

Validity of Zooplankton Biomass Estimates & Energy Equivalent in the Indian Ocean

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Analysis of the published data on zooplankton biomass in the Indian Ocean reveals that due to omission of data from highly productive neritic waters, the projected values of 519×10^6 tons become underestimated by 91×10^6 tons. 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, rather than the widely quoted value of 6.5%. The biomass production in terms of organic carbon estimated to be 3.5 and 12.9×10^6 tons for shelf and offshore regions respectively in the Indian Ocean thus stands corrected.

To determine the relative importance of different elements of biota to the rates through which the organic carbon synthesised by the primary producers reaches the exploitable marine resources, it is necessary to quantify the standing stock of biomass of each of the components, the requirements to sustain them and their rates of supply and utilization. In addition, one would wish to know in comparable units the amounts and distribution in 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 through 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 information about the zooplankton biomass and its organic carbon content. This information may be of relevance in determining the energy available to higher levels which in turn can be used to estimate the potential fishery resources.

The Indian Ocean, for the present study is considered to extend from 35°W as western boundary to the southern borders of the Mozambique, eastern boundary - 115°E , the northern boundary up to 25°N lat. and the southern boundary up to 35°S lat. The total area covered is $43.1 \times 10^6 \text{ km}^2$ which is about 57% of conventional Indian Ocean¹. The continental shelf (up to 200 m depth), occupies about $3.17 \times 10^6 \text{ km}^2$ or 15% of the total area under study.

Biomass data collected during the International Indian Ocean Expedition (IIOE) and by different ships in coastal and offshore regions after IIOE were utilized²⁻¹² to estimate the zooplankton biomass. Fur-

ther it was also assumed that displacement volume is a fair estimate of wet weight in zooplankton.

Data on biochemical analysis of zooplankton samples from Indian Ocean waters were used to work out the conversion of displacement volume to organic carbon¹².

Biomass determination has been the subject of much investigations and review^{13,14}. Information on organic carbon and the distribution of biomass with respect to time and space, depending on the scale of the determination is often inadequate. The only estimate of zooplankton biomass¹⁵ 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 were gathered from coastal as well as oceanic regions. However, no attempt has been made to use these data for updating the information.

Geographical distribution of zooplankton in the Indian Ocean¹⁶, based on the IIOE data, shows highly productive areas around the Somali and Arabian coasts and to a certain extent on the southwest coast of India. The northern Bay of Bengal also has moderately high biomass. The low productivity zones occupy the central part of the Arabian Sea. Taking all the zooplankton biomass data (1622 samples) into consideration, Prasad, *et al.*¹⁵ have 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 tons, respectively. In other words, the total zooplankton biomass of the Indian Ocean has been estimated to be 519×10^6 tons.

After IIOE, the data obtained in coastal as well as in offshore waters (Table 1) indicate that the biomass is

much higher in coastal waters than in oceanic waters suggesting that the projections based on IIOE data are likely to be underestimates.

By considering the data based on IIOE² and after IIOE³⁻¹² the biomass estimates for shelf and offshore regions are made separately. The biomass production has been estimated to be 130×10^6 tons for the shelf region and 480×10^6 tons for offshore region. These estimates indicate that the earlier projections of zooplankton biomass of the Indian Ocean are less by 91×10^6 tons.

For the productivity studies, information on mere abundance will not give any indication about the quantity 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 season¹⁷.

A factor of 0.065 has frequently been used to convert zooplankton biomass into organic carbon and is primarily based on Cushing¹⁸. But it is shown¹⁹⁻²² that organic carbon content of tropical zooplankton is lower than in higher latitude. 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 greater in tropical than in temperate waters and this progressive change in composition of zooplankton reflects on the organic content of these organisms²³.

Biochemical studies^{12,23-26} 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 give 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 factor¹⁸ (0.065).

So far most of the investigators engaged in productivity studies of the Indian Ocean have widely used the factor of Cushing¹⁸ for calculation of zooplankton and secondary production. Since the commonly used factor is more than double as compared to the actual, the earlier estimates of zooplankton production in the Indian Ocean are two times overestimated. In other words, the potential fishery estimates derived by using zooplankton production are more than double the presently used estimates.

The biomass production in terms of organic carbon estimated to be 3.5 and 12.9×10^6 tons for shelf and offshore regions respectively in the Indian Ocean, thus stands corrected.

Table 1—Zooplankton Biomass Values Calculated on Post IIOE Data

Region	Season	Biomass ml·(100 m) ⁻³			References
		Max	Min	Average	
North and northern Indian Ocean	Dec.-May	560*	—	—	3
Southwest coast of India	Jan.-Dec.	37.3	0.83	—	4
Arabian Sea	Oct.-Nov.	—	—	18.0	5
West coast of India	March-Apr.	59.9	7.9	—	6
Central west coast of India	Jan.-May	593**	78.0**	—	7
Laccadive Sea	March-April	37.5	4.5	14.7	8
Bay of Bengal	SW Monsoon	60	—	—	9
Western Bay of Bengal	SW Monsoon	480	1	—	10
Western Indian Ocean	Jan.-Feb.	10.4	1.6	—	11
Andaman Sea	Feb.	14.4	1.8	5.6	12

*ml (200 m)⁻³
**ml (1000 m)⁻³

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