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Bioaccumulation in tissues of fresh water fish *Cirrhina mrigala* on chronic exposure of heavy metal nickel for 60 days

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Abstract

For animals, although, nickel is a nutritionally essential trace metal but can be dangerous when the maximum tolerable limits are exceeded. So an attempt has been made in the present research to study its bioaccumulation in different tissues of fresh water fish, *Cirrhina mrigala* exposed to sublethal concentrations of nickel for 20, 40 and 60 days. The fish were kept in different aquaria for different exposures and one aquarium was kept unstressed as control. The first batch of fish was sacrificed after 20 days of exposure to sub lethal dose of nickel and the second after 40 days and so on. Tissues from liver, intestine, muscle, gills and kidneys were collected and then digested for AAS to determine the concentration of nickel accumulated in these tissues. The order of accumulation of nickel in different tissues of *Cirrhina mrigala* was intestine > liver > kidney > gill > muscle. This suggest that intestine is the prime site of accumulation with highest persistence which is followed by liver, kidney, gills and muscles in the test fish throughout the exposure period. The results indicate the effect of heavy metal on the aquatic life of fresh water fish. Hence a scientific method is essential to detoxify the aquatic ecosystems.

Keywords: *Pollution* | *Nickel* | *tissue* | *bioaccumulation*

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Introduction

Human population explosion and excessive anthropogenic activities like urbanisation, industrialization and agricultural processes have contributed to the contamination of aquatic systems. The disposal of industrial effluents is becoming a major problem (ATSDR, 1999). Heavy metals constitute a core group of aquatic pollutants and additional concentrations of these metals accumulate in the aquatic ecosystems as a result of land based activities (Vutukuru S.S, 2003). The toxic metals are held to be the most dangerous, since continuous exposure of aquatic organisms to their low concentration may result in bioaccumulation and transfer to man through food web (Gaspic *et al*., 2007). Heavy metals from natural and anthropogenic sources are continuously released into aquatic ecosystems and they are a serious threat because of their toxicity, long persistence, bioaccumulation and biomagnification in the food chain (Eisler, 1988).

Nickel is ubiquitous trace metal and occurs in soil, water, air, and in the biosphere. It is emitted into the environment from both natural and man-made sources. Once released to the environment, nickel readily forms complexes with many ligands, making it more mobile than

most heavy metals (Prathiban *et al*., 2011). Most nickel is used for the production of stainless steel. Nickel metal and its alloys are used widely in the metallurgical, chemical and food processing industries, especially as catalysts and pigments (Grandjean, P., 1984; Clarkson, T.W., 1988). Ni is also used extensively in electroplating as nickel sulphate and nickel hydroxide is used in nickel–cadmium batteries (Nanda and Behera, 1996). Metal mining, smelting, refining, and processing along with fuel combustion and waste incineration activities release siagnificant amounts of nickel (Ni) into freshwater habitats through atmospheric deposition and in liquid effluents and leachates (Chau and Kulikovsky-Cordeiro, 1995).

Humans may be exposed to nickel by breathing air, drinking water, eating food or smoking cigarettes. Skin contact with nickel-contaminated soil or water may also result in nickel exposure. In small quantities nickel is essential, but when the uptake is too high it can be a danger to human health. An uptake of too large quantities of nickel results in higher chances of development of lung cancer, nose cancer, larynx cancer and prostate cancer, sickness and dizziness after exposure to nickel gas, lung embolism, respiratory failure, birth defects, asthma and chronic bronchitis, allergic reactions such as skin rashes, mainly from jewellery, heart disorders. Nickel fumes are respiratory irritants and may cause pneumonitis. Exposure to nickel and its compounds may result in the development of a dermatitis known as “nickel itch” in sensitized individuals.

Fishes are sensitive to contaminants of the water and pollutants may damage certain physiological and biochemical processes when they enter the organs of the fish (Tulasi *et al*., 1992). The fishes which are largely being used for the assessment of the quality of the aquatic environment can act as bioindicator of environmental pollution (Dautrempuits et al, 2004). Fish residing in polluted freshwater systems are exposed to *Ni*, primarily, through the ingestion of contaminated food and sediments (Dallinger and Kautzky, 1985).

In fresh water fish, heavy metal uptake takes place mainly through three routes, namely gills, skin and also from food via intestinal wall (Karlsson-Norgran and Runn, 1985). On the other hand, the water retention capacity of the fish is dependent on the metal assimilation and excretion capacities of fish concerned (Rao and Patnaik, 1999). According to Ferard et al (1983) aquatic organisms take up heavy metals and concentrate them to amounts considerably higher than those found in environment. Therefore, it is important to find the pathways of accumulation of heavy metals and their affinity to different tissues. The unsafe concentrations of heavy metal pollution in our aquatic systems and their negative impact on fish necessitated to plan and conduct this research project i.e. bioaccumulation of nickel in the tissues of fresh water teleost fish, *Cirrhina mrigala.*

Materials and Methods

1. Collection and Acclimatization of Fish

The fish, *Cirrhina mrigala* were purchased from the local fish market having an average length 12±3 cm and wt 200 ±2 gms The fish were then kept in different aquaria for conduction of various experiments. The fishes were acclimatized to laboratory conditions in

aquaria for a few days. In one aquarium the fish were kept as control specimens given the same food and environment as that of the experimental fish except that they were not given the dose of heavy metal compound. To observe the chronic effects of Nickel, sublethal dose (1/10 concentration of 96 hr LC_{50}) of the heavy metal compound, nickel chloride ($NiCl_2$) was given for 20, 40, and 60 days.

2. Tissue Collection and Digestion for AAS

The first batch of fishes was sacrificed after 20 days of exposure to sub lethal dose of nickel and the second after 40 days and so on. Tissues from liver, intestine, muscle, gills and kidneys were collected and weighed quickly 1 gm each and digested to prepare a clear solution by leaving it in 5 ml mixture of nitric acid and sulphuric acid and perchloric acid in ratio of 1:1:1. The samples were put in kdjeldal flask at 125 degree centigrade for few days and adding nitric acid very slowly at intervals till the brown fumes of sulphuric acid ceased and the volume of the residue was made to 50 ml by addition of distilled water (Finney, D.J., 1978).

3. Sample Analysis by Atomic Absorbtion Spectroscopy

Atomic absorption Spectroscopy is an optical technique based on characteristic pattern of emission or absorption of light by atom or molecules and suitable for estimation of most metals (Curry et al, 1969). Atomic absorption measurements were carried out and the calculations were made (Lindsay, W.L. and Norwell, W. A., 1978).

The analyzed concentration expressed as the % of the metal is calculated from the following formula

$$X=m \times 100/M$$

X- Standard for the weight of the metal in the sample

m- Mass in microgram of the metal per millilitre of the solution (obtained from reading)

M- Mass in microgram per ml of the sample in the test solution.

Result and Discussion

Heavy metal Nickel(Ni) was analysed in different tissues like liver, gills, kidney, intestine and muscle of fresh water fish, *Cirrhina mrigala* exposed for 20, 40 and 60 days to salt of nickel (Table 1). In the present study, the fish kept under control (without exposure) were also found to have accumulated heavy metals in their tissues. This suggests heavy metal contamination of aquatic systems from which fish were procured. After 60 days of chronic exposure of sublethal concentration of nickel chloride, the order of accumulation of nickel in different tissues of *Cirrhina mrigala* was Intestine > liver > kidney > gill > muscle. The nickel content was higher in the intestine than the other organs tested. This suggest that intestine is the prime site of accumulation with highest persistence which is followed by liver, kidney, gills and muscles in the test fish throughout the exposure period.

In the present investigation the liver tissue of the exposed fish always contained a significantly higher level of Ni residue as compared to the control fish. The concentration of Ni in liver kept on increasing with period of exposure. After 20 days the concentration was 1.12µg/g and became almost double. after 40 days (2.20µg/g) and increased to 3.38µg/g after 60 days. The liver plays an important role in accumulation and detoxification of heavy

TISSUES	CONTROL	20 DAYS	40 DAYS	60 DAYS
LIVER	0.79±0.02	1.12±0.09	2.20±0.13	3.38±1.18
KIDNEY	1.30±0.04	2.07±0.15	2.25±0.05	2.79±1.10
INTESTINE	1.29±0.06	1.95±0.10	2.75±0.07	3.58±1.20
GILL	0.08±0.01	1.17±0.09	2.62±0.15	2.15±1.15
MUSCLE	0.62±0.12	0.93±0.07	1.35±0.08	1.75±0.07

Unit µg/gm wet weight
Values are mean ± SD,
n=6

Table 1: Nickel content in different tissues of *Cirrhina mrigala*

metals (Yousafzai, 2004). Exposure of fish to elevated levels of heavy metals induces the synthesis of metallothioneine proteins (MT) (Friberg *et al.*, 1971). MT has high affinities for heavy metals and in doing so, concentrate and regulate these metals in the liver (Carpene and Vasak, 1989). MT binds and detoxifies the metal ion (Kojima and Kagi, 1978). A. Rauf and M. Javed *et al.,* (2009) also found that liver exhibited highest tendency to accumulate heavy metals in the three major carps (*Catla catla, Labeo rohita and Cirrhina mrigala*) from the river Ravi, Pakistan. The higher accumulation in liver may alter the levels of various biochemical parameters in this organ. This may also cause severe liver damage (Ferguson, 1989; Mayers and Hendricks, 1984; Narayanan and Vinodhini, 2008).

Kidney is the gateway for heavy metal detoxification in the body. The concentration of nickel in the kidney kept on increasing from 2.07µg/g(20 days) to 2.25 µg/g (40 days) to 2.79µg/g till the end of exposure period (60 days). These results indicate kidney as target organ to heavy metal storage in *Cirrhina mrigala*. The high accumulation of Ni in the kidney corroborated the results obtained by Philips and Russo (1978). Also, Malik *et al.,* (2010) reported that kidney was the major site for heavy metal accumulation.

In the intestine of control fish, the concentration of metal was found to be1.29µg/g. The concentration of nickel increased to 1.95µg/g after 20 days. After 40 days of exposure, the concentration of metal accumulated (2.75 µg/g) was almost double the concentration of control fish. The maximum concentration of metal accumulated was after 60 days i.e. 3.58 µg/g. Alimentary canal can be considered as the interface of the organisms and its ambience. It is the system which receives the metal directly from the ambient source (Matheissen and Brafield, 1975). Similar increase in concentration of metal content in intestine has been observed in *Labeo dyocheilus* and *Wallagu attu* on exposure of lead and nickel by A.M. Yousafzai, *et al.,* (2010). Zheng Zhang et al (2007) also reported high concentration of heavy metals in the intestine of fish. Fish intestines accumulated more heavy metals in this study and might represent good biomonitors of metals present in the surrounding environment.

Gill surfaces are the first target of water-born metals (Spicer and Weber, 1991). In the present study accumulation of heavy metal nickel kept on increasing from 1.17µg/g (20 days) to 2.62µg/g after 40 days of exposure in gill tissue which can possibly be due to the fact that they are the main sites for metal uptake,

particularly in fresh water fish and due to large surface that is in contact with environmental water and the very thin barrier separating the external and internal media of the animals (S.S. Murugan *et al*.,, 2008). Laboratory experiments have indicated that in fishes which take up heavy metals from water, the gills generally show higher concentration than in the digestive tract. On the other hand, fish accumulating heavy metals from food show elevated metal levels in the digestive tract as compared to the gills (Ney and Van Hassel, 1983; Heath, 1990). Gills of *Cirrhina mrigala* accumulated relatively less metal than the intestine. So on the basis of our results we can suggest that major route of uptake of heavy metals in *Cirrhina mrigala* in present study was diet born. However, after 60 days of exposure of nickel, the concentration of the accumulated metal decreased to 2.15µg/g. Moreover the concentration of the accumulated heavy metal nickel in the gill tissue of this species was lower than that in the liver, intestine and kidney. Lower amounts of these heavy metals in gills suggest that heavy metals are excreted more rapidly and reduce the body burden of heavy metal and suggest that nickel is not accumulated for prolonged period in the gill tissue. According to B.Y. Kamaruzzaman *et al*., (2010) fishes exposed to longer period with minimal concentration tend to accumulate less heavy metals in gills as they are transported to other parts of the body and there is in-toxic mechanism practiced by the fish to defend itself from the toxicity of the pollutants.

Muscle is the major tissue of interest under routine monitoring of metal contamination because it is consumed by people. The concentration of nickel in the muscle of control fish was 0.62µg/g and after exposure, the concentration increased to 0.93µg/g (20 days), 1.35µg/g (40 days) and 1.75 µg/g (60 days). In muscle the accumulation of metal was less as compared to metal accumulated in other tissues. The low levels of nickel in the fish muscles appear to be due to low levels of binding proteins in muscles (Allen Gill and Martynov, 1995). R.Vinodhini and M. Narayanan (2008) also recorded low levels of Pb and Ni in the muscle tissue of *Cyprinus carpio* as compared to other tissues because the heavy metals were uniformly spread over the body muscles. Hence, the observed values were relatively lower than the other potential organs. According to Madhusudan *et al.,* (2003), the excessive heavy metal in muscle was transferred to other organs in fish exposed to heavy metal contaminated system. It is evident that the test fish *Cirrhina mrigala* has tendency to push heavy metal burden to other tissues like kidney from muscle during metallic stress, perhaps may be up to some limit of exposure concentration and time. But this heavy metal metabolism in fish definitely does not allow for excessive ambient metal in muscle tissue to pose a threat to fish. This ability of deloading of fish is advantageous to consumers who are using fish muscle as their food.

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Anticipated performance index (API) of some tree species grown in Aurangabad city

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Abstract

Vegetation affects local and regional air quality by altering the urban atmospheric environment. The trees grown in urban area affects the air quality in terms of reduction in air temperature, removal of air pollutants, energy effects on buildings and emission of volatile organic compounds. The plant response can be monitored by analyzing the plant extract for various parameters like chlorophylls, ascorbic acid, pH and water content. In the present investigation anticipated performance index (API) of four tree species is evaluated. *Azadirachata indica* and *Mangifera indica* were the tree species having good API values (4 of each) because of their biological and socio-economic uses while *Polyalthialongi folia* and *Dalbergia sissoo* were judged to be moderate and poor tree species having 3 and 2 API values respectively.

Keywords: *API* | *APTI* | *Biological* | *Socio-economic* | *Tolerance*

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Introduction

Air is one of the most important elements for all living beings. It is one of the important natural resource on which all life depends. Clean and pure air is needed for the healthy life of all living beings including plants. Nowadays the atmosphere is being polluted; impure air affects human health as well as other environmental resources such as water, soil, and forests. Ultimately air pollution affects adversely the process of development at local as well as global level. At the present condition crowded cities like India with increasing numbers of industries, intensive transport networks and high population density have became a major source of air pollution.

All over the world developed, developing and underdeveloped countries are experiencing rapid growth. This growth is occurring at a considerable, and often increasing, economic and social cost, without implementing environmental policy and action. Increasing

number of people, industry, and motor vehicles cause air pollution which poses a serious environmental threat in urban areas. The world health organization(WHO) and some other international agencies have identified urban air pollution as a serious concern.

Trees in city area are facing the adverse impacts of pollution. The leaf is the most sensitive part to air pollutants. Affected plants show some common effects such as decrease in chlorophyll content, Inhabitation in photosynthesis and decreasing plant growth (Davision and Blakemore, 1976). Air pollution tolerance index defines capability of plant to combat against the air pollution. Plants responses towards air can be assessed by air pollution tolerance indices (Sing and Rao, 1983). The present study was planned to access the tolerance capacity and anticipated performance index of common trees grown in and Aurangabad city.

Materials and Methods

Various biochemical parameters like Chlorophyll content (Maclachlan and Zalic, 1963), ascorbic acid content (Keller and Schwager, 1977), leaf extract pH (Singh and Rao, 1983) and relative water content (Singh, 1997) were done from the collected leaf samples.

Air pollution tolerance Index (APTI)

It was calculated byfollowing the method (Singh and Rao, 1983).

$$APTI= \{A (T + P) + R\} / 10$$

Where: A is ascorbic acid content (mg/g), T is total chlorophyll (mg/g), P is pH of leaf extract and R is relative water content of leaf (%).

API (Anticipated performance Index):

Combining the results of APTI values with some relevant biological and socio-economic characters (Plant habitat, canopy structure, type of plant, laminar structure and economic value) the API can be calculated for different species. Based on these characters, different grades (+ or -) are allotted to plants. Different plants are scored according to their grades.

Result and Discussion

Plant species were evaluated for various biological and socio- economic as well as some biochemical characters. These parameters were subjected to a grading scale to determine the anticipated performance of plant species as described by (Sing and Rao, 1983). API was calculated using the assessment parameters with respect to grading characters using a summation of the anticipated performance of the plant species. *Azadirachataindica* and *Mangiferaindica* was the tree species having good API value with respect to the biological and socio-economic uses while *Polyalthialongi folia* and *Dalbergia Sissoo*were judged to be moderate and poor tree species respectively.

Azadirachataindica found to be most tolerant tree species among all other species. It has dense canopy. The economic and aesthetic

value of this tree species is also well known. *Mangifera indica* is also another tree species having good API and tolerant to air pollution. It is an evergreen tree having dense canopy, rough leaves and valuable for aesthetic and economic uses. *Polyalthialongi folia* is also evergreen tree but its economic uses are less so the API value calculated is moderate. *Polyalthialongi folia* is an evergreen tree but its economic uses are less so the API value calculated is moderate. *Dalbergia Sissoo* is a deciduous tree and the size is medium texture is smooth so the API value calculated is poor and not recommended for the planting nearby roads.

Grading Character allotted	**Pattern of Assessment**	**Grade**
a) Tolerance (APTI)	8.00 – 12.00	-
	12.01 – 16.00	+
	16.01 –20.00	++
	20.01 – 24.00	+++
b) Biological and Socio-Economic:		
1) Plant habitat	Small-	
	Medium +	
	Large	++
2) Canopy Structure	Sparce/Irregular/ Globular-	
	Spreading crown/ Semi dense +	
	Spreading dense	++
3) Type of tree	Deciduous -	
	Evergreen +	
4) Laminar Structure – Size:	Small -	
	Medium +	
	Large ++	
Texture:	Smooth-	
	Coriaceous+	
Hardness:	Delineate	-
	Hardy	+
5) Economic value-	Less than tree uses-	
	Three to four uses+	
	Five or more uses	++

Sr. No	Score (%)	Assessment category
1	Up to 30	Not recommended
2	Up to 31-40	Very poor
3	Up to 41-50	Poor
4	Up to 51-60	Moderate
5	Up to 61-70	Good
6	Up to 71-80	Very good
7	Up to 81-90	Excellent
8	Up to 91-100	Best

Anticipated performance index (API) of some plant species

Sr. No.	Local Name	Scientific Name	APTI	Tree Habitat	Canopy Structure	Tree type
1	Neem	*Azadirachta Indica*	+++	++	+	-
2	Mango	*Mangifera Indica*	++	++	+	+
3	Ashoka	*Polyalthia Longifolia*	++	+	+	+
4	Sheesham	*Dalbergia Sissoo*	++	++	+	-

Anticipated performance index (API) of some plant species Table-1(a): Assessment parameters

Size	Texture	Hardness	Economic Value	Total Plus	% Scoring	API Grade
+	+	+	++	11	69	4
+	+	+	++	11	69	4
+	+	+	+	09	56	3
-	-	+	+	07	44	2

Anticipated performance index (API) of some plant species Table-1(b): Assessment parameters

Sr. No.	Local Name	Scientific Name	Total plus (+)	% Scored	API	Assessment
1	Neem	*Azadirachta Indica*	11	69	4	Good
2	Mango	*Mangifera Indica*	11	69	4	Good
3	Ashoka	*Polyalthia Longifolia*	09	56	3	Moderate
4	Sheesham	*Dalbergia Sissoo*	07	44	2	Poor

Assessment of plant species

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Hydrobiology assessment of the fresh water reservoir Nyari-II in relation to fisheries

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Abstract

Nyari – II reservoir is located in Rajkot district of Gujarat. The reservoir provides water for irrigation in surrounding agriculture fields and drinking water to the urban area of Rajkot. This reservoir is also used for stocking of fresh water fishes and is good source of inland fisheries of the Rajkot district. To evaluate sustained fisheries and estimate potential of fisheries, the hydrobiology of the reservoir was studied. The present study deals with the seasonal variation in the water quality of the reservoir during June 2005 to May 2006. The water samples were collected from the reservoirs for each month in the morning hours. Various physico-chemical parameters like pH, temperature, alkalinity, hardness, chloride, dissolved oxygen, phosphate, nitrate etc. were analyzed. The plankton dynamics and productivity were estimated. Significant seasonal variation was observed during the study for various parameters. Further, considerably good diversity and density with seasonal variations of plankton was recorded from the waters of the reservoir. The good ratio of gross and net productivity was recorded leads to consider the reservoir as good potential area for fisheries. The hydrological status of the reservoir is correlated with its plankton status and fisheries potential.

Keywords: *Hydrobiology | Plankton dynamics | Biological | Fisheries potential*

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Introduction

Gujarat state, broadly falls within the ecological term of semi arid zone (BES-GOG, 1986; GEC, 2000), is naturally water scarcity prone area. The water is one of the essential constituents of all living organism. Reservoir is a low line area of a river with surrounding earthen depression of a river with constructed dam to develop surface water sheet. Depending upon the water stocking capacity broadly reservoirs can be classified as major, medium or minor reservoirs (WRD-GOG, 1989). As

principally the water of the reservoir is used for irrigating agricultural fields and for the potable water supply to nearby inhabitants, they are termed as irrigation tanks also. Many of such reservoirs due to their good water holding capacity during summer termed as long seasonal or perennial reservoirs. Such reservoirs are used for natural capture fisheries or planned fish culture activities. Fishing activity always results into economical gain from the reservoirs, as primarily they are designed for other purposes. The rain water is pure but the reservoir holds impurities, turbid water with variation in its hydrological parameters. The present study was undertaken to examine various changes have been observed for the water quality parameter be attributed to the disposal of garbage, sewage and agricultural runoff. The hydrological parameters such as pH, Dissolved Oxygen, Biological Oxygen Demand, Chemical Oxygen Demand, Total hardness, phosphates and nitrates were assessed by recommended international standard method by APHA (1998). To overcome this long lasting major problem of water scarcity several varied capacity reservoirs have been created. Many of such reservoirs are exploited for fisheries activities though truly under exploited. Exploration of reservoirs for economical gain – fisheries – requires to be estimated for standing fish stock and its potential efficiency to increase the reward by fishing. Good fisheries sustenance is possible only if the water and soil quality is maintained. The ideal approach in such cases is to select a sample reservoir and thoroughly analyse it for ecological conditions and fisheries status. Inland reservoir in this case was treated as the unit, an ecosystem. The quality estimation was done for physico–chemical properties of water and soil, the biological conditions and finally fisheries aspects. The variation in above mention parameters influences each other as well as in total to the hydrological state of the reservoir. This may also influence on biological nature of the reservoir. Any reservoir requires to the assessed for its water budget, water quality. The water quality assessment helps in understanding its biological nature as well as pollution status.

Study site

An Inland reservoir, Nyari–II, is located in the Rajkot district of Gujarat state. This perennial reservoir is rain fed as well as receives flood water through Nyari River. Primarily the water resource is identified to be utilized for irrigation and community water supply to RUDA (Rajkot Urban Development Area). This long seasonal reservoir has the catchment area of 314 sq km and water storage capacity of 88.94 FRL, which is used for capture fisheries. Fisheries department of government of Gujarat has under taken this reservoir for stocking of Carp seeds due to its good quality and quantity of water. Study site fresh water

reservoir Nyari – II is located in Rajkot district Latitude: 22^0 – 21' – 45" N and Longitude: 70^0 – 40' – 15".

Methodology

Water samples were collected monthly for the entire year 2005 –06, from immediate sub – surface of the fresh water reservoir. Three samples were collected randomly from various zones of the reservoir and were pulled together and final sample was drawn for the analysis on the same day. These samples were processed, preserved etc. for further detailed quality estimations in the laboratory. All the quality parameters were analysed as per standard methods mentioned in APHA (1998). Table – 1. The estimation of dissolved oxygen (DO) was carried out by fixing the same in the sample on site by adding Winkler's reagents and then brought to the laboratory for further analysis in different container.

