.6	11		
11570 11575	16/7/70	19/7/70	0	46-16N, 161-45E	46-30N, 161-48E	M	17.4	17.5	0.8, 0.6	4		
11633	17/5/70	4/8/71	1	42-58N, 167-14W	48-07N, 156-32W	F	18.3	21.0	1-2+, 0-4	12	F90	
11780	24/7/70	21/7/71	1	52-13N, 147-40W	46-53N, 164-04W	M	18.3	18.5	5.2, 4.9	8		
Sei whales												
4181	12/6/54	19/7/64	10	53-40N, 157-49W	52-25N, 166-42W	M	10.1	13.6	4.0, 3.2	—		
4246	3/7/54	27/6/65	11	55-46.5N, 152-16W	55-49N, 143-51W	—	13.7	—	—	—		a)
6774	13/8/57	20/5/67	10	51-39N, 168-12E	45-54N, 171-13E	—	10.7	—	—	—		a)

(continued)

Mark no.	Date marked	Date recovered	Years	Position marked	Position recovered	Sex	Length (A, m)	Length (B, m)	Testes(kg) Ovaries	Age (Years)	Foetus (cm)	Remarks
Sei whales (continued)												
6792	13/8/57	21/5/67	10	53-04N, 168-03E	46-29N, 172-21E	—	10.1	—	—	—		a)
7052	21/7/56	28/7/64	8	53-43N, 157-38W	53-42N, 158-05W	F	—	14.7	0-6, 0-7	—	None	
7532	19/6/58	27/6/67	9	50-08N, 176-11E	50-03N, 172-17E	—	11.6	—	—	—		a)
7661	28/5/67	25/7/67	0	52-24N, 172-11E	52-59N, 166-32E	—	13.1	—	—	—		a)
7909	29/6/59	14/7/66	7	53-35N, 163-56W	49-53N, 173-09W	M	15.2	14.5	4.4, 3.8	—		
8078	4/6/59	22/6/65	6	53-19N, 165-29W	(54-08N, 146-54W)	—	13.4	—	—	—		c)
8479	12/7/61	7/8/63	2	51-22N, 151-43W	55-13N, 141-05W	M	12.8	14.5	3.0, 2.4	—		
8515	30/6/61	29-31/7/64	3	48-32N, 167-11W	52-51N, 157-17W	—	12.8	—	—	—		c)
8809	28/7/62	29/5/69	7	49-30N, 167-46W	37-13N, 144-51E	F	15.2	14.2	—	—		
8878	15/6/62	19/6/64	2	50-30N, 167-23W	51-50N, 166-10W	M	14.2	13.3	3.6, 2.8	—		
9066	22/5/63	2/9/66	3	48-21N, 179-15W	50-03N, 169-11E	M	12.9	13.4	1.8, 1.2	8+		
9199	17/6/63	12/6/64	1	55-08N, 155-01W	53-53N, 149-10W	M	15.2	13.9	3.8, 2.8	—		
9231} 9232}	16/6/63	13/7/66	3	52-59N, 159-15W	51-13N, 173-33W	M	13.7	—	—	—		a)
9233	16/6/63	11/9/65	2	53-23N, 158-23W	(51-26N, 167-34W)	F	13.7	—	—	—		a)
9249	16/6/63	13/7/66	3	52-49N, 159-15W	51-13N, 173-33W	M	13.1	—	—	—		a)
9375	20/6/64	31/7/66	2	46-00N, 130-00W	53-04N, 143-14W	—	13.1	—	—	—		a)
9469	29/5/64	12/7/64	0	54-46N, 137-07W	49-18N, 128-00W	M	11.6	14.3	—	—		Canada
9509	18/6/64	20/6/64	0	55-40N, 139-03W	55-29N, 139-02W	F	12.2	14.5	0-3, 0-7	25	None	
9544	10/7/64	14/7/64	0	55-24N, 154-18W	55-27N, 153-17W	M	15.2	13.9	3.6, 3.5	—		
9554} 9561}	23/5/65	3/6/67	2	49-02N, 172-49W	50-20N, 167-05W	M	14.6	13.2	2.8, 2.4	—		
9562	23/5/65	7/6/67	2	49-04N, 172-48W	51-23N, 162-02W	M	14.6	14.1	3.8, 3.7	—		
9591	27/5/65	14/7/65	0	49-59N, 166-53W	50-56N, 163-12W	M	12.8	13.7	4.2, 3.8	—		
9748	2/6/65	14/6/66	1	55-07N, 149-33W	53-28N, 150-36W	M	14.3	13.7	4.0, 3.2	22		
9753} 9755}	2/6/65	21/7/70	5	55-09N, 149-31W	47-34N, 138-45W	F	14.9	14.9	1-0, 0-2	—	F145	
9811	30/6/67	31/7/68	1	50-05N, 167-52W	50-40N. 168-10W	M	13.7	13.8	4.2, 4.2	26		
9889	18/7/66	20/7/66	0	51-08N, 161-38W	50-55N, 161-40W	F	14.6	14.0	0-1, 0-1	—	None	
9961	15/7/66	29/7/71	5	55-51N, 149-33W	51-10N, 152-58W	—	15.2	—	—	—		a)
9976	19/7/66	12/8/68	2	56-31N, 141-20W	49-28N, 147-10W	—	15.8	—	—	—		a)

