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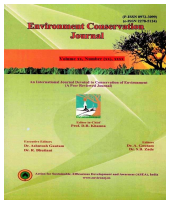

Water quality parameters and population of aquatic insect larvae in Pardi Lake, Gadchiroli District (M.S.) of India

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ABSTRACT

The present research deals with the study on some physicochemical parameters and the population of aquatic insect and insect larvae of Pardi lake, Gadchiroli which was carried out from February 2016 to January 2017. Total 10 genera of aquatic insect larvae recorded during the present piece of investigation, among which Order Diptera is represented by 07 genera and Coleoptera by 03 genera. The Dipteran species are found to be dominant in the lake. The high density of pollution indicator species like *Chironomus*, *Eristalis* and *Trichoptera larvae* indicates the polluted nature of the lake. Thus, keeping in view the importance of the study, the necessary steps should be taken for the conservation and maintenance of lake.

Introduction

India is very rich in water resources and is the second largest country in the world. Water is an elixir, blue gold, and abundant and the most precious natural resource on Earth. It is a medium of life. Water has the capacity to dissolve an extremely wide variety of substances. It is very useful to organisms and humans. Aquatic insect larvae are important aquatic fauna that contribute to the trophic structure of ecosystems and serve as a major component of the aquatic food chain. In freshwater ecosystems, aquatic macroinvertebrates are key inhabitants. Among the macroinvertebrates, the most abundant macroinvertebrates are insects (Macadam & Stockan, 2015). Many aquatic insects have both aquatic (larval and adult) and terrestrial (adult) life stages. The impact of aquatic insects is not limited to the aquatic environment alone but also affects stretches into the terrestrial riparian environment. This study aimed to determine the diversity of lake insect communities and lake water quality and to investigate the relationships between insect communities and water quality parameters.

Materials and Methods

In India, the seasonal conditions of pond life in Punjab, appears to be the first hydrobiological study. Several workers, such as Macadam and Stockan (2015**),** Fatalmoudou *et al.* (2018), and Kleber and Rhainer (2019), made noteworthy contributions to the field.

Study area (Pardi Lake, Gadchiroli):

Gadchiroli, a district headquarters of the Nagpur division of state Maharashtra, is situated at 20.09' 45"N 790' 55' 39"E in the northeastern region. The lake investigated was Pardi Lake, which has lovely sites. The lake is primarily used by inhabitants for domestic and agricultural purposes. Pardi Lake has a surface area of 3.21 hectors (9 acres) and an average depth of 10 feet and fills up after a heavy downpour in Pardi town.

Sampling sites

The sampling sites were marked by means of a weighted plastic float. Water samples were collected at monthly intervals in clean plastic containers using the standard method of collection and were subsequently transported to the laboratory for further estimations (APHA, 2005).

Sampling of aquatic insects and larvae

Aquatic insects were collected during the daytime, and the collected samples were subsequently

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transferred to individual jars containing water obtained from their habitat. Subsequently, the plants were placed in glass vials containing 90% ethyl alcohol. The vials were labeled for date and location. A stereo-typed microscope and dissecting microscope were used for observation and identification of the samples. The specimens were well preserved in the laboratory.

The results were recorded on a data sheet based on the order, family and genus. Aquatic insects were identified up to the genus level using the taxonomic keys of Yule and Yong (2004), Verma (2016), Verma (2017a), Vidotto-Magnoni and Carvalho (2009), Williams and Williams (2017).

Water sample analysis

The standard procedures of APHA (2005) were adopted for the analysis of water samples. The physico-chemical parameters, such as water temperature, pH, dissolved oxygen, free CO2, total alkalinity, phosphate (PO4)3- and nitrate (NO3-), were analyzed. The water temperature was determined by using a mercury thermometer. The pH of the water was determined using a pH meter (HANNA, Model no. -H19). In situ parameters, temperature (^{0}C), pH, and dissolved oxygen (DO) concentration (mg/l), were tested. DO, free CO_2, total alkalinity, nitrate and phosphate parameters were analyzed using the methods of APHA, AWWA and WPCF (2005). Aquatic insect larvae were randomly collected using a Surber net 0.3 m × 0.3 m in size at different sites in the lake. The samples were transferred to a plastic Zipper bag with 75% ethanol for preservation and returned to the laboratory for identification. The aquatic insect larvae were sorted and identified based on their morphology.

