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Estimation of pregnancy rate of the western North Pacific Bryde's whale

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ABSTRACT

The pregnancy rate and some behaviors related to the reproduction are examined for the western North Pacific Bryde's whale stock using biological data collected by the Japanese Whale Research Program under Special Permit in the North Pacific (JARPN II) in 2000-2005. The Bryde's whales appear to have a long breeding season. The body length at birth is estimated at 384 cm, and the body length at weaning at about 860 cm. The pregnancy rate of this whale stock is estimated at 55-59 %, and lactation rate of mature females at 29-32 % in the feeding ground. The breeding cycle of this stock is estimated at 1.7-1.8 years.

KEYWORDS: BODY LENGTH AT WEANING, BREEDING CYCLE, BRYDE'S WHALE, LACTATION RATE IN FEEDING GROUND, PREGNANCY RATE, WESTERN NORTH PACIFIC

INTRODUCTION

IWC/SC is now developing the *IST* of the RMP for the western North Pacific Bryde's whale, and a workshop was held for completing the *pre-implementation assessment* in Tokyo in March, 2005 (IWC, 2005). At that workshop it was suggested to prepare the data on the breeding cycle and range of MSYR for the future work (IWC, 2005). For this objective it is necessary first to obtain the value of pregnancy rate.

One of the methods to estimate the breeding cycle and birth rate is by mean of the long time observation of identified individuals. However this kind of non-lethal method is not practical because many baleen whales have large population size, are pelagic, and exhibit large scale migration. Then lethal method involving the examinations of internal tissues are more adequate to estimate those biological parameters.

It is practically difficult to estimate a true pregnancy rate for above kinds of baleen whales, without the conduct of research for all the year round. As pointed out by Omura (1962)、Ohsumi (1977)、Kato and Yoshioka (1993; 1995), the long breeding season of the Bryde's whale makes difficult to estimate the true pregnancy rate for this species.

There are several papers on the pregnancy rate of the Bryde's whale based on the analyses of commercial whaling data (Omura, 1962; Ohsumi, 1977; Yoshioka, 1989; Kato and Yoshioka, 1993; 1995). However, these data come from the whaling operation in which various regulation measures were forced. It has passed about 20 years after the moratorium of commercial whaling, and it will be needed to estimate recent figure on the pregnancy, as the population condition may have changed during the years.

Japan has been conducting the Japanese Whale Research Program under Special Permit in the North Pacific (JARPN) under Article VIII of the International Convention for Regulation of Whaling since 1994, and the collection of samples of the Bryde's whale started in 2000 as the second stage of the research program (JARPN II).

The objective of this paper is the estimation of the pregnancy rate of the western North Pacific Bryde's

whale by using data collected by JARPN II.

MATERIALS AND METHODS

Materials

Among 293 Bryde's whales collected by JARPN II during years 2000-2005, 113 sexually mature females and 9 suckling calves are used for the analysis. Samples were collected during seasons from late May to middle September, in the area comprised between 35°- 42°N, 143°-170°E.

Fifty Bryde's whales have been sampled annually in the JARPN II. Cow and calf pairs were collected in 2000 and 2001, but since 2002 cow calf pairs have not been targeted for sampling. Therefore, it will be needed to separate the period 2000 and 2001 from 2002 onward for the examination of the pregnancy rate.

Various kinds of measurements and collection of samples from whales caught by the sighting/sampling vessels (SSVs) are carried out on board of a research base ship. In this paper the following data were used for the analysis: date of catch, sex, corpora lutea and albicantia, lactation, sex and body length of fetus.

Methods

The sexual maturity of females is determined by the existence of corpus luteum or corpus albicans in either side of the ovaries. An individual which has a corpus luteum in the ovaries but no fetus is found in the uterus is classified as an ovulating animal. However, this animal is regarded as an early pregnant whale, considering the breeding behavior of this whale species. A pregnant whale is a female with a fetus in its uterus. A lactating whale is a female in which milk is found in the mammary gland. Pregnancy rate is defined as ratio of pregnant or ovulating whales in mature female.

RESULTS

Growth of fetuses and suckling calves

Fig. 1 shows the relationship between dates and body length of fetuses and suckling calves. In this figure, the dates of suckling calves are set at one year later, because they are regarded to be pregnant in the previous year.

The maximum body length of fetuses is 376cm, and the minimum body length of sucking was 670cm. The present samples are collected from the feeding ground, and a new born calf has not been reported yet, but the body length at birth will be between these two lengths. On this regard, Ohsumi (1966) found the interspecies relationship between the body length at sexual maturity of the female and body length at birth. As Kato and Yoshioka (1995) estimated the body length at sexual maturity of female Bryde's whale from the western North Pacific at 11.6-11.8 m, the body length at birth of this whale is calculated at 384cm by the formula of Ohsumi (1966). This figure is consistent with the actual figures above.

