Diversity and Abundance of Copepods in Taninthayi Coastal Waters, Myanmar

Khin May Chit Maung1, Thaung Htut2, Ei Thal Phyu1, Zaw Myo Hein1, Nyo Nyo Tun1

1. Myeik University, 1 Saparshwewar St., Kalwin Ward, Myeik City, Tanintharyi Region, Myanmar
2. Wildlife Conservation Society-Myanmar Program, Myanmar, No. 12 (B21-22), Yadanamyine Road, Kamayut, Yangon

**Article Info**

Received: 9 October 2020  
Accepted: 21 October 2020  
Published Online: 31 October 2020

**Keywords:**  
Abundance  
Copepods  
Calanoids  
Cyclopoids  
Harpacticoids

1. Introduction

Copepods, microscopic members of the subphylum Crustacea, are important and dominant zooplankton groups of the aquatic system. They are holoplanktonic organisms (permanent plankton) who spent their entire life cycle as the plankton. They provide a major food source for larval and juvenile fish. Therefore occurrence, abundance, and diversity of copepods are closely related to the abundance of fisheries resources.

Studies concerning the zooplankton of Myanmar have been carried out by authors [1-3]. The zooplankton species composition and distribution of Southern Myanmar Waters from the samples collected by Dr. Fridtjof Nansen were studied during the Myanmar ecosystem survey 2013 [4]. Based on the zooplankton samples collected by RV Dr. Fridtjof Nansen during the Myanmar Ecosystem Survey 2018, this paper aims to observe the species diversity and abundance of copepods and to find out the relation between copepod density and physico-chemical parameters of Taninthayi coastal waters.

2. Materials and Methods

Water samples were collected by multinet (0.25 m² in the mouth area and 405 µm in mesh size) at 14 stations along the Taninthayi coastal waters from 16 to 27 September 2018 (Figure 1) to analyze the diversity and abundance of copepods. The collected water samples were sieved on a 180 µm mesh and fixed in 96% ethanol in a bottle of 100 mL and then stored for further analyses of identification.
Copepods groups were examined under the light microscope and identified up as follows the classification systems [1-6].

Abundance of copepod species was presented as the individual number per m$^3$ of water. Species diversity indices were calculated by the formula of Shannon and Weaver (1963), Pielou (1966) as follows,

\[
H' = \sum \pi \ln \pi \\
E' = H'/\ln S \\
D' = S - 1/\ln N
\]

where $H'$ is species diversity index, $\pi$ is the population abundance of $i$th species calculated by $n_i/N$, $n_i$ is number of the $i$th species, $N$ is all individuals number in a station, $E'$ is species evenness index, $S$ is total species number and $D'$ is species richness index.

Temperature, salinity, oxygen, and fluorescence were measured by Seabird 911 CTD. Chlorophyll a analyses were carried out using the method of acetone extraction [8].

Multivariate statistics (nMDS) analysis of sampling stations was conducted by PRIMER v7 software package. The boxplot and correlation between physico-chemical water parameters and copepod abundance were analyzed using Microsoft Excel.

3. Results

Seventy-nine copepods species were recorded and composed by 51 species of calanoids, 21 species of cyclopoids, and 7 species of harpacticoids (Figure 2).

3.1 Composition

Calanoid copepods were dominated and accounted for 64.6% of the total sample, followed by cyclopoid copepod (26.6%) and harpaticoid copepod (8.8%). Copepod species composition by stations was presented in Figure 3. Calanoids dominated the copepod diversity of all stations. The species composition ranged from 16 species (St 846) to 59 species (St 799). High species composition was found at the nearshore stations (Sts 788, 790, 842, 867). Composition of copepod species was low at the offshore stations (Sts 802, 804, 823, 826, 865).

3.2 Abundance and Diversity

Copepods abundance by stations estimated from the direct counts of a sample (referring to the number per m$^3$) was presented in Figure 4. Density was found to be high at the nearshore stations: St 799 (2273 no/m$^3$), St 842 (2270 no/m$^3$), St 788 (2049 no/m$^3$), St 828 (1821 no/m$^3$) and low at offshore stations: St 846 (395 no/m$^3$), St 802 (520 no/m$^3$), St 823 (627 no/m$^3$). A high abundance of copepod species occurred in all stations were Paracalanus parvus (1071 no/m$^3$), Acrocalanus gibber (740 no/m$^3$), Nanocalanus minor (462 no/m$^3$) for calanoids, Oithona rigida (535 no/m$^3$) for cyclopoids, and Calanus finmarchicus (427 no/m$^3$) for harpacticoids.
m$^3$), Corycaeus andrewsi (491 no/m$^3$) for cyclopoids, and Microsetella rosea (296 no/m$^3$), Euterpina acutifrons (338 no/m$^3$) for harpacticoids.