Sr. No.	Parameter	Method	Instrument
1	Temperature	Laboratory or Field method	Mercury Thermometer
2	Electrical Conductivity	Instrumental method	Conductivity meter
3	Turbidity	Nephlometric method	Nephlo meter, Turbidity meter
4	pH	Electrometric method	pH meter
5	DO,	Winkler's method - Azide modification method	BOD bottle, Titration assembly
6	BOD	Winkler's method - Azide modification method	BOD bottle, Titration assembly
7	COD	Titrimetric Open Reflux Method	COD digestion apparatus
8	Alkalinity	Titrimetric	Titration assembly
9	Nitrogen	Colorimetric method (PDA)	Spectrophotometer
10	Phosphate	Stannous Chloride Method	Spectrophotometer
11	Sulphate	Turbidometric Method	Spectrophotometer
12	Free CO_2	Titrimetric Method	Titration assembly
13	Primary Productivity NPP & GPP	Titrimetric Method, DO – Difference	BOD bottle, Light & Dark bottle

Result and discussion

Hydrological assessment of subjected reservoir was carried out during year 2005 to 2006 on monthly basis. Water quality was determined for some physical and chemical parameters that were closely related to fisheries status of the reservoir. Surface temperature 28.33 average and ranged from 21^0C to 33^0C and usually minimum was recorded in January and maximum in the month of September-October. Similar observation was made by Kumar and Kapoor (2006) for such temperature condition is due to close relationship established between atmosphere and water. The turbidity of the water plays a vital role in interaction of penetrating light and photosynthetic pigments. Here, comparatively water is quite transparent and turbidity ranged from 2.0 to 6.0 NTU during entire period of observation. The chemistry of water interacts with the planktonic forms and generates organic carbon as well as plays important role in maintaining the balance between chemical and biochemical state of reservoir. In general pH of water remained alkaline with average pH 7.85, only in July the fluctuation was recorded more. According to Venkateshwarlu (1983) such

reservoirs were classified under alkaliphilous state which is found to be good for fisheries activity. Salts in water are the indicators of active chemical nature weather suspended or dissolved. Hence, the estimation of total solids as well as dissolved and suspended solids is required. In present investigation total solids were observed to be minimum during monsoon season and maximum usually in May and June months. The average 422 mg/l of total dissolved solids was recorded during the complete period of study as range from 680 to 218 mg/l. Electrical conductivity (EC) is closely related to the nature of salts and solids. It ranged from 0.5 to 2.0 mho and recorded minimum in September-October and maximum during the summer period. The organic status of a water body is sustained always if the status of dissolved gases and nutrients remains within normal required ranges (Water standards IS 10500, 1991). In this present study by and large the status of dissolved gases like dissolved oxygen, free carbon dioxide and chloride remained within the optimum ranges required. Dissolved oxygen value was ranged from 3.77 to 10.9 mg/l with an average of 7.19 mg/l for entire year; minimum dissolved oxygen is recorded during monsoon and maximum during winter season. The biological oxygen demand (BOD) and chemical oxygen demand (COD) for the water samples were estimated to qualify the water qualities suitability for fisheries purpose. The data indicates that the reservoir is not having either organic or inorganic pollution threats, therefore is suitable for fish stocking. Minimum value of BOD is around 3.0 mg/l may be due to retarded microbial activity and high value (8.0mg/l <) of BOD is observed during post monsoon may be attributed to high organic decomposition (Ara *et al*., 2003). Nutrients like Ammonical Nitrogen, Nitrite and Phosphate ranged within the normal limit which is the indication of balanced state between chemical nature of water and its productive potential. Organic decomposition produces Sulphate which ranged from 30 to 100 mg/l and do not represent any significant relationship of its quantity during different season. Estimated values of total hardness ranged from 210 to 540 mg/l with general average at 330 mg/l and minimum during October and maximum during June. Such moderate state of hardness in the water body might be due to the contribution through the runoff from the agricultural fields from the command area (Forsyth and McColl 1975; Pandarkar and Mane, 2006). In the water of this reservoir generally high total alkalinity values were recorded (~200 mg/l) it is indicative of the higher trophic status (Sarwar and Wazir, 1991), which is favourable condition to stocking of major carps seeds. Suitability of water for pisciculture or positive potential for fisheries requires good status of physico–chemical condition of the various above

mentioned abiotic parameters. On assessment of the ecological status of Nyari-II reservoir most of all the parametric results were within the stated quality criteria hence, may be considered that the reservoir is good for fisheries activity (Subbamma and Ramsharma, 1992; Chandraprakash, 2001).

Sr. No.	Month	Temp ^0C	pH	TDS mg./l	DO mg./l	BOD mg./l	COD mg./l	NH_3^- N	PO_4^-P	NO_3^-N	Salinity ppt	Turbidity N.T.U.	NPP	GPP
1	Jun	30	7.47	218	6.37	0.71	22	0.56	0.060	0.090	23.00	4.0	265.63	425.00
2	Jul	31	8.02	262	6.50	2.88	08	0.56	0.210	0.080	15.50	4.5	409.38	1025.00
3	Aug	31	7.96	238	3.77	2.74	13	0.56	0.010	0.070	11.75	4.8	446.88	1231.25
4	Sep	32	7.40	416	8.67	7.77	20	0.84	0.035	0.150	9.38	3.1	40.63	1100.00
5	Oct	33	7.69	392	7.68	1.03	23	0.56	0.050	0.680	8.38	2.8	68.75	1009.38
6	Nov	32	7.04	580	6.82	0.84	22	0.56	0.210	2.047	10.25	4.5	221.88	903.13
7	Dec	22	8.20	402	8.15	1.81	28	0.28	0.330	0.018	10.38	4.9	87.50	578.13
8	Jan	21	8.31	510	10.90	3.65	14	0.84	0.230	0.093	15.00	2.6	237.50	493.75
9	Feb	23	8.34	580	6.14	3.11	26	0.28	0.310	0.023	14.75	4.8	106.25	687.50
10	Mar	26	8.06	620	6.94	1.87	17	0.56	0.180	0.041	16.25	3.8	125.00	1068.75
11	Apr	29	7.40	474	4.77	0.79	21	1.12	0.008	0.135	17.75	5.8	265.63	956.25
12	May	30	7.44	680	4.72	9.71	37	0.56	0.007	0.130	19.88	5.1	118.75	868.75
	Average	28.33	7.85	422	7.19	2.64	19	0.56	0.163	0.329	14.36	4.2	199.48	862.24
	Maximum	33	8.34	680	10.9	7.77	28	0.84	0.33	2.047	23.0	5.8	446.88	1231.25
	Minimum	21	7.04	218	3.77	0.71	8	0.28	0.01	0.018	8.38	2.6	40.63	425.00

Table 2

Sr. No.	Year	Stocking Fish seeds	Fresh Fish kg	Dehydrated Fish kg	Total kg
1	1998-99	239000	9380	3450	12830
2	1999-00	40,000	5335	1100	6435
3	2000-01	600000	14396	6000	20396
4	2001-02	1205000	24192	6250	30442
5	2002-03	6,00,000	14890	6250	21140
6	2003-04	60,000	12920	100	13020
7	2004-05	120000	73990	5600	79590
8	2005-06	360000	78360	100	78460
9	2006-07	252000	8170	3450	12830
10	2007-08	328500	2340	1100	6435

Table 3: Fish catch Fresh & Dehydrated

Primary productivity was estimated as mgc/m^3/d and reported as gross primary productivity (GPP) and net primary productivity (NPP). GPP was ranged between 425 to 1350 mgc/m^3/d and was reported high during post monsoon. Present study revealed distinct seasonal and bimodal pattern of variation in GPP having peaks in winter and summer. Solar radiation perhaps is the prime factor for such variation in GPP (Kumar and Chaudhary, 2007). NPP value showed similar pattern like GPP with a slight sift in the monthly variation. This may be due to

reduction in productive zone, water level and nutrient recycling (Saran et al., 1985).

It has been observed that several Cypriniformes (fishes) were present as native fish of this reservoir and the Indian Major Carps were also introduced as a part of pisciculture programme, feed on this high amount of zooplankton. On the analysis of various parameters we may consider that Nyari–II reservoir is ecologically very well balanced ecosystem and it can sustain good biodiversity as well as fisheries. Several macrofauna observed in this reservoir were having direct or indirect relationship with ecosystem as well as fisheries, therefore, biodiversity analysis was carried out as one of the significant component. Native fishes were represented by major families like Cyprinidae, Siluridae, Gobidae, Channidae and Cichlidae. The regular and organized fishing activities are going on in this reservoir and good amount of inland fish catch have been regularly reported from Nyari–II reservoir. Regular stocking of Indian Major Carps like Rohu, Catla and Mrigal is done by the government fisheries department considering the water budget of the reservoir. Total fish yield return of this group has been reported well and since 2004 – 05 the yield has increased, the catch of Catla and Rohu was above 10,000 kg in the year 2005-06. The past records revealed good state of fisheries in Nyari–II reservoir was one of the important key factors to select the site for ecological analysis. Data collected for ecological analysis and fish catch were subjected to appropriate statistical analysis to arrive to necessary conclusion.

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Ecological understanding of Anchar Lake, Kashmir

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Abstract

As all of us are well aware that limnology plays an important role in water use and distribution. It also helps to maintain the aquatic habitat intact. For any managerial practice/'s of lake as an ecosystem, it is very important to understand the formation and history of the lake. Also to understand its structure, physical, chemical and biological conditions. For the present study, how Anchar lake was formed, its size and shape, drainage, topography, watershed, regional climate and biological communities of the lake will be discussed. In addition activities of humans during the past and at the present time will also be discussed. It will also be discussed how more and number of people who although are not well aware of the ecology of the Anchar lake but are associated; will be involved for better understanding of this beautiful aquatic ecosystem.

Keywords: *Ecological* | *Anchar Lake* | *Kashmir* |

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Introduction

The Anchar lake is fluviatile in its origin; shallow basined and is situated 12 kms to the northwest of Srinagar city within the geographical coordinates of 34° 20´-34° 26´ N latitude and 74°82´ and 74° 85´ E longitude at 1584m a.s.l. The lake is mono basined with its main catchment comprising Srinagar city and a number of bordering villages. A network of channels from the river Sind enters the lake on its western shore and serves as the main source of water. The littorals of the lake are surrounded by a thick canopy of trees, willows and popular trees providing the base material for the manufacture of baskets, cricket bats, wood carvings, wicker work, etc. Besides numerous values of the lake in meeting human needs for survival and socio-economic development. According to Lawrence (1895), the area of the Anchar lake during 1893-1894 was 19.54 km2 and since then there has been a considerable decrease in the surface area of the lake. The area of the lake was 6.5 km2 in the year 2004. On the northwest side of the lake

the catchment is under cultivation and used mainly for raising multiple crops. The lake is heavily infested with thick macrophytic growth and the littorals of the lake are dominated by *Phragmites* sp., *Typha* sp., *Sparganium* sp. and *Nelumbium nucifera*(Lotus). As a result of heavy anthropogenic pressures as they use resources of the lake like fishes, nelumbo, trapa etc. without any consideration to the lake ecology, negligence on part of the people as well as by the government. The Anchar lake has shrinked to a large extent in the recent past (Fig.1). With the result the water quality has also deteriorated posed the threat not only to the biotic life of the lake, but also to the humans who reside on the periphery of this lake. During the last one to two decades, human population has expanded manifold in the catchment area of the lake. In addition natural siltation accompanied by anthropogenic siltation has further deteriorated the lake. This lake is situated in the low lying area and flood plain of river Sind, the deposits of silt is a nonstop process. Towards the north-east of the lake is situated the hospital. At this site, the enrichment of lake water has advanced so badly thus causing excessive growth of water macrophytes particularly on the littorals with mucky waters towards centre accompanied by bad smell. Since the lake is located at the terminus of a drainage basin, it receives water with excessive inflow of Phosphorus and the pollutants that are carried in it from the entire drainage basin, the lake acts as a "BOWL FOR POLLUTANTS" entering it. Thus the present study was undertaken for ecological understanding of the Anchar lake, and also to find out information of the lake in the recent past; its management and problems. The strategies and actions taken to address the problems of the lake. Any lesson learned from the management of other lakes as it can provide guidance on how to effectively apply the management practices in action.

Materials and Methods

Three sampling sites were selected in the lake that represents different environmental features. The site-I is located at the point where a channel from the river Sind enters the Anchar lake. It is characterized by flowing water. The site-II is located in the centre of the lake where water is standing while the site-III is located close to the point where lake receives wastes from the peripheries, where there is human habitation living. Several sewerage outlets from the catchment area and the peripheries discharge their contents into water at this site. This site is also close to the point where hospital is located. In fact these studies were undertaken in two different periods of time and on this basis comparative studies were carried out.

The earlier sampling was carried out for a period of two years extending from September 2000 to August 2002. The recent sampling was carried out for a period of only one year from

March 2011 to February 2012. The physico-chemical analysis of water samples were carried out according to standard methods of Golterman and Clymo (1969) and APHA (1989). For biological study, the samples were preserved in 5% formalin (zooplankton) and Lugols solution (phytoplankton) and further concentrated through centrifugation and studied under phase contrast inverted microscope (Nikon) in a Sedgwick-Rafter cell. Hauling samples collected were also studied to obtain representative individuals. Identification of phytoplankton was done by using standard monographs and with the help of keys given in the books of Heurk (1896), Smith (1950), Disikachary (1959), Randhawa (1959), Philpose (1967), Round (1973), Prescott (1978) and Palmer (1980). The identification of zooplankton was done with the help of keys given by Pennak (1978), Ward and Whipple (1959), Mellanby (1963), Tonapi (1980), Koste and Sheil (1980) and Sharma (1980). For the collection of Macrozoobenthos (previous studies only-Sept'2000-Aug'2002), sampling was carried out by Ekman's grab. The series of sieves used for zoobenthos are in the size range of 0.5, 0.6, and 0.2mm while as for the collection of phytoplankton and zooplankton, a standard plankton net with 64nm pore diameter was used.

Results and Discussion

The physico-chemical features of water are summarized in Table-1. The water temperature in general showing usual seasonal trend with maximum values in summer and minimum values in winter. The pH values indicate that the water is well buffered. The dissolved oxygen values were recorded minimum at site-III and maximum at site-I in both the studies. The conductivity values of Anchar lake indicate high ionic concentration. As per Oslen (1950), the water of the lake can be categorized as of β-mesotrophic type. In the latest studies (March 2011 – February 2012), the ionic concentration is on the increasing trend.

S.No	Parameter	Unit	Range-I	Range-II
1	Temperature	^{0}C	3.0-28	Same as recorded in the previous study
2	pH	-	6.9-8.6	Same as recorded in the previous study
3	Conductivity	µS/cm	205-580	375-650
4	Dissolved oxygen	mg/L	0.4-9.5	Zero-4.5
5	Calcium	mg/L	9.0-43.0	20-42
6	Magnesium	mg/L	4.3-28.5	25-65
7	Total alkalinity	mg/L	59-315	75-450
8	Chloride	mg/L	9.0-95	25-215
9	Nitrate-nitrogen	µg/L	245-611	514-845
10	Total phosphate	µg/L	200-505	316-745

Range-I: September, 2000-2002; Range-II: March, 2011-Feb'2012

Table 1: Range in physico-chemical characteristics in Anchar lake

The calcium and magnesium values indicate that the lake water is nutrient rich. Total alkalinity values also indicate that the lake water is nutrient rich. Philipose (1960) suggested that a water body with alkalinity values more than 100mg/L is nutrient rich. The chloride content of water in both the studies indicates that the water is polluted with sewage. Krenkel (1974) also observed increase in chloride contents in water receiving sewage waste. The nitrate nitrogen and phosphate phosphorus values in both the studies indicate that the lake water is nutrient rich. Sawyer (1947) has set phosphate phosphorus concentration of 300 µg/L as the critical level beyond which eutrophicated status can be expected. In the latter studies, a considerable and alarming increase particularly in phosphate phosphorus and nitrate nitrogen has been recorded.

S.No	Taxa	Site-I	Site-II	Site-III
	Bacillariophyceae			
1	Acanthes sp.	-	++	+
2	Coconeis placentula	++	+++	+
3	Cymbella sp.	+	+	+
4	Diatoma sp.	++	++	+
5	Fragillaria sp.	-	++	+++
6	Gomphonema sp.	++	++	++
7	Melosira sp.	++	++	+
8	Navicula sp.	+	+++	+++
9	Nitzschia sp.	+	+++	+++
10	Synedra ulna	-	+++	++
	Chlorophyceae			
11	Ankistrodesmus sp.	+	+	-
12	Cosmarium sp.	++	++	-
13	Pediastrum sp.	++	++	
14	Sphaerocystis sp.	+	+	
15	Staurastrum sp.	+	+	
	Cyanophyceae			
16	Microcystis	++	++	++
17	Oscillatoria sp.	+	++	+++
	Euglenophyceae			
18	Euglena sp.	-	++	+++
	Chrysophyceae			
19	Dinobryon sp.	+	++	++
	Dinophyceae			
20	Peridinium sp.	++	++	

Table 2: Showing species composition and population density of Phytoplankton in Anchar lake September 2000 to August 2002.

S.No	Taxa	Site-I	Site-II	Site-III
	Bacillariophyceae			
1	Coconeis placentula	++	+++	+
2	Cymbella sp.	+	++	+++
3	Diatoma sp.	++	++	+
4	Fragillaria sp.	+	+++	+++
5	Gomphonema sp.	++	++	++
6	Melosira sp.	++	++	+
7	Navicula sp.	+	+++	+++
8	Nitzschia sp.	+	+++	+++
9	Synedra ulna	-	+++	++
	Chlorophyceae			
10	Ankistrodesmus sp.	-	+	-
11	Cosmarium sp.	+	++	-
12	Pediastrum sp.	-	++	
13	Sphaerocystis sp.	+	++	
14	Staurastrum sp.	+	++	
	Cyanophyceae			
15	Microcystis	++	++	-
16	Oscillatoria sp.	-	++	+++
	Euglenophyceae			
17	Euglena sp.	-	++	-
	Chrysophyceae			
18	Dinobryon sp.	-	++	-
	Dinophyceae			
19	Peridinium sp.	+	++	

Table 3: Showing species composition and population density of Phytoplankton in Anchar lake from March 2011 to February

S.No.	Taxa	Site-I	Site-II	Site-III
1	*Arcella mitrata*	+	+	
2	*A. discoides*	+	+	+
3	*A. megastoma*	+	+	+
4	*A. vulgairs*	++	+	-
5	*C. constricta*	+	+	+
6	*D. accuminata*	++	++	-
7	*D. aurela*	-	+	-
8	*D. corona*	+	+	+
9	*D. rubescens*	+	+	-
10	*Difflugia labostoma*	++	-	-
11	*D. oblonga*	++	+	+
12	*Euglypha ciliata*	-	+	-
13	*Lesquereusia modesta*	++	-	-
14	*L. spiralis*	+++	-	-
15	*Nebula sp.*	+++	-	-
16	*Paraeuglypha sp.*	+	+	+
17	*Paramecium sp.*	+++	+++	++

Table 4: Showing the population density and species composition of protozoa in the Anchar lake from March 2011 to February 2012.

S.No.	Taxa	Site-I	Site-II	Site-III
1	*Arcella mitrata*	+		
2	*A. discoides*	+	+	+
3	*A. megastoma*	+	+	+
4	*A. vulgairs*	+	+	+
5	*Bullinaria indica*	+	+	
6	*C. aerophila*	+	+	
7	*C. constricta*	+	+	+
8	*Centropyxis ecornis*	+	+	
9	*Centropyxis stellata*	+	+	+
10	*D. accuminata*	+	+	+
11	*D. tuberculata*			+
12	*D. aurela*	+		+
13	*D. corona*	+	+	
14	*D. rubescens*	+	+	
15	*Difflugia labostoma*	+	+	
16	*Difflugia lebes.*	+	+	+
17	*D. oblonga*			+
18	*Euglypha ciliata*	+	+	+
19	*Euglypha laevis*		+	
20	*Euglypha tuberculata*		+	+
21	*Lesquereusia modesta*	+	+	+
22	*L. spiralis*			+
23	*N. dentistoma*			+
24	*Paraeuglypha reticulata*	+	+	
25	*Paraeuglypha sp.*		+	+
26	*Paraquadrula irregularis*	+	+	+
27	*Paramecium sp.*		+	+
28	*Pyxidicula scutella*		+	+
29	*Trinema sp.*			+
30	*Wailesella sp.*		+	+

Table 5: Showing the population density and species composition of protozoa in the Anchar lake from September 2000 to August 2002.

S.No.	Taxa	Site-I	Site-II	Site-III
1	*Bdelloid Sp.*		+	+
2	*Brachionus quadridentata*	+		
3	*B. bidentata*			+
4	*B. calyciflorus*		+	+
5	*Cephalodella sp*	+		+
6	*Chromogaster ovalis*	+		
7	*Epiphanes sp.*		+	+
8	*Filinia longiseta*		+	+
9	*Gastropus sp*	+	+	
10	*Keratella cochlearis*	+	+	+
11	*Keratella valga*	+	+	+
12	*Polyarthra vulgaris*		+	
13	*Synchaeta sp.*		+	

Table 6: Showing the population density and species composition of Rotifers in the Anchar lake from September 2000 to August 2002.

S.No.	Taxa	Site-I	Site-II	Site-III
1	*Bdelloid Sp.*		+	+
2	*Brachionus quadridentata*	+		
3	*B. bidentata*			+
4	*B. calyciflorus*		+	+
5	*Chromogaster ovalis*	+		
6	*Filinia longiseta*	+++	+	+
7	*Gastropus sp*	+	+	
8	*Keratella valga*	+	+	
9	*Polyarthra vulgaris*		+	

Table 7: showing the population density and species composition of Rotifers in the Anchar lake from March 2011 to February 2012.

S.No.	Taxa	Site-I	Site-II	Site-III
1	*Alonella sp*	+	+	+
2	*Bosmina longirostris*		+	+
3	*Canthocamptus sp*		+	
4	*Ceriodaphnia*		+	
5	*Cyclops sp*	+	+	+
6	*Daphnia pulex*		+	+
7	*Macrocyclops*	+	+	+
8	*Mesocyclops sp*		+	+
9	*Moina affins*	+	+	
10	*Moina sp.*			+
11	*Pseudosida sp*	+	+	+
12	*Sida sp*		+	
13	*Diaptomus sp.*	+		

Table 8: Showing the population density and species composition of Crustaceaen in the Anchar lake from September 2000 to August 2002.

S.No.	Taxa	Site-I	Site-II	Site-III
1	*Ceriodaphnia*		+	
2	*Cyclops sp*	+	++	-
3	*Daphnia pulex*	-	++	-
4	*Macrocyclops*	+	+	-
5	*Mesocyclops sp*	-	+	-
6	*Moina affins*	+	++	+
7	*Moina sp.*	-	++	+
8	*Pseudosida sp*	+	++	-
9	*Sida sp*	-	+	-

Table 9: Showing the population density and species composition of Crustaceaen in the Anchar lake from March 2011 to February 2012.

The phytoplankton taxa collected at the three sites from September'2000 to August'2002 have been enlisted in the table-2. A total of 20 phytoplankton taxa were identified during the whole studied period. The maximum population density and species diversity of

bacillariophyceae was recorded during autumn. While as that of chlorophyceae and cyanophyceae was recorded during the summer period. No marked or definite seasonal trend was recorded for dinophyceae and chrysophyceae taxa. The population density and species diversity for *Euglena sp.* was recorded during the summer months. The phytoplankton taxa recorded for a period of only one year from March 2011 to February 2012 have been enlisted in the table-3. A total of 19 phytoplankton taxa were identified during this period of study. The overall distribution pattern of phytoplankton taxa indicates that the species composition is not much variable between the two periods of study. The density of *Fragillaria sp.* was recorded to increase in the later studies at site-II. David *et al.* (1981) opined that this species is favoured by highly enriched waters. Jarnfelt (1952) labeled it as indicator of eutrophy. Khan and Bhat (2000) recorded this species in Manasbal lake harbouring rich growth of aquatic weeds and water receiving multiple organic wastes from anthropogenic perturbations. The phytoplankton studies also reveal that at the site-III, the percent contribution of species diversity has reduced from 70% to 50% while comparing the two periods of study. However, the margin of this difference at site-I is little and there is no change at site-II.

The Protozoa taxa found to be distributed are given in the tables 4 and 5. In the studies carried out during September' 2000-August 2002, thirty protozoa taxa have been recorded in all. While as the studies carried out during March 2011 - February 2012, in all seventeen protozoa taxa were recorded. In both the studies, the maximum density of protozoa was observed during summer followed by spring season. The lowest density was recorded during winter. The percent contribution of protozoa in terms of species diversity at site-III is 70% in the earlier studies and 41% in the latter studies. While as at site-I it is 63% in the earlier studies and 88% in the latter studies. However, at site-II no marked difference was recorded in terms of species diversity. The literature survey on the protozoa revealed that they can live actively in nutrient poor to organically rich waters and fresh waters and also can thrive well in both aerobic and anaerobic environments. According to Beaver and Crisman, (1982), protozoa populations can thrive well in more productive lakes, although probably higher in absolute terms than those in oligotrophic lakes. The present study reveals that increase in the chloride, nitrate nitrogen and total phosphate contents might be responsible for decreased species diversity among the protozoa.

