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Production of *Acartia omorii* (Copepoda: Calanoida) in Ilkwang Bay, southeastern coast of Korea

Hyung-Ku Kang [a,*], Yong Joo Kang [b], Chul Park [c]

[a] *Marine Environment Research Department, Korea Ocean Research and Development Institute, Ansan P.O. Box 29, Seoul 425-600, Republic of Korea*
[b] *Department of Marine Biology, Pukyong National University, Nam-gu, Busan 608-737, Republic of Korea*
[c] *Department of Oceanography, Chungnam National University, Daejeon 305-764, Republic of Korea*

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Abstract

Production of the marine calanoid copepod *Acartia omorii* was measured from 2 October 1991 to 8 October 1992 at a station in Ilkwang Bay on the southeastern coast of Korea. *A. omorii* (nauplii + copepodites + adults) were present in the plankton throughout the year, with seasonal variation in abundance. Biomass of *A. omorii* was averaged at 0.44 mgC m^{-3}, with peaks in February and July, and relatively low biomass in late summer and fall. Egg production rate ranged from 2.4 to 151.9 μgC m^{-3} day^{-1}, which was equivalent to 95–6075 eggs m^{-3} day^{-1}. Fecundity of an adult female was averaged at 38 eggs $female^{-1}$ day^{-1}. Instantaneous growth rates of copepodites were higher than those of nauplii stages. Annual production of *A. omorii* ranged from 33.5 mgC m^{-3} $year^{-1}$ to 221 mgC m^{-2} $year^{-1}$, showing a seasonal variation of daily production rate with peaks in February and July. The daily production rate of *A. omorii* was significantly correlated with chlorophyll *a* concentration. These results suggest that standing stocks and/or productivity of phytoplankton are the major influencing factors, rather than water temperature for the seasonal variation of production of *A. omorii* in Ilkwang Bay.

Keywords: Copepoda; *Acartia omorii*; Biomass; Production; Temperature; Chlorophyll *a* concentration

1. Introduction

Copepods are the dominant mesozooplankton in the marine environment and are the major link between phytoplankton and fish larvae. The GLOBEC program has focused on the measurement of biomass and secondary production of zooplankton with respect to the variation of ecosystem in relation to the climate change (IGBP, 1999; Coyle and Pinchuk, 2003; Rebstock and Kang, 2003). Historically, a classic approach for measuring copepod growth and production, growth rate method, has been used in the ocean world (Peterson et al., 1991; Huang et al., 1993; Liang and Uye, 1996a,b; Peterson et al., 2002). However, this approach has been criticized as unfeasible method because it is time consuming and labor intensive (Poulet et al., 1995; Hirst and Bunker, 2003). Recently, an effort on the global integration of production parameters of copepods including growth and fecundity was made to facilitate the measurement of copepod production (Hirst and Lampit, 1998; Peterson et al., 2002; Hirst and Bunker, 2003). Nevertheless, the species-specific approaches are still

* Corresponding author. Fax: +82 31 408 5934.
E-mail address: kanghk@kordi.re.kr (H.-K. Kang).

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valuable to generate an understanding of a seasonal variation of biomass and production of a particular species in zooplankton over a wide range of space and time scales (Marine Zooplankton Colloquium, 2001).

Copepods are considered as the major constituent of zooplankton in Korean waters (Park et al., 1991; Hwang and Choi, 1993; Kim et al., 1993; Myung et al., 1994; Go et al., 1996; Kang and Kim, 2002; Rebstock and Kang, 2003). And *Acartia omorii* is known as one of the most dominant copepods in coastal waters of Korea. Although the abundance and distribution of *A. omorii* in Korean water are relatively well known (Kim, 1985; Yoo et al., 1991; Kim et al., 1993; Go et al., 1994; Lee et al., 2001; Kang and Kim, 2002), little information on copepod production is available. Given that Liang and Uye (1996a) studied the population dynamics and production of *A. omorii* in a eutrophic inlet of the Inland Sea of Japan, there are few data on the production and population dynamics of *A. omorii* in Korean water.

