

Seasonal Change in the Reproductive Pattern of the Marine Cladoceran *Podon polyphemoides* in Korean Waters

Kwang-II YOO and Se-Wha KIM

*Department of the Biology, Hanyang University,
Seoul 133-791, Korea*

Seasonal change in the reproductive pattern of the marine cladoceran, *Podon polyphemoides*, was studied using materials collected monthly during the period from January to December 1986 in Yongil Bay, Korea. The relative abundance of *P. polyphemoides* exceeded 10% of total zooplankton in July. While the species remained as a minor components of the zooplankton community during the other periods of occurrence from June to December. Occurrence of sexual individuals of *P. polyphemoides* (males and gamogenetic females) in higher proportion in cold months (30% in November and 40% in December) suggests that resting egg production of this species is largely confined to cold months in Korean waters as an overwintering strategy.

Introduction

Cladocerans are a group of crustaceans in which cyclic parthenogenesis occurs (Young, 1979; Sastry, 1983). Like seven other species of marine cladocerans, *Podon polyphemoides* reproduces parthenogenetically and gamogenetically as well (Onbé, 1974; Kim and Onbé, 1989a). During the period of favorable conditions, this species reproduces parthenogenetically, and can establish large populations in a short time (Bosch and Taylor, 1970; Onbé, 1985). When environmental conditions become unfavorable for its planktonic existence, sexual individuals appear and resting eggs are produced by fertilization (Onbé, 1974, 1985; Onbé et al., 1977). Namely *P. polyphemoides* has its own seasons of planktonic occurrence in temperate waters (Gieskes, 1971a; Onbé, 1974, 1977; Onbé et al., 1977; Yoo and Kim, 1987). Gieskes (1971a, b), Onbé (1974, 1977) and Onbé et al. (1977) reported that temperature is a leading factor to determine the period of the planktonic occurrence in this species.

Restriction in the distribution of *P. polyphemoides*

to inshore waters has been well documented in various area of the world oceans (Dolgopolskaja, 1958; Ackefors, 1971; Bosch and Taylor, 1973; Onbé, 1977). Ecological studies of this species is confined to its seasonal occurrence in Korean coastal waters (Kim, 1985; Yoo and Kim, 1987), however, they did not deal with the reproduction of this species.

This paper deals with the seasonal distribution of *Podon polyphemoides* in relation to its seasonal change in the reproductive pattern in the Korean waters.

Materials and Methods

Zooplankton samples were collected monthly from January to December 1986 in Yongil Bay (36° 04'N, 129° 28'E) which is located in the southeastern coast of Korean Peninsula. Samples collected by vertical hauls with a Nansen opening closing net (mouth diameter: 30cm, mesh aperture: 20 μ m), were fixed with 5% neutralized formalin.

Only a proportion of *P. polyphemoides* in the total

zooplankton was calculated. Fifty individuals (20 individuals in November) were randomly sorted from each sample and the occurrence of sexual individuals was examined.

Parthenogenetic and gamogenetic specimens were photographed by an inverted microscope (Olympus Model CK 2).

Results

Podon polyphemoides occurred from June to De-

cemver, 1986 in Yongil Bay, Korea. The proportion of this species exceeded 10% of total zooplankton in July when *Penilia avirostris* occurred together with extremely low abundance. *P. polyphemoides*, however, remained a minor component of the zooplankton community in other months.

A male, and parthenogenetic and gamogenetic females are shown in Fig. 1. The posterior outline of the carapace is more or less depressed in the male (Fig. 1A). This is apparently due to the absence of brood pouch in the male (cf. Onbé, 1983; Kim and Onbé, 1989a, b). A parthenogenetic