(continued)

Mark no.	Date marked	Date recovered	Years	Position marked	Position recovered	Sex	Length (A, m)	Length (B, m)	Testes(kg) Ovaries	Age (Years)	Foetus (cm)	Remarks
Sei whales (continued)												
9995	17/8/66	8/7/69	3	51-25N, 163-36W	46-11N, 166-40E	—	15.2	—	—	—		a)
10013 10028	11/8/66	13/8/66	0	53-50N, 143-59W	52-50N, 144-48W	F	14.5	15.1	0-0, 0-0	—	None	
10124	13/8/66	1/8/68	2	50-33N, 176-36E	49-47N, 168-00W	M	13.7	14.3	6.2, 5.4	—		
10223 10226	24/5/67	31/5/71	4	46-39N, 167-07E	47-55N, 171-20E	M	13.1	13.8	4.6, 4.5	22+		
10229	24/5/67	18/6/68	1	46-36N, 167-08E	49-16N, 173-54E	—	13.7	—	—	—		a)
10376	17/5/67	21/6/67	0	45-25N, 173-31E	49-17N, 177-49W	M	13.7	13.2	1.2, 1.2	14+		
10378	17/5/67	15/6/67	0	45-25N, 173-30E	49-47N, 175-12W	—	13.1	—	—	—		a)
10517	9/8/69	14/6/71	2	40-42N, 159-04E	44-06N, 173-41E	M	13.5	12.5	0.5, 0.4	—		
10530	23/8/69	15/6/72	3	39-53.5N, 157-31E	35-29N, 176-43E	F	13.8	14.5	0-1, 1-3	17+	M171	
10539	23/8/69	10/6/71	2	39-50N, 156-52E	41-36N, 171-29E	F	12.3	12.8	0-0, 0-0	4+	None	
10731	3/8/68	13/7/70	2	53-46N, 145-45W	48-37N, 133-33W	F	16.8	13.0	1-0, 0-0	—	F145	
10818	16/5/68	28/5/68	0	42-31N, 175-29E	45-06N, 175-21E	F	13.1	15.5	0-4, 0-9	—	None	
11298	27/8/69	10/6/70	1	52-32N, 151-28W	44-41N, 164-29W	F	14.3	14.4	0-9, 0-10	22	None	
11317	25/8/69	26/5/71	2	39-40N, 150-00E	35-49N, 145-30E	F	13.2	13.7	—	—	—	
11382	22/5/71	29/7/72	1	43-39N, 160-40W	45-10N, 163-32W	F	13.7	15.3	0-1, 0-0	—	None	
11525 11530 11531	7/10/70	20/5/71	1	41-01N, 154-56E	36-05N, 145-25E	M	13.8	13.5	—	—		
11529	7/10/70	25/6/72	2	41-01N, 154-56E	48-19N, 170-43E	M	13.8	13.3	1.6, 1.5	4		
11542 11545	17/10/70	12/8/71	1	39-13N, 151-42E	43-48N, 173-12E	F	13.8	14.6	1-1, 0-1	4+	Unknown	
11546	16/10/70	7/6/72	2	37-41N, 148-50E	37-35N, 167-14E	F	11.3	13.2	0-0, 0-0	—	None	
11652 11690	9/7/70	7/7/71	1	49-08N, 135-58W	46-43N, 137-26W	M	13.7	13.4	2.0, 1.5	—		
11831 11838	26/1/72	12/6/72	0	15-25N, 143-00E	46-50N, 172-24E	F	14.0	12.5	0-0, 0-0	—	None	
11974 11978	5/2/72	15/6/72	0	20-41N, 152-11.5E	35-12N, 177-06E	F	14.4	13.7	0-0, 0-0	6+	None	
11986	5/2/72	7/9/72	0	20-45N, 152-09E	Pelagic ground	—	12.9	—	—	—		c)
11989	6/2/72	23/7/72	0	21-37N, 151-26E	45-15N, 167-13E	M	14.3	13.0	0.8, 0.6	17		
11998	6/2/72	14/6/72	0	21-37N, 151-26E	36-38N, 178-13E	M	13.7	13.3	1.0, 1.0	6+		

