VOLUME 8 ISSUE 2 2022

ISSN 2454-3055

INTERNATIONAL JOURNAL OF ZOOLOGICAL INVESTIGATIONS

Forum for Biological and Environmental Sciences

Published by Saran Publications, India

International Journal of Zoological Investigations Vol. 8, No. 2, 428-434 (2022)

International Journal of Zoological Investigations
Contents available at Journals Home Page: www.ijzi.net
Editor-in-Chief: Prof. Ajai Kumar Srivastav
Published by: Saran Publications, Gorakhpur, India

ISSN: 2454-3055

Diversity of Zooplankton and Influences of Hydrobiology on Mangrove Backwaters of Ennore, Tamil Nadu, India

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Received: 24th August, 2022; **Accepted:** 20th September, 2022; **Published online:** 26th September, 2022

https://doi.org/10.33745/ijzi.2022.v08i02.052

Abstract: Hydrobiology regulates the plankton diversity in a water body and is a fundamental research area in aquatic and ecological studies. The present study was carried out to assess the zooplankton diversity and physico-chemical parameters viz. temperature, salinity, pH, phosphate and nitrite by collecting water samples at four stations in Ennore estuary for the period of one year from January to December 2021. Investigation of species diversity, composition, richness and evenness predicted that the diversity status of zooplanktons is influenced by the hydrobiology of Ennore backwaters.

Keywords: Hydrobiology, Zooplankton, Ennore, Diversity, Ecology

Citation: Padmavathy V., Sesh Serebiah J. and Stella C.: Diversity of Zooplankton and influences of hydrobiology on mangrove backwaters of Ennore, Tamil Nadu, India. Intern. J. Zool. Invest. 8(2): 428-434, 2022.

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Introduction

Planktons are small organisms (microns to millimetres) in the marine environment that drift passively in the surface water by the action of water currents. Animal plankton called zooplanktons are a major group of diverse aquatic organisms, constituting the biotic component and occupying the intermediate position of aquatic food web influencing energy flow between primary producers and pelagic fishes (Park and Shin, 2007). Grazing on phytoplankton, the primary consumers serve as food source for other fauna and contribute remineralization and nutrient transport. Diversity of zooplankton have been well studied from some tropical estuaries of India (Sivaswamy, 1990). However, information on relation between physico-chemical parameters and zooplankton diversity is limited. Hydrobiology of water plays a major role in distribution and diversity of zooplankton in the estuarine environment (Parekh and Gadhvi, 2015). As information on species diversity, richness and evenness is essential to understand the ecosystem

