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Zooplankton dynamics in the coastal waters of Malvan, Maharashtra, India

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Abstract

Zooplankton serve as food for fishes and thus occupy an important position in the food chain. Zooplankton from coastal waters of Malvan were collected from August 2011- May 2012 with the help of plankton net and were identified using standard keys. Results showed temporal variations amongst zooplankton populations. Copepods and their nauplii were present throughout the study period and they were the most abundant. Other groups present were appendicularians, polychaete larva, amphipods, mysids and fish larvae. Cladocerans were impoverished in occurrence. Study reveals that, there is good food for fish larvae and hence there is every chance to have good potential for fishing.

Keywords: Zooplankton, copepods, copepod nauplii, cladocerans, fish larvae.

Introduction

Zooplankton are an important component of the marine environment. They are the main link between primary producers and higher consumers. They are also being used as bioindicators of water quality[1]. Many studies on zooplankton and water quality of fresh water have been conducted from all over India[2-7]. Studies along the central west coast of India are quite rare[8]. Malvan is one of the biologically rich coastal regions of Maharashtra along the central west coast of India[9]. It is also a popular tourist destination. Review of literature of the work done in Malvan reveals that in 1981, 47 species of arthropods were recorded from Malvan[10]. Another survey[11] in 1999 recorded 34 species of copepods and 2 species of cladocerans. A study in 2010 [12] revealed good density of zooplankton in summer. The coastal area of Malvan is thickly populated with many people living along the coast, and depend on the sea for their livelihood. Fishing is one of the primary occupation of the people living along the coast of Malvan and as zooplankton serve as food for fishes, it becomes important to study zooplankton composition and their seasonal variability. Hence, the present study was undertaken to study temporal variations amongst the different group of zooplankton occurring in the coastal waters of Malvan.

Material and Methods

Study Area: Malvan situated in Maharashtra, is an open coastal ecosystem. It has a fort constructed by Emperor Shivaji and is of historical importance. Fishing activities and tourists are common year round. Several hundred fishing boats operate in this area.

Methodology: Water sample was collected for studying some environmental variables and the tests were conducted following standard methods[13]. Zooplankton samples were collected from the coastal waters of Malvan from August 2011 to May 2012 manually by horizontal haul method using plankton net (250 u) and were than fixed in 4% buffered formalin solution, prior to its transport to the laboratory. Zooplankton density was calculated using standard method[14]. Zooplankton were observed under Stereozoom Leica EZ4D, and were identified up to the species level by using standard keys [15-16].

Results and Discussion

The environmental variables studied have been presented in table-1. Most of them were within the standard permissible limits given by CBEP[17]. The analysed environmental parameters did not show significant relationship with the zooplankton groups.

In the present study, zooplankton population was represented by copepods, mysids, siphonaceae, appendicularians, amphipods, cladocerans, chaetognatha, copepod larval forms, polychaete larval forms, fish larvae and barnacle larvae. Figure 1, 2 shows the variations occurring among the zooplankton groups. Copepods and copepod nauplii occurred throughout the year. Siphonaceae, chaetognatha, cladocerans and barnacle larvae have been clubbed together as others as their density was low. Siphonaceae were maximum from October to January. Two peaks in zooplankton density were observed. First peak was seen in September and the second was in January. Earlier study[18] too had recorded two peaks in zooplankton population, in the coastal waters of Goa. They had observed one peak in Sept-Oct and the second in March-April. While the first peak was mainly due to copepods and copepod nauplii, the second peak was constituted by copepods, copepod nauplii, appendicularians, fish larvae and polychaete larvae. Another study[19] had reported zooplankton peak from October to January in the coastal waters off Bombay coast. Further, zooplankton diversity was maximum in October and March and least in August.

Table-1
Environmental variables recorded at the study site

Months	Temperature ◦C	pH	Turbidity NTU	Electrical conductivity US/cm	Alkalinity mg/l	TDS Mg/l
A	27	7.5	6	35200	150	15200
S	27	7.5	3	34600	115	33200
O	27.5	8	3	47000	175	37200
N	28	8	2	47000	175	38000
D	29	8	14	47100	175	35200
J	29	8.2	17	39000	145	32800
F	29	8.5	27	48700	150	14800
M	31	8.1	5	48100	180	29600
A	33	8	18	46900	180	41200
M	33	8	2	44500	190	34800

