Phytoplankton biomass and productivity of different size fractions in the Vellar estuarine system, southeast coast of India

Zen'ichiro Kawahata1, A Magendran2, S Palanichamy2, V K Venugopalan2 & Ryo Tatsukawa1
1Department of Environmental Conservation, Ehime University, Tarumi 3-5-7, Matsuyama 790, Japan
2Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai 608 502, Tamil Nadu, India
Received 25 August 1992; revised 26 August 1993

Chlorophyll a (chl-a) and the gross production of different size fractions of phytoplankton were measured in both the Vellar estuary (st. A, July 20, 1988) and the Pichavaram mangrove (st. B, July 18, 1988). The largest quantity of chl-a was found in the fraction of 5-10 μm at both stations; 3.6 μg.l⁻¹ (33% of total chl-a) at st. A, 6.5 μg.l⁻¹ (51% of total chl-a) at st. B. Similarily, the highest gross production was found in the fraction of 5-10 μm at both stations; 49 mgC.m⁻³.h⁻¹ (20% of total gross production) at st. A, 32 mgC.m⁻³.h⁻¹ (22% of total gross production) at st. B. This suggested that phytoplankton of 5-10 μm was important contributor to the primary production in this ecosystem at the time of this study.

Estuaries are economically important ecosystems for fisheries in tropical regions1. Phytoplankton is one of the initial biological component from which energy is transferred into higher organisms through food web. Biomass and productivity of phytoplankton in different sizes are important factors regulating the amount of organisms in higher trophic levels, because phytoplankton in different sizes play different ecological roles in ecosystems2-8. However, phytoplankton biomass and productivity of each size fraction in tropical estuarine regions are neither well documented nor well understood.

The purpose of this study is to describe the phytoplankton biomass and gross production of different size fractions in the tropical estuary along southeast coast of India.

The survey and experiment were conducted at st. A in the Vellar estuary and at st. B in the Pichavaram mangrove which is connected with the Vellar estuary in the north (Fig. 1). The average depth of st. A was 2.5 m with a 0.15 m tidal level. The tidal effect was felt up to 34 km upstream. The mean depth at st. B was 0.5 m with a mean tidal level of 0.15 m. The neritic water almost always dominates the mangrove except during the monsoon season (October-December).

Water samples taken on 18-20 July, 1988 at a 0.3 m depth were filtered using membrane filters with respective pore sizes of 1, 3 and 5 μm, and using nylon plankton nets with respective pore sizes of 10, 30, 50, 100, 200, and 300 μm. The vacuum of filtration were 5 cm Hg for the glass filter and membrane filters with pores of 1 and 3 μm and 1.5 cm Hg for the membrane filter with pores of 5 μm and for the nylon plankton net with pores of 10 μm. No vacuum was used for the filtration through the nylon plankton nets with pores larger than 30 μm. Each filtered water samples and untreated water sample were again filtered using a glass fiber filter with a 0.3 μm pore size. Chlorophyll a (chl-a) on the glass filter was measured one time as an indicator of phyto-

Fig. 1—Map of the Vellar estuary and station locations
plankton biomass. The unfiltered and filtered water samples were respectively transferred to four bottles, and gross production was determined using mean value of duplicate bottles. For the measurements of chl-a and gross production standard method was used. Chl-a and gross production of the 1-3 μm fraction size were obtained by subtracting the values for the filtrate through the membrane filter with 1 μm pores from the values for the filtrate through the membrane filter with 3 μm pores. Those of the other fractions were also obtained in the same way.

Chl-a of each size fraction is shown in Fig. 2. Total chl-a of 10.9 μg.l⁻¹ and 12.8 μg.l⁻¹ were found at sts A and B, respectively. At both sts A and B, the largest quantity of chl-a was found in the fraction of 5-10 μm; 3.6 μg.l⁻¹ (33% of total chl-a) at st. A and 6.5 μg.l⁻¹ (51% of total chl-a) at st. B.

The quantities of chl-a surveyed in the Vellar estuary and other estuaries showed that the chl-a of nanophytoplankton prevailed over that of net phytoplankton. This was also observed in other ecosystems under certain environmental conditions. In this study, chl-a of nanophytoplankton (3-30 μm) shared 47% and 77% of total chl-a at sts A and B respectively during this study. This suggests that phytoplankton of 5-10 μm is important fraction in phytoplankton biomass.

Gross production of each size fraction is shown in Fig. 3. Total gross production of 250 mgC.m⁻³.h⁻¹ and 144 mgC.m⁻³.h⁻¹ were found at sts A and B, respectively. At both stations highest gross production was observed in the size fraction of 5-10 μm: 49 mgC.m⁻³.h⁻¹ (20% of total gross production) at st. A, and 32 mgC.m⁻³.h⁻¹ (22% of total gross production) at st. B. Nanoplankton (3-30 μm) contributed 41% and 44% of the total gross production at sts A and B, respectively. This suggested that phytoplankton of 5-10 μm was important contributor to the primary production in this ecosystem at the time of this study.

This work was supported by a grant of the International Scientific Research Program: Field Research of the Ministry of Education, Science and Culture, Japan, No. 63041094.

References
4 Williams R B, Ecology, 45 (1964) 877.