

Distribution, abundance and species diversity of copepods from dandi creek west coast of India

Kadam Surendra S.¹ & Tiwari Lalchand .R.

¹N. B. Mehta Science college-Bordi Dist.-Thane, Pin-401701 (M.S.), India.

Maharshi Dayanand College Parel, Mumbai-400012(M.S.), India

[E. mail- surendrapices@rediffmail.com, *drlrtiwari@gmail.com]

Received 2 March 2014; revised 10 October 2014

In the present study total five stations were selected for collection of zooplankton (copepods) out of these, 3 stations were within the creek and 2 stations were in offshore region. Copepods formed the most dominant group of zooplankton sample at all the stations, at station 1 their population was in the range of 5845 to 54472 / 100m³ (av.36882.8 / 100m³), at station 2 12166 to 65700 / 100m³ (av. of 32472.38 /100m³), at station 3 17263 to 67652/ 100m³ (av.35385.2 /100m³), at station 4 12064 to 48990/ 100m³ (av. 31924.73/ 100m³) and at station 5 7060 to 41528 / 100m³ (av.25657.47/100m³). Species composition of copepods was evaluated based on analyses of sample from station 1 and 5, representing the outer and interior zone respectively. A total of 61 species belonging to the 20 genera and 11 families at station 1 and 48 species belongs to 15 genera and 8 families at station 5. *Calanoida* became the most dominant group in copepod population.

[Keywords- Copepods, Dandi Creek, Thane, West Coast, Maharashtra]

Introduction

Copepods are small crustaceans that comprise their own taxonomic class, the copepoda. There are over 7,500 described species of copepods; although the majority of these are found in marine habitats followed by freshwater forms. Some forms are even terrestrial, associated with moist soil. Free living species are perhaps most familiar, but there are also many highly specialized parasitic copepods. Most free living copepod species range from less than 1 mm to 5 mm in size. Free living marine copepods are among the dominant species in pelagic zooplankton communities. Most species are suspension-feeding grazers on phytoplankton and microzooplankton. They represent an important linkage between primary production and higher trophic levels in pelagic food webs. Many free living copepod species, including calanus, exhibit daily vertical migrations allowing them to escape detection by most visual predators by concentrating in deeper,

dim water strata by day, and swimming upward into the euphotic upper water layers where food is most abundant. Most of the vertically migrating copepods apparently synchronize their daily movements by visually tracking isolumines the specific threshold light levels up and down in the water column.

Copepods usually comprise at least 70% of the zooplankton fauna and rank as the world's most abundant metazoans. This group is important because of the great diversity and enormous abundance especially in the estuarine waters. Estuarine copepod population dwindles during the low saline period and several species move in to the high saline coastal waters¹. The three important orders of copepoda are calanoida, cyclopoida and harpacticoida. Studies on the copepods of the coastal waters suggest their prominence in zooplankton community in the creek environment²⁻¹¹.

Materials and Methods

Dandi is a coastal part of Thane District located between $19^{\circ} 48.041'$ North longitude and $72^{\circ} 41.255'$ East latitude. It is 61.6 km away from Thane and 105 km away from busting city of Mumbai. The Arabian Sea has a monsoon climate. Minimum air temperatures of about 24 to 25 °C at the sea's surface occur in the central Arabian Sea in January and February, while temperatures higher than 28 °C occur in both June and November. During the rainy season, which occurs when the southwest monsoon winds blow (April to November), salinities of less than 35 parts per thousand have been recorded in the upper 150 feet (45 meters) of the sea, while during the dry season (November to March), when the northeast monsoon winds blow, salinities of more than 36 parts per thousand have been recorded at the surface over the entire Arabian Sea north of latitude 5° , because evaporation exceeds the precipitation and riverine input taken together.

Zooplankton samples were collected from 5 different locations (Fig.1), using H.T.Net with TSK flow meter attached to the mouth of the net with the help of mechanized boat. Collected samples were immediately transferred in 500 ml of wide mouth clean plastic bottles and preserved in 5% buffered formalin. The volume of zooplankton was measured by displacement method after washing the zooplankton with distilled water and there after filtering through bolting clothes and water soaked on filter paper then transferring zooplankton in measuring cylinder having known volume of formalin. Volume of water filtered (V) through the plankton net was calculated by adopting the formula.

$$V = (A \times R) / k$$

Where A is the mouth area of the net, R is the revolutions of the flow meter and k is the constant (calibration value of the flow meter). Biomass of zooplankton was estimated by displacement method and expressed as ml/100 m³.

