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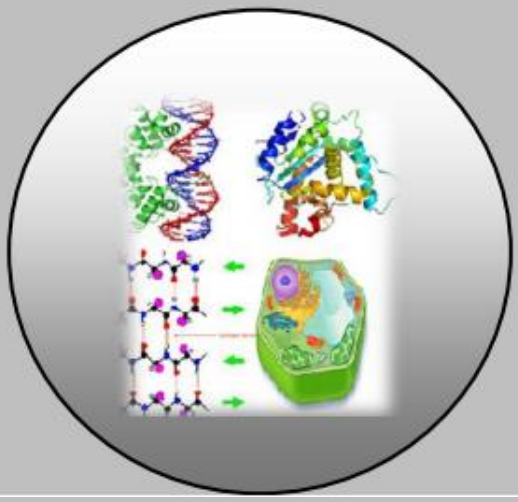

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RESEARCH PAPER

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Studies of Physio-chemical Conditions as well as Plankton Communities in Wetland Sarsainawer Distich Etawah (UP)

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ABSTRACTS

An ecological investigation was done in the Sarsainawer Wetland in District Etawah which is one of the important fresh water Wetland in Northern India. The Wetland has been declared as a protected area as it is an important habitat of saras bird which are about more than 2000 in number. In all, six sampling sites were setup in different parts of the Wetland with varied physiographical features. The samples were collected fortnightly during morning hours. Most of the physico–chemical parameters were done in the field. However, Dissolved Oxygen was fixed at the site and the analysis of Dissolved Oxygen was done in the laboratory B.O.D. was calculated after incubating the sampling in the B.O.D. incubator for 5 days at 20^0C. Surface samples were collected for biological examination and the species were identified using standard texts.

Key word: Sarsainawer Wetland, Etawah, Dissolved Oxygen, Physico–chemical parameters.

INTRODUCTION

Freshwater has always been of vital importance to man and early in habitations were within easy reach of lakes and rivers. Man's primary concern with water was thought to be for drinking, food and as a mean of cleaning. But with the passing of times, man realized the inherent mysteries of aquatic phenomenon and that water is the basis for all life activities. Animals cannot survive without water (Kant, and Kachroo, 1975, Jackson, 1969). Due to low concentration of salt and luxuriant vegetation, fresh water offers an excellent environment to a wider variety of animals.

Fresh water's supplementary academic information regarding the biology, periodic habits, and the physiology of the aquatic organisms will give an adequate potential to their endeavors. Ecologists started studying the impact of various factors on the aquatic organisms and their adaptations to the unfavorable conditions.

Streams, rivers, and lakes and reservoirs have been subjected to huge amounts of domestic sewage, industrial effluents, agricultural water, urban runoff, waste water, pesticides and numerous other pollutants. If the water quality of the Indian rivers, lakes and streams gets degraded beyond control, the situation will as well be out of hand which will not only adversely affect all uses of water such as domestic, agriculture, aquaculture, aesthetic, navigational, power generation etc. (Durrschmidt, 1990) but the entire aquatic system will be thrown out of gear and may lead towards a severe biological imbalance. It would be an ecological disaster. Hydrobiology is a young science of utmost importance to find principles and general relationship applicable to water management. The planning of water quality management needs be organized in a rational manner, based on sound limnological principles. Bio monitoring studies are essential to understand the structural changes in the biological communities to evaluate whether the water body in question has innate, resilient capacity to absorb the stress and attain a new dynamic equilibrium without lowering the desired water quality or depleting the fishery resources (Zutushi, *et al.* 1980). An important and long standing question in limnology relates to the extent and mechanism by which alterations in basin morphometery affect the biogeochemical cycling of nutrients and thus indirectly control the trophic status of the lake. The seasonal stratification on trophic status was specifically questioned. Many lakes throughout the world are going accelerated ageing or eutrophication due to man's activities (Durrschmidt, 1990). This includes the influences of agricultural, Industrial and domestic pollution which lead to deteriorating water quality, phytoplankton blooms, oxygen deficiency, fish kills and sediment infilling. In recent years limnologists have attempted to reverse eutrophication with lake restoration methods which limit fertility and sedimentation and attempt to control the consequences of eutrophication. Some varieties of lake restoration techniques have been utilized viz. curbing nutrient influx, to accelerate nutrient outflow: lake aeration, dredging sediment consolidation and other habitat manipulations (Durrschmidt, 1990). However, lake restoration techniques are in an early stage of development and there is need for detailed studies on a variety of lake types and geographic locations.

The present investigation is concerned with the Sarsainawer Wetland in District Etawah (UP). The observations are physio-chemical conditions as well as plankton communities.

MATERIAL AND METHODS

The limnological data of the wetland Sarsainawer was collected once every month in the morning hours. The six study sites selected for the present investigation are shown in the map of Sarsainawer wetland. The biological and physico-chemical parameters were assessed.

Physico-chemical parameters

Temperature

Air and water temperatures were recorded at the sampling sites with the help of a Celsius mercury thermometer.

Water Transparency

The transparency of water was recorded by standard secchi disc. The average depth at which secchi disc disappeared while immersing and reappeared while pulling up was taken as secchi disc transparency.

Hydrogen Ion Concentration

pH of the water samples was recorded with the help of pH meter. The pH meter was calibrated by using buffers of known pH strength.

Dissolved Oxygen (DO)

Samples for dissolved oxygen were collected in well-stopper glass bottles of 125 ml capacity. The initial fixation of the samples was done in the field by adding about 0.5 ml of Winker's reagent and 0.5ml of Magnus chloride. Measures were taken to avoid trapping of air bubbles. Analysis of water samples was carried out immediately in the laboratory using the method given in A.P.H.A. et al. (1985).

