RYUKYUAN HUMPBACK WHALING IN 1960

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INTRODUCTION

Accepting the invitation from the Government of Ryukyu Islands at the opening of the third Ryukyuan whaling since their regularization, the author had been engaged in the biological investigations about four months starting on December 16, 1959. Among this year's catches were 167 humpback whales, 14 sperm whales and one Bryde's whale. The author wishes to make a study of the humpback whale in this paper.

METHOD OF INVESTIGATION

In the Antarctic and the Aleutian Expedition there are a great deal of catches and a short time available in dealing with each of them. Therefore, a close and exact investigation has not been made and we usually concentrate on a few necessary items with the accumulated data for ten and some years and make a good result. On the other hand in Ryukyuan waters where there are a less amount of catches and more time available for each of them, we have decided to make a similar close investigation to that of 1959 on the earnest proposal of the Government of Ryukyu Islands to develop fundamental methods in whale research.

OUTLINE OF THIS WHALING SEASON

The season in 1959 began on 7th January, but by that time a fairly arge number of humpback whales had already been found to be migrating. In this respect this whaling season was to begin on December 15, 1959. Though the whaling operation and scouting started on that day, we could get the first catch on 28th of December. The ships leaving Japan for Ryukyu in the beginning of December could find no whales before that time, and it was impossible to carry out the marking project. After 28th of Dec. we did not get the consecutive catches, and as Fig. 1 shows, we had only a few catches in December and January. Scouting was done with great effort and there was some anxiety that the humpback whales were already exhaustible.

While the humpback whaling was very dull, sperm whale scouting was done around the 20th January with the major tide. It is a matter for congratulation that a school of about 30 middle-sized sperm whales was

encountered and 14 of them were caught. In the following major tide, the author was requested to scout sperm whales, but it is to be regretted that active scouting was not done for the main purpose of catching humpback whales. A Bryde's whale was caught by chance on March 4, and we did not dare to scout the whale positively. It is, however, sincerely expected that the two species play an important part in the future Ryukyuan whaling.

In February the amount of catches rose favorably. It is not a rare phenomenon that the activity of marine animals is subject to the tidal and lunar rhythms. Reaching the conclusion that the whales, especially in case of coastal migration, must be subject to these changes, the author has shown the data of three-year catches applied to the lunar and solar calendars in Fig. 1.

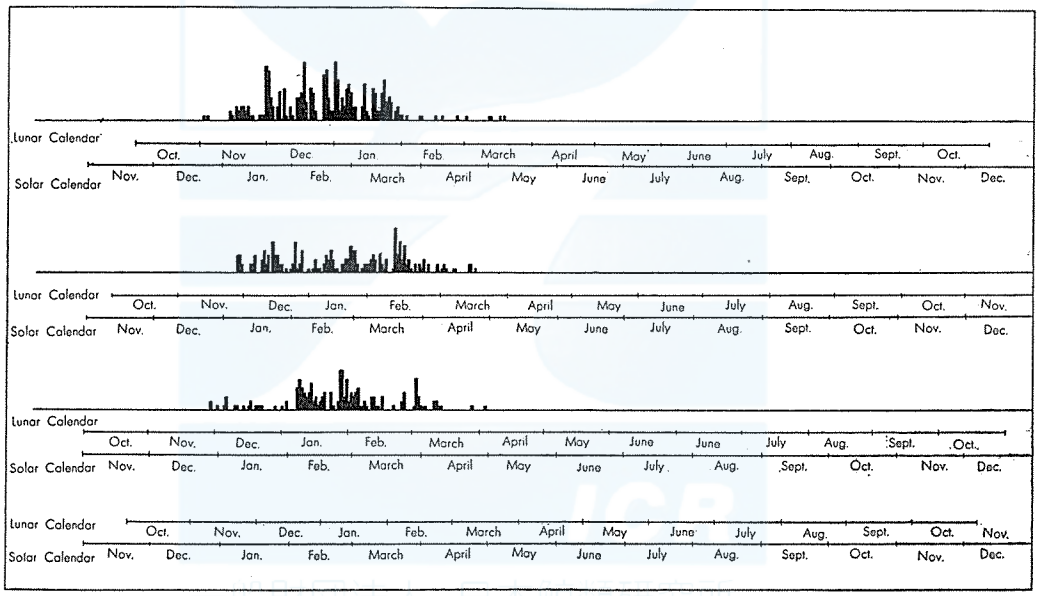

Fig. 1. Daily catches according to lunar and solar calendar.

