INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 15, No. 4, p. 62-69, 2019

RESEARCH PAPER OPEN ACCESS

Taxanomy of micro-invertebrates inhabiting in fresh water algal mats in ponds of Quetta City and Zhob District, Balochistan, Pakistan

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Key words: Microorganisms, Micro invertebrates, Algal mats, Aquatic environment, Ecosystem.

http://dx.doi.org/10.12692/ijb/15.4.62-69 Article published on October 08, 2019

Abstract

Microorganisms like micro invertebrates are the important living organisms of the world as well as having much importance for the ecosystem. The recent study focused the diversity and abundance of micro-invertebrates inhabiting in freshwater algal mats of freshwater ponds of Zhob District and Quetta City, Balochistan. The fresh water algal samples were collected between 10 am to 1pm during the year June-August 2017. For sampling technique free floating algal mats were collected in pre labeled dark glass bottles (400 mL) and brought to the laboratory in an ice box. The samples were preserved in 70% alcohol and 4% formaline in two different glass vials for taxonomy, to study diversity and abundance in freshwater bodies. The species were identified by standard taxonomic keys. In addition, during whole study different species were recorded and identified belonging to different orders and families at laboratory with their respective ratios. All the collected species showed fluctuation in each sample. The samples collected at Quetta also showed significant differences. The overall data describe that the specie range were high at warm temperature while low at cold temperature. The micro-invertebrates occur in all kinds of aquatic environment and play a key role in environmental pyramids.

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Introduction

Micro-invertebrates are tiny aquatic animals smaller than 2 mm, they are the most essential hyperlink inside the aquatic food web. They consume algae, protists, insect larvae such as mosquitoes (Chao and Martin, 2000). They predate on tiny organisms and eat early larval fish e.g. carp (Chao and Martin, 2000). Micro communities in freshwater streams and ponds are a numerous groups that consist of prokaryotes, eukaryotic, fungi, invertebrates etc. Darnell, (1961). They are heterotrophic and are important sources of energy and vitamins to carnivorous invertebrates and some vertebrates (Darnell, 1961). Micro-invertebrates have divided into numerous groups, having ecological importance in any aquatic ecosystem. They consist of insects, crustaceans, annelids, molluscs, leeches and so forth. Abunance of micro-invertebrates and water quality have interrelation with each other, as macro-invertebrates are consider as indicator of water quality (Suren, 1990). Freshwater micro fauna is a vital component in freshwater toxicology and for health of the benthos (Bachiller and Fernandes, 2011).

The moving freshwater biotope allows the survival and reproduction of existence forms capable of dwelling in a balanced region and others connected to the bottom. Aquatic areas are represented by using zooplankton (Martiny *et al.*, 2006). Smith *et al.*, (1950) studied the difference between marine and freshwater habitats. The revealed that there is a variety of algae commonly found in these environments. There were no exclusively fresh water divisions of algae, but certain groups exhibited greater abundance and diversity within fresh waters, especially Cyanophytes, Chlorophytes and Charophytes. Within the green algae, associated greens and desmids comprised a very rich collection of species that almost exclusively occupied in fresh water. Many algal taxa have particular environmental tolerances or requirements and they were ecologically restricted and geographically widespread, Smith *et al.*, (2001). The euglenophyte is almost exclusively epizooic in aquatic invertebrates and widely distributed throughout the North America. It is an exclusive inhabitant of cold mountain streams. Even specialized taxa such as *Basicladia chelonum* (Chlorophyceae), which was restricted mainly to the shells of turtles (Smith *et al.* 2001). The vast majority of marine species are restricted to a narrow and similar environment, but most freshwater species thrive in habitats exhibiting a wide (10-fold) range of dissolved salts, high carbonates, low sodium chloride and low potassium concentrations. Certain characters of the marine biota have usually been lost during transition and ecology of fresh-water environment, such as bioluminescence, bright body coloration and distinctive bright color patterns (Bachiller and Fernandes 2011).