The rotifer fauna collected have been enlisted in the tables 6 and 7. In the studies carried out during September' 2000-August' 2002, a total

of thirteen rotifer species were identified during the whole studied period. While as the studies carried out during March'2011-February'2012, a total of nine rotifer species were recorded. In both the studies, seasonal peaks in species diversity as well as population density in the lake was revealed during the summer. From the data it is revealed that majority of rotifer species exhibited wide occurrence. The site-I located in the feeding channel of the lake shows the minimum rotifer fauna in terms of species diversity and population density in the studies carried out during September 2000 - August 2002. While as during March 2011- February 2012, the minimum species diversity and density was recorded at the site-III, where the water area of the lake is polluted by the sewage. It can be regarded that pollution added by sewage play a significant role in the dynamics of rotifers. The percent contribution of rotifer reveals that species diversity has reduced at site-III in the latter studies (44%) in comparison to the earlier studies (61%), while as it has slightly increased at the site-I from 46% to 55%.

The crustacean fauna collected have been recorded in the tables 8 and 9. Thirteen crustaceans belonging to the orders cladocera and copepoda were discovered. Out of these, 6 were found at site-I, 11 at site-II and 8 at site-III during the period September 2000 – August 2002. While as during the period March 2011 - February 2012, only 9 crustacean taxa were recorded. Out of these, 4 were recorded at site-I, 9 at site-II and 2 at site-III. The crustacean population in both the studies showed single peak in the population density during summer. In both the studies, it has been recorded that the species diversity was much variable at different sites. The population density was highest at site-II. The percent contribution of crustaceae revealed that in the studies which were carried during March 2011 to February 2012, the species diversity has reduced considerably at the site-III in comparison to the studies which were carried earlier (Sept 2000 – Aug 2002). While as at site-II it has shown an increasing trend and negligible change at site-I.

Qualitative and quantitative analysis of zoobenthic invertebrate fauna revealed three groups viz. Annelida (5.5%), Crustacea (16.6%) and Insecta (77.0%). Phylum annelida was represented by a single taxon, *Placobdella* sp. (Hirudinea) while class crustacean included *Gammarus* sp (Amphipoda) and class Insecta was represented by 4 taxa namely *Stenonema* sp (Ephemeroptera), *Enallagma* sp (Odonata), *Chironomus* sp. (Diptera) and *Micropsectra* sp (Diptera) thereby showing the dominance of insect fauna. Out of these, 3 were recorded at site-I, 4 at site-II and only 1 at site-III. The zoobentic taxa in general showed a single peak in terms of species diversity and population density which was observed during spring. On the basis of these studies, it can be concluded that there has been an increase in

calcium, magnesium, chloride, total alkalinity, nitrate nitrogen and total phosphorus contents in the lake which is due to addition of agricultural run-off from the agricultural fields, sewage discharges from the catchment human habitation. Due to high ionic concentration and presence of rich macrophytic growth, water at site-III is highly nutritive, more turbid, less transparent. The wastes which are discharged at site-III have resulted in considerable decrease in the dissolved oxygen. The site-II where water from site-I and site-III mixes up, is moderately nutrient rich zone. The overall conditions depict that sewage, agricultural run-off associated with other factors have deteriorated the lake ecology. The normal discourse of the species diversity and density is also affected.

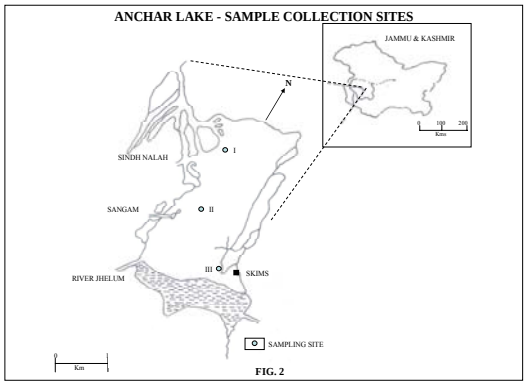

Figure - I

Management/issues associated with the Anchar lake:

There are several factors associated with which due to negligence has reduced the life span of this lake considerably.

1. Natural siltation of the lake associated with anthropogenic siltation.
2. Large scale encroachments in the catchment as well as in the lake itself.
3. The considerable inflow of sewage from the catchment areas.
4. Excessive macrophytic growth.
5. Increased levels of Phosphorus and nitrates.
6. In the close vicinity of the lake, the preliminary studies have shown that there are around 30-35 thousand people living. In addition there are several colonies around the lake in its catchment area.
7. The harmonious relationship between humans and the lake ecosystem is lacking.
8. Lake drainage basin management is totally lacking; therefore, no planning.
9. Preventive approach is lacking.
10. There is no policy for lake management.
11. Nobody comes to the front for resolution of conflicts if any with the people associated with this lake.

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Bird Diversity in Shallabug Wetland (Kashmir), India

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Abstract

Shallabug wetland is located in District Srinagar of J&K State covering an area of 700 hectares at an altitude of 1580m. The wetland depth ranges from 0.3 to 2.0 metres (Pandit, 1982). The wetland harbours a variety of aquatic and semi-aquatic vegetation providing a good habitat for a variety of birds. The supplementary food like mollusks, fishes and insects are also available in plenty. For the present study counting of birds was done on visual basis and with the help of binoculars following standard methods. The identification of birds was done according to the standard books and monographs. The present study examines the present status of birds in the Shallabug Wetland Kashmir, India.

Keywords: *Bird diversity | Shallabug Wetland | Kashmir |*

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Introduction

The State of J&K has a large number of wetlands due to glacial erosions and depressions which are mingled with rivers giving rise to lentic ecosystem. These lentic ecosystems (wetlands and lakes) are of great ecological and socio-economic importance as it harbours a diverse group of plants and animals. These wetlands are providing a good habitat for birds with abundant food, safe place for roosting, nesting and moulting. From the ornithologist point of view, the valley of Kashmir is heaven for migratory and endemic species of birds. Indeed the local populaces are not much aware of migratory and resident species of birds except few. However, during the recent past these wetlands and lakes have faced a lot of destruction due to agricultural activities in and around, pollution of water which ultimately enters these water bodies, soil erosion from the catchment areas, siltation, rampant removal of hydrophytes are few effects to mention. Earlier studies on the birds of wetlands of Kashmir were initiated during

British period. Many investigators have studied the diversity, distribution, seasonal migration etc. of birds in various wetlands and lakes of Kashmir (Magrath, 1921; Holmes and Parr, 1988; Qadri, 1989; Basher, 2002) but a little is known about the birds of Shallabug wetland in the recent past. In addition, the present study represents the comprehensive picture of the bird community of a small representative area in Kashmir, India.

Materials and Methods

Keeping in view the size of the study area sampling strategy was adopted for studying the birds of Shallabug wetland (July to December). For the present investigation the area was divided into four zones, north, south, east and west. The divisions were on the basis of characteristics of water depth and vegetation. The visual census method was used for bird population estimation after Watson and Gaston, 1975. Birds were observed with aid of 10 x 50 super Zenith prismatic field binocular. Observations were made once a month (July-December) for atleast 5 hours a day. The most important aspect kept in consideration was the activity of birds. Since the peak activity in most birds lasts for 1 or 2 hours after sunrise or before sunset, so monitoring was done either in early morning or late evening hours. The identification of birds was done according to the identification keys and monographs adopted by Bates and Lowther, 1952; Whistler 1963; Salim Ali, 1979. Residential status of the birds has been worked out and different status categories like resident, winter visitor and summer visitor have been assigned strictly with reference to the study area on the basis of presence or absence method.

Results and Discussion

The present studies on bird diversity of Shallabug wetland of Kashmir, India revealed the presence of 34 species of birds. Out of these 14 were found to be residents whereas 10 each were summer and winter migrant birds. (Table 1a,b,c).

S.No	Scientific name	Common name	Number of birds observed on monthly basis					
			July	Aug	Sept	Oct	Nov	Dec
1	*Anas acuta*	Pintail				++	++	+
2	*Anas crecca*	Common teal				++	+++	+++
3	*Anas Penelope*	Wigeon				+	+	+
4	*Anas strepera*	Gadwall				+	++	++
5	*Anas platyrhynchas*	Mallard				++	++	+++
6	*Athya ferina*	Common pochard				+	+	+
7	*Anas rufina*	Red crested pochard				+	++	+
8	*Anser anser*	Graylag goose				+	++	++
9	*Anas clypeata*	Northern shoveler				++	++	++
10	*Anas querquedula*	Garganey				+	+	+
Density: 1-50 = + ; 51-100 = ++; 101 and above; +++								

Table 1(a): Showing the abundance of **Winter migrant birds** in Shallabug wetland.

S.No	Scientific name	Common name	Number of birds observed on monthly basis					
			July	Aug	Sept	Oct	Nov	Dec
1	*Actitis hypoleucos*	Common sand piper	+	+	+	+		
2	*Acridotheres tristis*	Common Myna	+++	+++	+++	+++	++	++
3	*Ardea cinerea*	Eastern grey heron	+	+	+	+	+	
4	*Ardeola grayii*	Indian pond heron	+	+		+		
5	*Alcedo atthis pallasi*	Central Asian kingfisher	+	+	+			
6	*Corvus splendens*	House crow	++	++	++	+	+	
7	*Columba liva*	Blue rock pigeon	+	+		++		+
8	*Pycnonotus leucogenys*	White- cheeked bulbul	+	+	+			
9	*Milvus migrans*	Common pariah kite	+	+				
10	*Nycticorax nycticorax*	Black crowned night heron	+	+	+	+		
11	*Passer domesticus*	House sparrow	+	+	++	+++	+	
12	*Tachybaptus ruficollis*	Little grebe	+	+	+			
13	*Gyps himalayensis*	Himalayan griffon vulture	+	+	+			
14	*Bubo bubo*	Great horned owl	+	+	+			
Density: 1-50 = +; 51-100= ++; 101 and above; +++								

Table 1(b): Showing the abundance of **Resident birds** in Shallabug wetland.

S.No	Scientific name	Common name	Number of birds observed on monthly basis					
			July	Aug	Sept	Oct	Nov	Dec
1	*Chlidonias hybrida indica*	Indian whiskered tern	+	+	+			
2	*Gallinula chloropus indicus*	Indian Moorhen	+	++	++	++		
3	*Hydrophasianus chirurgus*	Pheasant tailed jacana	+	+	+			
4	*Hirundo rustica*	Common swallow	+	+	+			
5	*Lanius schach*	Rufous-backed shrike	+	+				
6	*Ixobrychus minutus*	Little Bittern	+	+	+			
7	*Oriolus oriolus kundoo*	Indian oriole	+	+				
8	*Psittacula himalayana*	Slaty-headed parakeet	+	+				
9	*Rostratula benghalensis*	Greater painted-snipe	+	++	+	+		
10	*Upupa epops*	European Hoopoe	+	+	+	+		
Density: 1-50 = + ; 51-100 = ++; 101 and above; +++								

Table 1(c): Showing the abundance of **Summer migrant birds** in Shallabug wetland.

Analysis of data on all the three classes of birds i.e. resident, summer migrants and winter migrants is given in the table. The data reveals that among the resident birds, *Acridotheres tristis* (common Myna) was sighted to be in larger numbers for all the months (July to December) followed by winter migrant bird *Anas crecca* (common teal). The resident birds like *Corvus splendens* (house crow) and *Passer domesticus griscigularis* (Kashmiri house sparrow) were also found in abundant numbers. Among the summer migrant birds *Gallinula chloropus indicus* (Indian Moorhen) were abundant for the present study. While as *Anas platyrhynchas* (Mallard) was recorded to be in large numbers among the winter birds.

Another bird *Anas clypeata* (Northern Shoveller) was also found in good numbers. The minimum density of birds among the resident was that of *Gyps himalayensis* (Himalayan griffon vulture), *Oriolus oriolus kundoo* (Indian oriole) among the summer migrants and *Anas Penelope* (wigeon) among the winter migrant birds.

The seasonal pattern of all the three classes of birds reveals that the resident birds were sighted almost throughout the study period. However, *Milvus migrans govinda* (common pariah kite) was sighted in the month of July and August only. Another bird *Alcedo atthis pallasi*(central asian kingfisher) was sighted in the month of July to August. In all the eight resident birds which were sighted from July up to October are *Actitis hypoleucos* (common sandpiper), *Acridotheres tristis* (common myna), *Ardea cinerea* (eastern grey heron), *Ardeola grayii* (Indian pond heron), *Corvus splendens* (house crow), *Columbaliva neglecta* (home blue rock pigeon), *Nycticorax nycticorax* (black crowned night heron) and *Passer domesticus griscigularis* (Kashmiri house sparrow). While as only four resident birds were sighted in the month of November which are common *Acridotheres tristis*, *Ardea cinerea*, *Corvus splendens*, *Passer domesticus griscigularis* and only *Acridotheres tristis* and *Columbaliva neglecta* were sighted in the month of December. In contrary the *Acridotheres tristis* (common myna) among the resident birds was sighted throughout the studied period. While as the birds which belong to summer migratory were found in the months of July to September except *Gallinula chloropus* (Indian moorhen), *Rastratula benghalensis* (greater painted snipe), *Upupa epops* (European hoopoe) which were also sighted in the month of October in the present study. On the other hand the all winter migratory birds were sighted during October to December months.

For the present study, a total of 4314 birds were recorded among which 1576 belong to resident, 752 belong to summer migrants and 1986 to winter migrants respectively (figure-1). The maximum number of birds recorded was winter migrants which constitute 46.04% of total bird population, followed by resident birds which constitute 36.53% and summer migrants 17.43% respectively in the following pattern.

Winter migrants (46.04%) > Resident (36.53%) > Summer migrants (17.43%)

The maximum number of birds were recorded during the month of September (636) among the resident category. Among the summer migrants, maximum number of birds observed were during the month of August (550) and among winter migrants maximum number of birds observed were during the month of November (1057) following the following trend.

Winter migrants (November)	**1057**
Resident (September)	**636**
Summer migrants (August)	**550**

The present study which is preliminary in nature reveals that large number of birds recorded were primarily due to availability of food, nesting and resting sites and also due to availability of dense great variety of plants. It was revealed that the migratory birds have mostly visited the area.

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Studies on the diatom flora of North Maharashtra Region: Genus – *Caloneis, Neidium, Diploneis, Stauroneis, Anomoeneis*

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Abstract

Diatoms are ubiquitous and form quite an important group in the aquatic ecosystems. Diatoms can be easily distinguished from almost all other algal groups by their silicified walls. Every collection of water whether freshwater, marine, polluted or even ordinary drinking water and moist soil invariably contains diatoms. They are common organisms in polluted waters. They are regarded indicators of pollution.

Though earlier workers have paid attention on taxonomy of diatoms in Maharashtra, but North Maharashtra region is unexplored regarding to taxonomy of diatoms. In present study the genus *Caloneis, Neidium, Diploneis, Stauroneis, Anomoeneis* which are represented by twenty nine species from only North Maharashtra, hitherto unexplored area. The total forty two diatom taxa were reported from different localities of North Maharashtra region, from the rivers, dams, nala, lakes, ponds, streams, ditches and several water bodies as the diatoms are cosmopolitan in habitat.

Keywords: *Biodiversity* | *Algae* | *Pinnales* | *Diatom* |

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Introduction

In India, the pioneer work was done by Venkatraman (1939, 1940, 1969) on diatoms. He gave a systematic account of south Indian Diatoms. Gonzalves (1947) was probably the first to record the Diatoms from Maharashtra. Gonzalves and Gandhi (1952 – 1954) gave a systematic account of the Diatoms of Bombay. Gandhi (1959, 1962, 1967) made the contribution to our knowledge of fresh water Diatoms of India. Sarode and Kamat (1984) studied fresh water diatoms of Maharashtra.

The present investigation is the outcome of studies on the genus- *Caloneis, Neidium, Diploneis, Stauroneis, Anomoeneis* from North Maharashtra region, from different habitats of different localities.

Materials and Methods

Algal samples were collected from different localities of North Maharashtra region or Khandesh comprises of three districts – Jalgaon, Dhule and Nandurbar. The present investigation pertains to nearly 24 places in their respective districts. Covering all habitats like rivers, ponds, dams, lakes, streams, ditches, barrages, from high altitudes like Toranmal, big dams like Hatnoor dam and Malangaon dam. Also, collections were made from epilithic, epiphytic, epipsammonic, and epipelic habitats. Collections as far as possible are made through out the year. Smol's method was used for isolation of diatoms. One ml. of wet sediment from each sample was placed in centrifuge tube and 1 % Hydrochloric acid was added to remove carbonates and avoids the formation of Calcium Sulphate. Samples were then washed several times before they were mixed with 1% solution of Sulphuric acid in which Potassium dichromate had been dissolved (10 ml: 1 gm) in order to remove organic matter. After five days, the samples were boiled for one hour to remove any final residue. Then samples were washed with distilled water for eight times. This washed sample is then placed in a drop of 70% alcohol. This is then mounted in Canada balsam. The slide is then observed under microscope. Line drawings are made with the help of Camera Lucida. All drawings are under oil immersion. All the taxa of the genus *Caloneis, Neidium, Diploneis, Stauroneis, Anomoeneis* are identified by using standard monograph and recent literature (Gandhi 1957, 1959, 1962; Hustedt 1930; Sarode and Kamat, 1984).

Results and Discussion

In present investigation **forty two** species of the genus ***Caloneis, Neidium, Diploneis, Stauroneis, Anomoeneis*** were recorded in North Maharashtra region. Such taxonomical study shows thirty two total taxa of the genus in which 1 variety is newly reported as- *Stauroneis anceps* Ehr. v. nova.

SYSTEMATIC ACCOUNT:

Caloneis Cleve

1. ***Caloneis aequatorialis* Hustedt v. *tugelae* Cholnoky (Pl. 1, Fig. 1)**

   Cholnoky 1956, p. 58, f. 7-10

   Valves 30- 36.3 µm long, 2.42- 6 µm broad, linear lanceolate, somewhat inflated in the middle, very slightly constricted towards both the ends; ends broadly rounded; raphe thin with distinct central pores and curved terminal fissures; axial area broad; central area large, reaching the margins; striae 22-24 in 10 µm, fine.

Distribution in India: Aurangabad (Sarode and Kamat, 1984).

Locality: Tamaswadi Dam (Parola).

2. ***Caloneis amphisbaena* (Bory) Cleve (Pl. 1, Fig. 2)**

Hustedt 1930, p. 230, f. 346

Valves 64.24 µm long, 21.9 µm broad, decidedly lanceolate or elliptical, axial area expanded mostly with the central area to form a lanceolate margin very large forms with about 20-21 stripes in 10 µm, central area circular, valves almost under 100 µm long, structure finer, central area rhombish.

Locality: Karwand Dam (Shirpur).

3. ***Caloneis bacillum* (Grun.) Mereschkowsky (Pl. 1, Fig. 3)**

Hustedt 1930, p. 236, f. 360 a-c

Valves 37.4- 40 µm long, 8.5- 8.7 µm broad, linear to linear lanceolate with broad rounded ends; raphe thin and straight with slightly unilaterally bent central pores; axial area moderate, linear lanceolate; central area wide reaching the sides; striae 22-24 in 10 µm, slightly radial, becoming perpendicular towards the ends; striae crossed by a fine longitudinal line near the margin.

Distribution in India: Lonavala (Gandhi, 1962b); Pali, Jalna, Osmanabad (Sarode and Kamat, 1979); Nagpur (Sarode and Kamat, 1980a); Wardha (Sarode and Kamat, 1983a); Kolhapur, Dhule, Mahad (Sarode and Kamat, 1984).

Locality: Dhule.

4. ***Caloneis beccariana* Grun. (Pl. 1, Fig. 4)**

Cholnoky 1956, p.59, f.11, 12

Valves 30- 51 µm long, 7.1- 9 µm broad, lanceolate to linear lanceolate, somewhat inflated in the middle, with constricted capitate to subcapitate, broadly rounded ends; axial area fairly wide; central area quite large and reaching the margins, sometimes more widened on one side than the other; striae 21-23 in 10 µm, conspicuously radial but clearly convergent at the ends, crossed by a fine longitudinal line near the margin.

Distribution in India: Osmanabad, Aurangabad (Sarode and Kamat, 1979); Wardha, Gangapur (Sarode and Kamat, 1983a); Kolhapur, Nagpur, Pavnar, Jalna, Bhir, Paithan, Bhusaval, Jalgaon, Dhule (Sarode and Kamat, 1984); Srinagar (Nautiyal and Singh, 1996).

Locality: Suki River (Raver), Suki Dam (Raver), Mor River (Yawal).

5. ***Caloneis clevei* (Lagst.) Cleve (Pl. 1, Fig. 5)**

Hustedt 1930, p. 236, f. 359

Valves 74.46 µm long, 13.14 µm broad, valves linear lanceolate, with narrowly constricted poles stripes at the poles

convergent margin suddenly expanded. Structure finer, long lines mostly unclear. Central area without these markings, raphe thin, terminal pores curved, striae convergent towards the ends, striae 21 in 10 µm.

Locality: Hartala Lake (Muktainagar).

6. ***Caloneis latiuscula* (Kuetz.) Cleve v. *subholstei* Hust.**

(Pl. 1, Fig. 6)

Hustedt 1930, p. 233, f. 352

Valves are 83.2 µm long, 35.04 µm broad. Freshwater forms with about 20 stripes in 10 µm. valves elliptical to lanceolate linear poles obtusely rounded, not constricted. Axial area expanded mostly with the central area to form a lanceolate margin, the irregular mat like marks widely present. Central area without markings, raphe thick, striae parallel, terminal pores curved.

Locality: Nakane Lake (Dhule).

7. ***Caloneis permagna* (Bail.) Cleve**

(Pl. 1, Fig. 7)

Hustedt 1930, p. 231, f. 349

Frustules large and robust; valves 70- 132 µm long, 27.4- 41 µm broad, rhombic lanceolate with somewhat produced, broadly rounded ends; raphe thick and straight; central pores large; unilaterally bent, terminal fissures broadly curved and clear; axial area large, moderately lanceolate; central area large, circular and somewhat unilateral; striae13-14 in 10 µm, radial in the middle and convergent at the ends, crossed by two longitudinal lines slightly away from the margin.

Distribution in India: Jalna, Pali (Sarode and Kamat, 1979); Nagpur (Sarode and Kamat, 1980a); Chandrapur (Sarode and Kamat, 1983a); Jalgaon (Sarode and Kamat, 1984).

Locality: Devbhane Dam (Dhule), Manudevi (Yawal).

8. ***Caloneis silicula* (Ehr.) Cleve**

(Pl. 1, Fig. 8)

Hustedt 1930, p. 236, f. 362

Valves 40- 48.18 µm long, 10.22- 12.5 µm broad, linear to linear lanceolate with triundulate margins and broadly wedge shaped ends; raphe thin and straight with slightly curved terminal fissures; axial area moderate, linear lanceolate; central area large striae 20-22 in 10 µm, slightly radial throughout; crossed by a fine longitudinal line near the margin.

Distribution in India: Kolhapur (Gandhi, 1958b); Bombay (Gandhi, 1955, 1959a, 1962a); Lonavala (Gandhi, 1962b); Thane (Sarode and Kamat, 1984); Srinagar (Nautiyal and Singh, 1996).

Locality: Patharad Dam (Bhadgaon), Jamkheli Dam (Sakri).

9. ***Caloneis silicula* (Ehr.) Cleve v. *intermedia* Mayer**

(Pl. 2. Fig. 1)

Cleve- Euler 1955, p. 100, f. 1144 i-l

Valves 60 µm long, 12.5 µm broad, linear, feebly undulate, slightly inflated in the middle and near the ends; ends somewhat cuneate rounded; raphe thin and straight with central pores distinct and curved terminal fissures; axial area broadly lanceolate; central area reaching the sides; striae 24-26 in 10 µm, slightly radial in the middle and perpendicular to the middle line towards the ends.

Distribution in India: Nagpur (Sarode and Kamat, 1980a); Yeotmal (Sarode and Kamat, 1983a); Jalgaon, Bhusaval (Sarode and Kamat, 1984).

Locality: Suki River (Raver), Mor River (Yawal).