Furthermore, Fig. 1 indicates that the pregnant whales migrate to feeding ground just after the mating in the breeding ground and stay in the feeding ground until just before the calves are born.

Considering the fact that it is difficult to find embryo just after the mating, Fig. 1 shows ovulating whales as a whale which has o cm long fetus. As some ovulating females are found in middle September, it can be regarded that the breeding season of the western North Pacific Bryde's whale is long, and it lasts from winter to the beginning of autumn.

It is estimated from Fig. 1 that the delivery season occurs from August of a year to May of the next year, and its peak is in December. And, from this figure it is estimated that there are some whales which fertilized in the last year in the research season. Although it is difficult to estimate pregnant period from this figure, it is estimated to be 11-12 months by use of estimated body length at birth and pattern of seasonal distribution of fetal length.

There are lactating whales which are simultaneously pregnant. Comparing these whales with usually pregnant whales, there is no difference in the fertilization date each other. This indicates that there are

some whales which become pregnant just after the delivery in the breeding season.

The smallest calf with its cow was 676 cm, and there is relatively large gap from the body length at delivery, although breeding season is long. This may indicate that cow and calf pairs stay in the breeding ground for a while after delivery before moving to the feeding ground.

It has been recognized that the weaning body length of calves is about two times of the body length at birth in cetaceans. However, the body lengths of two suckling calves were 854 and 857 cm, respectively, among 9 cow and calf pairs. This result indicates that the weaning body length of the Bryde's whale is larger than two times (770 cm) of the body length at birth, and it has a possibility to be around 860 cm.

Furthermore, from Fig. 1, the lactation period of the Bryde's whale is estimated to be at least 7 months which is longer than 6 month as considered previously.

Compositions of reproductive conditions of adult females collected

Lactating females (L) which were collected by JARPN II are classified into four categories by the existence of calves (C) and pregnancy (P). They are lactating simultaneously pregnant with calf (L+C+P), lactating simultaneously pregnant (L-C+P), lactating with calf (L+C-P), and lactating without calf (L-C-P).

As mentioned in the section of Materials, cow and calf pairs were sampled in 2000 and 2001, and such kind of sampling has not carried out since 2002. Therefore, it will be needed to separate two periods for the examination in this paper. Table 1 shows the composition of adult females by sexual conditions. In this Table, P indicates pregnant, O indicates ovulating, L indicates lactating, C indicates calf, and R means resting.

The apparent pregnancy rate in the later period (70%) is higher than that in the former period (59 %). It can be estimated that the pregnancy rate in former period indicates the un-biased value, because no restriction was applied to sampling of cow and calf pairs. On the other hand, the higher figure in later period is caused by the exclusion of catch of cow and calf pairs, and then it is needed to correct the figures to estimate un-biased pregnancy rate.

For this purpose two kinds of correction method are used here. One (method 1) is the value of P in 2000 and 2001 is set as the standard of pregnancy rate, and the figures of each reproductive condition in 2002-2005 is corrected by proportional distribution (51 %/63 %), then the figure of (L+C-P) is obtained as the difference of accumulation of each condition from 100 %. The result is shown in Table 1. Another method (method 2) is the correction of pregnancy rate in 2002-05 based on the figure of (L+C-P) to total figure in 2000-01. The corrected figures of each reproductive condition are shown also in Table 1. Thus, comparing the pregnancy rates (P+O+(L+C+P)+(L-C+P)) after correction, it is 59% in the former period and 57 % or 55 % in the later period. They are almost the same each other. Furthermore, when the lactation ratios ((L+C+P)+(L-C+P)+(L+C-P)+(L-C-P)) are calculated, the former is 30% and the latter is 29 % or 32 %, respectively. They are also close each other.

Pregnancy rate and breeding cycle

Therefore, it will be concluded that the pregnancy rate in the research area is 55-59% recently. However, as it can be considered that the pregnant whales which are just after fertilization or just before the delivery may leave the feeding ground, the true pregnancy rate may be higher than these figures. On the contrary, some cow and calf pairs may remain around the breeding ground, and this may be a factor to reduce the apparent figure of pregnancy rate. Considering these phenomena which are possible, the above figures (55-59 %) will be close to the true pregnancy rate compensating both factors.

As the breeding cycle is a reciprocal number of the annual pregnancy rate, it is calculated to be 1.7-1.8 years for the western North Pacific Bryde's whale.

