

## SECONDARY PRODUCTION IN THE COCHIN BACKWATERS, A TROPICAL MONSOONAL ESTUARY

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Secondary production in the segment of the Kerala backwaters, from Azhikode to Alleppey, was estimated and compared with the reported values of primary and tertiary production from the area. The average secondary production was estimated to be 31.8 mg/m<sup>3</sup>/day. It was considerably higher during the saline premonsoon period (60.0 mg/m<sup>3</sup>/day) than during the low saline period (8.0 mg/m<sup>3</sup>/day). Average transfer coefficient from primary to secondary level for the whole estuary was low (2.7%) showing a large surplus of primary production being available for alternate pathways in the food chain. The ratio of dry weight of exploited plankton-feeding fish to dry weight of zooplankton was only 3.8 to 7.0%. It is suggested that the large quantities of unutilized primary and secondary food of the estuary must be contributing to the production of the shelf waters of the region or the detritus ecology of the system. Organic detritus of the estuary (derived from other sources also) does play an important role in the ecology of the system as is evident from the large catches of detritus-feeding organisms such as prawns and clams from the estuary.

### INTRODUCTION

Estuaries are highly productive systems and form natural buffer zones between marine and limnetic regions. Apart from their contribution to capture fisheries, life cycles of many commercial forms like prawns are intimately associated with estuaries. Estimates of their production and potential are essential for their management and conservation. The present paper deals with estimates of secondary production and its comparison with production at other trophic levels in the Cochin estuary.

### MATERIAL AND METHODS

The portion of the Kerala backwaters (Fig. 1) from Alleppey to Azhikode (09°30' - 10°10'N, 76°15' - 76°25' E) was selected for the study. Estimates of secondary production are based on average zooplankton biomass from three sets of data (a) monthly day and night collections from barmouth, Cochin, Aroor and Narakkal (latter two stations about 14 km south and 10 km north of mouth respectively) from November, 1971 to October, 1972. (b) monthly collections from Cochin to Alleppey along seven stations (Haridas *et al.*, 1973) from January to December, 1972. (c) collections taken from Alleppey to Azhikode (32 stations) during premonsoon and monsoon periods in 1975. All samples were taken with a HT net (mouth area - 0.25 m<sup>2</sup>, length - 3 m, mesh - 300  $\mu$ ) with a flow meter attached in oblique hauls from bottom to surface. Dry weight of the samples were estimated after removing the larger primary carnivores such as hydro-

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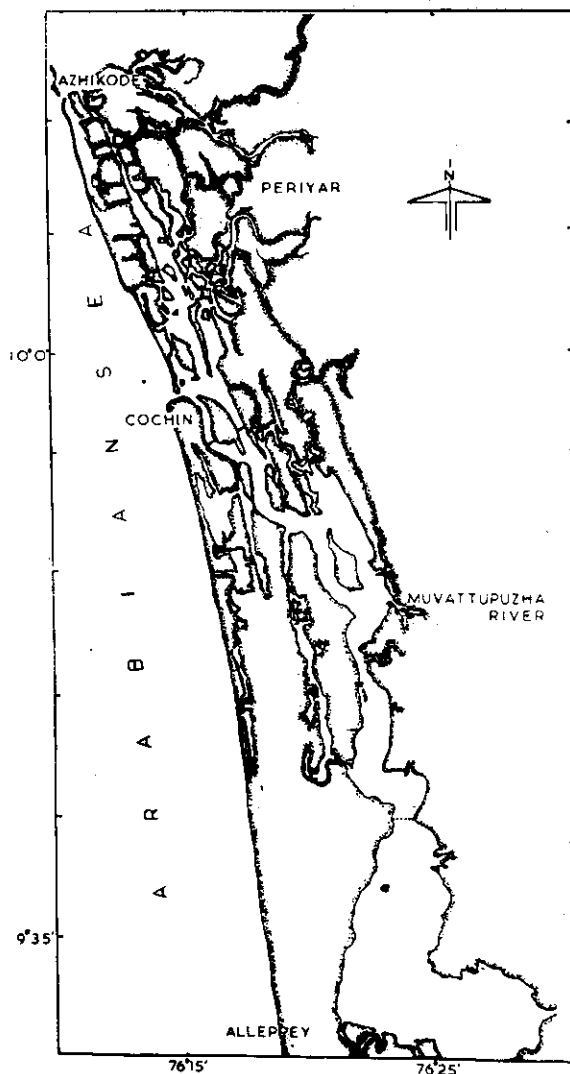


Fig.1. Map of the backwaters from Azhikode to Alleppey

medusae, ctenophores and chaetognaths. Secondary production  $P_t$  for  $t$  days was estimated using the formula

$$\frac{\sum_{i=1}^n P_i}{n} \times t$$

### RESULTS AND DISCUSSION

The physical conditions of the estuary are subjected to extreme variability especially in salinity due to periodic monsoonal flows. Zooplankton population is

very poor during the low saline period (Madhupratap and Haridas, 1975). The period from December to April is designated as saline period, (salinity incursion into the estuary begins by December and attains peak values by March-April), and May to November as low saline period.