The purposes of this study were, then, to estimate the production rate of *A. omorii* in Ilkwang Bay on the southeastern coast of Korea and, if possible, to identify the influencing factors. Also, we compared the production rate of *A. omorii* in Ilkwang Bay with the same species in the Inland Sea of Japan (Liang and Uye, 1996a) to understand the regional difference in the pattern of the production rate.

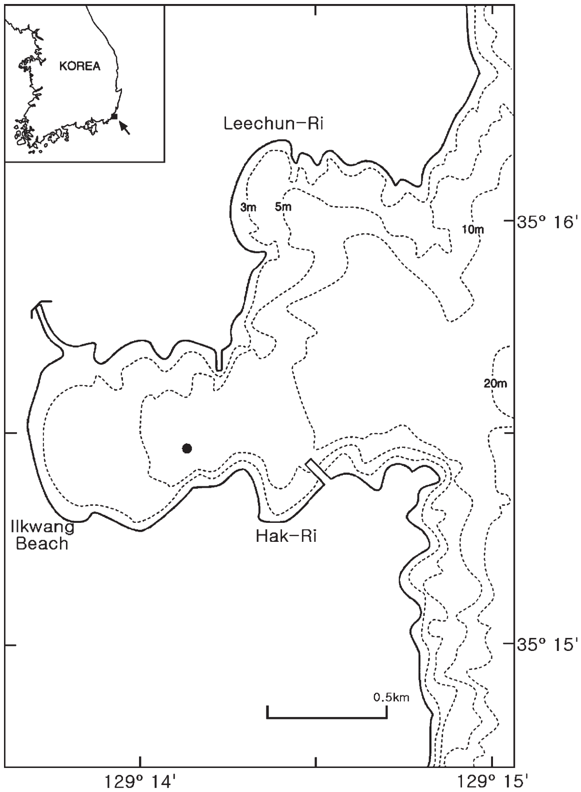

Fig. 1. Sampling station in Ilkwang Bay.

2. Materials and methods

A series of samples were collected at a station in Ilkwang Bay on the southeastern coast of Korea from 2 October 1991 to 8 October 1992 (Fig. 1), and sampling was conducted more frequently in warm season (about 3 times/month) than in cold season (about 2 times/month). Although detailed methods have been described previously (Kang and Kang, 2005), we briefly give an outline below.

Zooplankton samples were taken by oblique hauls from the bottom to the surface using a plankton net (31 cm mouth diameter, 64 μm mesh). The copepod *A. omorii* from whole samples or split sub-samples, were enumerated and stage-identified. The naupliar and young copepodite stages of *A. omorii* were differentiated from those of the other species of *Acartia* according to the absence of rostral filament in copepodite 2 to 5 (Lee, 1986; Kimoto, 1988), the difference of body length in nauplii 2 to copepodite 1 compared to *Acartia steueri* (Kang, unpublished data; Koga, 1984; Lee, 1986): the body lengths of nauplii and copepodite 1 of *A. omorii* were shorter than those of *A. steueri*. Our previous results (Kang, 1997) showed that the major *Acartia* species in Ilkwang Bay were *A. omorii* and *A. steueri* with minor abundance of other *Acartia* spp. (i.e. *A. pacifica*, *A. erythraea* etc.) in summer.

Water temperature, salinity and chlorophyll *a* were monitored during the sampling period. Water temperature and salinity were measured using a general stem thermometer and a salinometer (Tsurumi Seiki SM-2000) at surface and bottom water, respectively. Chlorophyll *a* concentration was measured by the spectrophotometric method (Parsons et al., 1984) for surface and bottom water (750–1000 mL) filtered onto membrane filter (0.45 μm pore size, Whatman), using a spectrophotometer (Cecil CE599).

Population production rate (P, μgC m^{-3} day^{-1}) of *A. omorii* was calculated using the growth rate method (Hutchings et al., 1995; Liang and Uye, 1996a; Liang et al., 1996):

$$P = \sum_{i=NII}^{CV} (B_i \times g_i) + B_f \times g_f$$

where, B_i and B_f are biomass (μgC m^{-3}) of stage i and adult females, respectively. g_i is the instantaneous growth rate (day^{-1}) of stage i. g_f is the specific egg production