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PRELIMINARY OBSERVATIONS ON THE DEVELOPMENT OF THE LARVAE OF *EUPHAUSIA CRYSTALLOROPHIAS* HOLT AND TATTERSALL IN THE LABORATORY (EXTENDED ABSTRACT)

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While much attention has recently been paid to *Euphausia superba* as part of international BIOMASS program, little study has been made on an allied species *Euphausia crystallorophias*. Within the Antarctic Ocean, *E. superba* is distributed mainly in oceanic waters, and *E. crystallorophias* in inshorewaters (JOHN, 1936; MAUCHLINE and FISHER, 1969). As in *E. superba*, *E. crystallorophias* is primarily a herbivore and often constitute an important food component of large carnivores, such as baleen whales, seals, birds, etc. (MAUCHLINE, 1980; KITTEL and LIGOWSKI, 1980).

Present available information on the early life cycle of *E. crystallorophias* is limited to those from field sampling programmes. MAKAROV (1980) and FEVOLDEN (1980) discussed diagnostic features of the young larval stages. In the Weddell Sea, the spawning of *E. crystallorophias* is considered to be in early December, preceding that of *E. superba* (FAVOLDEN, 1980), although year to year variations may exist (HEMPEL and HEMPEL, 1982). Development times of eggs and young larval stages are as yet unknown.

During the cruise of the M. S. NELLA DAN to Prydz Bay, Antarctica (November–December, 1982) gravid females of *E. crystallorophias* carrying spermatophores were collected. Individual females were placed into 2-litre glass bottles filled with natural seawater and maintained in the ship's coldroom, with the temperature adjusted to *in situ* conditions (−1.7°C). The eggs used in the following observation were those released by females having been maintained for 2 days after capture. Upon release, about 100 eggs were transferred into two new 2-litre glass bottles (50 eggs in each) filled with filtered seawater through 0.45 μm Millipore filter. The filtered seawater in each bottle was left unchanged until calyptopis I first appeared. During this period, the temperature in the coldroom was raised gradually from −1.7°C to 0°C. A mixture of laboratory cultures of *Phaeodactylum tricornutum* and newly hatched *Artemia* nauplii were provided as food to the larvae after calyptopis I, and bottles were placed on a roller system (3 rpm). Every 1–2 weeks when the larvae were transferred into new bottles with new seawater, the concentrations of *P. tricornutum* and *Artemia* nauplii in the bottles were adjusted accordingly to 1×10^5 cells ml^{-1} and 1 nauplius ml^{-1}, respectively.

To examine developmental stages, few specimens were sacrificed every 5–10 days after the nauplius stage. These specimens were preserved in buffered formalin-seawater for later examination. For the identification of the larval stage, MAUCHLINE and FISHER (1969) and MAKAROV (1980) were consulted. The developmental time from one stage

to the next is based on the first appearance of new stage. Body length (front edge of carapace to the end of telson, excluding spines) and preserved wet weight of the larvae were measured under a Wild dissecting microscope and a Cahn microbalance, respectively.

Table 1 summarizes the developmental time, body length and body wet weight of eggs and various larval stages of *E. crystallorophias* obtained in this study. Nauplii hatched out from eggs in 10 days. Compared with *E. superba*, eggs of *E. crystallorophias* were similar in size (outer diameter: *ca.* 0.6mm), but had a wider perivitelline space (Fig. 1A). The ratio of the diameter of embryo to that of the egg outer diameter was 0.72–0.82 (0.95–0.98 in *E. superba*, from MARSHALL, 1983). While fertilized eggs and nauplii of *E. superba* are known to be densier than seawater and thereby settle readily on the bottom of bottles (MARSHALL, 1983), those of *E. crystallorophias* tended to remain suspended in the seawater within the bottles. The nauplius (Fig. 1B) developed to metanauplius in 27 days after egg release. The characteristic setae on the frontal margin of carapace of this stage, having been noted by MAKAROV (1980) and FEVOLDEN (1980), was confirmed (Fig. 1C).