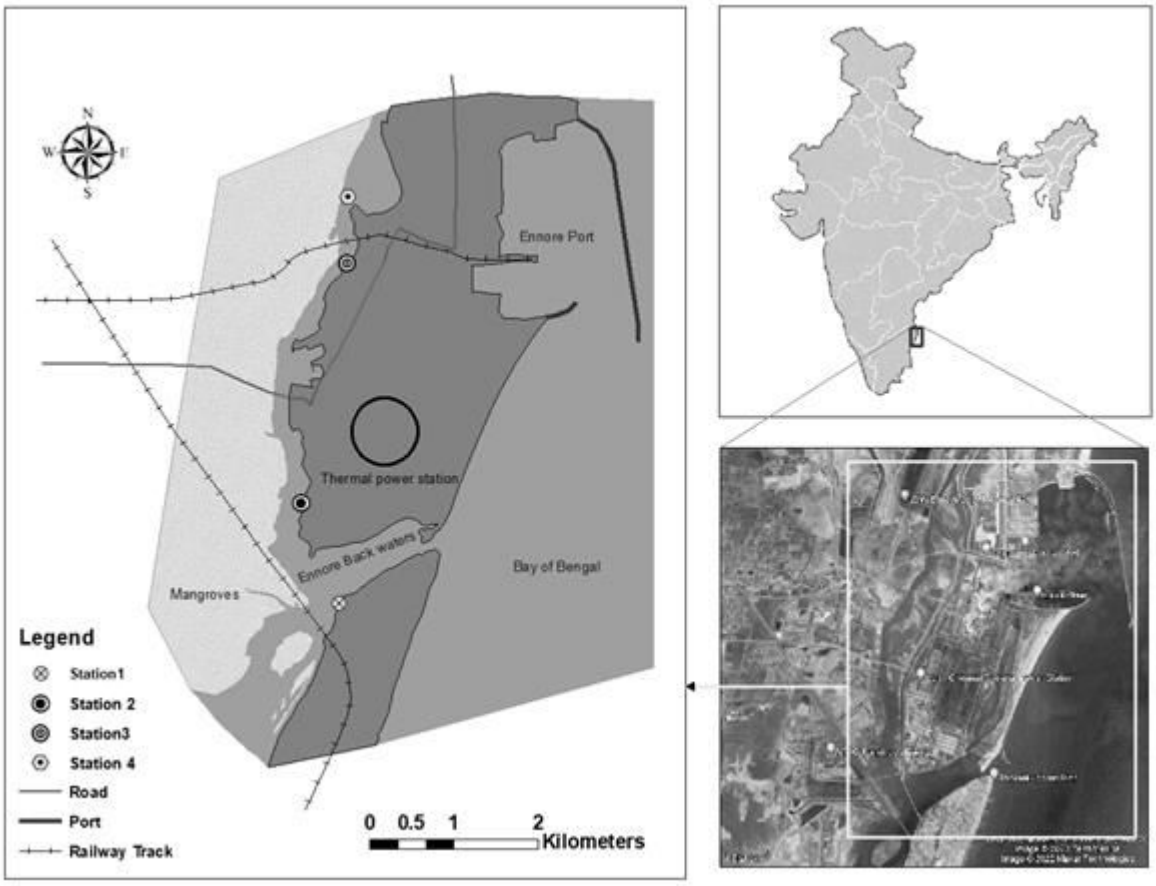

Fig. 1: Map showing study area—Ennore Backwaters.

Table 1: Stations with GPS units

STATION	CO-ORDINATES	
	LATITUDE	LONGITUDE
1	13°13'58"N	80°19'46"E
2	13°15'32"N	80°19'22"E
3	13°15'51"N	80°19'30"E
4	13°13'57"N	80°19'21"E

dynamics, the present study was aimed to measure the ecological status of the biota and the water quality of Ennore backwaters that safeguards a well- balanced Ecosystem.

Materials and Methods

Four sampling stations were fixed by GPS (Table 1; Fig. 1). Water and zooplankton samples were collected from the predefined stations for the period of one year from January 2021 to December 2021.

Samples were analysed and represented season wise. Temperature was measured using standard centigrade laboratory thermometer. The salinity and density were measured by salinity refractometer (ATAGO) by the principle of refraction. pH was measured by a pH pen (Eutech instruments), which was dipped in a beaker containing sample water. DO (Dissolved oxygen) and BOD (Biological oxygen demand) was determined by Winkler's method (Winkler, 1888). For nutrient analysis, the water samples were filtered through the Millipore filtering unit using Whatman GF/C filter and dissolved nutrients like

