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Beneficial effects of Blue- Green Algae and *Azolla* in rice culture

K.Bhuvaneshwari

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Abstract

Pot experiments were conducted to evaluate the potentiality of *Azolla* and Blue Green Algae as biofertilizers for rice productivity. Blue Green Algae inoculation increased grain yield by 15% and straw yield by11%, *Azolla* showed increment by 26% in grain yield and by 20% in straw yield. *Azolla*and Blue Green Algae showed considerable increased in the N-content of soil, grain and straw. *Azolla* double incorporation was found more effective than other methods of application.

Keywords:*Biofertilizer, Blue-Green Algae, Azolla, Rice*

Introduction

Intensive agriculture based on synthetic inputs popularly known as "Green Revolution" has practically replaced our traditional natural renewable resource based agriculture in over last 40 years. Although, the initial results of this technology was very exciting and resulted into four fold increase in production but all this success has come on the cost of future generations and our environment. Biotechnological harvesting of microbial potential in nutrient mobilization and plant protection is one of the widely acclaimed options, which suits both the requirement of optimum production and environment sustainability. Use of microbial system for nutrients mobilization, popularly known as biofertilizers are getting popular day by day and new systems are being introduced to meet our requirements of different crops and under different cropping systems. Rice (*Oryza sativa*) is the major food crop of nearly half of the world's population. It is the most important crop of India and it fulfills 31% of calorie requirement of Indian population. In India rice is cultivated in 44.0 million hectors (mha) of land and it contributes 43 and 46% of the total food grain and cereal production, respectively. Among the rice growing countries of the world, India has the largest area under rice; however it stands second next to China on its production (FAOSTAT, Database, 2007).Generally, urea is applied as nitrogen source for rice production. But the efficiency of added urea-N is very low, often only 30-40% (Singh, 1988; Choudhary *et al*., 2002). This low N-use efficiency is mainly due to denitrification, NH_3 volatilization and leaching losses(Ponnamperuma, 1972: De Datta and Buresh**,**1989)**.**NH_3 volatilization and denitrify-cation cause atmospheric pollution through the production of green-house gases like N_2O and NH_3 (Reeves *et al*., 2002). NH_3 leaching also ground water toxicity (Shrestha and Ladha, 1998). In addition to these environmental problems, the long-term use of urea might deplete soil organic matter. These problems are of great concern to soil and environmental scientists around the world. Hence, alternate sources of nitrogen should be applied to minimize these problems. Biological nitrogen fixation (BNF) technology can play an important role in substituting for commercially available nitrogen fertilizer used in rice cultivation.

Biological nitrogen fixers like *Azolla* and cyanobacteria can be the ultimate solution for proper rice production. *Azolla* commonly known water velvet is a small delicate free floating fern. *Azolla* is a genus of *Leptosporangiata*, an aquatic fern that harbors a heterocyst forming, nitrogen fixing blue-green alga, *Anabaena azolla*e as a symbiotic in the dorsal lobe cavity. *Azolla* in

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symbiosis with the cyano bacterium *Anabaena azolla*e fixes substantial amounts of nitrogen and isof great agronomic significance (Roger and Kulasooriya, 1980; Watanabe, 1984; Singh, 1977, 1985, 1989).Cyanobacteria or Blue-Green algae (BGA) are photosynthetic prokaryotic micro-rganism capable of fixing atmospheric nitrogen (N_2) using sunlight as the sole energy source. BGA are distributed worldwide and contribute to soil fertility in many agricultural ecosystems. BGA can adapt to various soil types and environments which have made it cosmopolitan in distribution. The importance of BGA in nitrogen nutrition of rice has earlier been reported by various workers (Singh, 1961; Singh, 1985;Venkataraman, 1972; Singh and Bisoyi, 1989; Kaushik, 1990).Efficient nitrogen fixing strains like *Nostoc linkia*, *Anabaena variabilis*, *Aulosira fertilisma*, *Calothrix* sp., *Tolypothrix* sp.and *Sytonema* sp. were identified from various agro-ecological regions and were utilized for rice production (Roger and Ladha, 1992; Singh, 1988; Kannaiyan *et al*., 1997; Kennedy and Islam, 2001). *Azolla* and BGA both have been reported to be effective in improving the organic content of soil, phosphorus availability in soil as well as improve the physical properties of soil (Mandal *et al*., 1999; Singh *et al*., 1981). In the present study an attempt has been made to evaluate the potential of *Azolla* and cyanobacteria as bio fertilizer for rice production.

Materialsand Method

Pot experiments were conducted at the Institute of Agricultural Sciences, Banaras Hindu University (BHU) Varanasi, India. The seed of rice variety (Mahsuri 3022) were procured from Agriculture farm of B.H.U. A mixture of blue-green algal strains (*Aulosira*, *Nostoc*, *Anabaena*, *Gleo trichia*) were collected from the rice fields and after identification and purification they were used for large scale production. The BGA grown in small tanks under field conditions were used as bio fertilizer inocula.

Azolla pinnata, a dominant strain of *Azolla* available in the rice field (which can with stand high temperature) was also collected and produced in mass in the clay pot.Soil was collected from the local areas Amrakhaira, Vidyapeeth, Block, Varanasi, from top 30 cm of the fields were thoroughly mixed, sieved and part of the soil was used for physico-chemical analysis; determination of pH (at 1:2 soil water ratio) by Systronics expanded Scale pH meter, total nitrogen by modified kjeldahl method (Jackson, 1973). Organic Carbon was analysed by Walkley and Black's Method (Jackson, 1967). Urea and single super phosphate (SSP) were used as mineral fertilizer in the experiments. Soil was alkaline (pH-8.8) with low nitrogen (0.003%).Pot experiment contained seven treatments with three replications. The treatments were:

T_1 – Control, T_2 - BGA inoculation, T_3 – NPK, T_4 – *Azolla* inoculation, T_5 – *Azolla* incorporation before transplantation, T_6 – *Azolla* incorporation after transplantation, T_7 – *Azolla* double incorporation. Five seedlings of twenty days old seedling of the rice variety Mashuri 3022 were transplanted in each pot containing 8 kg of soil. *Azolla* was applied @ 2t/ha in the pot. BGA inoculum was applied @ 400 g/acre. Nitrogen was applied in two splits, half nitrogen as basal dose and other half nitrogen as top dressing. The data required for yield attributes were taken before harvest and that for yield was taken after harvest.

Results and Discussion

In the pot experiments, all the treatments have shown better performance than the control (Table-2). Highest grain yield (11.0 g/pot) was supported by NPK treatment which was almost equal to that of *Azolla* double incorporation (10.8 g/pot). Straw yield was found maximum in NPK treated pots (T_3). BGA inoculation (T_2) increased the grain and straw yield by 9 and 10% respectively. In the pot experiment *Azolla* was utilized in four different ways. Among them *Azolla* double incorporation (T_7) supported highest grain yield (26%) while highest increase (21%) in the straw yield was recorded in the pots where *Azolla* incorporation was followed by inoculation (T_6). The result in the table clearly reveals that the least nitrogen content was found in the soil and plant materials of the control set (Table-3). Whereas maximum nitrogen in the grain was recorded in NPK treated pots (T_3) while it was maximally recorded in soil and straw in *Azolla* double incorporation pots (T_7).The poor yield in the control set might be attributed to the unavailability of sufficient nutrient to the control set (Table-2). High grain yield by *Azolla* inoculation could possibly be due to the good cover

and nitrogen supply by *Azolla*. However, comparatively low straw yield might be due to the hindrance in the growth of plant due to thick *Azolla* cover. The better grain yield and relatively low straw yield could also be explained on the basis of slow release of nitrogen by *Azolla*, thus rice plants at its early stage do not get sufficient nitrogen which is essential for better vegetative growth. Our results are also supported by Watanabe *etal*. (1997), where slow release of nitrogen by *Azolla* is accounting for better grain yield. Interestingly, *Azolla* double incorporation gave better yield than on its inoculation which could simply be due to the additional supply of nitrogen to the crop (Table-2). Better results by *Azolla* incorporation than inoculation have also been reported by (Singh, 1988) and Watanabe *et al*. (1997). Our findings are also supported by Singh and Singh (1986).

Table-1: Physico–Chemical properties of the soil collected from Khaira, Varanasi

S. No	Parameters	Control Soil
1	Temp (^{0}C)	36.6
2	Moisture (%)	3.62
3	W.H.C. (%)	22.4
4	pH	8.8
5	OrganicCarbon (%)	0.03
6	Organic matter (%)	0.051
7	Total Nitrogen (%)	0.003
8	C:N	10.0
9	E.C. (dsm-1)	0.86

Table-2: Effect of biofertilizers on the yield and yield attributes of rice

S. No	Treatments	Plant height (cm)	Panicles/ Pot	Weight of 1000 Grains (g)	No. of Grains/Panicle	Grain Yield (g/Pot)	% Increase	Straw Yield (g/Pot)	% Increase
1	T_1	68.2	4.7	21.8	91.4	8.6	100	10.7	100
2	T_2	74.2	4.7	22.3	98.6	9.4	109.3	11.8	110.3
3	T_3	78.6	6.3	22.8	115.2	11.0	127.9	14.4	134.6
4	T_4	76.7	4.7	22.4	100.6	10	116.3	12.3	115
5	T_5	75.0	4.7	22.1	95.6	8.9	103.5	10.9	101.9
6	T_6	77.1	5.0	22.7	110.2	10.2	118.6	12.9	120.6
7	T_7	77.0	5.0	23.2	109.2	10.8	125.6	12.8	119.5

Statistically significant 5%

Table-3: Effect of biofertilizers in the nitrogen content in rice

S. No	Treatments	Total Nitrogen Content (t/ha)		
		Soil	Grain	Straw
1	T_1	4.2	22.4	20.2
2	T_2	4.4	23.8	20.8
3	T_3	5.2	25.0	25.8
4	T_4	5.4	28.0	23.0
5	T_5	4.4	22.6	20.6
6	T_6	5.6	27.0	25.2
7	T_7	6.0	27.6	26.0
	F-test (5%)	Ns	*	*

***Statistically significant 5%**
NsStatisticallyinsignticant 5%

However, the percent of increment varied from the increase reported by Manna and Singh (1990), which could be due to the difference in the rice variety used, climatic and soil conditions and the difference in the amount of *Azolla* inoculated.The better grain and straw yield by split application was due to the availability of nitrogen to the rice at the early stage as well as the later stages of growth. Similar results were also reported by Whitton and Roger (1989) and Saha (1981), Singh (2010). Where basal dose of nitrogen is utilized for the vegetative growth and the nitrogen supplied as top dressing at the later stages of plant growth is utilized in panicle formation which accounts for higher grain yield. Comparatively poor performance by BGA could be due to their inability to colonize in the climate condition. Singh and Singh (1986) reported that BGA established itself in 40 days after transplantation (DAT) and then increased in biomass till harvest which might be the cause of low straw yield, while *Azolla* established itself within 30 DAT and then started decomposing and thus releasing nutrients to soil and water earlier. Increase in the nitrogen content of soil and plant material has been reported by many workers. Whitton (2000) reported considerable increase in the nitrogen content of soil incorporated with *Azolla*. Similarly, Singh *et al.* (1981) reported increase in nitrogen uptake by grain straw as well as nitrogen content in soil. They found *Azolla* more effective than BGA as more nitrogen was supplied by *Azolla* due to its fast decomposing property.

Conclusion

The use of *Azolla pinnata* and BGA results better yield and improves the nitrogen in rice by biological nitrogen fixation.Overall it can be concluded that *Azolla pinnata* can be used an alternative source of nitrogen in transplanted rice. *Azolla* are grown before and after planting rice, fixed sufficient nitrogen to meet the requirement of the rice crop.BGA however, could only replace 30kg Nha^{-1} supplied as urea. Thus *Azolla* can be recommended to rice growers as alternative source of nitrogen and BGA could only be used when supplemented with additional chemical nitrogen fertilizer in order to meet the total nitrogen demand of the rice. Thus *Azolla* and BGA can become an eco-friendly, cost-effective, renewable source of nitrogen to the flooded rice which can results better yield and sustainable agriculture in long-run.

Acknowledgment

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Phytochemical investigation and antimicrobial screening of extracts of *Litchi chinensis* leaves from Dehradun region, India

Rishi Kumar Shukla ✉, Deepak Painuly, Abha Shukla and Anirudh Porval

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Abstract

The aim of the present study is to establish a correlation between litchi leaves extracts and their activity against human pathogenic bacteria. For this fresh litchi leaves were collected and dried in shade, powdered and extracted successively with solvents of different polarity. Phytochemical investigation was performed using conventional natural products identification tests and antimicrobial screening was done for two Gram negative and three Gram positive bacterial strains. Antimicrobial test were performed by disc diffusion method. All the tests were performed in a triplicate. Presence of majority of phytoconstituents in acetone extract may be responsible for its prominent activity against all the pathogens.