(continued)

Mark no.	Date marked	Date recovered	Years	Position marked	Position recovered	Sex	Length (A, m)	Length (B, m)	Testes(kg) Ovaries	Age (Years)	Foetus (cm)	Remarks
Sei whales (continued)												
12013 12028	7/2/72	3/6/72	3	23-00N, 151-45E	42-07N, 168-18E	M	13.1	13.5	0.6, 0.6	—		
12012 12038	6/2/72	3/7/72	0	21-35.5N, 151-57E	38-52N, 174-53E	F	15.3	14.7	1-2, 0-1	12	M147	
12066 12073 12074	9/2/72	24/5/72	0	23-35.5N, 147-04E	39-23N, 169-44E	F	13.8	14.0	0-0, 0-0	10	None	
12076	9/2/72	8/6/72	0	23-35.5N, 147-04E	39-01N, 168-16E	M	13.1	12.8	0.8, 0.6	—		
12134 12142	9/2/72	26/6/72	0	23-38N, 147-09E	40-46N, 175-50E	F	12.8	12.9	0-0, 0-0	—	None	
Bryde's whales												
2429	6/7/52	11/7/63	11	27-23N, 142-51E	35-56N, 145-17E	M	12.8	12.9	—	—		
2470	9/7/52	27/8/63	11	24-43N, 141-48E	37-13N, 144-10E	M	13.1	13.0	3.0, 2.8	30		
2844 2846	5/9/52	21/6/71	19	39-11N, 155-36E	36-32N, 147-05E	F	13.7	13.7	—	—	—	
Humpback whales												
4258	4/7/54	11/9/65	11	53-17N, 157-46W	50-38N, 165-31W	F	9.1	13.6	0-0, 0-0	—	None	
6053	8/9/55	14/9/64	9	53-37N, 164-57W	52-50N, 165-25W	F	13.1	12.8	—	—	—	USSR
6789	7/9/57	4/9/64	7	54-03N, 167-12W	54-27N, 167-50W	F	—	12.8	—	—	—	USSR
7442	7/6/57	27/6/63	6	56-36N, 152-16W	52-12N, 158-30W	F	11.4	14.8	—	—	—	USSR
7448	12/6/57	1/7/65	8	52-31N, 163-17W	54-20N, 152-30W	F	11.4	13.7	—	—	—	USSR
8311	17/3/61	22/6/63	2	24-36N, 141-23E	35-08N, 145-02E	M	13.7	11.7	6.0, 5.0	32		
8329	17/3/61	30/7/63	2	24-36N, 141-23E	54-37N, 165-37W	F	15.2	13.0	—	—	—	USSR
8334	17/3/61	29/9/63	2	24-23N, 141-24E	63～64N, 178～179W	F	13.1	—	—	—	—	USSR
9185	18/6/63	14/6/64	1	56-30N, 152-23W	55-30N, 152-05W	M	12.8	13.0	—	—	—	USSR
Sperm whales												
34	17/7/49	10/12/66	17	39-39.5N, 151-15E	37-41N, 143-35E	F	9.8	10.8	—	—	—	
57	21/9/54	28/8/64	10	42-42N, 151-48E	37-44N, 142-48E	F	9.8	11.1	—	—	—	
244	30/4/49	3/9/67	18	26-55N, 143-41.5E	38-23N, 143-27E	M	9.8	11.2	—	—		
347	29/7/49	3/7/65	16	39-36N, 145-49E	37-03N, 143-36E	F	9.4	10.7	—	17	—	
606	6/8/49	8/9/66	17	39-01N, 151-58E	38-21N, 142-47E	F	9.8	10.7	—	—	—	
608	6/8/49	1/11/68	19	39-01N, 151-58E	38-14N, 144-04E	F	9.1	11.3	—	—	—	

