A PRELIMINARY NOTE ON THE OCCURRENCE OF COPEPODS UNDER SEA ICE NEAR SYOWA STATION, ANTARCTICA

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Abstract: Net samplings of zooplankton were done in the ice-covered sea area near Syowa Station (69°00′S, 39°35′E), Antarctica, during the summer, autumn and spring seasons in 1970 and 1975. Copepods were the main constituents of the zooplankton community. *Ctenocalanus vanus, Stephus longipes, Paralabidocera antarctica, Oithona similis, Oithona frigida, Oncaea curvata* and Harpacticoid copepods were identified. Among them, while unidentified copepod nauplii were numerously distributed, *O. similis* and *O. curvata* occurred dominantly during late summer, autumn and spring. *P. antarctica* and *O. frigida* occurred in small numbers in summer. Species composition of copepods changed seasonally.

1. Introduction

Although the importance of the investigations on zooplankton distribution in the ice-covered sea area in the Antarctic Ocean has been emphasized repeatedly (ANDRIASHEV, 1970; EL-SAYED, 1971; BRADFORD, 1978), because of rigors of the ice-cover itself, such works are very scarce. The present work was undertaken to obtain preliminary information about the zooplankton communities in the ice-covered area near Syowa Station, Antarctica. Particular interests were concentrated on the seasonal occurrence of copepods which found to be predominant in the communities throughout the year.

2. Methods and Materials

Zooplankton samplings were performed through a hole bored in the sea ice covering the Kita-no-seto Strait near Syowa Station (69°00′S, 39°35′E). The Strait stretches for about 500 m with the maximum width of about 100 m and the maximum depth of 20 m (MORIWAKI, 1979). A total of 12 samples was obtained in January, February, March, April, October and November of 1970 and in December of 1975. Samplings could not be performed in May through September, the austral winter season. The sampling sites were selected within a restricted area for each year though slightly different between 1970 (depth: 12 m) and 1975 (depth: 15 m). Thickness of the ice was approximately 100 cm and did not vary greatly throughout the present observations. It seemed to be a perennial sea ice. A conical plankton net (ϕ 30 cm × 120 cm long, 0.10 mm mesh openings) was hauled at a speed of about 1 m/s from the bottom to the surface. Every sample was preserved in about 10% buffered formalin sea water. A whole or an aliquot of 1/2 of each sample was examined and individual numbers of zooplankters were counted. All counts were then converted

into the density expressed as individuals per one cubic meter of water. Volume of filtered water was calculated on the assumption of 100% filtration efficiency of the net. Although the present samplings were done in two different years, the samples were treated as from a single year.

3. Results and Discussion

3.1. Net zooplankton

Total zooplankton number varied between 8 and 6183 indiv/m^3 throughout the investigations (Table 1). A marked change of the total zooplankton was observed from late summer till autumn; the number increased from 332 on 28 January to 6183 on 10 March and then decreased rapidly down to 474 indiv/m^3 on 28 March. In late autumn, 10 April, the number was 894 indiv/m^3. During spring, the density of total zooplankton was as small as 115 and 410 on 23 October and 22 November, respectively. In December or early summer of 1975, the density was as very small as 8 to 20 indiv/m^3.

Among the groups of zooplankton classified, Copepoda was the main constituents of zooplankton communities and occupied more than 50% in number of total zooplankton with two exceptions on 28 January and 5 March, when Ostracoda and Tintinnida occupied the first rank, *i.e.*, 48.8 and 44.3%, respectively. Following copepods, tintinnids were the second largest component and attained to their maximum of 1799 indiv/m^3 on 5 March. Polychaeta larvae and Ostracoda, though small in number, were also common. Appendicularia was observed to occur in a particular season, autumn (February and March). In the present samples, no chaetognaths and euphausiids were caught, although they are dominant components of zooplankton communities next to copepods in the open water of the Antarctic Ocean (see HOPKINS, 1971). At the present, because of insufficiency of our data, we could not give an appropriate account for this discrepancy in composition of zooplankton communities in open water and in ice-covered sea, and further works are necessary (*cf.* FUKUCHI and SASAKI, 1981).

3.2. Seasonal occurrence of copepods

Three Calanoida species (*Ctenocalanus vanus, Stephus longipes* and *Paralabidocera antarctica*) and three Cyclopoida species (*Oithona similis, Oithona frigida* and *Oncaea curvata*) were identified. Unidentified Harpacticoida copepods and copepods nauplii were also obtained. Both of these two groups were probably composed of more than one species, but they are treated as the individual groups here (Table 2).

Copepod populations became dense from 85 indiv/m^3 on 28 January to 4368 indiv/m^3 on 10 March and then decreased to 432 indiv/m^3 on 28 March. The populations were thin in the rest periods, especially in early summer (5–13 indiv/m^3 in December 1975). Seasonal change in the copepods was similar to that in the total zooplankton described above or the latter was governed by the copepods.