Results and Discussion

Pardi Lake Gadchiroli (M.S.) is a shallow mesotrophic lake that supports the larval population of aquatic insects. The morphometry of the lake is given in Table 1, and the diversity of the aquatic insect larvae population in different seasons is given in Table 2. The findings of the present investigation are described as follows:

Water temperature: Water temperature strongly fluctuates from a minimum of 16.10°C to a maximum of 23°C, and high temperatures from March onward initiate rapid decomposition of the organic matter in the substrate. Consequently, the mineral content in the lake water increased. The increase in water temperature was probably due to low flow conditions and heavy sunshine. These observations are similar to those of (Prommi & Payakka, 2015).

Table 1: Morphometry of the lake

Features	Morphometry
Shape	Slightly rectangular in shape.
Length	308 Meter
Width	158 Meter
Minimum Depth	10 Feet
Maximum Depth	15 Feet
Mean Depth	12.5 Feet
Surface Area	3.21 Hector (9 acre)
Water Volume	1, 44,000 meter^3
Type and Source of Water.	Perennial, Rain water is source,
Management status	Moderately managed, concrete dyke, fish culture practices
Political Status	MaMaTalav

pH: In the present study, pH values ranging from 7.7-8.4 were most suitable for fish production. The water at approximately pH 7 is called neutral. During daylight, aquatic plants usually remove CO_2 from water quickly, and the pH increases. At night, CO_2 accumulates, and the pH decreases. The magnitude of the daily fluctuation in pH depends on the buffering effect. pH is the most stable parameter, with small differences, and is also the most stable parameter every 3 months, with no drastic changes. These results are in agreement with those of Parveen (2010).

Dissolved oxygen (DO): During winter months, dissolved oxygen is plentiful when submerged macrophytes are luxuriant, as is dissolved oxygen during monsoon months when there is rich microplanktonic vegetation and excess oxygen is added from intensive rainfall. The minimum value of 11.09 mg/L was observed in December, and the maximum value of 27.0 mg/L was observed in February. The oxygen produced during this period often exceeds the amount of oxygen consumed by the organism. This finding conforms with the findings of Vafaei *et al*. (2007) and Turkmen and Kazanci (2013).

Free carbon dioxide (FCO_2): was detected mainly from the polluted region during the winter and monsoon months. The minimum value of 2.00 mg/L was recorded in June, and the maximum value of 14 mg/L was recorded in October. CO2, like other gases, readily exchanges with the atmosphere and is supersaturated with respect to the atmosphere. The results of this supportive study are from Tripathi *et al*. (2016), Verma (2017b and c), and Suhaila and CheSalmah (2017), Verma and Prakash (2018).

Table 2: Diversity of aquatic insect larvae in different seasons at Pardi Lake, Gadchiroli (M.S.)

Order	SN	Aquatic insect larvae population	Winter			Summer			Monsoon		
			Site A	Site B	Site D	Site A	Site B	Site D	Site A	Site B	Site D
Diptera	1	*Anopheles larvae,*	++	+	+	+++	+	-	+++	++	+
	2	*Culex larvae,*	++	++	+	+++	+	-	+++	++	+
	3	*Eristalis larvae,*	++	++	+	+++	++	+	+++	+	+
	4	*Trichoptera larvae,*	++	++	+	++	++	+	+++	+	-
	5	*Chironomus larvae,*	++	++	+	++	++	+	+++	++	+
	6	*Psychoda larvae,*	+	-	+	+	-	-	+	+	-
	7	*Dixa larvae*	+	-	+	+	+	+	++	+	+
Coleoptera	1	*Hydroporus larvae,*	+	-	-	+	+	-	+	+	+
	2	*Helichus larvae*	-	+	-	-	+	+	+	-	-
	3	*Cybister larvae*	++	+	+	+	+	++	+	+	+
	[Site-(A) Village site, Site (B) Dhobi ghat, Site (C)- Agriculture site] +++ Abundance, ++ Moderate, + Rare, - totally absent										