(continued)

Mark no.	Date marked	Date recovered	Years	Position marked	Position recovered	Sex	Length (A, m)	Length (B, m)	Testes(kg) Ovaries	Age (Years)	Foetus (cm)	Remarks
Sperm whales (continued)												
1347	6/9/50	9/9/67	17	40-08N, 155-26E	38-51N, 144-02E	F	11.3	10.9	—	—	—	
2053	22/8/51	10/10/66	15	41-25N, 147-31E	38-27N, 143-54E	M	10.7	12.8	—	—		
2085	27/8/51	23/10/69	18	41-51N, 146-24E	41-52N, 145-34E	M	8.5	11.5	—	—		
2153	28/8/51	21/6/69	18	41-06N, 149-58E	37-01N, 144-58E	F	—	11.2	—	—	—	
2572	1/9/52	4/11/64	12	38-55N, 147-55E	42-36N, 147-25E	M	10.1	11.0	—	—		
2671	1/9/52	7/9/66	14	38-55N, 147-55E	37-13N, 142-56E	F	10.7	10.8	—	—	—	
2678	1/9/52	14/7/65	13	38-55N, 147-55E	38-32N, 145-43E	M	9.1	11.5	—	—		
2712	4/9/52	3/10/65	13	39-34N, 153-39E	43-02N, 147-21E	M	11.6	13.5	—	—		
2735	4/9/52	27/8/63	11	39-34N, 153-39E	(38-50N, 143-50E)	F	11.6	—	—	—	—	d)
2802	12/9/52	7/10/65	13	43-41N, 148-20E	(41-45N, 146-18E)	—	10.7	—	—	—		c)
2936	12/9/52	20/6/63	11	43-43N, 148-36E	52-51N, 170-40E	M	7.6	12.5	2.2, 2.0	—		
2995	12/9/52	22/6/69	17	43-44N, 148-44E	37-16N, 144-47E	M	8.2	12.8	1.7, 1.2	—		
3069	12-13/9/52	3/10/69	17	44 N, 149 E	38-34N, 143-06E	F	—	10.7	—	—	—	
3122	13/9/52	5/10/68	16	43-50N, 149-30E	38-03N, 143-25E	F	7.9	10.7	0-0, 0-1	—	None	
3124	13/9/52	14/7/63	11	43-50N, 149-30E	42-08N, 146-32E	M	9.1	13.9	—	—		
3235	9/6/53	9/8/67	14	51-34N, 164-34E	39-08N, 155-50W	M	9.8	13.3	—	—		USSR
3241	17/6/53	23/9/65	12	45-20N, 154-30E	40-56N, 145-58E	F	7.6	10.9	1-4, lost	—	Unknown	
3330	24/6/53	15/9/65	12	51-15N, 164-40E	54-30N, 167-45E	F	7.6	10.7	—	—	—	USSR
4572	10/6/54	1/6/63	14	48-56N, 179-11E	Pelagic ground	—	12.8	—	—	—		On deck
5173	21/9/54	18/7/67	13	42-42N, 151-48E	55-29N, 166-32E	M	11.3	12.2	—	15		
6056	12/9/55	10/8/64	9	54-15N, 169-56W	52-31N, 175-48W	M	15.2	15.0	8.0, 8.0	—		
6387	7/8/55	23/10/64	9	41-09N, 148-16E	42-14N, 146-49E	F	9.1	10.7	—	25		
6411	6/8/55	30/9/64	9	40-56N, 149-44E	Japanese coastal	—	10.4	—	—	—		c)
6435	5/8/55	17/10/71	16	40-09N, 148-52E	36-55N, 143-01E	M	—	10.9	—	—		
6441	5/8/55	4/9/66	11	40-09N, 148-52E	37-22.5N, 143-29E	F	—	10.8	—	—	—	
6463	6/8/55	11/5/72	17	40-56N, 149-44E	37-05N, 145-58E	M	11.3	11.7	—	—		
6466	6/8/55	1/7/64	9	40-56N, 149-44E	38-41N, 147-37E	M	10.1	11.0	—	—		
6660	7/8/55	14/6/63	8	41-19N, 148-52E	41-51N, 146-43E	M	9.8	12.1	—	—		
6721	19/8/55	13/8/68	13	44-44N, 151-50E	38-08N, 144-00E	F	11.3	11.0	—	—	—	
6727〕 6749〕	19/8/55	5/9/70	15	44-44N, 151-50E	37-17N, 142-20E	F	10.7	10.8	—	—	—	