Calyptopis I, II and III stages appeared in 34, 54 and 67 days, respectively, after egg release (Figs. 1D, E, F). Calyptopis larvae of *E. crystallorophias* can be separated from those of *E. superba* by greater ratio of total body length to carapace length (FEVOLDEN, 1980). FEVOLDEN (1980) also pointed out the lack of a diminutive spinule on the middle of each lateral and posterolateral spines of the telson in calyptopis stages of *E. crystallorophias*. However, calyptopis larvae raised from eggs in this study had this extra spinule on the telson spines, as in *E. superba*. From field sampling data, HEMPEL and HEMPEL (1982) considered that the larvae of *E. crystallorophias* could develop three calyptopis stages within 4–6 weeks in the nearshore water of the Weddell Sea. Developmental time from calyptopis I to furcilia I recorded in this experiment was much longer than this (55 days).

Table 1. Cumulative developmental time (from date of egg release), body length, and body wet weight of eggs and larvae of E. crystallorophias *obtained in the laboratory. ND=not determined.*

Stage	Developmental time (days)	Body length (mm) Mean±1SD (N)	Body wet weight (μg) Mean±1SD (N)
Egg	0	0.60±0.02(6)	38±5(7)
Nauplius	10	0.58±0.02(6)	16±4(5)
Metanauplius	27	0.69±0.05(7)	44±7(5)
Calyptopis I	34	1.42±0.04(13)	62±18(6)
Calyptopis II	54	2.22±0.07(8)	132±65(4)
Calyptopis III	67	3.56±0.24(3)	349±211(3)
Furcilia I	89	4.72±0.30(2)	633±322(2)
Furcilia II	100	6.31±0.22(5)	1126±104(4)
Furcilia III	125*	ND	ND
Furcilia IV	159*	ND	ND
Furcilia V	180*	ND	ND
Furcilia VI	236*	ND	ND

* Based on moults collected.

