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Short Communication

Taxonomic survey of crustacean zooplankton in Wular Lake of Kashmir Himalaya

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Taxonomic survey of the crustacean community was conducted at five study sites in Wular Lake. Plankton samples were collected on monthly basis from September 2010 to August 2011 and identified in the laboratory under different magnifications using the Olympus microscope. Of the 42 taxa identified, 23 were Cladocera, 16 were Copepoda and only three were Ostracoda. Among the Copepoda, one taxa namely Cyclops latipes seems to be a new addition which was previously unreported in Kashmir. Cladocera dominated Copepoda followed by Ostracoda in the community throughout the study. However, the species more frequently found in the samples were *Chydorus sphaericus*, *Alona affinis*, *Bryocamptus minutus* and *Cyclops bicolor*. As per the species composition of crustaceans, Lake Wular is still enjoying the infancy stage of eutrophication.

Key words: Taxonomy, Cladocera, Copepoda, distribution, trophic status, Kashmir.

INTRODUCTION

The zooplankton is a major component of freshwater ecosystems (Gannon and Stemberger, 1978; Sladecek, 1983; Huys and Boxshall, 1991; Devi and Ramanibai, 2012) and as such assumes significant importance. The crustacean zooplankton plays a pivotal role in aquatic food chains, which is an important food item of fishes (Patalas, 1972). They are able to consume great quantities of phytoplankton from the open water zone, thereby influencing the primary production (Tonno et al., 2003). In addition, these planktonic organisms act as bioindicators of the aquatic systems (Gannon and Stemberger, 1978; Bays and Crisman, 1983; Stemberg and Lazorchack, 1994; Attayde and Bozelli, 1998; Pinto-Coelho et al., 2005; Burns and Galbraith, 2007; Davies et al., 2008; Shah and Pandit, 2013). Besides, they also help in improving water quality by grazing on phytoplankton and bacteria (Kumar et al., 2009).

Though the taxonomical composition of the crustacean communities of the lakes of Kashmir has been assessed several times in the last four decades, a thorough taxonomic categorization of the crustacean of the Wular Lake, a rural lake, designated a Ramsar Site of International Importance in Kashmir Himalaya, is yet to be achieved. Therefore, the objective of this work was to have a taxonomic assessment of the crustacean assemblages of Lake Wular.

MATERIALS AND METHODS

Study area

Geographically the lake is situated at an altitude of 1,580 m (a.m.s.l) between 34°16´-34°20´N latitudes and 74°33´-74°44´E longitudes. Wular Lake, an ox-bow type lake, is of fluviatile origin located in the North-West of Kashmir about 55 km from Srinagar City, formed by the meandering of River Jhelum, which is the main feeding channel besides other tributaries (Figure 1). The rural valley lake is drained in north-east by the only single outlet in the form of River Jhelum and plays a significant role in the hydrographical system of the Kashmir valley the by acting as a huge absorption basin for the annual flood waters.

The lake accounting for 60% of the fish production within the state of J&K and was included in 1986 as a wetland of national importance under the wetlands programme of the Ministry of environment and forests, Government of India. Subsequently in 1990 it was designated as a Wetland of International importance

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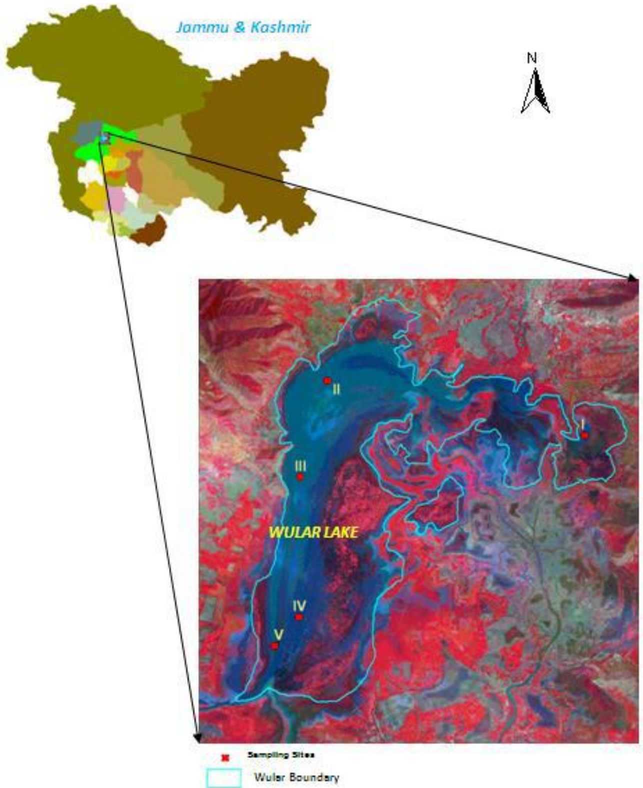

