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Physico - Chemical parameters and diversity of aquatic insects larvae of fresh water body of Seetadwar lake of district Shravasti (U.P.), India

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Abstract

Seetadwar lake is the historical lake situated in Shravasti district. Aquatic insects larvae is the important component of aquatic flora serve as a major component of aquatic food chain. Also it maintain proper equilibrium between biotic and abiotic components of aquatic ecosystem. The present investigation deals with the study of physico- chemical parameters and diversity of aquatic insect larvae of fresh water body of Seetadwar lake. The work was carried out for the period of one year that is January 2019 to December 2019. In the present work several physico- chemical parameters such as Temperature (16.1℃-23℃), pH (7.7-8.4), DO (11.9-27.0 ppm) , FCO_2 (2.0-14.0 ppm), Carbonate alkalinity (36-145ppm), Bicarbonate alkalinity (122-235ppm), Total alkalinity (112-260 ppm), Nitrate (0.11-0.42 ppm), Calcium (91-200 ppm), Chloride(12-75.5 ppm), Phosphate (0.026-0.080 ppm), Total organic matter (32.0-11.8 ppm) and Total nitrogen (1.19-3.30 ppm) were recorded .

Diversity of aquatic insects larvae in fresh water body of Seetadwar lake reported that presence of 10 genera of aquatic insects larvae, namely - Order- Diptera: Anopheles larvae, Culex larvae, Eristalis larvae, Ptychoptera larvae, Chironomus larvae, Psychoda larvae, Dixa larvae, Order - Coleoptera: Hydroporus larvae, Helichus larvae and Cybister larvae were identified and recorded in Seetadwar lake. In lake Dipteran aquatic insects larvae have been found to be dominant among aquatic insects larvae.

In Seetadwar lake generally present Eristalis larvae, Ptychoptera larvae and Chironomus larvae which indicate the polluted nature of the lake. Thus keeping in view the importantance of the study steps should be taken for the conservation and maintenance of the Seetadwar lake .

Keywords: Physico-chemical parameters, aquatic insects larvae, diversity and Seetadwar lake.

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Introduction

Water is an essential requirement for all kinds of life and the most abundant on the planet Earth and among the best solvents and unique in many physico-chemical ways. It is medium of life. Every cell contains some water and all life process reactions take place in water medium. Food and nutrients move from cell to cell through this medium. Water is also the raw material in the manufacture of carbohydrates through photosynthesis in green plants.

Animals are dependent on the food prepared in the body of green plants. Two things immediately become clear, first: that water is very abundant and second: that is the very basis of that is elixir in the real sense. Because of its capacity of dissolve an extremely wide variety of substances it is both very useful in making solutes available to cellular organelles for biosynthetic activities and harmful in getting readily polluted by dissolving harmful substances toxic to organisms and man.

Water like air has been one of the major environmental components. It is an indispensable and the most precious natural resource on this planet, as prime necessity of life and natural water bodies are of great importance to mankind.

India is very rich in water resources and stands second in the world. Its inland water resources occupy and area of about 1.37 million hectares.The inland water resources are scattered in the form of river, dams, lakes, ponds, stream and other freshwater bodies. According to directory of Indian wetlands (MoEF, Gol) 1990, India is having 2,167 natural and 65,253 manmade wetlands occupying 14, 58,580 hectares and 25, 87,965 hectares of land respectively. Moreover the association of man and wetland in Prehistoric, India also represent a rich variety of Inland and coastal wetland habitat. In Uttar Pradesh is having 125 natural and 28 manmade wetlands occupying 12,832 hectares and 2,12,470 hectares of wetlands respectively.

The available literature pertaining to the hydrobiological conditions of inland water has revealed that it was F.A. Forel (1892-1904) Swedish professor whose researches laid down the foundation of hydrobiology.

