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Studies On Water Related Parameters Affecting Growth of Water Hyacinth And Insect Herbivores At Raipur, Chhattisgarh

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Abstract

Correlation of the water related parameters with herbivores in three different ponds viz., Mandir Hasaud, Tikrapara and Fundhar under taken in the present work conducted during 2016-17 at Raipur Chhattisgarh, revealed that higher values of dissolved oxygen (7.00to 7.40mg/l) favoured maximum species diversity at Tikrapara pond whereas high pH and Electrical Conductivity (EC) values recorded at Mandir Hasaud reduced the herbivore diversity.

Keywords: Add some keywords here..

Introduction

Water hyacinth (*Eichhornia crassipes* Martius) is an exotic free floating perennial aquatic weed native to South America belonging to the family Pontederiaceae, related to the family Liliaceae. It was originally introduced in 1884, and has invaded most of the Southern United States and many tropical and sub tropical regions around the world. The plants grow up to 1 metre high although 40cm is the more usual height. The inflorescence bears 6 - 10 lily-like flowers, each 4 - 7cm in diameter. The stems and leaves contain air-filled tissue which give the plant considerable buoyancy. The vegetative reproduction is asexual and takes place at a rapid rate under preferential conditions. It displaces native vegetation due to its rapid growth during summer. Major economic impacts caused by invasion of water hyacinth include interference with navigation, irrigation and power generation. Additionally, dense mats can provide ideal mosquito breeding habitats.

E. crassipes plants are generally found in ponds, lakes, tanks, reservoirs, streams, irrigation channels and rivers. The plant is a free floating stoloniferous herb reproducing both sexually and asexually, and reported an increase in surface area by six to ten percent per day. It is capable of doubling its area every 12 to 14 days during the growing season (Srivastava, 2000). The consequences are devastating for those communities reliant on water bodies for water, food, sanitation and transport. It changes the ecological balance and habitat of an infested area, and reduces the water flow and increases the siltation. It interferes with fish life by reducing water dissolved oxygen levels and producing toxic substances such as hydrogen sulphide.

Water related parameters such as temperature, pH, amount of dissolved oxygen and the electrical conductivity has direct impacts on the aquatic herbivore biodiversity of water bodies such as lakes, rivers and ponds. The effect of these parameters were more prominent in stagnant waters of lakes and ponds.

Objective of the study

Water hyacinth has invaded the local ponds of Chhattisgarh also. The present studies were conducted to test the impact of the few above mentioned water parameters such as dissolved oxygen, temperature, Electrical Conductivity (EC) and pH , on the herbivore biodiversity in three local ponds of Raipur district, namely, Mandir Hasaud, Tikrapara and Fundhar to get the first hand information for further studies in future regarding the spread and management of the noxious aquatic weed.

Materials and Method

The present studies were conducted on three local ponds namely, Fundhar, Mandir Hasaud, Tikrapara and from Raipur district of Chhattisgarh state. Analysis of the water related parameters such as, temperature, pH, dissolved oxygen and electrical conductivity were done by collecting water samples from the three ponds. Record of the various aquatic flora and fauna were also done at weekly interval.

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Plate 1. Pond of Fundhar

Plate 2. Pond of Mandir Hasaud

Plate 3. Pond of Tikrapara

Studies on water related parameters affecting growth of water hyacinth and insect herbivores.

i) Determination of dissolved oxygen (DO) (Winkler's iodometric method) from water sample.

Calculation

Dissolved oxygen mg/L = V1N×8×1000

Volume of sample

Where, V1 = volume of titrant (ml)

N= normality of titrant (0.025)

8= equivalent weight of oxygen

ii) Determination of pH from water sample.

The pH was determined by taking about 50 ml of water sample in a 100 ml clean beaker by using pH meter.

iii) Determination of Electrical Conductivity (EC) (Soluble salts Concentration) from water sample.