Figure 1. Five sampling sites in Wular Lake.

under the Ramsar Convention for management purposes. Catchment of the lake is comprised of slopping hills of the Zanaskar ranges of the western Himalaya on the north eastern side and arable land around is used for agriculture purposes.

Sample collection and analysis

Crustacean samples for taxonomic analysis were collected on monthly basis at five study sites (Table 1). Hundred liters of subsurface lake water was filtered through Birge conical crustacean net having a mesh size of 75 µm. Preservation of the samples was carried out in 4% formalin to which four to five drops of glycerine and 5% sucrose were added. Various micro needles were used for dissecting the taxonomic parts (such as caudal ramous, 4^{th}, 5^{th} leg for copepods and the setae arrangement in the post abdominal claw for cladocerans). Identification of the crustaceans was done with the help of standard works of Pennak (1978), Battish (1992) and Edmondson (1992).

RESULTS AND DISCUSSION

During the entire study, a total of 42 taxa were reported, of which 22 species belonged to the order Cladocera represented by six families (Chydoridae, Daphniidae, Sididae, Bosminidae, Moinidae and Macrothricidae), 17 belonged to subclass Copepoda represented by three orders (Cyclopoida, Calanoida and Harpacticoida) and only three representative taxa comprised of order the Podocopida of class Ostracoda (Table 2). Among the Cladoceran, Chydoridae was the dominant family represented by four genera and nine species. Copepoda was dominated by the family Cyclopidae and was represented by six genera and thirteen species. Increase in number of *Cyclopoida* species over *Calanoida* effectively favours eutrophication (Patalas, 1972; Gannon and Stemberger, 1978; Straile and Geller, 1998; Anneville et al., 2007). However, Sendacz and Kubo (1984) associated the absence of Calanoida copepods to eutrophic conditions in reservoirs of São Paulo State. Ostracoda represented by family Cyprididae was composed of two genera (Eucypris and Cypris).

The most dominant species reported from the entire lake were *Chydorus sphaericus, Alona affinis, Macrothrix rosea* among Cladocera, while species like *Bryocamptus minutus, Cyclops bicolor, Bryocamptus nivalis* and *Diaptomus virginiensis* were dominant representatives of Copepoda. Majority of the species exhibited wide occurrence throughout the lake while others showed a limited temporal and spatial distribution. Nevertheless, the number of crustacean species varied little between various selected biotopes.

Rich diversity and abundance of crustaceans in the lake is due to shallow nature of the lake associated with macrophytes that play an important role in the structure and dynamics of the microcrustacean assemblages (Scheffer et al., 2006), as macrophytes provides shelter and protection to these microscopic organisms against predators such as fish and macroinvertebrates (Scheffer, 1998), reduce predation and disturbances in the system (Cardinale et al., 1998), and favor an increase in the number of species due to high niche availability (Fahd et al., 2000; Cottenie et al., 2001; Cottenie and De Meester, 2003).