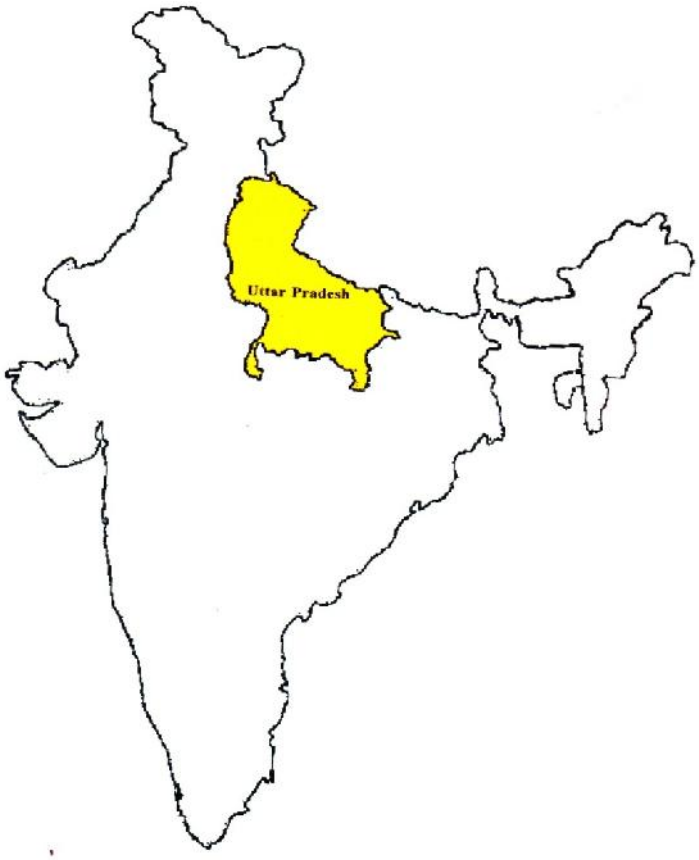
In India, the observation of Prasad (1916), on the seasonal conditions governing the pond life in Punjab, appears to be the first hydrobiological study. Since then such studies have progressed in different parts of the country and several notable contribution have been made so far. Since them such studies progressed and noteworthy contribution were made by several workers like Atkins (1932), Singh (1955), Srivastava (1956), Trivedi (1986), Kumar and Asija (2002) and Ismail and Dorgham (2003) .

All over the world about 45000 species of insects are known to inhabit diverse freshwater ecosystem (Balram, 2005). Aquatic insect constitute an important part of the aquatic ecosystem. These are involved in nutrient recycling and form an important element of natural food web in aquatic ecosystem. Some are of medical importance as they help in biological control of Mosquitoes and a number of aquatic insect larvae are used as food for fishes and as pollution indicator . They are primary bio-indicator of fresh water bodies such as ponds, lakes, wetlands, streams and rivers due to their different environmental disturbances tolerant levels (Arimoro and Ikomi, 2008). It is estimated that about 3% of total insects are aquatics spending at least a part of their life cycle in water and these comprise about 25000 to 30000 species (Cheng , 1976). The ponds, lakes and other stagnant water are homes of two great groups of aquatic insects that is the surface hunters and divers. The odonate larva uses the Anopheles larva as food and control the Mosquito's population , which itself are responsible for spreading of the epidemic illness like malaria (Mitra, 2000) .Information is also available on aquatic entomofauna studied by Tonapi (1980), Vijay Kumar and Ramesh (2002), Thakur (2003), Andrew et.al. (2008) etc. The present research paper deals with the study of Physico-chemical parameters and diversity of aquatic insects larvae of fresh water body of Seetadwar lake.

