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A REVIEW ON ZOOPLANKTON PRODUCTION IN THE INDIAN OCEAN*

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ABSTRACT

A perusal of the published reports on zooplankton biomass in the Indian Ocean, reveals that due to non-availability of data from reportedly productive neritic waters, the projected value of biomass of 519 million tonnes become underestimate by more than 90 million tonnes. Similarly, as deduced from the data on biochemical composition and energy content, it is evident that zooplankton of the Indian Ocean, contains on an average 2.7% organic carbon which is less than half, as compared to the widely used value of 6.5%. Thus, it necessitates the revalidation of zooplankton production based, exploitable fishery resources in the Indian Ocean.

INTRODUCTION

TO DETERMINE the relative importance of different elements of biota to the rates through which the organic carbon, synthesized by the primary producers, reaches the exploitable marine resources, it is necessary to quantify the standing stock of biomass of each of the component, the requirements to sustain them and their rates of supply and utilization. In addition, one would wish to know in comparative units the amounts and distribution, with space and time, of all the elements of the biomass on a regional scale depending on the scope of the examination. At present, these ideas are approached in an impressive fashion often based on somewhat unsound assumptions as well as scanty and patchy knowledge about the marine biomass.

In the present communication, an attempt has been made to update the information about the zooplankton biomass and its organic carbon content. This information will be of relevance in determining the energy available to the higher level which in turn can be used to estimate the potential fishery resources.

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MATERIAL AND METHODS

The Indian Ocean, for the present study is considered to extend from 35°E as Western boundary to the Southern borders of the Mozambique ; Eastern boundary — 115°E i.e. from Durban on the African Coast to Green Horn on West Australian Coast ; the Northern boundary upto 25°N and the Southern boundary upto 35°S. The total area covered is 43.1 million sq. km which is about 57 per cent of convential Indian Ocean (Sverdrup *et al.*, 1946). The continental shelf (upto 200 m depth) occupies about 3.17 million sq. km or 15% of the total area under study.

Biomass data collected during the International Indian Ocean Expedition (IIOE)

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and by different ships in coastal and offshore regions after IIOE has been utilized (Prasad, 1966 ; Goswami *et al.*, 1977 ; Nair *et al.*, 1977 ; Goswami, 1979 ; Achuthankutty *et al.*, 1980 ; Nair *et al.*, 1980 ; Madhupratap *et al.*, 1977, 1981) to estimate the zooplankton biomass. Further it is also assumed that displacement volume is a fair estimate of wet weight in zooplankton.

Data on biochemical analysis of zooplankton samples from the Indian Ocean waters, were used, to work out the conversion of displacement volume to organic carbon.

Results and Discussion

Biomass determination has been the subject of much investigation and review (Winberg, 1971 ; Dickie, 1972). The method may be imprecise and biased ; appropriate factors are used to convert the result (wet weight, dry weight, chlorophyll value, etc.) to common comparative units. Information on organic carbon and the distribution of biomass with respect to time and space depending on the scale of the determination are often inadequate. The only estimate about zooplankton biomass (Prasad *et al.*, 1970) of the Indian Ocean region was based on 1622 samples collected mainly from oceanic region during the IIOE (1961-65). After IIOE, much more biomass data has been gathered from coastal as well as oceanic regions. However, no attempt has been made to use this data for updating the information.

Geographical distribution of zooplankton in the Indian Ocean based on the IIOE data, shows highly productive areas around Somali and Arabian Coasts and to a certain extent on the south western Coast of India. The low productivity zones occupy the central part of Arabian Sea. The Northern Bay of Bengal also has moderately high biomass. Taking all the zooplankton biomass data into consideration (Prasad *et al.*, 1970), estimated the total biomass for the Western and the Eastern halves of the Indian Ocean to be 3.25×10^8 and 1.94×10^8 tonnes respectively. In other words, the total zooplankton biomass of the Indian Ocean has been estimated to be 519 million tonnes.

After IIOE, the data obtained in coastal as well as in offshore waters (Table 1) indicates that the biomass is much higher in coastal waters than oceanic waters, suggesting that the estimates based on IIOE data are more likely to be underestimate.

Table 1. *Zooplankton biomass values calculated on Post IIOE data*

Region	Season	Biomass ml (100 m)		
		Max.	Min.	Average
North and northern Indian Ocean	Dec.-May	560*	—	—
Southwest coast of India	Jan.-Dec.	37.3	0.83	—
Arabian Sea	Oct.-Nov.	—	—	18.0
West coast of India	Mar.-Apr.	59.9	7.9	—
Central west coast of India	Jan.-May	593**	78.0**	—
Laccadive Sea	Mar.-Apr.	37.5	4.5	14.7
Bay of Bengal	SW Monsoon	60	—	—
Western Bay of Bengal	SW Monsoon	480	1	—
Western Indian Ocean	Jan.-Feb.	10.4	1.6	—
Andaman Sea	Feb.	14.4	1.8	5.6

* ml (200 m)$^{-2}$
** ml (1000 m)$^{-2}$

By considering the data of IIOE and that of other investigation after IIOE (Goswami *et al.*, 1977 ; Nair *et al.*, 1977 ; Goswami, 1979 ; Achuthankutty *et al.*, 1980 ; Nair *et al.*, 1980; Madhupratap *et al.*, 1977, 1981), the biomass estimates for shelf and offshore regions are 130 million and 480 million tonnes respectively. These estimates indicates that the earlier estimates of zooplankton biomass of the Indian Ocean were less by 91 million tonnes.

For the productivity studies, information on mere abundance will not give any indication about the quantum of energy available to the secondary producers. It is therefore, necessary to have an estimate of organic carbon in zooplankton which gives theoretical information on energy available to the secondary producers. Organic carbon content can be used as reliable indicator of energy equivalent for any season (Platt *et al.*, 1969).

A factor of 0.065 has frequently been used to convert zooplankton biomass into organic carbon and is primarily based on results obtained by Cushing (1971). But it is shown that organic carbon content of tropical zooplankton is lower than in higher latitudes (Lovegrove, 1962 ; Beer, 1965 ; Lasker, 1966 ; Omori, 1969). Since the Indian Ocean is a tropical zone, it is necessary to use the conversion factor based on studies carried out in tropical waters. Species diversity is maximum in tropical than temperate waters and this progressive change in composition of zooplankton reflects on the organic content of these organisms.

Biochemical studies (Ostapenya *et al.*, 1967 ; Gupta, 1977 ; Qasim *et al.*, 1978 ; Nair, 1980 ; Madhupratap *et al.*, 1981) carried out in tropical waters, indicate that the ratio between dry weight and organic carbon varies between 31 and 41% (av. 38%) and that between displacement volume and dry weight fluctuates between 75.4 and 81.7 mg (av. 78.5 mg). These results gives a factor of 0.027 for conversion of displacement volume to organic carbon for the Indian Ocean region, which is less than half as compared to the widely used factor of 0.065.

By using the conversion factor of 0.027, the biomass production in terms of organic carbon estimated to be 3.5 and 12.9 million tonnes for shelf and offshore regions respectively of the Indian Ocean thus stands corrected.

Earlier workers engaged in productivity studies of the Indian Ocean have used the factor of 0.065 for converting displacement volume of zooplankton to organic carbon and these organic carbon estimates were further used for estimating the secondary production and fishery potential. Since the conversion factor (0.065) used by earlier workers is more than double as compared to the actual (0.027), the earlier estimates of zooplankton production/ secondary production are over estimates by the order of 2. In other words, the potential fishery estimates derived by using the zooplankton production based on conversion factor of 0.065 are more than double the actual estimates.

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