In the laboratory, the fixed samples were treated by concentrated H_2SO_4 to dissolve the precipitate of Mn $(OH)_2$ (Magnus hydroxide); which resulted in the liberation of iodine. 50 ml of treated samples was then titrated against N/100 or 0.01 N $Na_2S_2O_2$ solutions, using freshly prepared 1% starch as an indicator. Volume of Thiosulphate used was multiplied by normality factor of 1.6 giving the amount dissolved oxygen per liter and expressed as mg/lit.

Biochemical Oxygen Demand (BOD)

Dilution water was prepared in a glass container by bubbling compressed air in distilled water for about 30 minutes. 1 ml each of phosphate buffer, magnesium sulphate, calciumchloride and ferric chloride solutions were added to each litre of dilution water and mixed thoroughly. The sample was neutralized to pH around 7.0 by using 1 N NaOH or H_2So_4. Dilution of the sample was done in a bucket or a large glass trough by mixing the contents thoroughly. 2 sets of the BOD bottles were filled. One set of the bottles was kept in to the BOD incubator at 20 ^{O}C for 5 days. Do of another set of diluted sample was determined immediately. After the completion of 5 days of incubation, the DO was determined immediately. For blank, 2BOD bottles were taken for dilution water. In one, the DO was determined and the other was incubated for 5 days and DO content determined later.

Calculations

BOD (mg/1) = $(DO_1 – DO5)$ X dilution factor

Where DO_1 = Initial DO in the sample

DO_5 = DO after 5 days

Qualitative and Quantitative Enumeration of Plankton Population

(A) Zooplankton

For qualitative studies, the samples were collected by hauling standard plankton net no. 25 through horizontal and vertical directions of the lake at selected sites once every month. A live sub-sample of zooplankton thus collected was examined under the microscope while the other was preserved by adding 5% formalin. The samples were examined under 1000 X magnification of a compound microscope and identification was carried out by referring to the works of Edmondson (1959), Hutchinson (1967) etc.

Quantitative analysis of zooplankton population was done by filtering a known volume of water (10 liter) through plankton net.

The sample thus obtained was reduced in volume by centrifuging and then preserved in 5% formalin. The enumeration of zooplankton was done by taking 1 ml of preserved concentrated samples in a Sedgwik Rafter Chamber and counting entire contents of the Chamber for different zooplankton species. The results have been expressed as individuals/litre (ind./litre)

(B) Phytoplankton

For qualitative analysis of phytoplankton population, the standard plankton net was hauled through vertical and horizontal plane of the lake. In the laboratory, the diatoms so to say phytoplanktons were cleaned with sulphuric acid and potassium dichromate and mounted in Hyrex on glass microslides. Identification was done at 100 X and nearly fifty diatoms were identified at different sampling stations for identification. Following reference was consulted.

RESULTS

Morphological Features of the Wetland Sarsainawer

The Wetland of Sarsainawer in Distt. Etawah lies in South-Western portion of Uttar Pradesh at $26^0$47` N latitude and $79^0$20` E longitude and forms a part of the 'Kanpur's forest division. It is bounded on the north by the districts 'Farrukhabad and Mainpuri', while the eastern frontier adjoins the district of 'Auraiya'. The Sarsainwer Wetland in one of the largest wetland of the Dist. Etawah, located in the 'Takha' block of the Tehsil 'Bharthana'.

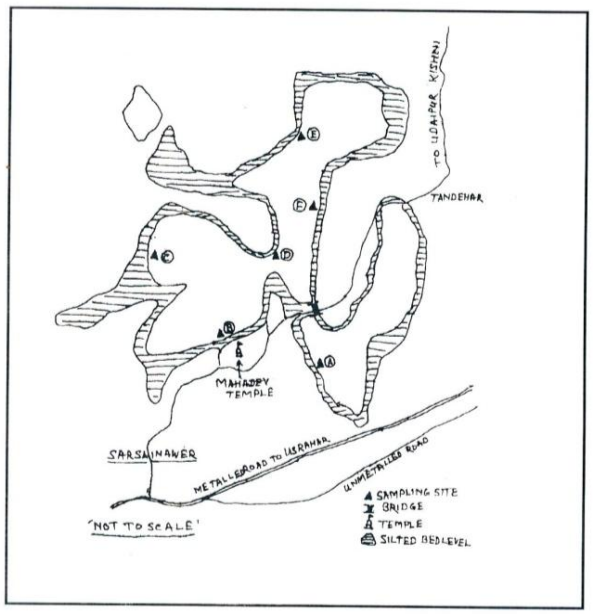


Figure 1. Sarsainawer Wetland in District Etawah (U.P.) showing sampling sites (A to F).

The wetland extends about 4 km. from north to south, which further extends to 5 Km. during Mansoon, whereas it is about 3 km. in length towards east-west side. In the south of the wetland is the village known as 'Udaipur Kalan' and at the north end is the 'Sarsainawer' village.

In the east extremity are 'Kuberpura' and 'Kishanpura' villages and in the west is 'Nagla Balsingh' (Fig. 1). This wetland is an important site from the point of view of biodiversity. It has a great diversity in its flora and fauna. The wetland is also visited by a number of birds including both local and migratory birds. But due to growing cultivation and human activities, their existence is endangered now.

Human population is extremely high throughout this alluvial plain area. The wetland of Sarsainawer is named as an 'ox-bow lake' in the wetland of U.P. by Remote Sensing Application Center, Uttar Pradesh.