The cell of the conductivity meter or solubridge was filled with 50ml of the water sample and the electrical conductivity (EC) was measured as described in case of water extract and expressed as dS/m at 25^0 C which is numerically equal to mmhos/cm at 25^0 C. Sometimes the unit of expression is also expressed in milli-Simons/cm

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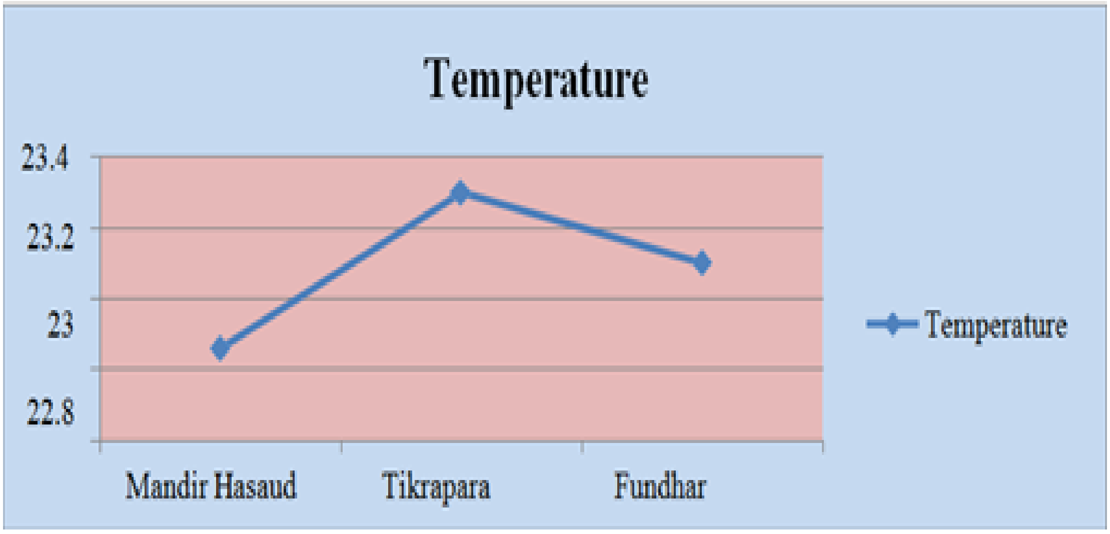
(mS/cm) which is numerically same as micromhos/cm that is 1/1000th of deci Simons per meter or millimhos/cm.

Results and Discussion

Temperature determines the density of water and therefore determines the stratification and thus affects vertical mixing in the water column. This effects the distribution of many properties such as quantities of dissolved oxygen. In the present studies temperature ranged from 28.86^{0}C to 23.3^{o}C throughout the sampling period. Relatively high mean temperature was observed in Tikra para (23.3^{o}C), while low mean temperature observed in Mandir Hasaud (22.86^{o}C).

Fig. 3 Showing the distribution of temperature on the section at different sites.



Temperature above 23.00^{o}C was recorded throughout the sampling period and relatively high temperature was observed in Tikrapara (23.30^{o}C), while comparatively slightly low temperature was observed in Mandir Hasaud (22.86^{o}C).

The present studies revealed a dissolved oxygen level of 5.53 – 7.40 mg/l recorded during the sampling period. Relatively low dissolved oxygen concentration was observed in Fundhar while highest dissolved oxygen concentration was observed in Tikrapara.(Table.1) Similarly, John, (2005) observed variation dissolved oxygen from 3.28 to 4.01 mg / l at different locations.

Aquatic environments normally require dissolved oxygen in the range of 6-8 ppm. Dissolved oxygen in pond Tikrapara ranged from 7.00 to 7.4 mg/l and in Fundhar pond it was between 5.00 to 5.53 mg/l. The variation may be due to rising temperature that caused low solubility of oxygen resulting in the decrease of dissolve oxygen.

