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Study of Water Parameters and Diversity in Larvae of Aquatic Insects at Sagra Talab of District Gonda (U.P.), India

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Abstract

Sagra talab is situated in city of district Gonda. Larvae of aquatic insect is the important component of aquatic flora serve as a major component of aquatic food chain. Also it maintain proper equilibrium between abiotic and biotic components of aquatic ecosystem. The present investigation deals with the study of water parameters and diversity in larvae of aquatic insects at Sagra talab. The work was carried out for the period of one year that is August 2019 to July 2020. In the present work several water parameters such as Temperature (15℃-21.8℃), pH (7.4-8.6), DO (12.0-28.0 ppm), FCO_2 (8.0-14.2 ppm), Carbonate alkalinity (45-144 ppm), Bicarbonate alkalinity (130-212 ppm), Total alkalinity (118-270 ppm), Nitrate (0.14-0.43 ppm), Calcium (100-184 ppm), Chloride (14-75.0 ppm), Phosphate (0.032-0.066 ppm),Total organic matter (6.5-11.6 ppm) and Total nitrogen (1.40-3.00 ppm) were recorded. According to water parameters it could classified as nutrient rich water body.

Diversity in Larvae of aquatic insects at Sagra talab reported that presence of 11 species viz . order-Diptera: Anopheles larvae, Chironomus larvae, Culex larvae, Dixa larvae, Eristalis larvae, Ptychoptera larvae, Tabanus larvae, Order - Coleoptera: Cybister larvae, Dytiscus larvae, Hydroporus larvae and Gyrinus larvae were identified and recorded in Sagra talab. In talab water larvae of dipteran aquatic insects have been found to be dominant among larvae of aquatic insects.

Generally Chironomus larvae, Eristalis larvae and Ptychoptera larvae present in Sagra talab which indicate the polluted nature of the talab. Thus keeping in view the importance of the study, steps should be taken for the conservation and maintenance of the Sagra talab.

Keywords: Water parameters, larvae of aquatic insects, diversity and Sagra talab.

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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.

Like air, water is also one of the major environmental component. 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 65,254 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 contributation 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 larvae 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). The present research paper deals with the study of water parameters and diversity in larvae of aquatic insects at Sagra talab of district Gonda (U.P.), India.

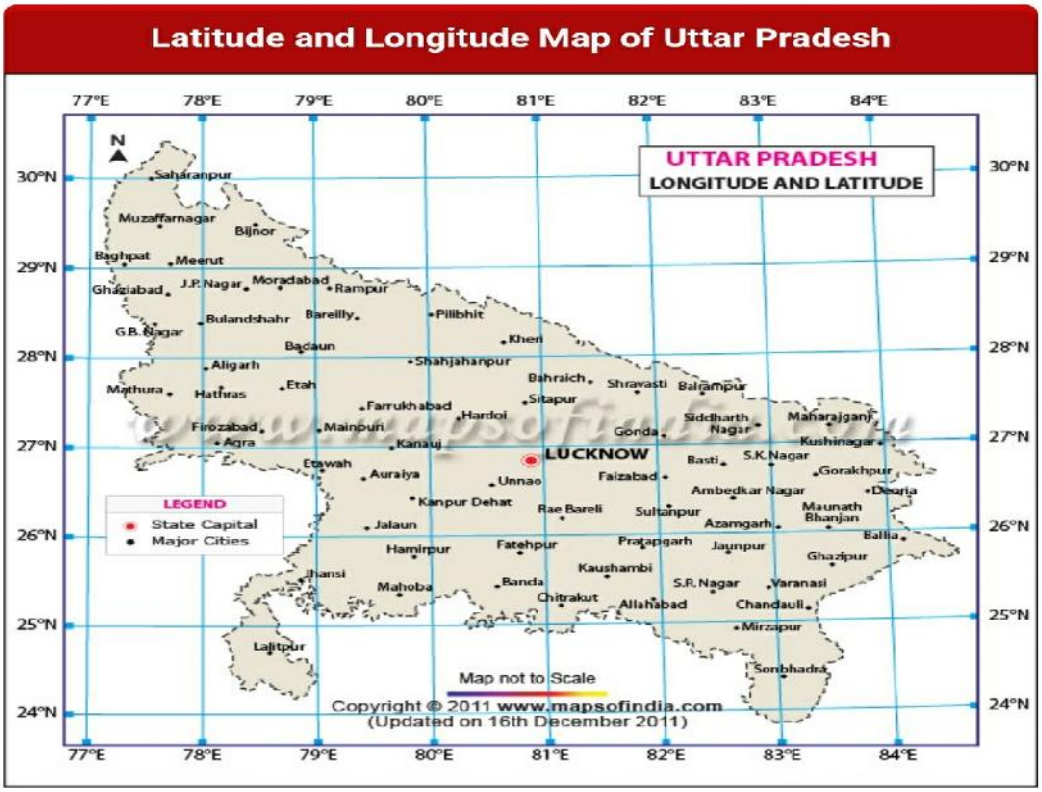
Materials and Methods

A: Location of study area:

Gonda district is located in Devipatan commissionary in Puravanchal of Uttar Pradesh state. District Basti on the eastern boundary,Bahraich district in the west, Balrampur district in the north and Faizabad district in the south. In the map of the world, the district Gonda is situated between 26'41to 27'51degrees north latitude and 81'30 to 82-06 east in the middle of the longitude. The total area of district is 4003 Sq km, which is 28.13% of area of the Devipatan commissionary (Map 1, 2 & 3).