Keywords: *Litchi chinensis, successive extraction, phytochemical investigation, and antimicrobial screening*

Introduction

The wealth of India is stored in the enormous natural flora which has been gifted to her, endowed with a wide diversity of agro-climatic conditions. Thus, providing favorable condition for the growth for variety of medicinal and aromatic plants. Due to climatic diversity the chemical constituents in a same plant vary from region to region. In north India Uttarakhand is known for its climatic diversity, Dehradun is popular for its litchi production. Litchi belongs to the family sapindaceae. It is the plant native to South China but now exotic to other parts of the world. In India it is wildly cultivated for its high nutritive value. It is a rich source of vitamin C **(**Ahmad, 1956**)**. The chemical composition of litchi reveals that it had the edible portion 74.5%, moisture 78.5%, citric acid 1.2%, ash 0.69% and sugar 13.57 % **(**Cabin, 1954**)**. Medicinally the fruit of litchi is tonic to heart, brain, and liver **(**Kritikar & Basu, 1998**)**. The potential of cultivated plants as a source for new anti-microbial drug and botanical pesticides is still largely unexplored. This is also true in India and only a small percentage of plants of this region have been evaluated for antibacterial activity (Varma, 1999**).** The present study is designed to explore the preliminary phytochemical and anti-microbial screening of leaves extract of *Litchi chinensis* of Dehradun region and to establish a correlation between the phytoconstituents and their pharmacological activity.

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Material and Methods

Collection of plant material**: -** Fresh leaves of *Litchi chinensis* were collected from "Bombay bagh" Dehradun in the month of April, and authenticated at Botanical Survey of India, (BSI), Dehradun with Acc. No. – 113638. The collected leaves were dried in shade, grinded in to powder and stored in polythene bags before use.

Extraction of plant material: - 50 gm shade dried, grinded leaves of *Litchi chinensis* were extracted in a soxhlet sequentially in 700 ml of Petroleum ether (40-60° C) and acetone. The obtained extracts were concentrated at reduced pressure in a rotary vacuum evaporator.

Preliminary phytochemical investigation: - Phytochemical analysis for major phytoconstituents of the obtained extracts was undertaken using standard qualitative methods **(**Harborne, 1984**).**

Microorganism used**:** - Two gram negative and three gram positive human pathogenic bacterial

strains were used in the present study. The bacterial species used are *Escherichia coli* (ATCC 433), *Bacillus cereus* (ATCC 11778), *Bacillus licheniformis* (ATCC1483), *Salmonella typhi* (ATCC 733), *and Staphylococcus aureus*. All the stock cultures in pure form were collected from S.G.R.R.I.T.S department of Life Sciences, Dehradun.

Culture media and inoculums: **-** Muller Hinton Agar and Agar Nutrient broth (Hi-Media Pvt. Ltd., Bombay, India) are used as culture for the test microorganism. Microbial cultures, freshly grown at 37°C were diluted in sterile normal saline solution and the turbidity of the suspension is adjusted equivalent to a 0.5 McFarland standard by adding more organisms, so as to obtain the cell suspension between 10^5 to10^8 CFU/ml.

Preparation of Test extract: **-** Solvent free extracts obtained were dissolved in sterilized and filtered DMSO (filtered with whatman filter of pore size 0.45 micron) to prepare a test solution of extract.

Antibacterial screening: **-** The anti-bacterial activity was performed by standard protocol of Kirby- Bauer disc diffusion susceptibility methods **(**Bauer *et al*.,1966**).** The disc devoid of extract and presence of DMSO served as control. Tetracycline (30 µg/ disc) was used as standard. All the test processes were performed in a triplicate in laminar chamber.

Results and Discussion

Extractive yield: **-** *Litchi chinensis* leaves when subjected to sequential soxhlet extraction with petroleum ether and acetone and further their concentration yields the extracts with different yield and consistency. Table No. 1 represents the % yield w/w of the obtained extract.

Preliminary Phytochemical Investigation**: -** The phytochemical screening test shows the presence of various bioactive secondary metabolites. Table No. 2 represents the presence of various phytoconstituents in different extracts.

Antimicrobial Screening: The antimicrobial activity showed significant reduction in bacterial growth in terms of zone of inhibition. The zone of inhibition was recorded and tabulated in Table No. 3. Acetone extract exhibit the maximum inhibitory effect against all bacterial strain. Petroleum ether shows zone of inhibition aginst *E. coli*, *B. licheniformis*, and *S. typhi* only.

Table 1: Percentage extractive values and physical characteristics of different extract of *Litchi chinensis* leaves.

Extracts	Weight of sample (gm)	Weight of extract (gm)	w/w % yield	Colour	Consistency
Petroleum ether	50	1.526	3.052	Greenish	Waxy
Acetone	50	2.726	5.452	Dark brown	Sticky

Table No. 2:- Phytoconstituents present in various concentrations in different extract of *Litchi chinensis* leaves.

Phytoconstituents	Extracts	
	Petroleum ether	Acetone
Carbohydrates	-	-
Alkaloids	-	+++
Amino Acids	-	-
Steroids	+++	+
Terpenoids	-	++
Protein	-	-
Tannin & Phenols	++	++
Flavonoids	-	+++

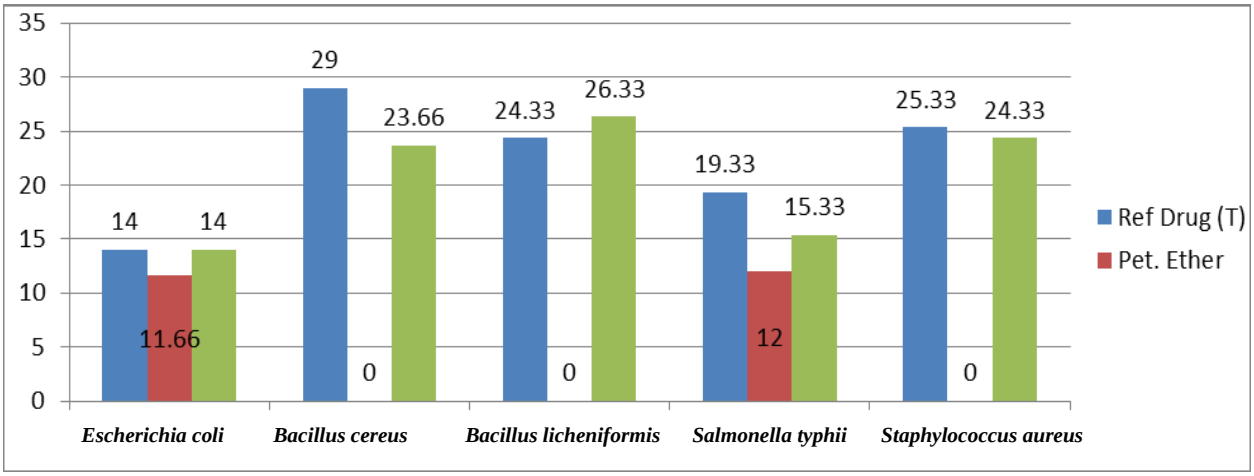
(+++) = high concentration, (++) = moderate concentration, (+) = low concentration, (-) = absent.

Table No. 3:- Antimicrobial screening of different extracts of *Litchi chinensis* leaf. All the values are mean zone of inhibition ± SD

Bacterial strain	Zone of inhibition in mm. (Mean ± SD)		
	Ref drug (T)	Pet. ether	Acetone
Escherichia coli	14 ± 1.732	11.66 ± 2.08	14.0 ± 2.0
Bacillus cereus	29.0 ± 1.00	-	23.66 ± 1.52
Bacillus licheniformis	24.33 ± 2.08	+	26.33 ± 2.08
Salmonella typhi	19.33 ± 7.09	12.0 ± 2.0	15.33 ± 3.05
Staphylococcus aureus	25.33 ± 1.52	-	24.33 ± 3.78

(+) = light zone of inhibition, **(-)** = no zone of inhibition

Plate 1:- Graphical representation of zone of inhibition of different extract against the selected pathogens.



Emergence of multi-drug resistance in human and animal pathogenic bacteria as well as undesirable side effects of certain antibiotics has triggered immense interest in the search for new antimicrobial drugs of plant origin. In the present study extracts from leaves of *Litchi chinensis* were tested against drug-resistant gram negative and gram positive bacteria. Table No. 1 shows that the acetone fraction contains a greater proportion by mass of the component compound. Phytochemical screening shows the presence of various bioactive secondary metabolites which are well known to have curative activity against several human pathogenic microorganisms and therefore could suggest the use traditionally for the treatment of various diseases **(**Usman and Osuji 2007**).** The literature revealed that the presence of polyphenolic compounds including condensed tannin and flavonoids in *Litchi chinensis* are responsible for its potential anti-cancer, anti-oxidant, **(**Wang *et al*. 2006 & Jiang and Li 2007**)** and cardio-protective activity **(**Deng *et al*. 2010**).** Acetone extract is evidenced for the presence of Terpenoids which shows cytotoxic, **(**Xinya *et al*. 2010**)** anti-tumor, anti-inflammatory, anti-viral and anti- bacterial activity **(**Sashi and Sucharitra 1997**)**. On correlating the results an inference can be drawn that presence of majority of phytoconstituents in acetone extract may be responsible for its prominent activity against all the pathogens. The active components usually interfere with growth and metabolism of microorganisms in a negative manner **(**Aboba and Etuwape 2001**).** The reason for the difference in sensitivity between the gram-positive and gram-negative bacteria could be ascribed to the morphological differences between them. Gram- negative pathogens have an outer phospholipidic membrane carrying the structural lipopolysccharide components. This makes the cell wall impermeable to lipophilic solutes, while porins constitute a selective barrier to hydrophilic solutes. The gram positive bacteria should be more

susceptible having only an outer peptidoglycone layer which is not an effective permeability barrier **(**Nikaido and Vaara 1985**).** Phenolic content of plant extract possess antimicrobial activity **(**Acar *et al*. 2010**)** and highly oxidized phenols are more inhibitory because of phenolic toxicity to microorganisms **(**Ciocan and Bara 2010**).** The above mechanism also confirms that due to the presence of appreciable amount of Phenolic compounds in acetone extract, it shows potent antimicrobial activity but it is also evidenced that more hydrophilic phytoconstituents are present in acetone extract; due to which it shows more prominent antimicrobial activity against gram-negative bacteria. Lastly further explorations on plant derived antimicrobials are needed, to determine the identity of that particular compound in this plant and also to determine their full spectrum.

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The temperature dependence of the acute toxicity of heavy metals (cadmium, copper and mercury) to a freshwater pond snail, *Lymnae aluteola* L.

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Abstract

Responses of a freshwater pulmonate snail *Lymnae aluteola* L. to copper, cadmium and mercury were observed at four temperatures in the range of 15.0 °C to 30.0 °C. Acute static bioassays were carried out at 15.0 °C, 20.0 °C, 25.0 °C and 30.0 °C to determine the percent mortality and median lethal concentrations (LC_{50}) and their 95 percent confidence limits. The acute toxicity of mercury, copper and mercury increased with the increase of temperature from 15°Cto 30°C. The 96 h LC_{50} values and percent mortality indicate that metals at 15°Cwas least toxic while at 30°C it was highly toxic.

Keywords: *Temperature dependence, heavy metals, LC_{50}, snails*

Introduction

Temperature is a single important environmental factor having marked influence on the physiology of aquatic organisms (Pechenik *et al*., 2003, Perschbacher, 2005; Matias-Peralta *et al*., 2005). In tropical countries freshwater bodies exhibit great variations in temperature. In order to understand the direct effect of temperature prevailing at the breeding habitats on the biology of snail population, it is necessary to undertake studies in controlled laboratory conditions. Such studies will help to understand how snail populations may fluctuate at different seasons of the year. Lymnaeids have been subject of this type of study, due to their varying responses to thermal stresses (Parashar *et al*., 1983).Seasonal temperature changes have profound effects on the physiology of ectotherms, resulting in altered toxicity of chemicals (Garnacho *et al*., 2000). All most ecotoxicological data are produced at a single temperature supposed to reflect the optimal living conditions of an organism, and thus may not easily be extrapolated to other temperatures. The snail *Lymnaea luteola* is used commonly intoxicological studies its physiology is both temperature and season-dependent (Gupta *et al*., 1981). However very few data are shown the lethal toxicity of these snails at different temperatures have been carried out (Mathur, 1995). Here, we report the effect of different temperature (15.0°C, 20.0°C, 25.0°C, 30.0°C) to acute toxicity of Cu, Cd and Hg.

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Material and Methods

Adult *L. luteola* were collected from unpolluted ponds from the Gheru campus, Lucknow, and acclimatized in the laboratory conditions for 15 days before the experiment. Almost same sizes are chosen for toxicity test. They had an average wet weight of 450 mg (range, 350-550 mg) and shell length 21 mm (range 19-25 mm). In this experiment criteria for death were the failure of snails to respond to prodding of their 'foot' with a needle.

