

POPULATION DYNAMICS AND ECOLOGY OF FRESHWATER GASTROPODS IN MANCHAR LAKE SINDH, PAKISTAN

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ABSTRACT

The present study is first of its kind that deals with freshwater gastropod populations at Manchar Lake from six selected sampling stations. Gastropods were collected from August 2011 - July 2012. A total of ten species were recorded, these included *Bellamya bengalensis*, *Bellamya naticoides*, *Thiara tuberculata*, *Lymnaea acuminata chlamys*, *Lymnaea acuminata rufescens*, *Lymnaea acuminata patula*, *Physa acuta*, *Gabia arcuata*, *Planorbis exustus* and *Gyraulus euphraticus*. Gastropod population was higher in summer while low population was evident in winter. Various physico-chemical parameters were measured during that period. Minimum average temperature (17.8 °C) was recorded in February, while maximum (34.0°C) in June. Minimum DO was (2.5 mg/l) seen in June, while maximum (7.0 mg/l) in February. Minimum and maximum salinity was (2.2 - 5.9 ppt) in August and June, respectively. The TDS ranged from 2101.7 mg/l to 6529.3 mg/l in January and June, respectively. Lowest transparency was (61cm) observed in August, while maximum (124.5cm) in March. Minimum pH (7.6) was recorded in September, while maximum (8.5) in March. Electrical Conductivity ranged from 4.1 mS/cm to 10.1 mS/cm in January and June, respectively. The total hardness was minimum (854mg/l) in September while maximum (1446mg/l) in July. The gastropod population showed a positive correlation with the temperature, TDS, electric conductivity, hardness and salinity. On the other hand pH, transparency and DO showed a negative correlation with population density.

Key words: gastropod, occurrence, ecology, Manchar Lake.

INTRODUCTION

Manchar Lake is the largest shallow floodplain freshwater lake of Asia. It is located at a distance of about 18 Km from Sehwan city of Jamshoro district. The area of the lake varies with the seasons from as little as 200 Km² to 360 Km² during flood. The lake is saucer shaped flanked by Khirthar Mountain at the west, Lakki hills in south, Indus River in the east and on the north and north eastern runs protective embankments. The physico-chemical parameters are very important to understand any kind of aquatic ecosystem.

Freshwater molluscs have been known to play significant roles in the public and veterinary health and thus need to be scientifically exploring more extensively (Supian & Ikhwanuddin, 2002). About 100 species of freshwater gastropods are reported to act as intermediate hosts for the diagnostic trematode parasites and among Prosobranchs, members of the family Pilidae and Thiariidae were recorded to harbor larval trematodes (Subba-Rao, 1993).

In Pakistan occurrence of mollusks (Pelecypod) has been done by Khan and Dastagir (1972). Tirmizi (1973) gave the taxonomic account of the freshwater mollusks of Pakistan in her unpublished thesis. Khattoon and Ali (1978) also worked on mollusk and described

Lymnaea rufescens as separate species instead of a form (variety) of *Lymnaea acuminata*. Burdi *et al.*, (2008) reported the ecological studies on freshwater Gastropods (snails) of Indus River near Kotri Barrage, Sindh, Pakistan. No work has been done on Mollusks of Manchar Lake.

Freshwater gastropods are bioindicators and play a vital role in purifying water bodies since they are saprophytic. Some gastropods are of great importance for being intermediate hosts of infectious trematodes and other parasites of animals and human beings (Brown, 1994). They feed on algae, zooplankton and organic wastes and provide food for many types of fish, birds and human beings. Dillon (2000) described that distribution of freshwater gastropods depends on their abilities to colonize a habitat and survive there. Survival of gastropods is regulated by various physico-chemical factors that play major role to determine the ecological traits associated with a particular species. Various physico-chemical parameters of water bodies, pollution, diseases and vegetation are among the significant aspects influencing the distribution and abundance of gastropods. According to Russel-Hunter and Eversole (1976) calcium salts in both food and water are important for growth of gastropods.

The aim of present study was to describe the distribution, ecology, population dynamics and seasonal

variation of freshwater gastropods in Manchar Lake district Jamshoro, Sindh, Pakistan.

MATERIALS AND METHODS

Physico-chemical parameters: physico-chemical parameters were carried out at monthly intervals. Water temperature, Electrical conductivity and Total Dissolved Solids (TDS) were measured by using digital meter (Cond 330i wtw, Germany). Whereas dissolved oxygen and pH were determined by (pH/oxi 340i wtw, Germany). Water transparency was measured using secchi disk while hardness was determined by titration method in laboratory by EDTA (APHA, 1992).