(continued)

Mark no.	Date marked	Date recovered	Years	Position marked	Position recovered	Sex	Length (A, m)	Length (B, m)	Testes(kg) Ovaries	Age (Years)	Foetus (cm)	Remarks
Sperm whales (continued)												
7051	18/9/55	16/8/64	9	53-46N, 170-39W	54-12N, 171-27W	—	13.4	—	—	—		c)
7304	18/8/55	20/8/63	8	45-55N, 152-56E	36-21N, 144-24E	F	11.0	11.2	—	—	—	
7322	12/8/55	21/9/65	10	42-26N, 149-40E	41-06N, 147-50E	M	9.8	11.6	—	—		
7325	15/8/55	14/10/68	13	41-32N, 152-56E	41-03N, 143-48E	F	13.7	10	—	—	—	USSR
7326	18/8/55	20/8/63	8	45-55N, 152-56E	36-22N, 144-35E	F	10.7	—	—	—	—	e)
7342	7/8/55	14/6/63	8	41-19N, 148-52E	42-07N, 146-03E	F	10.7	11.5	—	—	—	
7348	7/8/55	20/6/63	8	41-19N, 148-52E	42-06N, 146-15E	M	9.8	13.8	—	—		
7391	6/8/55	20/10/70	15	40-56N, 149-44E	38-57N, 142-53E	M	—	11.8	—	—		
7558	19/8/55	7/10/67	12	44-40N, 151-50E	46-03N, 152-18E	F	9.8	10.3	—	—	—	USSR
7576	19/8/55	10/10/67	12	44-40N, 151-50E	45-02N, 150-01E	M	9.8	11.0	—	—		USSR
7741	24/6/58	30/5/65	7	54-29N, 166-43W	54-20N, 136-00W	F	—	10.4	—	—	—	USSR
7768	28/5/67	29/5/67	0	52-59N, 171-34E	52-55N, 171-49E	M	12.8	12.4	—	—		
7806} 7808}	15/8/55	31/8/65	10	41-39N, 152-13E	38-08N, 143-45E	M	11.3	11.8	—	—		
8394	6/7/61	25/8/72	11	52-15N, 176-00W	37-11N, 176-10E	—	11.0	—	—	—		USSR
9729	29/5/65	26/6/67	2	54-10N, 141-50W	46-20N, 134-26W	F	11.6	11.6	—	—	—	USSR
10154	19/6/67	6/9/68	1	46-17N, 171-22W	37-55N, 143-10E	—	9.1	—	—	—		On deck
10562	27/5/68	End/4/68	0	47-59N, 145-23W	Pelagic ground	—	11.6	—	—	—		USSR
10709	27/5/68	19/8/68	0	47-59N, 145-23W	44-03N, 135-30W	—	11.6	—	—	—		USSR
11333	4/10/70	22/6/72	2	39-54N, 151-01E	48-41N, 154-39E	—	15.2	—	—	—		USSR
11343	5/10/70	7/5/72	2	40-27N, 152-21E	36-05N, 146-03E	M	14.4	16.2	—	—		
11344	5/10/70	31/8/71	1	40-27N, 152-21E	47-19N, 164-18E	M	14.4	15.7	4.8, 4.7	—		
11346	5/10/70	25/12/72	2	40-27N, 152-21E	Japanese coastal	—	14.4	—	—	—		c)
11505	5/10/70	15/6/71	1	40-54N, 153-05E	37-39N, 144-32E	M	13.8	13.6	—	—		
11518	5/10/70	20/6/72	2	40-54N, 153-00E	46-21N, 150-21E	—	13.7	—	—	—		USSR
11813	14/8/71	16/8/71	0	50-16N, 171-56E	49-07N, 172-11E	M	13.1	13.0	2.0, 1.8	—		
11814	14/8/71	16/8/71	0	50-16N, 171-56E	49-14N, 172-13E	M	12.5	12.6	1.5, 1.6	—		
11815	14/8/71	16/8/71	0	50-16N, 171-56E	49-25N, 172-19E	M	12.8	12.8	4.1, 4.0	—		

Remarks: Length (A): Body length at the time of mark release (estimated), Length (B): Body length at recovery, F: Female, M: Male, a): From refrigerator vessel, b): At meat cutting, c): From cooker, d): At treating whale oil materials, e): At cutting bone.