High levels of dissolved oxygen supports increased aquatic fauna (Table 4) and herbivore species (Table 3a). As from the data depicted in Table 4 clearly shows that maximum number of aquatic weeds (8 species) were recorded from Tikrapara pond with highest levels of dissolved oxygen (7.4) supported by mean maximum temperature of 23.3° C where as minimum number of aquatic fauna was recorded from Fundhar pond which possessed minimum pH (7.1), EC (0.40) and values of dissolved oxygen (5.53)

The present findings are in agreement with Kibria, 2017, who also stated that aquatic species abundance is strongly associated with the dissolved oxygen(DO) concentrations and poor DO concentrations can eliminate the more sensitive species from an ecosystem, causing a decline in species diversity.

Rising temperatures enhanced plant growth has been reported by Velthuis *et al*., 2017 and Rooney and Kalff, 2000; Feuchtmayr *et al*., 2009. As per Barko *et al.,* 1982 and Pedersen *et al.,* 2013, the optimum temperature for photosynthesis for temperate submerged aquatic plants are usually located between 25 and 32◦C and as per Zhang *et al*.,2019, highest temperature of 25◦C was close to optimal for growth which is in support to our findings.

In case of pH, higher pH values and Electrical Conductivity (EC) values were observed at the site Mandir Hasaud (7.77) and (1.15) which supported minimum population of herbivores respectively and the lowest lowest pH value in Fundhar Fundhar. (0.40)

Fig. 2 Showing the distribution of dissolved oxygen on the section at different sites.

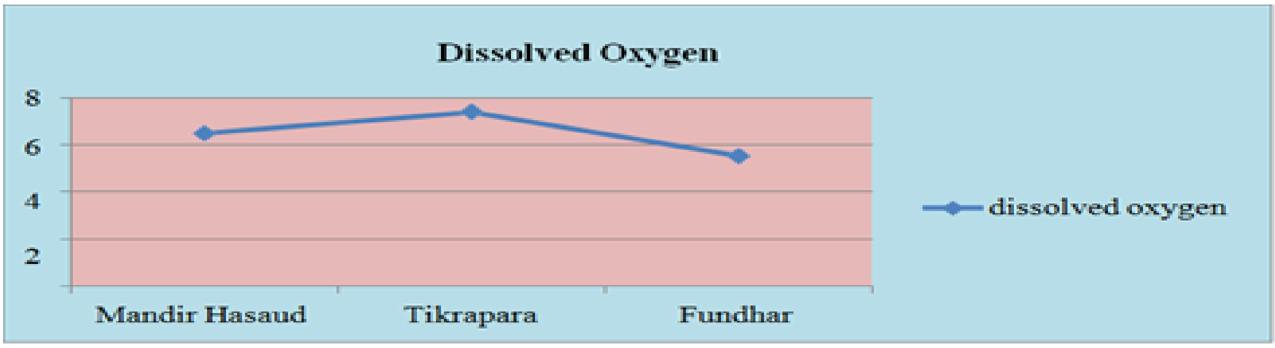
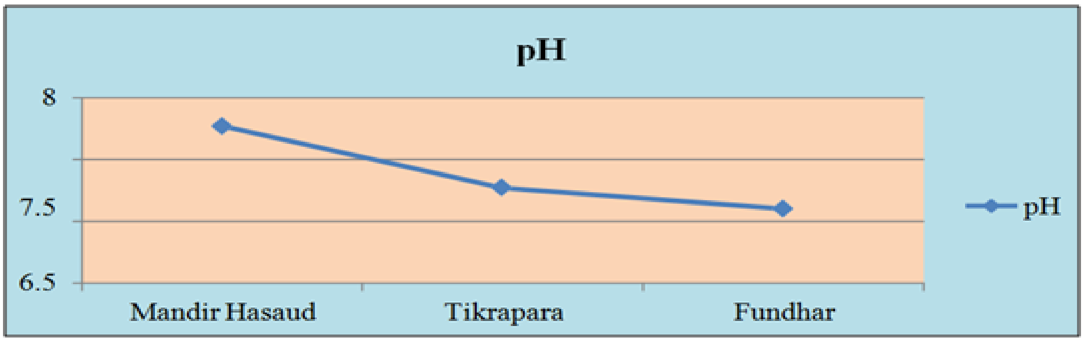


Fig. 1 Showing the distribution of pH on the section at different sites.