Figure 4. Abundance Calanoid, Cyclopoid and Harpacticoid group by stations

Diversity indices ($H'$, $E'$, $D'$) calculated from copepod species was shown in Figure 5. The resulted values ranged from 2.61 to 3.78 in species diversity index ($H'$), from 0.89 to 0.97 in the evenness index ($E'$), and from 2.51 to 7.50 in species richness index ($D'$).

Figure 5. Copepods diversity indices ($H'$, $E'$, $D'$) by station

3.4 Physico-chemical Parameters, Correlation Matrix and nMDS Plot

Mean values of physico-chemical parameters along Taninthayi coastal waters were 28.4°C ± 0.42 for temperature, 26.2‰ ± 3.4 for salinity, 0.4 µg/L ± 0.4 for chlorophyll a, 4.74 ml/l ± 0.3 for oxygen and 0.13 ug/l ± 0.1 for fluorescence (Figure 6).

According to the correlation matrix between the abundance of copepods density and environmental parameters, it showed a positive correlation with the temperature (r=0.19), chlorophyll a (r=0.26), and fluorescence (r=0.27) and negative correlation with the salinity (r=-0.11) and oxygen (r=-0.19) (Table 1).

Non-parametric MDS based on copepods composition (Figure 7) showed two distinct groups composed of nearshore stations (Sts 788, 799, 842, 867) and offshore stations (Sts 802, 823) exhibited more than 60% of similarity. Except for the outer station St 846, all of the stations showed 40% of similarity level.

Figure 6. (A-E). Boxplot showing the variables of A) Temperature °C; B) Salinity‰; C) Chlorophyll a µg/L; D) Oxygen ml/l and E) Fluorescence ug/l

Figure 7. nMDS plot showing copepod species composition groups by stations

Table 1. Correlation matrix between the copepods density and physico-chemical parameters

|         | Copepods count | Temperature | Salinity | Chlorophyll a | Oxygen | Fluorescence |
|---------|----------------|-------------|----------|---------------|--------|--------------|
| Copepods count | 1              |             |          |               |        |              |
| Temperature   | 0.19           | 1           |          |               | -0.09  | -0.50        |
| Salinity      | -0.11          | 0.42        | 1        |               |        |              |
| Chlorophyll a | 0.26           | -0.09       | -0.0006  | 1             |        |              |
| Oxygen        | -0.19          | -0.20       | -0.05    | -0.46         | 1      |              |
| Fluorescence  | 0.27           | -0.16       | -0.14    | 0.94          | -0.34  | 1            |

4. Discussion

A total of seventy-nine marine copepods species were recorded from the zooplankton samples collected by multi-net along Taninthayi coastal waters. The total recorded copepod species during the present survey period was lower than that of copepods results by R/V Dr. Fridtjof Nansen 2013 [4] in which total copepods species revealed were...
collected by three types of equipment: Juday net, WP2 net, and Hydrobios multinet in November-December 2013. That could be due to the different sampling periods, and plankton net mesh size used.

Although there was a difference in species composition and abundance by the station, calanoid copepods dominated and accounted for 64.6% of all recorded copepods, followed by cyclopoid copepods (26.6%) and harpacticoid copepod (8.8%). Similarly higher species numbers of calanoid copepods were observed in Ayeyawaddy and Taninthayi coasts[9], on the southeast coast of India[10] and in the Bay of Bengal[13]. But the predominant of cyclopoids was stated in the zooplankton diversity of Wular Lake, Kashmir Himalaya[12].

In the present study, the population density of zooplankton ranged from 500 no/m$^3$ to 3230 no/m$^3$ which was higher than that of zooplankton standing stock collected by MV SEAFDEC 2 in Ayeyawaddy and Taninthayi coasts[9]. Common copepods species of the present survey were Canthocalanus pauper, Paracalanus parvus, P. erasiostis, Centropages furcatus, Acartia eurythraea, A. centrula, Oncaea clevei, O. venusta, Microsetella norvegica, and M. rosea. The common copepods species in R/V Dr. Fridtjof Nansen survey in 2013 were Canthocalanus pauper, Acartia eurythraea, Eucalanus subcrassus, Oithona nana, Oncaea venusta, and Microsetella norvegica[14].

The species diversity index of plankton communities can indicate that the ecosystem is under the influence of pollution or eutrophication. An increase in diversity values means the water quality is recovered. Lower species diversity indicated the influence of pollution[13]. The calculated copepod diversity of the present study (2.61-3.78 for H‘, 0.89-0.97 for E‘ and 2.51-7.50 for D‘) indicated higher species diversity of the copepod community in the Taninthayi coastal waters.

According to the correlation matrix between the abundance of copepods density and physico-chemical parameters, it showed a positive correlation with the temperature (r=0.19), chlorophyll a (r=0.26), and fluorescence (r=0.27) and negative correlation with the salinity (r=−0.11) and oxygen (r=−0.19). Chlorophyll a, pH, and salinity seem to play a role in the copepod abundance[14]. Chlorophyll a and phosphate concentration is a major factor controlling the abundance of copepod[15].