Table 3: Mean values of water quality parameters of the lake

Month	PHYSICO-CHEMICAL PARAMETERS						
	WT (^{0}C)	pH	DO (mg/l)	FCO_2 (mg/l)	TA (mg/l)	Phosphate (mg/l)	Nitrate (mg/l)
Feb-16	18.5	8.0	**27.0**	11.9	195	0.077	0.41
March-16	20.1	7.9	25.6	12.5	187	0.076	0.40
April-16	19.5	7.8	24.9	10.4	225	0.069	**0.42**
May-16	22.0	7.8	26.8	5.8	**260**	**0.080**	0.38
June-16	**23.0**	**7.7**	23.1	**2.0**	228	0.078	0.40
July 16	21.3	7.9	24.5	3.1	240	0.065	0.30
Aug-16	20.9	7.9	13.9	4.9	238	0.056	0.21
Sept-16	23.0	8.1	12.5	12.0	**112**	**0.026**	0.18
Oct-16	18.2	8.2	12.0	**14.0**	114	0.035	0.19
Nov-16	17.9	**8.4**	13.6	12.0	182	0.031	0.12
Dec-16	16.8	8.2	**11.9**	11.1	195	0.039	**0.11**
Jan-17	**16.1**	8.2	12.8	13.2	189	0.041	0.14

WT-Water temperature, pH, DO-Dissolve oxygen, Free CO_2, TA-Total alkalinity, Phosphate $(PO4)^{3-}$ and Nitrate (NO^{3-})

Total Alkalinity: Carbonates and bicarbonates are the major constituents of lake water, and their concentrations are expressed as total alkalinity The minerals in water from the soil, atmosphere and waste discharge provide the source of alkalinity. Similarly, the ranges observed were between 112 mg/l (September) and 260 mg/l (May) in Ganai (2010), Parveen (2010). The amount of nitrate and phosphate in the present investigation was relatively low. Moderate values of nitrate (0.11-0.42 mg/l) and phosphate (0.026-0.080 mg/l) were recorded, which are similar to the results of Tripathi (2016) and Vatandoost *et al*. (2018).

Aquatic insect larvae (order Diptera and Coleoptera) population:

Aquatic insect populations occur in diverse groups in most ecosystems. Aquatic insects play an important role in preserving the health of water bodies, and their abundance and diversity provide information about the nature of aquatic ecosystems. The present study revealed the presence of 10 genera of aquatic insect larvae (fig. 1). The order Diptera included *Anopheles larvae, Culex larvae, Eristalis larvae, Trichoptera larvae, Chironomus larvae, Psychoda larvae, and Dixa larvae*, and the order Coleoptera included *Hydroporus larvae, Helichus larvae and Cybister larvae.* Dipteran aquatic insect

larvae have been found to be dominant. The occurrence of *Eristalis larvae, Trichoptera larvae* and *Chironomus larvae* indicated the polluted nature of the lake. The odonate larva uses *Anopheles larvae* as food and controls Mosquito's population, which is responsible for the spread of epidemic illnesses such as malaria (Prakash (2017), Prommi and Payakka (2015), Saeidi and Vatandoost (2018). Aquatic insect larvae are primary bioindicators of freshwater bodies due to their different environmental tolerance levels (Parveen, *et al.,* 2010; Sharma, *et al.,* 2010). During the present investigation, Chironomus was prominently observed at the village site, where a greater amount of sewage water entered the village site, indicating heavy contamination of the effluent by Culex and Anopheles larvae.