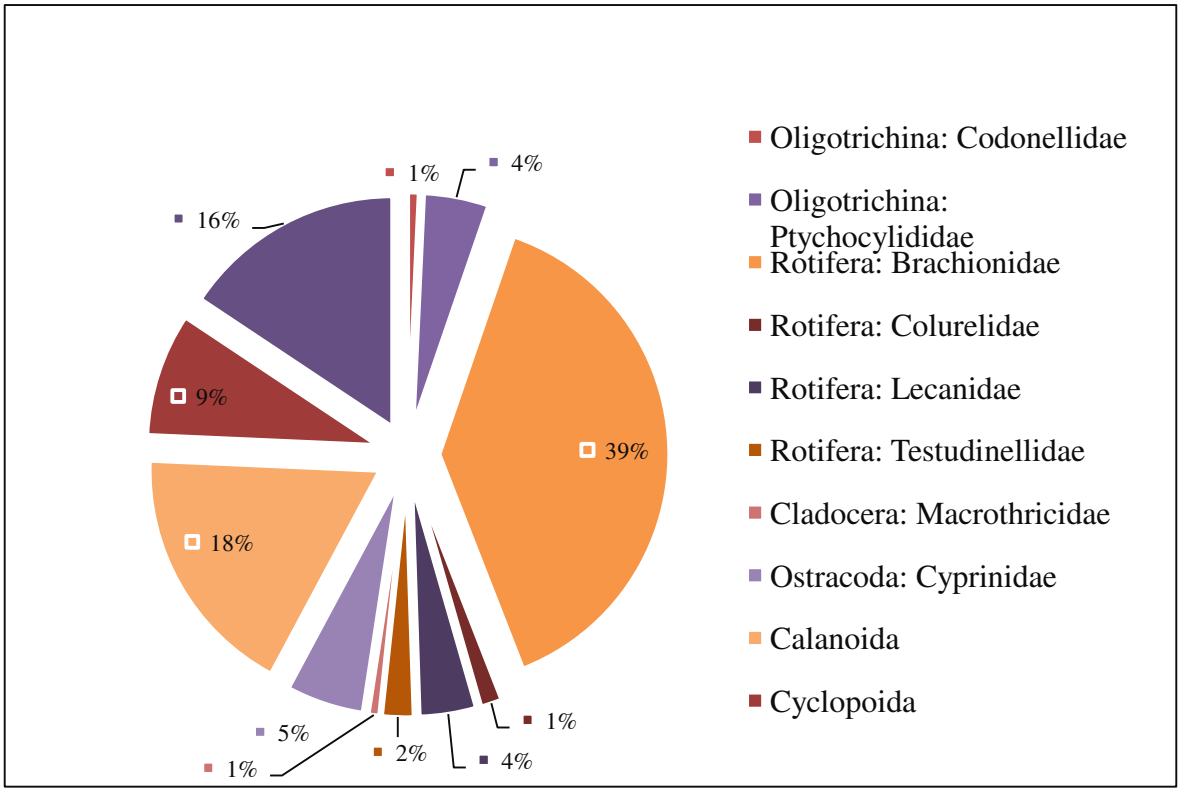

Fig. 2: Percentage contribution of Zooplankton observed in the present study.

nitrite, inorganic phosphate were estimated by calorimetric method using ECIL CE 303 Grating, Spectrophotometer at appropriate wave lengths as described by Strickland and Parsons (1972).

Zooplankton samples were collected from the surface waters using plankton net with mesh size 60 µm by towing for half an hour at each station. These samples were preserved in 5% neutralized formalin for further analysis. The quantitative analysis of Zooplankton was carried out using Sedgwick Rafter plankton counting cell in accordance to Welch (1948). Qualitative plankton analysis was carried out using Utermohl's inverted plankton microscope by using standard references. Biodiversity indices such as species diversity, richness and evenness were calculated by standard methods (Shannon and Weiner 1949, Simpson 1949, Pielou, 1966).

Results

Monthly variation in zooplankton species and its contribution, percentage composition, population density, species density, richness, evenness and physico-chemical parameters viz., temperature, pH, salinity, phosphate, nitrite, silicate were documented for a period of one year from January 2021 to December 2021 at the four stations as a means to evidence their inter-relationship in balancing the ecosystem.

A total of 50 species of zooplanktons were observed in the present study. The species percentage contribution is represented in Figure 2. The population density ranged from 50-1120 cells/liter (Fig. 3), the overall richness value ranged from 0.77-5.36, species evenness varied from 0.67-1 and the species diversity ranged from 1.332-3.354 across the four stations in the study year. In the present study, a minimum surface temperature of 25°C in pre-monsoon (July 2021) and a maximum temperature of 34°C in summer (April 2021) was recorded. The salinity varied from a minimum of 22.35 ppt in post-monsoon (February 2021) and a maximum of 54.65% in

