

Biomass & Composition of Zooplankton in the Nearshore Waters of Thal, Maharashtra

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Biomass and composition of zooplankton in the nearshore waters of Thal were studied at 9 stations during Feb. 1980 to Jan. 1981. The recorded variation in zooplankton biomass was $4.8-80.6 \text{ ml.}(100 \text{ m}^3)^{-1}$ [av. $22.9 \text{ ml.}(100 \text{ m}^3)^{-1}$]. High biomass observed along the nearshore water during the premonsoon period shifted towards the offshore area with the advent of the monsoon. Zooplankton production was maximum in the postmonsoon season. Mean rate of secondary production for the survey area was $39.12 \text{ mgC.m}^{-2}.\text{d}^{-1}$. The fishery potential of the area of investigation was estimated to be 1554 t.y^{-1} . There was gradual increase in zooplankton towards the offshore area with concomitant increase in diversity. Larval forms of echinoderms, cephalopods and brachiopods were confined to the offshore stations. Pycnogonids were recorded for the first time from the west coast of India.

Comprehensive account on zooplankton from the west coast of India has emerged from the results of IIOE and subsequent investigations¹⁻³. However, these studies are for extensive areas in the Indian Ocean and regular observations from selected areas are necessary to augment the available knowledge on the secondary production. A few studies conducted along the coastal waters of Bombay⁴⁻⁹ indicate the fairly high productivity of the region. Apart from these no information is available on the zooplankton of the Maharashtra coast. Present study on zooplankton from the nearshore waters of Thal has been made to assess the production potential of the area. Compared to the coastal waters of Bombay the prevailing water quality off Thal indicates healthy conditions¹⁰ and the reported data can be considered as representative of an unpolluted environment.

Materials and Methods

Thal is situated in the coastal approaches to Bombay harbour entrance (Fig.1). The entire area is characterized by sand banks and reef. The reefs consist of rocks which extend up to about 2.5 km offshore. Three transects (Southern, Middle and Northern) each consisting of 3 stations were studied from Feb. 1980 - Jan. 1981. Stations were fixed approximately at a distance of 1-2 km. Variation in depth at sts 1-3 of all the transects were respectively 4-7.5, 7.5-11 and 8.5-12.5 m. Monthly zooplankton collections were made by taking oblique hauls using a Heron-Tranter net (mesh size 0.3 mm; mouth area 0.25 m^2) with an attached flow meter. In order to avoid the variability caused by flood and ebb conditions samples were taken covering both ebb and flood conditions and for interpretation of data average values were considered.

Results

Environmental conditions—The prevailing physico-chemical characteristics of the area were extensively investigated¹⁰ and the following observations are based on the above study. The tide at Thal is of mixed semi-diurnal nature. The currents in the area are mostly tide induced and vary from spring to neap. The shoreward component of the currents was stronger during flood tide and the offshore component during ebb tide. The salinity was maximum (38.7×10^{-3}) in May and minimum (20.2×10^{-3}) in July. Relatively low salinity ($20.2-29.5 \times 10^{-3}$) was observed during July to Aug. and the values increased ($34.5-35.7 \times 10^{-3}$) soon after the monsoon. Vertical gradient in salinity was noticed only during the monsoon period and this was more pronounced at the offshore station. The range of dissolved oxygen in the area was $3.8-9.4 \text{ mg.l}^{-1}$. Seasonal variation in the DO level was not pronounced. Nitrate and phosphate values showed