10. ***Caloneis silicula* (Ehr.) Cleve v. *minuta* Grun.**

(Pl. 2, Fig. 2)

Cleve- Euler 1955, p. 100, f. 1144 m, n

Valves 35 µm long, 6.6 µm broad, valves linear lanceolate, constricted towards the poles; raphe thin and straight; axial area lanceolate; central area large; reaching the margins; striae 22-24 in 10 µm, fine and slightly radial.

Distribution in India: Lonavala (Gandhi, 1962b); Palli, Sav, Rajewadi, Unapdev (Chopda) (Thomas and Gonzalves, 1965); Osmanabad, Bhir (Sarode and Kamat, 1979); Amrawati, Wardha, Gangapur (Sarode and Kamat, 1983a); Kolhapur, Panhalgad, Nagpur, Bhandara, Akola, Jalna, Aurangabad, Jalgaon, Bhusaval, Dhule, Sangli, Barshi, Satara, Karad, Ahmednagar, Chiplun, Mahad, Karjat, Kalyan (Sarode and Kamat, 1984); Bhagalpur (Saha, 1986).

Locality: Jamphal Dam (Shindkheda).

11. ***Caloneis silicula* (Ehr.) Cleve v. *truncatula* Grun**

(Pl. 2, Fig. 3)

Hustedt 1930, p. 236, f. 364

Valves 39.42 µm long, 10.22 µm broad, smoothly linear elliptical with rounded ends; raphe thin and straight with distinct central pores and curved terminal fissures; axial area fairly broad, narrowly lanceolate, central area small and reaching the margins; striae 18-20 in 10 µm, fine but distinct, very slightly radial in the middle but more so towards the ends, crossed by a longitudinal marginal line.

Distribution in India: Wardha (Sarode and Kamat, 1983a); Jalgaon (Sarode and Kamat, 1984)

Locality: Kanji River (Khapar)

12. ***Caloneis silicula* (Ehr.) Cleve v. *truncatula* Grun. f. *borivaliana* Gonzalves et Gandhi**
(Pl. 2, Fig. 4)
Gonzalves and Gandhi 1953, p. 248, f. 76
Valves 40- 48 µm long, 8.7- 10.22 µm broad, gibbous in the middle with broadly wedge shaped ends; raphe thin and straight; axial area broadly lanceolate; central area large, stauroid; striae 18-20 in 10 µm, slightly radial in the middle and perpendicular towards the ends, crossed by a longitudinal line near the margins.
Distribution in India: Bombay (Gonzalves and Gandhi, 1953); Alibag, Mahad, Thane (Sarode and Kamat, 1984).
Locality: Kanji River (Khapar).

13. ***Caloneis ventricosa* (Ehr.) Meist. v. *alpina* (Cleve) Part.**
(Pl. 2, Fig. 5)
Lawson and Rushforth 1975, p. 27, pl. 16, f. 2
Valves 70 µm long, 12.5 µm broad, broadly linear, gibbous in the middle with rounded poles; raphe thin and straight, terminal fissures hooked in the same directions; axial area narrow, widening towards the middle; central area elliptical; striae 16-18 in 10 µm, parallel in the middle and becoming radial near the poles, crossed by a longitudinal line away from the margins.
Distribution in India: Jalgaon, Bhusaval (Sarode and Kamat, 1984).
Locality: Mehrun Lake (Jalgaon), Dongargaon Lake (Dhule).

Neidium Pfitzer.

14. ***Neidium affine* (Ehr.) Cleve**
(Pl. 3, Fig. 1)
Hustedt 1930, p. 242, f. 376
Valves 50- 55 µm long, 13.75- 16 µm broad, margin of the valve less convex, structures generally fine, over 20 stripes in 10 µm. Valves with regularly broad and obtuse constricted poles, valves with more or less convex margin, finely punctate striae.
Locality: Panzara River (Dhule), Arunawati River (Shirpur), Jamda Dam (Chalisgaon), Latipada Dam (Pimpalner), Kondaibari (Sakri).

15. ***Neidium affine* (Ehr.) Cleve v. *amphirhynchus* (Ehr.) Cleve f. *truncatula* Gonzalves et Gandhi**
(Pl. 3, Fig. 2)
Gonzalves and Gandhi 1953, p. 249, f. 78
Valves 40- 42 µm long, 10- 12 µm broad, linear with almost parallel margins, suddenly contracted towards the ends and produced into broadly truncate poles; raphe thin and straight, central pores bent in opposite directions and terminal fissures narrowly bifurcated; axial area narrow;

central area small and rhomboid; striae 20-22 in 10 µm, fine but clearly punctate, crossed by a hyaline furrow near the margins.

Distribution in India: Bombay (Gonzalves and Gandhi, 1953); Thane, Alibag (Sarode and Kamat, 1984).

Locality: Devali- Bhoras Dam (Chalisgaon), Dhule-chaufuli Lake (Dhule), Shirpur, Akkalpada Dam (Dhule), Bhokarbari Dam (Parola).

16. ***Neidium amphigomphous*** **(Ehr.) Cleve v.** ***obtusum*** **A. Cl.**

(Pl. 3, Fig. 3)

Cleve- Euler 1955, p. 115, f. 1168 d

Valves 30- 38.72 µm long, 9.68- 10.5 µm broad, elliptic lanceolate with obtuse, rounded ends; raphe thin and straight with central pores bent in opposite direction; axial area narrow, central area large, slightly transversely widened; striae 18-20 in 10 µm, finely punctate, crossed by more than two longitudinal furrows.

Distribution in India: Panhalgad (Gandhi, 1959c); Pune, Matheran, Khandala (Sarode and Kamat, 1984).

Locality: Bori River (Amalner), Mor River (Yawal), Waghur River (Jamner), Shivkhetale (Sakri), Dhaner- amli Stream (Navapur).

17. ***Neidium bisulcatum*** **(Lagerst.) Cleve f.** ***undulata*** **O. Muell.**

(Pl. 3, Fig. 4)

Hustedt 1930, p. 242, f. 375

Valves 45.3- 46 µm long, 7.3- 8 µm broad; linear, slightly gibbous in the middle, with broadly rounded, wedge shaped ends; raphe thin and straight with central pores bent in opposite directions and terminal fissures bifurcated; axial area narrow; central area somewhat elliptical; striae 25-26 in 10µm, finely punctate, perpendicular to the middle line but convergent at the ends, crossed by a longitudinal furrow near the margins.

Distribution in India: Bombay (Gonzalves and Gandhi, 1953). Wardha, Alibag (Sarode and Kamat, 1984).

Locality: Dedargaon Lake (Dhule), Dahiwad Nala (Sakri), Mor River (Yawal), Vidyanagari (Dhule), Prakasha (Shahada).

18. ***Neidium hercynicum*** **Mayer**

(Pl. 3, Fig. 5)

Cleve-Euler 1955, p. 119, f. 1173

Valves 35- 36 µm long, 13.2- 14.6 µm broad, lanceolate to elliptic lanceolate with obtuse, broadly rounded ends; raphe thin and straight with central pores bent in opposite directions; axial area narrow; central area large, roundish; striae 24-26 in 10 µm, finely punctate and crossed by a marginal longitudinal furrow.

Distribution in India: Bhusaval (Sarode and Kamat, 1984).

Locality: Suki River (Raver), Suki Dam (Raver), Mor River (Yawal), Amravati Dam (Dondaicha).

19. ***Neidium iridis*** **(Ehr.) Cleve f.** ***dhulensis*** **Sarode et Kamat**

(Pl. 3, Fig. 6)

Sarode and Kamat1984, p. 83, pl. 9, f. 194

Valves 39- 52 µm long, 9.5- 12 µm broad, linear elliptical to liner lanceolate with almost parallel margins and broadly rounded, somewhat wedge shaped ends; raphe thin and straight with central pores bent in opposite directions and terminal fissures bifurcated; axial area narrow, linear; central area large, transversely rectangular; striae 28-30 in 10 µm, finely punctate, radial, crossed by a marginal furrow.

Distribution in India: Dhule (Sarode and Kamat, 1984).

Locality: Panzara River (Dhule), Latipada Dam (Pimpalner), Gomai Dam (Shahada), Nakane Lake (Dhule), Hartala Lake (Muktainagar).

20. ***Neidium longiceps*** **(Greg.) A. Cl. v.** ***undulatum*** **(Mayer) A.Cl.**

(Pl. 3, Fig. 7)

Cleve-Euler 1955, p. 112, f. 1163 f

Valves 40- 42 µm long, 10- 11.22 µm broad, linear elliptical with very slightly triundulate margins and constricted broadly produced, feebly capitate rounded ends; raphe thin and straight with central pores bent in opposite directions; axial area very narrow; central area large, transversely elliptical; striae 22-24 in 10 µm, finely punctate, slightly radial, crossed by a faint longitudinal furrow near the margins.

Distribution in India: Ramtek (Sarode and Kamat, 1983a).

Locality: Pond at Ground fort (Parola), Changadev (Muktainagar), Devabhane Dam (Dhule).

21. ***Neidium marathwadensis*** **Sarode et Kamat**

(Pl. 3, Fig. 8)

Sarode and Kamat 1984, p. 83, pl.10, f. 200

Valves 28- 32 µm long, 6- 7.5 µm broad, linear lanceolate with slightly undulate margins and constricted, obtusely capitate ends, raphe thin and straight; axial area narrow; central area broad, reaching the margins; striae about 30 in 10 µm, punctate, faint, crossed by a longitudinal hyaline furrow near the margins.

Distribution in India: Gangapur (Sarode and Kamat, 1984).

Locality: Jamphal Dam (Shindkheda), Manyad Dam (Chalisgaon), Aner Dam (Shirpur).

22.*Neidium oblique- striatum* A.S. v. *parallella* Gonzalves et Gandhi

(Pl. 3, Fig. 9)

Gonzalves and Gandhi 1953, p.251, f. 83

Valves 34.5- 40 µm long, 10-12 µm broad, broadly linear with parallel margins and wedge shaped rounded ends; raphe thin and straight, central pores slightly bent in opposite directions and terminal fissures bifurcated; axial area narrow, linear; central area obliquely rectangular; striae about 24 in 10 µm, strongly oblique and lineate, interrupted by a hyaline furrow near the margins.

Distribution in India: Bombay (Gonzalves and Gandhi, 1953); Wardha (Sarode and Kamat, 1983a); Akola (Sarode and Kamat, 1984).

Locality: Panzara River (Ner), Anjani River (Erandol), Akkalpada Dam (Dhule).

Diploneis Ehrenberg.

23. *Diploneis elliptica* (Kuetz.) Cleve

(Pl. 4, Fig. 1)

Hustedt 1930, p. 250, f. 395

Valves 30 µm long, 20 µm broad, elliptical or slightly rhombic elliptical; raphe between the ribs, widened in the central nodule; axial area very narrow; central area slightly inflated; furrows narrow, widened in the middle, lanceolate; costae 12-13 in 10 µm, slightly radial in the middle and strongly radial towards the ends, alternating with a single row of coarse punctae or alveoli.

Distribution in India: Palli (Thomas and Gonzalves, 1965); Aurangabad (Sarode and Kamat, 1980b).

Locality: Panzara River (Ner).

24.*Diploneis marginestriata* Hust.

(Pl. 4, Fig. 2)

Hustedt 1930, p. 250, f. 393

Valves 23.36- 30 µm long, 10.22 µm broad; cross ribs alternate with single row of punctae or alveoli rows; structure in the middle not interrupted valves not or only less narrowed, long ribs unclear the interspaces between the cross ribs therefore roundish and small punctae seen, valves often have fine structure furrows very broad.

Locality: Karwand Dam (Shirpur).

25.*Diploneis ovalis* (Hilse) Cleve

(Pl. 4, Fig. 3)

Hustedt 1930, p. 249, f. 390

Valves 37.96 µm long, 14.6 µm broad, cross ribs alternate with single row of punctae or alveoli rows, structure in the middle not interrupted valves not or only less narrowed. Long ribs unclear, the inter space between the cross ribs therefore roundish and small punctae seen, valves often have fine structure, central knots large, roundish, the inner space between the cross ribs clearly punctate.

Distribution in India: Srinagar (Nautiyal and Singh, 1996).

Locality: Karwand Dam (Shirpur).

26. ***Diploneis ovalis* (Hilse) Cleve v. *oblongella* (Naeg.) Cleve**

(Pl. 4, Fig. 4)

Hustedt 1930, p. 249, f. 391

Valves 75.92 µm long, 26.28 µm broad, linear elliptic with almost parallel margins and broadly rounded ends; raphe between the ribs; axial area very narrow; central area widened, elliptic; costae 14 in 10 µm, radial, alternating with a single row of puntae or alveoli; alveoli about 25 in 10 µm.

Distribution in India: Lonavala (Gandhi, 1962b); Satnavari, Yeotmal (Sarode and Kamat, 1983a); Akola (Sarode and Kamat, 1984).

Locality: Nakane Lake (Dhule).

27. ***Diploneis puella* (Schumann) Cleve**

(Pl. 4, Fig. 5)

Hustedt 1930, p. 250, f. 394

Valves 17.52 µm long, 8.76 µm broad, elliptic with rounded ends, valve surface costate; costae 13-14 in 10 µm, thick and distinct, continued into the furrows as large alveoli; central nodule large, dilated.

Distribution in India: Madras (Krishnamurthy, 1954); Kolhapur (Gandhi, 1958b, Sarode and Kamat, 1984); Bombay (Gandhi, 1962a); Lonavala (Gandhi, 1962b); Wardha, Satnavari, Katta (Sarode and Kamat, 1983a).

Locality: Kanji River (Khapar).

28. ***Diploneis subovalis* Cleve**

(Pl. 4, Fig. 6)

Hustedt 1933, p. 667, f. 1063 a, b

Valves 25 µm long, 15 µm broad, broadly elliptical with rounded ends; central nodule large and rounded; furrows narrow and closely following the central nodule and its horns; costae 8-10 in 10 µm, strong, alternating with double row of alveoli; alveoli 16-18 in 10 µm.

Distribution in India: Madras (Venkataraman, 1939); Dahisar (Gonzalves and Gandhi, 1949); Bombay (Gonzalves and Gandhi, 1953); Lonavala (Gandhi, 1962b); Nagpur (Sarode and Kamat, 1980a); Jalna, Pali (Sarode and Kamat, 1980b); Allahabad (Pandey and Pandey, 1980); Wardha, Katta (Sarode and Kamat, 1983a); Kolhapur (Sarode and Kamat, 1984); Bareilly (Chaturvedi, 1985); Srinagar (Nautiyal and Singh, 1996).

Locality: Suki River (Raver), Suki Dam (Raver), Mor River (Yawal).

Stauroneis Ehrenberg.

29. ***Stauroneis anceps* Ehr.**

(Pl. 5, Fig. 1)

Hustedt 1930, p. 256, f. 405

Valves 35.4- 59 µm long, 7.3- 15.6 µm broad, elliptic lanceolate with constricted, capitate and broadly rounded ends, raphe thin, thread like, straight with slightly curved terminal fissures; axial area narrow, linear; central area wide and stauroid widening towards the margins; striae 22-24 in 10 µm, finely punctate and radial throughout.

Distribution in India: Madras (Venkataraman, 1939); Bombay (Gonzalves and Gandhi, 1953); Madras (Krishnamurthy, 1954); Panhalgarh (Gandhi, 1959c); Lonavala (Gandhi, 1962b); Allahabad (Pandey and Pandey, 1980); Shahajahanpur (Pandey, 1982); Kolhapur, Wardha, Jalna, Pali, Aurangabad, Bhir (Sarode and Kamat, 1984); Karnataka (Bongale, 1985); Bareilly (Chaturvedi, 1985); Bhagalpur (Saha, 1986); Midnapore (Pal and Santra, 1990).

Locality: Devbhane Dam (Dhule), Sonvad Dam (Shindkheda).

30.*Stauroneis anceps* Ehr. f. *gracilis* (Ehr.) Cleve

(Pl. 5, Fig. 2)

Hustedt 1930, p. 256, f. 406

Valve 42.34- 105 µm long, 7.3- 17.5 µm broad, lanceolate gradually tapering from the middle towards the poles, ends capitate, rounded; raphe thin and straight, axial area narrow; central area linear, stauroid; striae 20 in 10 µm, indistinctly punctate and strongly radial.

Distribution in India: Bombay (Gonzalves and Gandhi, 1953); Dhule, Jalgaon, Thane (Sarode and Kamat, 1984).

Locality: Dhule, Dehali River (Khapar), Jamphal Dam (Shindkheda).

31.*Stauroneis anceps* Ehr. v. *amphicephala* (Kuetz.) V. H.

(Pl. 5, Fig. 3)

Cleve- Euler 1953, p. 207, f. 943c

Valves 41.5- 53 µm, 10.6- 11 µm, linear lanceolate with somewhat suddenly constricted, slightly produced capitate ends; raphe thin and straight, threadlike, central pores distinct; axial area narrow; central area large; stauroid; striae about 25 in 10 µm, indistinctly punctate, fine.

Distribution in India: Pali, Bhir, Aurangabad (Sarode and Kamat, 1980b), Mansar (Sarode and Kamat, 1983a), Jalna, Osmanabad (Sarode and Kamat, 1984).

Locality: Bhusaval, Meharun Lake (Jalgaon).

32.*Stauroneis anceps* Ehr.v. *hyalina* Brun. et Perag.

(Pl. 5, Fig. 4)

Hustesdt 1930, p. 256, f. 408

Valves 53.1- 61 µm long, 10- 10.8 µm broad, sub elliptical lanceolate with produced, feebly capitate ends; raphe thin and straight, central pores distinct and

terminal fissures very slightly curved; axial area very narrow; central area large, narrowly rectangular and reaching the margins; striae about 30 in 10 µm, radial and very finely punctate.

Distribution in India: Nagpur (Sarode and Kamat, 1980a); Osmanabad (Sarode and Kamat, 1980b); Gangapur (Sarode and Kamat, 1983a).

Locality: Devbhane Dam (Dhule), Sonavad Dam (Shindkheda), Jamphal Dam (Shindkheda).

33.*Stauroneis anceps* Ehr. v. *udayensis* v. nova

(Pl. 5, Fig. 5)

Hustedt 1930, p.256, f. 405

Valves 80.3 µm long, 10.22 µm broad, valves lanceolate, ends slightly capitate, central area linear, stauroid, raphe thin and straight; stripes 22 in 10µm.

Locality: Nakane Lake (Dhule).

34.*Stauroneis montana* Krasske

(Pl. 5, Fig. 6)

Hustedt 1930, p. 259, f. 418

Valves 16.06 µm long, 2.92 µm broad, Valves without the formation of the septa, cross stripes regularly thickly punctate, valves with parallel margin and beak like poles, narrow linear, mostly small form stripes at most 20 in 10 µm, stripes in the middle division of the valves strong, towards the poles becoming narrow.

Locality: Girna River (Jamda).

35.*Stauroneis phoenicenteron* Ehr. f. *capitata* Gonzalves et Gandhi

(Pl. 5, Fig. 7)

Gonzalves and Gandhi 1953, p. 256, f. 92

Valves 80.7- 93 µm long, 14.8- 19 µm broad**,** narrowly lanceolate and delicate with large, rounded, capitate ends; raphe thick; axial area fairly wide; central area stauroid, slightly dilated towards the margins; striae 22-24 in 10 µm, fine, distinctly punctate and radial.

Distribution in India: Bombay (Gonzalves and Gandhi, 1953); Katta (Sarode and Kamat, 1983a); Midnapore (Pal and Santra, 1990).

Locality: Waghur River (Jamner)**,** Jamkheli Dam (Sakri).

36.*Stauroneis phoenicenteron* Ehr. f. *producta* Gandhi

(Pl. 5, Fig. 8)

Gandhi 1958a, p. 252, f. 7

Valves 94.38 µm long, 14.52 µm broad, narrowly lanceolate, with slightly constricted, produced, rounded ends; raphe thick with distinct central pores and curved terminal fissures; axial area narrow; central area a linear stauros; striae 18-24 in 10 µm, radial, fine and distinctly punctate.

Distribution in India: Panhalgad (Gandhi, 1959c); Lonavala (Gandhi, 1962b); Nagpur (Sarode and Kamat, 1980a); Wardha, Katta

(Sarode and Kamat, 1983a); Kolhapur (Sarode and Kamat, 1984); Midnapore (Pal and Santra, 1990).

Locality: Mhasawa Lake (Parola).

37.*Stauroneis phoenicenteron* Ehr. v. *gracilis* (Ehr.) Dippel

(Pl. 5, Fig. 9)

Hustedt 1930, p. 255, f. 406

Valves 131.4 µm long, 21.9 µm broad, narrowly rhombic lanceolate with produced, rounded ends; raphe straight, thick with curved shortly bifurcated terminal fissures, axial area fairly wide; central area stauroid, widening towards the margins; striae 20-22 in 10 µm, strongly radial, fine and clearly punctate.

Distribution in India: Panhalgad (Gandhi, 1959c); Nagpur (Sarode and Kamat, 1980a); Aurangabad, Pali (Sarode and Kamat, 1980b); Amravati, Bhandara, Katta (Sarode and Kamat, 1983a); Jalna, Osmanabad, Bhir, Karad, Dhule, Kolhapur (Sarode and Kamat, 1984).

Locality: Parola, Anjani River (Erandol).

<u>Anomoeoneis</u> Pfitzer.

38.*Anomoeoneis sculpta* (Ehr.) Cleve

(Pl. 6, Fig. 1)

Hustedt 1930, p. 262, f. 423

Valves 31.46 µm long, 12.1 µm broad, elliptic lanceolate, robust with constricted rostrate ends; raphe thin and straight with central pores unilaterally bent and terminal fissures slightly curved; axial area very fine indistinct punctae, irregularly disposed; striae 18-20 in 10 µm, radial, coarsely punctate, crossed by many hyaline longitudinal irregular spaces.

Distribution in India: Aurangabad (Sarode and Kamat, 1984).

Locality: Mhasawa Lake (Parola).

39.*Anomoeoneis serians* (Breb.) Cleve

(Pl. 6, Fig. 2)

Hustedt 1930, p. 264, f. 426

Valves 45.26 µm long, 8.7 µm broad, valves rhombic lanceolate to narrowly rhombic lanceolate with acute ends, raphe thin and straight with closely placed central pores; central area fairly large and quadrate, striae radial perpendicular to marginal striae 16-20 in 10 µm.

Locality: Patharad Dam (Bhadgaon).

40.*Anomoeoneis serians* (Breb.) Cleve v. *brachysira* (Breb.) Hust.

(Pl. 6, Fig. 3)

Hustedt 1930, p. 264, f. 427

Valves 30.66 µm long, 7.3 broad, valves rhombic narrowly lanceolate with acute ends, raphe thick and straight with straight terminal fissures, closely placed central pores; central area small, transverse striations interrupted by several longitudinal, zigzag hyaline spaces.

Locality: Karwand Dam (Shirpur).

41.*Anomoeoneis sphaerophora* (Kuetz.) Pfitzer

(Pl. 6, Fig. 4)

Hustedt 1930, p. 262, f. 422

Valves 54.02- 63.5 µm long, 14.6- 20 µm broad, sub elliptical to elliptical lanceolate with narrowed, produced, slightly capitate ends; raphe thin with curved central pores and semicircular terminal fissures; axial area broad, linear; central area large, unilaterally widened; striae 16-18 in 10 µm, irregularly interrupted by longitudinal wavy hyaline bands.

Distribution in India: Madras (Venkataraman, 1939); Bombay (Gonzalves and Gandhi, 1953); Kolhapur (Gandhi, 1958b, Sarode and Kamat, 1984); Osmanabad, Aurangabad, Bhir (Sarode and Kamat, 1980b); Allahabad (Pandey and Pandey, 1980); Yeotmal (Sarode and Kamat, 1983a); Paithan, Dhule, Karad, Pune, Satara, Alibag, Thane, Mahad (Sarode and Kamat, 1984); Bareilly (Chaturvedi, 1985).

Locality: Dhule, Jamphal Dam (Shindkheda), Malangaon Dam (Sakri), Suki River (Raver), Suki Dam (Raver), Mor River (Yawal).

42.*Anomoeoneis styriaca* (Grun.) Hust.

(Pl. 6, Fig. 5)

Hustedt 1930, p. 265, f. 432

Valves 30 µm long, 3.4 µm broad, rhombic lanceolate with broadly rounded ends; raphe thin and straight with central pores wide apart; axial area narrow; central area constricted in the middle, small; striae about 26-28 in 10 µm, punctate, radial and crossed by many longitudinal wavy hyaline bands.

Distribution in India: Kolhapur (Gandhi, 1956b); Nagpur (Sarode and Kamat, 1984)

Locality: Latipada Dam (Pimpalner), Bopkhel Dam (Sakri).