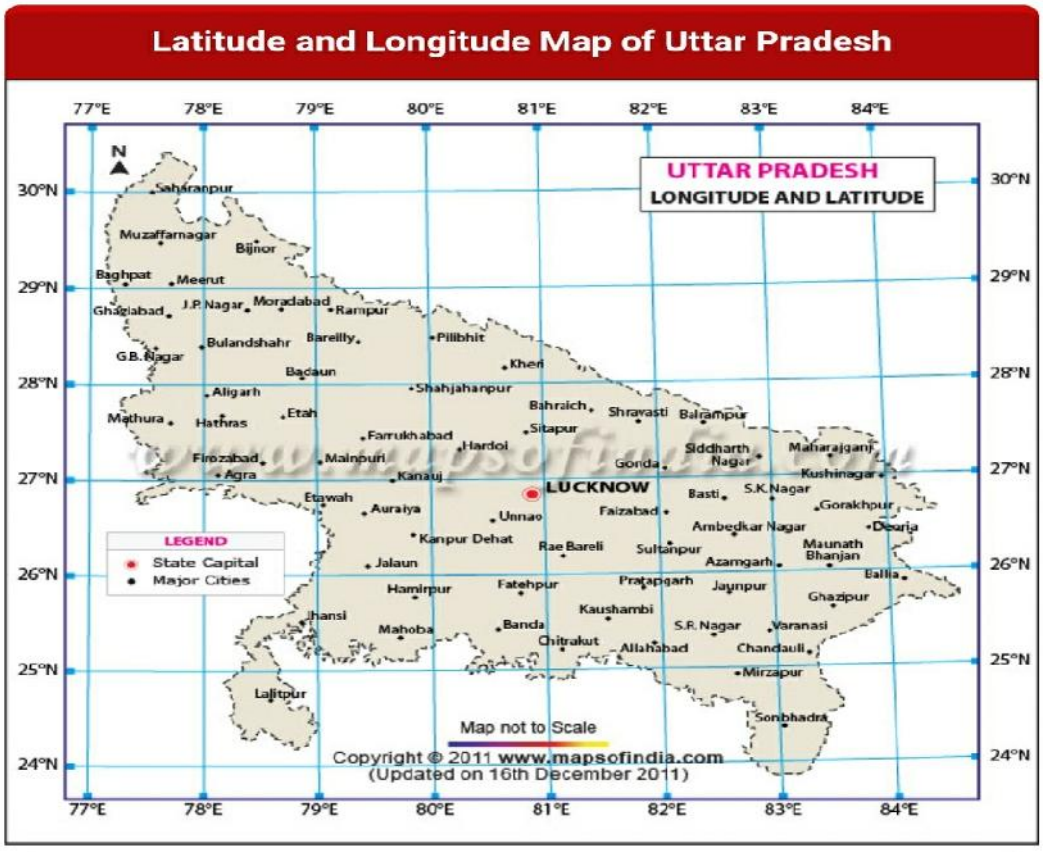
Materials and Methods

A : Location of study area :

The latitude of district Shravasti Uttar Pradesh India is 27.505379 and longitude is 82.035988. Shravasti is a part of historic Avadh was carved out from Gonda district to the south and Bahraich district on the west. Shravasti also borders Balrampur to the east and Nepal's district Dang -Deukhuri to the north east and Banke district Nepal to the north west. It is the frontier district of eastern Uttar Pradesh with northern boundaries marching with Nepal for a long distance of the district. The district is traversed by a large number of annual and perennial water bodies (Map : 1, 2 & 3).



Map- 1: Location of study area in India



Map- 2 : Location of study area in Uttar Pradesh

Map-3: Location of study area in district Shravasti

Seetadwar lake is very well known from ancient period. It is regarded as historical symbol of worship by hindus. It is also important from an ethical point of view because Maa Seeta had disappeared in the core of the earth at this place that is why it is called Seetadwar. Seetadwar lake of Shravasti district is an important historical wetland of this region of eastern Uttar Pradesh and is spread about 750 acres area . It is a natural wetland situated on Balrampur - Bahraich road near Ikauna town at a distance of about 30 Km from P.G. Department of Zoology, M.L.K. P.G. College, Balrampur in the west direction.

B: Sampling and preservation :-

The present work was carried out for a period of one years from January 2019 to December 2019. A short description of material and methods applied during the present investigation has been presented below -

(a) Sampling:- The study of hydrobiological (physico-chemical and biological) condition of the water body and to assess the actual position of aquatic insects larvae diversity, the entire area of the Seetadwar lake has been taken into account. For the purpose three sampling station namely littoral, pelagic and polluted were set out, depending upon the degree of inflow and water turbidity. At a glance station littoral and pelagic were marked non polluted. The sampling stations were marked by means of a weighted plastic float.