Sampling sites

Six sampling sites were set up in the Sarsainawer wetland to study the various physico-chemical and biological parameters.

A. Sampling site A Daulatpura
B. Sampling site near Mahadev Temple
C. Sampling Site towards Kachhpura
D. Sampling site towards Chandrapura
E. Sampling Site towards Nagla Balsingh
F. Sampling Site towards Kuberpura

Physico- Chemical Characteristics of the Wetland Sarsainawer

Water-Temperature

During the study period, the water temperature ranged between 55-378 ^{O}C. The lowest temperature was recorded at sampling site C in January, 2007 (5.5 ^{O}C) and highest temperature was recorded (37.8 ^{O}C) at sampling site A and C in June, 2008 seasonally, sampling site a recorded highest temperature of 35.4 ^{O}C during June 2007 and sampling site C recorded lowest temperature of 5.5 ^{O}C during January 2007 (Table 1).

Transparency

The monthly variations of transparency value at various sampling sites are depicted in table-3. During the study period, the values of transparency ranged between 20.4 -75.6 cm. The lowest value of transparency was recorded at sampling sites A during August, 2007 (20.4 cm.) and the highest value was recorded at the sampling site C in the month of January (75.6 cm) in 2008 (Table 2).

Hydrogen Ion Concentration (pH)

In the monthly variations in pH (hydrogen ion concentration) at various sampling sites of the wetland. The hydrogen ion concentration varied from a minimum of (7.0) at the sampling site A, B,C,D,F in July, August, September, October in 2007-08 to a maximum of (8.6) at the sampling site F in May 2008 (Table 3).

Dissolved Oxygen (DO)

The monthly fluctuations in dissolved oxygen at various sites of the Wetland Sarsainawer ranged between 3.3-8.8 mg/lit in the Wetland. The lowest concentration was recorded from the surface waters at sampling site A in June 2007 and highest concentration at site C in October 2007 (Table 4).

Biochemical Oxygen Demand (BOD**)**

At site 'A', the minimum BOD recorded was 3.1 mg/lit in December and maximum 16.4 mg/lit in June 2007.

Whereas, in the year 2008, the minimum BOD was recorded 3.4 mg/lit in Jan and maximum 18.4 mg/lit in June. At site 'B' in 2007, the minimum BOD was recorded as 2.0 mg/lit in December and maximum 14.3 mg/lit. in June. In the year 2008, the minimum value recorded was 3.1 mg/lit in January and maximum 18.5 mg/lit in the month of June. At site 'C' in 2007, the minimum BOD was recorded 2.9 mg/lit in December and maximum 16.7 mg/lit in June. While in the year 2008, the minimum BOD was 4.3 mg/lit in January and maximum 17.3 mg/lit June (Table 5). At site 'D' in 2007, the lowest BOD was recorded as 3.1 mg./lit. in November and higher value was 14.5 mg/lit in June. Whereas, in the year 2008, at this site, the minimum BOD was recorded as 3.5 mg/lit in Janury and higher value was 17.1 mg/lit in the month of June. At site 'E' in 2007, the BOD fluctuation ranged, as recorded, was from 3.0 mg/lit to 14.8 mg/lit The minimum value was recorded in November and the maximum in June. In the year 2008, the range of fluctuations recorded was from 3.0 mg/lit to 18.1 mg/lit. The minimum value was recorded in January and the maximum in June. The site 'F' had BOD fluctuations ranging from 2.6 mg/lit to 14.1 mg/lit. The minimum value was recorded in December and the maximum in June 2007. In the year 2008, the minimum value recorded was 3.6 mg/lit in January and the maximum 17.2 mg/lit in June.

Biological Examination of Sarsainawer Wetland

A. Phytoplankton

The families which represented the Phytoplankton were Chlorophyceae. The increasing trend in the lake was Chlorophyceae that way formed the largest group followed by Bacillariophyceae and then Cyanophyceae in the Wetland sites. The major genera out of Chanophyceae were *Spirogyra, Zygnena, Characium, Chlmydomonas, Volvox, Chaetonema, Ulothrix, Cladophora* and *Oedogonium* which showed their dominance and subdominance at the various sampling sites of the wetland. The most dominant species of Bacillariophyceae were *Diatoma elongatum, Fragilaria Construens, Navicula sp, Syndera ulna, Nitzschia acicularis, Gyrosigma* sp. at the various sampling sites from A to F. Out of Cyanophyceae, seven species were observed either in the dominant or subdominant phase. Out of them, *Oscillatoria* and *Anacystis* were observed in the dominant and subdomiment range at almost all sampling site. *Oscillatoria* dominated from site A to Site E. *Anacystis* spp. Showed dominance at sampling site A and D and subdominance at sampling site C and E.

B. Zooplankton

The sampling site A showed very low zooplankton density. Almost identical maximum values were recorded in June, 2007. December 2007 and 2008 at all the mentioned sites. Sampling site B recorded the maximum density in August 2008 (288 ind/lit) Sampling site C and F recorded maximum density in April, 2007 (398 ind/lit) and sampling site D recorded maximum density in October 2008 (492 ind/lit) whereas sampling site E and F recorded maximum density in October, 2008 as 368 ind/lit However, the sampling site F registered the highest value in August 2007 as 402 ind/lit The sampling site A, B and C registered the highest values during summers whereas sampling site D, E and F highest values in post monsoon months. The lowest values were noted during monsoon months.

DISCUSSION

The temperature plays an important role in physico-chemical and bio-chemical activities in any wetland. The water temperature recorded at various sites in the sarsainawer wetland corresponded more or less to the ambient air temperature.