PLATE : 1

Caloneis aequatorialis Hustedt v. *tugelae* Cholnoky

1. *Caloneis amphisbaena* (Bory) Cleve
2. *Caloneis bacillum* (Grun.) Mereschkowsky
3. *Caloneis beccariana* Grun.
4. *Caloneis clevei* (Lagst.) Cleve
5. *Caloneis latiuscula* (Kuetz.) Cleve v. *subholstei* Hust.
6. *Caloneis permagna* (Bail.) Cleve
7. *Caloneis silicula* (Ehr.) Cleve

PLATE: 1

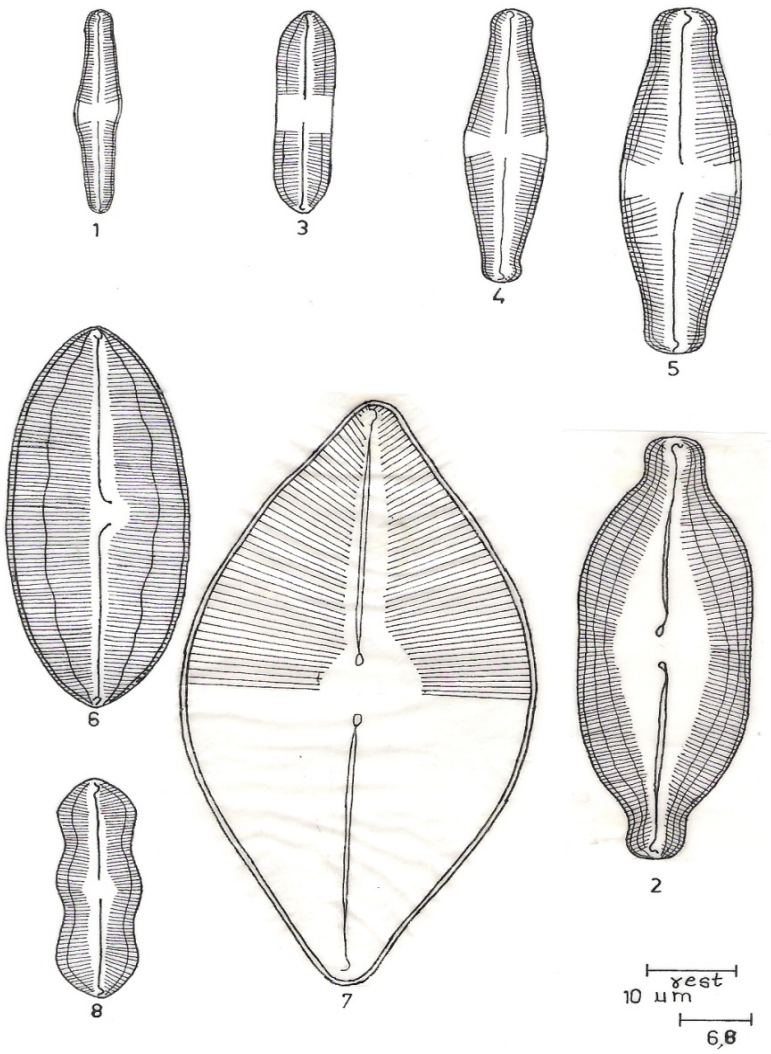


PLATE: 2

1. *Caloneis silicula* (Ehr.) Cleve v. *intermedia* Mayer
2. *Caloneis silicula* (Ehr.) Cleve v. *minuta* Grun.
3. *Caloneis silicula* (Ehr.) Cleve v. *truncatula* Grun.
4. *Caloneis silicula* (Ehr.) Cleve v. *truncatula* Grun. f. *borivaliana* Gonzalves et Gandhi
5. *Caloneis ventricosa* (Ehr.) Meist. v. *alpina* (Cleve) Part

PLATE: 2

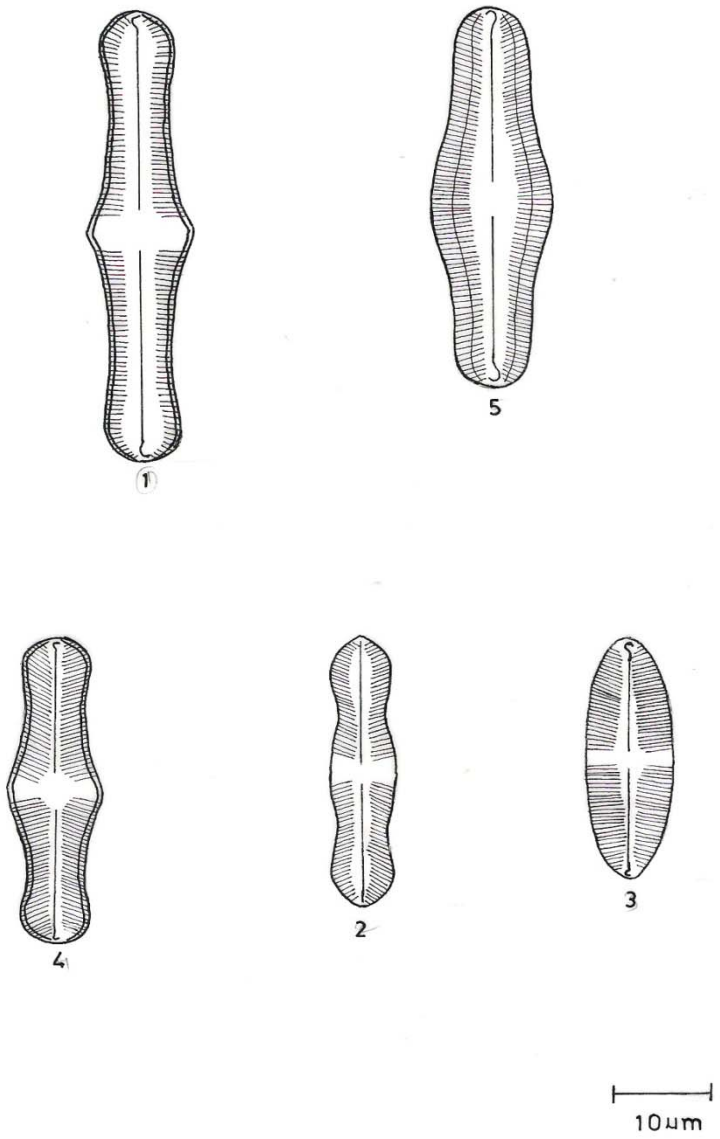


PLATE: 3

1. *Neidium affine* (Ehr.) Cleve
2. *Neidium affine* (Ehr.) Cleve v. *amphirhynchus* (Ehr.) Cleve f. *truncatula* Gonzalves et Gandhi
3. *Neidium amphigomphous* (Ehr.) Cleve v. *obtusum* A. Cl.
4. *Neidium bisulcatum* (Lagerst.) Cleve f. *undulata* O. Muell.
5. *Neidium hercynicum* Mayer
6. *Neidium iridis* (Ehr.) Cleve f. *dhulensis* Sarode et Kamat
7. *Neidium longiceps* (Greg.) A. Cl. v. *undulatum* (Mayer) A.Cl.
8. *Neidium marathwadensis* Sarode et Kamat
9. *Neidium oblique- striatum* A.S. v. *parallella* Gonzalves et Gandhi

PLATE: 3

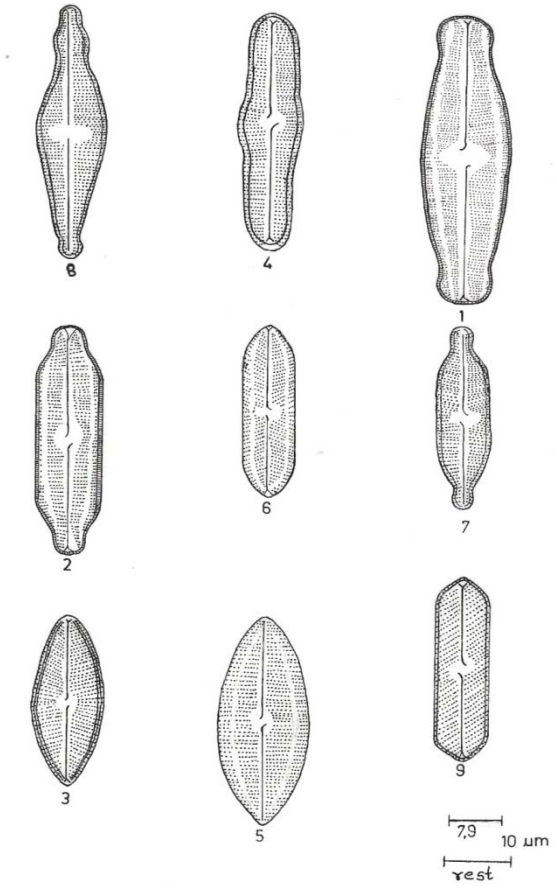


PLATE: 4

1. *Diploneis elliptica* (Kuetz.) Cleve
2. *Diploneis marginestriata* Hust.
3. *Diploneis ovalis* (Hilse) Cleve
4. *Diploneis ovalis* (Hilse) Cleve v. *oblongella* (Naeg.) Cleve
5. *Diploneis puella* (Schumann) Cleve
6. *Diploneis subovalis* Cleve

PLATE: 4

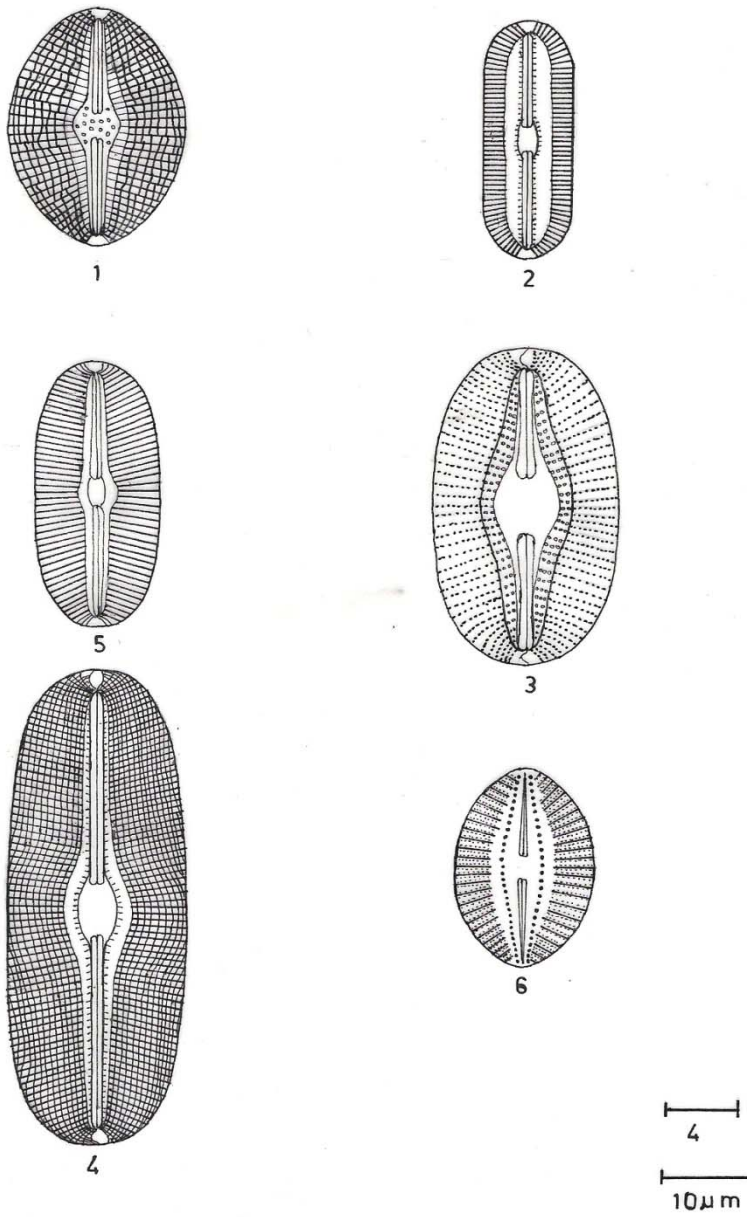


PLATE: 5

1. *Stauroneis anceps* Ehr.
2. *Stauroneis anceps* Ehr. f. *gracilis* (Ehr.) Cleve
3. *Stauroneis anceps* Ehr. v. *amphicephala* (Kuetz.) V.H.
4. *Stauroneis anceps* Ehr.v. *hyalina* Brun. et Perag.
5. *Stauroneis anceps* Ehr. v. *anceps*
6. *Stauroneis montana* Krasske
7. *Stauroneis phoenicenteron* Ehr. f. *capitata* Gonzalves et Gandhi
8. *Stauroneis phoenicenteron* Ehr. f. *producta* Gandhi
9. *Stauroneis phoenicenteron* Ehr. v. *gracilis* (Ehr.) Dippel

PLATE: 5

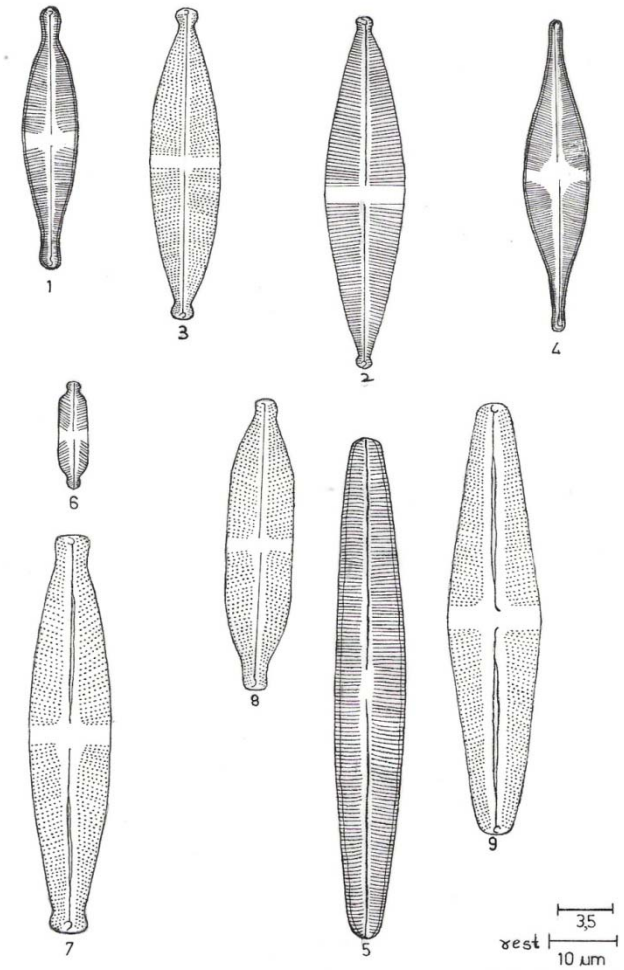
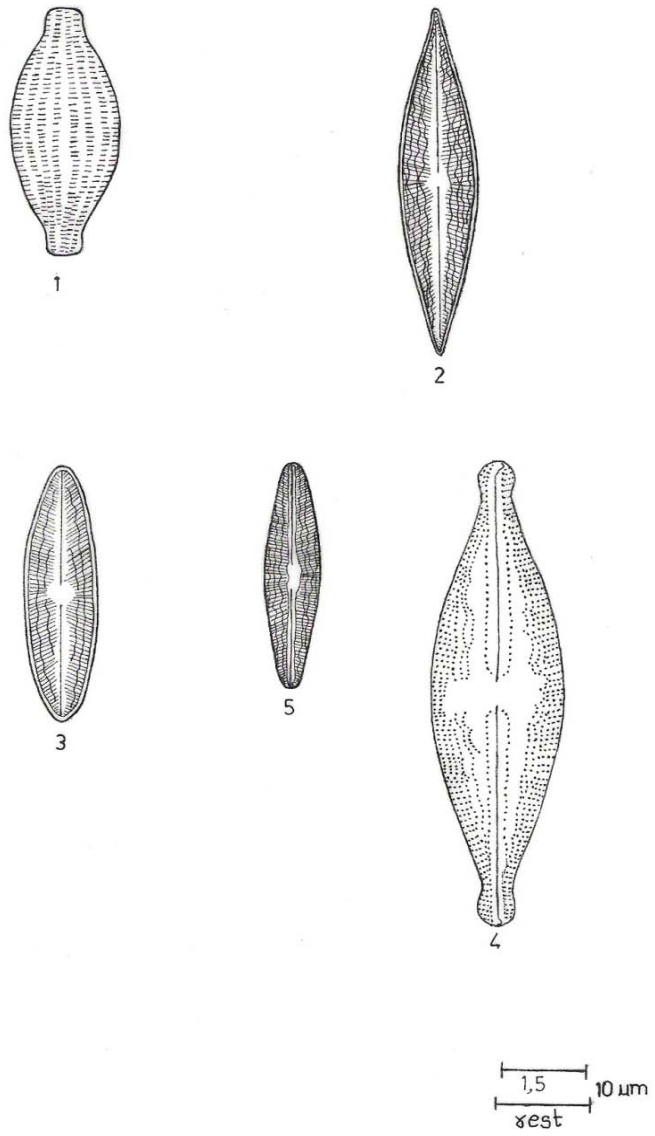


PLATE: 6

1. *Anomoeoneis sculpta* (Ehr.) Cleve
2. *Anomoeoneis serians* (Breb.) Cleve
3. *Anomoeoneis serians* (Breb.) Cleve v. *brachysira* (Breb.) Hust.
4. *Anomoeoneis sphaerophora* (Kuetz.) Pfitzer
5. *Anomoeoneis styriaca* (Grun.) Hust.

PLATE: 6



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Biodiversity of littoral benthic community and shorebirds of Sirpur Lake, Indore

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Abstract

Sirpur Lake located in the south west area of Indore city, is mainly surrounded by large trees on half its shoreline and the rest, by shrubs and open agriculture land. The lake receives considerable amount of domestic sewage from the city and is the bathing place of its human inhabitants. The main source of water of this lake is rain water. The shoreline of Sirpur Lake has a dense population of benthic communities and shorebirds. The shoreline area of this shallow tropical lake is not only an ideal habitat for the shorebirds and the benthic community but it also plays an important role in the exchange of allochthonous and autochthonous food cycles in the lake ecosystem. Whereas the benthic community serves as major component of secondary production in the lake, the shorebirds act as "biological filters" particularly in the shoreline zone. In homothermal and polymictic tropical lakes the plankton communities and benthic organisms are reported as main components of the food chain, but the shorebirds which are an integral part of this cycle is not mentioned in previous reports. It was therefore, thought worth while to make inventory of shorebirds, and benthic species diversity. The present study is focused on biodiversity of the benthic community and the shorebirds of Sirpur Lake, Indore.

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Introduction

The littoral area of lake is an interspace of land and water. Its fauna is poorly studied (Belsare, 1979). The investigations have not gone a great deal beyond necessary descriptive analysis of their types and distribution within freshwaters. The population dynamics and trophic

interrelationships of the benthic fauna are poorly understood (Hynes, 1970, Belsare, 1979, Sharma, 2002). Much of the difficulty in studying benthic fauna is due to their heterogeneous distribution of the diverse fauna in littoral waters in relation to their requirements for feeding, growth and reproduction. These requirements interact with and are altered by changes in the substratum and overlying water on a seasonal basis e.g. changes in oxygen contents, and in the input of living and dead organic matter for food. These organisms either possess adaptive mechanisms to cope up with their changes, enter relatively dormant stages until more physiological amenable conditions, return more or die. Within their limits, the adaptive capacity of the benthic animals of the dynamics of environmental parameters and food are basic to their distribution, growth and productivity, and reproductive potential.

The littoral region is an important interface between land and pelagic zone of water body. It is occupied by rooted plants, micro and macro-invertebrates and demersal fish species. The studies on benthic communities of shallow tropical lakes of India are reported by several authors (Shrivastava 1956, 1957; Krishnamurthy 1966, Michael 1968; Mandal and Moitra, 1975, Belsare & Oommachan, 1979, Oomachan & Belsare 1979, 1985; 1986; Pahwa 1979; Sarkar 1989; Kaushal and Tyagi 1989;; Malhotra et al 1990; Jaiswal & Singh 1994; Singhal, 1991). Gupta and Pant (1983) reported energy content of macro-invertebrates and their seasonal changes in Indian sub-tropical lake water body which explains rich biodiversity of the region.. The present study was undertaken to discover macro-invertebrate diversity in littoral zone of a shallow tropical lake which receive waste water from domestic sewage and agricultural effluent.

Materials and Methods

After survey of Sirpur lake for the benthic biodiversity and nature bottom, there four sampling stations are selected for the study in shore line of lake. Monthly sampling were made from March 2000 to October2000.a rod net was used in collecting samples and sieving them for isolation .the bigger animal species picked by hand where the smaller forms were isolated by sugar isolation method and studied them under low power (X 50) microscope. They were preserved by narcotizing them by methanol and chloral hydrate and later 70% alcohol. The benthic organisms were identified with help of standard books and keys. Counts were expanded to standard units of numbers per square meter by a conversion factor, which was taken from the area sampled by the grab. The conversion factor is the ratio of 1 m2 to the surface area sampled by the grab. Counts were multiplied by the conversion factor to estimate the number per square meter present in the lake

The birds were observed with the help of field binocular from a distance of 100 meters and were identified with the help of Collins birds of India by martin woods cock 1980 and artificial key prepared by belsare (1997).

Results and Discussion

The macroinvertebrate benthic fauna mainly constitute of Oligochaeta, Mollusca and Arthropoda groups. Their distribution at various stations of littoral region is summarized in table 1, 2, 3 & 4. The most common species are *Tubifex tubifex, Limmodrilus hoffmeisteri*, *Telmatodrilus multispinosus*, *Dero dorsalis, Stylaris fissciarrs, Branchiodrillis hartensis, Tubifex albicola*, *Limnaea aluminata, Unio sp. Bellamiva bengalensis*, *Digoniostoloma punchella, Melanoides tuberculatus, M. lineatus, Thira scabra, Indoplanorbis exustus*, *Pissidium clarkeanum*, *Vivipara bengalensis*, *Chironomus sps.*, *Chaborus sps*. *Prociadius sps.* etc.

The oligochaetes decrease in number during monsoon. They reappear in the beginning of post monsoon and continue to remain dominant during hot period. Among molluscs, except *Digoniostroma punchella*, *Malenoides tuberculatus* and *Vivipara bengalensis,* the other species remain at their lowest level. However the arthropods dominated the macro-benthic invertebrates during post monsoon and cold period. It is surprising that the molluscs species *Thira scabra* was absent at station I & IV, whereas it was present in large number at other stations examined.

The most dominent species among oligochaetes were, *Tubifex tubifex, Limmodrilus hoffmeisteri* and *Telmatodrilus multispinus* at station I. At station II *L. hoffmeisteri* is dominant during August to December and at station III the other species such as *Dero drosalis, Stularia fissuaris,* were abundant. *Tubifex albicola* was the dominant species at station IV.

Among molluscs all species except *M. lineatus*, *T. Scabra* and *P. clarkanum* were dominent at all stations , whereas *L. aluminate* was abundant in number at station II and station IV. Similarly *Vivipara bengalensis* was large number at station III .*Unio sps.* appear in large number during September to February period .

The arthropod benthic species were observed in more number at all stations, although there is slight fluctuation during monsoon, but increase in large number during post-monsoon season.

The shore bird species observed are Black winged Stilt (*Himantopus himantopus*), Common Sandiper (*Aclitus hyoleuces*), Black-tailed Godwit (*Limosa limosa*), White-winged Black Tern (*Chlidorias hybrida*), Wiskered Tern (*Chliodorias* sp), Little Tern (*Sterna albifrons*), Black-headed Gull *(Larus hemtorichii*), Avocet *(Recurviorostra*

avosetta), Indian Skimmer (*Rhynchops albicollis*), Red -wattled Lapwing (*Vanellus indicus*) and Pond Heron (*Ardiola grayii*). The grebs, coots, Mergansers (pond ducks) restrict themselves to pelagic region of lake and rarely visit littoral region. Their seasonal distribution is summarized in table 5. It is seen that they are abundant during cold season (late post – monsoon and beginning of summer).The migratory species vanish from shoreline area during onset of monsoon rains.