The season both in 1958 and 1959 was in full swing early in December according to the lunar calendar. The migration which comes round every twelve months is apt to occur earlier. It has something to do with water temperature and it must be regulated in nature, as there is a regulator in a leap year.

It is considered that there is some difference in the occurrence of migration period, and that whales come round just at a suitable temperature. The time of migration does not change by days, but by a month in relation with the major and neap tides.

In this way it is reasonable to think that the migration of main groups this year occurred not in the beginning of December, but in the beginning of January in the lunar calendar. The beginning of January in the lunar calendar referred to the beginning of February in the solar calendar.

The cause for the small amount of catches in that year is the scarce source of whales in the sea, as well as the disagreeable weather.

There were many windy days when the catcher boats could not find a blow as the sign of the appearance of a whale and therefore could not get any catches. This seems the main cause of the poor catch in the middle of February and also in the middle and at the end of March. The staying period of the main group was considered to be until the end of February in the lunar calendar, according to the two-year data, and so this year it was to be until the first decade of April. This year there ware comparatively some catches before 9th of April, but after that we could get nothing but two whales for 20 days between 10th and 29th of April.

COMPOSITION OF CATCH

In Table 1 there is a classification of the body length and physical condition. The male whose testis on either side is about 2.0 kg in weight is defined as mature. The female whose ovary contains neither new nor old corpus luteums is defined as immature. Some of them whose Graafian follicle was more than 30 mm in diameter was defined as puberty.

In the mature females, the stage was divided into three; the *first ovulation stage* where a female whale has a new corpus luteum (sometimes two new corpora lutea are found), the *ovulation stage* where she has both a new (sometimes two) and some old corpora lutea, and the *resting stage* where she has some old corpora lutea and her Graafian follicle is less than 30 mm in diameter. The female whose Graafian follicle is more than 30 mm in diameter, though she has only some old corpora lutea is included in the *ovulation stage*.

The *lactating whales* were defined as those who were found to be capable of secreting milk in mammary glands and who did not have any new corpus luteum or a Graafian follicle more than 30 mm in diameter. As the results of these definitions it was believed that from the process of the development of a Graafian follicle, existence or non existence of the new and old corpus luteum, the diameter of the old corpus luteum in a breeding area which different from a feeding area in the Antarctic or the Aleutian waters. The author divided into two groups; the first group who brought up the calves last year and have

TABLE 1. SIZE DISTRIBUTION OF THE WHALES CAUGHT ACCORDING TO PHYSICAL CONDITIONS

Body length in feet	Male whale			Female whale								Grand total
						Mature						
	Immature	Mature	Total	Immature	Puberty	Ovulating		Resting	Lactating	Sum	Total	
						First	Multipola					
28				1							1	1
29												
30												
31	1		1									1
32	2		2	2							2	4
33	2		2	1							1	3
34	2		2	3							3	5
35	8		8	10							10	18
36	11		11	7	1						8	19
37	3	3	6	5	3						8	14
38	3	2	5	4	1						5	10
39	3	2	5	2	3	1	1			2	7	12
40		4	4	1		1			1	2	3	7
41	1	4	5	1		3	2	2	3	10	11	16
42		4	4				4	4		8	8	11
43		6	6			1			3	4	4	11
44		1	1				6		1	7	7	8
45		2	2				7	1	1	9	9	11
46							5		3	8	8	8
47		2	2				2			2	2	4
48							1		1	2	2	2
49							1			1	1	1
50												
51									1	1	1	1
Total	36	30	66	37	8	6	29	7	14	56	101	167
Average length	35.5	41.4	38.3	35.8	37.8	40.8	44.8	42.1	44.1	43.7	40.3	39.6
Sex ratio			39.5				43.8				60.5	100.0
Maturity rate	54.5	45.5	100.0	36.7	7.9	(5.9	28.7	6.9	13.9)	55.4	100.0	
Rate of ovulation							62.5			100.0		
Rate of lactating									25.0	100.0		
Rate of under size	10.6		100.0	6.9							100.0	

Rate of under size for total animals was 8.4%, and rate of immature animal was 43.7%.

weaned them this year and the second group who have been delivered of the calves and have been bringing them up this year.

In comparison of the results in 1959 and 1960, sexually immature whales, 32.3% of all in 1959 went up to 43.7% in 1960. This cause does not consist in the small difference of the female rate, 36.7% this year against 36.5% in 1959 but in the increasing rate of males, 54.5% this year against 36.2% in 1959.