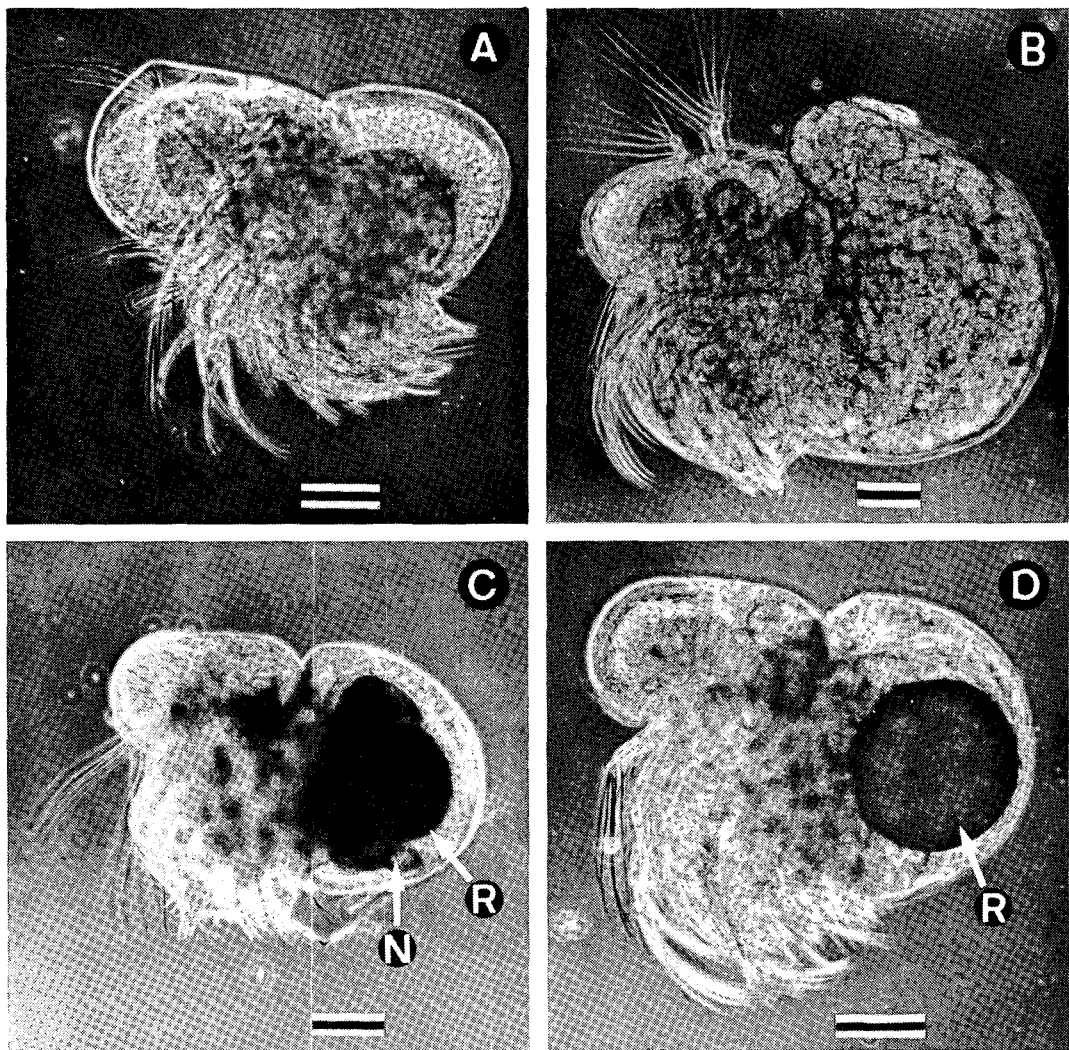


Fig. 1. *Podon polyphemoides*. A: male, B: parthenogenetic female, C: gamogenetic female with a developing resting egg, D: gamogenetic female with a well-developed resting egg. N=nourishing cells, R=resting egg. Scale bars indicate 100 μ m.

female shows an expanded brood pouch in which well-developed embryos are contained (Fig. 1B). Figs. 1C, D show gamogenetic females with the developing (Fig. 1C) and the well-developed resting egg (Fig. 1D). A developing resting egg was observed to be surrounded by nourishing cells which disappeared when the development of the resting egg was completed (cf. Cheng, 1947).

Fig. 2 shows the seasonal change in the composition of parthenogenetic and gamogenetic individuals in the population of *Podon polyphemoides*. The frequency of occurrence of sexual individuals was 30% in November and 40% in December. With the increase in the occurrence of sexual individuals in cold months, sporadic occurrence of males was observed in August.

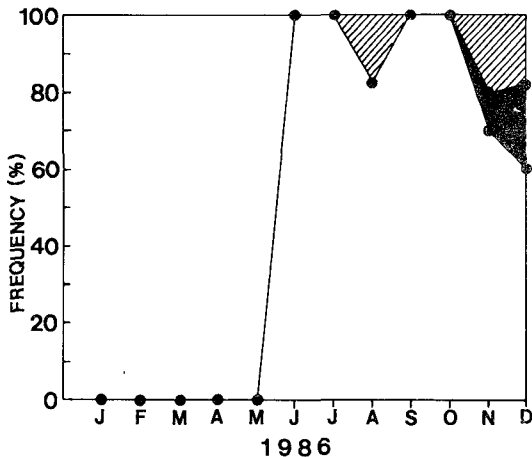


Fig. 2. *Podon polyphemoides*. Seasonal change in the composition of parthenogenetic and gamogenetic individuals in 1986 in Yongil Bay. Open area: parthenogenetic females, solid area: gamogenetic females, hatched area: males.

Discussion

Podon polyphemoides is the species commonly found in warm temperate coastal waters. Due to the parthenogenetic reproduction, this species often becomes a dominant component of the local zooplankton community (Bosch and Taylor, 1968; Onbé, 1985).

Occurrence of this species through warmer sea-

sons at the present study agrees well with the high temperature preference of *P. polyphemoides* previously reported by Onbé (1974) and Yoo and Kim (1987). Occurrence of parthenogenetic females in higher proportion in warmer seasons also supports that high temperature favors this species to reproduce parthenogenetically, then establish abundant populations in the summer.

Resting egg production in *P. polyphemoides* is generally known to be an overwintering strategy in temperate coastal waters (Onbé, 1974, 1977, 1985; Onbé et al., 1977). Seasonal cooling might cause the occurrence of sexual individuals. Resting egg of this species, however, is reported from the Korean waters for the first time by the present study. Moreover, the increase of gamogenetic reproduction, which results resting eggs, in colder seasons was observed. Sporadic occurrence of male in August seems to be due to the cold water prevalence in this month in Yongil Bay previously reported by Kim et al. (1988).

Knowledges on biology and ecology of *Podon polyphemoides* is still rather poorly known in Korean coastal waters. Observations on the embryonic development and the influence of environmental conditions which might alter parthenogenesis to gamogenesis will help to understand precisely the role of the reproductive pattern of this species on its seasonal distribution.

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