Physico-chemical properties of test water: At the beginning of the experiments physico-chemical properties of test water such as pH, total dissolved solids (TDS), dissolved oxygen, and chloride were determined using the routine standard methods (APHA *et al*., 2002). The temperature of the experimental water was 21 ± 1^{o}C. The mean and range of test water physico-chemical characteristics were as follows: pH 7.5 (7.35-7.65), dissolved oxygen 6.5 (5.8-6.9) mg L^{-1}; total dissolved solids

940 (910-1023) mg L^{-1}; chloride 13 (10-17) mg L^{-1}; total hardness 320 (218-240) mg L^{-1} as $CaCO_3$ and alkalinity 180 (170-210) $CaCO_3$. Dissolved oxygen was determined by Azide modification of Winkler's methods (APHA *et al*., 2002). Hardness and alkalinity were measured by titrating with 0.01 EDTA solutions and 0.02N H_2SO_4, respectively. Mean and ranges of selected heavy metals (µg L^{-1}) in control test water were: Zn, 5.4 (4.1-6.5); Cu, 4.3 (3.1-5.6), Ni, 4 (3.2-6.8); Fe, 40 (25-59); Cd, 3 (1-6); and Cr, 4 (1-6.1). Heavy metals were determined using a simultaneous multielement atomic absorption spectrophotometer (AAS). Stock solution of Cu, Cd and Hg were prepared by distilled water. We maintained the different temperature in our laboratory at 96h of experiment. Following this holding period, ten snails were exposed to 500 ml glass beaker for each metal (Cu, Cd and Cd) concentrations. Three replicates were carried out with each experiment. At 24, 48, 72 and 96 h the mortality of snails and the behaviors of the snails were observed. The static bioassay technique was employed in the study. The toxicity solutions and control water were changed after every 24 h. The experimental results were processed for the determination of LC_{50} values and their 95 percent confidence limits are determined by Harris method, (1959).

Results and Discussion

Control and metal-exposed individuals were temperature-dependent at 15, 20, 25, and 30^oC and both metal exposed snails demonstrated significantly increased mortality at 15 and 30^oC compared with controls which are presented in Table 1. In our study the percent mortality of snails at temperature 20^oC of 96 h of exposure was lower, but at 30^oC with the same period of exposure and concentrations, the percent death was higher. The observations indicate that copper, cadmium and mercury toxicity increases with temperature increase. Similar trend were also observed in other experiments tested at different temperature. The toxicity of metals at different environmental temperatures thus varied considerably.In higher copper, cadmium and mercury concentrations, snails spent most of their time at the bottom closing their opercula, and secreting copious mucus and discharge eggs and embryos in the test solution. This secretion of mucus and delivery of eggs and embryos decreased in low copper and cadmium concentrations and snails remained attached to the wall of the container. In control jars, most of the animals remained attached to the container surface without secreting mucous and discharging eggs and embryos. Temperature is one of the most important environmental factors controlling the distribution of benthic organisms. (Masilamoni *et al*., 2002). According to Urban, (1994) the temperature tolerance of mollusks complies with their area of distribution. Heat death of organisms occurs due to many reasons such as denaturation and thermal coagulation of proteins, thermal inactivation of enzyme systems, inadequate oxygen supply and /or effects on membrane structure (Nielsen, 1994; Masilamoni *et al*., 2002). The temperature at 15, 20 and 25^o C the snail mortality was close. Our results were similar to other experiments. Gupta *et al.* (1981) observed an increased mortality to copper as temperature increased. It was noticed that raising the temperature from 20.3 ^oC to 32.5 ^oC reduced the 96 h LC_{50} value of snail from 0.39 to 0.06 ppm of Cu thereby increasing the toxicity by a factor of 6.52. However, a converse situation was obtained when the 96 h LC_{50} values from other two temperatures were considered. A rise of temperature from 24 ^oC to 27.3 ^oC increased the 96 h LC_{50} from 0.06 to 0.09 ppm of Cu. Thus the toxicity was decreased by a factor of 1. 34. These results are in excellent agreement with the findings of (Wurtz, 1962; Gupta *et al*., 1981) who also reported that rise in temperature increased the zinc toxicity in hard water to ramshorn snail (*Helisoma capannulatum*). However, the picture becomes somewhat less clear, when the information from other studies of Wurtz, (1962) is considered whereas he claimed that in the case of another species of freshwater pond snail (*Physa heterostropha*), rise in the temperature decreased the zinc toxicity in hard water but had no effect in soft water. Alternatively, crabs maintained at 5 and 25^oC experienced their thermal tolerance limits perhaps rendering them more susceptible to copper exposure as suggested by Heugens *et al*. (2001). Crabs exposed to waterborne copper may sustain gill damage resulting in internal hypoxia (Nonnotte *et al*., 1993).Cairns *et al*. (1975) reported that increase in temperatures may potentiate the toxicants that act on cellular enzymes. The delayed mortality at low temperatures as compared to higher temperatures may be due to changes in several physiological processes especially

respiratory and circulatory rate as also suggested by Cairns *et al*., (1975). The physiological activities in *L. luteola* increased as temperature are increased up to 35°C. Similar results were recorded for the species *Mytilus edulis* (Bayne *et al*., 1976); *Perna perna* (Bayne, 1967); *Dreissen apolymarpha* (Quigley *et al*., 1993); *L. luteola* (Gupta *et al*., 1981; Mathur, 1995;); *Perna indica* (Rajagopal *et al*., 1995a) and *Perna viridis* (Rajagopal*et al*., 1995b). Increased physiological activities in relation to elevated temperature may be due to higher enzyme activity. Brock *et al*. (1986) studied 13 bivalve species and reported that the activity of digestive enzymes was maximum at temperatures between 24-32°C. However, the maximum activity temperature is species specific. The biochemical activity in the cellular micro environment depends on the molecular mobility within and across the cell membrane which varies directly with temperature (Tayler, 1987). As a result, reduced temperature slowed down biochemical activity by reducing the molecular movement.

The physiological activities were found to be decreasing in relatively low and high temperatures. Mussels (*Dreissena polymorpha*) were reported to be more susceptible to lower level temperatures than higher level temperatures (Claudi and Mackie, 1993).

Table-1: Effects of temperature on *L. luteola* L. LC_{50} values and their 95% C.L.

Temperature	LC_{50} values and 95% confidence limits (mg L^{-1})			
(°C)	24h	48h	72h	96h
		Mercury		
15	0.055 (0.049-0.069)	0.055 (0.044-0.067)	0.048 (0.040-0.059)	0.033 (0.026-0.041)
20	0.050 (0.043-0.060)	0.05 (0.043-0.060)	0.0514 (0.043-0.060)	0.049 (0.040-0.059)
25	0.042 (0.034-0.050)	0.039 (0.034-0.047)	0.0297 (0.020-0.049)	0.027 (0.019-0.040)
30	0.092 (0.064-0.139)	0.092 (0.064-0.139)	0.013 (0.008-0.022)	0.013 (0.008-0.022)
		Copper		
15	6.988 (6.406-10.761)	0.650 (0.544-0.762)	0.527 (0.433-0.676)	0.344 (0.259-0.420)
20	1.198 (1.132-1.1555)	0.156 (0.105-0.259)	0.107 (0.080-0.130)	0.0927 (0.075-0.122)
25	0.306 (0.254-0.379)	0.094 (0.075-0.122)	0.068 (0.055-0.080)	0.053 (0.046-0.064)
30	0.320 (0.220-0.415)	0.050 (0.042-0.063)	0.032 (0.030-0.046)	0.0310 (0.020-0.046)
		Cadmium		
15	96.88 (84.07-123.020)	96.88 (84.07-123.020)	76.76 (62.54-86.14)	54 ----*
20	88.61 (72.81-117.02)	71.03 (57.40-81.98)	59.60 (49.27-68.80)	5.93 (45.88-68.84)
25	92.90 (75.33-113.08)	79.15 (64.44-97.03)	67.39 (55.77-80.09)	62.47 (49.99-72.83)
30	73.66 (62.56-87.14)	29.56 (22.260-37.33)	29.56 (22.263-37.35)	29.57 (22.27-37.36)

LC_{50}, median lethal concentration; Number of replicates = 3

The present study clearly indicates that heavy metals toxicity greatly varies with the temperature. Furthermore, results also indicate the danger of setting water quality standards on the basis of bioassay tests alone without considering the effects of environmental factors on chemical toxicity. The effect of temperature on pollutant toxicity is an important factor to consider when setting individual pollutant standards. Additional experiments with other heavy metals, test organisms and effects of temperatures changes on acute and chronic toxicity are urgently needed to gain more knowledge of temperature effects on chemical toxicity and predict "safe" concentration to save the aquatic organisms.

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Prevalence of dental fluorosis in children and associated fluoride levels in drinking water sources of District Doda, J&K, India

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Abstract

The present study was carried out to find the relationship between prevalence of dental fluorosis among the school children and concentration of fluoride ion in drinking water sources of village Arnora and Bhaboor of District Doda, J&K, India. All the underground drinking water sources of the area were analysed for fluoride ion estimation which was found ranging between 0.3-2.4 mg/land 1.5-2.5 mg/l in spring and hand pump, respectively. Dental health status for a total of 215 school children of the age group 12-16 years was examined using Dean's fluorosis Index. The prevalence of dental fluorosis was 78.6% with 80% in female and 77.14% in males. No significant relation (P>0.05) between prevalence of dental fluorosis to the socioeconomic status of the children was found. The high prevalence of dental fluorosis in the area under survey suggests that the children are exposed to higher than optimal level of fluoride.

Keywords:*Dean's fluorosis Index, dental fluorosis, fluoride, prevalence, school children*.

Introduction

Fluoride is one of the very few chemicals known to cause significant effects on public health through drinking water. Like several other naturally occurring elements, fluoride can enter human body through air as well as by ingestion of food and water, and thus affect health (WHO, 1996). The critical period of exposure of fluoride that leads to manifestations of enamel or dental fluorosis is during the formation of permanent teeth, generally from birth to the age of 7-8 years. The excessive exposure to fluoride in drinking water alone, or in combination with exposure of fluoride from other sources, can give rise to a number of adverse effects. The effects of fluorosis range from mild dental fluorosis to crippling skeletal fluorosis and are associated with increase in the level and period of exposure to fluoride (Fawell *et al*., 2006).Endemic fluorosis is now known to occur globally in almost all continents affecting millions of people worldwide and is a public health concern in 24 nations around the globe including India. In India approximately 62 million people (including 6 million children) suffer from dental, skeletal or non-skeletal fluorosis due to consumption of water with high fluoride content (Susheela, 1999). The highest rate of endemicity in India has been reported from Andhra Pradesh, Haryana, Karnataka, Punjab and Tamil Nadu (Gopala krishnan *et al*., 1999). Though Jammu and Kashmir has approximately 33% of the districts affected with fluorosis, Susheela, (1987 & 2007), only few references highlighting the problem of fluorosis in the state are available(Raina and Kant, 1995). Despite the frequent occurrence of a number of cases of dental fluorosis in district Doda (J&K) no published data regarding the prevalence of the disease and its association with fluoride level in drinking water is available. The problem of high fluoride concentration in drinking water source has become an important health related geo-environmental issue in various areas of district Doda. Therefore a study was carried out to find out the relationship between prevalence of dental fluorosis along with assessing the concentration of fluoride ion in drinking water sources of two villages of District Doda*viz*. Village Arnora (consisting of 6 hemlets*viz*. Ghat, Arnora, Badroon, Bari, Shaie and Bhali) and Village Bhaboor (consisting of 5 hemlets viz. Bhaboor, Manyana, Arshala, Rai and Shira) located in middle

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mountains of Himalaya. This paper presents the first report on dental fluorosis and associated fluoride level in drinking water sources in district Doda.

Material and Methods

Sampling of water sources

Thorough survey of the two villages *viz*. the revenue village Arnora, and the village Bhaboor of Doda district have been conducted to identify different drinking water sources used by the public for the drinking purposes. Samples were collected in strong, colorless polyethene bottles of two liters capacity from almost all the sources and analyzed in laboratory for the fluoride content using SPADNS method.

Statistical survey

Schools (both private and government) falling in the study area have been surveyed for determining the prevalence of dental fluorosis in and among children of the study area. A total of 215 children of age group ranging from 12 to 16 years were examined for dental mottling and characteristic dental pigmentation. The oral examination of each student was carried out under bright daylight under the supervision of a dentist trained in the field of public health. The presence and severity of dental fluorosis was recorded using Dean's index (1934) [Table 1] as previously used by Baskardoss *et al*. (2008) and according to WHO (1997) criteria. Each tooth in the mouth was rated according to one of the six categories of Dean's index and the individual's dental fluorosis score was given based on severest form recorded for two or more teeth. The association of dental fluorosis with gender as well as with socioeconomic status was studied using chi square test.

Table 1: Clinical criteria for Dean's enamel fluorosis Index (Dean 1934).