Appendix table V. USSR whale marks recovered by Japan in the North Pacific during years 1963-1972.

Mark no.	Date marked	Date recovered	Years	Position marked	Position recovered	Sex	Length (A, m)	Length (B, m)	Testes(kg) Ovaries	Age (Years)	Foetus (cm)	Remarks
Blue whale												
610161	21/4/62	27/6/64	2	56-14N. 136-39W	54-16N, 136-54W	M	—	23.5	18.0, 17.6	—		
Fin whales												
637	22/5/58	20/6/64	6	50-03N, 153-06E	59-45N, 147-13W	F	—	21.2	0-6, 0-6	14	None	
2245	31/7/59	11/6/65	6	56-40N, 174-14W	52-38N, 152-20W	M	—	18.6	7.9, 7.2	—		
610008	3/7/62	21/6/63	1	55-16N, 157-12W	59-25N, 149-18W	F	—	20.0	1-4, 0-1	27	F187	
610056	27/8/60	5/8/71	11	51-42N, 166-37W	51-01N, 151-00W	F	—	20.7	—	27	None	
610160	2/7/62	7/6/66	4	54-30N, 153-30W	55-43N, 139-49W	M	—	19.0	5.5, 5.3	4+		
610774	28/5/63	12/6/66	3	54-45N, 147-07W	54-51N, 147-47W	F	—	18.3	0-0, 0-0	10	None	
610780	28/5/63	2/8/71	8	47-00N, 148-12W	47-52N, 155-36W	M	—	18.9	5.0, 4.5	30		
610968	29/7/67	29/7/67	0	53-20N, 175-00W	53-20N, 175-00W	F	—	17.1	0-0, 0-0	5	None	
610981	6/8/64	25/7/65	1	65-25N, 169-40W	55-00N, 169-04W	F	—	16.9	0-0, 0-0	—	None	
Sei whales												
610147	17-20/6/62	25/7/63	1	54～55N, 156～157W	55-12N, 139-21W	M	—	13.3	3.2, 3.2	—		
610601	—	12/6/67	—	—	37-01N, 143-12E	F	—	13.3	—	—	—	
610881	25/3/66	4/9/69	3	30-13N, 152-23E	41-33N, 149-35E	F	—	14.7	—	—	—	
650889	4/7/66	-/8/68	2	42-25N, 164-30E	Pelagic ground	—	—	—	—	—		c)
651150	16/4/66	-/9/68	2	42-09N, 179-52W	Pelagic ground	—	—	—	—	—		c)
Sperm whales												
524	16/10/56	31/8/65	9	46-20N, 151-15E	38-30N, 143-16E	M	—	11.9	—	—		
569	21/10/57	12/10/66	9	44-38N, 149-54E	38-57N, 144-14E	F	—	11.2	—	—	—	
570	21/10/57	25/10/71	14	44-38N, 149-54E	36-54N, 141-46E	M	—	11.6	—	—		
698	5/8/57	6/11/66	9	46-33N, 152-43E	42-07N, 145-51E	F	—	11.2	—	—	—	
754	23/8/58	26/10/67	9	46-20N, 152-20E	37-53N, 143-34E	F	—	10.9	—	—	—	
790	15/10/54	27/8/63	9	46-20N, 150-14E	(42-39N, 145-43E)	—	—	—	—	—		c)
903	1/10/56	25/8/68	12	46-30N, 152-30E	Japanese coastal	—	—	—	—	—		c)
911	26/10/54	19/10/71	17	44-12N, 149-26E	36-19N, 142-14E	M	—	10.9	—	—		
952	20/10/54	27/5/67	13	45-24N, 150-34E	51-16N, 178-06W	M	—	13.6	—	13		
988	3/9/54	13/5/66	12	44-46N, 159-36E	38-16N, 144-39E	F	—	10.7	—	—	—	

(continued)