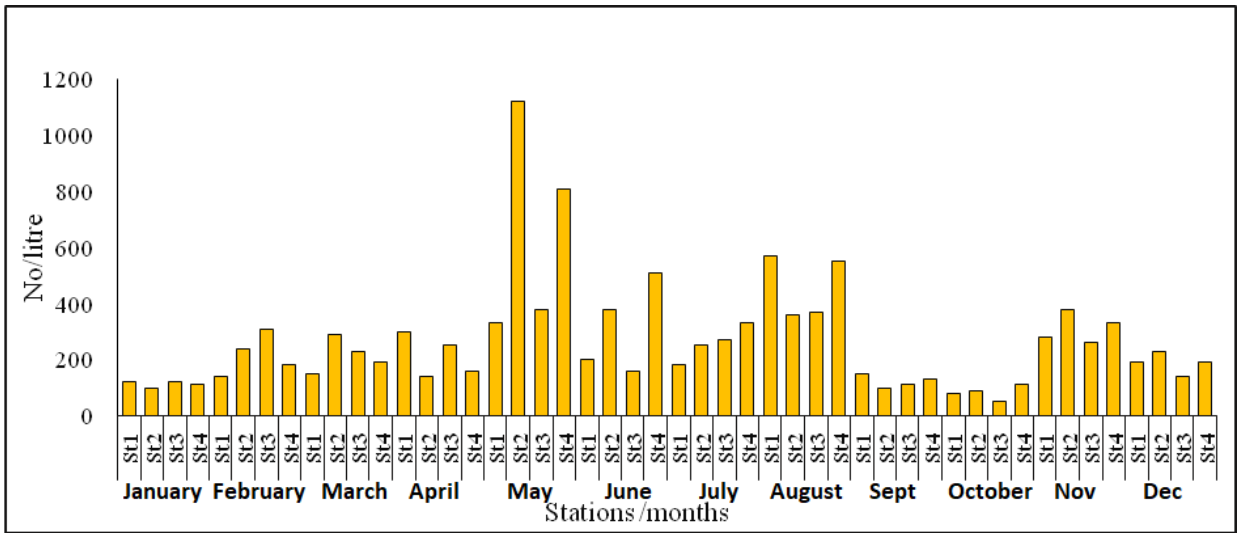

Fig. 3: Density of Zooplankton in the study area (No/litre).

summer (April 2021), the pH ranged from a minimum of 7.5 in monsoon (December 2021) and maximum of 8.5 in summer (Apirl 2021), minimum dissolved oxygen of 0.59 mg/l in pre-monsoon season (July 2021) and maximum of 3.4 mg/l in monsoon season (November 2021) was recorded. The maximum value of BOD was recorded as 10.25 mg/l across the four stations. In the present study a minimum phosphate concentration of 0.02 µg/l in post-monsoon season (March 2021) and a maximum of 0.68 µg/l was recorded in monsoon season (Dec 2021), minimum silicate concentrate of 0.05 µg/l in post-monsoon (August 2021) and maximum of 0.05 µg/l in Monsoon (December 2021) and minimum nirite concentration of 0.005 µg/l in pre-monsoon (July-September 2021), and a maximum of 0.12 µg/l was recorded in post-monsoon (March 2021).

Discussion

Hydrobiology of water viz., temperature, salinity, pH and nutrients influences distribution of zooplanktons and causes seasonal changes in community structure (Thirunavukkarasu *et al*., 2020) which is evidenced in the present study at Ennore Mangrove ecosystem. The study area showed significant variation in the hydrobiological parameters, population density, species composition, species diversity, species evenness and species richness of zooplankton community across the four stations in the study. The distribution of aquatic organisms are greatly influenced by surface water temperature (Manickam *et al*., 2014) as it speeds up biochemical reactions. In the present study, increase in solar radiation increased water temperature from April to August (summer-pre-monsoon) and decrease in solar radiation with a fall in temperature from October to February (monsoon-post-monsoon) accompanying a simultaneous maximum zooplankton density during summer and minimum density during monsoon. Low light intensity and cloudy sky minimized zooplankton population as reported by Dhanasekaran *et al.* (2017). Higher zooplankton density in summer coincided with higher phytoplankton density as recorded from Uppanar backwaters (Murugan and Ayyakannu, 1991). Salinity is a key factor that influenced zooplankton community as in Goa waters. Fresh water influx during monsoon (Padmavathy and Goswami, 1996) brought by rain (Bhunia and Choudhury, 1982) lowered salinity values and temperature and hence decreased zooplankton density. The elevation in salinity recorded during summer season indicated that increased temperature prominently led to high evaporation of water

thereby, documented a high zooplankton community. The study also proves the direct proportion of temperature and salinity in influencing zooplankton density.The pH is associated with salinity and the study area remained alkaline throughout the study period (Katariya *et al.*, 1996), observed maximum level of pH during summer as a reason of effective photosynthesis. Similarly, the present study recorded a maximum pH during summer with high temperature and a minimum during monsoon indicating the low value is because of higher utilization of carbon dioxide in the backwaters. The high and low pH values associates with the maximum and minimum density of zooplankton species, evidencing the inter-relationship among the three parameters establishing the water quality.Water temperature proves its significance in determining the solubility of oxygen (Harvey *et al*., 2013). Dissolved oxygen influences metabolic processes such as growth and development and hence crucial for survival (Ekau *et al*., 2010). In the present investigation, the summer season recorded maximum dissolved oxygen due to increased photosynthesis by primary producers supporting zooplankton survival and decrease in level and hence density during monsoon season due to utilized DO. The decomposition of organic matter and decay of vegetation might have resulted in high BOD.