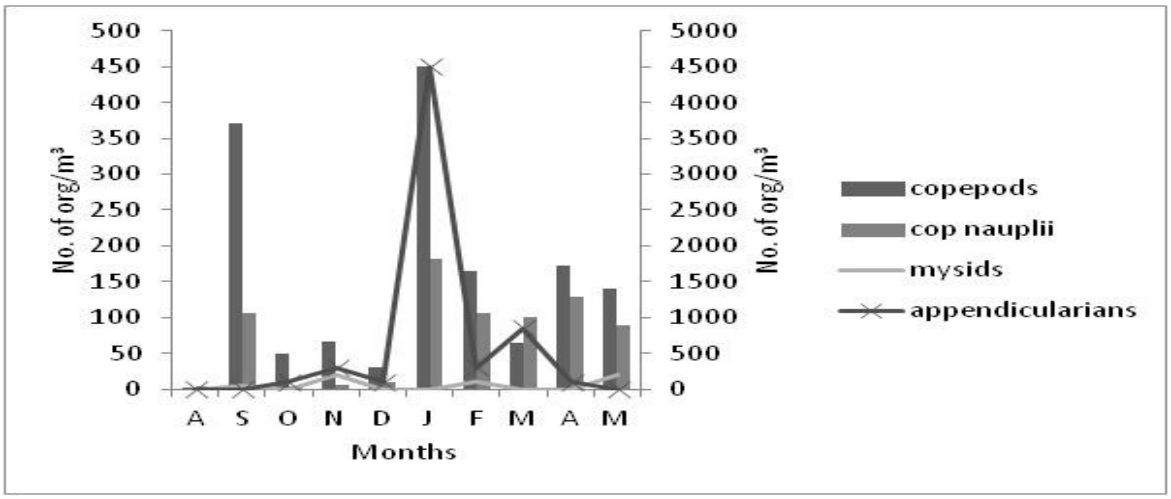

Figure-1
Monthly variations among the zooplankton groups

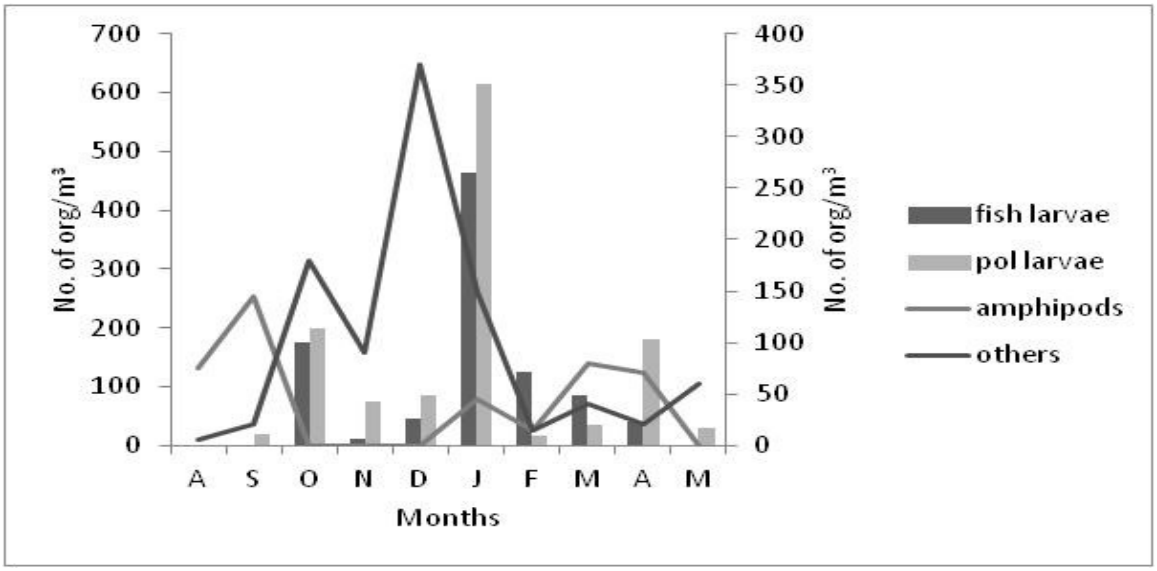

Figure-2
Monthly variations among the zooplankton groups

Copepods showed maximum diversity and density among all the groups present. They contributed 56.5% to the bulk zooplankton density. Dominance of copepods is also reported by other studies[20]. They were represented by calanoids, cyclopoids, harpacticoids and poicilostomatoids (figure - 3). Among them, Harpacticoids showed peak in September and January. The peak in September was due to increase in *Euterpina acutifrons* and in January *Miracia efferata* was abundant. The peak of Cyclopoids in September was due to *Oithona* sps. Calanoids showed highest peak in January, mainly due to the abundance of *Acartia sps.*, *Paracalanus parvus* and *Centropages furcatus*. Poicilostomatoids were represented by *Corycaeus sps*. They occurred occasionally and were in low numbers.