Morphological characters of marine biota are common, including cirri, palps, setation, protuberances and respiratory organs, but such structures are uncommon among fresh-water species. It is suggested that respiratory organs have been developed to an excessive and "unnecessary" degree among many marine forms, as well as in a few fresh-water insects and most Eubranchiopoda (Pennak, 1985). In freshwater environments, toxic algal species mostly belong to Cyanophyceae. They are a well-defined group of prokaryotic organisms, concerning about 150 genera and over 2000. The toxic species were about 40; the ability to produce toxins wich also an important taxonomic significance Manickem *et al.* (2015).

The present study was made with the aim of to identify micro invertebrates population founds in fresh water algal mats in fresh water ponds of Quetta City and Zhob District District, Balochistan

Materials and methods

Sampling was done from fresh water bodies of Zhob District District and Quetta City, Balochistan. The samples were collected in pre labeled dark glass bottles (100 mL) and brought to the laboratory in an ice box.Zooplankton collection samples were fixed and preserved before they were analyzed for counting and identification of zooplankton upto genus and/or

species. The samples were stored under conditions to prevent any deterioration i.e. placed in refrigerator and out of direct sunlight. The samples were allowed for 2 weeks as the minimal fixation periods. After fixation, the zooplankton were transferred and saved in bottles with 100 mL of preservative. The bottles of samples were tagged to include collector name, type of specimen, date of preservative and any other field information. The taxonomic identification of all samples was made by the compound microscope (Leica, Germany) at 40X and 100X magnifications.. The morphological characteristics of micr-invertebrates were noted to identify them using available literatures and keys (Datta and Subhendu, 2009). For counting of micro-invertebrates, a thin smear of algal mats was transferred on a grid slide and to count the micro-invertebrates under microscope. The micro photographs were taken using compound microscope with camera.

Results

Diversity of Zooplankton;

Table 1. Shows that there are total 8 species of zooplankton were observed in fresh water of zhob district pond and Quetta city, Balochistan Pakistan. All of the total 8 species were belongs to three orders specifically Cladocera (6 species, i.e *Cladocera Ephippia, Flavalona costata, Dunhevedia crassa, Alona bicolor, Daphnia laevis Daphnidae*) while the remaining one was belong to order Hymenostomatida (*Paramecium grohmanna*) and Crustecea (*Daphnia Pulex*) , 3 classes specifically Branchiopoda (6 species) while remaining one belongs to class Ciliates and Crustecea. The total details of the all species were given in Table 1. While Table. 2 shows the morphological characteristics of all species found during the experiment in both places like Zhob district and Quetta city Balochistan Pakistan.

Table 1. Shows the collected samples of micro invertebrates and their taxanomic classification.

S. No	Local Name	Phylum	Class	Order	Family	Genus & species
1	Water flea	Crustacea	Branchiopoda	Cladocera	Cladocera	*Cladocera Ephippia*
2	Slipper cule	Protozoa	Ciliates	Hymenostomatida	Parameciidae	*Paramecium grohmanna*
3	Water fleas	Crustecea	Crustecea	Crustecea	Daphnidae	*Daphnia Pulex*
4	N/A	Crustacean	Branchiopoda	Cladocera	Chydoridae	*Flavalona costata*
5.	N/A	Crustacean	Branchiopoda	Cladocera	Chydoridae	*Dunhevedia crassa*
6.	N/A	Crustacea	Branchiopoda	Cladocera	Chydoridae	*Alona bicolor*
7.	Water fleas	Crustacea	Branchiopoda	Cladocera	Daphniidae	*Daphnia laevis*
8.	Water fleas	Crustacea	Branchiopoda	Cladosera	Daphnidae	*Daphnidae*

Temperature

The temperature of Zhob District in June to August 2017 was 30°C to 37°C and the temperature of Quetta in June to August 2017 was ranged from 30°C to 36°C. It was concluded that the temperature was same in ponds of both locations (Fig. 1).