It is known according to the investigations on humpback whales in Ryukyuan waters in 1959 and also in other waters that the migration begins with the young male group. Therefore in the season like that of this year when whaling started at the beginning of migration, it was considered that the rate of immature males increased. In the same reason there are naturally many whales whose body length are under the limitation, and it is attributed to this that the rate of under sized whale, 3.7% for 1959 went up to 8.4% for this year.

Fig. 2 shows the items in Table 1 according to the period. The period was classified by each month in 1959, but this year by the peak of the catches. There are four peaks; from Dec. 28th to Jan. 31st, Feb. 1st to Feb. 22nd, Feb. 23rd to March 18th, March 19th to April 29th. In the first period as explained before, there are many immature groups, especially immature males.

As the season goes on, the average body length becomes longer, and it is easily understood that the male body length in the first period is short. Also the mature female whales increase in number, especially the rate of the lactating whales increased with the advance of period. This explains as last report, that the whales remaining to die in these waters are the females which have been delivered of the calves and have been bringing them up this year. Judging from this phenomenon, the delay of the season gives an unfavorable influence on the resources.

One more data for the early start of this season in comparison with the whale migration is the periodic change of the thickness of blubber. The measured thickness of blubber divided by body length was calculated and averaged in each period in Fig. 3. In the arrangement of data in 1959 and 1960 (according to the lunar calendar), not only the trend of the decrease but also the rate of value against the body length is the same in both years. Particularly the data on males is quite similar. It is proved by many species that the relationship between fatness and thinness follows a way by the migration. Though blubber becomes thinner while migrating in these waters, this year the catch started in the period when it was thicker than last year.

The other items which are shown by the change of blubber thickness

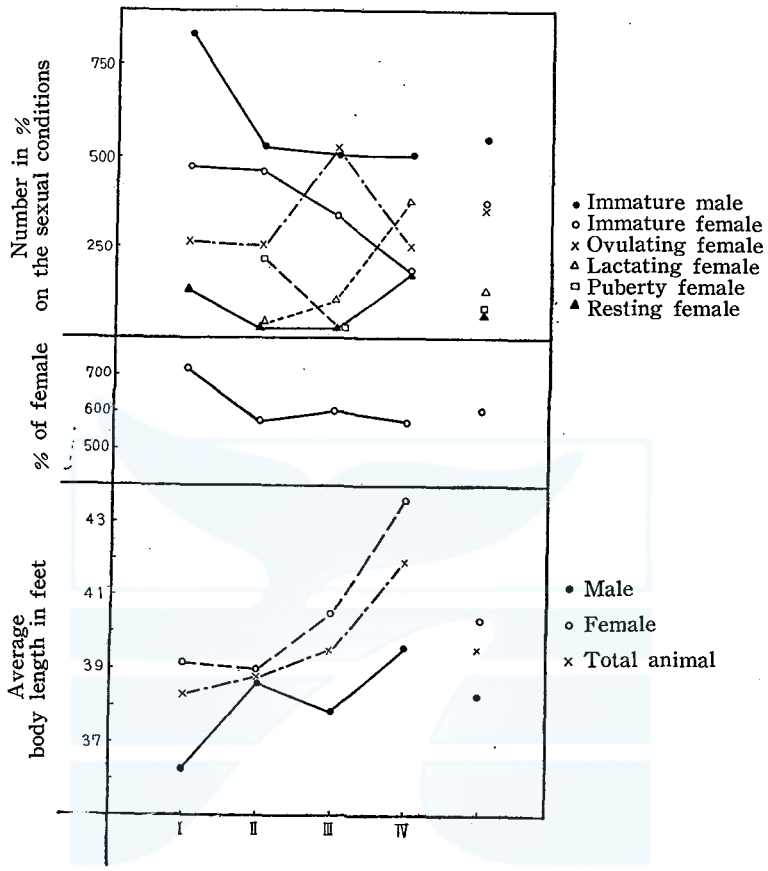

Fig. 2. Average length, sex ratio and percentage of sexual conditions on each period.