Correlation of insect herbivores with water related parameters

Correlation of water related parameters with insect herbivores revealed that higher values of dissolved oxygen favoured herbivores as seen in the present studies where maximum species diversity was recorded in Tikrapara pond (Table 3a). Higher pH values and Electrical conductivity (EC) values lessened herbivore bio-diversity. (Table 3b and Table 3c)

In case of Tikrapara pond, highly significant negative correlation was obtained with pH, EC, dissolved oxygen and temperature in case of both species of weevils *ie N. bruchi* and *N. eichhorniae,* where as positive and highly significant positive correlations were obtained in case of grasshopper. This shows that weevils preferred low pH, low values of EC, low dissolved oxygen content and low temperatures.

In case of Mandir Hasaud pond, where higher pH and EC values were noted, showed negative but non-significant impact with grasshopper population and in case of Fundhar pond which recorded lowest pH, EC and dissolved oxygen values.

pH

pH was recorded at various times during the sampling period and the mean value is presented in Table. Higher pH values were observed at the site Mandir Hasaud (7.77) and the lowest in Fundhar. (7.1) as per (Table 1) Similarly, John, (2005) also observed variation in the pH of experimental ponds varied which ranged from 6.9 -7.3

Electrical Conductivity (EC) Electrical Conductivity, can be treated as an indicator of pollution (by incoming ionic salts) and a tracer of flow of polluting effluents. This is based on the near unreactive behaviour of ionic constituents. Data presentation Table 1 shows electrical conductivity at various sites during the sampling period. Higher Electrical Conductivity (EC) values were observed at the site Mandir Hasaud (1.15) and the lowest Electrical Conductivity (EC) value observed in Fundhar. (0.40) Higher EC did not favour aquatic fauna nor plant herbivore biodiversity. (Table 4 and Table 3b)

Table 1. Analysis of various water parameters

Sites	pH	EC	Dissolved oxygen mg/l	Temperature (C˚)
Mandir Hasaud	7.77	1.15	6.5	22.86
Tikra para	7.27	0.46	7.4	23.3
Fundhar	7.1	0.40	5.53	23.1

Table 2 a. Correlation coefficients between different bio-agents of water hyacinth, *Eichhornia crassipes* with water related parameters at Tikrapara.

S.N.	Name of insect	pH	EC	Dissolved oxygen	Temperature

1.	*N. bruchi*	-0.86941**	-0.87483**	-0.86141**	-0.86945**
2.	*N. eichhorniae*	-0.69093**	-0.71437**	-0.66391**	-0.69109**
3.	Grasshopper	0.81319**	0.81981**	0.80403**	0.81324**
4.	Mite	-0.27799	-0.2776	-0.27772	-0.27799

(*: Significant at 5% level, **: Highly Significant at 1% level)

Table 2b. Correlation coefficients between different bio-agents of water hyacinth, *Eichhornia crassipes* with water related parameters at Mandir Hasaud.

S.N.	Name of insect	pH	EC	Dissolved oxygen	Temperature
1.	Grasshopper	-0.21516	-0.18606	-0.22214	-0.20826

(*: Significant at 5% level, **: Highly Significant at 1% level)

Table 2c. Correlation coefficients between different bio-agents of water hyacinth, *Eichhornia crassipes* with water related parameters at Fundhar.

S.N.	Name of insect	pH	EC	Dissolved oxygen	Temperature
1.	*N. bruchi*	-0.47277	-0.47079	-0.45888	-0.47228
2.	Aphid	0.77615**	0.76699**	0.74215**	0.77387**

(*:Significant at 5% level, **: Highly Significant at 1% level)

Table 3a. Population of major and minor bio-control agents of water hyacinth, *Eichhornia crassipes* recorded on site no.01 (Tikrapara pond)