During the present study, the minimum temperature 5.5 ^{O}C was recorded in January (2008) at site C and the maximum 37.8 ^{O}C in June (2008) at site A. the various sites in the wetland did not show much variations in their seasonal water temperature. Wind mixing is the primary factor maintaining isothermal conditions in shallow wetlands (Kannan, and Pandiyan 2010) even in tropical lakes where surface heating is extreme. An apparent difference in water temperature at various sites in the same month is largely due to the different sites sampled on different dates.

Hydrogen ion concentration or pH is regarded as a measure of concentration of H^+ ions in water. Natural water bodies usually showed a pH range between 6-9, which registered higher pH values during summer and lower values during autumns. In wetland the seasonal highest pH values were recorded at site E in May 2008 with lowest pH values during July, August, September, October 2007 and 2008 at sites A,B,C,D and E.

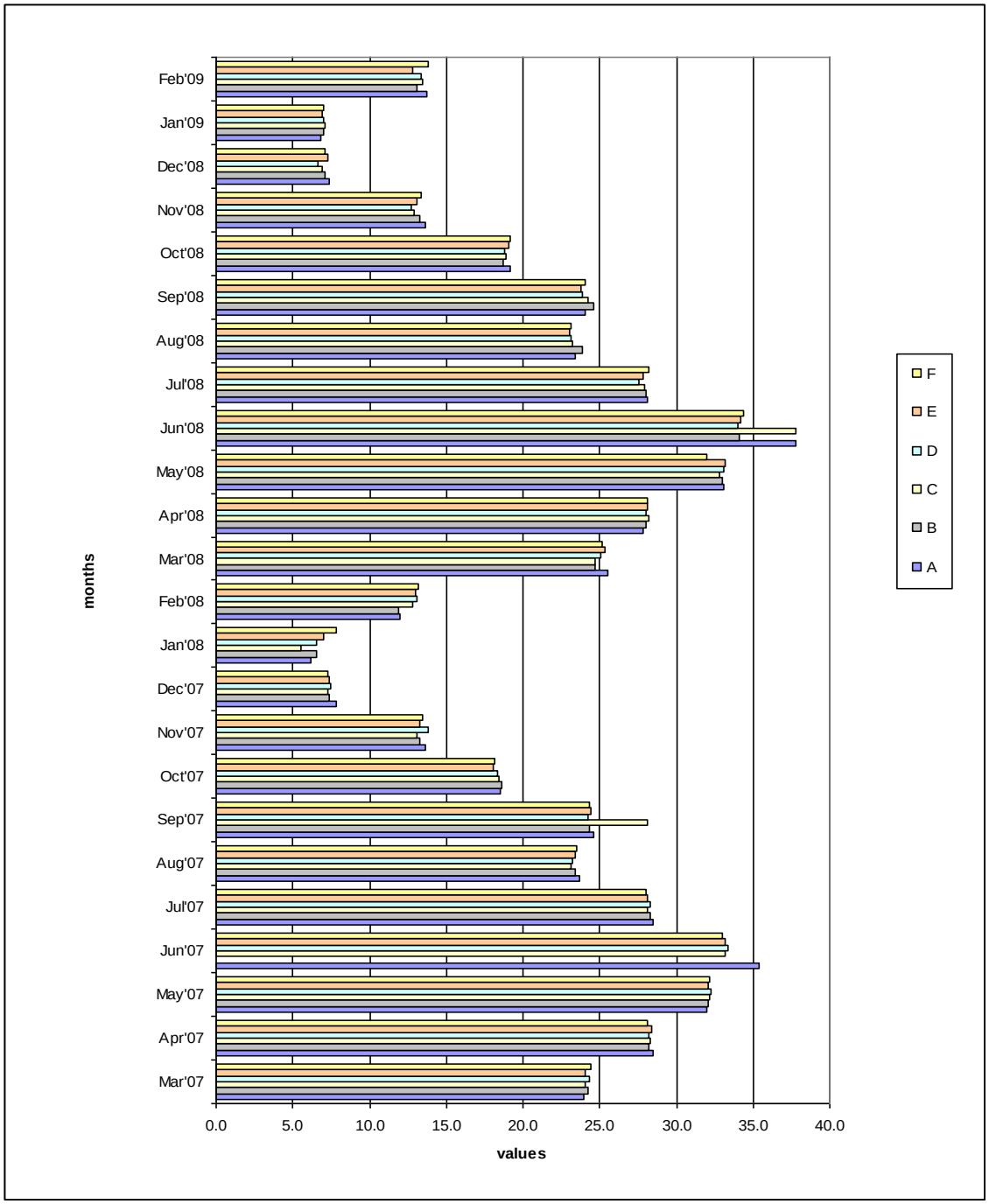
The highest pH value was attributes to rise in carbonates alkalinity resulting from photosynthetic activity of phytoplankton and other green-aquatic plants. Low pH values during autumn were probably due to release of anaerobic waters affected by the decomposition of concentrated organic matter and the respiration of biota. Mostly the pH of the wetland at almost all sites was on the alkaline sides.

Dissolved oxygen is one of the most reliable parameter in assessing trophic status and the magnitude of eutrophication in an aquatic ecosystem. All living organisms are dependent upon oxygen in one form or another to maintain the metabolic processes. It provides a key information about the biological and biochemical reaction going on in the water. In the wetland dissolved oxygen at various sites ranged between 3.3-8.8 mgl^{-1}. The lowest concentration was recorded from the surface waters of sites A in June, 2007 and the highest concentration from site C in October 2007. Seasonally winter 2007, recorded highest dissolved oxygen concentration at site C (8.8 mgl^{-1}) and Summer 2007 lowest dissolved oxygen concentration at site A (3.3 mgl^{-1}). The wetland recorded highest concentration of dissolved oxygen which appears to be due to intensive diffusion from atmosphere at low temperature, with quite agreement to the finding of Hutchinson (1975) i.e. at low temperature the capacity of the water to hold dissolved oxygen is always higher. This is as well in conformity with the higher dissolved oxygen saturation in winter due to great retention capability of water at low temperature as reported by, Zutushi, *et al* (1980) and Qadri and Yousuf (1978).

