

SOME OBSERVATIONS ON SWARMS AND MATING BEHAVIOR OF ANTARCTIC KRILL (*EUPHAUSIA SUPERBA* DANA)

Yasuhiko NAITO¹, Akira TANIGUCHI² and Etuyuki HAMADA³

¹National Institute of Polar Research, 9-10, Kaga 1-chome, Itabashi-ku, Tokyo 173

²Faculty of Agriculture, Tohoku University, 1-1, Tsutsumidôri-Amamiyamachi, Sendai 980

³Tokyo University of Fisheries, 5-7, Konan 4-chome, Minato-ku, Tokyo 108

Abstract: During the cruise of SIBEX I, the authors seized a chance to observe a krill swarm in the pool made by icebreaker in the ice zone and the krill's mating behavior which has never been reported from the Antarctic Sea. A swarm was observed on December 27, 1984. It began to appear at 2000 LT with a peak at 2100 LT when the density was 195 krills/m², and disappeared at 2200 LT. The mating behavior was observed in the low density swarm on December 28. The mating occurred only at the surface when the male chased the female and grasped it in the form of letter T. Both swam in a circle of 2-3 m in diameter maintaining the T form for about 10 s. One female was chased 2-3 times by different males before mating.

1. Introduction

During the 25th Japanese Antarctic Research Expedition (JARE-25), icebreaker SHIRASE participated in the Ice Zone Study of the Second International BIOMASS Experiments. During the cruise to Syowa Station (69°00'S, 39°35'E), the authors had an opportunity to observe swarms of Antarctic krill (*Euphausia superba* DANA) on December 27 and 28, 1984 and its mating behavior in the ice zone on December 28. Swarms were found in the small open pool formed in the ship's wake when the SHIRASE charged the very thick hummocked ice (up to 8-10 m). The location was at the mouth of Lützow-Holm Bay (68°23.2'S, 38°40.0'E), 170 miles from the ice edge and 3 miles from the edge of hummocked ice, where a small flaw lead, 0-5 miles wide, developed along the edge of hummocked ice or permanent ice (Fig. 1). The pool which was connected to the stern of the ship was about 30 m wide and 50 m long. The water temperature and transparency were -1.6°C and 37-45 m respectively in the two days during which the swarms were observed and the weather was fine.

2. Movement and Density of a Swarm

The swarm was first observed on December 27. At this time no mating behavior was noticed. The swarm began to appear at 2000 LT and disappeared at about 2200 LT. At first, a low density swarm began to appear from the ice-covered area moving very slowly. Since about 2100 LT when the half of the pool was occupied by a swarm, the density increased rapidly as the krills surfaced and a swarm itself enlarged until it fully covered the pool (Fig. 2). Movement of the krill was orientated and synchronized with

