Current Environment. 2022;2:28-32
Fully Open Access International Journal
https://doi.org/10.54479/ce.02.2022.0106

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ORIGINAL RESEARCH ARTICLE

Freshwater Zooplankton in Rain-fed Wild Ponds: A Perspective on Species Diversity and Water Quality

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Zooplanktons play an important role to transfer energy from the primary level to upper trophic organisms in aquatic bodies. Naturally, in rainy seasons, a number of rain-fed ponds have occurred for short existence. These seasonal rainy ponds are sustained for a maximum of two or three months before winter. In this short period, newly introduced rain-fed ponds are known for the nourishment of zooplankton with temporal nutrients supplied from surface run-off and subsequently freshly flourishing algae. As in result, the fisheries could be enhanced and exploited as promising food sources to people through these seasonal rain-fed ponds. The present study is demonstrated with rotifer (10677.778 ± 2306.27 ind/l) followed by copepod (2184.72 ± 601.56 ind/l) and cladocera (884.72 ± 96.72 ind/l) with some aquatic chemical parameters such as dissolved oxygen (4.7-5.5 mg/l), ammonia (0.21-0.27 mg/l), nitrate (0.15-0.22 mg/l), total dissolved solids (245-508 mg/l) and pH (6.8-7.8).

Keywords: Cladocera, Copepods, Rotifera, Seasonal ponds.

The roles of zooplankton in freshwater reservoirs are obvious grazing on algae and supplying nutrition to fish and fish-related organisms.Zooplanktons play an ecological role in algal bloom control by foraging on them and as a protein source to the higher trophic level. Therefore, zooplankton executes an interconnecting role between algae and superior aquatic micro and macro-organisms (1-8). The restoration and reformation of zooplankton in newly oriented rain-fed ponds are depending on many environmental parameters such as temperature, alkalinity, nutrients (nitrogen, phosphorus), and geo-morphological conditions of ponds (9-14). Additionally, the algal community also controls the zooplankton distribution in aquatic bodies (11,13). Hence, zooplankton prefers chlorophyta (green algae), bacillariophyta (diatoms) over cyanophyta (blue-green algae), and euglenophyta for feeding because of some ecological factors such as nutrient content, toxicity, edibility, and allelopathic actions of these algal groups (15-19). However, zooplanktons are playing a crucial role in fisheries production by contributing essential proteins which are constituted by aquatic nutrient availability and algal composition. The major groups of zooplankton such as cladocera, copepod, and rotifer are mainly dominating the freshwater bodies (20). On the other hand, among these three groups which preferably dominate, it depends on the tolerance level to the organic and inorganic pollution (11,13,14). By nature, copepods are selective feeders but cladocera and rotifers are mostly filter feeders. Copepods can select toxic or no-toxic algae and also avoid poor nutritional, less digestive filamentous algae for feeding. In contrast, filter feeders have limited options to specifically identify any harmful algae and consequently save themselves from algal toxicity and allelopathic activities (11,21-23). However, all of these zooplankton groups support the nutritional backbone of fisheries. The seasonal ponds are widely used for daily house chores such as bathing, washing, drinking water, and sometimes for exploiting indigenous fishes and crustaceans which shortly appeared only in the monsoon (24-26). The zooplankton distribution in these rain-fed wild ponds is very important to monitor and possibly manage for better nutritional aquaculture because of their short-timed but nutritious food requirement. Zooplanktons have obvious demand in hatcheries for larval feeding and brood growing of fishes but artificial feeds are preferred more

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than live feeds for rapid profits in aquaculture (4-8,10,21-23). However, the zooplankton supply essential amino acids and fatty acids associated with obligatory digestive enzymes to fishes and crustacean larvae (21-23). In both wild and aquaculture ponds the nutritional contribution of zooplankton is obligatory to support the higher trophic invertebrates and vertebrates A number of literature are reported on the ecological functions of zooplankton in healthier wild and aquaculture fisheries (27-36).

Thus, this article is attempted to identify and estimate zooplankton species in temporal ponds during monsoon and discuss the potential and opportunistic usages of wild zooplankton in aquaculture.

METHODS AND MATERIALS

The conducting study aimed to select three rain-fed ponds during the first monsoon (August 2021 to October 2021) in Noakhali, one of the coastal districts in Bangladesh. In Noaklhali a tropical climate with an annual average temperature 25.6 °C and rainfall of about 3,302 mm is observed (37). Water and plankton samples were collected monthly during sampling periods for further laboratory analysis. The pH meter (Brand: HANNA-Serial number: H196107) and Secchi disc were used to measure water pH and transparency for on-spot analysis, respectively. The other water parameters: dissolved oxygen, nitrate, and ammonia were determined by following determined by following methods (38). The Plankton samples were collected and preserved by using a plankton net (mesh size: 20 µm) and 5% buffered formalin, afterward three groups of zooplankton such as rotifers, copepods, and cladocera were identified and counted by using Sedgwick rafter cell under a compound light microscope by following guidelines from the literature (39-41). The statistical analysis was conducted in SPSS (Version 17) and Microsoft Excel (2010) for data analysis.

