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FEEDING BY THE NOTOTHENIID FISH, *PAGOTHENIA BORCHGREVINKI* ON THE ICE-ASSOCIATED COPEPOD, *PARALABIDOCERA ANTARCTICA*

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Abstract: More than 90% of food items in the stomach contents of the nototheniid, *Pagothenia borchgrevinki* were found to be copepods and copepod nauplii. Most of the nauplii was identified as *Paralabidocera antarctica*. As this copepod lived in the sea ice feeding on ice algae, it was concluded that there is a food chain, ice algae–*P. antarctica*–*P. borchgrevinki* in the Antarctic cryopelagic ecosystem. In feeding on nauplii, the fish preferred developed and larger individuals.

1. Introduction

Pagothenia borchgrevinki (BOULENGER) (= *Trematomus borchgrevinki* BOULENGER) is one of the most common constituents of both ice fauna and sub-ice fauna (ANDRIASHEV, 1968). It occupies the niche of secondary consumer as a plankton feeder in the coastal marine ecosystems of Antarctica (EASTMAN and DE VRIES, 1985). HOSHIAI and TANIMURA (1981) reported that *Oithona similis* CLAUS and an unidentified copepod nauplius were the dominant constituents of the stomach contents of *P. borchgrevinki* fry (35–50 mm long). We have subsequently identified this nauplius as the calanoid copepod, *Paralabidocera antarctica* (I.C. THOMPSON). In this paper, information on the food relation between *P. antarctica* nauplius and the *P. borchgrevinki* fry is presented in conjunction with cryopelagic ecosystems.

2. Materials and Methods

The stomach contents of 5 fishes were examined in addition to the 5 reported in HOSHIAI and TANIMURA (1981). The fish were collected on September 6, 1970 in the Kita-no-seto Strait near Syowa Station (69°00′S, 39°35′E). The nauplii in the stomach contents of the 5 fish reported previously (HOSHIAI and TANIMURA, 1981) were re-examined. The developmental stages of nauplii in the stomach and in the sea ice were investigated. The ice-dwelling nauplii were collected from the bottom part of sea ice cores sampled by a SIPRE ice auger at the adjacent site to the fish hole in August and September 1970.

3. Results

The species composition of stomach contents of all fish examined was essentially similar. The stomachs contained copepods, appendicularians, tintinnids, polychaetes and unidentified items. More than 90% of food items were copepods, including nauplii. *Ctenocalanus vanus* GIESBRECHT, *Stephus longipes* GIESBRECHT, *Oithona similis* CLAUS, *Oithona frigida* GIESBRECHT and *Oncaea curvata* GIESBRECHT could be identified to species level. A few harpacticoid species and other copepods, including two calanoid species, could not be identified due to taxonomic difficulties and advanced digestion. Most of copepod nauplii were identified as *P. antarctica* but the rest could not be determined. The numerical composition of copepods in the fish stomachs is shown in Table 1. *O. similis* was dominant followed by the nauplius of *P. antarctica* in all but one of the fish examined. In the stomach of this fish the nauplius of *P. antarctica* was dominant.

The nauplius populations in the stomachs were composed of individuals of developed stages compared with those in the sea ice (Fig. 1).

4. Discussion

The trophic relationship between ice algae, ice fauna and sub-ice fauna in the Antarctic fast ice areas was described by ANDRIASHEV (1968) based on the observations that their occurrence was sympatric in and/or beneath the sea ice (GRUZOV *et al.*, 1967) and the stomach contents analysis of *P. borchgrevinki*. ANDRIASHEV's scheme of trophic interaction has been supported by other observations. RAKUSA-SUSZCZEWSKI (1972) mentioned that the amphipod, *Palamoera walkeri* STEBBING which fed on ice algae during winter was eaten by *P. borchgrevinki* (as *T. borchgrevinki*) near Molodezhnaya Station (67°40′S, 45°50′E). RICHARDSON (1975) reported a food chain consisting of ice

Table 1. Copepods contained in the

Fish	a*	b*	c*	d*	e*
Total length (mm)	45.5	45.4	38.7	49.8	47.9
Copepod species	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Ctenocalanus vanus	7 (4.8)	3 (0.6)	1 (0.3)	3 (2.1)	6 (1.2)
Stephus longipes	0	0	0	1 (0.7)	1 (0.2)
Paralabidocera antarctica	16 (11.0)	186 (39.3)	76 (19.8)	11 (7.6)	194 (39.0)
Calanoida species	0	0	0	0	0
Oithona similis	102 (70.3)	250 (52.9)	244 (63.5)	79 (54.9)	257 (51.6)
Oithona figida	0	0	0	0	0
Oncaea curvata	3 (2.1)	1 (0.2)	13 (3.4)	0	5 (1.0)
Harpacticoida species	2 (1.4)	9 (1.9)	15 (3.9)	11 (7.6)	25 (5.0)
Unidentified copepods	11 (7.6)	20 (4.2)	27 (7.0)	37 (25.7)	10 (2.0)
Unidentified nauplii	4 (2.8)	4 (0.8)	8 (2.1)	2 (1.4)	0
Total	145	473	384	144	493

* Referred to HOSHIAI and TANIMURA (1981).