BOD was recorded minimum (2.0 mg./lit.) in winter at sampling site 'B' and the maximum (18.5 mg/lit) at site 'B' in June, 2008. The difference between dissolved oxygen and bio-chemical oxygen demand established a good relationship with the pollution because as long as the oxygen balance remained positive, the conditions in the water may be regarded as satisfactory from the chemical point of view. When the oxygen balance turned negative, it was presumed that high BOD gave rise to condition of negative oxygen balance. Bhati and Rana (1982) have described the river Jamuna receiving excessive pollution and thus exhibiting high BOD value. In the present study, the higher pollution load during summer at site 'A' and 'E' was noticed which was usually neutralized during monsoon due to heavy rains. Condition of the river was unsatisfactory especially during dry weather and the water becoming highly polluted. Low temperature is indicative of low biological activity as opined by earlier workers (Pyatkan and Krivo Shein, 1980).

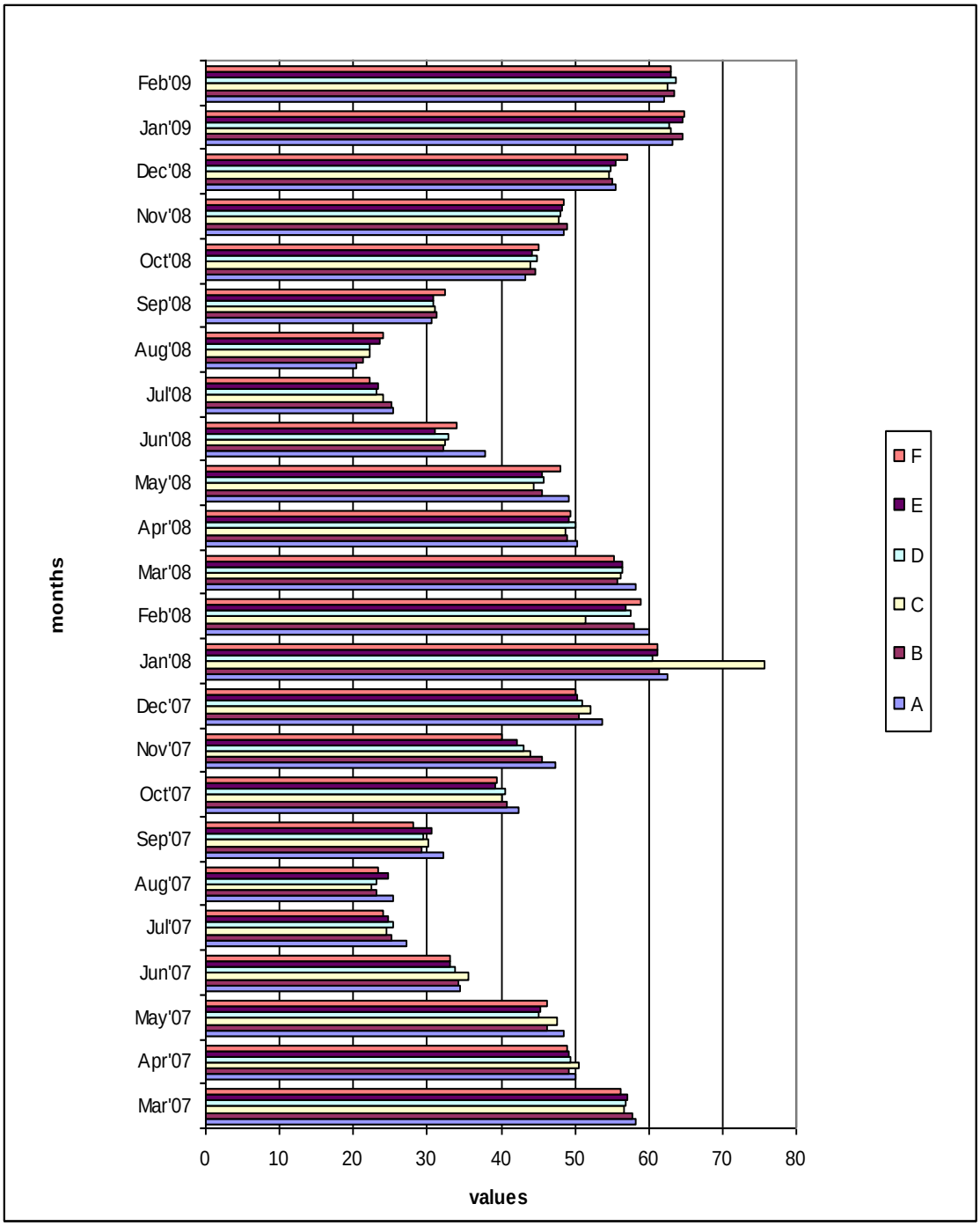
Joshi (1993) recorded high BOD in summer, which is an indication of an augmented organic load due to rapid growth of microorganism. Jackson, D.F. (1969) recorded the values were ranging between 4.0-170.0 mg./lit. in Kali Nadi. BOD is the amount of oxygen utilized by the microorganism in stabilizing the organic matter. On an average basis, the demand for oxygen is proportional to the amount of organic waste to be degraded aerobically and as such, the BOD value can be regarded as a measure of waste strength.