Sagra talab is located in city at the bus station road, Jhanjhari block of district Gonda. The Sagra talab constructed by Maharaja Devi Bakash Singh's ancestor is still increasing the beauty of the city and covers and area about 12 acres (Fig.-1).

Map - 1: Location of study area in India



Map -2 : Location of study area in Uttar Pradesh

Map-3: Location of district Gonda (U.P.), India

Fig. 1 Sagra talab in city of district Gonda

B: Sampling and preservation:

The present work was carried out for a period of one years from August 2019 to July 2020. 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 larvae of aquatic insects diversity, the entire area of the Sagra talab has been taken into account. For the purpose three sampling station namely littoral, pelagic and polluted were setout, depending upon the degree of inflow and water turbidity. At a glance station littoral and pelagic were marked non polluted. The sampling station were marked by means of a weighted plastic float.

All the sample for abiotic and biotic component (ex.-water and larvae of aquatic Insects) of Sagra talab were collected during the second week of each month between 08.00AM to 10.00AM.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 water 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: pH of 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: Larvae of aquatic insects sampling and preservation:

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

Identification: Collected samples were examined under a stereo zoom microscope (Carl Zeiss, Stemi DV4) and identified using standard taxonomic literatures. Larvae of aquatic insects were identified up to the lowest taxonomic category using taxonomic keys for the particular group. Following keys are useful for identification: Order-Diptera and Coleoptera (Fraser 1933 -1936 and Hoell et.al.1998).

Results and Discussion

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

Hydrology of Sagra talab: The various water parameters of water sample of Sagra talab in relation to periodic changes have been described in (Table -1).

Water conditions: In aquatic habitat of Sagra talab discussed the environmental factors include various water properties of water such as solubility, Temperature, pH, phosphates and nitrates are very important for growth and density of phytoplankton on which larvae of aquatic insects 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 water parameters of the habitat. The high temperature from April onwards initiates rapid decomposition of the organic matter in the substrate and consequently the mineral content rises in the talab water during the following months (Table 1).

Table: 1- Monthly fluctuation of water parameters at Sagra talab of district Gonda (U.P.), India (Data of August 2019 to July 2020)

S.No.	Parameters	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1	Temperature (0°C)	20.8	19.5	18.5	19.0	16.0	15.0	17.6	19.0	21.8	21.0	21.4	20.2
2	pH	7.8	8.1	8.0	8.2	7.9	7.7	8.6	8.3	8.0	8.0	7.5	7.4
3	DO (ppm)	21.3	20.0	15.4	14.0	12.0	24.0	25.0	22.0	24.2	17.0	21.5	28.0
4	FCO_2 (ppm)	-	13.0	14.2	11.2	10.0	-	-	-	-		-	8.0
5	Carbonate alkalinity (ppm)	144	96	48	50	55	80	55	45	68	90	98	100
6	Bicarbonate alkalinity (ppm)	212	174	180	175	171	130	175	190	185	182	199	200
7	Total alkalinity (ppm)	249	118	188	180	160	140	190	215	212	270	184	180
8	Nitrate (ppm)	0.16	0.14	0.25	0.21	0.22	0.20	0.25	0.27	0.43	0.36	0.23	0.24
9	Calcium(ppm)	164	149	110	120	140	141	100	145	119	111	184	182
10	Chloride(ppm)	70.5	14.0	18.0	45.5	38.0	35.0	50.0	52.0	72.0	22.0	74.8	75.0
11	Phosphate (ppm)	0.032	0.035	0.042	0.060	0.040	0.042	0.045	0.047	0.066	0.046	0.055	0.063
12	Total organic matter (ppm)	11.6	10.3	8.5	10.0	9.0	10.4	10.5	10.8	10.2	6.5	9.5	10.6
13	Total nitrogen (ppm)	2.49	2.19	1.40	2.22	2.10	1.44	2.95	1.52	2.66	3.00	2.05	2.02

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 7.4-8.6 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 exceeded many a time the oxygen consumed by the organisms as have also been observed by Kumar (2002).