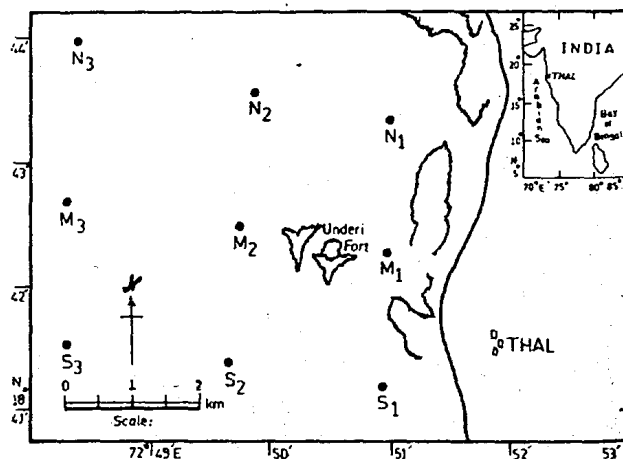
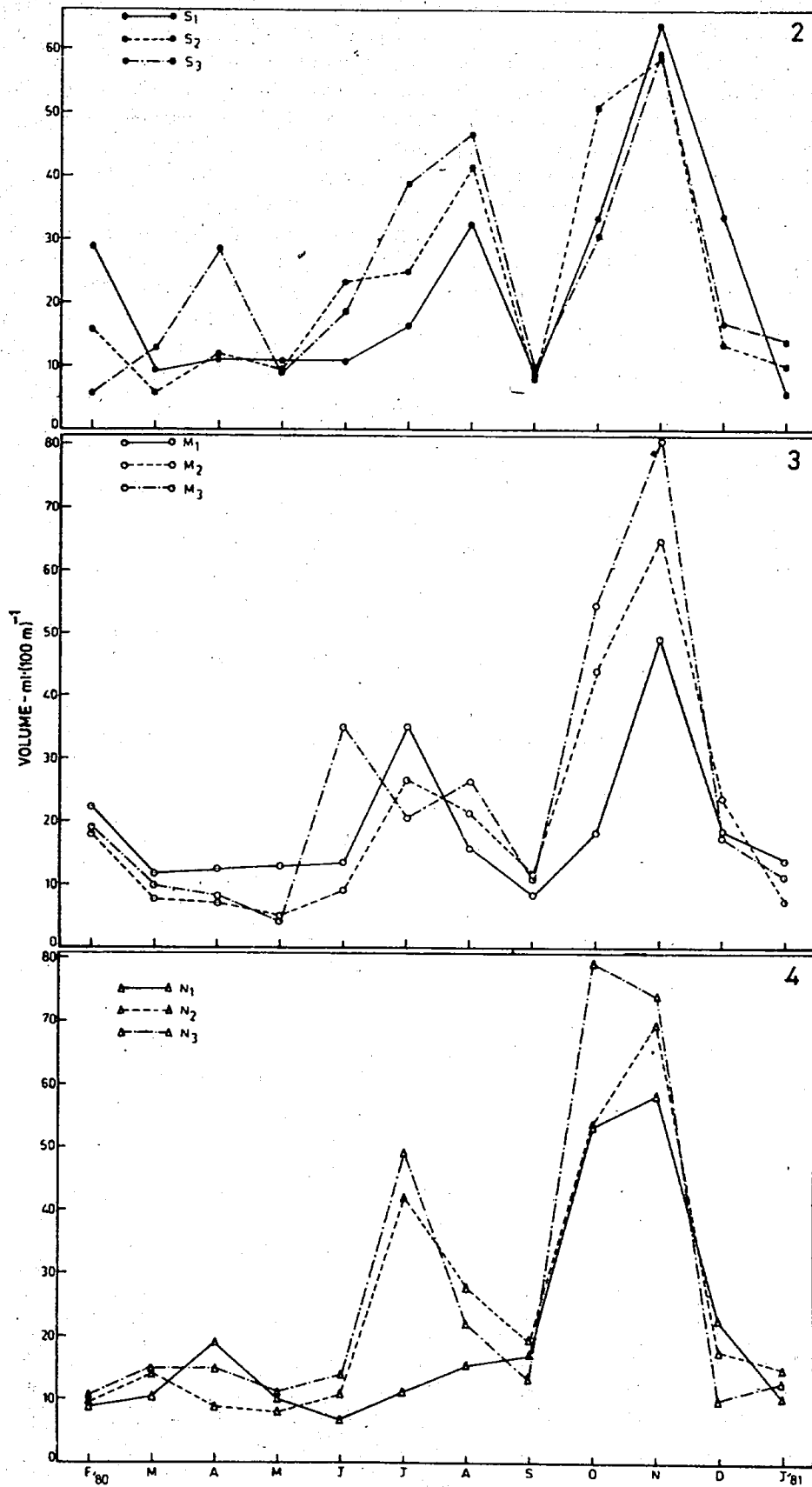


Fig. 1—Station positions



Figs. 2 to 4—Distribution of zooplankton biomass along the southern (2) middle (3) and northern (4) transects

great amount of fluctuations and the range was 0.21-17.71 and 0.71-5.16 $\mu\text{mol.l}^{-1}$ respectively.

Zooplankton biomass—The annual variation in the standing stock of zooplankton along the 3 transects are represented in Figs 2-4. Along the southern transect zooplankton standing stock varied from 5.5 to 63.9 $\text{ml.}(100\text{ m}^3)^{-1}$ [av. 23 $\text{ml.}(100\text{ m}^3)^{-1}$]. Four major peaks in zooplankton production were observed with the maximum during the postmonsoon period of Oct.-Dec. The pattern of distribution at all the stations was identical and in general st 3 sustained relatively higher standing stock.