OLIGOCHEATES	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
Tubifex tubifex	15	17	21	19	11	5	10	15
Limmodrilus hoffmeisteri	7	8	9	6	5	3	4	7
Telmatodrilus multispinosus	11	12	13	13	5	5	7	13
Dero dorsalis	4	10	7	5	15	10	7	9
Stylaria fossularis	8	7	4	2	5	8	3	5
Branchiodrillus hortensis	9	8	10	9	8	4	8	6
Tubifex albicola	13	17	20	12	13	4	7	13
MOLLUSCS	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
Limnaea auricularia	24	23	39	37	17	11	10	8
Bellamva bebgalensis	19	14	9	20	14	3	4	9
Digoniostoma punchella	55	45	65	60	80	75	32	25
Melanoides tuberculatus	25	35	45	55	40	20	15	35
M.lineatus	2	3	4	7	5	2	4	5
Thira scabra	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Indoplanovbis exustus	13	18	15	11	5	6	7	8
Pissidium clarkeanum	6	5	4	6	9	10	7	6
Vivipara bengalensis	21	32	25	19	9	5	45	36
Unio sp.	19	17	12	10	8	9	6	19
Pila sp.	6	8	5	9	7	8	10	12
ARTHROPODS	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
chironomus sp.	27	23	27	7	9	10	69	74
Chaoborus sp.	21	25	32	27	7	4	60	71
Procladius sp.	19	12	32	30	4	2	54	75

Table 1: Seasonal Variation in Benthic Fauna at Station - 1 (2000)

OLIGOCHAETES	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT
Tubifex tubifex	22	19	16	14	27	38	45	60
Limmodrilus hoffmeisteri	7	08	08	15	12	8	10	09
Telmatodrilus multispinosus	17	18	17	11	08	2	09	11
Dero dorsalis	27	10	17	14	7	06	06	13
Stylaria fossularis	14	19	13	11	13	16	18	21
Branchiodrillus hortensis	11	18	12	9	15	13	11	15
Tubifex albicola	12	10	10	12	NIL	2	3	5
MOLLUSCAN	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
Limnaea auricularia	54	31	32	19	17	3	12	32
Bellamva bebgalensis	25	24	24	18	16	4	3	21
Digoniostoma punchella	17	25	22	12	11	8	5	19
Melanoides tuberculatus	11	27	21	14	12	6	7	14
M.lineatus	27	10	13	15	2	5	5	11
Thira scabra	7	14	12	13	12	8	4	18
Indoplanovbis exustus	24	18	14	15	13	4	3	7
Pissidium clarkeanum	9	11	12	11	3	6	6	3
Vivipara bengalensis	10	14	12	7	6	5	10	7
Unio sp.	17	20	11	9	7	9	8	21
Pila sp.	8	7	9	5	7	6	12	14
ARTHROPODS	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
chironomus sp.	29	30	29	31	2	4	60	77
Chaoborus sp.	26	17	31	32	8	7	51	72
Procladius sp.	20	17	31	35	9	8	52	61

Table 2: Seasonal Variation in Benthic Fauna at Station - 2 (2000)

OLIGOCHAETES	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
Tubifex tubifex	22	31	24	17	28	47	59	63
Limmodrilus hoffmeisteri	9	12	14	16	2	13	16	NIL
Telmatodrilus multispinosus	18	14	12	9	2	3	9	NIL
Dero dorsalis	17	24	10	19	44	56	47	34
Stylaria fossularis	21	17	7	14	29	23	33	39
Branchiodrillus hortensis	31	26	19	9	26	36	51	43
Tubifex albicola	10	8	9	14	3	3	2	6
MOLLUSCAN	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
Limnaea auricularia	35	46	42	37	28	23	13	10
Bellamva bebgalensis	24	23	10	23	17	5	7	13
Digoniostoma punchella	51	46	62	60	89	79	36	28
Melanoides tuberculatus	42	48	79	61	49	17	9	26
M.lineatus	7	4	8	4	6	7	3	4
Thira scabra	9	19	13	16	2	2	6	19
Indoplanovbis exustus	29	21	19	15	1	1	2	9
Pissidium clarkeanum	12	14	24	18	9	12	5	2
Vivipara bengalensis	88	57	53	65	72	50	43	37
Unio sp.	20	23	11	12	9	7	5	20
Pila sp.	13	9	8	9	6	4	2	12
ARTHROPODS	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
chironomus sp.	31	26	29	32	2	4	61	73
Chaoborus sp.	33	18	39	32	5	8	51	71

Table 3: Seasonal Variation in Benthic Fauna at Station - 3 (2000)

OLIGOCHAETES	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT
Tubifex tubifex	13	19	27	28	19	7	9	18
Limmodrilus hoffmeisteri	9	5	7	5	3	5	3	7
Telmatodrilus multispinosus	11	17	14	7	3	3	11	16
Dero dorsalis	7	19	5	2	3	7	12	11
Stylaria fossularis	9	9	7	3	4	2	9	6
Branchiodrillus hortensis	11	7	13	2	2	2	8	8
Tubifex albicola	16	24	24	15	2	2	7	15
MOLLUSCAN	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
Limnaea auricularia	29	26	49	40	19	12	2	3
Bellamva bebgalensis	29	19	7	22	4	3	4	7
Digoniostoma punchella	53	46	69	61	82	76	37	28
Melanoides tuberculatus	29	30	45	57	42	25	15	NIL
M.lineatus	3	NIL	2	9	1	1	1	1
Thira scabra	14	17	9	7	6	6	5	5
Indoplanovbis exustus	5	18	16	7	6	3	2	7
Pissidium clarkeanum	23	5	5	18	9	12	9	9
Vivipara bengalensis	24	38	32	13	10	10	45	39
Unio sp.	20	17	14	12	8	9	7	20
Pila sp.	9	9	7	7	6	10	13	11
ARTHROPODS	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
chironomus sp.	24	25	25	28	7	5	61	77
Chaoborus sp.	22	21	29	31	9	4	67	71
Procladius sp.	17	12	33	32	7	3	53	67

Table 4: Seasonal Variation in Benthic Fauna at Station - 4 (2000)

NAME OF SHOREBIRDS	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
Black winged stilt [*Himantopus himantopus*]	23	24	13	12	NIL	NIL	8	10
Common sand piper [*Aclitus hyoleuces*]	10	8	4	1	1	NIL	NIL	5
Black tailed Gadwit [*Limosa limosa*]	18	12	13	14	4	5	9	14
White Winged Black Tern [*Chlidorias hybrida*]	20	22	25	16	12	NIL	NIL	17
Whiskered Tern [*Chlidorias hybrida*]	24	26	14	13	NIL	8	14	19
Little Tern [*Sterna albifrons*]	25	24	25	14	2	2	3	16
Black headed Gull [*Larus hemtorichii*]	28	10	4	3	NIL	NIL	NIL	15
Avocet [*Recurviorostra avosetta*]	32	12	5	3	NIL	NIL	NIL	NIL
Indian skimmer [*Rhynchops albicollis*]	21	10	6	2	NIL	NIL	NIL	NIL
Red Wattled lapwing [*Vanellus indicus*]	36	22	13	14	NIL	NIL	NIL	17

Table 5: Average Number Of shorebirds (2000)

There is difficulty in studying benthic macroinvertebrate diversity due to their heterogenous distribution in littoral water in relation to their requirements for feeding, growth and reproduction. They cope up with these changes with their adaptive mechanisms, return or die. Another major problem encounters in effective analysis of these organisms is the difficulty of sampling them quantitatively because of substrate heterogeneity which leads to a patchy and nonrandom distribution. Furthermore

taxonomy of many groups is confusing and in some cases incomplete. In spite of these difficulties the present investigation has generated quantitative evaluation of populations of oligochaetes, mollusks and arthropods.

Due to greater number of different microhabitats in littoral region of Sirpur Lake, they are abundant in hot as well as cold climates. Their abundance at station III of the lake is due to organic matter of domestic sewage effluent and run-off water from agricultural fields. During cold season the diversity of oligochaete populations and their abundance, even though shore birds, which feed on them, are abundant, probably indicate interacting mechanism permitting coexistence in the habitat. The population of these worms is regulated by selective breeding and adaptive regulatory mechanism.

The littoral region of lake is much influenced by shore birds, which feed on fish, variety of benthic communities and also control vector population of water borne diseases (Morris, 1994; Batzer and Resh, 1994; Carlson *et al*, 1994; Belsare *et al*, 1999). Belsare (1994) mentioned important role played by fish and shorebirds in maintaing trophic relationship of littoral aquatic food chain. However, limnologists in studying productivity and water quality of topical lake neglected these important communities. Belsare (1981) reviewed the work done on tropical lakes the New as well as of Old world and reported that there is no information on benthic communities and the role played by them in maintaining aquatic ecosystem of tropical region. The present observations indicate that the population of oligochaetes is increased during cold period, which might be due to their breeding habit and adaptability to organic waste and has nothing to do with abundance of shore birds which feed on them. The decreased population of oligochaetes during summer is probably due to their dormancy period rather than reduced organic matter from domestic waste and run off water from catchments area which is a source of food to them. On the contrary littoral mollusk population depends on dissolved oxygen and suitable substratum. The littoral benthic fauna of insects is influenced by detritus mass and recycled organic matter. The presence and absence of shore birds which feed on them do not limit insect biodiversity.

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Study of Environmental imperatives of sustainable development in India

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Abstract

The concept of sustainable development is still being developed and the definition of the term is constantly being revised, extended, and refunded, its main components are the economic, social, and environmental factors. Sustainable development is the concept of environmental protection for the sake of future generation. Sustainability is the process of change in which exploitation of resources, direction of investments orientation of technological changes, etc. Sustainable development is the preservation of the production possibilities of an economy to provide the same goods and services obtained from nature. Sustainable development involves disciplines such as ecology, biology, an opinion but imperative. For a better India to live in; we need good air, pure water, nutritious food, healthy environment and greenery ethics, economics, chemistry, physics, statistics, and engineering. Sustainability is not around us. Without sustainability environmental deterioration and economic decline will be feeding on each other leading to poverty, pollution, poor health, political upheaval and unrest. The environment is not to be seen as a stand-alone concern. We need to tackle the environmental degradation in a holistic manner in order to ensure both Economic and Environmental sustainability. Forests play an important role in environmental and economic sustainability. They provide numerous goods and services and maintain life support systems for life on earth. Some of these life support systems of major economic and environmental importance.

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Introduction

Sustainable development is playing important role to all societies, but critical for poor ones, which depends more heavily on natural resources such as soils, rivers, fisheries, and forests than do the richer nations. It is argued that environmental problems in developing countries are predominantly driven by poverty, while those of richer nations are driven by affluence and over consumption. This is the subject of the future, especially when considered in a long-term generation perspective. Sustainability is about the possibility that the things we value in the present will continue to exist in the future. Sustainable development is the concept of relationship between economic growth and the environment. This paper addresses some pertinent issues concerning economics of Sustainable development in the present context through literature.

Objectives of sustainable development

Economic objectives

-Growth

-Efficiency

-Stability

Social objectives

-Full employment

-Equity

-Security

-Education

-Health

-Participation

-Cultural identity

Environmental objectives

-Healthy environment for humans

-Rational use of renewable natural resources

-conservation of non-renewable natural resources

Review of literature

As suggested by Barbier (1987) sustainable economic development is likely to require simultaneous account to be taken of at least three systems, namely the biological system, the economic system and the social system. He contends that sustainable development is indistinguishable from the total development of society and cannot effectively be analyzed separately as sustainability depends upon the interaction of economic changes with social, cultural, and economic transformations. Human ascribed goals apply in relation to each of these systems and must be taken into account simultaneously in determining a path or path of sustainable developments. He suggested that goals in relation to each of these three systems must be:

-For the biological system: maintenance of genetic diversity, resilience and biological productivity

-For the economic system: the satisfaction of basic needs, equity enhancement, increasing useful goods and services

-For the social system: ensuring cultural diversity, institutional sustainability, social justice and partition.

Georgescu Roegen (1972) suggested that actual human population need to be reduced rather than stabilized to ensure the maximum period of existence of human species. He based his view on the Entropy low of physics. Economic growth relies on high entropy which it uses and disperses. Eventually the stock of such resources will be completely dispersed and no longer available for production. In his view unlimited economic growth is in principle impossible and there is no possibility of human intervention making it so because of operation of the basic principles of entropy.

United Nations conference on Environment and development held in Rio de Janeiro, Brazil in 1992, United Nations conference on sustainable development 1993; and world summit for sustainable development Johannesburg 2002.

Brundtland Report 1987: Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Global warming - climate change

We have to pay the ecological and human costs of globalizing agriculture as well as industry. It is a major signal that we need a shift from production oriented conventional modern agriculture to ecologically resilient agriculture.

Besides these phenomena, the emission of green house gases through thermal plants, chemical industries units, nuclear arsenal, petrochemical units, leads to climate change. With countries habitual to periodic epidemics facing he menaces of bird flue fraught with disastrous consequences for human life.

Its spread in winter appears a trickle unusual. The recent surfacing to chikungunya in Italy, a disease so far confined to warmer tropical climate change which emerges critical to horizon. These are cases of global warming. Experts had been warming that global warming is fuelling the spread of epidemics in areas higher to unaffected. Large scale emission of carbon dioxide from industries is responsible for these climate devastations and the adversely affected 262 million people between 2000 and 2004 by these climatic disasters have been mostly the poor.

Thus, globalization enthused conventional productivity oriented growth models with excessive consumerism and comfortable, life style ,has led to climatic change through emission of green house gases, mainly carbon-dioxide which trap heat in atmosphere leading to large scale climatic disasters causing miserable life conditions for poor in developing world.

Poverty eradication and sustainable livelihoods

Poverty and a degraded environment are closely inter-related, especially where people depend for their livelihoods primarily on the natural resource base of their immediate environment. Restoring natural systems and

improving natural resource management practices at the grassroots level are central to a strategy to eliminate poverty. The survival needs of the poor force them to continue to degrade an already degraded environment. Removal of poverty is therefore a prerequisite for the protection of the environment. Poverty magnifies the problem of hunger and malnutrition. The problem is further compounded by the inequitable access of the poor to the food that is available. It is therefore necessary to strengthen the public distribution System to overcome this inequity. Diversion of common and marginal lands to 'economically useful purposes' deprives the poor of a resource base which has traditionally met many of

Their sustenance needs. Market forces also lead to the elimination of crops that have traditionally

Been integral to the diet of the poor, thereby threatening food security and nutritional status.

Changing unsustainable patterns of consumption and production

With increasing purchasing power, wasteful consumption linked to market driven consumerism is stressing the resource base of developing countries further. It is important to counter this through education and public awareness. In several areas, desirable limits and standards for consumption need to be established and applied through appropriate mechanisms including education, incentives and legislation. Several traditional practices that are sustainable and environment friendly continue to be a regular part of the lives of people in developing countries. These need to be encouraged rather than replaced by more 'modern' but unsustainable practices and technologies. Development decisions regarding technology and infrastructure are a major determinant of consumption patterns. It is therefore important to evaluate and make development decisions which structurally lead to a more sustainable society. Technologies exist through which substantial reduction in consumption of resources is possible. Efforts to identify, evaluate, introduce and use these technologies must be made.

Protecting and managing the natural resource base of economic and social development

The integration of agriculture with land and water management, and with ecosystem conservation is essential for both environmental sustainability and agricultural production. An environmental perspective must guide the evaluation of all development projects, recognizing the role of natural resources in local livelihoods. This recognition must be informed by a comprehensive understanding of the perceptions and opinions of local people about their stakes in the resource base. To ensure the sustainability of the natural resource base, the recognition of all stakeholders in it and their roles in its

protection and management is essential. There is need to establish well-defined and enforceable rights (including customary rights) and security of tenure, and to ensure equal access to land, water and other natural and biological resources. It should be ensured that this applies, in particular, to indigenous communities, women and other disadvantaged groups living in poverty. Water governance arrangements should protect ecosystems and preserve or restore the ecological integrity of all natural water bodies and their

Catchments. This will maintain the wide range of ecological services that healthy ecosystems provide and the livelihoods that depend upon them. Biomass is, and will continue for a long time to be, a major source of fuel and energy, especially for the rural poor. Recognizing this fact, appropriate mechanisms must be evolved to make such consumption of biomass sustainable, through both resource management and the promotion of efficient and minimally polluting technologies, and technologies which will progressively reduce the pressures on biomass, which cause environmental degradation. The traditional approaches to natural resource management such as sacred groves and ponds, water harvesting and management systems, etc., should be revived by creating institutional mechanisms which recapture the ecological wisdom and the spirit of community management inherent in those systems.

Environment and development

The United Nations general assembly through its agenda 21 has provided a compressive picture of inter links related to environment and sustainable development. The agenda 21 suggests an action plan is to link national and international policies for revitalizing economic agro with sustainability. Combating poverty ,improvement in demographic structure ;change in consumption patterns health, human settlements, pollution control, energy management, treatment of industrial wastes, control of hazardous materials and after the input sustainability are vital requirements for overall sustainable development of nations.

- Changing consumption patterns: Less wasteful life styles sustainable consumption levels; informed consumer choices.
- Health: Pollution health risks, urban health, Basic needs; communicable diseases; vulnerable groups.
- Human settlements: shelter, land and settlement management, environmental infrastructure, energy and transport, human resources and capacity building, disaster prone areas.
- Urban water supplies: drinking water, sanitation, intercultural planning, monitoring
- Fresh water resources: integrated assessment, development and management, production of quality and resources,

drinking water, sanitation, water for agriculture.

- Energy: Sustainable energy development and consumption, house hold, transport, industry.

India's green economy

Economics is going green. Its latest concept is sustainable development which can only be achieved if economic theory can be utilized to determine sustainable natural resources. Development can be sustainable if it has roots in its own people, culture, soil and heritage rather than the glamour of the others. Sustainability is not an option but imperative. For better a better world to live in; we need good air, pure water, nutritious food, healthy environment and greenery around us. Without sustainability environmental deterioration and economic decline will be feeding on each other leading poverty, pollution, poor health, political upheaval and unrest.

India's environmental ethics

Ecological economics accounts not only for the financial constraints on consumption, as in conventional economics, but also for the natural constraints implied by the limited ability of the environment to provide natural resources and to absorb the wastes of production and to absorb the wastes of production and consumption. Sustainable management of the economic and ecological system is one of the major focuses of ecological economics.

Conclusion

Social and Environmental stresses are the failures of institutions to manage and provide public goods to correct the spillovers. Getting socially preferred outcomes require institutions that can identify who bears the burden of social preferred outcomes require institutions that can identify who bears the burden of social and environmental neglect and who benefits and who balance these diverse interests within society. This perspective helps in understanding why technically sound policy advice is so seldom taken up. Thus, sustainable development is about enhancing human well being thorough time.

So, is enjoying physical security and basic civil and political liberties. And so is it appreciating the natural environment, breathing fresh air, drinking clean water, living among an abundance of plant and animal varieties, and not irrevocably undermining the natural processes that produce and renew these features.

There is both a need and a scope for regional and global cooperation in sustainable development. Some of the areas of common concern are marine and riparian issues, transboundary environmental impacts, and management of bioresources, technology sharing and sharing of sustainable development experiences. Efforts must be made, especially

by developing countries, to work towards synergizing experiences and raising shared regional concerns as a strong united front in international forums. Mechanisms must be put in place to facilitate such international exchange of domestic and global experiences in sustainable development. There must be mechanisms for monitoring the compliance of countries to their obligations under various environmental agreements. Currently there is a multiplicity of institutions with fragmented responsibilities. A better governance regime is required to ensure cooperation and compliance. Climate change and loss of biodiversity undermines sustainable development. However, there is no dichotomy between economic progress and protecting our environment by limiting climate change and loss of biodiversity. Indeed, the cost to mitigate climate change is less than the cost of inaction if one takes the ethical position of not discounting future generations, and delaying action can significantly increase costs. Efficient resource use (e.g., energy or water) saves money for businesses and households. Valuing and creating markets for ecosystem services can provide new economic opportunities. A green economy will be a source of future employment and innovation. Governments, the private sector, voluntary and civil society at large all have key roles to play in the transition to a low-carbon economy, adaptation to climate change and a more sustainable use of ecosystems.

If we are to achieve our dream, the time to act at scale is now, given the inertia in the socio-economic system, and that the adverse effects of climate change and loss of biodiversity cannot be reversed for centuries or are irreversible (e.g., species loss). Failure to act will impoverish current and future generations.

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Vermitechonological potential of *Lampito mauritii (*Kinberg) on leaf litter and vegetable waste during different seasons of year in Jammu

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Abstract

Epigeic earthworm species have been appeared as key organisms to convert organic waste resources into value-added products, *i.e.*, vermicompost and worm biomass. From the study it was concluded that vermitechnological potential *Lampito mauritii (*Kinberg) varied with type of substrate as well as with season of the year on same substrate. Vermicompost production and biomass of *Lampito mauritii (*Kinberg) was higher in summer months as compare with that of winter months of the year, because in summer months microbial activity was more which helped in the vermicomposting with increase in vermicomposting potential biomass increase vice- versa. Whereas, in winter months temperature decreased which also reduced the microbial activity that effect the efficiency of vermicomposting that led to decrease in biomass as well. Earthworms are cold bolded so variation of temperature leads to direct effect on the rate of metabolism.

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Keywords: *Vermicompost* | *Biomass* | *Season* |

Introduction

Vermitechnology is new concept for conversion of organic waste into useful fertilizer with the help of different species of Earthworm. Vermitecnology include two important components - vemicompoting and vermiculture. Vermicomposting is the bioconversion of organic waste materials through earthworm consumption (Gupta and Dwivedi, 2001), where as vermiculture means scientific method of breeding and rearing specific variety of earthworm in controlled conditions. Under favourable conditions of temperature and moisture, earthworms maintain the aerobic conditions in the vermicomposting process, ingest organic

waste materials and egests a humus-like granular substance, the vermicasts, which are rich in nutrients and more homogeneous than the organic wastes or raw materials used (Arancon *et al*. 2003, Edwards and Burrows, 1988). The actions of the earthworms in this process are both physical and biochemical. The physical actions include fragmentation, turnover and aeration. Whereas biochemical actions include enzymatic digestion, nitrogen enrichment, transport of inorganic and organic materials (Edwards and Lofty 1972). During this process, important plant nutrients such as nitrogen, potassium, phosphorus and calcium present in the waste materials are converted through microbial action into such chemical forms which are much more soluble and available to the plants than those in the parent substrate (Ndegwa and Thompson 2001). This may be due to the presence of various enzymes in earthworms gut viz., proteases, lipases, amylases, cellulases, chitinases etc. which degrade the cellulosic and proteineceous materials in organic waste (Hand *et al*. 1988) and enzymatic activity vary with temperature and other climatic factors. Almost all the trees exhibit sequential senescence of leaves throughout the year and all the deciduous trees exhibit synchronous senescence of leaves during winter. All these leaves are collected at a spot and are burnt and it is known fact that burning.

India is the second major producer of vegetables and ranks next to Brazil and China respectively, in the world. It contributes 10 percent of world fruit production and 14 per cent of world vegetable production. Indian Agricultural Research Data Book 2004 showed the estimated production of fruits and vegetables in India at 150 million tones and the total waste generated at 50 million tons per annum. *i.e.* 30% of the estimated production of fruits and vegetables. The high moisture and organic content in these wastes can be utilized in biological treatment like vermitechnology.

Material and methods

Epigeic species of earthworms (*Lampito mauritii* Kinberg as has been identified by Dr. J.M. Julka Former Jt. Director & Emeritus Scientist Zoological Survey of India has been collected from moist, well aerated, loose soils rich with organic matter, at a depth of 3 to 10 cm from soil surface in the urban and sub-urban areas of Jammu District.

Vermibeds were prepared in wooden boxes of size 40cm x 30 cm x 26 cm using paddy straw, sand and garden soil and 50g of earthworms in each vermibed. 30 gm of shredded leaf litter and 120 gm vegetable waste (on dry wt. basis) was separately transferred after soaking in 24hrs into vermibeds replicas of three sets for each type of waste slowly in a period of 2-3 days.

After the completion of vermicomposting process, the loose layer of soil along with decomposed organic material (bio waste) from each type of vermibed was collected. After the complete harvesting of vermicompost the earthworms from each vermibed were separated out and weighed to find out increase in earthworm's biomass per vermibed *i.e.* to evaluate the vermiculture potential of each species.

Observation and discussion

From the study it was concluded that vermitechonological potential of (*Lampito mauritii* Kinberg) varied with type of substrate as well as with season of the year on same substrate (Fig. 1 and 2) .The study revealed that vermicompost potential on vegetable waste was more as compared with that on leaf litter in summer as well winter months (Fig.1). The vermiculture potential of *Lampito mauritii* Kinberg was also observed to be more on vegetable waste as compared with that on leaf litter in summer as well winter month. So the ideal substrate and season for vermitechonological potential is vegetable waste and summer respectively. From the data it is revealed that vermicomposting potential of *Lampito mauritii* on vegetable waste and leaf litter is higher in the month of July, August and September (Fig.1).This is due to high humidity in these months that accelerate activity of micro-organism that initiated decomposition of vegetable waste and leaf litter after that earthworm easily feed on vegetable waste and leaf litter.