The free carbon dioxide (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 talab 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 Suchi Tiwari (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 talab water and their concentration expressed as total alkalinity. Calcareous water with alkalinity more than 50 ppm is most productive. Water alkalinity less than 10 ppm rarely produces large crops. Water intermediate between 10 ppm - 50 ppm may give useful results. In highly productive water, the alkalinity is thought to be over 1000 ppm. However, the range of alkalinity as 0.00-20 ppm for low production, 20-90 ppm for medium production and 90-299 ppm for high production are considered. Since in the present Sagra talab of district Gonda 118-270 ppm is obtained during different month of the year August 2019 to July 2020, hence it could classified as nutrient rich Sagra talab (Table 1). Similar result obtained by Parveen (2010).

(Table 1) 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 Sagra talab is relatively small (Table 1).

The result of water pramaters of Sagra talab include pH value varied from 7.4 in the month of July and 8.6 in the month of February at site, temperature (°C) of water ranged from 15.0°C in the month of January and 21.8 °C in the month of April , DO (ppm) 12.0 in the month of December to 28.0 in the month of July, FCO_2 (ppm), 8.0 in the month of July to 14.2 in the month of October, carbonate alkalinity (ppm) 45 in the month of March to 144 in the month of August, bicarbonate alkalinity (ppm) 130 in the month January to 212 in the month of August, total alkalinity (ppm) 118 in the month of September to 270 in the month of May. Nitrate (ppm) 0.14 in the month of September to 0.43 in the month of April, Calcium (ppm) 100 in the month of February to 184 in the month of June, Chloride (ppm) 14.0 in the month of September to 75.0 in the month of July, phosohate (ppm) 0.032 in the month of August to 0.066 in the month of April, total organic matter (ppm) 6.5 in the month of May to 11.6 in the month of August and total nitrogen (ppm) 1.40 in the month of October to 3.00 in the month of May -2020.

Larvae of aquatic insects population at Sagra talab:

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 11 species of larvae of aquatic insects belonging two order *viz.* Order - Diptera - Anopheles larvae, Chironomus larvae, Culex larvae, Dixa larvae, Eristalis larvae, Ptychoptera larvae and Tabanus larvae, Order-Coleoptera: Cybister larvae, Dytiscus larvae, Hydroporus larvae and Gyrinus larvae were identified and recorded in Sagra talab water body (Table -2).

Larvae of dipteran aquatic insects have been found to be dominant among larvae of aquatic insects. Generally Chironomus larvae, Eristalis larvae and Ptychoptera larvae present in Sagra talab which indicate the polluted nature of the talab. Similar observation were 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 insects 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 larvae 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 in Sagra talab. Our result are good in agreements with Vass et.al. (1977), Khan and Ghosh (2001), Baba (2002), Nautiyal (2005), Jaiswal (2012), Majumder et.al. (2013), Choudhary and Gupta (2015).

Table-2: Diversity in larvae of aquatic insects at Sagra talab of district Gonda (U.P.), India (Data of August 2019 to July 2020)

S.No.	Aquatic insects	Months											
	Genera	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
	Order - Diptera												
1	Anopheles larvae (Family- Culicidae)	+	+	+	+	-	-	+	+	+	+	+	+
2	Chironomus larvae (Family- Chironomidae)	+	+	+	+	-	-	+	+	+	+	+	+
3	Culex larvae (Family-Culicidae)	+	+	+	+	-	-	+	+	+	+	+	+
4	Dixa larvae (Family -Dixidae)	+	+	+	+	-	-	+	+	+	+	+	+
5	Eristalis larvae (Family -Syrphidae)	+	+	+	+	-	-	+	+	+	+	+	+
6	Ptychoptera larvae (Family-Ptychopteridae)	+	+	+	+	-	-	+	+	+	+	+	+
7	Tabanus larvae (Family-Tabanidae)	+	+	+	+	-	-	+	+	+	+	+	+
	Order - Coleotera												
8	Cybister larvae (Family-Dytiscidae)	+	+	+	-	-	-	-	+	+	+	+	+
9	Dytiscus larvae (Family- Dytiscidae)	+	+	+	-	-	-	-	+	+	+	+	+
10	Hydroporus larvae (Family- Dytiscidae)	+	+	+	-	-	-	-	-	+	+	+	+
11	Gyrinus larvae (Family-Gyrinidae)	+	+	+	-	-	-	-	+	+	+	+	+

Note : + = Present
- = Absent

Conclusion

The present contribution is the result of the extensive and intensive studies on water parameters and diversity in larvae of aquatic insects carried out during August 2019 to July 2020. During present investigation in Sagra talab, according to water parameters it could classified as nutrient rich water body, larvae of dipteran aquatic insects have been found to be dominant among larvae of aquatic insects and generally Chironomus larvae, Eristalis larvae and Ptychoptera larvae present in Sagra talab which indicate the polluted nature of talab. Thus keeping in view the importance of study, steps should be taken for conservation and maintenance of Sagra talab. It is the necessarily step which have to be followed for the safety of Sagra talab.

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