Collection and Identification of Gastropods: A total of 2885 gastropods were collected from August 2011 to July 2012. Sampling sites were selected based on their distribution, extent of shoal habitat with depth less than one meter, and accessibility. Specific sampling localities were recorded by latitude and longitude using a hand held Global Positioning System (GPS, Garmin etrex H, USA). Gastropods were collected by sight and touch (Crail *et al.*, 2011). In order to compare the gastropods diversity with the rest of the lake, six stations were selected. Specimens were collected by hand picking from the dry areas and where water was shallow scoop net was used. All samples were transported to laboratory in large plastic bottles. The gastropods were washed, counted, photographed and identified using the keys of Preston (1915) and Brown & Kristensen (1989).

RESULTS

Physico-chemical parameters: The water chemistry did not show much difference among the sampling stations thus it is presented as an average. Minimum temperature was recorded in February (17.8 °C), while maximum in June (34.0°C). Dissolved oxygen (DO) was minimum

(2.5 mg/l) in June and maximum (7.0 mg/l) was observed in February.

Water was very transparent from January to April having maximum transparency 124.5cm in March and minimum 61cm in August. TDS was lowest (2101.7 mg/l) in January, while highest (6529.3 mg/l) in June. The Electrical Conductivity was minimum (4.07mS/cm) in January and highest (10.1 mS/cm) in June. Low pH (7.6) was seen in September while in March it was higher (8.5). The water was alkaline throughout the year. The minimum hardness (854 mg/l) was observed in September while maximum hardness (1446 mg/l) was evident in July. The salinity was lower (2.2 ppt) was observed in August while maximum salinity (5.9 ppt) was observed in June.

Population dynamics of gastropods: A total of 2885 specimens were collected from the six sampling stations of Manchar Lake. A total of seven genera including ten species of gastropods were identified (Table 1, Fig. 3). The gastropod population was dominated by Genus *Bellamya* in which *B. bengalensis* (16.8%) and *B. naticoides* (15.9%) were abundantly found at all stations. Genus *Lymnaea* was most diverse having three species including *L. acuminata chlamys* (13.0%), *L. acuminata rufescens* (12.7%), *L. acuminata patula* (8.9%) in which *L. acuminata chlamys* was dominant among three getting second position in terms of population density. *Thiara tuberculata* (14.3%) showed moderate population density and it ranked third position in dominance. The population of *Physa acuta* (6.6%), *Gabia arcuata* (5.2%), *Planorbis exustus* (4.2%) and *Gyraulus euphraticus* (2.4%) were found in very less numbers.

The gastropods population size fluctuated markedly during the study period. The gastropod population showed higher number from March to July and lower number from August to February. The peak of gastropods were noted in June and lowest number in the month of February.

Table 1. List of gastropod species and their average annual density contribution (%).

Name of Species	St.1	St.2	St.3	St.4	St.5	St.6	Mean	Stdev
<i>Bellamya bengalensis</i> (Lamarck)	20	16.3	19.7	18	17	10	16.83	3.65
<i>Bellamya naticoides</i> (Theobald)	17	15.6	18.7	16.3	12.5	15	15.85	2.08
<i>Thiara tuberculata</i> (Muller)	12	12	17	15	11.6	17.9	14.25	2.78
<i>Lymnaea acuminata chlamys</i> (Benson)	11.2	15.7	10.5	14.4	10	16.4	13.03	2.80
<i>Lymnaea acuminata rufescens</i> (Gray)	9.5	12.2	8.5	12.2	21	13	12.73	4.41
<i>Lymnaea acuminata patula</i> (Troschel)	8.2	11.3	7.5	7.3	7	11.9	8.87	2.16
<i>Physa acuta</i> (Drapanaud)	7.3	8	6.3	9	5.4	3.8	6.63	1.87
<i>Gabia arcuata</i> (Benson)	6.8	5	5.9	2.5	6	5.2	5.23	1.48
<i>Planorbis axustus</i> (Deshayes)	5.2	2.5	4.6	3.9	4	4.9	4.18	0.97
<i>Gyraulus euphraticus</i> (Mousson)	2.8	1.4	1.3	1.4	5.5	1.9	2.38	1.63

The population density of gastropod showed strong positive correlation with temperature ($R^2=0.9524$) and slight positive correlation ($R^2=0.4595$) with total hardness (Fig. 1a & 2b). A negative correlation ($R^2=0.6822$) of gastropod population with transparency was also seen (Fig. 2a). It indicated that in early monsoon the population was at highest but it declined with the highest

transparency. The pH versus density (Fig. 1 d) showed negative correlation ($R^2= 0.4562$). Salinity showed positive correlation ($R^2= 0.5643$), while strong negative correlation ($R^2= 0.8902$) was seen with DO (Figs. 2c, 2d). The coefficient of determination of electrical conductivity ($R^2= 0.6418$) and TDS ($R^2= 0.7376$) with snail population were positive (Figs. 1b, 1c).