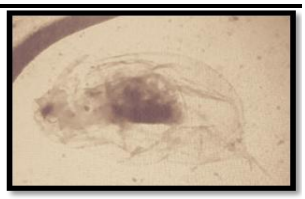
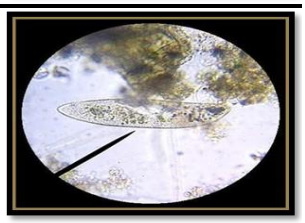
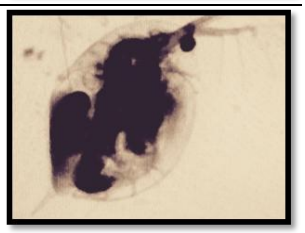
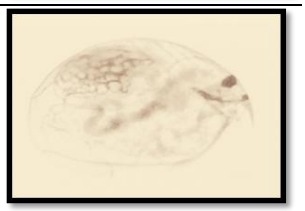
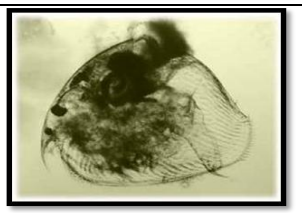
pH

In Zhob District the variation in pH values basically depended upon hydrolysis the low acids and excessive bases, so that the minimal pH 7.2 recorded with the use of the pH meter. In Quetta pH value was recorded 7-7.2. Where is the temperature and pH of both locations were recorded same. That's why cladocera species were found dominant in both locations in fresh water bodies (Fig. 1).

Species distribution and hydrographical parameters in the freshwater ponds of zhob district

The water temperature showed a close relation with distribution of micro-invertebrates (Fig.1). The pH was always neutral, except it was slightly alkaline in pond number 2, 3 and 5 of Zhob District. The maximum number of *D. ephippia* (16) was recorded at 32°C with 6.98 pH (Fig. 1A) followed by *D. lomholtz* in number (14) was recorded at 30°C with 6.98 pH (Fig. 1D). *D. laevis* were absent in pond 1 at 30°C with 7 pH (Fig. 1C).

Table 2. The morphological characteristics and their micro images of micro invertebrates.

1	*Daphnia ephippia* Morphological characteristics; A couple of anterior appendages, every with a row of faspines, which might be derived from the dorsocephalic suture between the top protect and the carapace. In maximum species (subgenera Hyalodaphnia, Daphnia and a few Ctenodaphnia) the ephippial capsule reaches ventral facet ofthe carapace, at the base of the terminal.	
2	*Paramecium grohmannae* Morphological characteristics; Elongated and rounded from one end. Free living organism. *P. grohmannae* is characterized by using a completely unique combination of functions. It is far a counterclockwise rotating freshwater *Paramecium* with body outline intermediate between “aurelia” and “bursaria” forms, contractile vacuoles, each with one excretion pore.	
3	*Daphnia pulex* Morphological characteristics; Center pectin of postabledominal claw very stout. Concave ventral head margin Small, polygonal markings on rostrum Marginal denticles extending much less than half of the duration of the postbdomen Incised anterior margin of the top	
4	*Flavalona costata* Morphological characteristics; Not often two linked head pores and slit-shaped, rarely rounded lateral head pores. PosTabledomen as an alternative long, distally narrowed, with robust marginal denticles and weakly advanced lateral fascicles of setules.	
5	*Dunhevedia crassa* Morphological characteristics; Recorded 1 species crassa that's characterised with the aid of bifid labrum posterior ventro function is triangular shape. Rostrum short and straight post abdominal claws with one basal spine	
6	*Alona bicolor* Morphological characteristics; PosTabledominal claw with one basal spine Anal groove of postabledomen completely edged by means of companies of spinules. The center setae of the lateral fascicles are the longest inside the group. Shell colour amber with at the least the brood chamber being colorless or faintly amber.	
7	*Daphnia laevis* Morphological characteristics; All three pectens with first-class tooth.swimming hair at base of second section of three segmented ramus extends past give up of ramus. Ocelllus present, eye big, second stomach system.	
8	*Chydorus poppei* Morphological characteristics; Each caudal ramus with 5 setae Third phase from the end of the right antenna with a process that's curved and pointed. The system is shorter than the second segment from the give up of the same antenna Lateral spine on the second one exopod proper fifth leg placed close to the end of the phase and is longer than the section	

This was not the favourable condition for this species. The less number of *D.lumholtz* (1) was recorded at 30°C with 7pH (Fig. 1D).