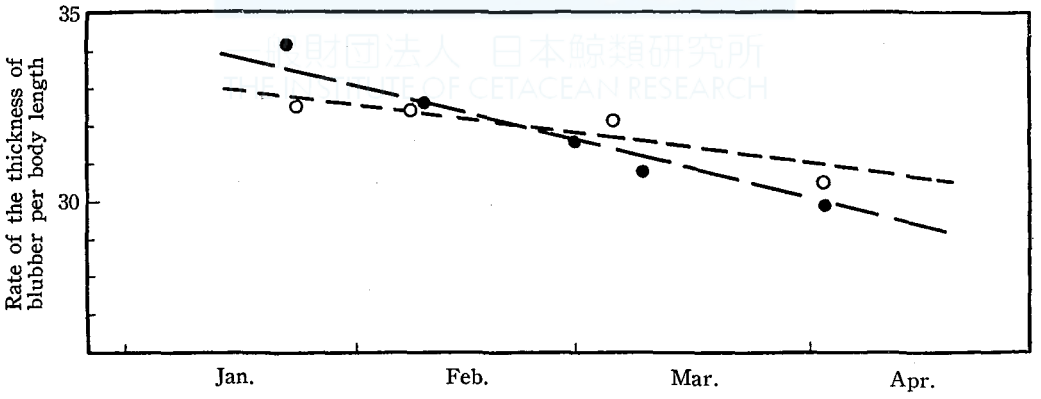

Fig. 3. Monthly decreasing rate of the thickness of blubber.

quite agree with the last report, as the explanation is omitted.

EXAMINATION FROM GENITAL GLANDS

The weight of the testis was all measured this year and gave almost the same result as that of the data for 1959. Fig. 4 is shown the

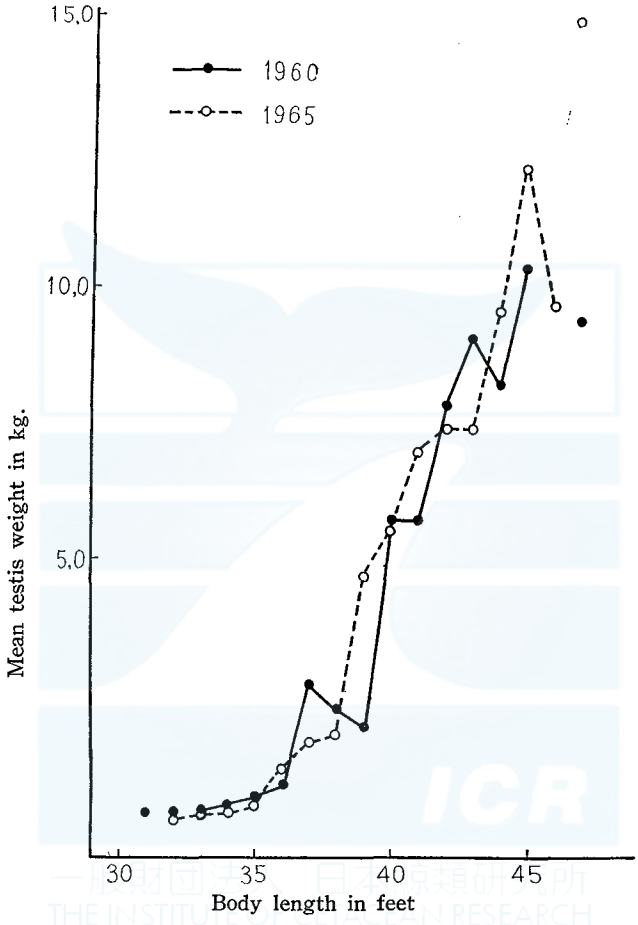

Fig. 4. Geometric means of testis weight according to body length.

geometric means of testis weight according to the body length. On the supposition that the testis weight, when the whale gets sexually mature is 2.0 kg, the mature body length is between 37 and 39 feet. In female, the relationship between body length and total ovulation numbers is shown in Fig. 5, and the body length at the sexual maturity is between 39 and 40 feet. Other items are all similar to those in 1959.

Not a single data is found to change the schematic figures of the

humpback stock in Fig. 6 of the last report (in the Scientific Reports of the Whales Research Institute, No. 14) which was studied mainly from the physiological point of female whales.