All the sample for abiotic and biotic component (ex.- water and aquatic Insects larvae) of Seetadwar lake were collected during the second week of each month between 09.00AM to 11.00AM.They were taken from different sampling station fixed up in littoral, pelagic and polluted region and were transported to the laboratory of P.G. Department of Zoology, M.L.K. P.G. College Balrampur (U.P.) at the earlier for qualitative and quantitative estimations.

Water samples were collected in three replicates from each of the site in clean plastic containers, using standard method of collection (APHA, 2005).

(b) Preservation:- The samples collected in sample containers of polyethylene. Labels on different bottles clearly indicated the name and locations of sampling station, date and time of Sampling, station number and depth.

The samples tightly cappped containers were brought to the laboratory in an ice box and kept in freezer to check the biological activity and preserve them. The physico-chemical analysis used standard method **(APHA-AWWA, WPCF 2005).**

(C) Water sample analysis:- The procedures described by Michael (1984), Trivedi (1986) have been adopted in the analysis. The brief description of the methods employed are given here.

(a) Physical Parameters

Temperature (℃): For determination of temperature, soon after the collection of sample in the polyethylene bottle, a mercury thermometer of (0.0 - 60℃)

(b) Chemical Parameters:

pH: pHof water was determined using pH meter (HANN, Model no. -H19)

DO, FCO_2, Carbonate alkalinity, bicarbonate alkalinity, total alkalinity, nitrate, calcium, chloride, phosphate, total organic matter and total nitrogen. Rest of the parameters will be analysed using the method of Michael (1984) and **APHA, AWWA and WPCF (2005)**.

D: Aquatic Insects larvae (Order - Diptera and Coleotera) sampling :-

Aquatic Insects larvae were randomly collected using Surber net with a size of 0.3 m × 0.3 m at several microhabitat at lake. The samples transferred in to a plastic Zipper bag with 75% of ethanol as preservation and brought back to the laboratory for identification process.

The sample of aquatic insects larvae were sorted & identified based on their morphology. Samples were placed in the universal bottle with 75% ethanol.

Results and Discussion

Seetadwar lake of district Shravasti Uttar Pradesh on which ecological studies has been carried out represents a special type of habitat. It is a shallow, eutrophic lake and supports a rich aquatic insects larvae. The monthly changes of different physico-chemical and aquatic insects larvae (order-diptera and Coleoptera) condition of the lake has already been described in preceding research article. The salient features of finding of all parameters have been discussed here.

Hydrology of Seetadwar Lake: The various physico-chemical parameters of water sample of Seetadwar lake in relation to periodic changes have been described in (Table -1).

Water conditions: In aquatic habitat of Seetadwar lake discussed the environmental factors include various physico-chemical properties of water such as solubility, Temperature, pH, phosphates and nitrates are very important for growth and density of phytoplankton on which aquatic insect larvae and some higher consumer depend on their existence (Table 2).

The fluctuation of the water temperature in any aquatic habitat has little to do with the distribution of species but it does influence the physico-chemical parameters of the habitat. The high temperature from March onwards initiates rapid decomposition of the organic matter in the substrate and consequently the mineral content rises in the lake water during the following months (Table. 1).

Kumar (2002) has pointed out the pH expresses the acidity or alkalinity of water which is determined by means of hydrogen ion (H^+) and hydroxyl ion (OH-) in water. Higher concentration of H^+ ions gives lower score on the pH scale and lower concentration of H ion gives higher scores on the pH scale. Water of around pH-7 is called neutral. During daylight, aquatic plants usually remove the CO_2 from the water quickly and pH increases. At night CO_2 accumulates and pH declines. The magnitude of daily fluctuation pH depends on the buffering. In the present study pH shown in (Table.1). The water with pH values ranging 7.7-8.4 at day break is most suitable for fish production. This observation is in concurrence with those of Singh (1992) and Shukla (1996).

Further an inverse correlation was found between pH and the temperature which is contrary to the observations of Kaushik and Saksena (1999) and Parveen (2010).