Type (Diagnosis)	Weight	Description
Normal Enamel	0	The enamel presents the usual translucent semi-vitriform type of structure. The surface is smooth, glossy, and usually of a pale, creamy-white color.
Questionable fluorosis	0.5	Slight aberrations from the translucency of normal enamel seen, ranging from a few white flecks to occasional white spots.
Very mild fluorosis	1	Small opaque, paper white areas scattered irregularly over the tooth but not involving as much as approximately 25% of the tooth surface.
Mild fluorosis	2	The white opaque areas in the enamel of the teeth are more extensive, but do not involve as much as 50% of the tooth.
Moderate fluorosis	3	All enamel surfaces of the teeth are affected and surfaces subject to attrition show marked wear. Brown stain is frequently a disfiguring feature.
Severe fluorosis	4	All enamel surfaces are affected and hypoplasia is so marked that the general form of tooth may be affected. The major diagnosis of this classification is the discrete or confluent pitting. Brown stains are widespread, and teeth often present a corroded like appearance.

Results and Discussion

The analysis of the water samples showed that 71% of the water sources have fluoride level higher than the recommended level of 1.5 mg/l (WHO, 2004). The fluoride content of the collected water samples ranged between 0.28 mg/l to 2.4 mg/l. According to Ministry of water resources, Central Ground Water Board (2010) the fluoride content in the Doda district ranges from traces to 4.7 mg/l (Kanga). Gopalakrishnan (2000), Srinivas *et al*. (2000), Tripathi and Sultana (2007) and Raju *et al*. (2009) have reported higher fluoride concentration in the ground waters of Tamil Nadu, Hyderabad, Tehsil Purwa of Unnao and Sonbhadra district (Uttar Pradesh), respectively.Data collected from the survey of different schools revealed that no school was free of being affected with prevalence ranging from 62.96 to 100%. The occurrence of dental fluorosis was found maximum in English medium school Arshalla and minimum in Government middle school Bhaboor [Table 2]. A total number of 215 students (boys=105, girls=110) were examined and a high prevalence (78.6%) was found in the study area [Table 3] which is in agreement with Ramezani *et al*. (2004) who has found a high prevalence (80%) of dental fluorosis in the students of Dyer city (Iran). Similar results have been obtained by Tripathiand Sultana (2007)

Table 2: Prevalence of dental fluorosis in children from various schools

School	Name and Place of school	No. of students examined	No. of students affected	% of affected students	% of boys affected	% of girls affected
1.	Govt. Girls Middle School Ghat	22 B=12 G=10	20 B=11 G=9	90.9	55	45
2.	Govt. Boys Middle school Ghat	26 B=14 G=12	17 B=9 G=8	65.38	52.9	47.05
3.	Govt. Higher Secondary school Ghat	39 B=8 G=31	32 B=7 G=25	82.05	21.87	78.12
4.	Royal Academy Ghat	40 B=22 G=18	27 B=14 G=13	67.5	51.16	48.14
5.	English Medium School Arshalla	8 B=4 G=4	8 B=4 G=4	100	50	50
6.	Govt. Middle School Bhaboor	27 B=15 G=12	17 B=10 G=7	62.96	58.8	41.17
7.	Public High School Arnora	53 B=30 G=23	48 B=26 G=22	90.56	54.16	45.83
Total		215 B=105 G=110	169 B=81 G=88			
B= Boys; G= Girls						

Table 3: Percentage incidence of dental fluorosis among children.

Fluorosis			
Valid	**Frequency**	**Percent**	**Cumulative Frequency**
Present	169	78.60	78.60
Absent	46	21.40	100
Total	215	100.0	-

who also reported a high prevalence of 84% in the village Vishnu Khera of Tehsil Purwa of Unnao (UP). However, Baskardoss *et al*. (2008) has reported a lower prevalence (15.8%) in the school children of Kanyakumari District, Tamil Nadu.

In the present study Dean's Index was used to evaluate the severity of dental fluorosis among the school children and it has been observed that most of the affected children have moderate category of dental fluorosis (26.9%) followed by severe category (22.32%). Mild dental fluorosis was found to be present in 15.8% of children while 13.49% were having very mild fluorosis and 14.9% were found to exhibit questionable fluorosis. Only 6.5% of children represented normal status [Table 4]. Ramezani *et al*. (2004), Baskardoss *et al*. (2008) and Umeshi Koleoso (2004) have found maximum cases of mild dental fluorosis among the school children of Dyer city (Iran), District Kanyakumari (Tamil Nadu) and in Nigerian children, respectively. This indicated that the severity of dental fluorosis, calibrated according to Deans fluorosis Index, was high in the examined sample. Analysis of data to know the severity of fluorosis with respect to age revealed that children of age 13 were affected to the maximum extent [Table 5]. A similar type of study was carried out by Nagarajan *et al*. (2004) among school children of age group 7-13 and children of 9-10 age groups were found to be affected the most.

Table 4: Degree of fluorosis among children based on Dean's Index.

Classification	Frequency	Percent (%)	Cumulative frequency
Normal	14	6.51	6.51
Questionable	32	14.91	21.42
Very Mild	29	13.49	34.91
Mild	34	15.8	50.71
Moderate	58	26.97	77.68
Severe	48	22.32	100
Total	215	100	

Table 5: Percentage distribution of dental fluorosis according to age.

Age (in years)	Deans Fluorosis Classes						Total	Prevalence P = 1+2+3+4
	0	0.5	1	2	3	4		
12	2 (2.7%)	13 (17.3%)	10 (13.3%)	18 (24%)	22 (29.3%)	10 (13.3%)	75	60 (80%)
13	1 (2%)	8 (16%)	6 (12%)	5 (10%)	16 (32%)	14 (28%)	50	41 (82%)
14	4 (11.1%)	6 (16.7%)	3 (8.3%)	4 (11.1%)	10 (27.8%)	9 (25%)	36	26 (72.2%)
15	2 (12.5%)	1 (6.25%)	3 (18.7%)	2 (12.5%)	6 (37.5%)	2 (12.5%)	16	13 (81%)
16	5 (13.1%)	4 (10.5)	7 (18.4%)	5 (13.1%)	4 (10.5%)	13 (34.2%)	38	29 (76.3%)
Total	14 (6.5%)	32 (14.9%)	29 (13.5%)	34 (15.8%)	58 (26.9%)	48 (22.3%)	215	169 (78.6%)
Statistical weight for Deans Fluorosis Classes: 0 = Normal; 0.5 = Questionable; 1 = Very mild; 2 = Mild; 3 = Moderate; 4 = Severe								

Also study carried out by Raina and Kant (1995) revealed that the children within the age group of 5-10 years and 11-20 years were more affected than the adults and the aged.

Prevalence of dental fluorosis was also assessed according to gender which revealed that more girls (80%) were affected as compared to boys (77.14%) thus showing a greater risk for girls to develop dental fluorosis than boys [Table 6]. However, gender difference was not statistically significant (P>0.05). Our results are consistent with Gopalakrishnan *et al*. (1999) and Nagarajan*et al*. (2004) who have reported higher prevalence of fluorosis in females of TirunelveliKattabomman district and Salem District of Tamil Nadu, respectively.

Dental fluorosis in case of children with lower socioeconomic strata was found to be 77.42% and for children with higher socioeconomic strata was 80.22% [Table 7]. However, no relation between prevalence of dental fluorosis to the socioeconomic status was observed (P>0.05).

Table 6: Prevalence of dental fluorosis according to gender.

Variables	No. of children examined		Prevalence %
	Examined	Affected	
Gender			
Boys	105	81	77.1
Girls	110	88	80

Table 7: Distribution of school children according to socio-demographic characteristics and frequency of fluorosis

Category	Total No. of Students	Percentage %	No. of children not affected	%ge of children not affected	No. of affected children	%ge of affected children
APL	91 B = 41 G = 50	42.3 B = 45.1 G =54.9	18 B = 9 G = 9	19.78 B = 50 G = 50	73 B = 32 G = 41	80.22 B = 43.8 G = 56.2
BPL	124 B = 64 G = 60	57.7 B =51.6 G =48.4	28 B = 15 G = 13	22.58 B = 53.6 G = 46.4	96 B = 49 G = 47	77.42 B = 51.1 G= 48.9
APL= Above poverty line; BPL= Below poverty line						

Conclusion

From the above study it can be concluded that both of the selected villages of district Doda have fluoride content in ground water above the recommended level and also there is a high prevalence of mild-to-severe dental fluorosis. The study acts as a pointer to public health physicians, dentists, chemists, planners, administrators, engineers and water supply authorities. The information furnished can be utilized as preliminary data and a well-designed epidemiological investigation can be undertaken at tehsil level and district level to confirm and assess dental fluorosis and to evaluate the risk factors associated with the condition in the study region. There is a need to improve water supplies and defluoridation of water sources in affected area. An urgent awareness based programme is also needed for rural population regarding the fluoride consumption and its ill effects on health.

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Induced breeding of snowtrout (*Schizothorax richardsonii* -Gray), from Garhwal Himalaya (Uttarakhand, India) by pituitary gland extract.

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Abstract

Comparative breeding experiments were done in *Schizothorax richardsonii* by using pituitary gland extract (PGE) and stripping technique. Experiments were conducted for two successive years. PGE dose administered was 5mg/kg body weight to male fishes and 7 mg/kg to female fishes. Each dose was administered as two split doses 4 hours apart. For induced breeding, fecundity ranged from 5,200 to 13,542 eggs per female. In 15 sets of induced breeding experiments performed over two years, using PGE extract, fertilization success ranged from 78±1.98% to 76.7±2.18% and hatching success ranged from to 63.3±%3.05to 63.9±1.81%. Stripping experiments yielded similar results with their fertilization ranging from 67.7±3.48% to 64.4±2.67% and hatching ranging from 58.9±3.47% to 57.26±2.8%. Our results conclude that induced breeding is better than stripping and can be used effectively to breed *Schizothorax richardsonii*.

***Keywords**: induced breeding, Schizothorax, pituitary gland extract*

Introduction

*Schizothorax richardsonii*and other *Schizothorax* species (*S. plagiostomus* and *S.sinuatus*; Singh *et al*., 1987) are distributed in snow fed rivers of Himalaya including areas from Afghanistan, Pakistan, India, Burma, and China. This fish species is usually found above an altitude of 670 meters in the rivers and streams along the Himalayan range (Tilak and Sinha, 1975; Talwar, 1978). Raizada (1985) and Jhingran (1982) classified fishes of this subfamily as *Schizothoracine* under the family Cyprinidae and gave them a common name, snow trout. These fishes prefer rivers and streams having rapid water along with big pools and having water temperature range of 8– 22 degree centigrade (^{0}C). S*chizothorax* species is one of the main game and food fish of these rivers in Garhwal Himalaya and constitute about 85% of the total fish catch (mostly *S.richardsonii*) in upper stretches of Himalayan region of Uttarakhand. There is little information on population biology of snow trout of this region; however, Baloni and Tilak (1985) and Agrawal (1989) conducted investigations on spawning ground and fecundity of these fishes. In Garhwal Himalaya there has been no systematic and long term study to monitor the population of this native fish species (*Schizothorax* sp.). As there is no data available it is almost impossible to tell if there has been any change in population of this native fish species.

Population of these native snow trout are imperiled and if the situation is not yet alarming but will surely be the case after couple of years. Their population is rapidly declining primarily due to (1) the over exploitation of the fishery caused by poaching methods such as explosives, bleaching, poisoning, electrocuting, spearing which have destroyed brood stock, and (2) construction of roads and dams leading to siltation problem (3) Introduction of exotic carnivore fishes in rivers of Uttarakhand. In recent times, there has been construction of many hydroelectric projects in Garhwal Himalaya and it has been suggested that the population of this species would be threatened (Raina *et al*., 1985a: 1985b, 1986; Joshi, 1987). In Uttarkashi district, there are about five (05) major dams/barrages (Dabrani, Lohari-Nag Pala, Manari,

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Uttarkashi), either planned or functional, within a span of 100 kilometers on river Bhagirathi besides Tehri Dam (district Tehri). Many hydroelectric projects are also being constructed on river Alaknanda. It has been well documented that dams and barrages influence population dynamics of fishes as they cause huge fluctuation in water level as well as water flow patterns (Baxter, 1977, Ark *et al*., 2004, Gunkel *et al*., 2003, Tiemann *et al*., 2004, Merona *et al*., 2005, Lucas *et al*., 2009, New *et al*., 2009, Heppner *et al*., 2009). Both, river Bhagirathi and river Alaknanda have a very noticeable change in water level and water flow-rate due to these dams but no scientific study has been done so far documenting changes in population of native *Schizothorax* species. Moreover, feasibility studies regarding culturing this fish species in hatcheries using induced breeding technique and then releasing them are almost non- existent which may help in this native species conservation and development of commercial fisheries in Uttarakhand using this species. This is because most of the efforts are focused on fast growing fishes like carp (*Cyprinus carpio*), while no attention has been paid to manage native fish populations.The present study was undertaken to evaluate the possibility of developing artificial propagation techniques and better fishery management and conservation of snow trout (*Schizothorax richardsonii*). The objective of the present work was to evaluate the efficacy of injecting PGE for inducing ovulation and artificial spawning (hypophysation) and compare it with generally used technique of stripping. Successful artificial propagation techniques would be helpful to conserve the native fish and convert an indigenous fish to a culturable fish for commercial uses. It will also generate fish farming in Uttarakhand as the hatcheries would provide the 'seeds' of an indigenous, economically important fish to interested farmers.