Depending on the size of the sample an aliquot of 25-50% was taken using Folsom Splitter and analysed for the common major groups while the entire sample was analysed for rare groups. Population density is represented as no/100 m³. The number of zooplankton were counted using counting chamber with binocular compound microscope. Identification of copepods were done following the standard methods¹²⁻¹⁶.

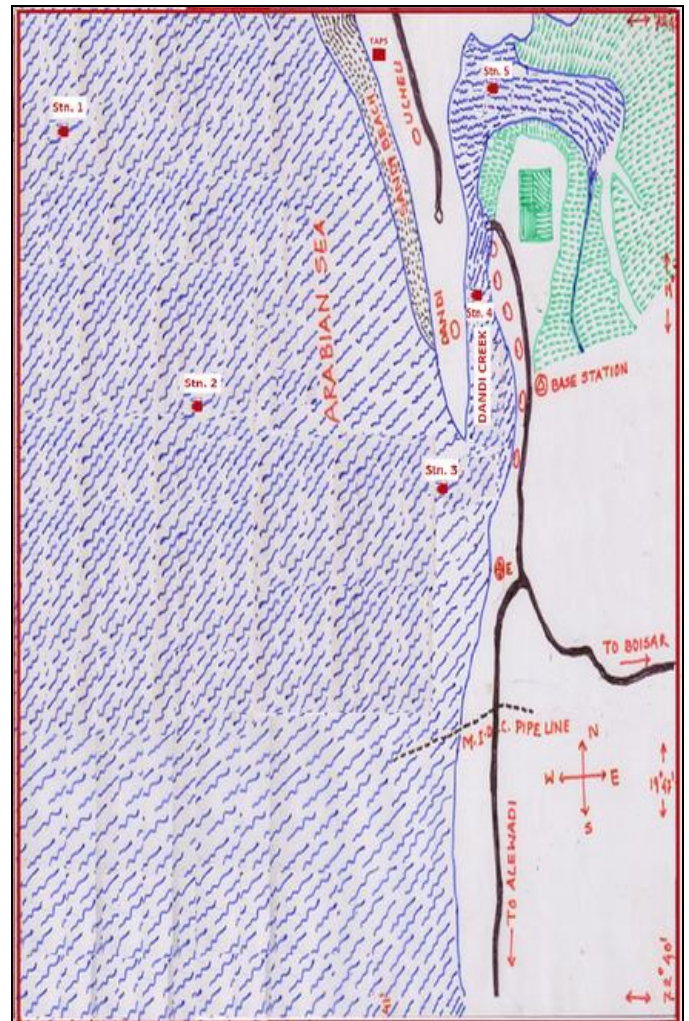


Fig.1 Map showing location of the station

Results

Major components of zooplankton community which shared the maximum contribution in zooplankton population were copepods, decapods, and chaetognaths. Copepods formed the most dominant group of zooplankton at all the stations, at station 1 copepod population was in the range of 5845 to 54472 / 100m³ (av.36882.8 / 100m³). Maximum population was recorded in the month of September, 10 and the minimum in the month of November. Seasonal values for pre-monsoon, monsoon and post-monsoon periods respectively were 33289.25, 43953.2 and 34888 / 100m³. Observed population of copepod at station 2 ranged between 12166 to 65700 / 100m³ with an average of 32472.38/100m³. Maximum population was obtained in the month of September, 09 and the minimum in the month of March. Seasonal values for pre-monsoon, monsoon and post-monsoon periods respectively were 24710.75, 38237.8 and 33027.25 / 100m³. Variation in copepod population at station 3 was in the range of 17263 and 67652 / 100m³ (av.35385.2 / 100m³). Maximum population of copepod

was recorded in the month of January and the minimum in the month of April. Seasonal values of copepod population were 26553 / 100m³ (pre-monsoon), 32902 / 100m³ (monsoon) and 43785.25 / 100m³ (post-monsoon). Copepod population at station 4 ranged between 12064 and 48990 / 100m³ giving an average of 31924.73 / 100m³. The maximum population was recorded in the month of September, 09 and the minimum in the month of May. Seasonal values of copepod population for pre-monsoon, monsoon and post-monsoon periods were respectively 30615, 32426.8 and 33305.75 / 100m³. Variation in copepod population at station 5 was in the range of 7060 to 41528 / 100m³ (av.25657.47 / 100m³). Maximum population was obtained in the month of September, 09 and the minimum in the month of August. Seasonal values of copepod population for pre-monsoon, monsoon and post-monsoon periods respectively were 24558, 70444.8 and 27421 / 100m³.

