

**Brief review of the studies of feeding ecology in the minke whale
Balaenoptera acutorostrata from the western North Pacific prior to JARPN surveys**

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1. INTRODUCTION

This document reviews the available information prior to JARPN surveys of feeding ecology of the western North Pacific minke whale. This review is prepared as a background information for the discussion to be carried out during the Japanese Whale Research Program under Special Permit in the North Pacific (JARPN) review meeting.

2. BACKGROUND

This document contains information of feeding ecology of the western North Pacific minke whales until 1994 (prior to JARPN research). As a background for the review of the studies on feeding ecology of the North Pacific minke whale, we briefly described here three related major matters: prey species, feeding activity and food consumption of minke whales.

3. METHODOLOGY OF DATA COLLECTION AND ANALYSES METHODS

Omura and Sakiura (1956), Kasamatsu and Hata (1985) and Kasamatsu and Tanaka (1992) have made studies of the stomach contents of minke whales around coastal waters of Japan. They analyzed the prey species of minke whale using the catch data recorded by whalers. These records contained the following: name of vessel, time, location, species, sex, body length and stomach contents. Among the stomach contents data, prey species were identified and recorded. There were also records of empty stomachs, unspecified prey species and blank. These authors explained that there might be some cases where the kind of food has been miss-identified. They analyzed the geographical, seasonal and yearly change of frequency of occurrence of prey species consumed by minke whales in each whaling area. The study of quantitative of prey species of minke whales was none in the North Pacific. Nemoto (1959) and Kawamura (1980) reviewed the food of baleen whales in the World. They discussed the feeding type and kind of prey species of minke whale.

4. RESULTS OBTAINED OF THE FEEDING ECOLOGY PRIOR TO JARPN SURVEY

Betesheva (1954)

This report was from Soviet sources. The author reported the minke whale off the Kuril Islands in 1951 fed on walleye pollack (*Theragra chalcogramma*) and krill (*Thysanoessa raschii*).

Betesheva (1955)

This report was from Soviet sources. The author reported the minke whale off the Kuril Islands in 1953 fed on only walleye pollack.

Kimura and Nemoto (1956)

In this study the authors reported the information that the minke whale had been kept for about a month in the Mito aquarium. The whale attacked many mackerels in the same pool in the morning. The intervals between respiration decreased gradually as night came, but increased again after midnight.

Omura and Sakiura (1956)

This study made the prey species clear in each whaling ground used the Whaler's reports in 1953 and 1954. The 695 stomach contents data from Whaler's report collected in Japanese coastal whaling in 1953 and 1954 was described. In the West Kyushu, Wakasa Bay, Southern Okhotsk Sea and Sanriku coast, krill (or/and copepods) was the most important prey species. Atka mackerel (*Pleurogrammus azonus*) was reported only from the Sea of Japan coast of Hokkaido. In the Southern Okhotsk Sea and Pacific coast of Hokkaido, walleye pollock, Pacific cod (*Gadus macrocephalus*) or Pacific herring (*Clupea pallasii*) have been recorded. Squids are eaten in the Wakasa Bay, Sea of Japan coast of Hokkaido and Sanriku coast. Japanese anchovy (*Engraulis japonica*) have been recorded in all whaling areas.

Nemoto (1959)

In this study the author reported the reviews of food of baleen whales in the world. In the southern Okhotsk Sea in 1945, 9 minke whales fed on sand lance (*Ammodytes personatus*) and walleye

pollock. In 1953 - 1956, minke whales fed on only 1 euphausiids (*Euphausia pacifica*). The feeding type of minke whale was considered the euphausiids feeder and fish feeder.

Tomilin (1967)

This report was from Soviet sources. The author reviewed reports from Soviet sources. Off Sakhalin, pteropods were taken. The saffron cod (*Eleginus gracilis*) were eaten in the Peter Great Bay. The half of the minke whale caught by the pelagic and coastal whaling was eating fish, and the others were eating euphausiids alone or with copepods in the Kuril Islands. He reported one exceptional minke whale stomach containing saffron cod with a total weight of 25 kg.

Kawamura (1980)

In this study the author reported the reviews of food of balaenopterid whales in the world. The feeding type of minke whale was swallowing type, more suitable for harvesting the krill and swarming fish.

Ivashin and Votrogov (1981)

They reported the appearance of minke whale off the Chukotka coast with the approach of the polar cod in late June and July.