Mark no.	Date marked	Date recovered	Years	Position marked	Position recovered	Sex	Length (A, m)	Length (B, m)	Testes(kg) Ovaries	Age (Years)	Foetus (cm)	Remarks
Sperm whales (continued)												
1472	—	29/7/66	—	—	53-06N, 172-22E	M	—	12.6	—	—		
1606	15/8/60	30/10/68	8	54-00N, 169-20E	41-41N, 144-39E	F	—	10.8	—	—		
1653	—	18/8/63	—	—	37-23N, 146-21E	M	—	12.3	2.4, lost	—		
1710	1/8/58	19-24/9/65	7	55-05N, 165-45E	40～42N, 144～146E	—	—	—	—	—		c)
1715	24/9/58	19/12/71	13	54-57N, 165-54E	38-34N, 142-30E	F	—	10.9	—	—	—	
1767	—	11/9/69	—	—	36-50N, 142-11E	M	—	12.3	—	—		
1852	14/8/58	30/7/65	7	50-19N, 178-49W	52-54N, 176-34E	M	—	13.4	—	23		
2002	17/10/58	30/7/66	8	47-45N, 154-21E	53-23N, 170-08E	M	—	12.0	—	—		
2026	25/8/58	8/9/65	7	48-46N, 156-57E	39-17N, 144-08E	M	—	11.2	—	—		
2043	-/58	16/7/67	—	—	54-16N, 167-21E	M	—	12.1	—	19+		
2047	15/9/58	19/8/64	6	46-23N, 152-08E	42-35N, 146-27E	M	—	12.1	—	—		
2070	10/9/58	10/8/69	11	46-08N, 153-16E	35-46N, 144-45E	F	—	10.8	—	—	—	
2087	18/5/58	23/8/70	12	46-53N, 153-38E	Pelagic ground	—	—	—	—	—		c)
2090	14/5/58	8/9/64	6	49-11N, 156-15E	41-22N, 148-38E	F	—	10.7	—	—		
2093	16/8/58	30/8/63	5	48-34N, 156-07E	53-20N, 169-35E	M	—	11.9	2.0, 1.8	—		
2144	19/10/58	23/9/65	7	48-21N, 154-03E	39-31N, 144-32E	F	—	10.7	—	—	—	
2149	19/10/58	18/9/66	8	47-56N, 153-39E	41-53N, 145-31E	F	—	10.7	—	—	—	
2161	27/9/59	17/9/68	9	46-07N, 151-47E	37-27N, 144-00E	F	—	10.7	—	—	—	
2164	27/9/59	31/10/69	10	46-07N, 151-47E	40-38N, 143-21E	M	—	12.0	—	—		
2211	23/8/58	19/6/63	5	45-44N, 151-44E	54-21N, 178-50E	M	—	13.0	3.2, 2.8	—		
2308	24/9/59	12/11/71	12	47-56N, 155-16E	38-44N, 142-11E	M	—	11.2	—	—		
2322	22/7/59	3/9/69	10	46-54N, 154-30E	35-16N, 143-25E	F	—	10.7	—	—	—	
2334	—	24/9/64	—	—	40-42N, 146-38E	F	—	10.7	—	—	—	
2358	22/6/60	12/11/72	12	49-32N, 158-30E	37-19N, 142-10E	F	—	10.8	—	—	—	
2374	28/7/59	6/10/65	6	45-43N, 151-54E	42-24N, 144-18E	F	—	11.0	—	—	—	
2406	18/8/58	28/10/68	10	46-54N, 154-30E	42-15N, 145-34E	F	—	10.7	—	—	—	
2410	18/8/58	26/8/70	12	46-49N, 154-30E	45-42N, 163-10E	M	—	14.6	1.9, 1.8	—		
2423	15/10/58	20/9/65	7	45-00N, 150-36E	37-53N, 143-37E	F	—	10.7	—	—	—	
2465	10/6/58	3/9/70	12	47-50N, 154-30E	36-13N, 142-01E	M	—	11.0	—	—		
2491	7/10/58	6/9/65	7	49-30N, 156-50E	38-15N, 143-00E	M	—	14.0	—	22		

(continued)