Table- 1 Total population (no/100m³) and percentage contribution (in parenthesis) of copepod at different stations during 2009-10.

Months	Station 1	Station 2	Station 3	Station 4	Station 5
Sep,09	50319 (66.34)	65700 (74.76)	30480 (54.36)	48990 (86.43)	41528 (73.34)
Oct	41906 (82.74)	35832 (78.85)	28377 (68.19)	17933 (31.80)	40834 (81.85)
Nov	5845 (19.06)	21590 (31.05)	58774 (66.39)	33652 (56.91)	20022 (38.60)
Dec	48393 (67.00)	54031 (70.63)	20338 (36.90)	37132 (79.60)	29006 (65.84)
Jan,10	43408 (68.05)	20656 (47.23)	67652 (69.76)	44506 (68.93)	19822 (47.96)
Feb	31654 (76.66)	33132 (67.36)	35564 (83.29)	47422 (74.63)	27354 (70.48)
Mar	23310 (56.14)	12166 (29.89)	24665 (42.96)	48248 (78.95)	23352 (71.82)
Apr	35026 (76.72)	22058 (72.78)	17263 (78.77)	14726 (69.26)	22394 (60.73)
May	43167 (77.96)	31487 (77.52)	28720 (45.36)	12064 (37.24)	25132 (78.95)
Jun	38883 (69.23)	34452 (70.30)	32662 (63.09)	22348 (54.75)	24874 (72.37)
Jul	41322 (72.86)	41480 (82.58)	33954 (58.93)	28185 (50.58)	29752 (70.29)
Aug	34770 (55.45)	18052 (51.93)	34598 (53.76)	31816 (73.86)	7060 (17.65)
Sep	54472 (76.48)	31505 (75.70)	32816 (70.60)	30795 (58.09)	25144 (62.84)

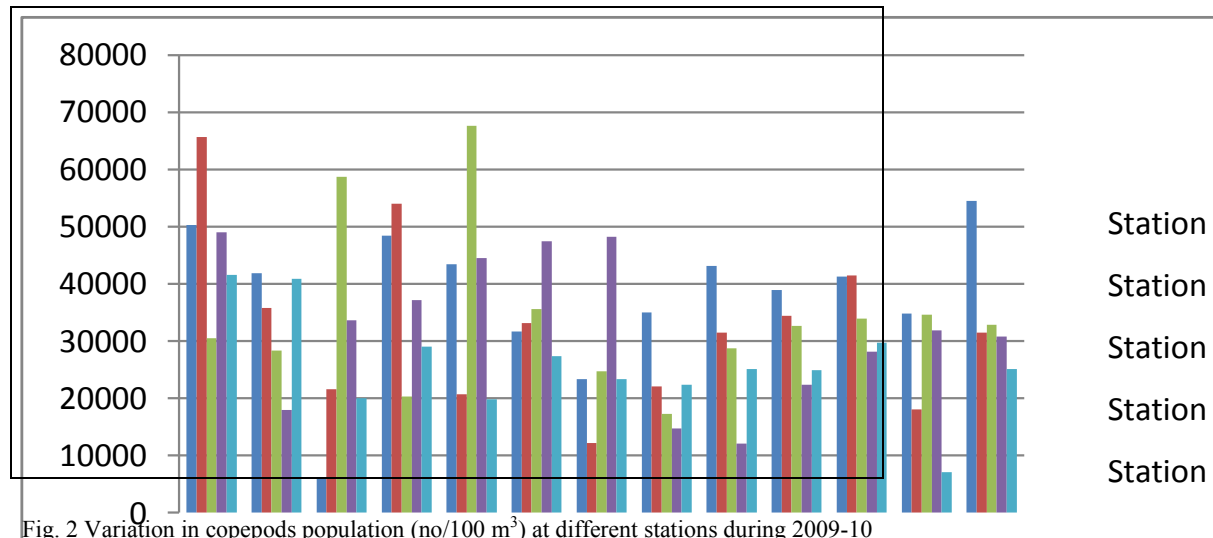


Fig. 2 Variation in copepods population (no/100 m³) at different stations during 2009-10

Species composition of copepods was evaluated based on analyses of sample from station 1 and 5, representing the outer and interior zones respectively. Copepods were comprised of a total of 61 species belonging to the 20 genera and 11 families at station 1 and 48 species belong to 15 genera and 8 families at station 5. However, all the species recorded at station 5 were common species, also recorded from station 1. All the species were *calanoid* copepod.