RESULTS AND DISCUSSION

In present study three important water quality parameters are measured such as dissolved oxygen (4.7-5.5 mg/l), ammonia (0.21-0.27 mg/l), nitrate (0.15-0.22 mg/l), transparency (33.02-55.80 cm) and pH from 6.8 to 6.9 (Table 1).

Table 1. Water quality parameters (range: lowest-highest) during sampling periods in stations A, B, and C.

Rain Fed Ponds	Dissolved Oxygen (mg/l)	Ammonia (mg/l)	pH	Nitrate (mg/l)	Transparency (cm)
Station A	4.9-5.4	0.22-0.24	7.6-7.8	0.15	55.88
Station B	4.7-4.8	0.25-0.27	7.5-7.7	0.20	50.80
Station C	5.1-5.5	0.21-0.23	6.8-6.9	0.22	33.02
Lowest Value	5.1	0.21	6.8	0.15	33.02
Highest Value	5.5	0.23	7.8	0.22	55.88

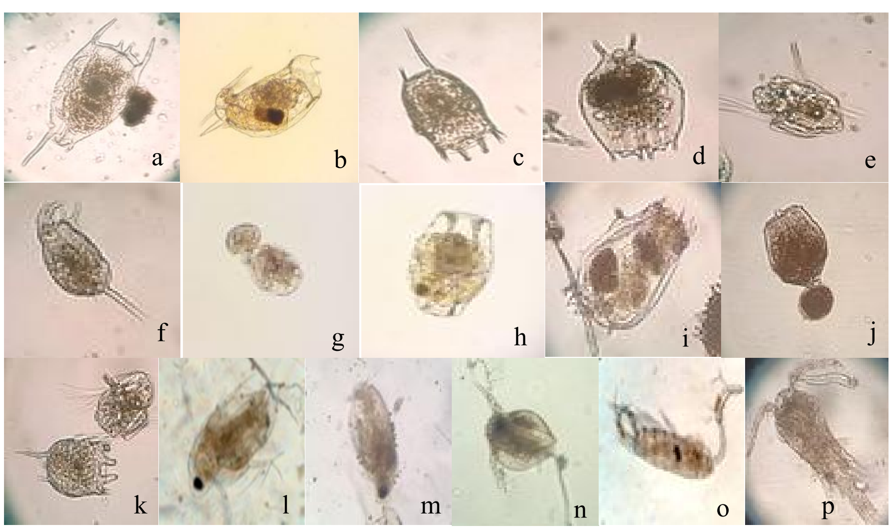

Figure 1. The zooplankton genera (rotifer: a-k, cladocera: l-n, and copepod: o-p) in all sampling stations (rain-fed ponds). Here, (a) *Brachionus*, (b) *Filinia*, (c) *Keratella*, (d) *Lecane*, (e) *Polyarthra*, (f) *Cephalodella*, (g) *Conochilus,* (h) *Amuraeopsis,* (i) *Lepadella,* (j) *Ascomorpha,* (k) *Plationus,* (l) *Alonella,* (m) *Sida,* (n) *Macrothrix*, (o) *Neodiaptomus,* and (p) *Thermocyclops.*

These physicochemical water qualities such as dissolved oxygen, ammonia, nitrate, transparency, and pH are related to zooplankton distributions in freshwater bodies (3,4,9,12,13,18,20).

Furthermore, there are eleven (*Brachionus, Filinia, Keratella, Lecane, Polyarthra, Cephalodella, Conochilus, Amuraeopsis, Lepadella, Ascomorpha* and *Plationus*) genera and three (*Alonella, Sida,* and *Macrothrix*) genera of rotifer and cladocera, respectively are found in sampling ponds. Additionally, there are two (*Neodiaptomus* and *Thermocyclops*) genera of copepod also recorded (Figure 1). During late summer there are six (*Amuraeopsis, Ascomarpha, Brachionus, Lepadella, Plationus* and *Polyarthura*) genera, four (*Heliodiaptomus, Mesocyclops, Neodiaptomus* and *Thermocyclops*) genera and five (*Alona, Alonella, Chydorus, Macrothrix, Scapholeberis,* and *Sinocephalus*) genera were recorded in wild ponds by Khan et. al 2020a (3).

The total abundance (ind/l) of zooplankton (16514.58 ± 3699.53, 15929.16 ± 2859.30, 8797.91 ± 1443.28) is consisted with rotifer (14031.25 ± 2431.14, 11743.75 ± 2094.001, 6258.33 ± 1620.38), cladocera (770.83 ± 385.41, 806.25 ± 608.99, 1077.08 ± 341.30) and copepod (1712.5 ± 367.33, 3379.16 ± 1451.11, 1462.5 ± 260.78) in pond A, B and C, respectively (Figure 2 & 3). Furthermore, Rotifer was found dominated (10677.778 ± 2306.27 ind/l) by copepod (2184.72 ± 601.56 ind/l) and cladocera (884.72 ± 96.72 ind/l) in conducting the study.