5. Conclusion

Abundance and diversity of copepods in the water are of significance for fishery management, fertility, and the health status of the ecosystem. A total of 79 copepod species was composed in the zooplankton community of Taninthayi coastal waters. Copepods species number and density were found to be high at the nearshore stations and low at the offshore stations. Long term monitoring survey on the status of copepods of Taninthayi coastal waters is still needed to give base line information for fisheries resources management.

Acknowledgments

We would like to express our special thanks, to Dr. Ni Ni Oo, Rector and Dr. Win Win Than, Pro-Rector of Myeik University for their permission to participate in this survey. First author acknowledges Kathrine Michalsen and Jens-Otto Krakstad (Cruise Leaders), Stamatina Isari (Team Leader Plankton) from Institute of Marine Research, Bergen, Norway and Dr. Tun Thein (Local Cruise Leader), Department of Fisheries, Myanmar for supporting during the survey. Thanks are also due to plankton team members: Dr. Thu Thu Min, Dr. Aung Myo Hsan, U Thura Tun from Marine Science Department, and Dr. Thet Yu Yu Swe, Daw Zi Za Wah, U Ye Min Aung from the Department of Fisheries for supporting during the survey.

References

[1] Han Shein. Study on some marine plankton copepod of Myanmar Waters. Unpublished M.Sc. Thesis, Department of Marine Biology, Art and Science Yangon University, Yangon, Myanmar, 1975.
[2] Aung Kyi, U. Study of the morphology and abundance of copepods from the mouth of the Salween River estuary. Unpublished M. Sc. Thesis. Department of Zoology, Art and Science University, Ragoon, Myanmar, 1976.
[3] Gayder Kittim Ku, U. The systematic of some planktonic copepod and their distribution during the pre and post monsoon in the Gulf of Martaban. Unpublished M. Sc. Thesis. Department of Zoology, Art and Science University, Ragoon, Myanmar, 1979.
[4] Zin Lin Khine. Zooplankton Species Composition and Distribution of Southern Myanmar Waters. Myeik University Research Journal, 2014, 5(1): 101-122.
[5] Kasturirangan, L.R. A key for the identification of the more common planktonic copepod of Indian coastal waters. Council of scientific and industrial research, New Delhi, 1963: 91.
[6] Newell, G.E, Newell, R.C. Marine plankton; a practical guide. University of London Press, London, 1973: 225.
[7] Ludwig, J.A., Renylods, J. F. Statistical ecology a primer on methods and computing. Wiley international Press, America, 1988: 202.
[8] Jeffrey, S.W., Humphrey, G.F. New spectrophotometric equations for determining chlorophyll a, b, cl and
c2 in higher plants, algae and natural phytoplankton. Biochemie und Physiologie der Pflanzen, 1975, 167: 191-194.

[9] Zin Lin Khine. Plankton Diversity in the waters off Ayeyarwaddy and Taninthayi Coasts. Unpublished M. Res Thesis. Department of Marine Science, Myeik University, Myeik, Myanmar, 2008.

[10] Kavitha, M., Padmavathy, P., Srinivasan, A., Jawahar, P., Ranjith, L., Prabu, D. L. Copepod abundance and Diversity from offshore region of Tuticorin, south east coast of India. International Journal of current Microbiology and Applied Science, 2018, 7(4): 2767-2792.

[11] Shanthi, M., Ramanibai, R.. Studies on copepods from Chennai coast (Cooum and Adyar), Bay of Bengal- during the Cruise. Current Research Journal of Biological Sciences, 2011, 3(1): 132-136.

[12] Shah, J. A., Pandit, A. K., Shah, G. M. Distribution, diversity and abundance of copepod zooplankton of Wular Lake, Kashmir Himalaya. Journal of Ecology and the Natural Environment, 2013, 5(2): 24-29.

[13] Nassar, M. Z. A., Gharib, S. M. Spatial and temporal patterns of phytoplankton composition in Burullus lagoon, Southern Mediterranean Coast, Egypt. Egyptian Journal of Aquatic Research, 2014, 40: 133-142.

[14] Abdel-Aziz, N. e., Ghobashi, A. e., Dorgham, M. M., El-Tohami, W. S. Qualitative and quantitative study of copepods in Damietta harbor, Egypt. Egyptian Journal of Aquatic Research, 2017, 33(1): 144-162.

[15] Fazeli, N., Marnani, H. R., Sanjani, S., Zare, R., Dehghan, S., Jahani, N. Seasonal variation of copepoda in Chabahar Bay Gulf of Oman. Jordan Journal of Biological Sciences, 2010, 3(4): 153-164.