Copepod nauplii showed higher density from January to May and in September. This could be due to availability of abundant food and less predation pressure, as their predators which usually consist of chaetognatha, ctenophores and siphonophores[21] were high from October to December. They contributed 27.5% to bulk zooplankton density. Variations among the different zooplankton groups can be seen in figure-4.

Another interesting observation was the impoverished appearance of cladocerans and they were represented by only one species *Penilia avirostris*. *Evadne tergestina* and *Penilia avirostris* have been reported to occur in near shore waters in high abundance in August- September[22]. Cladocerans are filter feeders feeding on flagellates and diatoms[23]. They occur from August -September when their food is abundant. In the present study, though high density of diatoms was observed in August-September, the cladoceran population was negligible. The fact that, these two species were rare in spite of abundant food supply, suggests that some water quality variable may be affecting their occurrence. Cladocerans are known to be highly sensitive to salinity and also to pollution. Increased anthropogenic activities in near shore coastal waters may not be favorable for their occurrence.

Larval fish contributed 3.5% to the bulk zooplankton density. With the exception of August and September, larval fish was present throughout the study period. Ample availability of appendicularians, copepod and polychaete nauplii may have provided them with good food availability. October showed their highest density.

Appendicularians were present from October to April. They contributed 2.3% bulk zooplankton density. Appendicularians have been reported to be one of the important components of food in diet of some fishes [15-16]. Their appearance coincides with the occurrence of larval fishes.

Amphipods, polychaete larvae and mysids together contributed 6.49% to bulk zooplankton density and others contributed 3.5%.

Species indices were calculated for the zooplankton data (Shannon –Wiener [24-25]). While the results showed good species diversity and richness (H'=2.39, SR=19.3), species evenness was low (J'=0.8). Low species evenness may be due to high temporal variations in zooplankton occurrence.