Nutrient loading plays an important role in distribution of zooplankton population. Nitrification of Nitrite, in the form of dissolved inorganic nitrogen in water leads to high nitrite level that may not be suitable for growth of phytoplankton and ultimate proliferation of zooplankton (Wang *et al*., 2006). The high level of Phosphate observed could be attributed to influx of fresh water and industrial effluents, domestic sewage as Ennore being an industrial area. High levels of both nitrites and phosphates can lead to eutrophication causing reduction in dissolved oxygen (Cuihong*et al*., 2011) reducing the zooplankton density. Similar observation has been recorded in the present study during the pre-monsoon season.

Species diversity indices indicate the functional relationship between number of species and number of individuals in zooplankton population and holds good to analyse zooplankton biota in the ecosystem. Generally diversity index coincides with species richness and species evenness. The number of different species inhabiting the area constituted species diversity and it was well diverse state. The species evenness determined by Pielou Evenness Index measured the relative abundance of different species and proved compatible when the number of individuals represented. The species richness was determined by Simpson Richness Index and the high species richness entitled the movement of standing water circulation that allowed good water renewal in the downstream sector. Diversity index is a good tool for assessing water quality (Singh and Singh, 2002), that in turn supports the biotic components. During monsoon season, flow of fresh water altered the estuarine backwaters and resulted in reduced number of species and hence decreased the diversity index, while the increased number during summer season presented a wide diversity index.

Conclusion

The study revealed that the Hydrobiology of Ennore backwaters contributes the fundamental intuitiveness for the sustenance of zooplanktons and higher biotic components. The results further showed that an integrity of environmental parameters such as temperature, pH, salinity and nutrient content with a maximum or minimum influenced seasonal variations in zooplankton distribution and abundance across the four stations. The diversity indices compliments the mangrove functional ecosystem and serves useful to predict the subtle changes transcending among the biotic linkages of the backwaters. Hence, the current study brings to light that the zooplankton community still proliferates by the favourable limitation factors amidst the highly polluted

environment and sustains other biota in the ecosystem.

Acknowledgements

Authors would like to express sincere thanks to the Head, Department of Oceanography and Coastal Area Studies, Alagappa University, Karaikudi, for having given an opportunity to pursue this research work and the lab facilities provided to carry the analysis.

References

Asriansyah A, Wildan DM, Pratiwi NTM, Simanjuntak CPH, Sulistiono, Hestirianoto T, Shafrudin D and Nugroho T. (2021) Study on zooplankton diversity aquatic ecobiology of Batang Toru River, North Sumatera, Indonesia. Int Symp Aquat Sci Resource Managm. 744: 012003.

Baxi KD, Beleem B, Poriya PU and Gohil BM. (2018) Diversity status of zooplankton and water quality assessment of coast of Alang shipbreaking yard, Bhavnagar district, Gujarat, India. Int J Fish Aquat Stud. 6(4): 300-304.

Corinne P, Sastri AR and Beisner BE. (2015) Evaluation of functional trait diversity for marine zooplankton communities in the Northeast subarctic Pacific Ocean. J Plankton Res. 37(4): 712-726.

Dhanasekaran M, Bhavan PS, Manickam N and Kalpana R. (2017) Physicochemical characteristics and zooplankton diversity in perennial lake at Dharmapuri (Tamil Nadu, India). J Entomol Zool Stud. 5(1): 285-292.

Dhinamala K, Pushpalatha M., Samuel T. and Raveen R. (2015) Spatial and temporal variations in the water quality parameters of Pulicat Lake, Tamil Nadu, India. Int J Fish Aquat Stud. 3(2): 255-259.

Harris R, Peter W, Jurgen L, Hein-Rune S and Mark H. (2000) ICES Zooplankton Methodology Manual, Academic Press, San Diego.

Harney NV, Dhamani AA and Andrew RJ. (2013) Seasonal variations in physico-chemical parameters of Pindavani pond of Central India. Sci Weekly 1(6): 1-8.

He R, Jiao HP, He N, Chang YY, Jiang HY, Zhang Y, Li YQ and Jiang R. (2021) Seasonal variation of zooplankton communities and the effects of environmental factors in the seawater near Taishan Power Station. Nature Environ Poll Technol. 20(4): 1475-1484.

Katariya HC, Iqubal SA and Sandilya AK. (1995) Limno-chemical studies of Tawa Reservoir. Int J Environ Poll. 16(11): 841-846.

Khishma M, Chandani A and Sadasing O. (2010) An investigation on the phytoplankton and zooplankton abundance and diversity at the Balaclava marine protected area in the north-west coast of Mauritius. J Environ Res Develop. 5(2): 366-374.