We found the zooplankton distribution in newly oriented and short-timed rain-fed ponds are low than comparatively other water-stable wild and aquaculture ponds according to related studies (2-4,12-15). Social ignorance is the most prominent threat to these seasonal ponds. Local people have no interest in these ponds except only water usage and fishing as far as possible (10,11,20). Mainly they treat these ponds for waste deposition. As a result, several chemical pollutants such as phosphorus and nitrogenous compounds are ending up in these ponds through agricultural and residential surface run-off. Consequently, rapid algal blooms are happened and cause trophic impairment by threatening zooplankton communities (12-15,17). The appearance or invisibility of zooplankton indicates the water quality such as very promising biological indicators (4,42).

The dominance of rotifers upon copepods and cladocerans indicates the moderate water quality which might be not favorable to the other suppressed zooplankton groups such as copepod and cladocera (2-3). Additionally, comparatively in favorable water bodies cladocerans and copepods are dominated over rotifers. The favorable water qualities are defined by some important physico-chemical parameters such as temperature, alkalinity, free carbon-di-oxide, dissolved oxygen, ammonia, nitrate, nitrite, phosphorus etc (11,12).

The present study was focused to measure some essential aquatic parameters such as dissolved oxygen, ammonia, nitrate, pH, and transparency which could influence zooplankton diversity and abundance in ponds. Dissolved oxygen plays a crucial role in zooplankton distribution in water bodies (13,15-18). Water transparency is found positively correlated with rotifer, cladocera, and copepod distribution in aquaculture ponds (18). The aquatic chemical properties such as ammonia and nitrate are found essential for algal growth (37) and subsequently influence the assemblages of cladocera and copepod (18). As well, water pH indicates the chemical buffering capacity of aquatic bodies, the acceptable pH range for the ideal living of aquatic organisms is varied from 6.5 to 9.0 (9,13,24).

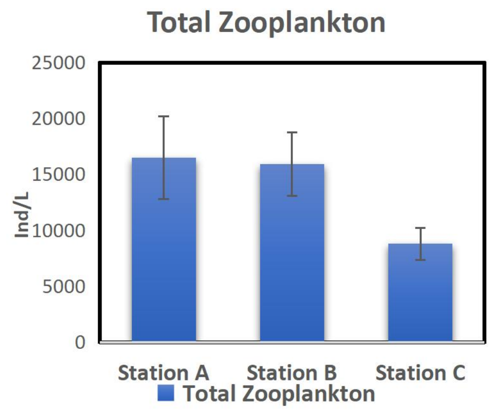

Figure 2: Total zooplankton abundances (ind/l) in stations A, B and C (rain-fed ponds).

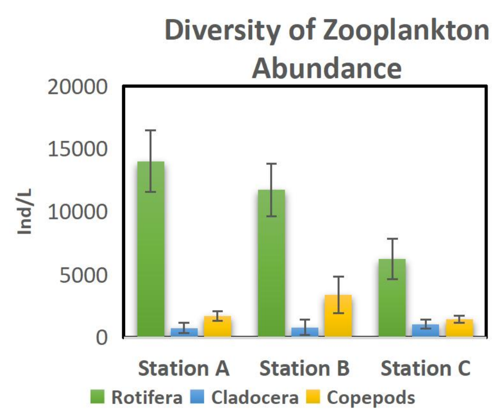

Figure 3: Total zooplankton abundances (ind/l) in stations A, B, and C (rain-fed ponds).

The ecological sensitivity of zooplankton to the algal bloom, toxicity, and chemical pollutants might be proper reasons for their existence in harsh environments. Moreover, anthropogenic activities also influence eutrophication (nutrient enrichment) and increase algal bloom which causes suffocative and noxious habitats for zooplankton (4,11,13,29).

CONFLICT OF INTEREST

All authors declared no conflict of interests.

ACKNOWLEDGEMENT

This study was successfully completed with the funds and logistical support provided by Research Cell (Grant Number: NSTU/RC-OC-04/T-22/64), Noakhali Science and Technology University. The authors highly appreciate the professional supports during water and plankton sample analysis in the Coastal Plankton Laboratory, Department of Oceanography, Noakhali Science and Technology University.

CONCLUSION

The monsoonal ponds have a crucial ecological role in providing shelters for the indigenous and rare freshwater zooplankton groups as rotifer, copepod and cladocera. Consequently, zooplanktons are able to proclaim the pollution status of their belonging habitats through their sensitivity to aquatic organic and inorganic pollutants.

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ARTICLE HISTORY

Received: 28 Jun 2022, **Revised:** 16 Aug 2022
Accepted: 25 Aug 2022, **Published:** 08 Sep 2022

AUTHOR(S) CONTRIBUTION

All authors are equally contributed.

TO CITE THIS ARTICLE

Islam MS, Uddin M, Asma Jaman, Bhowmik S, Rifa TJ, Mashkova I, Khan NS. Freshwater zooplankton in Rain-fed wild ponds: A perspective on species diversity and water quality. Current Environment. 2022;2:28-32.