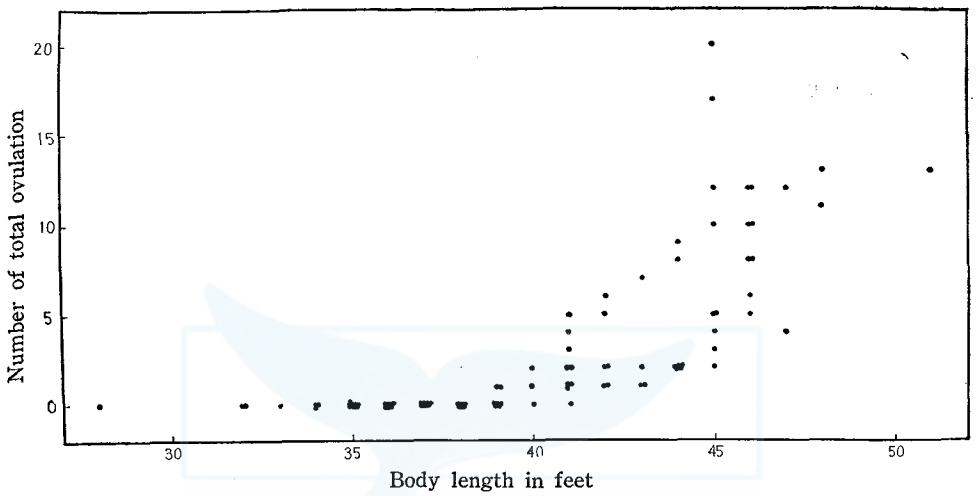

Fig. 5. Relation between body length and total ovulation number.

RELATIONSHIP BETWEEN BODY LENGTH AND EAR PLUG

The relationship between body length and ear plug is shown in Fig. 6. The mean growth curve in this figure is taken from the report for 1959, and it is understood that the data both last year and this year show the same result. The fact in these items shows that the group of humpback whales migrating in the Ryukyuan waters this year is no other than the North Pacific stock of humpback whales of those previously reported.

STOMACH CONTENTS

No food has been found in the stomach under the investigation before April, and two samples were found to contain small shrimp type Crustacea in April. It was after the author left the islands, and the specimen were not checked. They, however, seems to be *Euphausia similis*, and the whales perhaps start feeding about this time of the year.

PARASITIC ANIMAL

The infection rate of the parasitic animals, being similar to that of 1959 leaves nothing to be explained. The data giving the effective suggestions on migration were not available, but it was a rare case that some *Nematoda* species were found in the stomach and intestine of a whale.

