An analysis of conception date of common minke whales sampled by JARPN and JARPN II in the context of stock structure hypotheses

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ABSTRACT

Stock structure of the North Pacific common minke whale was examined by distribution pattern of conception dates with DNA types, from the samples collected during 1994-2007 JARPN/JARPN II. J stock animals, which was assumed to distribute mainly in the Sea of Japan and sampled in sub-areas 7W and 11, showed extended periods of conception dates from autumn to winter. On the other hand, O stock animals, which were assumed to distribute mainly in the North Pacific and the Okhotsk Sea, had single winter peak of conception. J stock animals sampled in sub-area 7W had conception date of autumn and winter, which contradicts the hypothesis that different two stock (Jw, Je) exists in both side of Japan, one in Sea of Japan with bimodal distribution of conception dates and another in coastal area of Pacific side of Japan with only winter conception. Conception date of J stock animals sampled in sub-area 7W overlapped with that of J stock animals in sub-area 11, and O stock animals in sub-area 7W showed similar pattern with that in offshore sub-areas. These results indicate that two stocks, each has different conception period mix in sub-area 7W, which contradicts the hypothesis that intermediate Ow stock distributes in coastal area of sub-area 7. From the analysis of conception date, two stock hypothesis proposed by Pastene *et al.*, (2010) that one stock distributes in the Sea of Japan and another in the western North Pacific and Okhotsk Sea and each stock mix in coastal sub-area 7W and sub-area 11, is considered as the most plausible.

INTRODUCTION

Conception date of North Pacific common minke whale was examined by Matsuura (1936), Omura and Sakiura (1956), Wang (1985), Best and Kato (1992) and Kato (1992). Omura and Sakiura (1956) examined fetus length of whales taken in the Sea of Japan, East China Sea, Okhotsk Sea and Pacific side of Japan with catch date and found that there are two groups of fetuses one smaller and other bigger with conception dates of six month apart. Kato (1992) estimated conception date from fetal body length and found two peaks of conception in samples from southern Okhotsk Sea and the Sea of Japan, one in autumn and another in winter. Kato (1992) interpreted these results as a mixing of two stocks with different conception periods in these areas and proposed stock structure hypothesis that 'autumn breeding stock' distributes in Yellow Sea, East China Sea and Sea of Japan and 'winter breeding stock' distributes off the Pacific coast of northern Japan and both stocks mix in the southern Okhotsk Sea in early summer. Using this procedure, Kato and Best (1992) estimated proportion of each stock in several whaling grounds around Japan.

In the discussion of PIA of western North Pacific common minke whales in the 62IWC/SC, new stock structure hypotheses were proposed, and some of them used conception date as supporting evidence (IWC, in press). Analyses of conception date in the past were conducted for whales of different localities and no genetic information was available for these samples. On the other hand, JARPN/JARPN II surveys sampled 107 fetuses of common minke whales and genetic information was available for each samples. In this paper, we examined conception date of common minke whales by using samples collected by JARPN and JARPN II to examine the plausibility of some stock structure hypothesis proposed at the 62IWC/SC.

MATERIALS AND METHODS

Samples

Fetuses of common minke whales collected during 1994-2007 JARPN/JARPN II surveys were used in this study (Table 1).

Table 1. Number of common minke whale fetuses sampled by JARPN/JARPN II. Number of J stock animal is shown in parenthesis.

Survey		Sub-area				
		7W	7E	8	9	11
JARPN (1994-1999)	Offshore	6	0	3	13	17(8)
JARPN II (2000-2007)	Offshore	14	1	5	13	0
	Coastal - Sanriku	31(3)	-	-	-	-
	Coastal - Kushiro	4	-	-	-	-
	Total	55 (3)	1	8	26	17 (8)

Estimation of conception date

Conception date was estimated by the formula of Kato and Miyashita (1991), which was developed for Antarctic minke whales and used for common minke whale in Kato (1992). Number of days from conception was estimated from fetal body length by the following formula:

Fetal length less than 15cm : $t = 0.0655L^{2.676}$

Fetal length 15cm or more : $t = 1.622L^{0.892} + 74$

t: days from conception, L: body length of fetus (cm)

Conception date was determined from days from conception and date of sampling.

DNA typing

Each whale was classified into three DNA types, according to method established by Kanda *et al.*, (2009).

J stock: Assigned as J-stock with membership probability of over 90%

O stock: Assigned as O-stock with membership probability of over 90%

Type ??: Could not be assigned to stock with probability of over 90%

J stock and O stock animals were used in this study.

RESULTS AND DISCUSSION

Conception date of J stock and O stock animals

Conception dates pooled by 10 days were shown in Fig. 1. Sample size of J stock animal is 3 from

sub-area 7W and 8 from sub-area 11. Conception period of J stock animal spreads from August to March. Because coastal area of Pacific side of Japan and southern Okhotsk Sea is considered as northern limit of J stock whales migratory range (Hatanaka, *et al.*, 2010), whales collected in these areas might be stray and therefore might not reflect true conception period of J stock animals. Nevertheless, these data suggest the possibility that J stock animals have long conception season from autumn to winter.

O stock animals had single winter peak of conception, which consists with the 'winter breeding stock' in Kato (1992).