Biomass (dry wt) in the estuary ranged from 0.7 to 384.0 mg/m<sup>3</sup>. The average zooplankton production was estimated as 31.8 mg dry wt per cubic metre per day (11.6 g/m<sup>3</sup>/year). This gave a P/B ratio of 0.8 per 24 hr or a P/B ratio of approximately 30 per year. Average production during the saline period was 60.0 mg/m<sup>3</sup>/day whereas it was only 8.0 mg/m<sup>3</sup>/day during low saline period. The deeper regions of the backwaters showed higher secondary production (52.5 mg/m<sup>3</sup>/day) than the shallow reaches at the head (14.0 mg/m<sup>3</sup>/day) and between Cochin and Azhikode (9.1 mg/m<sup>3</sup>/day).

Qasim *et al.* (1969) have estimated the net primary production in the lower reaches as 124 gC /m<sup>2</sup>/yr and that 90% of the total primary production is confined to the upper 1.5 m. The total primary production was computed based on this data. Taking the metabolic requirements of zooplankton in terms of carbon to be 12% of its dry wt (Menzel and Ryther, 1961) the ratio of secondary production to primary production at the lower reaches (Cochin to Aroor) was found to be 12.5%. This closely matches Cushing's (1971) average transfer coefficient (12.4%) from primary to secondary level from the major upwelling areas of the world. But if the rate of primary production is extrapolated for the entire estuary, the transfer coefficient is a bare 2.7%. It will be still lower if the carbon content of dry zooplankton is taken as 6.5% (Cushing, 1971). A large surplus of basic food seems to be available for alternate pathways in the food chain of the estuary as suggested earlier by Qasim *et al.* (1969).

Mean figure for tertiary production taking 1% of primary production and 10% of secondary production (Cushing, 1971, 1973) and raising their carbon values by the factor 7.41 to obtain wet weight for fish (Vinogradov, 1953) is approximately 2400 tonnes (Table 1). The total annual fish landings from Kerala Backwaters (50,000 ha) is reported to be 14-17000 tonnes - including prawns 60 - 70% and cat fishes - 9% (George and Sebastian, 1970). Accordingly the catches of plankton-eating fishes from the study area will be about 1470 to 2640 tonnes. Most of the estuarine fishes are omnivorous and the common estuarine fishes like *Mugil* can feed in several trophic levels (Odum, 1971). The actual percentage of transfer is possible to be higher. Considering the unexploited stock also, the total wet weight for fish is likely to include energy derived from other sources such as detritus.

Ratio of the dry weight of the exploited plankton-eating fish (30% of wet weight, Vinogradov, 1953) to the dry weight of zooplankton is only about 3.8 to 7.0%. This indicates that apart from primary food, part of the secondary production also contributes to the detritus ecology of the system. Any estimate of fish production from plankton alone, without considering detritus will be an underestimate (Qasim and Senkaranarayanan, 1972).

In fact organic detritus plays an important role in the food chain of the backwaters. This is evident from the higher percentage of prawns in the composition of annual fish landings and comparatively heavier catches of clams (88,000 tonnes of live and 1,70,000 tonnes of dead shells annually — George and Sebastian, 1970). Certain regions of the bottom of the estuary harbour dense populations of amphipods and tubicolous polychaetes. Detritus in the estuary is derived from other sources also such as land drainage, wastes dumped into it, faecal pellets of

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TABLE 1. PRODUCTION AT THE THREE TROPHIC LEVELS

A	Area (square km)	250
B	Primary Production (tonnes carbon/year)	51319
C	Secondary production (tonnes dry weight/year)	11391
D	12% of C (tonnes carbon/year)	1377
E	D/B Transfer coefficient (%)	2.7
F	Tertiary production 1% of B × 7.41	3802
G	10% of D × 7.41	1020
H	$\frac{F + G}{2}$	2411

its inhabitants and the decay of large quantities of the weed *Salvinia* brought into it during the monsoons. The organic detritus is not probably being completely recycled or utilized in the backwaters itself but must be contributing to the ecology of coastal waters especially during the monsoonal washout. The availability of large quantities of detritus and phytoplankton provide ample scope for the expansion of culture fishery of prawns, mussels and oysters in the estuary.

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