Species distribution and hydrographical parameters in the freshwater ponds of quetta city

The variation in water temperature according to distribution of micro-invertebrates is mentioned in Fig. 2. The pH was neutral and same as in Zhob District ponds, except it was slightly alkaline in pond number 2, 3 and 5 of Quetta City.

The maximum number *D. pulex* of (11) was recorded at 34°C with 7 pH (Fig. 2B). The less number of *D. lumholtz* (1) was recorded at 32°C with 7.2 pH (Fig. 2D).

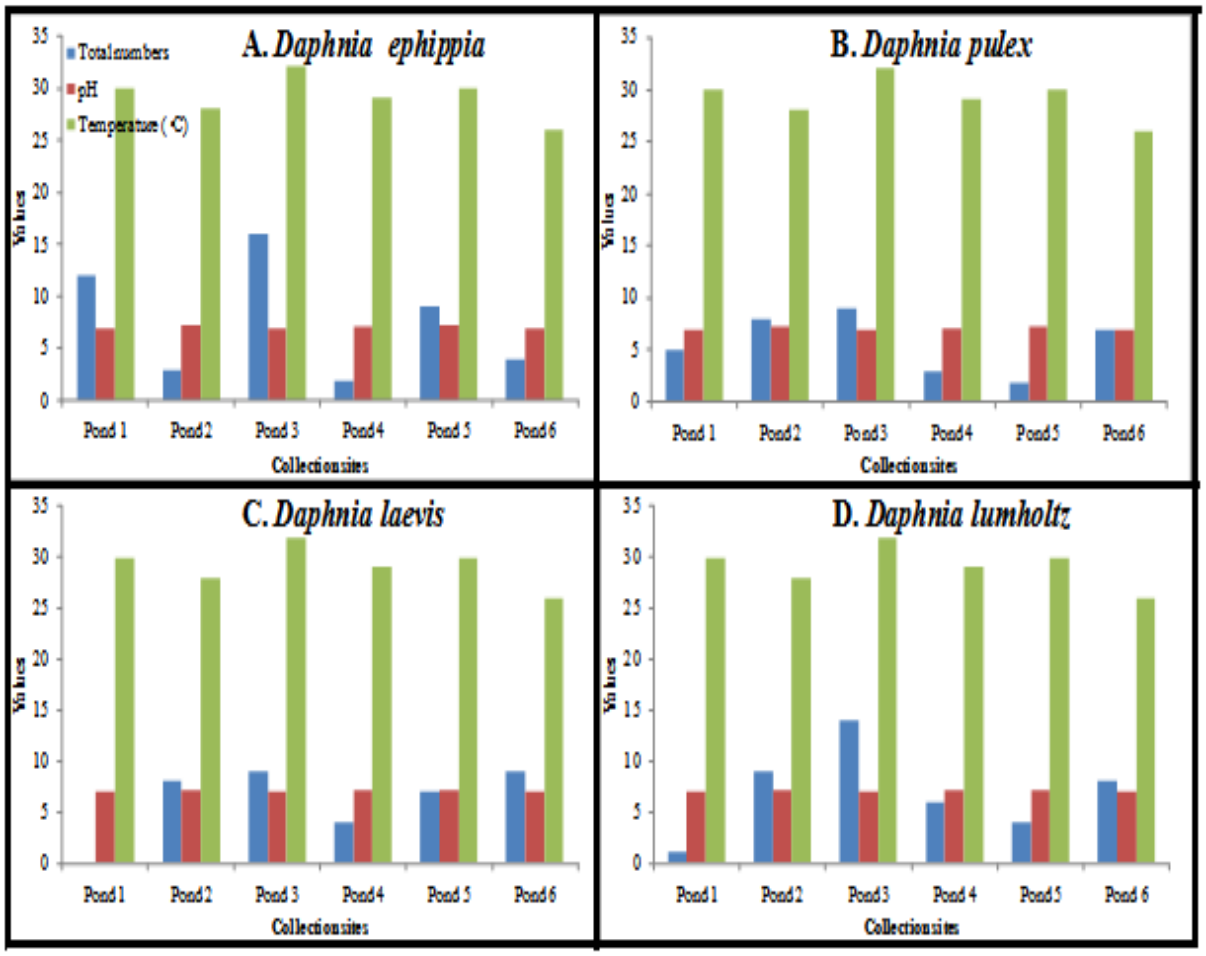


Fig. 1. The abundance and distribution of *Daphnia* spp. in relation with temperature and pH, recorded in the freshwater ponds of Zhob District.

Discussion

On this study, Investigated the distribution and abundance of invertebrates in algal mats within McMurdo Ice Shelf melt pools differing in water chemistry (Mcinnes and Ellis-Evans, 1990). The results from the present study revealed that the freshwater bodies of Zhob District (881 total species) were enrich in nutrients, oxygen, had suitable temperature and good health of ecosystem to support the micro-fauna comared with Quetta City (607 total species).