Zhongxue et al. (1983)

The authors reported the minke whale from the northern Yellow Sea feeds on sand lance and krill (*Euphausia pacifica*) mostly from March to July. They reported feeding of the minke whales in the northern Yellow Sea was usually at 5:00 – 10:00 and 14:00 – 18:00, they did not feed at night.

Kasamatsu and Hata (1985)

They reported the 208 stomach contents taken by *Miwa-maru* (1974-75) and Japanese fleets (1969-70) in the offshore waters of the Southern Okhotsk Sea, North Okhotsk Sea, Western North Pacific offshore (sub-area 8) and Bering Sea. In the North Okhotsk Sea, the Pacific herring was the most important prey species from July to September. In the East Sakhalin (sub-areas 11 and 12), walleye pollock was the most important prey species from June to August. The stomachs from the Western North Pacific offshore (sub-area 8) contained the Chub mackerel (*Scomber japonicus*), Pacific saury, and krill. In September all the fish eaten were Chub mackerel, whereas in October they were all Pacific saury. In the Bering Sea, krill was the most important prey species in August. They concluded the minke whales around Japanese waters were relatively flexible in their prey species

and feed opportunistically on the most convenient and abundant food in the area at the time.

The monthly frequency of occurrence of Japanese pilchard (*Sardinops melanostictus*), sand lance and krill in the stomach of whales from coastal catches was also reported in the Okhotsk Sea and Sanriku. In the Okhotsk Sea, krill appeared as the dominant prey species, but in fact dominates with sand lance in the early summer, and feeding in late summer largely consists of Japanese pilchard. Off Northeast of Honshu, the krill was the dominant prey species in April, but was replaced by Japanese pilchard from May. In the Pacific of Hokkaido, only Japanese pilchard were eaten from June to September, averaging 99 % of the diet. In the three areas sampled in 1981 and 1982, Japanese pilchard were much more important than in 1953 and 1954.

Kasamatsu and Tanaka (1992)

They examined annual changes of prey species in the seven whaling grounds off Japan, using data recorded by whalers on the 10,164 stomach contents of minke whale from 1948 to 1987. In Pacific coast of Hokkaido (a part of sub-area 7W) from April to October, prey species recorded were krill, squid, Japanese pilchard, Japanese anchovy, Chub mackerel, walleye pollock, cod, sand lance, Pacific saury and so on. They noted that the change of prey of minke whales from Chub mackerel to Japanese pilchard in 1977 corresponded with a change of the dominant species taken by commercial fisheries in the same area in 1976. On the other hand, They reported krill was dominant prey species from 1964 to 1987 in the Okhotsk Sea.

5. CONCLUSIONS

There were geographical, seasonal and yearly changes of prey species of minke whales in the western North Pacific. They are opportunistic feeders with a broad diet and with flexible feeding habits. They feed on swarming zooplankton and schooling fish, indicating an ability of the minke whales to pursue single prey species aggregations. These changes in the prey species of minke whales probably reflect the changes in the availability of prey species in these areas.

For example in sub-area 7W, the change of prey species of minke whales from Chub mackerel to Japanese pilchard in 1977 corresponded with a change of the dominant species taken by commercial fisheries in the same area in 1976.

Unfortunately, knowledge of feeding activity and food consumption of minke whales in the western North Pacific was insufficient before JARPN surveys.

In the western North Pacific, dramatic change have been observed in pelagic fish stock (e.g. Japanese pilchard) which are thought to be a major source of prey species for minke whales. On the other hand, Pacific saury was most important prey species of minke whales in sub-area 9 in 1994 and

1995 JARPN. A "Top Down Control" concept, which assume higher components (species) of trophic level control the biomass of lower components through feeding, has been suggested by salmon scientists specializing in the North Pacific (Nagasawa *et al.* 1995). Furthermore, the North Pacific Marine Science Organization (PICES) established the "Working Group on consumption of Marine Resources by Marine Birds and Mammals" at its 1995 annual meeting. It has been revealed by the Norwegian scientific permit research that minke whales contributed to reduce the abundance of prey species such as capelin and herring in the North Atlantic. The study of feeding ecology of minke whales is necessary to elucidate the role of minke whales in stabilizing or shifting the ecosystem of western North Pacific through predation. Therefore, an additional objective was to start a feasibility study on feeding ecology of minke whale in 1996 JARPN (The government of Japan, 1996).

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