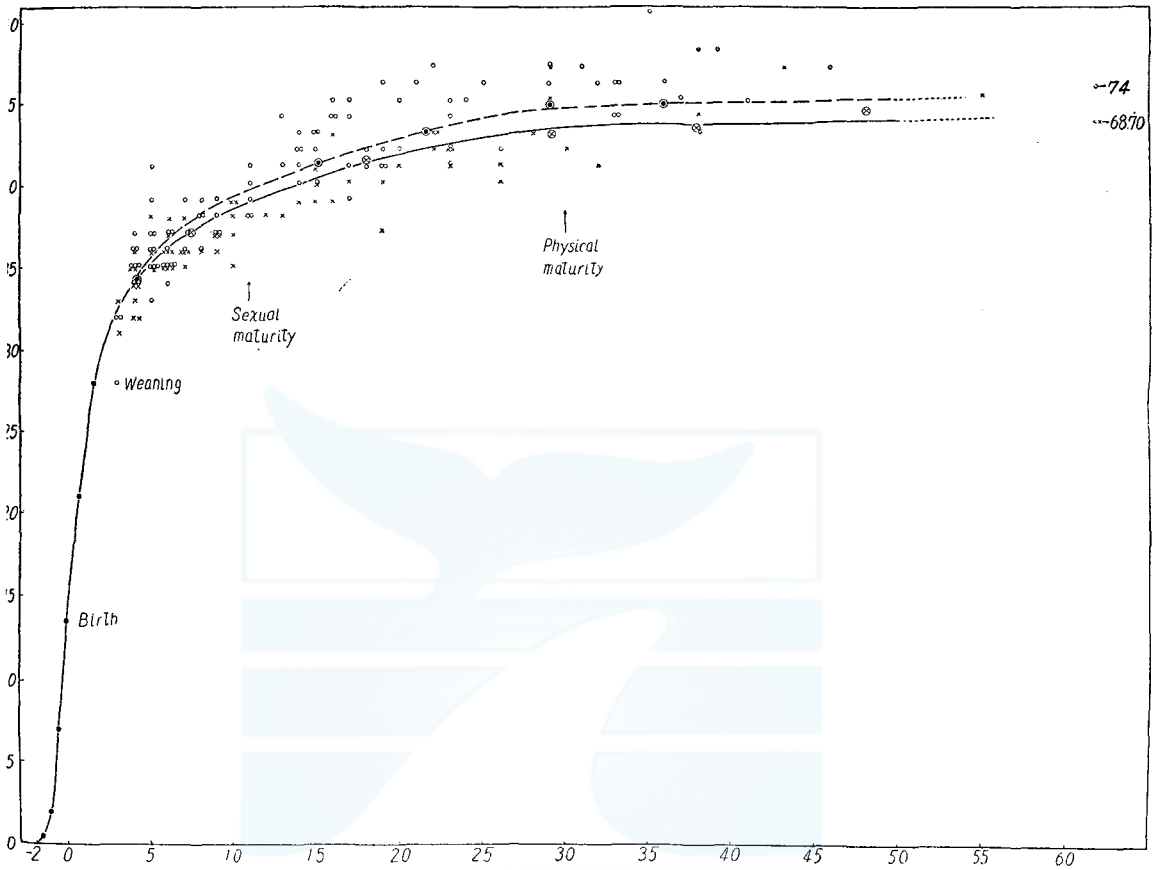

Fig. 6. Growth curve of body length according to the number of laminations in ear plug (age).
Cross and solid line: male, open circle and broken line: female.

BODY COLOUR

In Table 2 there is a classification of white pattern distribution on the abdominal side according to the same standard in 1959. In the grade 1 or the black humpback group the percentage of occurrence is quite similar in these two years. In the grade 2 decreased it in this year, and in the grade 3 increased.

It is interesting to notice the tendency that there are more females than males with white pattern on the abdominal side in both years, but it is difficult to discriminate the migration groups only from this data.

TABLE 2. OCCURRENCE OF BODY COLOR OBSERVED

Period	Sex	Grade of body color 1	2	3	4
Dec. 28 ~ Jan. 31	Male	6	0	0	0
	Female	12	1	2	0
Feb. 1 ~ Feb. 22	Male	23	0	0	0
	Female	26	4	1	0
Feb. 23 ~ Mar. 18	Male	23	1	1	0
	Female	36	1	2	0
Mar. 19 ~ Apr. 29	Male	12	0	0	0
	Female	16	0	0	0
Total	Male	54	1	1	0
	Female	90	6	5	0
	Animal	144	7	3	0
% of occurrence		93.5	4.6	1.9	

FREQUENCY OF OCCURRENCE OF BLOOD TYPES AND MIGRATION OF WHALES

(Examined by Mr. Kazuo Fujino of our Institute)

The similar method to that in 1959 was used in classifying the blood types, from Type 1 to Type 4. In Table 3 is shown the frequency of occurrence of Type 4 was almost the same in these two years, but there was a considerable difference in the frequency of occurrence between Type 1 and Type 3.

As far as the recovered whales which had been marked were concerned, there were three in 1958, one in 1959 and one in 1960. The captured ones in 1958 and 1960 were all marked in the Aleutian waters

TABLE 3. FREQUENCY OF OCCURRENCE OF BLOOD TYPES COMPARED WITH THE LAST YEAR

Blood type	Occurrence 1959 Number	1959 Per cent	1960 Number	1960 Per cent
1	1	1.0	2	2.35
2	4	4.0	8	9.4
3	7	7.0	2	2.35
4	87	87.0	73	85.9
5	1	1.0	0	0.0
2 or 3	100		85	

in 1956. The captured one in 1959 was marked in the same area in 1954. In 1954 there were much more marked whales than in 1956. If the humpback whales from the North Pacific consist of the only one population to mix equally and migrate together, it is said with safety that several of the marked whales in 1954 ought to be recovered.