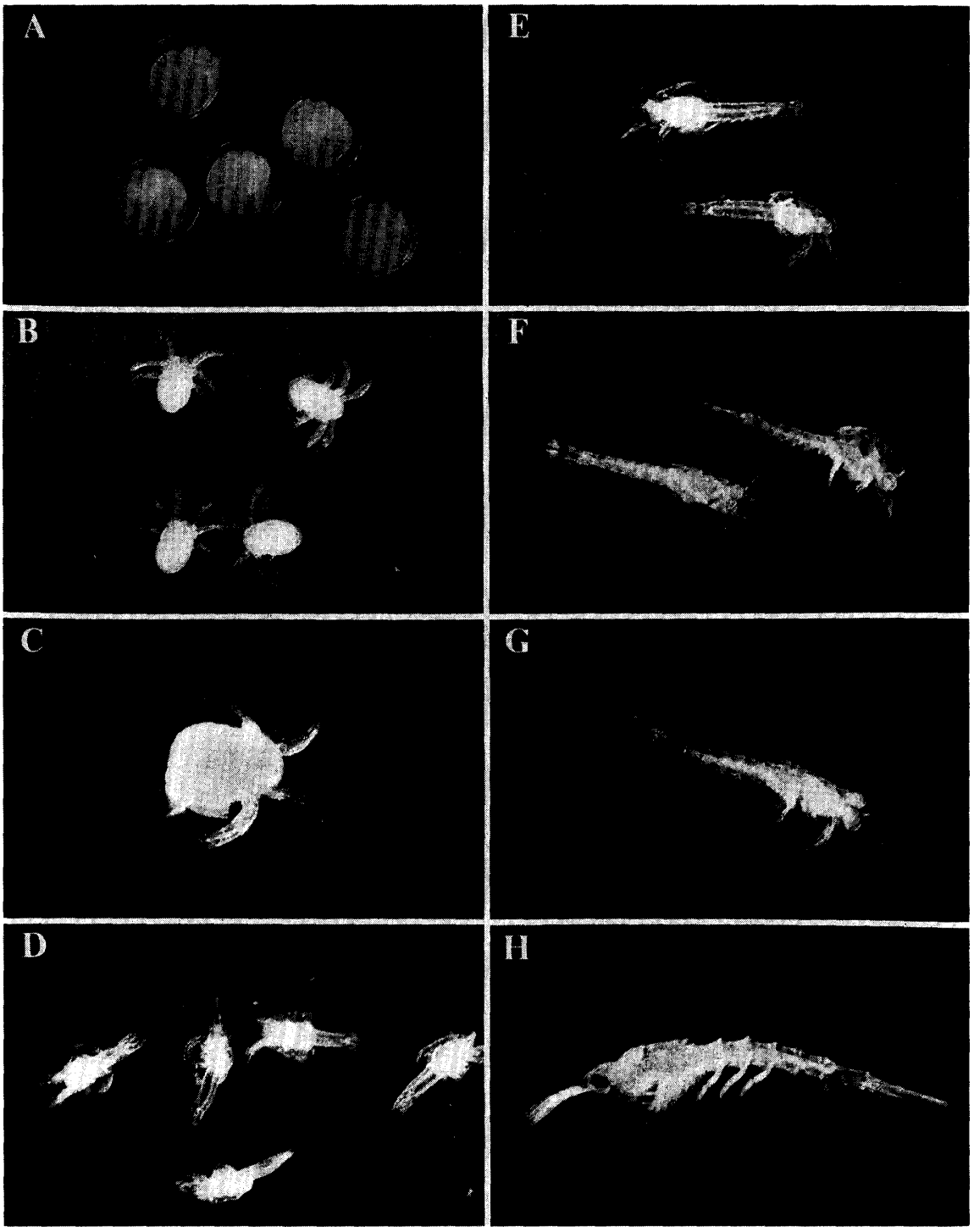

Fig. 1. Egg (A), nauplius (B), metanauplius (C), calyptopis I (D), calyptopis II (E), calyptopis III (F), furcilia I (G) and furcilia II (H) of E. crystallorophias *obtained in the laboratory. For body length and wet weight of each stage, see Table 1.*

Furcilia I and II stages appeared in 89 and 100 days, respectively, after egg release. All furcilia I had five pairs of nonsetose pleopods and all furcilia II five pairs of setose pleopods (Figs. 1G, H). Observations on the larvae older than furcilia II were limited to few specimens, and only one specimen reached the furcilia VI stage in 8 months after egg release. Compared with the developmental time of the larvae of *E. superba* observed under similar experimental conditions (127 days to furcilia VI stage after egg release, *cf.* IKEDA, 1984), the time for *E. crystallorophias* obtained in this study is very long, especially after furcilia I, suggesting unfavourable conditions for the larvae.

Because of the few numbers of larvae at each stage and abnormally long developmental time seen in late furcilia larvae, the usefulness of the present results are limited. However, it is demonstrated clearly that the raising of larvae of *E. crystallorophias* in the laboratory is feasible. Considering that the water temperature where *E. crystallophias* live is low consistently throughout a year (0°C or less, *cf.* MARR, 1962), the most important parameter affecting to the larval growth of this species would be the food availability. KITTEL and LIGOWSKI (1980) listed a wide range of planktonic and benthic algae found in the stomach of post-larval *E. crystallorophias*. Although no information is currently available for natural food of the larval stages (calyptopis and furcilia) of this euphausiid, the poor growth rate observed in the furcilia larvae in this study may partly be due to the use of inadequate food. Further refinement of experimental techniques is therefore necessary to obtain more useful growth data of the larvae of *E. crystallorophias* which will assist interpretation of field data of the larvae.

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