Table 1. Fluctuations in water temperature (O ^{O}C) at various sites of the Sarsainawer Wetland of District Etawah (UP).



A,B,C,D,E,F ARE THE VARIOUS SAMPLING SITES

Table 2. Values of Transparency (cm) at various sites + B3 in the Sarsainawer Wetland of District Etawah (UP).



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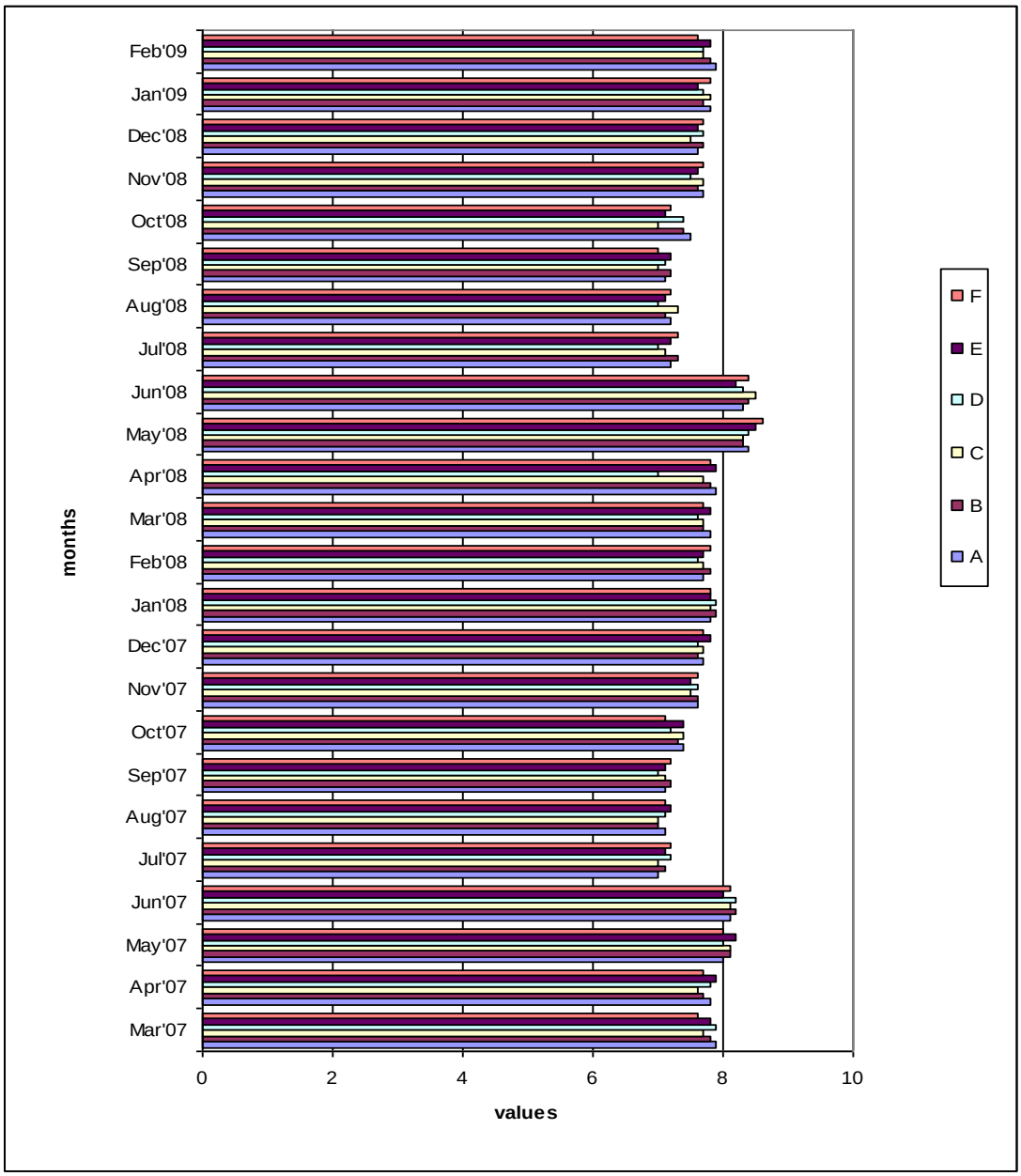
Chemical oxygen demand is the oxygen required by the organic substance in water to oxidize them by a strong chemical oxidant. The test is measure of strength of organic wastes for all practical purposes because its values are varying close to the amount of chemically oxidisable carbonaceous matter. The COD shared a rising trend from June to July onwards.