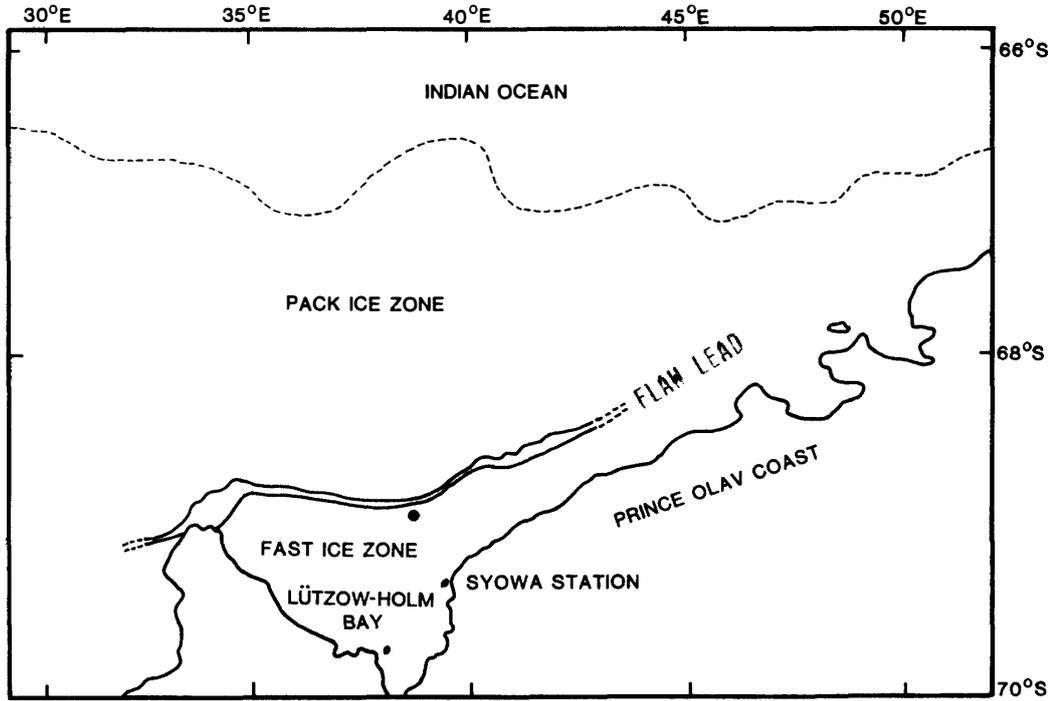


Fig. 1. The krill swarms were observed in the pool (solid circle) made by icebreaker SHIRASE in the fast ice zone off Lützow-Holm Bay.



Fig. 2. The krill surfaced and swarmed. The density was 195 individuals per square meter.

discontinuous rapid swimming. They were well spaced from each other. Although the size of the swarm was not estimated, it appeared to be not very large judging from its movement and the pool size. It would have been nearly as large as the pool size (50 m by 30 m). The thickness of the swarm was also uncertain; however, the fact that the krill appeared from the deeper water may indicate that the swarm was much thicker than 2–5 m that could be detected through the dark water. A peculiarity we found in this swarm was that the krill could be detected only when it moved upwards by their pale blue luminescence. The luminescence, however, was not continuously observed but could be seen at the moment the krill began to swim.

Density of the krill in the swarm was calculated from the photographs taken by a 35 mm camera from the stern deck (8.5 m above sea level) using the 200 mm lens. The density of the krill could only be determined in 0–0.5 m surface layer by focus level. The krill density at peak was 195 krills/m². The catch record from the same swarm revealed that the swarm contained 12% of furcilia VI stage of total 76 individuals caught by the hand net (56 cm in diameter, 0.33 mm in mesh size) from the deck. The sex ratio was 1:1 (Fig. 3). Ratio of sub-adults to adults among 34 males was 21:13 and no difference in the mean body length was observed between these two maturity stages. Among 33 females, though their maturity stages could not be examined precisely, only one individual was observed to possess the spermatophores. Its body length was 3.7 mm on 6th abdominal segment. Along with the krills, 75 copepods, 2 amphipods and 1 chaetognath were caught.

As to the swarm movement in relation to the time of day, it is noted that the krill surfaces to the upper layer at night and sinks in the daytime (MAUCLINE and FISHER, 1969; BAKER, 1978; ARIMOTO *et al.*, 1979; MURANO, 1982). However it is also reported that vertical movements are variable in connection with a food availability, particularly

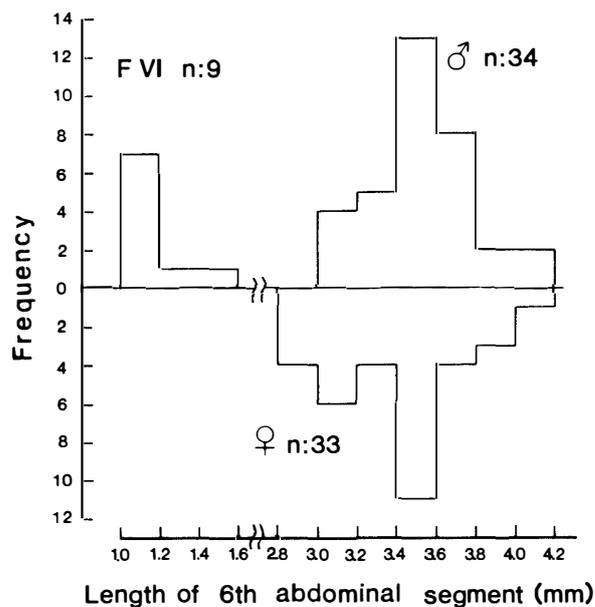


Fig. 3. Length-frequency histograms of furcilia VI stage, males and females collected from a swarm found on December 27, 1983.

in large-sized krills (EVERSON, 1984). In this respect, it is possible that the krill surfaces at the pool for food, because the icebreaker charged and crashed the ice to a certain extent so that ice-trapped or ice-anchored algae could be free from ice.