Table 1. Density of zooplankton taxa estimated by vertical hauls with a conical net (ø30 cm × 120 cm long) in the Kita-no-seto Strait near Syowa Station (69°00′S, 39°35′E), Antarctica, in 1970 and 1975. Densities were expressed in individual number per one cubic meter of water filtered by the net.

Zooplankton	1970									1975		
	Jan.	Feb.	March			Apr.		Oct.	Nov.	December		
	28	27	5	10	18	28	10	23	22	8	13	18
Tintinnida	19	787	1799	1071	638	40	118	20	96	—	—	—
Polychaeta larvae	40	34	69	378	30	—	—	1	1	2	—	—
Ostracoda	162	34	126	99	90	1	1	—	—	—	—	1
Copepoda	85	1806	1596	4368	1901	432	774	80	293	5	5	13
Appendicularia	—	235	288	186	232	—	—	—	—	—	—	—
Others	26	198	183	81	120	1	1	14	20	1	4	6
Total	332	3094	4061	6183	3011	474	894	115	410	8	9	20

Table 2. Population density of copepods obtained by vertical hauls with a conical net (ø30 cm×120 cm long) in the Kita-no-seto Strait near Syowa Station (69°00′S, 39°35′E), Antarctica, in 1970 and 1975. For dimension see Table 1.

Species	1970									1975		
	Jan.	Feb.	March			Apr.	Oct.	Nov.		December		
	28	27	5	10	18	28	10	23	22	8	13	18
Ctenocalanus vanus	1	39	33	47	15	4	2	1	—	—	—	—
Stephus longipes	—	—	—	—	—	—	—	—	2	—	—	—
Paralabidocera antarctica	—	—	—	—	—	—	—	—	—	5	5	6
Oithona similis	—	229	257	1300	249	84	186	8	19	—	—	4
Oithona frigida	—	—	—	—	—	—	—	—	—	—	—	1
Oncaea curvata	5	845	571	445	254	80	191	17	12	—	—	—
Harpacticoida copepods	12	12	27	11	17	7	80	2	24	—	—	2
Copepods nauplii	67	681	708	2565	1366	257	315	52	236	—	—	—
Total	85	1806	1596	4368	1901	432	774	80	293	5	5	13

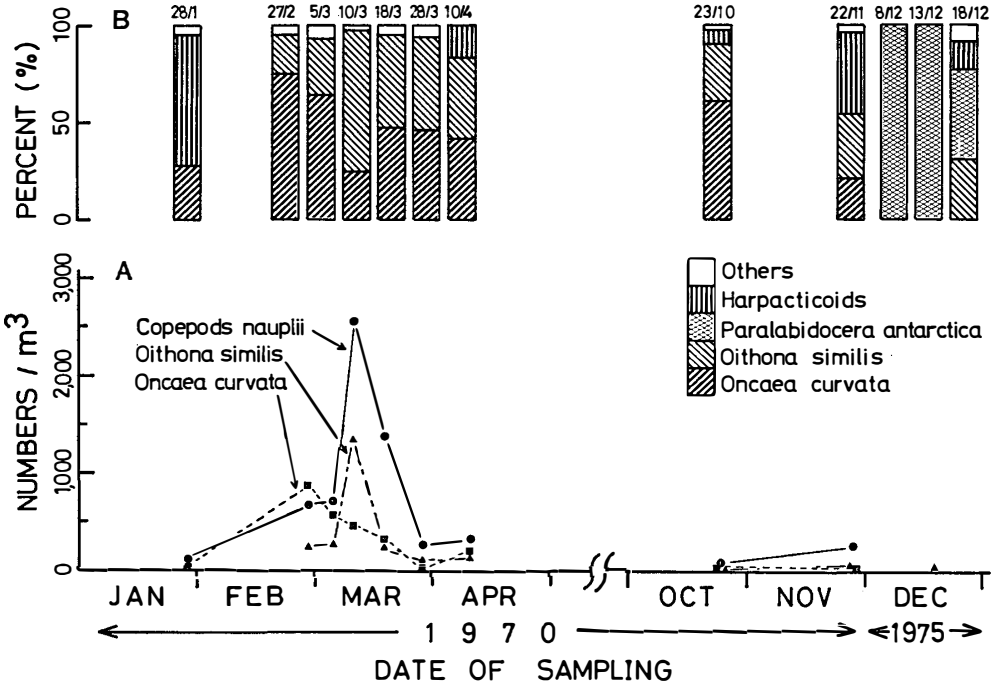

Fig. 1. Seasonal changes of (A) population density of copepod nauplii, Oithona similis and Oncaea curvata, and (B) species composition of copepods other than nauplii observed in the Kita-no-seto Strait near Syowa Station (69°00'S, 39°35'E), Antarctica, in 1970 and 1975.