The previous studies showed that the organic matter is one of the essential resources of power for benthic species in shallow-water habitats. Benthic invertebrates are expected to procedure 20–73% of riparian leaf-muddle inputs to headwater streams. Second, benthic invertebrates begin clear vitamins into answer by way of their feeding sports, excretion, and burrowing into sediments. Bacteria, fungi, algae,

and aquatic angiosperms can quick take up those dissolved nutrients, accelerating microbial and plant increase (Covich *et al.*, 1999).

This expanded increase of benthic microbes, algae, and rooted macrophytes is consumed by means of herbivorous and omnivorous benthic invertebrates (Cronin 1998). Third, many benthic invertebrates are predators that influence the numbers, places, and sizes in their prey (Crowl and Covich, 1999). Fourth, benthic invertebrates provide food for both aquatic and terrestrial vertebrate customers (fishes, turtles, and birds). Sooner or later, benthic organisms accelerate nutrient switch to overlying open waters of lakes in addition to adjacent riparian zones of streams (Wehr and sheath, 2003). The volume of knowledge of the outcomes of benthic organisms on freshwater procedures varies with the form of freshwater bodies (i.e., streams, lakes, and wetlands). For example, a whole lot greater is understood about how benthic species of aquatic bugs and other clients affect detritus processing in streams than about how they accomplish that in lakes or wetlands (Piasecki *et al.*, 2004).