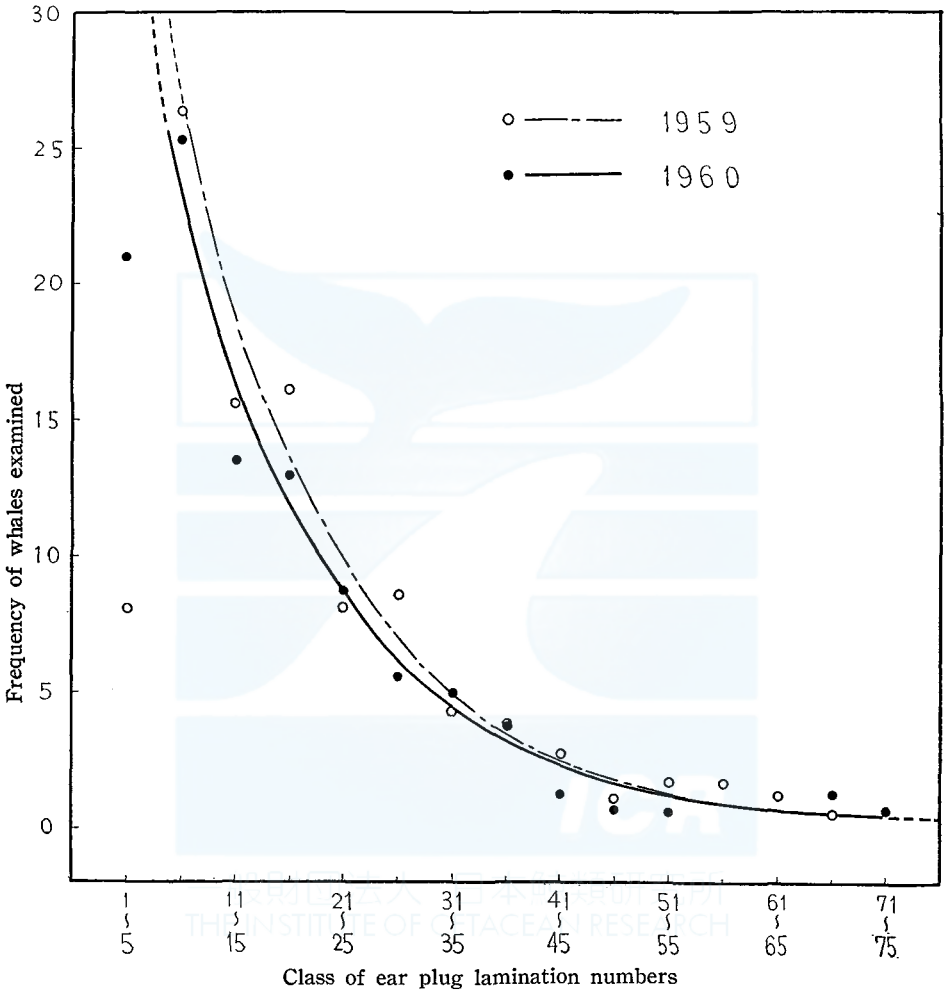

Fig. 7. Frequency curve of whales caught according to ear plug lamination.

If the mixture is equal in the blood type, the frequency of the occurrence also ought to be similar, too. It is presumed by the difference of the recovering rate of marked whales and the rate of occurrence of the blood types in both years that the captured group of the humpback whales migrating in Ryukyuan waters in 1958 is the same group in 1960, being different from the group in 1959. In other words the humpback

whales from the Aleutian waters may be regarded not to be of one group but to be of the groups that migrate in turn every other years. In order to reach the conclusion the studies on the heredity of blood types and the marking investigations are necessary as well as the data collection in the Aleutian water.

PRESUMPTION OF STOCK FROM EAR PLUG SURVEY

The collection of ear plugs to supply us with the most suitable data on the age determination is due to the great cooperation of the Fisheries Agency of the Government of Ryukyu Islands as well as the recogni-

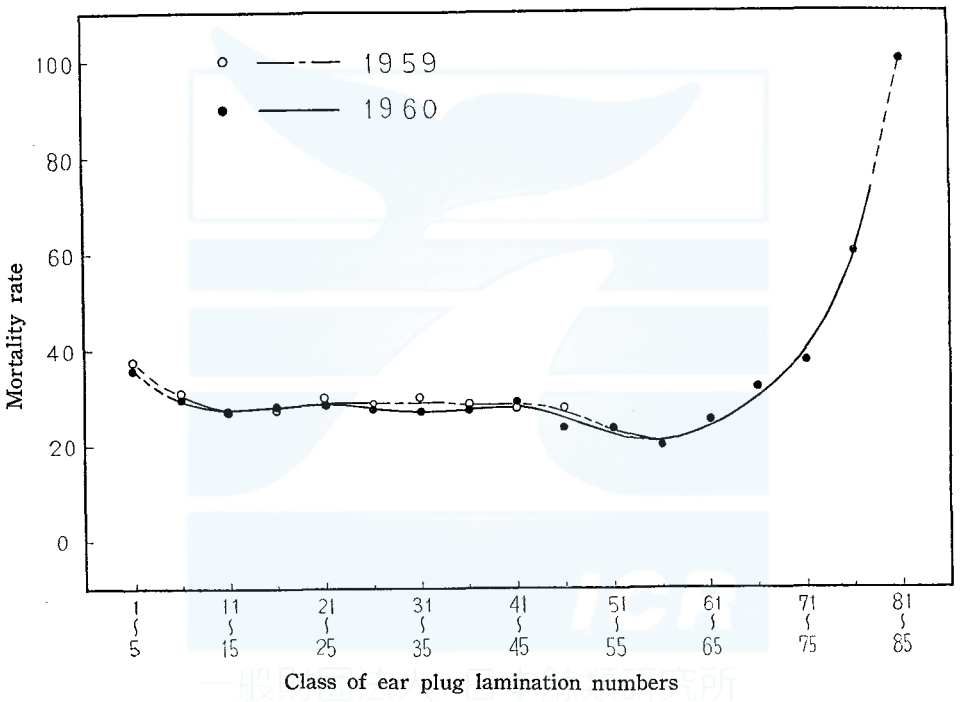

Fig. 8. Mortality curve according to ear plug lamination.

tion of its significance and the progress of collecting techniques. The data from the ear plugs of 162 whales among the 167 catches for this year has been used successfully.