The dissolved oxygen (Table. 1) in the present investigation is plentiful during winter months when submerged macrophytes were luxuriant and monsoon months, when there was rich microplanktonic vegetation and addition of excess oxygen from intensive rainfall. The oxygen production during these period exceed many a time the oxygen consumed by the organisms as have also been observed by Kumar (2002).

The free carbondioxide (Table.1) was detected mainly from the polluted region during the winter and monsoon months. Its absence from the littoral and pelagic water of the lake suggested that probably all the carbon dioxide produced during the respiration of living organisms was either utilized in photosynthesis of the autotrophs or converted in the bound forms of mono and bicarbonates a features reported by SuchiTiwari (2004).

Ganai (2010) has pointed out the amount of acid required titration the bases in a measures of alkalinity of water or it is the ability of water to neutralize of acids. The minerals, which dissolves in water from soil, atmosphere and waste discharge, provide the source of alkalinity. Carbonate and bicarbonate is the major constituent of lake water and their concentration expressed as total alkalinity. Calcareous water with alkalinity more than 50ppm is most productive. Water alkalinity less than 10ppm rarely produces large crops. Water intermediate between 10ppm - 50ppm may give useful results. In highly productive water, the alkalinity is thought to be over 1000ppm. However, the range of alkalinity as 0.00-20ppm for low production, 20-90 ppm for medium production and 90-299 ppm for high production are considered. Since in the present Seetadwar lake of district Shravasti 112-260 ppm is obtained during different month of the year January-2019 to December -2019, hence it is could classified as nutrient rich Seetadwar lake (Table.1). Similar result obtained by Parveen (2010).

A direct link was observed between chloride content and the water temperature, since both of them fluctuated identically. Further increase in the chloride content, the nitrate and phosphate contents also increased which is agreement with the findings of Tripathi (2016) has pointed out that the quantity of available nitrogen and phosphorus in any water is indicative of its productivity. The amount of nitrate and phosphate in the present Seetadwar lake is relatively small (Table.1).

The result of physico-chemical parameters of Seetadwar lake include pH value varied from 7.7 in the month of June and 8.4 in the month of November at site, temperature (°C) of water ranged from 16.1°C in the month of January and 23°C in the month of June, DO (ppm) 11.9 in the month of December to 27.0 in the month ofFebruary , FCO_2 (ppm), 2.0 in the month of June to 14.0 in the month of October , carbonate alkalinity (ppm) 36 in the month of March to 145 in the month of August , bicarbonate alkalinity (ppm) 122 in the month January to 235 in the month of July, total alkalinity (ppm) 112 in the month of September to 260 in the month of May. Nitrate (ppm) 0.11 in the month of December to 0.42 in the month of April, Calcium (ppm) 91 in the month of February to 200 in the month of July, Chloride (ppm) 12.0 in the month ofSeptember to 75.5 in the month of April, phosphate (ppm) 0.026 in the month of September to 0.080 in the month of May, total organic matter (ppm) 3.2 in the month of January to 11.8 in the month ofAugust and total nitrogen (ppm) 1.19 in the month of February to 3.30 in the month of September -2019.

Table : 1- Monthly fluctuation of physico-chemical parameters in water of Seetadwar lake of district Shravasti (U.P.), India
(Data of January 2019 to December 2019)

