DIVING DEPTH OF NORTHERN FUR SEALS IN THE FEEDING TIME

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Northern fur seals (*Callorhinus ursinus*) are sometimes taken by fishing gears in the open waters. Scheffer (1946) reports seven cases of fur seals taken accidentally by the floating drift net along the Oregon coast of the eastern Pacific and he estimates that fur seals can dive 24 feet (7 meters) to 240 feet (73 meters) below the sea surface. Kenyon (1952) states that fur seals off Sitka, Alaska, have no evidence which they descend much deeper than 30 fathoms (55 meters). He estimates the diving depth of fur seals from the depth of fishing lines on which fur seals sometimes get hooked. In these two reports, there is no description on the time when fur seals were taken by nets or lines.

Generally, fur seals at sea show the inactive behaviors in the day time, except for the migrating period from the breeding islands to wintering areas or from the latter to the former. In the wintering area off the Pacific coast of the northern Japan, sleeping fur seals often are observed in the day time. Japanese research vessels for fur seals have observed and recorded the behavior of seals before these seals are taken at sea. Provided that swimming or moving to some directions indicates the active behavior and sleeping or resting at a location does the inactive behavior of seals, we can examine from the observation records when fur seals move about at sea. The activity index (M) of seals at sea, therefore, will be expressed by the following formula.

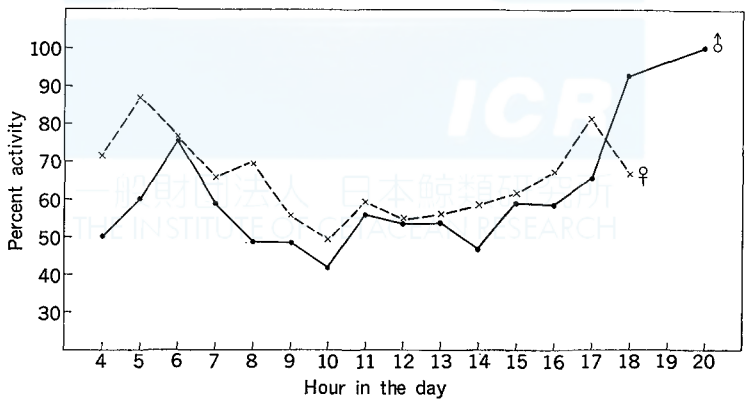

Fig. 1. Activity of fur seals at sea in each hour of the day, in the Pacific coast of the northern Japan from March through June.

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$$M = a / a + i \times 100$$

Where, a is the number of active seals and i is the number of inactive seals at the time of observation. Fig. 1 is given when the value of M is arranged by each hour in a day on the basis of observation records from March through June, when is the latter half of the wintering season of fur seals. Number of seals observed comprised 1483 males and 1677 females from 1958 to 1967. In both sexes, while seals are the most inactive at 1000 in the morning, they are active before 0600 in the morning and after 1800 in the afternoon. Hence, 5 of 10 seals are in the state of sleeping or resting at 1000. This pattern of activity is maintained in spite of the progress of month. Although females are relatively more active than males, it is clear that fur seals are the nocturnal animal. According to several records, fur seals unexpectedly observed at night always were quick in action. Such a nocturnal behavior relates directly to feeding activity of fur seals. Most of seal stomaches collected in the day time has no food or food under digestion. According to the report of the Japanese pelagic research in 1958 off the coast of the northern Japan, about 90% of seals taken at 0500 has food in their stomachs. With the progress of hour in the day time, the occurrence of empty stomach increases and reaches 80% of the total samples collected at 1800 in the afternoon.

Fig. 2. Images of diving fur seals recorded by the echo-sounder of 28 KHz, in the Japan Sea.

After examining the digestive stages of food in the stomach by each hour, this report suggests that fur seals generally take food before sunrise. When the feeding activity of fur seals reaches the maximum is not known because the hunting of seals at night is difficult. Probably the searching activity for food at night determines the nocturnal behavior of fur seals.