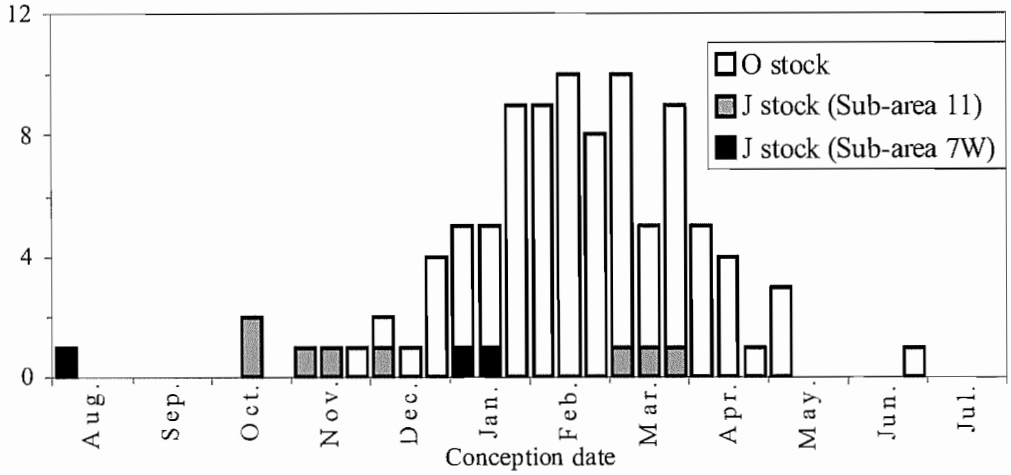

Fig. 1. Seasonal distribution of conception dates of common minke whales by stock

West coast of Japan vs east coast of Japan

Conception date of J stock animals sampled in sub-area 7W is shown in Fig. 1. One animal had conception date in August and two in January. One hypothesis proposed by Wade and Baker (2010) claims that different stock distributes on each side of Japan, because whales in the Sea of Japan had bimodal (autumn and winter) distribution of conception dates and single winter peak in Sanriku region. Although sample size is too small to reach conclusive decision, one whale in sub-area 7W with autumn conception suggests that the hypothesis of Jw and Je stocks is not supported by conception date.

Coastal SA7 vs offshore

Conception date of common minke whales sampled in sub-area 7W and offshore sub-areas are shown in Fig. 2. O stock animals in sub-area 7W showed similar conception period with animals in offshore areas. These results are consistent with a single O stock and mixing of J and O stock in coastal areas (Figs. 1 and 2), and contradicts the hypothesis of intermediate Ow stock in coastal sub-area 7 proposed by Wade *et al.*, (2010).

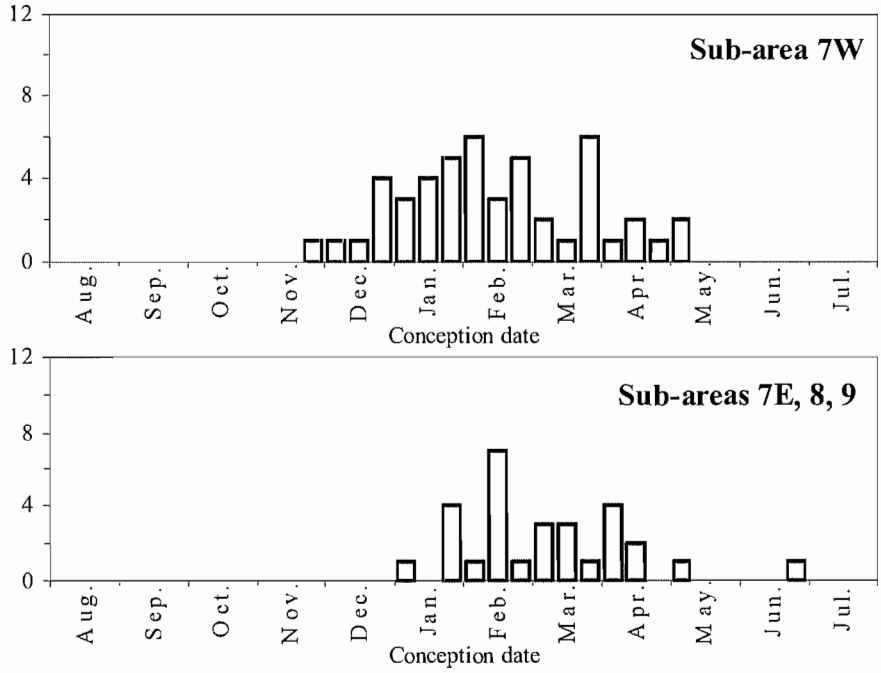

Fig. 2. Seasonal distribution of conception date of O stock common minke whales sampled in sub-area 7W and offshore sub-areas.

Plausible stock structure hypothesis inferred from conception date

J stock animals sampled in sub-areas 7W and 11 showed similar conception dates which spread from autumn to winter. On the other hand, O stock whales sampled in sub-areas 7, 8, 9 and 11 showed one peak of conception dates in winter. These results contradict with the hypotheses of two (Jw and Je) stocks distribute in each side of Japan and intermediate Ow stock in coastal area of SA7 proposed by Wade and Baker (2010). From the analysis of conception date, two stock hypothesis proposed by Pastene *et al.*, (2010) that one stock distributes in the Sea of Japan (J stock) and another in the western North Pacific and Okhotsk Sea (O stock) and each stock mix in coastal sub-area 7W and sub-area 11, is considered as the most plausible.

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