S.N.	Name of insect	27 Jul	13 Aug	27 Aug	11 Sep	29 Sep	16 Oct	30 Oct	13 Nov	27 Nov	14 Dec	30 Dec	14 Jan	28 Jan	12 Feb	26 Feb	Overall mean
	SMW	30	33	35	37	39	42	44	46	48	50	52	2	4	7	9	
	Major bio-agents																
01.	*N. bruchi*	0	0	0.5	0.8	1.1	1.3	1.5	1.3	1.1	1.8	1.5	1.7	1.5	1.8	1.6	1.16
02.	*N. eichhorniae*	0	0	1.6	1.2	1.4	1.2	1.4	1.5	1.4	1.4	1.5	1.5	1.7	1.4	1.2	1.22
03.	Grasshopper	0.9	0.9	0.6	0.4	0.4	0.4	0.3	0.4	0.2	0.3	0	0	0	0	0	0.32
	Minor bio-agents																
04.	Aphid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05.	Mites	0	0	0	0	365.1	327.6	391.6	117.5	0	0	0	0	0	0	0	80.12

Table.3b. Population of major and minor bio-control agents of water hyacinth, *Eichhornia crassipes* recorded on site no.02 (Mandir Hasaud pond)

S.N.	Name of insect	27 Jul	13 Aug	27 Aug	19 Sep	01 Oct	16 Oct	30 Oct	16 Nov	27 Nov	14 Dec	30 Dec	14 Jan	28 Jan	12 Feb	26 Feb	Overall mean
	SMW	30	33	35	38	40	42	44	46	48	50	52	2	4	7	9	
	Major bio-agents																
01.	*N. bruchi*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02.	*N. eichhorniae*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03.	Grasshopper	0	0	0.8	0.7	0.3	0.6	0.7	0.4	0.2	0.4	0.5	0.4	0.2	0	0	0.34
	Minor bio-agents																
04.	Aphid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

05.	**Mites**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 3c. Population of major and minor bio-control agents of water hyacinth, *Eichhornia crassipes* recorded on site no.03 (Fundhar pond)

S.N.	Name of insect	16 Nov	27 Nov	14 Dec	30 Dec	14 Jan	28 Jan	12 Feb	26 Feb	12 Mar	26 Mar	09 Apr	23 Apr	Overall mean
	SMW	46	48	50	52	2	4	7	9	11	13	15	17	
Major bio-agents														
01.	*N. bruchi*	0.6	0.5	0.8	0.6	0.9	1.5	1.3	1.1	0.8	1.5	0.9	0.5	0.91
02.	*N. eichhorniae*	0	0	0	0	0	0	0	0	0	0	0	0	0
03.	Grasshopper	0	0	0	0	0	0	0	0	0	0	0	0	0
Minor bio-agents														
04.	Aphid	71.8	48.4	10.9	11.3	22	0	0	0	0	0	0	0	13.7
05.	Mites	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4: Important aquatic weeds observed in different ponds at Raipur

Tikrapara pond			
S.N.	**Common Name**	**Botanical Name**	**Family**
1.	Garundi ark	*Alternanthera sessilis*	Amaranthaceae
2.	Alligator weed	*Alternanthera philoxeroides*	Amaranthaceae
3.	Water hyacinth	*Eichhornia crassipes*	Pontederiaceae
4.	Water fern	*Azolla filiculoides*	Salviniaceae
5.	Duck weed	*Lemna spp.*	Araceae

6.	Common purslane	*Portulaca oleracea*	Portulacaceae
7.	Doob grass	*Cynodon dactilon*	Poaceae
8.	Green algae		

Mandir Hasaud pond			
1.	Garundi ark	*Alternanthera sessilis*	Amaranthaceae
2.	Water hyacinth	*Eichhornia crassipes*	Pontederiaceae
3.	Alligator weed	*Alternanthera philoxeroides*	Amaranthaceae
4.	Doob grass	*Cynodon dactilon*	Poaceae
5.	Green algae		
Fundhar pond			
1.	Water hyacinth	*Eichhornia crassipes*	Pontederiaceae
2.	Water fern	*Azolla filiculoides*	Salviniaceae
3.	Duck weed	*Lemna spp.*	Araceae
4.	Green algae		

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