The variability in zooplankton biomass along the middle transect was from 4.8 to 80.6 $\text{ml.}(100\text{ m}^3)^{-1}$ [av. 21.6 $\text{ml.}(100\text{ m}^3)^{-1}$]. Three prominent peaks in zooplankton biomass were recorded in Feb., June-July and Oct.-Nov. Very high values were confined to the postmonsoon period. From Feb. to July higher biomass was recorded at the nearshore station and later zooplankton production became more at sts 2 and 3. Variation in the biomass at the 3 stations showed similar trend throughout the year.

Zooplankton biomass in the northern transect was at the rate of 7.1 to 74.4 $\text{ml.}(100\text{ m}^3)^{-1}$ [av. 24.1

$\text{ml.}(100\text{ m}^3)^{-1}$]. The peaks observed were in April, July and Oct.-Nov. In general, the middle and offshore stations sustained higher biomass than the nearshore station. The trend in the variability of zooplankton standing stock is comparable at different stations along the transect.

Seasonal variability in the distribution of zooplankton biomass is shown in Table 1. During the premonsoon period (Feb.-May) high biomass was observed along the nearshore waters with moderate values along the offshore area. During the monsoon period (July-Sept.) area of high biomass was shifted towards st 3 and low values were confined all along the nearshore area. Zooplankton production was maximum during postmonsoon season (Oct.-Jan.) and high density areas were concentrated more towards the northern area.

Total population and composition—Maximum population of zooplankton was caught during July and Oct.-Nov. (Table 2). As there is no correlation between biomass and population in accordance with the increase in biomass, consequent increase in the total number of zooplankton was not generally observed. Percentage composition of common groups

Table 1—Seasonal Variation in Zooplankton Biomass [$\text{ml.}(100\text{ m}^3)^{-1}$] at Different Stations

| | Southern transect | | | Middle transect | | | Northern transect | | |
|----------------------------|-------------------|----------------|----------------|-----------------|----------------|----------------|-------------------|----------------|----------------|
| | S ₁ | S ₂ | S ₃ | M ₁ | M ₂ | M ₃ | N ₁ | N ₂ | N ₃ |
| Premonsoon (Feb.-May) | 15.09 | 10.58 | 13.94 | 14.96 | 9.61 | 10.07 | 11.98 | 10.18 | 12.72 |
| Monsoon (June-Sept.) | 17.18 | 24.67 | 27.57 | 18.34 | 17.40 | 23.03 | 12.71 | 25.29 | 24.7 |
| Postmonsoon (Oct.-Jan.) | 34.19 | 33.45 | 30.1 | 25.1 | 35.12 | 40.93 | 36.47 | 39.14 | 43.95 |

Table 2—Zooplankton Population (n.m^{-3}) at Different Stations

| Month | Southern transect | | | Middle transect | | | Northern transect | | |
|-------|-------------------|----------------|----------------|-----------------|----------------|----------------|-------------------|----------------|----------------|
| | S ₁ | S ₂ | S ₃ | M ₁ | M ₂ | M ₃ | N ₁ | N ₂ | N ₃ |
| | 1980 | | | | | | | | |
| Feb. | 409 | 204 | 201 | 167 | 677 | 573 | 204 | 331 | 1400 |
| March | 215 | 198 | 377 | 159 | 581 | 200 | 251 | 854 | 4427 |
| April | 283 | 492 | 515 | 168 | 141 | 244 | 1060 | 505 | 495 |
| May | 97 | 352 | 353 | 216 | 360 | 103 | 672 | 450 | 222 |
| June | 168 | 438 | 190 | 380 | 471 | 272 | 116 | 269 | 301 |
| July | 256 | 1090 | 1072 | 1160 | 1033 | 1043 | 641 | 1494 | 891 |
| Aug. | 187 | 2346 | 359 | 265 | 322 | 1128 | 566 | 912 | 1200 |
| Sept. | 171 | 286 | 185 | 445 | 83 | 264 | 126 | 200 | 69 |
| Oct. | 661 | 188 | 1334 | 633 | 2334 | 2042 | 1296 | 1477 | 1443 |
| Nov. | 534 | 1659 | 1684 | 344 | 1687 | 2184 | 446 | 1460 | 2055 |
| Dec. | 116 | 252 | 140 | 393 | 150 | 359 | 574 | 156 | 181 |
| | 1981 | | | | | | | | |
| Jan. | 275 | 300 | 402 | 663 | 459 | 252 | 469 | 360 | 297 |