Material and Methods

Stripping Method- Brooders for stripping were caught from the Alaknanda River with the help of gill nets. Brooders of both the sexes were hand-stripped bank-side by applying slight pressure on the sides of the fish abdomen. First eggs were stripped out of a single female and collected in an enamel tray which was filled up-to 1/3rd with river water. Milt from 2 males was dropped directly right on top of eggs. Then eggs and milt were mixed with the help of bird's feather for 5 to 10 min. The excess milt was later washed off by changing the water in the trays. Total of 8 experiments was carried out in two years – 4 sets each year during breeding season.

PGE injection —PGE extract was prepared according to Chaudhri and Singh (1984) with some modifications. Briefly, pituitary gland was taken from fresh specimen (over 1 kg weight only) of Schizothroax species (*S.richardsonii* or *S. plagiostomus*) during winter months (Sept – Feb) and was preserved in absolute alcohol. The pituitary hormone extract was prepared by crushing the glands inside a tissue homogenizer and adding measured quantity of distilled water to it. The gland suspension was then centrifuged (8000 rpm for 8 minutes) and the supernatant were used for injection. The concentration of the extract was around 1–4 mg gland in 0.5 to 1 ml of water according to convenience of injection. The hormone was injected intramuscularly near the tail region of the fish. Induced breeding experiment was carried out on the bank of the Alaknanda River. Hapas (n = 15; 6 feet x4 feet x3 feet) were set in the shallow water of the river held the brooders. Each hapa had two male and one female brooder. These were taken in the first week of September and reared until the fishes were ready for spawning. Doses of PGE were given intramuscularly (with number 22 needle) to the brooders in the region of the caudal peduncle: 5mg/kg of body weight for each male and 7mg/kg for each female. The total dose was given in two split doses, 3-4 h apart. The injected fishes were returned to the hapas. Total of 8 induced breeding attempts were made in two years – 4 set of experiments each year.

Statistical Analysis: All comparative statistical analysis was done using Origin 8.6 software.

Results and Discussion

Stripping Method

Nine egg lots were generated by stripping the gametes together. The weight of the male fishes ranged from 125 to 1,025 gm while it was 500 to 1,225 gm for females. The number of eggs obtained by stripping varied from 2,592 to 8,768 while the percentage of fertilized eggs varied from 67.7±3.48% to 58.9± 3.37% and the hatching

percentage varied from 58.9±3.47 to 57.26±2.80% (Table 3a & 3b).

PGE injections

Of the 15 sets of hapas with *S. richardsonii* brooders, eggs were obtained in fourteen cases during the breeding season. The weight of the adult females ranged from 500 to 1,380 g and that ofmales ranged from 100 g to 1,000 g (Table 1 and 2). During experiments with PGE administration, the female *S. richardsonii* treated with 7mg/kg of PGE ovulated. Fecundity ranged from 5,200 to 13,542 eggs per female. Fertilization and hatching percentages ranged from 78.4±1.98% to 76.7±2.18% and 63.3±3.05% to 63.9±1.81%, respectively (Table- 1 and 2).

The percent fertilization (p>.002) and percent hatching (p>.02) was significantly higher in case of induced breeding method as compared to stripping method.Physico-chemical parameters of water measured during the course of study were: Water temperature varied from 15 to 19°C, while the atmospheric temperature was 12 to 20° C. Dissolved oxygen ranged from 8.2 to 9.8 mg/L and free CO_2 was 0.6 to 1.9 mg/l respectively and pH varied from 7.6 to 7.8. (Table 4a & 4b) All measurements were made as per APHA 1992 and Goyal and Trivedi (1986).

Table 1: Details of induced breeding experimental setup for *S.richardsonii* during YEAR 1

Batch	brooders	Weight male fish (g)	Total dose of PGE (mg/ml)	Dose		Weight female fish (g)	Total dose of PGE (mg)	Dose		Response to treatment	Number of Eggs	Fertilization %	Hatching %
				1st	2nd			1st	2nd				
Batch 1	2 male 2 female	i. 900 ii. 347	4.5 1.7	1.5 0.5	3.0 1.2	1000 1210	7.0 8.47	2.0 2.4	6.0 3.0	Ovulated Ovulated	9924 11624	78.6 83.0	61.5 64.5
	2 male 2 female	i. 556 ii. 455	4.7 2.2	0.5 0.5	2.2 1.7	650 975	4.55 6.825	1.5 2.8	3.0 4.0	Ovulated Ovulated	6754 7222	65.9 73.5	63.76 63.83
	1 male 1 female	i. 500	2.5	0.5	2.0	765	5.355	2.3	3.0	Ovulated	7008	78.7	63.5
Batch 2	2 male 1 female	i. 700 ii 580	3.5 2.9	1.5 0.9	2.0 2.0	1200	8.4	2.4	6.0	Ovulated	10,538	81.22	68.0
Batch 3	2 male 2 female	i. 1000 ii. 950	5.0 4.7	2.0 1.7	3.0 3.0	950 1100	6.65	2.6 3.0	4.0 4.7	Ovulated Ovulated	6575 7400	83.0 83.6	68.5 69.7
	2 male 1 female	i. 750 ii. 400	3.7 2.0	1.7 0.5	2.0 1.5	850	7.70 5.65	2.0	3.9	Ovulated	-	- -	
Batch 4	2 male 2 female	i. 700 ii. 725	0.5 3.6	0.2 1.6	0.2 2.0	1150 1100	8.05 7.7	3.0 2.7	5.0 5.0	Did Not Ovulate	-	-	-
										Did Not ovulate	-	-	-
	3 male 2 female	i. 310 ii 556 iii. 100	1.5 2.7 0.5	0.5 0.8 0.2	1.0 2.0 0.3	1100 950	7.7 6.65	2.7 2.6	5.0 4.0	Ovulated Ovulated	9998 6840	85.2 71.4	72.6 37.6
												78.4 ±1.98	**63.3 ±3.05**

Table 2: Details of induced breeding experimental setup for *S.richardsonii* during – YEAR 2

Batch	brooders	Weight male fish (g)	Total dose of PGE	Dose 1st	Dose 2nd	Weight female fish (g)	Total dose of PGE (mg)	Dose 1st	Dose 2nd	Response to treatment	Number of eggs	Fertilization %	Hatching%
Batch 1	2 male 1 female	i. 450 ii. 825	2.2 4.1	1.0 1.0	1.3 3.2	1250 1250	8.75 8.75	3.0 3.0	5.7 5.7	Ovulated Ovulated	13261	75.4	59.9
	2 male 2 female	i. 1000 ii. 535	5.0 2.6	2.0 1.0	3.0 1.7	996 780	6.972 5.46	2.9 2.4	4.0 3.0	Ovulated Ovulated	13192 8949	72.52 74.0	63.8 68.2
Batch 2	2 male 1 female	i. 600 ii 425	3.0 2.1	1.0 1.0	2.0 1.2	1380 1100	9.66 7.7	3.6 4.7	6.0 5.0	Ovulated	7740	77.0	62.5
	3 male 2 female	i. 455 ii. 400 iii. 250	2.2 2.0 1.2	1.0 0.5 0.5	1.2 1.5 1.2						13542 9998	73.0 82.26	60.72 64.60
Batch 3	2 male 2 female	i. 950 ii. 700	4.7 3.5	1.7 1.5	3.0 2.0	765 1300	5.355 9.1	2.3 3.1	3.0 6.0	Ovulated Ovulated	5200 13000	82.5 62.26	69.2 51.38
	1 male 1 female	i. 900	4.5	1.5	3.0	500	3.50	1.5	2.0	Ovulated	5013	83.8	68.8
Batch	1 male 1 female	i. 840	4.2	1.2	3.0	700	4.90	4.9	3.0	Ovulated	5509	84.8	70.2
												76.7 ±2.18	**63.9 ±1.81**

Table 3a: Results from stripping on *S.richardsonii* YEAR 1

Batch	Experimental set of brooders	Number of eggs	% Fertilization	% Hatching
Batch 1	- 2 male + 1 female	4500	77.8	68.5
Batch 2	-1 male + 1 female	8208	64.3	55.5
Batch 3	- 2 male + 1 female	4695	62.1	52.5
Batch 4	- 2 male + 1 female	8442	66.8	59.3
			67.7±3.48	**58.9±3.47**

Table 3b: Results from stripping on *S.richardsonii* YEAR 2

Batch	Experimental set of brooders	Number of eggs	% Fertilization	% Hatching
Batch 1	2 male + 1 female	8768	70.39	65.7
Batch 2	2 male + 1 female	8158	68.4	60.2
Batch 3	2 male + 1 female 2 male + 1 female	8500 7212	67.2 59.8	58.3 52.0
Batch 4	1 male + 1 female	2592	56.5	50.1
			64.4±2.67	**57.26±2.8**

Our results and comparative analysis done during the investigations clearly show that, if used, PGE induced breeding of *Schizothorax richardsonii* would be advantageous over conventionally used technique of Stripping. Attempts to breed *Schizothorax* using induced breeding techniques were successful. In our induced breeding experiments fertilization ranged from 78.4±1.98% to 76.7±2.18% while hatching success was between 63.3±3.05% to 63.9±1.81%respectively. These results from induced breeding experiments were significantly higher than stripping experiments. Thus induced breeding method can be attempted to save the declining fish population due to dam construction and their by changing the characteristics of the ecological niches where these native fishes reside.Induced breeding has been carried out in other fish species also. The effective dose of the pituitary extract to precipitate ovulation varies in different fishes. Homoplastic and heteroplastic pituitary extract injections alone or in combinations with other synthetic hormones have been used by various workers to induce ovulation. Further, the number of injections required also varies (Rajaya lakshmi *et al.* 1991). In induced spawning of sliver carp and grass carp fish pituitary hormone was administered in combination with Synarian human choronicgonodotropin (hCG) to the female breeders, while the male breeders received injection of pituitary hormone only (Joshi, 1981; Joshi and Khanna, 1983). In *Labeo gonius* female breeder were injected with gonadotropin along with the fish pituitary extract and only pituitary injections was given to the male to fertilize the ovulated eggs (Desai *et al*. 1981, Joshi and Khanna, 1983). In the present experiment on *S.richardsonii* fish pituitary extract alone wasadministered to the male and female breeders for spawning and it resulted in successful ovulation. Pickford and Atz (1957) and Dodd (1960) have reported the finding of many investigators who have obtained negative results with human chorionic gonadotropin (hCG). These may be attributed either to the existence of phylogenetic specificity or more likely to seasonal unresponsiveness of the gonads. The timing of the experiment in relation to the spawning season is of great importance as suggested by the work of Ramaswami and Sundaraj (1957) who found that administration of hCG to gravid *Clarius batrachus* was ineffective during May and June (pre-spawning season) whereas the same treatment induced optimum spawning in July and August (spawning period). Joshi and Khanna (1983) observed that in *L.gonius* the hCG alone as well as in combination period (last week of June and early July) in Nanaksagar reservoir. In *S.richardsonii* found in river Alaknanda around Srinagar Garhwal the pituitary gland extract (PGE) was quite effective during its peak spawning period (September to early November) – post monsoon time in river Alaknanda.Nandeesha *et al.* (1991) concluded that in economic terms, the use of ovaprim is advantageous. In trials on fish farm, the percentage of spawning success, the number of eggs obtained per kilogram of body weight of brooders, the fertilization rate and hatching percentage remained consistently higher with ovaprim as compared to crude extract of carp pituitary gland (CPE) or hCG treatment in almost all instances. Das *et al*. (1994) did induced spawning and hatching of *Puntisjavanicus* (Bleeker), injecting a single dose of ovaprim, an ovulation agent, resulted is complete spawning within 4 to 5 hours. Results of successful spawning through a single dose of ovaprim have been reported in several carp species in India (Nandeesha *et al.*, 1990). Induced spawning in *Labeo gonius* with 100 IU/day of chorionic gonadotropin occurred after 5 to 7 injections to female breeders that varied from 260 to 400 gm in their body weight and 296 to 318 mm in length (Joshi and Khanna, 1983).