DISCUSSION

A biological characteristic of the western North Pacific Bryde's whale in the estimation of pregnancy rate is that the breeding lasts for long season. As shown in Fig. 1, this whale stock has a possibility to breed though the year, although the peak is estimated to be in winter. Therefore, it will be ideal to conduct research in all life ranges and seasons. However, the research period in this paper has been from late May to middle September and the research area has been north of 35 N and west of 170 E.

On the other hand, we were able to collect valuable research data, which could not be obtained by the commercial whaling, in 2000 and 2001. It was the sampling of cow and calf pairs. As the sampling of such pairs has not carried out after 2002, the composition of sexual conditions has been changed. As the result, the apparent pregnancy rate increased to 70 % after 2002 from 59 % in 2000 and 2001. A figure of pregnancy rate of 76.5 % which was reported by Yoshioka (1989) was the result that the cow and calf pairs were prohibited to be caught in the commercial whaling by the IWC, and the apparent pregnancy rate which is obtained by commercial whaling has a possibility to be higher than true value is shown in the present study.

Some papers report on the pregnancy rate of the western North Pacific Bryde's whale. Omura (1962)'s figure of 42.9 % comes from small number (28 whales). Ohsumi (1977a) reports a figure of 41.7 % is excluded the ovulating animals, and when the ovulation rate (5.1 %) is included in the pregnancy rate, the revised pregnancy rate becomes 46.8 %. Yoshioka (1989) reported that apparent pregnancy rate of 76.5 %. Furthermore, Kato and Yoshioka (1993) describe that the pregnancy rate is most likely about 60 % for the western North Pacific Bryde' whale. This figure is close to the present result.

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Table 1. Comparison of reproductive conditions of mature female Bryde's whales which were collected by JARPN II.

	Sample size		Ratio (%)			
	2000-2001	2002-2005	2000-2001 (A)	2002-2005 (B)	Correction of B by method 1	Correction of B by method 2
Preg.	19	48	51.4	63.2	51.4	49.5
Ovu.	2	4	5.4	5.3	4.3	4.1
Preg. & Lact. & calf	0	0	0.0	0.0	0.0	0.0
Preg. & Lact. & no calf	1	1	2.7	1.3	1.1	1.0
Lact. & calf	8	0	21.6	0.0	18.7	21.6
Lact. & no calf	2	9	5.4	11.8	9.6	9.3
Rest.	5	14	13.5	18.4	15.0	14.4
Total	37	76	100.0	100.0	100.0	100.0
Preg. Rate (%)			**59.46**	**69.74**	**56.70**	**54.66**

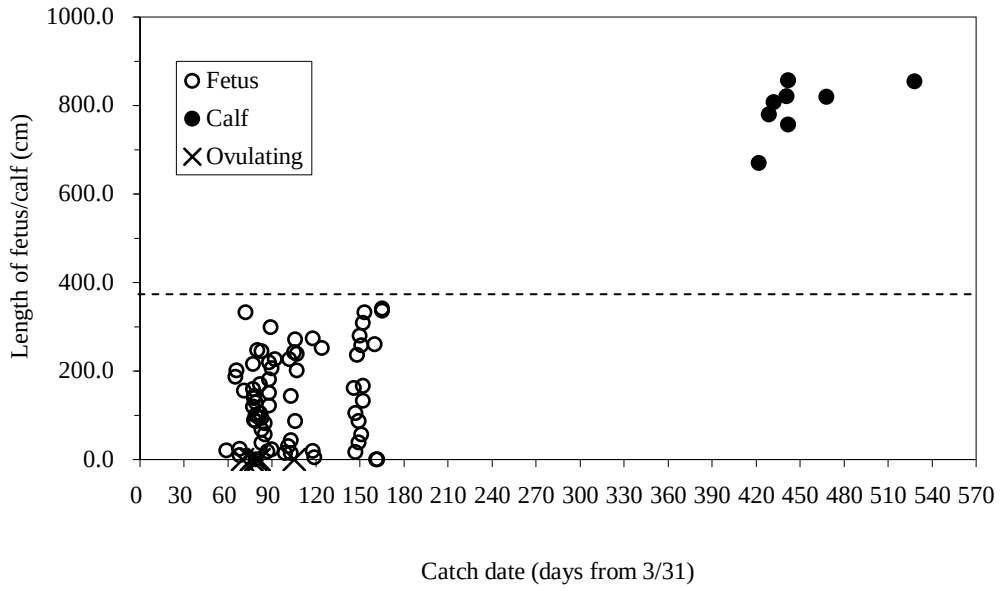

Fig. 1. Growth of fetuses and suckling calves of the western North Pacific Bryde's whale. Open circle: fetus, Closed circle: Calf, Cross: Ovulating, Dotted line: Length at birth (384cm).