Owing to the small number catches, individual data was summed up in each 5 laminations, and then the frequency was calculated. It was thus used to presume the stock of whales. In Fig. 7 is the frequency curve according to the ear plug laminations.

The mortality curve which was based on the above items is shown in Fig. 8. Both of these curves are quite similar to those of last year.

In Fig. 7 there is a small decrease. It is considered that, however, the effect of the present catches do not give a considerable decrease on the stocks.

CONCLUSION

The above mentioned results in each item have been summarized as follows.

1. It may be reasonable to think over the late migration of the humpback whales according to the lunar calendar. Therefore the migrating period of the main group in the next season will be from early in December to late in February in the lunar calendar, or from January 10th to the middle of April in the solar calendar.
2. Judging from the biological investigations, the humpback whales are apt to decrease in number year by year. The stock may not be small enough to be indicated by the catches. The main cause of the decrease of migrations (known by sights and catches) is an unfavorable weather especially an unusually greater amount of windy days when a blow could not be found.

   It is still unknown whether the humpback whales will be intelligent enough to change their migrating routes because of the increase of catching intensity. The further investigation is necessary to solve this problem.
3. This whaling season started too early and therefore they became impatient not to choose the whales. As a result this brought the decrease of average body length and the increase of the catching rate of immature whales.

   Afterward, a bad weather and strong wind at the time of the migration of the main group also brought the decrease of discoveries and of the catches, even per a catching effort. Therefore there was an increase of the catches below the catching limit, but fortunately they were only 8.4% of all. The main cause of the decreasing tendency of stocks which has been mentioned above must be taken great care of.
4. The whales before the main group migrate, mainly consist of young, small whales, as has been considered. The whales that remain after the main group is gone, are the females bringing up the calves. From this fact the best time of the seasons must be adequately chosen and the intensive operations must be made. The method of prolonging the season and spending as much as all gained ought to be abandoned without hesitation.

   There are usually male whales though young and small before the migration of the main group, and the early start of the season seems

to have little drop on the stocks.

5. Judging from the recoveries of the marked whales and the rate of occurrence of blood types, the same group does not migrate every year. If some groups migrate wilfully all over the North Pacific waters, and one of them migrates to the islands in turn, the stocks all over these waters must be taken into consideration.

In order to make these facts sure, it is necessary to continue whale marking in Ryukyuan, Aleutian and California waters and also to continue biological investigations. This requires a great deal of time, and if, for instance, during that time A and B groups among all that gather to the Aleutian area to seek for food, migrate to Ryukyuan waters, and C and D groups do not happen to migrate, it will be a serious condition to the Ryukyuan whaling.

The safety operation is to be made if the quota is fixed against the worst conditions. It is important after all to find the standard numbers of migrating whales in the Ryukyuan waters. In this season the decrease of discoveries which occurred by many causes increased catching intensity a good deal. As a result the profit was not large in proportion with the expense. The whale stocks are limited and therefore the profitable operations must be made.

In order to make this possible, incooperation of the organizations, decrease of the number of catches, and use of small numbers of excellent boats are thought necessary.

ACKNOWLEDGEMENT

In concluding the report for the season of 1960, the author wishes to thank every one concerned for his kindnesses suggestions and assistances. All the efforts that the officials of USCAR had to make the Ryukyuan whaling an enduring industry set a good example to us, and they were heartedly appreciated.

The author must particularly acknowledge his request of the cooperation of the U.S. helicopter troop. With this, our work proved more fruitful than last year.

The author has a great admiration for the earness of the Ryukyu Government officials to the development of the whaling industry, which can be grasped through the mastery of the techniques by the whaling inspectors and their fine leadership given to the Fisheries Agency, and besides this he expresses his hearty thanks for their cooperation to the investigations.

Great thanks are also due to each member of the Ryukyuan whaling association who has always given a big favor in spite of the unexpected

depresses operations.

The author is quite indebted as well to the Ryukyu Suisan Company for their kindness in keeping the frozen blood and to Mr. Rikio Kuroiwa director of Nitto Whaling Company for carrying the samples to Tokyo with him by airway.

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