Figure 1: Satellite image of Pardi Lake

Figure 2: Map of Gadchiroli district, Maharashtra state and India

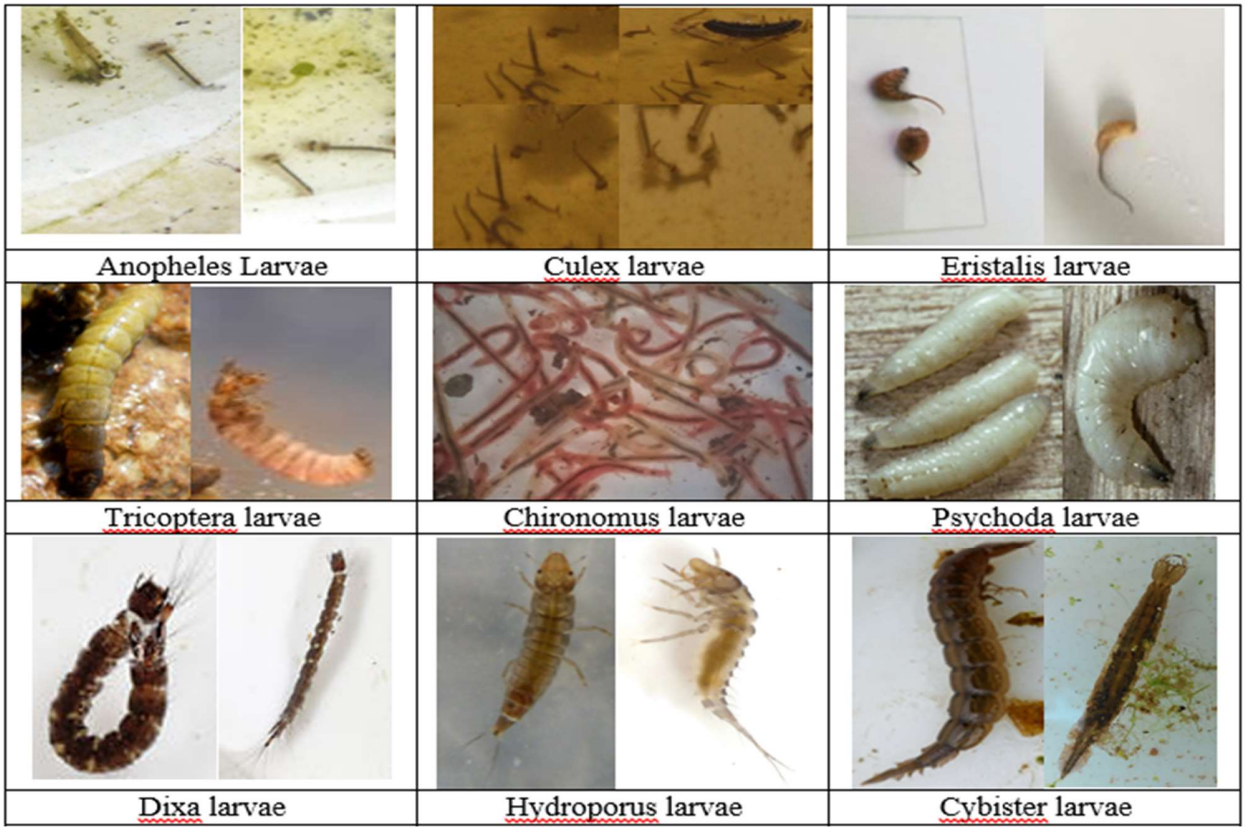

Figure 3: Aquatic insect larval population at Pardi Lake, Gadchiroli, during Feb. 2016-Jan. 2017

Water quality parameters and aquatic insects: The physico-chemical parameters did not vary widely during the entire study period. Water temperature, pH, phosphates and nitrates are very important for the growth and density of phytoplankton, on which aquatic insect larvae and some higher consumers depend.

Conclusion

The present study revealed that the physicochemical parameters studied showed little variation. Aquatic insect communities are useful as faster and less expensive tools for rapid assessment of lake water quality. Mosquitoes and a number of aquatic insect larvae are used as food for fishes and as pollution indicators. Aquatic insects are involved in nutrient recycling and are important elements of natural food web in aquatic ecosystems. In view of the above, such research could provide a better representation of aquatic insect communities. Thus, in view of the importance of this study, necessary steps should be taken for the conservation and maintenance of the lake.

Conflict of interest

The authors declare that they have no conflicts of interest.

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