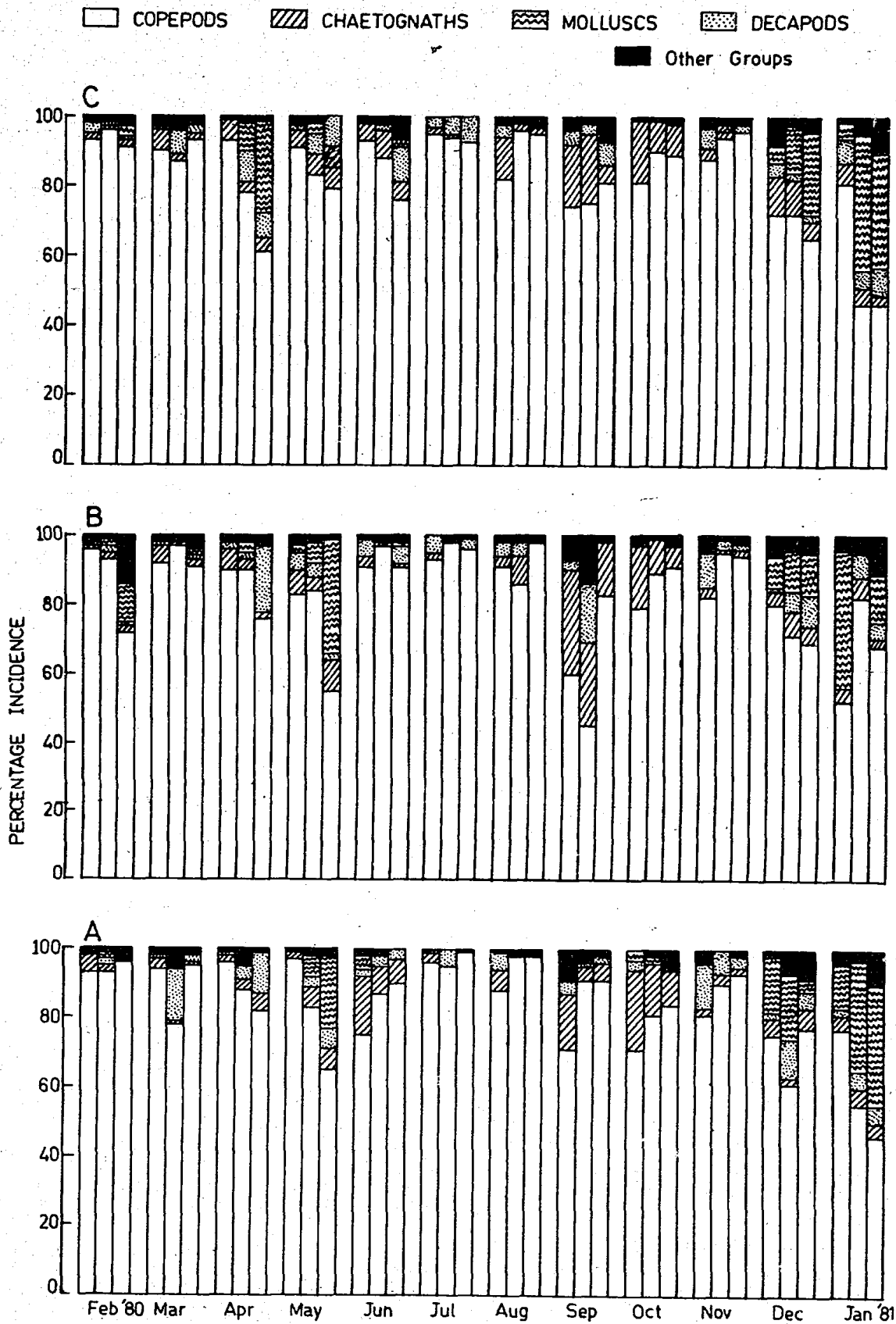


Fig. 5—Percentage composition of different groups of zooplankton along the 3 transects [A-southern, B-middle and C-northern. Under each month data for sts 1, 2 and 3 are given from left to right]

of zooplankton is presented in Fig.5. Groups and species which are occasional inhabitants of the area are clustered under miscellaneous group.