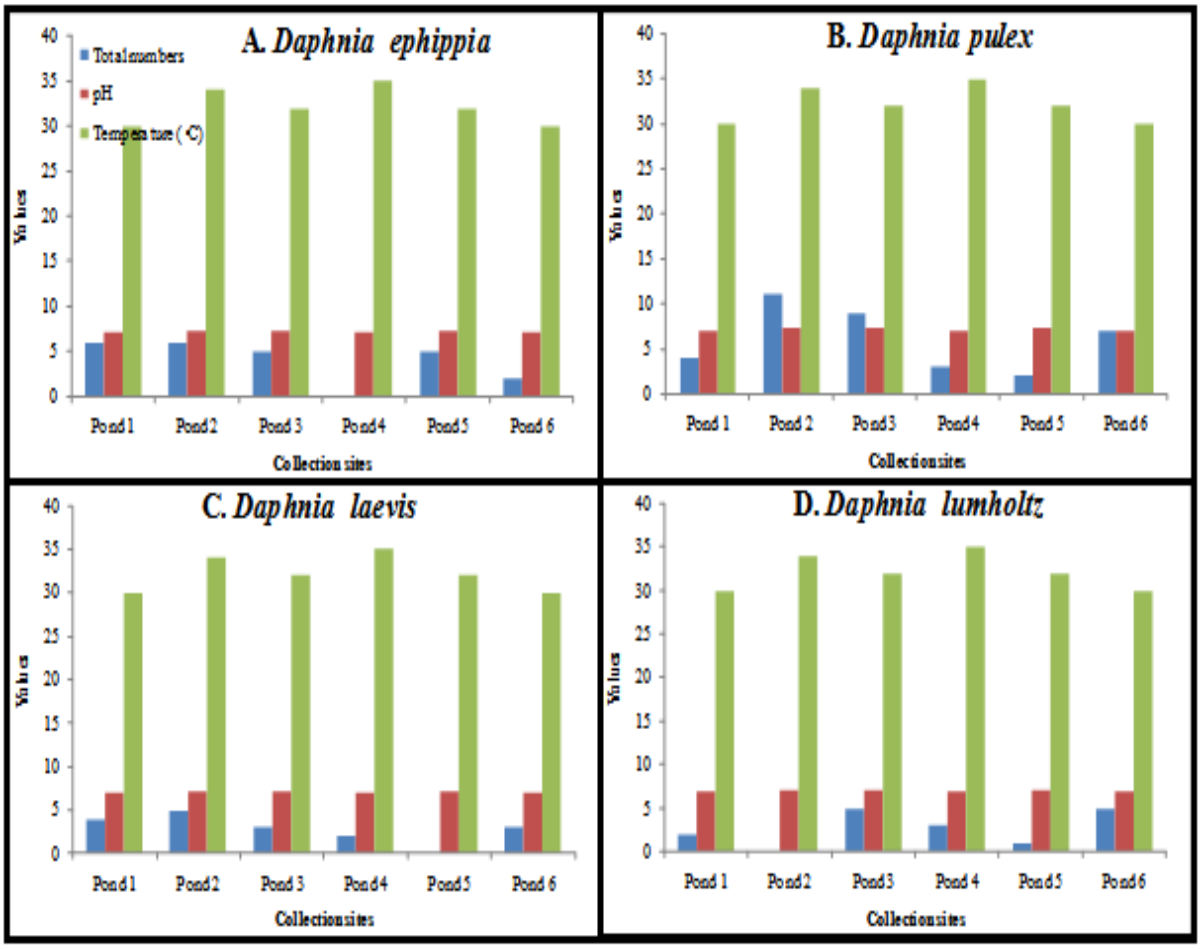


Fig. 2. The abundance and distribution of *Daphnia* spp. in relation with temperature and pH, recorded in the freshwater ponds of Quetta City.

Species-precise linkages are acknowledged to algal explosion and productivity (Radzikowski *et al.*, 2016), and discipline experiments are beginning to expose that benthic macro-invertebrates have species vital roles in processing natural matter. Each shrimp are detritivores, they do not replacement completely for each other in leaf-detrital processing and nutrient biking. In stream reaches where in each of those shrimp species co-arise (Covich *et al.*, 1996). Aquatic microfauna are an incredibly crucial link within the aquatic food web, serving both as purchasers of algae, micro-organism, other microorganisms, plus larval

macro-invertebrates and barbecue and as prey for larger animals inclusive of macro-invertebrates, small fish species and the juvenile ranges of larger species, and lots of water birds (Covich and Crowl, 1999).
In streams, bio-tracking can be performed by the use of benthic micro-invertebrates and fish (Voshell, *et al.*, 1997). In streams, bio-monitoring can be achieved using benthic micro-invertebrates and fish however benthic micro invertebrates are typically the institution of preference (Voshell, *et al.*, 1997).

Conclusion

It was concluded from the study that parameters like water quality, temperature and pH have impact on the density and diversity of micro-invertebrates. The micro-invertebrates occur in all kinds of aquatic environment and play a key role in environmental pyramids. The study area of Quetta and Zhob District had diversity in aquatic micro fauna. Furthermore, a comprehensive study is recommended for identifying the aquatic micro fauna of the study area.

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