The species of copepods recorded at station 1 are *Cathocalanus pauper*, *Eucalanus crassus*, *Paracalanus dubia*, *P. crassirostris*, *P. aculeatus*, *Acrocalanus similis*, *A. monachus*, *A. inermis*, *Centropages alcocki*, *C. furcatus*, *C. orsinii*, *C. trispinosus*, *C. tenuiremis*, *Isian tropica*, *Phyllodiaptomus blanci*, *Heliodiaptomus cinctu*, *H. contortus*, *H. viduus*, *H. pulcher*, *Tropodiaptomus orientalis*, *T. nielsenii*, *Sinodiaptomus indus*, *Allodiaptomus mirabilipes*, *Neodiptomus strigilipes*, *Pseudodiaptomus annandalei*, *P. binghami*, *P. binghami malayalus*, *P. jonesi*, *P. ardjuna*, *P. dubia*, *P. aurivillii*, *P. serricaudatus*, *P. tollingerae*, *P. hickmani*, *P. lobipes*, *P. mertonii*, *Temora turbinata*, *T. stylifera*, *Candacia bradyi*, *Calanopia elliptica*, *Labidocera pectinata*, *L. pavo*, *L. gangetica*, *L. kroyeri*, *L. icrojeri gallensis*, *Pontella andersoni*, *P. danae*, *Acartia centrura*, *A. spinicauda*, *A. erythraea*, *A.*

chilkaensis, *A. plumosa*, *A. southwelli*, *A. pacifica*, *Acartiella keralensis*, *A. gravelyi*, *A. major*, *A. minor*, *A. sewelli*, *A. toraniformis* and *Trtanus forcipatus*.

As compare to station 1 copepod species composition at station 5 was little lower. Total 48 species belonging to 15 genera and 8 families. They includes *Cathocalanus pauper*, *Eucalanus crassus*, *Paracalanus dubia*, *P. crassirostris*, *P. aculeatus*, *Acrocalanus similis*, *A. monachus*, *A. inermis*, *Centropages alcocki*, *C. furcatus*, *C. orsinii*, *C. trispinosus*, *C. tenuiremis*, *Isian tropica*, *Phyllodiaptomus blanci*, *Heliodiaptomus cinctu*, *H. contortus*, *H. viduus*, *H. pulcher*, *Tropodiaptomus orientalis*, *T. nielsenii*, *Pseudodiaptomus annandalei*, *P. binghami*, *P. binghami malayalus*, *P. jonesi*, *P. ardjuna*, *P. dubia*, *Calanopia elliptica*, *Labidocera pectinata*, *L. pavo*, *L. gangetica*, *L. kroyeri*, *L. icrojeri gallensis*, *Pontella andersoni*, *P. danae*, *Acartia centrura*, *A. spinicauda*, *A. erythraea*, *A. chilkaensis*, *A. plumosa*, *A. southwelli*, *A. pacifica*, *Acartiella keralensis*, *A. gravelyi*, *A. major*, *A. minor*, *A. sewelli*, *A. tortmlijbrnzis*.

Table 3 - Occurrence of copepod species at station 1 and 5 during 2009-10.

Sr. No	Name of the Species	Station 1	Station 5
1	<i>Cathocalanus pauper</i>	+	+
2	<i>Eucalanus crassus</i>	+	+
3	<i>Paracalanus dubia</i>	+	+
4	<i>P. crassirostris</i>	+	+
5	<i>P. aculeatus</i>	+	+
6	<i>Acrocalanus similes</i>	+	+
7	<i>A. monachus</i>	+	+
8	<i>A. inermis</i>	+	+
9	<i>Centropages alcocki</i>	+	+
10	<i>C. furcatus</i>	+	+
11	<i>C. orsinii</i>	+	+
12	<i>C. trispinosus</i>	+	+
13	<i>C. tenuiremis</i>	+	+
14	<i>Isian tropica</i>	+	+
15	<i>Phyllodiaptomus blanci</i>	+	+
16	<i>Heliodiaptomus cinctus</i>	+	+
17	<i>H. contortus</i>	+	+
18	<i>H. viduus</i>	+	+
19	<i>H. pulcher</i>	+	+
20	<i>Tropodiaptomus orientalis</i>	+	+
21	<i>T. nielsenii</i>	+	+
22	<i>Sinodiaptomus Indus</i>		
23	<i>Allodiaptomus mirabilipes</i>	+	
24	<i>Neodiaptomus strigilipes</i>	+	
25	<i>Pseudodiaptomus annandalei</i>	+	+
26	<i>P. binghami</i>	+	+
27	<i>P. binghami malayalus</i>	+	+
28	<i>P. jonesi</i>	+	+
29	<i>P. ardjuna</i>	+	+
30	<i>P. dubia</i>	+	+
31	<i>P. aruvilli</i>	+	
32	<i>P. serricaudatus</i>	+	
33	<i>P. tollingerae</i>	+	
34	<i>P. hickmani</i>	+	
35	<i>P. lobipes</i>	+	