Copepods formed the dominant group throughout the period of study and maximum percentage incidence of the species was observed in July. There was no appreciable difference in the quantitative distribution of copepods along the 3 transects. Chaetognaths were very common in the collections with maximum incidence during Sept.-Oct. In general, population of chaetognaths was more towards the nearshore area. *Sagitta bedoti*, *S. enflata*, *S. pulchra* and *S. robusta* were the species found in the collections. *S. bedoti* was the dominant species in the area. Numerical abundance of *S. enflata* was more towards sts 2 and 3. Molluscs were represented by gastropods and lamellibranchiates. During Dec.-Jan. pteropods were observed from the offshore area. Congregations of molluscs were observed during April-May and Dec.-Jan. Molluscs were usually represented in higher numbers at sts 2 and 3. Decapods were very common in the collections and numerical representation was usually more at sts 2 and 3 of the different transects. The common decapods in the area were *Acetes* spp, *Lucifer hansenii*, Palemonids, Alpheids and zoea of Porcellanida and Brachyura.

Other groups were represented mainly by coelenterates, fish eggs and fish larvae. Fish eggs and larvae were present throughout the period of study. Hydromedusae, siphonophores and ctenophores showed maximum representation during the postmonsoon period, and they were very rare during June to July. Foraminiferans, polychaetes, appendicularians, isopods, mysids, amphipods, cirripede nauplii and stomatopod larvae were occasionally represented. The ostracod species *Cypridina dentata* was often obtained in fairly good numbers during April-May and Dec.-Jan. Pycnogonids, larvae of cephalopods, echinoderms and brachiopods, platyhelminthes and cladocerans were recorded only at middle and offshore stations.

Discussion

The present investigation shows that the nearshore water of Thal is rich in zooplankton. The mean standing stock of zooplankton along the S, M and N transects were respectively 23, 21.16 and 24 ml.(100 m³)⁻¹. When rate of secondary production was calculated according to Nair¹¹ the carbon equivalent for different transects amounted to 39.28(S), 36.96(M) and 41.2 (N) mgC.m⁻²d⁻¹. The zooplankton production in the Thal area is comparable to the reported value for the coastal waters around Bombay⁹. At both the places, maximum peak was observed during Oct.-Dec. The rate for the northern coast of

India also indicated very high biomass [$> 50 \text{ ml.}(100 \text{ m}^3)^{-1}$] off the Maharashtra coast³. However, the values recorded for the central coast of India¹ showed very low values [$\approx 6.3 \text{ ml.}(100 \text{ m}^3)^{-1}$].

The composition of zooplankton indicated that group diversity of zooplankton increased from nearshore to offshore area. Total number of groups represented at st 1 (14 to 18) increased towards st 3 (20-22). The reported value of group diversity of zooplankton for the nearshore waters of Bombay⁹ is less than that observed at Thal. Larvae of echinoderms, cephalopods and brachiopods were mostly confined to sts 2 and 3. Pycnogonids were rarely reported in plankton hauls from the coastal waters¹² and in the present collections they were sparsely found at st 3. The available data on pycnogonids of the Indian Ocean¹² indicate that this group is recorded for the first time from the west coast of India.

Maharashtra ranks second in total marine fish landing among all the maritime states¹³. Considering this high resources potential of the coastal waters around Maharashtra the secondary production rate obtained from the present study was utilised to assess the tertiary production of the region. Average standing stock of zooplankton in the nearshore waters of Thal was 22.9 ml.(100 m³)⁻¹. Mean rate of secondary production for the survey area is estimated to be 39.12 mgC.m⁻²d⁻¹. The area of study extends to 38.72 km² (Fig.1, north of 18°41'). The mean rate of primary production reported for this area¹⁰ is 78.2 mgC.m⁻²d⁻¹. Tertiary production in terms of primary and secondary production was calculated following the method suggested earlier¹⁴ and the values are given below.

| | |
|--------------------------|---------------------------|
| Primary production (a) | 7736.3 tC.y ⁻¹ |
| Secondary production (b) | 3386.4 tC.y ⁻¹ |
| Tertiary production | |

$$\frac{a+b}{2} \times 7.47 = 1553.75 \text{ t.y}^{-1}$$

The fishery potential of the area worked out to be 1554 t.y⁻¹. The Maharashtra State Fishery statistics on total landing for the period 1977-80 for Thal gives an average landing rate of 4070 t.y⁻¹. The present estimate for a limited area within the shallow region of Thal itself is high, suggesting the rich fishery potential.

Acknowledgement

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