Mark No.	Date marked	Date recovered	Years	Position marked	Position recovered	Sex	Length (A. m)	Length (B, m)	Testes(kg) Ovaries	Age (Years)	Foetus (cm)	Remarks
Sperm whales (continued)												
610035	26/7/63	13/7/66	3	50-00N, 168-28W	50-14N, 168-10W	M	—	14.9	—	—		
610210	18/8/63	9/6/68	5	38-50N, 143-07W	46-36N, 177-11E	F	—	11.6	0-2, 0-2	30	None	
610440	14/9/66	24/10/72	6	37-17N, 164-19W	37-22N, 142-45E	F	—	10.6	—	—	—	
610616	23/10/64	24/9/66	2	41-31N, 143-49E	42-09N, 145-42E	F	—	10.9	—	—	—	
610622	24/10/64	3/7/65	1	41-22N, 149-15E	38-06N, 144-03E	M	—	11.0	—	—		
610783	28/6/63	25/7/68	5	45-19N, 146-56W	42-35N, 155-28W	M	—	14.7	4.2, 4.0	—		
611005	6/7/64	23/8/64	0	58-00N, 176-00E	56-44N, 172-34W	M	—	14.3	3.8, 3.0	—		
611052	20/7/66	29/5/69	3	42-58N, 156-30E	37-25N, 144-57E	F	—	10.7	—	—	—	
650283	17/9/68	7/9/70	2	40-00N, 144-25E	36-35N, 141-50E	F	—	10.8	—	—	—	
650332	23/8/66	20/12/69	3	40-01N, 144-04E	36-05N, 141-43E	—	—	—	—	—		b)
650335	23/8/66	9/9/66	0	40-01N, 144-04E	39-30N, 143-37E	F	—	11.0	—	—	—	
650801	30/6/66	-/6/68	2	28-59N, 165-06E	(48-54N, 165-39E)	—	—	—	—	—		c)
650811	26/6/66	17/10/71	5	28-59N, 165-06E	41-30N, 144-18.5E	F	—	1.80	—	—	—	
650924	5/9/67	14/9/71	4	49-47N, 153-57E	37-11N, 142-25E	M	—	12.2	—	—		
651143	7/11/66	26/10/67	1	46-00N, 149-40E	38-09N, 144-40E	M	—	10.8	—	—		
651192	8/6/67	16/9/71	4	19-58N, 125-01E	36-27N, 141-32E	M	—	12.5	—	—		
651212	18/5/67	6/9/67	0	32-05N, 154-19E	42-23N, 146-16E	F	—	0.7	—	—	—	
651216	19/5/67	13/9/69	2	30-36N, 156-05E	37-42N, 142-30E	F	—	10.7	—	—	—	
651220	18/5/67	11/9/67	0	32-05N, 154-19E	42-30N, 146-19E	M	—	11.0	—	—		
651222	19/5/67	14/9/71	4	30-36N, 156-05E	37-07N, 141-43E	M	—	10.7	—	—		
Unknown species												
1550	—	2-19/8/63	—	—	Japanese coastal	—	—	—	—	—		c)
1812	—	-/8/69	—	—	Pelagic ground	—	—	—	—	—		c)

Remarks: Notations of symbols are the same as shown in Appendix table IV.

Appendix table VI. Canadian and USA whale marks recovered by Japan in the North Pacific during the years 1963–1972.

Mark no.	Date marked	Date recovered	Years	Position marked	Position recovered	Sex	Length (A, m)	Length (B, m)	Testes(kg) Ovaries	Age (Years)	Foetus (cm)	Remarks
Fin whales												
A 78	18/1/64	19/6/65	1	33-09N, 120-50W	56-18N, 141-21W	F	19.1	18.4	1-0, 0-0	—	Unknown	
A 290	27/2/65	16/7/71	6	25-44N, 113-13W	Pelagic ground	—	—	—	—	—		c)
A 613	11/12/65	14/7/71	6	32-40N, 119-25W	49-32N, 138-45W	M	—	17.4	3.8, 3.8	10		
Sei whale												
A 472	—	25/7/69	—	—	47-43N, 140-15W	—	—	—	—	—		a)
Fin or sei whale												
C 53	—	8/9/66	—	—	Pelagic ground	—	—	—	—	—		c)
Sperm whales												
A 439, 444	10/12/65	17/7/71	6	32-58N, 120-43W	48-35N, 131-26W	F	—	11.6	0-5, 0-3	—	None	
C 473	27/3/65	11/6/66	1	49-28N, 128-30W	51-45N, 173-30W	M	14.0	12.1	18.0, 17.3	—		

Remarks: A: USA mark, C: Canadian mark, Notation of other symbols are the same as those shown in Appendix table IV