A characteristic seasonal pattern of species was observed that depends on the local conditions, environmental characteristics and quality of temporary aquatic systems in and around the aquatic systems throughout the study period (Williams, 1999; Fahd et al., 2000; Tavernini et al., 2008). Among Cladocerans genus Bosmina was eurythermal (having wide tolerance range to temperature) and as such showed different seasonal pattern in terms of population density. One of its species, *Bosmina longirostris* was abundant in winter, while the other species, *Bosmina coregoni*, was seen in summer. This replacement process may also be attributed to high-food availability dominated by large food particles as it is a summer plankton of eutrophic lakes (Gulati et al., 1991). Dominance of Chydoridae among cladocerans represent eutrophic condition of the lake (Gannon and Stemberger, 1978; Magadza, 1980). Further, dominance of small sized cladocerans over large bodied Cladocera is a clear sign of accelerated eutrophication (Pandit, 1980; Bays and Crisman, 1983; Sampaio et al., 2002). During the entire study, the low population density of large sized cladocerans like *Daphnia* sp., *Moinodaphnia* sp. and *Diaphanosoma* sp. were registered and may be ascribed to a shift mechanism for large bodied to smaller bodied organisms as a result of racing eutrophication (Pandit, 1980; Kaul and Pandit, 1982; Pandit, 1988;

Table 1. Location of five study sites in Wular Lake.

Site	Latitude (N)	Longitude (E)	Distinguishing feature
I	34°21´ 51	74°39´42	Anthropogenic pressures
II	34°24´ 15	74°32 ´35	Good macrophytic growth
III	34°21´ 29	74°31´ 48	Profuse growth of macrophytes
IV	34°17´43	74°31´30	Centre of lake basin
V	34°17´ 16	74°30 ´25	Near outlet of the lake

Table 2. Classification of Crustacean.

Class/ Subclass	Order	Family	Genus	Species
Branchiopoda	Cladocera	Chydoridae	Alona	*affinis, costata, guttata, rectangula*
			Alonella	*dentifera, exigua*
			Camptocercus	*rectirostris*
			Chydorus	*sphaericus, ovalis*
		Daphnidae	Daphnia	*laevis, magna, pulex, retrocurva*
			Ceriodaphnia	*Quadrangular*
			Moinodaphnia	sp.
		Sididae	Diaphanosoma	*brachyurum*
			Sida	*crystallina*
		Bosminidae	Bosmina	*coregoni, longirostris*
		Moinidae	Moina	*affinis, brachiata*
		Macrothricidae	Macrothrix	*rosea*
Maxillopoda/ Copepoda	Cyclopoida	Cyclopidae	Cyclops	*scutifer, vernalis, panamensis, bicolor, latipes, bisetosus, bicuspidatus, vicinus*
			Eucyclops	*agilis*
			Megacyclops	*viridis*
			Macrocyclops	*fuscus*
			Paracyclops	*affinis*
			Acanthocyclops	*bicuspidatus*
	Calanoida	Canthocamptidae	Bryocamptus	*minutus, nivalis*
	Harpacticoida	Diaptomidae	Diaptomus	*virginiensis,* sp.
Ostracoda	Podocopida	Cyprididae	Eucypris	*hystrix*
			Cypris	sp.
			Cyclocypris	sp.

Kingdom, Animalia; Phylum, Arthropoda; Subphylum, Crustacea.

Sampaio et al., 2002).

Copepoda, in the present study showed long growth patterns, it may be due to high food availability in the form of phytoplankton (Santer and Lampert, 1995), besides temperature (Marcus, 1982) that modulates egg development (Dole-Olivier et al., 2000). As per literature available (Zago, 1976; Crisman, 1978; Frey, 1980; Pandit, 1980., Crisman et al., 1992; Haberman, 1998; Rossa et al., 2001) among the 42 species listed during the present study 14 species (*Alona guttata*, *Bosmina coregoni*, *Bosmina* longirostris, *Chydorus ovalis*, *Chydorus* sphaericus, *Ceriodaphnia, Moina, Daphnia, Diaphanosoma, Macrothrix rosea, Cyclops vernalis, Eucyclops agilis* and *Cyclops bicuspidatus*) prefer eutrophic lake water conditions, while only five species (*Sida crystallina, Cyclops scutifer, Eucyclops* sp., *Megacyclops* sp. and *Diaptomus* sp.) prefer oligotrophic conditions. The remaining species can thus be categorized as eurytrophic exhibiting wide ecological amplitude and tolerating a wide range of salt concentration.

Therefore, the dominance of eutrophic (14) and eurytrophic (23) over oligotrophic (5) species is an indication that the lake is still enjoying the infancy stage of eutrophication (E/O=7.4) as per Jarnefelts Plankton Quotient System (Jarnrnefelt, 1956, c.f. Pandit, 2002).

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