Mem. Natl Inst. Polar Res., Spec. Issue, 44, 125-127, 1986

LABORATORY OBSERVATIONS ON MOLTING AND GROWTH OF ANTARCTIC KRILL, *EUPHAUSIA SUPERBA* DANA (EXTENDED ABSTRACT)*

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Growth observation under rearing condition may provide valuable information on the longevity of *Euphausia superba*, which has not been clearly known. However, long-term rearing experiments on this species are rare. Specimens of *E. superba* were transported alive from the Antarctic water to Japan and subjected to the laboratory experiment.

The krill were collected off Queen Maud Land in January 1985 during the BIOMASS SIBEX II cruise of R. V. KAIYO MARU (SUISANCHÔ, 1986). They were fed with *Artemia* nauplii on board the ship for *ca.* 2 months. On arrival at Japan on March 10, 1985, 35 animals were transferred to the Marine Science Museum, Tokai University in Shimizu.

Fifteen animals were placed in 1-*l* glass containers individually which were floated in a 300-*l* acryl aquarium by a Styrofoam block. Remaining 20 animals were for supplies and exhibitions. Water temperature was cooled down to 0.19°C (±0.33°C). Rearing was done under a continuous dim light, 0.7 lx. Seawater used for the maintenance of the krill was collected from adjacent Suruga Bay and filtered through a 0.2 μm-mesh filter (TOCEL TCR-0.2 filter). About three-fourth of the water in containers was changed daily.

Three feeding regimes were established:

- group A; fed with Tetra Conditioning Food (6 individuals)
- group B; fed with Tetra Krill-E + *Artemia* nauplii (6 individuals)
- group C; without food (3 individuals).

Tetra Conditioning Food is made from both animal and plant materials. Tetra Krill-E is freeze-dried *E. superba* enriched with vitamin E.

Molts were checked daily. At the same time, residual food and fecal pellets were removed and new food was given. Quantities of food given in terms of carbon were 14.8 and 7.6% of average body carbon for groups A and B, respectively. BOYD *et al.* (1984) showed that the maximum daily ration for the species is 10%. Group A was then given excess food and group B less than the maximum. Length of the exopodite of uropod was measured for each molt and converted to body length (from the tip of the rostrum to the distal end of the telson) by the equation of IKEDA and DIXON (1982).

Mean intermolt periods of groups A and B showed no significant difference and

* Contribution from the Marine Science Museum, Tokai University, No. 95.

the combined value is shown in Table 1. Generally, intermolt period is longer at lower water temperature. The value obtained in this study, 21.7 days, is close to those with similar experimental temperature (*e.g.* 20.9 days of MURANO *et al.* (1979) at 0.7°C and 20.1 days of POLECK and DENYS (1982) at 0.1°C). Starved animals showed significantly longer intermolt periods than fed animals ($p<0.01$), which was also noted by IKEDA *et al.* (1985).

Table 1. Intermolt period (IP) of Antarctic krill determined by various authors. Carapace lengths in MORRIS and KECK (1984) were converted to body lengths by the equation of MURANO et al. (1979).

Author	Mean exp. temp. (°C)	Body length (mm)	IP (days) mean±SD (N)
MACKINTOSH (1967)	2.5	22.9-29.7	13.5±1.0 (10)
MURANO *et al.* (1979)	0.7	16.6-38.0	20.9±1.8 (13)
IKEDA and DIXON (1982)	−0.5	22.7-48.2	26.8±2.3 (32)
	−0.5	25.9-50.2	29.6±2.7 (13)*
POLECK and DENYS (1982)	0.1	23.5-30.0	20.1±1.6 (10)
	1.0	23.5-30.0	16.9±1.7 (15)
	4.5	22.0-34.5	12.5±0.9 (23)
MORRIS and KECK (1984)	3	21.2-29.2	14.3±1.9 (10)
This study (Groups A & B)	0.2	32.3-46.1	21.7±1.0 (12)
(Group C)	0.2	36.5-42.6	24.1±1.5 (3)*

* Specimens were starved.

Table 2. Daily growth rate (mm/day) of Antarctic krill under 3 feeding regimes.

Group	Animal No.	Sex	No. of molts	Daily growth rate: Range	Daily growth rate: $\bar{X}$
	1	M	4	0-0.123	0.053
	2	M	4	−0.035-0.037	0.012
	3	M	3	−0.018-0.116	0.049
A	4	F	4	0-0.050	0.022
	5	M	4	−0.018-0.064	0.031
	6	F	5	−0.037-0.088	0.030
				−0.037-0.116	0.033
	7	F	7	0-0.070	0.015
	8	M	5	−0.018-0.055	0.019
	9	F	7	−0.018-0.067	0.024
B	10	F	3	−0.039-0.033	0.003
	11	M	7	−0.070-0.067	0.019
	12	F	5	−0.048-0.096	0.016
				−0.070-0.096	0.016
	13	J	3	0-0.044	0.022
C	14	M	4	−0.016-0.031	0.005
	15	M	4	−0.105-0.123	−0.014
				−0.105-0.123	0.004

F: female, M: male, J: juvenile

Daily growth rates were variable among 3 groups (Table 2). The highest group average, 0.033 mm/day, was found for group A, which was not significantly different from that of group B but significantly different from that of group C ($p<0.01$). Group A krill, however, were short-lived. The longest lived krill in this group lived for 16 weeks from the beginning of the experiment. Group B krill the growth rates of which were lower than those of group A, lived longer; 3 animals survived the half-a-year period of experiment. Daily growth rate of starved animals was the lowest. The animal No. 15 in group C showed negative growth. All starved animals died during the experiment; the longest lived animal survived for 15 weeks.

Stages of sexual maturity were determined on molts according to MAKAROV and DENYS (1980). Progression of maturity stage was observed in 3 animals; No. 2 male (group A) progressed from IIA1 to IIA2, and Nos. 10 and 12 females (group B) progressed from IIB to IIIA. No developmental regression was found in this study although it was observed by IKEDA and DIXON (1982) and POLECK and DENYS (1982).

The krill fed with artificial pet fish food grew well without a lag in contrast with the report of IKEDA *et al.* (1985). Maximum daily growth rate estimated in this study, 0.053 mm/day, exceeds that by POLECK and DENYS (1982), 0.037 mm/day, reared at similar temperature. Four out of 6 daily growth rates in group A krill were within the range of maximum value of IKEDA *et al.* (1985) who averaged higher growth rates over 4–5 consecutive molts during 3-year experiment.

It is noteworthy that group B krill which were fed mainly with freeze-dried krill grew well and lived fairly long, which may suggest that cannibalism, if any, is one of their possible overwintering strategies.

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(*Received March 24, 1986; Revised manuscript received August 7, 1986*)