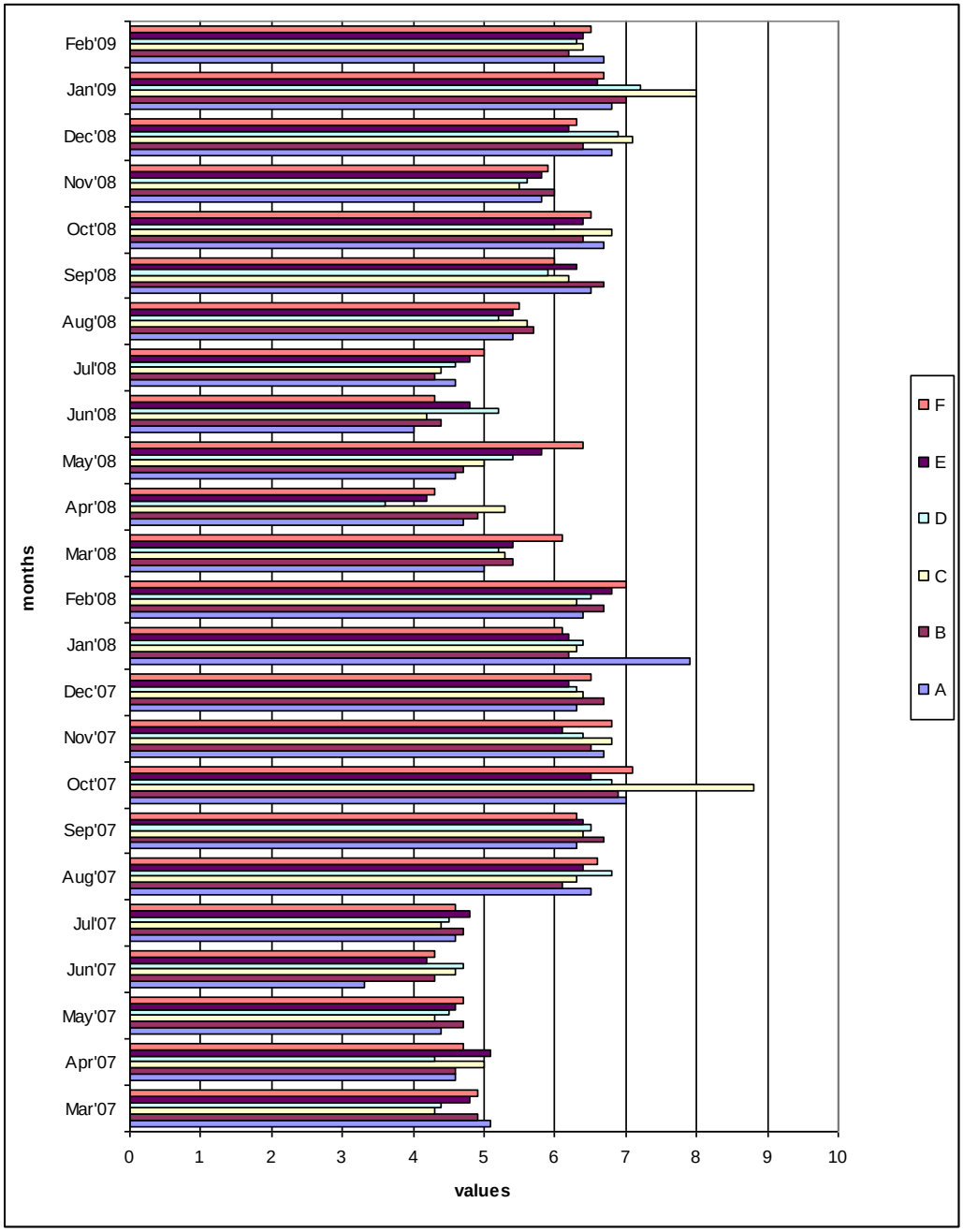
The maximum values were recorded in the month of June as 52.6 mg/lit at site A 'D' in the year 2008 whereas the minimum COD was recorded as 24.0 mg./lit. in December 2007 at site A and B. Kannan and Pandiyan (2010) observed the highest value of COD (9.6 mg/lit.) in the month of July and the lowest of 3.0 mg/lit. in the month of March in the river Bhagirathi. Ajmal et al. (1985) observed the COD in the winter season in the range of 5.0-320 mg./lit. in Kali Nadi. In river Yamuna, COD was found higher than BOD by Kannan, and Pandiyan 2010) from which may be concluded that some degree of biodegradable oxygen demanding pollutants were present in the water near the cities.

Table 3. Values of PH (Hydrogen Ion Concentration) at various sites in the sarsainawar wetland of district Etawah (UP).



A,B,C,D,E,F ARE THE VARIOUS SAMPLING SITES

Table 4. Values of Dissolved Oxygen (Mg./Lit.) at various sites in the Sarsainawer Wetland of District Etawah (UP).