Table 4a: Physico-chemical and meteorological parameters of breeding ground during year 1

Experiment Batch	Water temperature (degree C)	pH	DO (mg/l)	Free CO_2 (mg/l)
Batch 1	19	7.61	8.5	1.7
Batch 2	17	7.8	8.7	1.9
Batch 3	15	7.62	9.2	0.7
Batch 4	15.5	7.83	9.4	0.6

Table 4b: Physico-chemical and meteorological parameters of breeding ground during year 2

Experiment Batch	Water temperature (degree C)	pH	DO (mg/l)	Free CO_2 (mg/l)
Batch 1	18	7.6	8.2	1.9
Batch 2	17.5	7.64	8.8	0.7
Batch 3	17	7.68	9.5	0.6
Batch 4	16.5	7.82	9.8	0.9

In *Labeo calbasu* the dose of PG per kg body weight was given to the females in two split doses. The first dose of 2 mg / kg of body weight and the second dose was 3 mg/kg body weight while it was 2 mg/kg of body weight for the males (Jain et al 1985). As per our knowledge, probably, no induced breeding experiments have been done on *Schizothorax richardsonii*. Raizada (1985) made attempt on induced breeding on *S. plagiostomus* in Himachal Pradesh using homoplastic pituitary extract. He injected it in two doses at 5 mg/kg and 2 mg/kg body weight in females at an interval of 6 hours and 3 mg/kg and 2 mg/kg on males at same duration. But this approach of induced breeding was never applied for commercial hatcheries. Striping method has also been used in case of *Tor putitora*, *Tor khudree* and has given good results (Kulkarni and Ogale 1986; Tripathi, 1978)

Author concludes from two years of breeding experiments with *S. richardsonii* in Garhwal Himalaya that snow-trout is a post-monsoon breeder when the water is clear and the river water level is low. Low temperature and clear weather accelerates spawning and results were better. The percentage of fertilization and hatching is significantly higher when induced breeding technique is used as compared to stripping. Hence

by using induced breeding technique, hatcheries can produce seeds in large number that will help them financially. The author found that there has been rapid decline of this fish species in specific pockets along the dam sites, including spots where introductions of exotic species have been carried out, and serious attempts should be made to assess and monitor the population of this native fish species. Findings from our study would be implemented for hatcheries breeding Schizothorax species. Further experiments are also being carried out to modulate reproductive cycle of this fish species by controlling Light: Dark photo cycle, water temperature and water turbidity. This would help breed this fish faster.

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A report on anthropogenic activities in the riparian zone of River Manuni, Himachal Pradesh

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Abstract

Rivers are highly vulnerable to anthropogenic changes. The hill streams so far considered pristine are now being subjected to increased anthropogenic influences. The present study was undertaken to identify and assess the anthropogenic activities in the riparian zone of River Manuni, in Beas watershed. During the course of investigation anthropogenic activities like slate mining, river bed mining, water withdrawal for drinking and agriculture purpose, initiation of micro hydroelectric projects and number of miscellaneous activities have been observed in River Manuni during March 2009- February 2011.

Keywords*: River Manuni, anthropogenic activities, riparian zone, benthic macroinvertebrates*.

Introduction

Rivers are highly vulnerable to anthropogenic changes and their flow is often manipulated to provide water for human use (Bredenhand and Samways, 2009). Anthropogenic activities are considered to be the major cause of water quality degradation. It is well known that the water quality is influenced by activities on the landscape, watershed hydrology and biogeochemical processes occurring within the streams. There is now probably no large, tropical Asian river in pristine condition (Hynes, 1989). Even the hill streams, so far considered pristine are being subjected to increased anthropogenic influences.Human activities on all spatial scale affect both water quality and quantity (Peters and Meybeck, 2000). Understanding the role of these factors as well as their spatial and temporal interactions is important for maintaining the quality of freshwater ecosystems.Throughout the world, streams have been degraded by anthropogenic stresses including channelization, removal of riparian vegetation, agricultural and industrial pollution, hydrological alteration and other deleterious land use practices (Karr *et al*., 1985; Litvan *et al*., 2007). Many of these have resulted in increased perturbations in aquatic environments. As a consequence, the biological diversity of freshwater ecosystems is experiencing much greater loss than is seen in terrestrial ecosystems (Sala *et al*., 2000; Dudgeon *et al*., 2006). The freshwater biota is experiencing a biodiversity crisis brought about by multiple interacting threats i.e. habitat degradation due to in-stream alterations including dams, dredging, channelization, harmful activities along the water edges that destabilize river banks and changes in land use that affect hydrology with secondary consequences for the physical processes and the biota (Allan and Castillo, 2007). Therefore, recent research on river processes has focused on the immediate riparian zone (shoreline communities) or land use pattern and type adjacent to river (Corkum, 1999). The present study was undertaken to identify and assess the anthropogenic activities in the riparian zone of River Manuni, in Beas watershed (Himachal Pradesh, India).

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Material and Methods

Himachal Pradesh is a mountainous state of north India with altitude varying from 350 to 7000 m asl. The present study was carried out at three sites i.e., Khaniyara (S1), Bhadwal (S2) and Purana Kangra

(S3) on River Manuni, a tributary in River Beas watershed. The study area is located between latitude $30^0$5'-$32^0$15' North and longitude $76^0$15'-$76^0$25' East (Fig.1).The present study was carried out during March 2009 to February 2011. The anthropogenic activities namely, slate mining, river bed mining, water withdrawal, micro-hydroelectric projects and miscellaneous activities were observed and recorded in the field.To ascertain the water quality, selected physiochemical parameters were analyzed following standard methods outlined in Welch (1952), ICMR (1963), Schwoerbel (1970), Goltermane*t al*. (1978), Trivedy and Goel (1984) and APHA (2005). Identification of benthic macroinvertebrates was carried to lowest recognizable level with the help of keys by Burks (1953), Usinger (1956), Needham and Needham (1962), Hynes (1977), Macan (1979), Edington and Hildrew (1981), Elliott *et al*. (1988), Wallace *et al*. (1990), Dudgeon (1999) and Jessup *et al*. (2003).

Results and Discussion

In River Manuni during the present study following anthropogenic activities were observed:

Slate mining at S1 (Khaniyara)

Slate is a fine grained metamorphic rock characterized by a prefect cleavage, usually black, blue black, gray or light green in color. Generally used as roofing, flooring and wall paneling material. In addition, slate flour is also used in paints, rubber products for decorative uses. This non-metallic material is extracted by surface mining since time immemorial. In Himachal Pradesh quality slate is found in Chamba, Kangra, Kullu, Mandi and Shimla districts. At Khaniyara slate extraction is done manually by using crow bars, chisels and digging tools, often using blasting materials from the southern slopes of Dhauladhar range within an altitudinal range of 1500 to 2200m asl (approx.) (Fig. 2 a).The name Khaniyara has been derived from word Khan meaning mine or quarry, hence denoting a place of quarries. It is presumed that Dhaugri, Hali and Scippy communities were the early settlers in this village from Chanauta area of Chamba district and lower areas of Kangra district. Of these, Dhaugri community used to quarry and sell slates. In 1867, Mr. Robert Warkley Shaw took the quarrying right from Zimindars (local landlords) of Khaniyara for Kangra Valley Slate Company. However, after independence the quarrying rights were transferred to village Panchayats in 1954. In 1975, Khaniyara and Dari villages constituted Khaniyara Gabli Dhar Slate Quarries Board, through which they leased out slate mines in village shamlat (common land) to the contractors. The amount of royalty collected was divided between Dari and Khaniyara panchayats (Singh, 1993).Since the extraction site remains operational for long period of time, the debris generated in mining activities keep on accumulating down the slope. Also, the mining wastes dumped along the slopes, results in serious damage to houses, field crops besides choking of water courses especially during monsoon. The situation has particularly caused immense damage in the Thatharna forest zone.

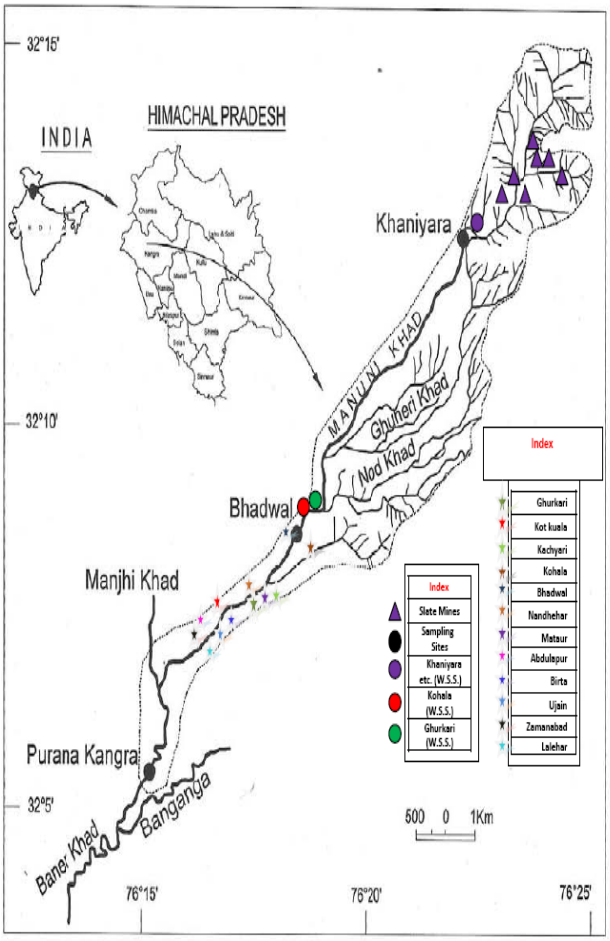

Fig. 1 Location map of River Manuni, Himachal Pradesh

Fig 2a Photograph showing slate mine and godown at Khaniyara

In 1995, a public interest litigation (PIL) was filed by Mrs. Trisha Sharma against the unscientific mining in Khaniyara. The Hon'ble High Court vide its judgment dated 11.12.96 in above PIL allowed the mining activities subject to certain stipulations viz. in conformity with the provisions of various legislations relating to mining activities, prevention and control of Pollution and Forest Conservation Act. As a result the Govt. of Himachal Pradesh vide notification No. Ind-VI (F) 12-40/ 78-1 dated 3-5-97, Shimla-2 has withdrawn the leasing rights from Panchayats and transferred these to Department of Industry (Mines). Based on the study conducted by Central Mining Research Institute (CMRI) with respect to the possibility of scientific mining of slates two areas, one in the catchment of ManuniKhad (16 Hectare) and another in the catchment of Manjhi Khad (9 Hectare) were identified. Till date 9 mining leases have been granted out of which 7 are in the catchment of ManuniKhad in the vicinity of Khaniyara village (Table 1). The production of slate in these quarries was 816 (MT) in 2009-2010 and 616 (MT) in 2010-2011, whereas the royalty collected were Rs. 204000 (2009-2010) and Rs. 153500 (2010-2011) respectively (Source: District Mining Office, District Kangra at Dharmshala, 2011). The debris from the mines invariably finds way to the river thus disturbing the substratum and water quality.

River bed mining

River bed and riparian area mining are in practice since times immemorial, causing a great loss to aquatic biotic resources (Joshi and Shah, 2011). According to Himachal Pradesh state river/stream bed mining policy **"**river natural resources must be utilized for the benefit of the present and future generation.**"** However, no River/Stream bed mining shall be allowed without the recommendation of the sub-divisional level committee which is supposed to look into all environmental and other related issues (Source: River/Stream Bed Mining Policy Guidelines, Govt. of Himachal Pradesh, 2004).In the study stream, river bed mining was observed at all the three sites (Fig.2 b). The sand and boulders were transported by mules and tractors. It was also noted down that people engaged with river bed mining were working under MGNREGA (Mahatama Gandhi National Rural Employment Guarantee Act) scheme, launched to provide employment to local people and engaging them in the development activities at grass root level. Generally 15 to 20 people were seen working at a time. Also, 4 to 8 mule and 3 to 4 tractor were engaged in mining activities with each making 7-10 trips in a day. Although, no stone crusher was observed to be in operation in River Manuni, nevertheless manual stone cutting with chisel and hammer was observed.

Water withdrawal for drinking and agriculture purpose

Almost all rivers of the Indian subcontinent are regulated to serve as a source of irrigation water (Chitale, 1992).According to state water policy clause (11.1), "adequate, safe and sustainable drinking water facilities will be provided to the entire population both in urban and in rural areas throughout the year. Drinking water needs of human beings and domestic animals shall be first

charge on any available source of water." In pursuance of this, three water supply schemes (W.S.S.) are in operation in River Manuni. Khaniyara-Dari-Sidhbari W.S.S. is drawing water from the right bank of ManuniKhad in Khaniyara, supplying drinking water to Khaniyara, Dari and Sidhbari villages. Similarly, Kohala and Ghurkari W.S.S. are also withdrawing water from Manuni and supplying to Kohala and Ghurkari villages. According to clause (7.0) of the state water policy irrigation requirement comes at number two in priority list. Also in the study stream water channels known as *Kuhl* have been constructed for irrigating the agricultural fields. The *Kuhls* operating between S1 (Khaniyara) and S3 (Purana Kangra) in the study stream are depicted in Table 2. These water channels further distribute water in the surrounding fields giving rise to dendritic pattern.In order to have uniform distribution of water especially during lean period in summer season a system locally called as Dol is followed in the area customarily, since 1918. In this system lower regions of Manuni watershed have fixed dates for carrying water through Kuhl to the rice fields. These include Ujain, Birta, Lalehar, Kachyari, Ghurkari, Zamanabad, Abdulapur, Nandhehar, Mataur and Bhadwal villages. Further, each village has appointed its own Kohli (a caretaker of Khul) for the maintenance and systematic distribution of water resource amongst the farmers, who in turn, is given a small fraction of crop yield by every family. The water withdrawal (Fig. 2c), impose stress on the water bodies thereby affecting the fauna also.