The analysis of data revealed that the leftover of vegetable waste and leaf litter was more in winter months thereby exhibiting less vermicomposting whereas in case of summer months leftover of vegetable waste and leaf litter was less thereby exhibiting high rate of vermicomposting in summer months. (Table I). Deka *et al*. (2011) also observed that vermicomposting process was influenced by seasonal variation and summer was more productive than winter on earthworm species *Perionyx excavates*. The analysis of data further revealed that the vermiculture potential of *Lampito mauritii (*Kinberg) exhibited the same pattern like that of vermicomposting *i.e.* higher values in summer months and lower values in winter months. So from the present study it can be concluded that the ideal substrate for *Lampito mauritii (*Kinberg) was vegetable waste and ideal season was summer month. Suthar (2006) also observed the same trend of vermitechnological potential of Perionyx sansibaricus (Perrier) more on vegetable waste than leaf litter.

Gjalaakshmi (2001, 2005) reported that *Lampito mauritii* was not only the most efficient producer of vermicast but also generated more offspring during experimental time period .thereby exhibiting more vermicomposting as well as vermiculture potential on the

composted mango tree leaves indicating the sustainability of this type of technology. Ananthakrishnasamy (2009) vermicomposted fly ash using *Lampito mauritii* thereby reducing the cost of its disposal and suggesting its best utilization, it was planned to convert the fly ash into a valuable by the potential role of indigenous earthworm .

Months	Left over of vegetable waste after Vermicomposting (g)	Left over of Leaf litter after Vermicomposting(g)	Biomass of *Lampito mauritii* on vegetable waste (g)	Biomass of *Lampito mauritii on leaf* litter waste(g)
MAY	18.6 ± 3.75	9.72 ± 0.88	43.64 ± 2.54	32.67 ± 0.86
JUN	15.81 ± 3.71	7.89 ± 1.45	43.75 ± 2.09	34.21 ± 1.01
JUL	13.4± 3.22	6.3 ± 1.06	46.22 ± 1.91	34.54 ± 1.19
AUG	15.05 ± 1.09	8.38 ± 1.59	45.95 ± 0.1	35.62 ± 1.54
SEP	15.38 ± 2.18	8.09 ± 0.95	46.43 ± 1.48	35.37 ± 0.75
OCT	17.52 ± 2.1	10.15 ± 1.35	44.12 ± 1.74	33.64 ± 1.41
NOV	23.03 ± 2.9	10.98 ± 1.1	41.69 ± 1.6	34.03 ± 1.01
DEC	31.13 ± 2.17	14.01 ± 1.55	38.22 ± 0.5	32.48 ± 0.83
JAN	30.64 ± 1.66	14.21 ± 0.8	37.92 ± 1.62	32.08 ± 1.03
FEB	27.12 ± 2.19	12.53 ± 1.09	39.52 ± 1.16	32.61 ± 1.33
MAR	29.87 ± 2.37	12.72 ± 1.35	38.43 ± 1.88	33.73 ± 1.03
APR	26 ± 2.69	11.62 ± 0.89	40.87 ± 1.68	33.85 ± 1.05

Table 1: Showing average and standard deviation of vermitechnological potential of *Lampito mauritii (*Kinberg) on vegetable waste and leaf litter.

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Effect of Codex-551 on germination and seedling growth of wheat (*Triticumaestivum*) crop in saline-alkaline black soil

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Abstract

Saline alkaline-black cotton soil can affect seed germination and plant growth. The high concentration of soluble salts can lead to problem of hindered germination and shunted growth with low seedlings. In present study, the germination of wheat (*Triticumaestivum*) under the salt stress and soil treated conditions with different Codex-551concentrations of (10 ppm up to 100 ppm) was studied under laboratory conditions. Lowest germination (1 ± 0.44) was observed in control after 24 hours while highest (15.2 ± 1.81) germination was observed in 60 ppm. Seed germination up to (20 ± 3.03) was observed in the treatment of codex-551 with 60 ppm concentration after 48 hours while the least germination (6 ± 0.92) was observed in control consisted of saline-alkaline black cotton soil without any treatment. After 7 days in control the lowest 1.6 cm root length and 1.9 cm shoot length was observed while in 60 ppm, highest root length up to 4.1 cm and shoot length up to 6.3 cm was observed. After 15 days lowest root length (2.5 cm) and shoot length (3.7 cm) was observed in control while highest root length observed was 5.6 cm andshoot length was 11.7 cm in 60 ppm

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Keywords: *Agricultural crop* | *Codex-551* | *Saline soil* | *Soil amendment* | *seed germination*

Introduction

Vermitechnology the United Nations Environment Program (UNEP) estimated that 20% of the total agricultural and 50% of the available cropland in the world is salt stressed or salt affected (Flowers and Yeo, 1995). Soil salinity imposes a serious environmental problem, affects vegetation cover and the

availability of animal feed limiting the availability of grasses in arid and semiarid regions (El-Kharbotly *et al.*, 2003). Salt stress unfavorably affects the plant growth and reduces the productivity during all developmental stages of crops. It has been reported(Epstein *et al.*, 1980) that soil salinity decreases the seed germination process, retards plant development and reduces crop yield (Shokohifard *et al.* 1989). Salt affected soils occupy wide regions that are scattered all over the world and account to about 954 millions of hectares, particularly in arid and semi-arid regions. Salt stress is one of the most serious limiting factors for crop growth and production in these regions. About 23 % of the world's cultivable agricultural lands are saline and 37 % are sodic. These soils are affected with high concentrations of sodium (Na^+) salts and represent a different set of problems which cannot be so easily rectified. The saline soil has an EC value more than 4 ds m^{-1} and exchangeable sodium percentage (ESP) more than 13%. Soils with high in sodium salts contents have decreased rates of water penetration and infiltrations problems due to the dispersion of clay particles within these soils (Amezketa and Aragues, 1995).

Germination is the most critical period for a crop subjected to salinity. Germination failures under saline soils are often the results of high salt concentrations in the seed planting zone because of upward movement of soil solution and subsequent evaporation at the soil surface (Bernstein 1974).These salts interfere with seed germination and crop establishment (Fowler 1991). Seed germination has been reported to decline with increasing salinity levels (Steppuhn and Wall, 1999). The reduction in osmotic potential of the growth medium is the primary causeof the adverse effects of salinity on plant growth and survival, both the directly and indirectly. The high concentration of specific ions in soil can cause disorders in mineral nutrition in the plants. For examples, high sodium concentrations may cause deficiencies of other elements, like potassium and calcium. The high levels of sulfate and chloride can diminish the rate of nitrate absorption in plants. Specific ions such as sodium and chloride have toxic effect on plants. They reduce the growth or cause damage to cells and membranes. The nutritional deficiencies and toxicities of plants are characterized by necrosis that results in tip burning or marginal scorch, chlorosis which results in turning the leaves yellow in color, and abscission which results in premature dropping of leaves..

Material and methods

Study area and soil sampling

The soil sample was collected from Sharnapur, District Aurangabad. The upper layer (25cm) of saline soil sample was collected. The soil sample was collected in polythene bags. These saline soil samples were analyzed for physico-

chemical parameters for the comparative study, the pH, electrical conductivity, sodium, potassium, moisture, total alkalinity etc. Garden soil was collected from Botanical garden of Dr. B. A. M. University, Aurangabad and characterized for same physico-chemical parameters using standard methods (Trivedy and Goel, 2000; P. K. Guptta, 2002). The wheat seeds of variety- MACS. 3125 were procured from local market for the present study.

Nature of Codex-551

The Codex-551 is the synonym of phosphono butane tri carboxylic acid and abbreviated as PBTC. Its chemical formula is $C_7H_{11}O_9P$ and molecular weight is 270. It is colorless or light pale yellow liquid having specific gravity 1.3^{+}-0.01 at 25°C. The pH of 1% solution is less than 2 due to active acidic nature. It has wide applications in cooling water treatment, boiler water treatment; Codex-551 was investigated as soil amendment for saline soil reclamation.

Experimental method

The experimental work was carried out under laboratory conditions. The healthy seeds were selected, sterilized with 0.05 N $HgCl_2$ and seeds were germinated in Petri plats. Total of 20 seeds were kept for germination in each sterilized Petri plate with all sets in triplicate. At the bottom of each Petri plate wet filter paper were placed and 20 seeds of wheat were arranged on it. The papers were replaced every two days to prevent accumulation of salts (Rehman et al. 1996). A set of control without any treatment was arranged for comparison with only saline soil suspension. Treatments were (11) control i.e., there was no addition any chemicals only saline soil suspension (Abdurrahman Hanay *et al*., 2004) and sets 1 to 10 were treated with different ppm concentrations viz. 10ppm, 20ppm, 30ppm, 40ppm, 50ppm, 60ppm, 70ppm, 80ppm, 90ppm, 100ppm concentrations were prepared. The seeds were considered to have germinated, when the emerging radical elongated to 1mm. Shoot and root length (cm), and seedling fresh and dry weight mg/plant were measured on the 7th and 15th day. Germination percentage of seeds was observed and recorded after 24 hours and 48 hours. Dry weights were measured after drying samples at 70°C for 48 hours in an oven (Bohm, 1979). Germination was recorded.

Results and Discussion

The Physico-chemical parameters of saline alkaline-black cotton soil were studied. Salinity indicator parameters, electrical conductivity and exchangeable sodium values of soil were determined 4.19ds/m and 13.5 mg/kg respectively.

Sr. No.	Properties	Average values
1	pH	10.2
2	Electric conductivity	4.19 ds/m.
3	Total alkalinity	30 g/lit.
4	Exchangeable sodium	13.5 mg/kg.
5	chloride	17.4 g/lit.

Table 1: Physico-chemical properties if saline alkaline-black cotton soil

Sr. No.	Treatments Conc. Of Codex-551	Mean ±SD After 24 hr.	Mean ±SD After 48 hr.
1	10 ppm	4.08±0.83	10.8±1.33
2	20 ppm	6±1.00	13.00±1.51
3	30 ppm	8.2±1.14	14.03±1.80
4	40 ppm	9.1±1.30	14.07±2.05
5	50 ppm	12.00±1.48	16.01±2.34
6	60 ppm	15.3±1.81	20.00±3.03
7	70 ppm	13.5±1.67	19.02±2.77
8	80 ppm	12.8±1.58	17.00±2.38
9	90 ppm	11.01±1.44	13.08±1.78
10	100 ppm	10.6±1.37	13.02±1.71
11	Control	1±0.44	06±0.92

Table 2: Effect of Codex-551 on seed germination of wheat.

Treatments Conc. Of Codex-551	Root Length after 7 days in (cm)	Shoot length 7 days (mg)	Fresh weight after 7 days (mg)	Dry weight after 7 days (mg)
10 ppm	2.9	3.7	0.133	0.034
20 ppm	3	4.4	0.174	0.041
30 ppm	3.4	4.10	0.197	0.050
40 ppm	3.6	5.1	0.204	0.053
50 ppm	3.8	5.6	0.223	0.057
60 ppm	4.1	6.3	0.247	0.065
70 ppm	3.11	5.9	0.239	0.060
80 ppm	3.7	4.5	0.200	0.054
90 ppm	3.5	4.2	0.184	0.047
100 ppm	2.8	3	0.161	0.039
Control	1.6	1.9	0.097	0.024

Table 3: Effect of Codex-551 on root, shoot length, fresh weight and dry weight after 7 days.

Codex-551 was used for the treatment of saline soil. Ten different concentrations at ranging from 10 ppm to 100 ppm were used for the treatment of saline soil. Lowest germination (1 ± 0.44) was observed in control after 24 hours while highest (15.2 ± 1.81) germination was observed in 60 ppm. Seed germination up to (20 ± 3.03) was observed in the treatment of codex-551 with 60 ppm concentration after 48 hours while the least germination (6 ± 0.92) was observed in control consisted of saline-alkaline black cotton soil without any treatment.

The treatment of codex-551 was 10 ppm concentration. The root length and shoot length observed were after 7 days 2.9 cm and 3.7 cm. The sixth set treated with 60 ppm concentration. The highest root length up to 4.1 cm and shoot length up to 6.3 cm was observed in after 7 days. It is observed that the root length and shoot length were increasing with treatment concentration maximum at 70 ppm and were decreasing there after indicating the toxic effect. The lowest root length 1.6 cm and shoot length 1.9 cm after 7 days was observed in saline soil without any treatment.

The treatment of codex-551 was found beneficial at lower and moderate concentration and reflected through the increase in fresh weight and dry weight per plant. With its 10 ppm concentration, the total fresh weight of wheat crop observed was 0.247 gm and dry weight was 0.065 gm per plant 7 days. In the sixth set (60 ppm concentration) had maximum total fresh weight (0.419 gm per plant) and maximum dry weight (0.107 gm per plant) after 15 day. In saline soil (Control) without any treatment it was observed the lowest total fresh weight of wheat crop 0.097 gm and dry weight 0.024 gm was after 7 days respectively.

Treatments Conc. Of Codex-551	Root length15 days (mg)	Shoot length15 days (mg)	Fresh weight after 15 days (mg)	Dry weight after 15 days (mg)
10 ppm	3.7	6.11	0.257	0.065
20 ppm	4.3	7.1	0.270	0.070
30 ppm	4.5	7.8	0.316	0.081
40 ppm	4.6	8.3	0.368	0.094
50 ppm	4.9	9.10	0.391	0.100
60 ppm	5.6	11.7	0.430	0.110
70 ppm	5.1	11.5	0.419	0.107
80 ppm	4.4	7.9	0.388	0.098
90 ppm	4.1	7.2	0.354	0.090
100 ppm	3.10	5.6	0.245	0.062
Control	2.5	3.7	0.162	0.041

Table 4: Effect of Codex-551 on root, shoot length, fresh weight and dry weight after 15 days.

The treatment of codex - 551 with 10 ppm concentration the root length per plant was 3.7 cm and shoot length was 6.11 cm per plant after 15 days. The sixth set treated with 60 ppm concentration the root length highest was (5.6 cm) and shoot length was also highest (11.7 cm) after 15 days. It observed that the overall root length and shoot length was decreasing after the treatment with 60 ppm concentration indicating the toxic effect or hindering effect evidenced by reduced the root and shoot length respectively. In saline soil (Control) without any treatment the lowest root length (2.5 cm) and shoot length (3.7 cm) was noticed after 15 days.

The treatment of codex-551 with 10 ppm concentration the total fresh weight of wheat crop 0.257 gm per plant and dry weight was 0.065 gm after 15 days which is lowest among the all treatments except control. In the sixth set (60 ppm concentration) had maximum total fresh weight (0.419 gm per plant) and maximum dry weight (0.107 gm per plant) after 15 days respectively. The minimum total fresh weight per plant (0.162 gm) and minimum dry weight (0.041 gm) was observed in saline soil (Control) without any treatment after 15 days which clearly suggests that the Codex-551 reduces the toxicity in saline alkaline-black cotton soil.

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A report on some threatened plant taxa of Harda district of Madhya Pradesh, India

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Abstract

A study was carried out in Harda district of Madhya Pradesh in connection with the threatened plants of this area. In all 200 species of angiospermic plants were identified out of which160 species belong to 138 genera and 42 families of dicotyledons and 40 species, 33 genera and 15 families of monocotyledons. In the present investigation 15 species were found to be threatened which may disappear if causal factor of depletion would be continued in future.

Keywords: *Threatened plants | Threatened plants | Threatened plants | Biodiversity | Harda district | Plant exploration*

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Introduction

It is well known that on account of current trend of their exposition and destruction, thousands of plants species are endangered and facing extinction at global level. .Harda district is situated in the eastern part of Madhya Pradesh. It lies in between 21^0 53' and 22^0 36' N longitude and 76^0 47' and $77^0$20' E Latitude. The total geographical area of the district is 3330 sq.km out of which forest area is 2643 Sq.km. The percentage of forest cover is 35.4 and its percentage contribution to the state forest is 1.4 only. The district is bounded by Satpura ranges in the North. The district is covered by Satpura Mountains in the South and extension of Malwa plateau. while North-East and central part of the district is occupied by Alluvial plain The study area is mainly drained by Narmada river and its tributaries are Ganjal, Ajnal, Sukni, Midkul, Dendra, Machak, Syani, and Kalimacchak rivers. Tropical dry deciduous forest is the characteristic feature of

the study area. Dominant tribes inhabiting the area are Korku, Gond, Bhils, Bhilalas and Gurjars. Tribal groups form two-thirds of the total population of the Harda district. Earlier research work has shown that meager work on ethno botanical studies have been done in Harda district (and still much work is to be done in this tract.

Since the world vegetation cover under natural forest is continuously depleting at an alarming rate and replaced by secondary forests or is being denuded completely. Hence keeping this point in view, the present investigation was undertaken to fill this gap.

Materials and Method

The study was conducted during the year 2010 – 11. And in this connection regular field survey was carried out and places which were visited are Bamori, Nayapura, Chipawad, omgawoan, Charva, Siralia, Bunnas, Chipaner, Timarni, Kirkia, Ratatalai, Sontlai, Allanpur, Nandra and Handia Extensive field trips were organized for collecting the plants and data, using an integrated approach of Botanical collections, interviews and questionnaires. Standard guide line was followed (Jain and Goel, 1995, Jain and Mudgal, 1999). A field dairy with details of visit was maintained. All Habitats of the study area surveyed carefully .Plant specimens were preserved by dipping the whole specimens in saturated solution of mercuric chloride and alcohol. Herbarium sheets of the dried and preserved plants were prepared following conventional methods (Jain & Rao, 1977). Different floras and monographs were consulted for identification of plant (Cook, 1957;Jain & Rao, 1957; Verma *et al* , 1993; Mudgal *et al*, 1997; Singh *et al* , 1999; Shah, 1978 and Naik, 1998). The herbarium sheets were prepared[15]. Main forest area of study area was confined to Timarni and Khirkia tehsils where rich population is rich.

In all 200 species of angiospermic plants were identified out of which160 species belong to 138 genera and 42 families of dicotyledons and 40 species, 33 genera and 15 families of monocotyledons. The statistical data are shown in Table 1. The scientific, vernacular name and family names of these plants along with status, place of collection and their cases of depleting are enumerated in Table 2.

Results and Discussion

An extensive and intensive plant survey was carried out in different regions of the Harda district of Madhya Pradesh, India. Due to various factors such as changing environmental conditions, biotic factors, destruction of habitat etc. some endemic and medicinal species are facing threats for their existence. Conservation and sustainable utilization of plant resources are recognized as one of the vital segment in the natural resource management. According to the International Union of conservation of Nature **(IUCN)**, it is estimated that the extinction rate of the current species is between 1000 and 10,000 times higher than it would be

in natural condition. These potential medicinal plants are used in different diseases.

From Table 1, it is revealed that out of 200 angiospermic plant species collected in various field trips, 160 species, 138 genera and 42 families belong to dicotyledons while 40 species, 35 genera and 15 families belonging to monocotyledons. Thus preliminary study of Harda district shows rich plant diversity in respect to the distribution of species, genera and families of both dicotyledons and monocotyledons. Table 2 indicates a list of 15 threatened plants which are depleting from the area at an alarming rate and there is possibility that these species may be disappeared from the area if causal factor of depletion continues in future. Hence there is an urgent need of conservation of these plant species for their survival. Thus the present study provides some valuable information of conservation and maintenance of biodiversity. Before few decades, Harda district has floristically very rich with diverse habitats. But due to over exploitation and various other factors responsible for threatening the vegetation of the region have caused rapid destructions of habitats of the plants.

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Angiosperm		Species	Genera	Families
Dicot	Polypetalae	70	56	19
	Gamopetalae	75	70	18
	Monochlaydeae	15	12	05
	Total	160	138	42
Monocot		40	35	15
	Grand Total	200	173	57

Table 1: Distribution of angiospermic Species, Genera, and Families reported in Harda district of Madhya Pradesh.

S. No.	Common name	Botanical name	Family	Status	Place	Causes
1	Bandar laddu	Gardenia gummifera L.	Rubiaceae	Rare	Handia	Loss of habitat
2	Lutki	Cynoglossum wallichi G. Don.	Boraginaceae	Vulnerable	Nandra	Climatic
3	Tumbadi	Lagenaria leucantha (Dauch.) Rasby.	Cucarbitaceae	Rare	Allanpur	Human interference
4	Kando	Drima indica (Roxb.) J.P. Jessop	Liliaceae	Vulnerable	Sontalai	Over exploitation
5	Utran jad	Aristolochia indica L.	Aristolochiaceae	Rare	Ratatalai	Over exploitation
6	Bharang	Clerodendrum serratum (L.) Moon.	Verbenaceae	Rare	Kirkia	Over exploitation
7	Salai	Boswellia serrata Roxb.ex.Colebt.	Burseraceae	Rare	Timarni	Industrial use
8	Rohindo	Soymida fabrifuja (Roxb.) A. Juss.	Meliaceae	Vulnerable	Chipaner	Harvesting
9	Marsang	Spilanthes paniculata Wall.ex.DC.	Asteraceae	Endangered	Bunas	Climatic
10	Kalihari	Gloriosa superba L.	Liliacaeae	Endangerd	Siralia	Over exploitation
11	Bhach	Acorus calamus L.	Araceae	Endangered	Charva	Over exploitation
12	Bijasal	Pterocarpus marsupium Roxb.	Fabaceae	Rare	Somgawoan	Harvesting
13	Ghada palash	Erythrina suberosa Roxb.	Fabaceae	Rare	Chipawad	Climatic
14	Kullu	Sterculia urens Roxb.	Sterculliaceae	Rare	Nayapura	Harvesting
15	Somlata	Sarcostemma acidum (Roxb.) Voigt.	Asclepiadaceae	Endangered	Bamori	Human interference

Table 1: List of threatened plants reported from Harda District of Madhya Pradesh

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Morphological variations and Inhibition of growth of *Escherichia coli* due to exposure of first transition series metal compounds

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Abstract

Escherichia coli was isolated from sewage sample of Nag-Nallah Nagpur and confirmed by conventional source tracking technique including morphological, cultural, biochemical and enzymic characterization. The cells were exposed to 0.2 µgm/ml, 2 µgm/ml, 20 µgm/ml, 200 µgm/ml, 2000 µgm/ml, and 20000 µgm/ml of each metal compounds of first transition series from Vanadium to Zinc. The exposure showed to such compounds showed morphological variations in gram staining and Scanning Electron Micrography. The cells showed distinct increase in length and breadth. The exposure to these compounds also resulted in the inhibition of growth of *Escherichia coli*.

Keywords: *Escherichia coli* | *first transition Series compounds* | *morphological variations*

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Introduction

Since in the ever changing environments the exposure of the metallic abiotic factors to the microbes may vary to both the extremes, albeit, depending upon the situation. The degree or the extent to which microbes can sustain or develop systems to tide over such situations with respect to the exposure to the transition metal ions is not completely yet clear. Since the increase in pollution of both water bodies and landfills are resulting in increased levels of the transition metal ions therefore their effect on the micro flora of any ecological niche is of prime importance.

Escherichia coli are known to be the most common micro flora of human intestine. In fact, it is alternatively also known as colon bacteria and is an opportunistic pathogen.

The effects of Cr (III) and Cr (VI) species ($Cr_2O_7^{2}$, CrO_4^{2} and Cr^{3+}) on the growth of *Escherichia coli* have been investigated and the inhibitory ratio of Cr (III) to *Escherichia*

coli was smaller than that of Cr (VI). The k values of *Escherichia coli* in the presence of Cr (VI) and at high concentrations of Cr (III) were decreased with increasing the concentrations of these chromium species (YAO *et al.,* 2008). The influence of nickel (II) ions concentration on the growth and nickel (II) bioaccumulation properties of *Escherichia coli and* it was found that the growth of *Escherichia coli* was delayed obviously with the increasing nickel (II) ion concentration, while the accumulation capacity increased until the maximum was obtained (Wu *et al.,* 2009).

Material and methods

Isolation of *Escherichia coli* strain

10 ml of sewage was collected from Nag-Nallah Nagpur, and filtered through Whatman No.1 filter paper to remove the residual solid matter. 0.1 ml of filtrate sewage was sprayed over the sterile plate of McConkey's agar and Eosin methylene blue agar aseptically in triplicate. The plates were incubated at 37^0C ± 2^0C for 24 hours. Colonies showing typical characteristics of green metallic sheen on EMB agar and typical pink colour colonies on McConkey's agar were aseptically picked and purified by four-way streaking method on sterile Nutrient agar.

Confirmation of *Escherichia coli*

All the isolated colonies were obtained which were subjected to confirmation studies using standard conventional source tracking method. Gram Staining, Motility, Cultural characterization, Sugar fermentation, IMViC Test and Enzyme studies including H_2S production, Urea hydrolysis, Phenyl Alanin deaminase, Lysine decarboxylase, Lipase and OF test.