3. Mating Behavior

Mating behavior was observed on December 28 in the same pool during 1900–2000 LT. A swarm at this time was very small occupying only one-third of the pool at maximum, and its density was also quite low. Mating behavior began with rapid chasing. While the sex could not be determined by observation, one krill, perhaps male, suddenly chased another, supposedly female, until it could seize the escaping female. Such chasing occurred suddenly without any preceding behavior. The chasing behavior was observed within a few meters range when the chased female was seized and was followed immediately by mating behavior which continued for about 10s. During this period the male grasped the female in the form of letter T, and both swam in a circle of 2–3 m in diameter maintaining the T form (Fig. 4). In some cases the mating couple

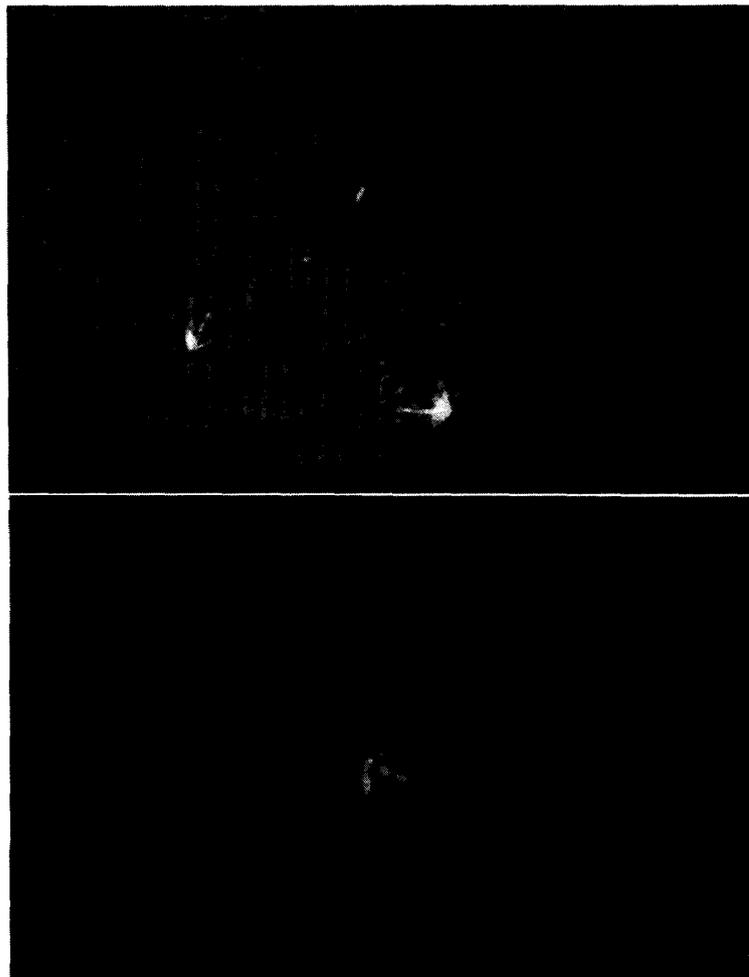


Fig. 4. A male krill chased a female and mated in the form of letter T, and the couple, keeping the same posture, swam in a circle.

was followed by 1–3 other males which sometimes interrupted the mating and one of them took the place of the original male. Only 1–3 mating couples were observed at any time in the pool, but the mating occurred in rapid succession and it is probable that mating between one female and 2–3 males occurred. Information on the breeding of Antarctic krill, particularly with respect to mating, is sparse. However, it is well known that a female Antarctic krill usually carries several spermatophores in the summer season (NEMOTO and MURANO, 1979). The above observation explains how such females can carry several spermatophores. It can be considered from these observations that one mating stimulates other krill to do likewise. We are uncertain if there is some key releaser for the mating behavior. However, a very high possibility of multimating may be a feature of the mechanism of breeding behavior in the species.

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