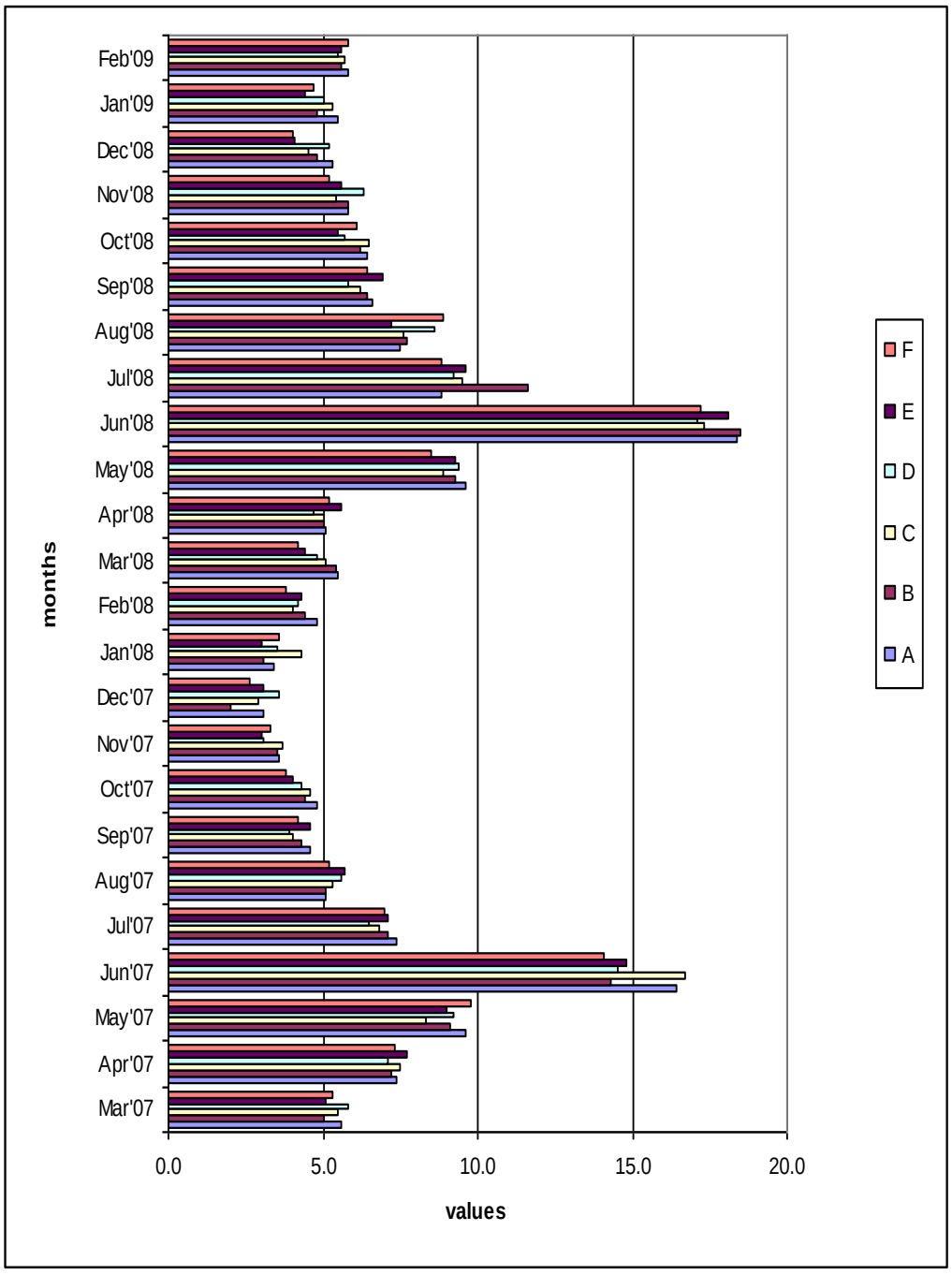


A,B,C,D,E,F ARE THE VARIOUS SAMPLING SITES

Studies on the ecology of plankton of a water body are very helpful to know its general economy and to understand the basic nature of the wetland or pond. All waters are known to be characterized by quantitative and qualitative fluctuations in the plankton populations. Since plankton serve as a food for the economically important cultural Indian carps and their fingerlings, hence some attempt was made to provide a list, at least of the Ichthyofauna of Sarsainawer Wetland during the present study.

The plants and animals provide a record of the prevailing conditions and are not affected by a temporary condition of effluent (Kant and Kachroo, 1975). Every species has an optimum condition resulting from the combination of factors which brings about its predominance in a water body. It is generally difficult to single out the factor which may the limiting one because it is not only the physico-chemical conditions which determine the well being of the species but also its physiological abilities to acclimatize to a set of conditions.

Table 5. Fluctuation in Bio-chemical oxygen Demand (BOD) (Mg/lt) at various sampling sites in the Sarsainawer Wetland.



A,B,C,D,E,F ARE THE VARIOUS SAMPLING SITES

Planktonic organism varies qualitatively and quantitatively with the site, time and season. They also differ in different water bodies according to the source of water, its organic, inorganic, biological and climatic factors (Kannan, and Pandiyan, 2010). Since very little is known about the planktonic diversity of freshwaters bodies of different qualities and more over information on the planktonic fauna of the different fresh waters is assorted and incomplete, hence the stress was made on the qualitative, estimation of phytoplankton abundance along with major macrophytes and inchthyofauna of Sarsainwer Wetland whereas the qualitative and quantitative analysis of Zooplanktons was made.

The three major and important families that represent phytoplankton were Chlorophyceae; Bacillariophyceae and Cyanophyceae. The increasing trend in the Wetland was chlorophyceae > Bacillariophyceae > Cynophyceae, that way chlorophyceae formed the major group. The major genera recorded at various sites are chlorophyceae-*Spirogyra*, *Volvox, Ulothrix, Oedogonium* and *Cladophora.*

Aquatic organisms range in size and complexity from the smallest single celled microorganisms to the largest fish so to say water may serve as a medium in which literally thousands of biological species spend part, if not all of their life cycle. The presence or absence of this biological community may indicate in general terms, the characteristics of a given body of water. Zooplankton, foming the most important animal group of aquatic environment, constitutes a major portion of the diet of fish and other aquatic organism. The majority of economically important fresh water teleosts are known to pass through stages in their life history when they subsist on zooplankton for food. Besides, many adult major carps of commercial importance are reported to feed selectively on this organism. Zooplanktons form an important productive component. Being the primary consumers, they constitute an essential link in the food chain of an aquatic ecosystem. Therefore, their study is important in so much so that together with other limnological variables, they help in the evaluation of the trophic state of the system zooplankton also play an important role in nutrient regeneration the nutrients in a particular water layer may be zooplankton excretion and by lower rates of nutrient uptake due to reduced numbers of algae (Goldman and Horne 1983). Zooplankton has been a subject of study by several authors in India and abroad during the past decades. The important contributions were made by Edmondson (1962), (1973), Zutushi *et al* (1980, 82), Zutushi and Vass (1982). The changes in the physico-chemical condition, interspecific and intraspecific competition, pollution level and the presence or absence of planktivorous or piscivorous fish are some of the factors influencing zooplankton species composition and structure in any aquatic ecosystem.

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