Scanning Electron Microscopy (SEM)

Scanning Electron Microscopy of isolates was performed at NBSS & LUP Nagpur and Shraddha Analytical Services Mumbai, for confirming the morphological changes due to stress responses by the method of Klainer A. S, *et al.,* 1970.

Result and Discussion

Sewage samples were processed and inoculated on EMB, McConkey's and Nutrient agar plates. Twelve isolates showed typical colonies with green metallic sheen on Eosin Methylene Blue agar, pink colour on McConkey's and pin headed colonies on Nutrient agar. These isolates subjected to complete characterization by conventional source tracking technique (Table 1) and the results were compared with the standard response table in Bergey's manual of Determinative Bacteriology vol. 9. These isolates were confirmed as *Escherichia coli* and referred to as EC-Test for further study. The results are compared with *Escherichia coli* ATCC 8739 procured from NCL Pune and used as the reference Strain.

The test organism was exposed to 0.2µgm/ml, 2.0µgm/ml, 20µgm/ml, 200µgm/ml, 2000µgm/ml, and 20000µgm/ml of Vanadium

pentoxide, Chromium nitrate, Mangnous acetate, Ferric oxide, Cobalt chloride, Nickel nitrate, Cupric sulphate and Zinc sulphate respectively by supplementing membrane filtered solutions of these compounds in 10 ml of sterile nutrient broth. These dilutions are equivalent to the micromoles of the compounds as shown in Table 2. The tubes were incubated at 37^0c±2^0c for 24 hours. A loop full of culture was aseptically removed and Gram staining was performed. The rest of the culture was harvested as 1000 g for 30 min. the pellets were then processed for Scanning Electron Micrograph as per Klainer et al 1970. The results are shown in photomicrograph 1 and 2.

Sterile nutrient agar plates were prepared and they were flood with 1 ml inoculum of the EC-Test organism where in the inoculum sizes standardized using MacFarland Standard. A well of 0.5 cm diameter were cut in each plate aseptically. 0.5 ml each of dilutions of all the compounds was placed in the wells of nutrient agar plates. The plates were then incubated at 37^0C ± 2^0C for 24 hrs, in straight position. After 24 hrs, the zone of inhibition was measured using Hi-Media zone measuring scale. The zone of inhibition verses the exposure to compounds is shown in Graph 1.

Statistical analysis was performed using prism pad version 5. The one way Annova analysis using Newman Keuls multiple comparison test was performed.

Discussion

Robert *et al.* (1994) have shown that the faecal coliforms abundantly present in sewage. Bell *et al.,* (1981) has shown that the faecal coliforms present in sewage are abundant and around 10.80% of the faecal coliforms show the presence of R factor and hence are resistant varieties of *Escherichia coli*.

H. M. Dalton *et al.,* (1994) have shown that the morphology of bacteria changes particularly in marine bacteria when they are exposed to different surfaces. The colonization pattern and the resultant morphological changes can only be visualized using high resolution techniques such as Confocal Microscopy, Scanning Electron Micrograph and Real Time Lapse Video Microscopy etc**.**

Roberta *et al.* (2006) and Dutta *et al.* (2010) have shown that TM doped and surface modified nano particles of ZnO exposure to E coli results sever morphological defects in the membrane and increase permeability of the nano particles resulting in higher internalization. Similarly Gugang *et al.* (2009) have shown that nanoparticles of copper also results in subtle morphological changes along with antimicrobial properties against *Escherichia coli*.

Shailendra Mishra (2009) have shown that While bacillus species shows distinct morphological change in the form of formation of cage like structures, Arthrobacter instead produces excessive Exo-Polysaccharide (EPS)

for the same.

Ackerlev *et al.* (2006) have shown that *Escherichia coli* K12 experiences a stress condition when exposed to chromate. Within 3 hrs of chromate exposure the cells tend to show filamentous morphology.

In our study we find definite changes in the length and breadth of the cells when exposed to first transition series compounds. While Vanadium, Copper and Zinc shows very slightly change in width but moderate change in length, Chromium, Manganese, Cobalt, Iron and Nickel showed both changes in width and length. At very high concentrations of iron there was a tendency to become filamentous. Comparably large cells can be observed in both Gram staining slides as well as Scanning Electron Micrographs.

Ezaka and Anyanwu (2011) have reported Chromium VI bacterial cell isolated from sewage. They have shown chromium tolerant *Escherichia coli*, *Staphylococci, Bacillus, Pseudomonas* and *Micrococcus* which could tolerate up to 200µgm/ml and above concentration of chromium. Chromium tolerant bacteria have also been reported from industrial applicants and contaminated soils by other workers (Shakoori A. R. *et al.,* 1999 and Linna Ma *et. al.,* 2011).

Olukoya *et al.* (1997) have listed large number of bacterial species including *Bacillus*, *Pseudomonas*, *Escherichia coli*, *Klebsiella* and *Salmonella* that could tolerate many heavy metals including mercury, lead, zinc, cobalt.

Enteric bacteria particularly *Escherichia coli* is known to show copper resistance. Williams, (1993) have reported copper tolerant *Escherichia coli*, *Salmonella* and *Citrobacter*. *Escherichia coli* K 12 strain showed resistant level up to 18 millimolar of $CuSO_4$.

All the first transition series compounds under study showed oligodynamic action as they inhibited the growth *Escherichia coli* at very low concentration of 0.2 µgm / ml of the compounds. The Newman keuls multiple comparison tests performed under one way Annova shows no significant difference in the oligodynamic action at p value less than 0.05. when the test culture was compared with the EC- Ref strain ATCC 8739 using student t test all the 8 compounds there was no significant difference found between them suggesting there by that the oligodynamic action on test and reference strain are identical.

Philip *et al.* (1950) have shown that when intercellular magnesium is low the uptake of these metal ions increases resulting in the inhibition of the *Escherichia coli* growth. Increased concentration of magnesium however reduces the uptake of these metals resulting in lowering of the inhibition effect. Since, in our case the cells were grown in the medium containing uniform amount of magnesium, which is not very high, therefore the uptake of these metals must be fairly high resulting in decreased growth or complete

inhibition at very high level as can be seen from Fig 1.

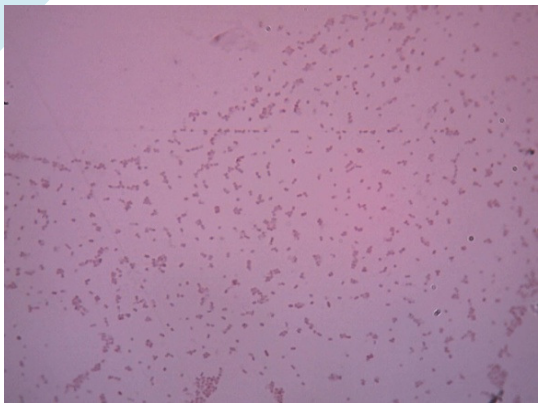
Sr. No.	Property	Observations	Sr. No.	Property	Observations
Morphology			**Sugar Test**		
1	Gram Reaction	Gram Negative Small Rods Coccobacillary	10	L-Arabinose	A
2	Motility	Sluggishly Motile	11	Lactose	A/G
Cultural			12	Maltose	A
3	EMB	Colonies with profuse green metallic sheen	13	D-Mannose	A
4	McConkey's Agar	Pink colour colonies	14	D-Manitol	A/G
5	Nutrient Agar	Pin Headed colonies	15	D-Sorbitol	A
			16	D-Xylose	A
IMViC Test			**Enzyme Production**		
6	I	+	17	H2S Production	-
7	MR	+	18	Urea hydrolysis	-
8	VP	-	19	Phenyl Alanin deaminase	-
9	Citrate	-	20	Lysine decarboxylase	+
			21	Lipase	-
			22	ONPG	+
			23	OF Test	F

Table 1: Characterization of *Escherichia coli* EC-Test organism

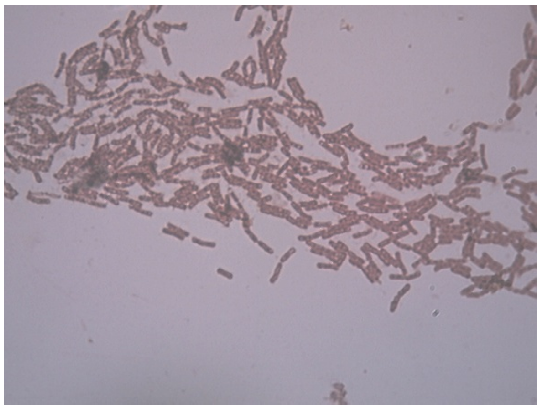
Compounds	0.2µgm/ml	2.0µgm/ml	20µgm/ml	200µgm/ml	2000µgm/ml	20000µgm/ml
Vanadium pentoxide	0.054µmol	0.54µmol	5.4µmol	54.0µmol	540.0µmol	5400.0µmol
Chromium nitrate	0.024 µmol	0.24 µmol	2.4µmol	24.0 µmol	240.0 µmol	2400.0 µmol
Mangnous acetate	0.040 µmol	0.40 µmol	4.0 µmol	40.0 µmol	400.0 µmol	4000.0 µmol
Ferric oxide	0.062 µmol	0.62 µmol	6.2 µmol	62.0 µmol	620.0 µmol	6200.0 µmol
Cobalt chloride	0.042 µmol	0.42 µmol	4.2 µmol	42.0µmol	420.0 µmol	4200 µmol
Nickel nitrate	0.034 µmol	0.34 µmol	3.4 µmol	34.0 µmol	340.0 µmol	3400.0 µmol
Cupric sulphate	0.040 µmol	0.40 µmol	4.0 µmol	40.0 µmol	400.0 µmol	4000.0 µmol
Zinc sulphate	0.034 µmol	0.34 µmol	3.4 µmol	34.0 µmol	340.0 µmol	3400.0 µmol

Table 2

Gram staining



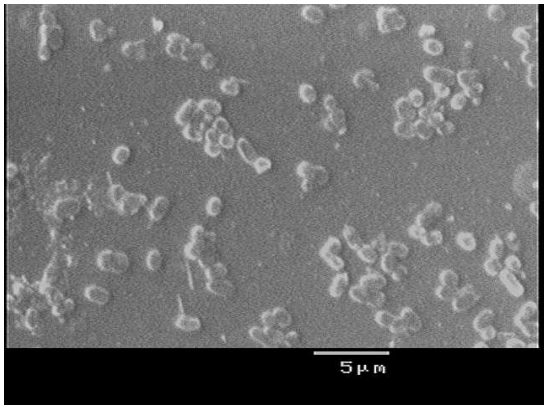
EC- Test Before exposure (Control)



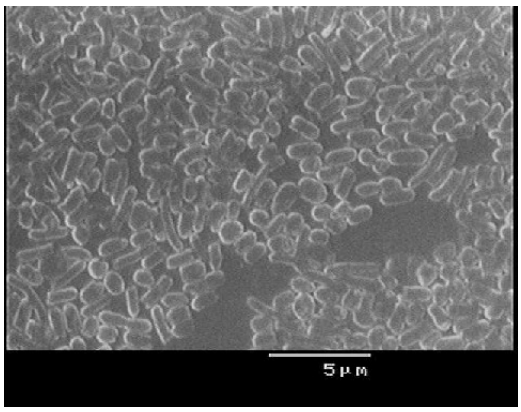
EC-Test Exposed to Ferrous at 200µgm/ml

Fig: 1

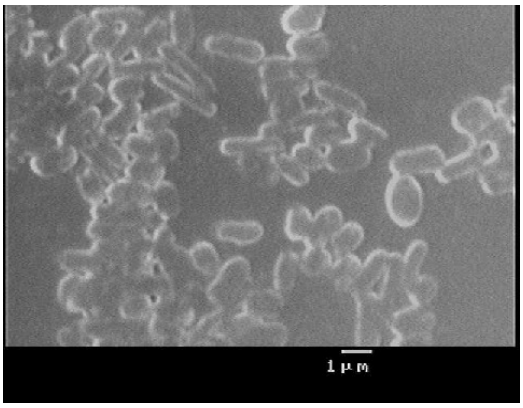
Scanning Electron Photomicrograph:



Control EC7 Test

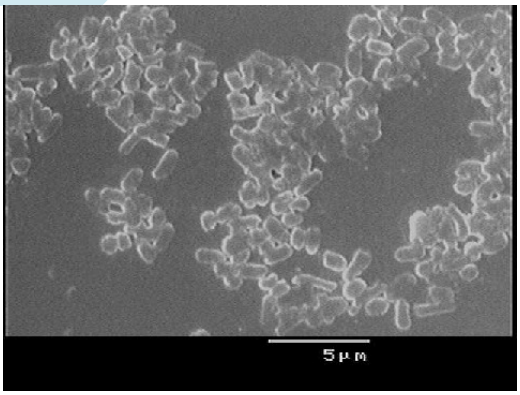


EC-Test Exposed to Vanadium at X-5000

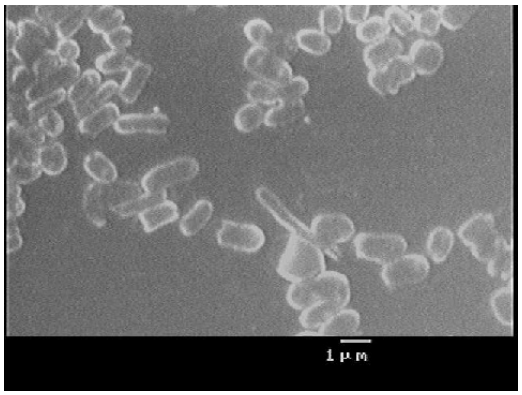


EC- Test Exposed to Chromium at X- 7500

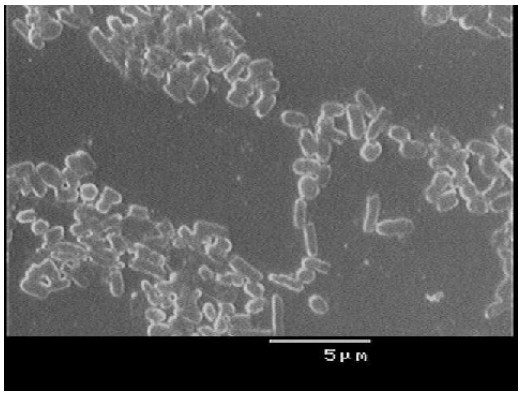
Fig: 2 continued next page



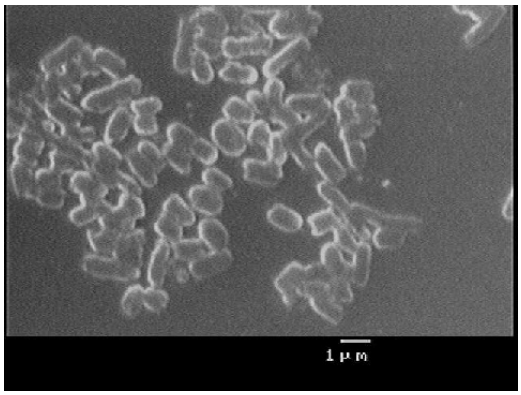
EC-Test Exposed to Manganese at X-7500



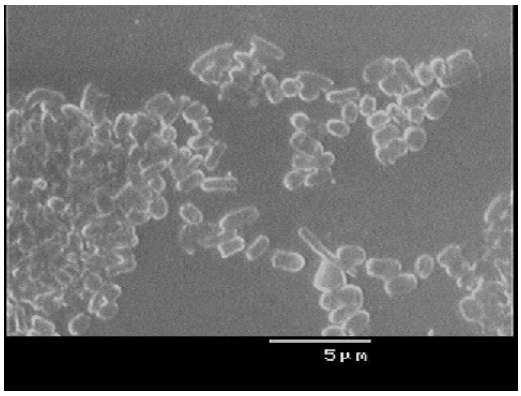
EC- Test Exposed to Ferrous at X-7500



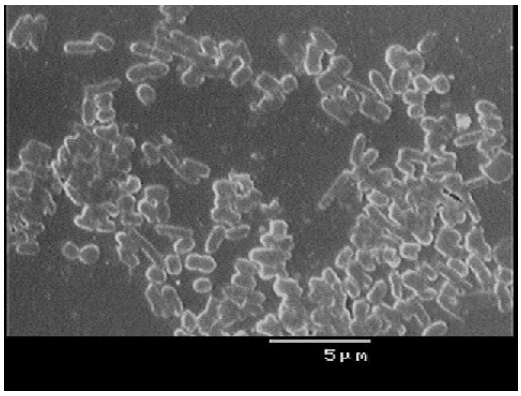
EC-Test Exposed to cobalt at X-5000



EC-Test Exposed to Nickel at X-7500

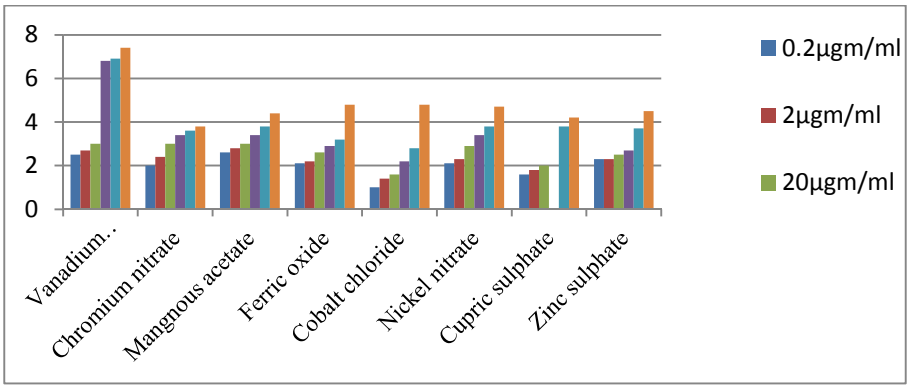


EC- Test Exposed to Copper at X-5000



EC- Test Exposed to Zinc at X-5000

Fig. 2



Zone of inhibition

Graph 1: Effect of First transition series metal compounds on growth of EC-Test

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Knowledge Societies, Human Security and Human rights

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Abstract

Twenty-first century geopolitics will be deeply influenced and reshaped by the emergence of knowledge societies. Knowledge and information will increasingly become strategic resources par excellence, as illustrated by the very quick growth of secrecy in the most advanced industrial societies over the past decades, Thus,the crucial political challenge inknowledge societies will concern the struggle for the control of knowledge resources. Knowledge can serve the cause of good or evil indifferently. To say this is not to call into question the ethical trend towards progress but rather to question, in some cases, the very rationality of the scientific enterprise, which can bring benefit or harm to human beings. In view of the value-neutrality of knowledge, it is more necessary than ever to argue the need for the development of ethical and political consciousness in knowledge societies.

Keywords: Knowledge Societies | human security | human rights

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Introduction

Knowledge societies will be increasingly confronted to doubts about the future of humanity and the planet. Mounting dangers linked to the dwindling of natural resources could accentuate existing asymmetries, particularly North-South asymmetries.

Most local or international armed conflicts are more or less closely related to struggles for the control of natural resources – whether such conflicts originate in rivalries over raw materials or in antagonistic uses of a same resource by different across. Would it not be disastrous if the universal dissemination of knowledge within knowledge societies were to be accompanied by a resurgence of conflicts arising from resource scarcity – water wars, energy wars, wars to control increasingly scare strategic resources? One of the challenges that knowledge societies will have to meet is the creation of sustainable, concerted and peaceful forms of resource uses, in order to prevent conflicts or wars through regulation and mediation. This task will be efficiently carried out only through the joint action of natural sciences and society.

Knowledge societies, New knowledge tools to better define risks and treats

Presented in particular in the 1994 UNDP Human Development Report and later developed in the Report of the Commission on Human Security(2003)[8] and the work of the Human Security Net-

work,[9] the human security agenda advocates for an enlarged conception of security covering all the dimensions of human life (economic, social, political, democratic, cultural, and legal security – to cite but a few) in order to respond to non-military and non-armed threats to peace. Centred on the needs of the individual and of populations (protection against illness, hunger, unemployment, crime, social conflicts, political repression and natural disasters), the human security concept fully takes into account the transnational evolution of threats. It is a known fact that conflicts, threats to the environment, pandemics and emerging diseases are borderless. This enlarged conception is aimed at enriching and extending the traditional notion of security as guaranteed by the state, which is focused above all on the maintenance of law and order and on national defense. According to the Commission on Human Security, the purpose of human security is to create "political, social, environmental, economic, military and cultural systems that together give people the building blocks of survival, livelihood and dignity" This new conception of security presupposes that integrated solutions will be developed to address a whole range of problems that give rise to insecurity. The concept of human security brings together fields that disciplinary specializations have long led to regard as separate. The appearance of new non-military threats to peace and security requires the development of new tools of knowledge and watch to define the impact of each one of them as precisely as possible, above all when the threat concerns the most vulnerable populations. In this framework, essential issues – such as the interactions between populations, environment and food security – must be tackled from an integrated and interdisciplinary point of view, in knowledge societies, such integration of research and policies should be encouraged through the pooling of knowledge resources and the development of trans-disciplinarily – it is reasonable to hope that knowledge societies will encourage the promotion of human security through new and appropriate processes.

Education as the cornerstone of human security and knowledge societies

There is a strong connection between the goals of human security and those of education and training. Shall we recall that in the societies of the written word, illiteracy has become a source of insecurity, as developing countries are cruelly aware?[11] Moreover, through education, the battle is joined not only against ignorance but also against other forms of insecurity. Education encourages people to take better care of their health, favours securing employment on the job market and pacifies the everyday violence in relationships between individuals. Education also encourages awareness and thereby the prevention of old and new threats, particularly crucial at a time when many experts consider that we have entered the "risk society"(Ulrich Beck). Indeed, it is important to prepare citizens for better self-protection and risk

management. Education is the keystone of the policies on human security and the main tool to encourage the emergence of knowledge societies.

Contributing to the respect of human rights

Human security comprises everything that is "empowering" individuals: human rights, including economic social and cultural rights, access to education and health care, equal opportunities, good governance etc. The assumption underpinning the agendas of human security is that all individuals, provided that they are free from the main causes of insecurity, can become the architects of their own well-being as well as that of the community. Indeed, access to knowledge and knowledge sharing can pro-vide individuals with the abilities needed to ensure the conditions for human security. These conditions include a certain number of fundamental rights – freedom of conscience, freedom of expression and information, freedom of association, freedom of the press and universal suffrage, as well as economic, social and cultural rights, among which is the right to education. Therefore, the free movement of ideas, information and images, coupled with broad access to knowledge and information, are prerequisites for the emergence of know-ledge societies. If access to political, social, scientific and economic information is an inalienable right. It nevertheless remains important to be aware of the dangers associated with the movement of data concerning individuals. Indeed, threats to privacy have increased, particularly with the advent of new information and communication technologies, and especially when the use of such technologies is presented as security-related. The complexity of this situation shows that, in order to be democratic, knowledge societies will need to strike the right balance between individual freedom and the demands of security.

Human security and normative action

Trust in the everyday environment and the reliability of goods and services are also prerequisites for human security, whether it is the food, health, environment or socioeconomic sector that is concerned. Product and service certification is essential, in particular when related to nutrition and health, which are themselves directly related to the individual's well-being, indeed, medicine counterfeiting and the lack of food control entail very important direct risks for health and food security.

The first imperative is to create norms adapted to local realities. But creating standards is not sufficient. Standards must be subjected to positive and negative sanctions, and citizens, companies, and the main actors of civil society must be informed about the existence and validity of such norms and standards. How can prevention policies be efficient if the public does not believe the information they receive?

Normative action and the certification procedures undertaken by the public authorities must be taken over by initiatives within civil society. Companies that abide by these norms and show their validity in practice play a key role. In the same way, non-governmental organizations hold a key position in terms of health, food security and environment, because they can have an instrumental role before the

actual certification process takes place, by providing information on the populations' needs, or after this phase, by ensuring monitoring, training and information activities integrating the new norms into the everyday environment and adpting them to local situations.

Conclusion

The new prominence of the terrorist threat following the attacks of 11 September, 2001 also illustrate how the rise of knowledge societies could serve to accentuate risks and threats in the twenty first century. The free circulation of information and the public character of scientific debate and expert discussion in knowledge societies which are in themselves inviolable principles, can facilitate the misuse of knowledge falls into the wrong hands, such as those of terrorist networks, cyber criminals or crime bosses. The possibility of knowledge being reduced for a very long time in history as is illustrated by the famous anec-dote Archimedes putting all his knowledge in the hands of the tyrant of Syracuse. Scientists have a duty to be vigilant in assessing the public-safety implications of the disclosure of their discoveries.

Reference

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