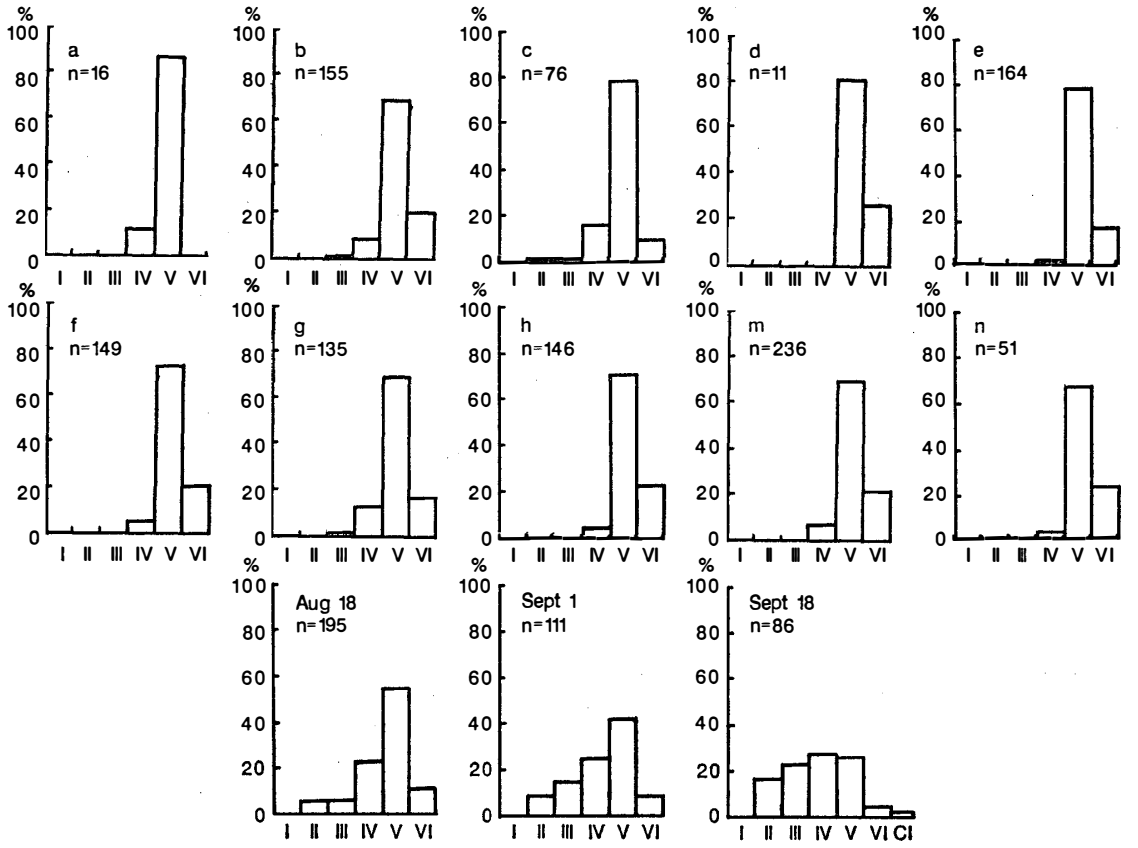

Fig. 1. The developmental stage composition of P. antarctica *nauplii in the stomachs of* P. borchgrevinki *(a-n) and that of nauplii and copepodite in the sea ice. Roman numerals indicate the developmental stages of nauplii and CI copepodite stage I.*

stomach of Pagothenia borchgrevinki.

f	g	h	m	n	Mean±SD	
41.4	40.5	41.1	47.0	49.1	44.64±3.73	
No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No.	%
5 (0.9)	6 (1.2)	2 (0.4)	12 (2.3)	3 (1.2)	4.80± 3.01	1.50± 1.26
0	1 (0.2)	0	0	0	0.30± 1.24	0.11± 0.23
173 (31.0)	150 (29.6)	166 (33.7)	258 (48.6)	59 (23.6)	128.90±78.65	28.30±12.28
0	0	0	1 (0.2)	0	0.10± 0.30	0.02± 0.06
324 (58.1)	278 (54.8)	284 (57.6)	206 (38.8)	174 (69.6)	219.80±75.67	57.20± 9.03
0	1 (0.2)	0	1 (0.2)	0	0.20± 0.40	0.04± 0.08
8 (1.4)	5 (1.0)	2 (0.4)	4 (0.8)	2 (0.8)	4.30± 3.63	1.10± 0.96
10 (1.8)	7 (1.4)	11 (2.2)	9 (1.7)	2 (0.8)	10.10± 6.25	2.80± 2.03
27 (4.8)	58 (11.4)	25 (5.0)	40 (7.5)	10 (4.0)	26.50±14.54	7.90± 6.42
11 (2.0)	2 (0.4)	3 (0.6)	0	0	3.40± 3.44	1.00± 0.96
558	508	493	531	250	398.40±151.88	

algae, *Trematomus* species, *T. bernacchii* and *T. newnesi* from Signy Island (60°42.5'S, 45°36'W). Feeding by this amphipod on the ice algae was confirmed by gut contents analysis (RICHARDSON and WHITAKER, 1979). A similar relationship between Antarctic krill, *Euphausia superba* DANA and ice algae was reported by GARRISON *et al.* (1986).

Nauplii of *P. antarctica* live in the sea ice feeding on ice algae (HOSHIAI *et al.*, 1987). Accordingly, the present work shows that there is a food chain which *P. antarctica* links ice algae and *P. borchgrevinki*. HOSHIAI and TANIMURA (1981) speculated that *P. borchgrevinki* preferred larger copepods as food. The stage composition of nauplii as well as the species composition in stomach contents supports their assumption.

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