Table1: Detail of mining leases granted for slate mining in the catchment of ManuniKhad in the vicinity of village KhaniyaraDistt. KangraHimchal Pradesh

SN	Name & Address of Lessee	Khasra No.	Ownership of Land	Area (Ha.)	Mohal	Mouza	Date of Grant Order	Lease Period
1	M/s Chobu Slate Mines Prop. Sh. HarbansRana V.P.O. Khaniyara	285/2/1	Govt.	0-30-00	Chakban	Khaniyara	26-09-08	25-07-09 to 24-07-19
2	Sh. O.P. s/o Sh. N. Ram V.P.O. Sidhbari	285/1	-do-	2-04-00	-do-	-do-	1-07-09	12-07-10 to 11-07-20
3	M/S ManooniEnterprises c/o B. Mehta Vill. Rakkar	167/1	-do-	1-21-10	-do-	-do-	1-1-09	06-9-11 to 05-09-21
4	M/S Koungri Valley Enterprises c/oSh. A. Singh V.P.O. Khaniyara	285/2/2/1	-do-	1-05-10	-do-	-do-	24-9-08	27-08-11 to 26 -08-21
5	M/S Bhagsu Enterprises c/oSh.Kamlesh Kr. VPO. Khaniyara.	167/2	-do-	3-01-91	-do-	-do-	29-5-09	13-07-10 to 12-07-20
6	M/S Shalotu Valley Enterprises c/oSh. R. Lal	160/1	-do-	2-15-82	-do-	-do-	3-8-09	20-08-10 to 19-08-20
7	M/S Dhauladhar Enterprises c/oSh. Rajesh Gupta Vill. Khaniyara	167/3	-do-	1-26-94	-do-	-do-	26-8-09	05-10-10 to 04-10-20

Total Slate Production (Sr. No.1-7) = 816 MT(Year 2009-2010) & 616 MT (Year 2010-2011)
Total Royalty (Sr. No.1-7) = Rs. 204000 (Year 2009-2010) & Rs. 153500 (Year 2010-2011)

Initiation of Mini Hydroelectric Projects

Three mini hydro electric power projects upstream to S1 have been sanctioned by the Govt. of Himachal Pradesh. These are Manuni hydroelectric project of 2.5 MW (Winsome Textile Industries Ltd.), Mini project of 2.0 MW and Manuni-II 4.8

MW(Ind-Barath Energies Ltd. (Source: HIMURJA, 2011). The work is under progress in the first project (Fig. 2d). Land clearing anddumping of debris in river generated by power projects add sediment to the river channel thereby affecting the water quality and the fauna.

Fig 2b Photograph showing river bed mining

Fig. 2c Photograph showing water withdrawal by IPH & Kuhl (Local water channel)

Table 2 Name and number of 'Kuhl' local water channels drawing water from River Manuni, Himachal Pradesh.

Between Sites	Name of Khuls
Khaniyara (SI)& Bhadwal (S2)	DodanKuhl, FakiriniKuhl, SaiherKuhl, TapdulKuhl, LachyadKuhl, DivdiKuhl, ManuniKhad Ki Kuhl-1, GhurluKuhl, NadahdhiKuhl, Nale de Kuhl, Lahta re Kuhl, ChamaradiKuhl, KtaserKuhl, ManuiKhad Ki Kuhl-2, ChauKuhl, LoharuKuhl (Total No.=16)
Bhadwal (S2) & PuranaKangra (S3)	Pul Bali Kuhl, GangalKuhl, NayeeKuhl, GailaKuhl, MaltiKuhl, DebadKuhl, ThaduKuhl, BatrulKuhl, RajoolKuhl, ChudhalKuhl and UjainbaliKuhl(Total No.=11)

(Source: Revenue Department, District Kangra Himachal Pradesh, 2011)

Miscellaneous Activities

In many rivers the domestic waste, sewage and industrial effluents are discharged directly into water courses (Ranjit, 1995). It was observed that people have been using River Manuni as waste dumping site mainly of domestic origin. River Manuni is also being used as site for bathing, washing utensils and clothes in addition to defecating by some people. Also, fishing is common in lower stretches of the river during summer.

Since, the riparian zone of River Manuni downstream to Khaniyara is surrounded by extensive agriculture fields, the agriculture related activities are prevalent throughout the year.

Fig 2d Photograph showing upcoming microhydroelectric project at Khaniyara

Fig 2e Photograph showing miscellaneous anthropogenic activities

Generally rice and wheat are grown in rotation in these fields. Grazing of goat and sheep by *Gaddi* (nomadic people) during their six months stay of the year in Kangra valley has also been recorded in riparian zone of River Manuni. Lastly, all adjoining villages use River Manuni as cremation sites for the last rituals of their near and dear ones (Fig. 2d). All these anthropogenic activities have been comprehensively affecting the ecology of River Manuni. The water discharge was visibly reduced in summer as compared to the winter season at all the sampling sites i.e., at S1: 0.67±0.26 & 0.70±0.35 $m^{-3}s^{-1}$ (SU-I, SU-II) and 0.89±0.33 & 1.28±0.65 $m^{-3}s^{-1}$ (WI-I & WI-II); at S2: 0.88±0.53 & 0.47±0.10 $m^{-3}s^{-1}$ (SU-I & SU-II) and 1.59±0.92 & 2.46±1.05 $m^{-3}s^{-1}$ (WI-I & WI-II) and at S3: 1.66±0.99 & 0.99±0.42 $m^{-3}s^{-1}$ (SU-I & SU-II) and 3.04±1.54 & 5.36±1.34 $m^{-3}s^{-1}$ (WI-I & WI-II) respectively. Also, increase in nutrient level was recorded in River Manuni in the downstream. During the study period the mean annual nitrate was recorded 0.023±0.009 (2009-10) and 0.105±0.105 mgl^{-1} (2010-11) at S1 and 0.050±0.01 (2009-10) and 0.214±0.168 mgl^{-1} (2010-11) at S3. Whereas, the phosphate was recorded 0.012±0.004 mgl^{-1} (2009-10) and 0.055±0.055 mgl^{-1} (2010-11) at S1; 0.025±0.01 (2009-10) and 0.112±0.100 mgl^{-1} (2010-11) at S3 during study duration. A similar increase in nutrient concentrations downstream due to increased anthropogenic activities was also reported by Aura *et al*. (2011).Also, during the present study, 67 taxa of benthic macroinvertebrates were recorded from River Manuni. The benthic macroinvertebrate taxa recorded showed a decreasing trend from S1 (Khaniyara) to S3 (Purana Kangra). An increased number of taxa in the upper zone of study area may be due to the presence of thick riparian vegetation, as the intact riparian forest buffer support higher levels of biodiversity (Moore and Palmer, 2005).

As such, monitoring of benthic macroinvertebrate communities is necessary to understand the changes over a period of time. Further, these results can be used for conservation and management of the ecosystems (Kazanci and Dugel, 2008). Therefore, conservation program at drainage level need to protect the headwater region from degradation, as the headwater streams may act as source habitats for some species occurring also in large rivers (Angermeier and Winston, 1999; Heino *et al*., 2005). Further, long term studies are required to keep an eye on the anthropogenic activities in the watershed so as to provide the base data for ecological planning.

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Seed germination of wheat (*Triticum aestivum*) and the effect of textile industrial effluents on radical and hypocotyls lengths

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Abstract

Textile industries consume high quantity of water and release it as toxic effluents after some colouring processes. However, some wastewater may be recycled as fertilizers in aquaculture and agriculture, horticulture after dilutions. But industrial effluent of synthetic products like azo dyes may be harmful for germination and growth performance of crop seeds. The present paper deals with the physico-chemical parameters of textile industrial effluents and its impacts on germination and growth performance of Wheat, *Triticum aestivum* (Family: Gramineae/ Poaceae). Seeds were found more tolerant against 25% concentrated effluent.

Keywords:*Industrial effluents, seed germination, Triticum aestivum*

Introduction

Textile industrial effluent containing different colours, inorganic and organic chemicals and heavy metals are highly polluted in nature and varies in its compositions. The practice of disposing textile wastewater without any treatment affects, the adjoining land and its soil system were observed very sodic (highly alkaline) and loosing water holding capacity. In the adjoining agricultural area of textile industries sector, there is immense degradation of crops productivity being contaminated by irrigation through tube wells or directly from the water channel of village pond (Bharti, 2007).Developing countries like India, Bangladesh, etc. discharge the effluents to the surface water without any treatment or sometimes little treatment due to technological and economical limitations. Colours affect the nature of water, inhibit sunlight penetration and reduce the photosynthetic action. Some of the dyes cause rapid depletion of dissolved oxygen in aquatic ecosystem affecting aquatic life and floral diversity adversely.

Material and Methods

Textile industrial area is situated on Jatal road at Panipat, which is very famous spot for handloom business. More than 25 dye houses are situated around a common drain and discharge their effluents collectively into drain openly.Effluent was collected from main common effluents channel of textile industrial area of Panipat, Haryana and stored in tightly closed plastic container.

Four polythene bags were taken for sowing the 100 treated seeds of Wheat (*Triticum aestivum*)with 750 gm soil in Green house condition and irrigated by textile industrial common effluent for three days. 25 seeds were treated with absolute effluent, 25 seeds with 50% concentrated effluent, 25 seeds with 25% concentrated effluent and rest 25 seeds were treated with distilled water as control performance. Germination of seeds and growth performance were noticed for each poly bags everyday. Physico-chemical characteristics of effluents were analyzed according to APHA (1995) and Trivedi and Goel (1984).

Results and Discussion

The reults of various physicochemical charachterstic of common effluent of textile industry is given in table 1 while the germination activity of wheat (*Triticum aes*.) is given in table 2.Textile effluents were compositely discharged into nearest pond through a drain and in this drain the appearance of effluent was pinkish red in common effluent drain of textile industries and dye houses, which might be due to the presence of

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synthetic dyes (Malik *et al*., 2006). Mean value of effluent pH was found alkaline (8.2) at pH scale. Solids, BOD and COD values were very high, due to the presence of chemicals used in various processess. Effluents with 25% (S/4) concentration had shown positive performance of seeds germination, radical and hypocotyls growth, almost growth of seedlings. similar to control condition with distilled water, while 50% (S/2) concentration showed some negative effects on per cent seed germination.

Saxena and Kaushik (2005) also reported the similar effects of effluents of wood products factory on seed germination of pigeon pea. 100 % absolute effluent (S) was found highly unfavorable for seeds germination and growth of seedlings.

Table-1: Characteristics of common effluents of textile industries

Parameter (Unit)	Temp (°C)	TDS (mg/l)	TSS (mg/l)	Color	Odor	pH	TS (mg/l)	DO (mg/l)	BOD (mg/l)	COD (mg/l)	Cl (mg/l)	Alkalinity (mg/l)
Common Effluent	22.5 ±1.5	336.3 ±81.89	33.6 ±8.21	Pinkish Red	Thresh old	8.2 ±0.14	370.0 ±90.0	1.64 ±0.21	272.5 ±42.5	791.5 ±51.5	340.8 ±28.4	590 ±60

Table-2: Germination activities of Wheat (*Triticumaestivum*) during experiment

Effluents	Exposure Hour	Number of seed	% Germination	Hypocotyls (Shoot) Length (Cm)	Radical (Root) Length (Cm)
100% (S)	24	25	24	0.750	1.20
	48	25	32	1.250	1.80
	72	25	40	1.350	2.40
50% (S/2)	24	25	28	0.800	1.35
	48	25	36	1.300	2.25
	72	25	44	1.450	3.25
25% (S/4)	24	25	36	0.900	1.42
	48	25	40	1.400	2.38
	72	25	48	1.550	3.52
Control (Distilled water)	24	25	32	0.850	1.50
	48	25	44	1.425	2.45
	72	25	48	1.500	3.50

Highest root length of germinated seeds with 100% concentration effluent was found 2.40 cm on third day, which was the shortest root among all the radicals in any poly bag. 25% (S/4) concentrated effluent indicated the high growth rate and seed germination among all other concentrations and it was similar to control conditions with distilled water. Dutta and Boissay (1998) also stated that the effluent at low concentrations exhibit greater shoot and root length.Transfer values of heavy metals from soils to plants may influence the growth performance of plant species. Seeds of Wheat (*Triticumaestivum*) were found more tolerant against 25% concentrated effluent, while against 100% absolute effluent it was found too week as only 10 seeds were germinated in poly bag of 25 seeds.