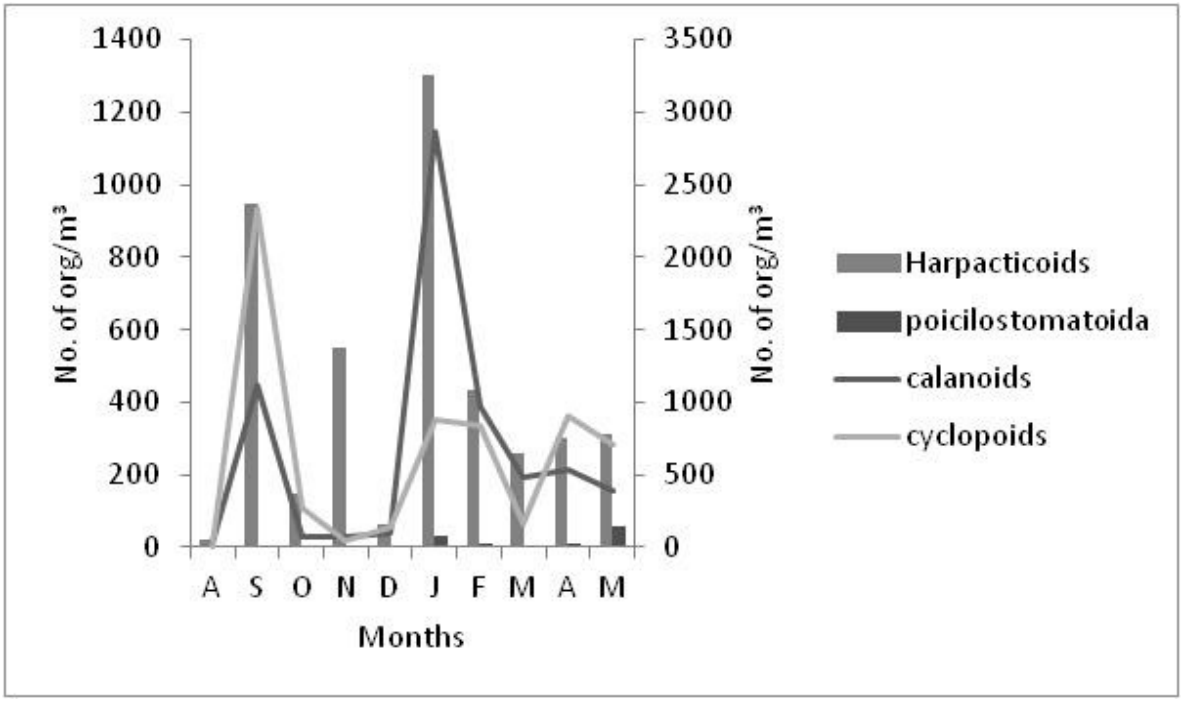

Figure-3
Monthly variations among the copepods during the study period

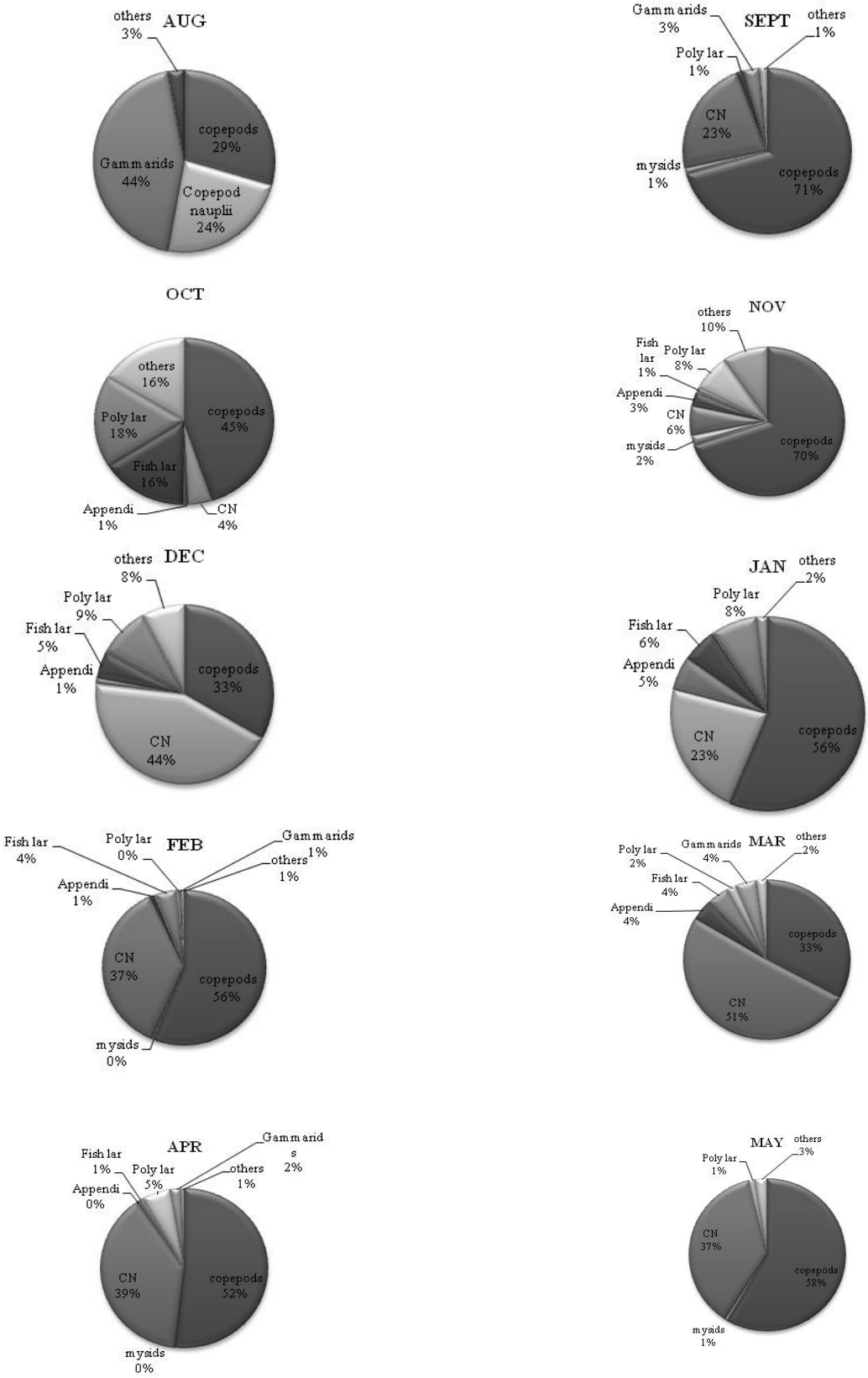

Figure-4
Monthly variations among zooplankton groups

Conclusion

Malvan shows good diversity and density of zooplankton. Copepods and their nauplii are present throughout the year. They serve as a good source of food for fishes. Environmental variables studied are also within the standard permissible range. However, impoverished appearance of cladocerans is a matter of concern. If fishing and anthropogenic activities continue in controlled manner, the zooplankton population should not be affected in the region in near future. This in turn should ensure good fish production.

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