Nauplii occurred abundantly being 37.7–80.6% of total copepod number, while no nauplii were captured in early summer or December 1975. Nauplii began to increase from 67 on 28 January to their maximum number of 2565 on 10 March, then decreased to 257 on 28 March, 315 on 10 April, and finally to 52 and 236 indiv/m^3 on 23 October and 22 November, respectively.

Apart from the nauplii, *Oithona similis* and *Oncaea curvata* predominated. *O. similis* appeared on 27 February in early autumn as many as 229 individuals and reached a maximum of 1300 indiv/m^3 on 10 March in autumn. *O. curvata* attained to the maximum on 27 February, one month earlier than the other species, and decreased thereafter (Fig. 1A). In the rest season their numbers were small. Maximum numbers of *Ctenocalanus vanus* and harpacticoids were 47 and 80 indiv/m^3, respectively. *Paralabidocera antarctica* was seen in summer, but the individual number was very small (5–6 indiv/m^3). Two specimens of *Stephus longipes* were collected on 22 November in spring and one specimen of *Oithona frigida* was seen on 18 December in summer.

Species composition of copepods excluding nauplii is shown in Fig. 1B. In late summer, before *O. similis* and *O. curvata* became predominant, harpacticoids were the main constituents. In autumn and early spring, *O. similis* and *O. curvata* were the leading populations, while their relative abundance changed during early autumn.

Although the winter data were not available, the composition of copepods in late autumn and that in early spring seems to be comparable as shown in Fig. 1B. *Paralabidocera antarctica* occurred only in early midsummer when the other species were rare.

Number of copepod species identified from the present samples was smaller than those reported by ZVEREVA (1972) who found 15 and 20 species from the ice-covered sea areas near Mirny and Molodezhnaya Stations, respectively. This might be caused partially by the difference in sampling depths; while she sampled 85–100 m water columns, our samples were hauled from 12–15 m depths. ZVEREVA (1972) reported, however, *Oithona similis* and *Ctenocalanus vanus* were the most common followed by *Oncaea curvata* and *Stephus longipes* but a only small number of *Paralabidocera antarctica* was found in January in the Molodezhnaya area; her findings are fundamentally the same with the present results, although *Stephus longipes* was one of the most rare species in the present observations.

FUKUCHI *et al.* (1979) observed a dense population of *Paralabidocera antarctica* on the undersurface of the fast ice in February in Lützow-Holm Bay. Furthermore, we also found the predominancy of *P. antarctica* in number as well as in composition exceeding 43% of total copepod numbers in the Ongul Strait (depth at the sampling site: 92 m) near the present sampling stations on 1 and 6 December 1967. From the facts mentioned above, it seems to be reasonably deduced that *P. antarctica* occurs in particular summer season. If so, our assumption that all the present samples originated from a single successive seasonal cycle may be reasonable.

The present work is able to provide some fundamental knowledge on zooplankton communities under sea ice. However, in order to clarify the structure and function of such communities, it is necessary to continue and preferably expand the zooplankton investigations.

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References

ANDRIACHEV, A.P. (1970): Cryopelagic fishes of the Arctic and Antarctic and their significance in polar ecosystems. Antarctic Ecology, Vol. 1, ed. by M.W. HOLDGATE. London, Academic Press, 297–304.

BRADFORD, J.M. (1978): Sea ice organisms and their importance to the Antarctic ecosystem (Review). N. Z. Antarct. Rec., **1**(2), 43–50.

EL-SAYED, S.Z. (1971): Biological aspects of the pack ice ecosystem. Symposium on Antarctic Ice and Water Masses, Tokyo, 1970, ed. by G. DEACON. Cambridge, SCAR, 35–54.

FUKUCHI, M. and SASAKI, H. (1981): Phytoplankton and zooplankton standing stocks and downward flux of particulate material around fast ice edge of Lützow-Holm Bay, Antarctica.

Mem. Natl Inst. Polar Res., Ser. E (Biol. Med. Sci.), **34**, 13–36.

FUKUCHI, M., TANIMURA, A. and HOSHIAI, T. (1979): "NIPR-I", a new plankton sampler under sea ice. Bull. Plankton Soc. Japan, **26**, 104–109.

HOPKINS, T.L. (1971): Zooplankton standing crop in the Pacific sector of the Antarctic. Biology of the Antarctic Seas IV, ed. by G.A. LLANO and I.E. WALLEN. Washington, D.C., Am. Geophys. Union, 347–362 (Antarct. Res. Ser., **17**).

MORIWAKI, K. (1979): Submarine topography of the central part of Lützow-Holm Bay and around Ongul Islands, Antarctica. Mem. Natl Inst. Polar Res., Spec. Issue, **14**, 194–209.

ZVEREVA, Zh. A. ed. (1972): Seasonal changes of Antarctic plankton in the Molodezhnaya and Mirny region. Exploration of Marine Fauna, XII(XX), Geographical and Seasonal Variability of Marine Plankton. Jerusalem, Israel Program for Scientific Translations, 248–262, 1975.

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