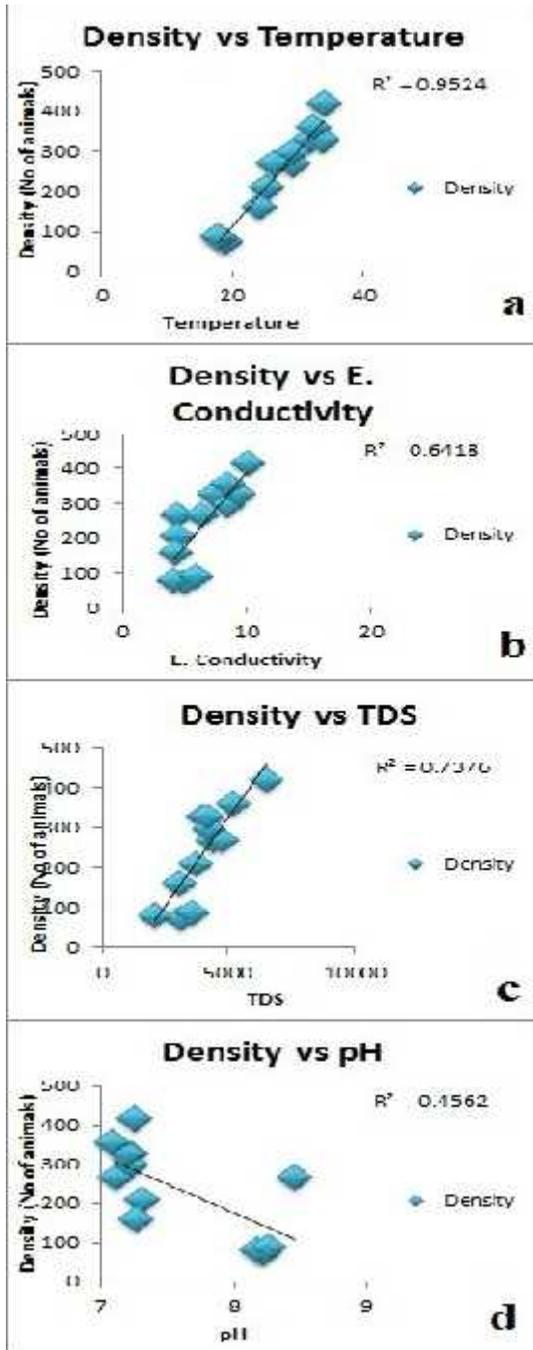


Figure 1 Relationship of gastropod density with temperature (a) conductivity (b) TDS (c) pH (d).