Mayalagu R, Azhagar S, Sun J, Jenkinson IR, Mustafizur MR and Sesh Serebiah J. (2020) Seasonal variations of plankton in Kodiakkarai and Arukattuthurai on the Vedharanyam coast, South India. Regional Stud Mar Sci. 39: 101461.

Murugan A and Ayyakannu K. (1991) Ecology of Uppanar backwater Cuddalore, 1. Physico-chemical parameters. Mahasagar-Bull Natl Inst Oceanogr. 24: 31-38.

Narasimman M, Bhavan PS, Perumal S, Rajagopal B, Thirunavukkarasu M, Veeran S, Annamalai A, Gopalan R, Rajendaran U and Madhayan K. (2018) Impact of seasonal changes in zooplankton biodiversity in Ukkadam Lake, Coimbatore, Tamilnadu, India, and potential future implications of climate change. J Basic Apppl Zool. 79: 15.

Newell GE and Newell RC. (1963) Marine plankton, A practical guide. Hutchinson Education Ltd., London, pp. 169-225.

Padmavathi G and Goswami SC. (1996) Zooplankton ecology in Mandovi. - Zuari estuarine system of Goa, West Coast of India. Indian J Mar Sci. 25: 268-273.

Parekh H and Gadhvi IR. (2015) Seasonal variation in physic-chemical parameter of seawater at Mithivirdi coast Bhavnagar-West coast of India. Int J Res Engineer Biosci. 3(1): 41-47.

Park KS and Shin HW. (2007) Studies on phyto-and-zooplankton composition and its relation to fish productivity in a west coast fish pond ecosystem. J Environ Biol. 28: 415-422.

Pawan P and Deshmukh SV. (2021) Study of zooplankton diversity in Rajura Dam at Buldhana District of Maharashtra. J Global Biosci. 10(5): 8744-8751.

Pielou EC. (1966) The measurement of diversity in different types of biological collection. J Theoret Biol. 13: 144.

Rajagopal T, Thangamani A, Sevarkodiyone SP, Sekar M and Archunan G. (2010) Zooplankton diversity and physico-chemical conditions in three perennial ponds of Virudhunagar district, Tamilnadu. J Environ Biol. 31: 265-272.

Sameer T and Pai IK. (2001) Statistical approaches for computing diversity of zooplankton in the Andaman Sea. Trop Ecol. 42(2): 243-250.

Shannon CE and Weiner W. (1949) The mathematical theory of communication, University of llinois Press, Urbana, pp. 117.

Singh R and Singh SP. (2002) Ecology of polluted waters, A.A.P.H. Publishing Corporation, New Delhi, SPSS Statistics 17.0.

Sivaswamy SN. (1990) Plankton in relation of coastal pollution at Ennore, Madras coast. Indian J Mar Sci. 19: 115-119.

Strickland JDH and Parsons TR. (1972) A practical handbook of seawater analysis. J Fish Res Bd Canada 167: 185-199.

Supider Kaur and Harvinder KS. (2020) Diversity and distribution od zooplankton in river Ghaggar of Punjab with special reference to pollution bioindicators. Eco Env Cons. 26: S242-S247.

Thirunavukkarasu S, Vasanthi R, Karunasagaran G and Munuswamy N. (2020) Coastal water quality impact on community structure and genotoxicity of marine Zooplankton. Regional Stud Mar Sci. 39: 101392.

Varadharajan D and Soundarapandian P. (2013) Zooplankton abundance and diversity from Pointcalimere to Manamelkudi, South East Coast of India. J Earth Sci Clim Change 4: 5.

Wang YS, Zhi-Ping L, Cui-Ci S, Wu M and Han S. (2006) Multivariate statistical analysis of water quality and phytoplankton characteristics in Daya Bay, China, from 1999 to 2002. Oceanologia 48: 193-211.

Welch PS. (1948) Limnology methods. Mc Graw Hill Book Co. Inc. New York.

Winkler LW. (1888) Berichte der Deutschen Chemischen Gesellschaft 21: 2843-2855.

Xia Wen Cheng, Lan-Lan Zhang, Fei Gao, Ye-Hui Tan, Rong Xiang, Zhuo-Ya Qiu and Li-Jun H. (2022) Biodiversity of zooplankton in 0-3000 m waters from the eastern Indian Ocean in spring 2019 based on metabarcoding. Water Biol Security 1(1): 100005.