36	<i>P. mertoni</i>	+	
37	<i>Tremora turbinata</i>	+	
38	<i>T. stylifera</i>	+	
39	<i>Candaciabadyi</i>	+	
40	<i>Calanopia elliptica</i>	+	+
41	<i>Labidocera pectinata</i>	+	+
42	<i>L. pavo</i>	+	+
43	<i>L. gangetica</i>	+	+
44	<i>L. kroyeri</i>	+	+
45	<i>L. icrojeri gallensis</i>	+	+
46	<i>Pontella andersoni</i>	+	+
47	<i>P. danae</i>	+	+
48	<i>Acartia centrura</i>	+	+
49	<i>A. spinicauda</i>	+	+
50	<i>A. erythraea</i>	+	+
51	<i>A. chilkaensis</i>	+	+
52	<i>A. plumose</i>	+	+
53	<i>A. southwelli</i>	+	+
54	<i>A. pacifica</i>	+	+
55	<i>Acartiella keralensis</i>	+	+
56	<i>A. gravelyi</i>	+	+
57	<i>A. major</i>	+	+
58	<i>A. minor</i>	+	+
59	<i>A. sewelli</i>	+	+
60	<i>A. toraniformis</i>	+	+
61	<i>Trtanus forcipatus</i>	+	

Discussion

The copepod population from Dandi creek ranged between 5845 and 67652/ 100 m³ with an average of 32630.8/ 100 m³. They formed the most dominant group giving an average contribution of 62.35% to total population. Present copepod population value was comparable with those reported from Mahim (30982/100 m³) and Versova (21258 /100 m³) by Gajbhie, 1982, but the higher than Thane creek (18836/100 m³) reported by Quadros, 2001. Shaikh, 2011, reported a copepod population range between 419 and 403287/100 m³ (av.73554/100 m³) from Sewri creek. The highest copepod density (5539000 / 100 m³) was recorded from Cochin backwaters¹⁷.

Copepod population in Dandi creek was higher during monsoon period (June to September) as compared to premonsoon and postmonsoon seasons. The outer zone showed marginally higher population density (av.35093.3/100 m³) and percentage contribution (63.77%) as compared to interior zone (population density 32630.8/100 m³), percentage contribution 62.35). The copepods were comprised of a total of 61 species belonging to the 20 genera and 11 families at station 1 and 48 species belong to 15 genera and 8 families at station 5. However, all the species recorded at station 5 were common species, also recorded from station 1, all the species were *calanoid* copepod and *cyclopoids* and *herpacticoids* were not recorded from Dandi creek this may be due to the tidal influence in creek area.

Conclusion

Dandi creek supported rich standing stock of zooplankton with two fold increase in population density from outer to interior zone. Zooplankton forms the vital link in pelagic food chain. It is an ecologically important coastal ecosystem which is surrounded by heavily industrialized area of Tarapur. Many industrial establishments are cropping up along the coastal zone of Dandi creek and this may cause the problem of waste disposal into this important creek system. The ability of the creek to assimilate and

disperse pollutants without modifying the ecosystem is a pertinent aspect to be monitored frequently. In this context a detailed study on the zooplankton community living in this vital zone was initiated and the data emerged can be used for the determination of comparative ecological changes, if any, over a period of time subsequent to the discharge of waste water. The data generated from the present study provides baseline information for future ecological comparisons. Continuous ecological assessment and monitoring is needed for to maintain the health of this ecologically important creek system.

