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Highly Synchronous Intra- and Post-marsupial Developments in *Nippoleucon hinumensis* (Crustacea, Cumacea), Observed in the Seto Inland Sea of Japan*

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Introduction

Cumaceans (Crustacea, Paracarida, Cumacea) are epibenthic fauna of soft substrate from shallow waters to deep-sea. Cumacean embryos, which are incubated in the marsupia or the brood pouch of females, undergo direct development, and hatch out as the manca larvae which are similar to the adults except lacking fifth walking leg. The first manca larvae (first instar) come out of the marsupia and begin post-marsupial development.

Most cumaceans in the family Leuconidae usually live in cold water, but some Japanese species are known to inhabit shallow waters or brackish lakes, where ambient temperature is rather high in summer. In the present field study, the timing course of intra- and post-marsupial development in *Nippoleucon hinumensis* (Leuconidae) were investigated.

Materials and Methods

Specimens of *Nippoleucon hinumensis* were collected from the muddy bottom of about 6 m depth in the mid region of the Seto Inland Sea (36°36'N, 134°09'E). Small epibenthic sledges equipped with 250 μm or 500 μm nylon mesh were towed for 50 m, and the collected sediments were sieved through nylon mesh of the same opening, then fixed in a solution of 5–10 % borate buffered formalin sea water. Two to 12 collections were made a month between August 1998 and March 2002. The animals were sorted under a stereo microscope and preserved in 5 % borate buffered formalin sea water.

Stages of the intra-marsupial development were determined as follows; Stage I, spherical embryos; Stage II, embryos with small dorsal notch; Stage III, embryos with the segmentation visible; Stage IV, embryos with appandeges (nauplius and 1st postnauplius stages); Stage V, larvae showing ventral curvature (2nd postnauplius stage); Stage VI, 1st manca larvae. The post-marsupial developmental stages (instars) were identified and sex was determined by the shape of the appendages.

Results and Discussion

Females incubated their first brood between February and March, and their second brood between April and May. The intra-marsupial development showed clear synchronism among embryos. The time of the development of the first brood was much longer than the second brood. It is suggested that the environmental temperature affected the speed of embryonic development. The manca larvae, released in late March, grew rapidly, undergoing 3 moltings in about 10-day intervals. Exopods of the fourth walking leg in males remained small, indicating no increase of sexual dimorphism during this period. The animals stored numerous lipid droplets in their body cavity. In May, the animals stopped feeding for about 10 days after their third molt. No food residue was observed in the body until late November, indicating that they underwent summer diapause for 6 months. Lipid droplets in their body cavity decreased and disappeared during this period.

After the diapause, they showed a distinct semilunar rhythm of molting cycles, and became adult males or preparatory females in early February. Exopods of the fourth walking leg in males increased in size by each molt, leading to an increase of sexual dimorphism. The change of the sex ratio of the specimens in February indicated deaths of males after mating. Most of the females died during the incubation of the second brood in May.

The process from the onset of embryonic development to the end of the diapause were highly synchronous. All these processes finished between 10 and 14 days. Cold water leuconid cumaceans do not show such a highly synchronous development (Granger *et al*., 1979; Bishop, 1982; Bishop and Shalla, 1994; Cartes and Sorbe, 1996). This synchronism in the development of *N. hinumensis* leads us believe that these specific adaptation of their life cycle are result of the seasonal high temperatures.

Less than 1% of total population of this species

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showed no diapause. These individuals did not show synchronism in post-marsupial development. Non-diapause individuals became adults within a period of one and a half months after hatching, and these individuals molted three times less than the diapause-group. This suggests that diapause increases the individual life-span, synchronized development, and as a consequence, brings about a more effective reproduction.

References

Bishop, J.D.D. (1982) The growth, development and reproduction of a deep sea cumacean (Crustacea: Peracarida). *Zoological Journal of the Linnean Society*, **74**, 359–380.

Bishop, J.D.D. and S.H. Shalla (1994) Discrete seasonal reproduction in an abyssal peracarid crustacean. *Deep-Sea Research*, **41**, 1789–1800.

Cartes, J.E. and J.-C. Sorbe (1996) Temporal population structure in deep-water cumaceans along the western Mediterranean slope (between 400 to 1300 m). *Deep-Sea Research*, **43**, 1423–1438.

Granger, D., P. Brunel and D. Messier (1979) Cycle de dévelopment de *Leucon nasica* (Crustacea, Cumacea) dans la nappe glaciale circalittorale de la baie des Chaleurs, golfe du Saint-Lawrent, en 1968 et 1969. *Canadian Journal of Zoology*, **57**, 95–106.