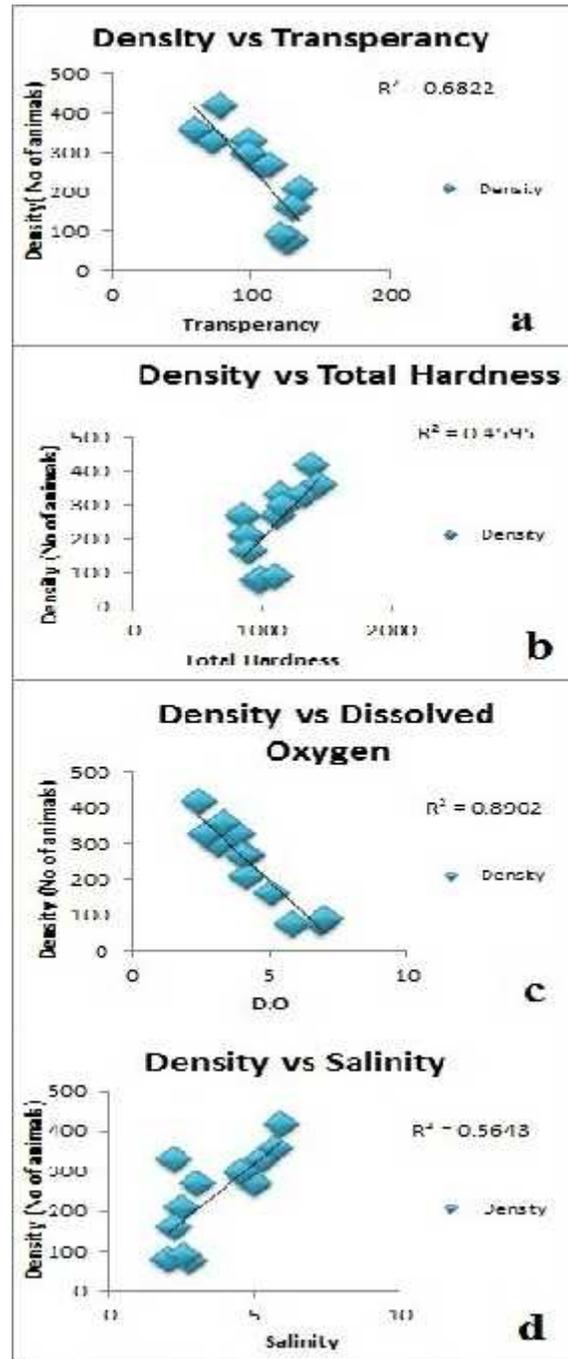


Figure 2 Relationship of gastropod density with transparency (a) total hardness (b) D.O (c) salinity (d)



Figure 3. Gastropod species occurring in Manchar Lake, Sindh, Pakistan.

DISCUSSION

Studies on freshwater mollusk fauna of Pakistan are very scarce, especially no research work has been undertaken on mollusk fauna of Manchar Lake previously. Thus our present studies mostly concentrated on species composition and ecology of gastropods. The population density of gastropods was inversely proportional to transparency, pH and DO while directly proportional to temperature, total hardness, salinity, E. conductivity and TDS.

The temperature plays a vital role in the physiology of molluscan fauna. Aziz *et al.*, (1996) also reported that the degree of interaction was higher with the rise of temperature from 20 °C to 35 °C, especially effect of 30 °C was highly significant as far as the duration of reproduction of a gastropods. According to Pennak (1953) 30 °C is the critical temperature at which mostly the species survive. The population of gastropod was higher in summer which agrees with previous studies (Nazneen *et al.*, 1994). There was a positive correlation (Fig. 2b) of gastropods with the hardness unlike Burdi *et al.*, (2008), Chatterjee *et al.*, (2008) found a negative correlation in between hardness and gastropods from running water (lotic) environment. Our studies differ because of the medium and source of water.

The great majority of molluscan species and the largest number of individuals occur under alkaline conditions (Smith, 2001). The pH of Manchar Lake ranged from 7.2-9.2 thus water was alkaline but shows negative relation with pH. In Manchar Lake mostly dead shells were found. Same ranks were also observed by Burdi *et al.*, (2008) from Indus River and its canals at Kotri barrage Sindh, Pakistan. All species of gastropods recorded have also been documented from other water bodies of Pakistan (Begum and Nazneen, 1991, 1992a, 1992b). Burdi *et al.*, (2008) from Indus River and its canals. The annual contribution of *B. bengalensis* was highest among all species (Table 1). The other prominent contributors were *B. naticoides*, *T. tuberculata*, *L. acuminata chlamys* and, *L. acuminata patula*. In Pakistan the molluscan studies have been limited to taxonomical

work only Akhtar (1978) and Khatoon and Ali (1978) have described *Lymnaea rufescens* as separate species instead of a form (variety) of *Limnaea acuminata*. However, Preston (1915) and Nazneen and Begum (1990) have described it as the form (variety) of *Lymnaea acuminata*. The *Physa* snails are cosmopolitan and have been spread through human agency around the world (Dillon *et al.*, 2002). *Physa acuta* is a “weedy” species (Dillon, 2000). *Physa* occurs in greatest abundance where there was a moderate amount of aquatic vegetation and organic debris (Smith, 2001 and Pennak, 1953). Eleutheriadis and Lazaridou-Dimitriadou, (1995b) expressed the phenomenon that freshwater snails aggregate on the filamentous algae and diatom clusters. Lodge *et al.*, (1987) concluded that at large biogeographic scales the important variables were colonization ability and water chemistry, and at local scales disturbance regimes, competition, and predation were stronger explanatory variables.

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