S.No.	Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Temperature (°C)	16.1	18.1	19.0	19.5	20.0	23.0	20.6	22.0	22.1	20.0	19.0	18.5
2	pH	8.0	8.2	8.0	7.9	7.8	7.7	7.9	7.8	8.1	8.3	8.4	8.1
3	DO (ppm)	24.3	27.0	22.0	22.4	18.0	19.0	18.0	20.0	19.0	14.2	12.0	11.9
4	FCO_2 (ppm)	-	-	-	-	-	2.0	4.0	-	13.0	14.0	12.2	11.0
5	Carbonate alkalinity (ppm)	78	42	36	55	65	110	115	145	98	80	49	48
6	Bicarbonate alkalinity (ppm)	122	168	175	180	181	230	235	213	175	185	170	168
7	Total alkalinity (ppm)	140	180	192	200	260	230	240	250	112	170	160	158
8	Nitrate (ppm)	0.18	0.22	0.31	0.42	0.32	0.28	0.21	0.17	0.13	0.16	0.12	0.11
9	Calcium(ppm)	132	91	112	118	170	190	200	165	110	111	122	121
10	Chloride(ppm)	25.5	17.0	15.0	75.5	68.0	75.0	70.0	72.0	12.0	22.0	28.0	27.0
11	Phosphate (ppm)	0.31	0.052	0.062	0.067	0.080	0.052	0.042	0.037	0.026	0.032	0.036	0.035
12	Total organic matter (ppm)	3.2	3.3	9.5	10.5	10.0	11.0	11.5	11.8	6.0	6.5	6.6	6.2
13	Total nitrogen (ppm)	1.47	1.19	1.68	2.68	2.01	1.74	2.56	2.52	3.30	2.01	1.52	1.48

Aquatic insects larvae (order- Diptera and Coleoptera) population of Seetadwar lake:

Aquatic insect plays important role to preserve the good health of water body. They are probable indicator of aquatic ecosystem and their abundance and diversity provides information about the nature of water body. In the present investigation reported that presence of 10 genera of aquatic insects larvae, namely- Order – Diptera: Anopheles larvae, Culex larvae, Eristalis larvae, Ptychoptera larvae, Chironomus larvae, Psychoda larvae and Dixa larvae, Order-Coleoptera: Hydroporus larvae, Helichus larvae & Cybister larvae were identified and recorded in Seetadwar lake water body (Table -2).

Dipteran aquatic insects larvae have been found to be dominant among aquatic insects larvae. In lake generally present Eristalis larvae, Ptychoptera larvae and Chironomus larvae which indicate the polluted nature of the lake. Similar observation was reported by Majumder et.al. (2013) reported 31 sp. from urban freshwater lake of Tripura belonging to 23 genera, 15 families, 4 orders and recordered the order - Hemiptera and Odonata are dominant order. Choudhary and Gupta (2015) studied aquatic insect community of Deepor beel Assam and reported 31 sp. belonging to 18 families of 5 orders and noticed that Hemiptera is the dominant order representing 17 sp. and 18 families. These type of findings are reported in present study. Vass et.al. (1977) also investigated red Chironomus as pollution detector in Dal lake. During present investigation Chironomus is observed at water inlet site where more amount of sewage water enter such site show water pollution, Culex larvae and Anopheles larvae noted from the small spot like holes and back water of present lake. Our result are good in agreements with Vass et.al. (1977), Khan and Ghosh (2001), Baba (2001), Nautiyal (2005) Jaiswal (2012), Majumder et.al. (2013), Choudhary and Gupta (2015).

Table-2: Aquatic insects larvae population of Seetadwar lake of district Shravasti , U.P, India (Data of January 2019 to December 2019)

S.No.	Aquatic Insects Genera	Months											
		Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
	Order -Diptera												
1	Anopheles larvae	-	-	++	+++	++++	++++	++	+++	++	+	+	-
2	Culex larvae	-	-	++	+++	++++	++++	++	+++	++	++	+	-
3	Eristalis larvae	-	-	++++	+++	+++	++++	++	++	++	+	-	-
4	Ptychoptera larvae	-	-	++++	+++	+++	+++	+++	++	++	++	-	-
5	Chironomus larvae	-	-	++++	+++	+++	+++	+++	++	++	++	-	-
6	Psychoda larvae	-	-	+++	+++	+++	+++	++	++	++	++	-	-
7	Dixa larvae	-	-	++	+++	++++	++++	++	+	+	-	-	-
	Order-Coleoptera												
8	Hydroporus larvae	-	-	++	+++	+++	++++	+	+	+	-	-	-
9	Helichus larvae	-	-	++	+++	++	++++	+ +	+	+	+	-	-
10	Cybister larvae	-	+	++	+++	+++	+++	++	+	+	+	-	-

Note :-

++++ = Abundant (51-100%); +++ = Common (26-50%); ++ = Frequent (11-25%); + = Rare (0-10%)

- = Absent (Nil)

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