Acknowledgements

I express my deep sense of gratitude to my research guide Dr. L. R. Tiwari, Principal (Rtd.), M. D. College, Parel, Mumbai for his inspiring and encouraging way to guide and to Dr. Ashok Jaiswar, Scientist, CIFE (Deemed University), Mumbai, Dr. Anirudh Ram, Scientists of NIO, regional centre, Mumbai, and Scientists of CSMCRI, Bhavnagar (Gujarat) for their kind help in identification of copepods.

References

1. Achuthankutty, C.T., Ramaiah Neelam and Padmavati, G. Zooplankton variability and copepod assemblage in the coastal and estuarine waters of Goa along the central- west coast of India. *IOC workshop report no. 142*(1972), 1-11.
2. Pillai, V .K., Observations of the plankton off Bombay coast with remark on the hydrographic condition and fishery., *Journal of Mar. Biol. Asso. India* 10(2), (1968) 237-244.
3. Tranter, D.J. and George, J., Zooplankton abundance at Karavati and Kalpeni atolls in the Laccadives, In : Proceeding of the symposium on Corals and Coral Reefs. *Marine Biology Association of India*, (1972) 239-256.
4. Haridas, P., Madhuratap, M. and Rao, T.S.S., Salinity, temperature, oxygen and zooplankton biomass of the backwaters of Cochin to Alleppey. *Indian Journal of Marine Sciences*, 2(1973) 94-102.
5. Madhuratap, M., Status and strategy of zooplankton of tropical Indian estuaries: A review., *Bull. Plankton Soc. Of Japan*, 34,1(1987) 215-219.
6. Nair, V.R., Production and association of zooplankton in estuarine and nearshore waters of Goa. *Indian J. Mar.Sci.*, 10 (1980) 66-69.

7. Nair,V.R., Gajbhiye,S.N.and Desai,B.N., Biomass and composition of zooplankton in Auranga, Ambika, Purna and Mindola estuaries of south Gujarat.,*Indian Journal of Marine Sciences*,10 (1981)116-122.
8. Achuthankutty, C.T., Nair,S.R.S.,Devassy, V.P. and Nair, V.R., Plankton composition in two estuaries of the Konkan coast during premonsoon season., *Mahasagar-Bull. Natn. Inst. Oceanogr.*, 14,1(1981) 55-60.
9. Gajbhiye, S.N. and Desai, B. N., Zooplankton variability in polluted and unpolluted waters off Bombay. *Mahasagar* 14,3(1981)173-182.
10. Gajbhiye,S.N., Ram,J., Nair, V. R. and Desai, B. N., 1981.Plankton of the Narmada estuary and adjacent creek., *Mahasagar* 14,1(1981)23-31.
11. Gajbhiye,S.N., The ecology of zooplankton with special reference to polluted environment of Bombay., *Ph.D.Thesis University of Mumbai* (1982) 497 pp.
12. Goswami S.C., Zooplankton of the Antarctica waters. First Indian Expedition to Antarctica , *National Institute of Oceanography, Goa.*, (1982) 202-212 .
13. Tiwari L.R., Nair V.R., Zooplankton composition in Dharamtar creek adjoining Bombay harbour. *Indian J .Marine Sci.* 22(1993) 63-69.
14. Shaikh Md. Zuber, U., Ecological study of Sewri mudflats with reference to biodiversity., *Ph.D.Thesis, University of Mumbai* (2011) 295 pp.
15. Quadros, Goldin, I., Study of intertidal fauna of Thane creek., *Ph.D. Thesis, University of Mumbai* (2001) 264 pp.
16. UNESCO., Zooplankton sampling, Monograph on oceanographic methodology, 2: *UNESCO Paris* (1968) 174pp.
17. IBOC., Handbook of the international zooplankton collection 1, station list., *IOBC Natl. Inst. Oceanogr., CSIR, Cochin, India* (1966) 129 pp.
18. Conway, D.V.P., White, R.G., Hugues-Dit-Ciles,J., Gallienne, C.P. and Robins,D.B., Guide to the costal and surface zooplankton of the south-western Indian Ocean., Maine Biological Association of the United Kingdom Occasional Publication.UK- DEFRA Darwin Initiative Project 162/09/2004 *Zooplankton of the Mascarene Plateau*,15(2003) 1-354.
19. Santhanam, R.and Srinivasan, A., A Manual of marine zooplankton, oxford and IBH publication ., New Delhi (1984)160 pp.