In the pelagic research in the Japan Sea, we fortunately took the records of

diving fur seals with eco-sounder of 28 KHz. At 1900 on May 3 in 1970, the research vessel Tokai University II, 702.61 ton, stopped to sail as it became dark at the location of 39–47 N, 132–47 E in the western Japan Sea. It was foggy in the evening and the visibility was about 150 meters. In the afternoon of that day, no seal was observed along the sailing course of the vessel. Induced by the light from the deck, however, 5 seals began to swim about the vessel and sometimes passed beneath the bottom of vessel. The sonar which operated continuously through the voyage to examine the vertical distribution of marine organisms, took the swimming images of fur seals on the recording paper. As the vessel was equipped with the sonar at the bottom of the bridge, from the bridge we could confirm seals coming to surface to respire. The other mammals than fur seals were not observed in the waters near the research vessel. The click of dolphins recorded through 28 KHz echo-sounder by Shibata and Nishimura (1969) was not observed in our recording paper. Fig. 2 shows the diving images of seals within the beam of 28 KHz sound. Such clear images were recorded from 1937 through 2245 at night and afterwards 1 or 2 seals repeated to enter the beam of sonar.

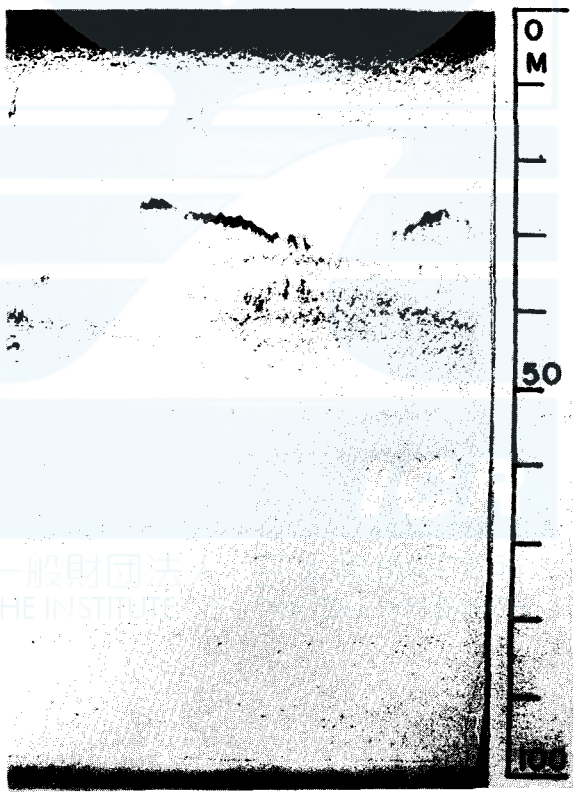

Fig. 3. Experimental image of a killed fur seal recorded by the echo- sounder of 28 KHz.

In order to confirm the image of animal observed on the record of sonar, we

tried a test by using a killed fur seal. On May 19, we took a female seal of age 5 in the Pacific coast of the northern Japan. The body weight and the body length of the animal was 34 Kg and 128 cm respectively. Two small boats were prepared for the test in both sides of the research vessel. The weighted seal tied up with a long rope was pulled rapidly in the water along the center of beam of sound. When the seal passed through the bottom of the research vessel, an image was recorded as shown in Fig. 3. We can find the similarlity in images between Fig. 2 and Fig. 3, although the recorded depths are different between them.

In Fig. 2, fur seals swim in the depth of 100 meters and over from 40 meters under the drifting vessel. The record of sonar shows that deeply diving seals do not move horizontally but move rapidly to the deeper waters. As fur seals pursued after schools of squids which were induced by the light of vessel, it is reasonable to suppose that these records indicate the diving depth in the feeding period of fur seals. The species of squids was not determined. The water temperature was 10.1°C in 0 meter, 9.7°C in 10 meters, 8.6°C in 25 meters, 5.3°C in 50 meters and 2.8°C in 100 meters deep at the position of recording, and no remarkable thermocline was observed within 100 meters in depth. These fur seals were not bull at the naked eye observation on their sizes in the sea surface. This record indicates that fur seals descend the depth over 100 meters in the feeding and that they can dive deeper than in the previous records.

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