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Species diversity in two different forest of Siwalik Range in J&K Himalaya, India

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Abstract

The present study deals with the species diversity of two identified forest i.e., mixed broad leaved forest (Forest type-1) and pine forest (Forest type-2) of Shiwalik range in J&K Himalaya. Ten plots of 10×10 m were randomly established in the forest for the determination of species diversity and other vegetation parameter ranging from 500-1200m asl. *Acacia modesta* was the dominant species of forest type-1 followed by *Mallotus philippensis, Cassia fistula,* etc. *Pinus roxburghii* was the dominant tree species of forest type-2 but also shows some sort of dominancy in forest type-1. Shrubs and herbs diversity and density was shown decreased with pine dominating forest. It was also observed that the studied forest was unstable and degraded, and will be vanished if not maintained properly.

Keywords:*Broad leaved forest, distribution pattern, disturbance effect, Pine forest, regeneration status, Species diversity*

Introduction

The forest is defined as "a plant community predominately of trees and woody vegetation usually with a closed canopy". The Indian sub-continent was under forest vegetation for quite a long time; however, the area under forest is gradually shrinking due to the increasing demands of the exploding population for forest products including pastures. Forests are a good asset in every country. They yield material for industries, timber for housing and other purposes and fuel wood for the poor masses. They also ensure aesthetic value, helps in precipitation, check floods and prevent soil erosion. Unfortunately, this highly valued wealth has been vanishing owing to the reckless activities of man. According to UN estimate, an acre of forests is being destroyed every second. India's forest loss has been particularly heavy (Anonymous, 1987).Besides exploring floristic diversity and invention of the plant resources of the western Himalayas and the State J&K, documents about phyto-sociological diversity as well as ethno-medicinal utilization of plants has been initiated by several worker during last two decades(Champion *et al.*,1965; Saxena and Singh., 1982; Negi, 2009; Pande, 2001; Mishra *et al*. 2003.; Sharma *et al*., 2009; Jain, 1991; Singh &Kumar, 2000; Anjula*et al*., 2007; Gupta *et al*., 1982; Kachroo & Nahvi., 1976; Kaul *et al*., 1987).

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Study area

The present study was conducted in sub-tropical Chir Pine forest of block Nowshera District Rajouri (J&K) in the year 2009-2010. The study area is located at an elevation ranges from 500 -1200 m asl and lies between of 32^0-57' to 33^0-17' N latitude and of 70^0-0' to 74^0-33' E longitude. The study area lies in South-West of the District Rajouri and in Western circle of the Jammu division. It is bounded by block Rajouri in North, Kalakote and Sunderbani in East and Mirpur Pakistan in West and South. Most of the area is mountainous and rugged. Landscape consists of low lying undulating hills and valleys. Northward topography become very steep and high merging ultimately with PirPanjal range near Ans River. Soil under forest is characterized by sandstone, shale, clay and calcareous sandstone in lower siwalik and massive,

soft, coarse, sandstone with sub ordinate clay in upper siwalik. The annual rainfall ranges from 920-960mm. The minimum and maximum temperature throughout the year ranges from 9^0C to 32^0C.Although some ethno-botanical studies in sub-tropical belt of the study area have been carried out (Rashid *et al*., 2008; Dangwal *et al*., 2010, 2011), but no quantitative data on phyto-sociology of this block is available. The present study describes the species composition, regeneration status and distribution pattern of two different forest type in siwalik range of J&K Himalaya.

Material and Methods

The present study was undertaken to find out the species diversity of two different forest types i.e., mixed broad leaved forest (Forest type-1) and pine forest (forest type-2). Phyto-sociological studies were conducted during 2009-2010. The plants were indentified with the help of published regional forest flora of Jammu and Kashmir (Sharma & Kachroo, 1983; Swami & Gupta, 1998; Gaur, 1999). Tree layer was analysed by sampling of 10 randomly placed quadrats of 10×10 m size in each forest. The samples was quantitatively analysed for abundance, density and frequency (Curtis & McIntosh, 1950). Importance Value Index (IVI) for the tree layer was determined by following Curtis and Cottom 1956. The Distribution pattern of different species was studied by using ratio of abundance to frequency (Whitford, 1949). Tree species were considered to be individuals >30cm cbh (circumference at breast height) and sapling 10-30cm cbh and seedling <10cm cbh (Saxena*et al*., 1984). The shrubs, herbs and seedling were analyzed by sampling of 5×5m and 1×1m quadrats, respectively for each forest. The abundance to frequency ratio was studied for eliciting their distribution patterns. This ratio indicates regular (<0.025), random (0.025-0.05) and contagious (>0.05) distribution of species (Curtis &Cottom, 1956).

The floral diversity and concentration of dominance was calculated by Simpson's index (Simpson, 1949) as:

$Cd=\sum (ni/n)\ 2.$

Where, n is the total number of species and ni is individuals of a species.

Results and Discussion

A total of 56 plant species were recorded from the study area out of which 19 were tree, 10 were shrubs and 27 were herbs. Total species diversity is greater in mixed broad leaved forest (forest type-1) than pine forest (forest type-2). The results indicated that species diversity decreased in pine forest than mixed broad leaved forest as shown in Table 1, 2, 3 & 4.In forest type-1 it was shown greater diversity of trees, shrubs and herbs than forest type-2 (Table 1, 3 & 4) by Simpson index. In forest type-1 tree diversity in sapling as well as seedling was higher than forest type 2. Herbs and shrubs diversity was also observed higher in forest type-1 than forest type-2 as shown in Table 1,2,3&4.

Tree

In forest type-1 *Acacia modesta* and *Pinus roxburghii* was dominant species of forest type -1(IVI= 52.88 & 68.84, respectively) followed by *Dalbergia sissoo*, *Mallotus philippensis, Oleacus pidata, etc*. (IVI=35.02, 31.77, 22.55, respectively)and the lowest dominant species was *Ficus palmata* (IVI=4.43). While in forest type -2 *Pinus roxburghii* was the dominant one (IVI=180.35) followed by *Mallotus philippensis, Pistacia integerrima, Terminalia chebula, Phyllanthus emblica, Terminalia bellirica* (IVI=24.52, 17.27, 11.89) and the lowest dominant was *Ficus roxburghii* (IVI= 4.97) Table -2.

Sapling

In forest type-1 *Acacia modesta* was the dominant species (IVI=73.44) followed by *Mallotus philippensis,Oleacu spidata, Pinus roxburghii* (IVI=46.93, 39.86, 31.01, respectively) and in forest type-2 *Pinus roxburghii* was the dominant species (IVI=110.30) followed by *Phyllanthus emblica, Mallotus philippensis, Terminalia bellirica, Grewia vestita* (IVI=34.11, 33.17, 27.28, 22.12, respectively).

Seedling

Higher diversity of seedling was shown by *Mallotus philippensis* (IVI=101.22) in forest type-1 followed by *Pyrus pashia, Acacia modesta, cassia fistula* (IVI=72, 39.21, 31.55, respectively) and in forest type-2 *Pinus roxburghii* was the dominant

Table-1 Diversity, distribution patterns and regeneration status of forest type-1(Broad leaed forest)

	Tree			Sapling			Seedling		
Name of Species	**A/F Ratio**	**IVI**	**Simpson index**	**A/F Ratio**	**IVI**	**Simpson index**	**A/F Ratio**	**IVI**	**Simpson index**
Dalbergia sissoo	0.032	35.02	0.01	0.000	0.00	0.00	0.100	8.61	0.00
Pyrus pashia	0.100	4.52	0.00	0.050	18.44	0.00	0.069	72.00	0.06
Oleacus pidata	0.044	22.55	0.01	0.067	39.86	0.02	0.000	0.00	0.00
Toona ciliata	0.075	14.44	0.00	0.000	0.00	0.00	0.000	0.00	0.00
Acacia modesta	0.072	52.88	0.00	0.052	73.44	0.06	0.078	39.21	0.00
Ficus palmata	0.100	4.43	0.00	0.100	9.55	0.00	0.000	0.00	0.02
Pinus roxburghii	0.084	68.84	0.05	0.150	31.01	0.01	0.044	29.90	0.00
Mallotus philippensis	0.063	31.77	0.01	0.078	46.93	0.02	0.039	101.22	0.01
Cassia fistula	0.200	7.43	0.00	0.075	21.01	0.00	0.044	31.55	0.11
Syzygium cumini	0.056	18.70	0.00	0.125	29.54	0.01	0.400	17.50	0.01
Flacourtia ramontchi	0.100	4.54	0.00	0.100	9.22	0.00	0.000	0.00	0.00
Phyllanthus emblica	0.075	11.70	0.00	0.000	0.00	0.00	0.000	0.00	0.00
Ficus roxburghii	0.050	9.59	0.00	0.000	0.00	0.00	0.000	0.00	0.00
Grewia vestita	0.100	13.58	0.00	0.000	0.00	0.00	0.000	0.00	0.00
Euphorbia royleana	0.000	0.00	0.00	0.075	21.01	0.02	0.000	0.00	0.00
		299.99	0.096		300.01	0.14		299.99	0.21

A/F= Abundance/Frequency ratio, IVI= Importance Value Index

species (IVI=64.85) followed by *Terminalia bellirica, Mallotus philippensis* (IVI=41.50, 40.84).

Shrubs

It has been noticed that diversity of shrubs was decreased in pine dominating forest. In forest type-1 *Carissa spinarum* was the dominant species(IVI=120.51) and *Woodfordia fruticosa* IVI=181.07) was the dominant species of forest type-2 (Table-3).

Herbs

Diversity of herbs was also shown decreasing trend in pine dominating forest as shown in Table-4. In forest type-1 *Cynodon dactylon* (IVI=31.87) and in forest type -2 *Biden spilosa* was the dominant species.

The vegetation of Nowshera block was very diverse and similar to other Indian Himalayan forests. The geographical location, climate and topography ofthe block have contributed to its characteristic vegetation and flora.

Forest type-1 showed the highest species diversity followed by forest type-2. Forest type -1 showed greater shrubs and herbs diversity. Shrubs and herbs diversity decreased in pure pine forest and it may be due to anthropological disturbances in these types of forest. Rathore (1993) noticed high species richness and diversity in *Pinus roxburghii*-mixed broad leaved forest. Bruns,(1995) and Austin *et al*., (1996) analyzed association between species richness and climate, slope position and soil nutrient status and found that that total species diversity was greater in low elevations, warm site with moderate rainfall and intermediate to high nutrient level.

Table-2 Diversity, distribution patterns and regeneration status of forest type-2(Pure pine forest)

	Tree			Sapling			Seedling		
Name of Species	**A/F Ratio**	**IVI**	**Simpson index**	**A/F Ratio**	**IVI**	**Simpson index**	**A/F Ratio**	**IVI**	**Simpson index**
Pinus roxburghii	0.079	180.55	0.36	0.058	110.30	0.14	0.022	64.85	0.05
Mallotus philippensis	0.089	24.52	0.01	0.067	33.17	0.01	0.078	40.84	0.02
Grewia vestita	0.200	6.34	0.00	0.125	27.28	0.01	0.300	17.96	0.00
Cassia fistula	0.000	7.99	0.00	0.000	0.00	0.00	0.100	8.03	0.00
Phyllanthus emblica	0.100	13.10	0.00	0.067	34.11	0.01	0.044	38.65	0.02
Terminalia bellirica	0.075	11.89	0.00	0.200	12.00	0.00	0.031	41.50	0.02
Termenalia chebula	0.033	15.99	0.00	0.033	22.12	0.01	0.044	36.57	0.02
Pistacia integerrima	0.033	17.27	0.01	0.050	14.90	0.00	0.050	18.14	0.00
Ficus palmata	0.050	10.94	0.00	0.050	15.69	0.00	0.100	10.62	0.00
Ficus roxburghii	0.100	4.97	0.00	0.050	14.90	0.00	0.200	14.29	0.00
Pyrus pashia	0.200	6.44	0.00	0.050	15.53	0.00	0.100	8.55	0.00
		300.00	0.38		300.00	0.18		300.00	0.13

A/F= Abundance/Frequency ratio, IVI= Importance Value Index

Table-3 Diversity and distribution patterns of shrubs in forest type -1 and forest type-2

Shrubs	**Forest type-1**			**Forest type-2**		
Name of Species	**A/F Ratio**	**IVI**	**Simpson index**	**A/F Ratio**	**IVI**	**Simpson index**
Justicia adhotoda	0.214	71.77	0.06	0.000	0.00	0.00
Dodonaea viscosa	0.150	26.84	0.01	0.000	0.00	0.00
Carissa spinarum	0.110	120.51	0.16	0.250	76.83	0.07
Myrsine africana	0.100	8.35	0.00	0.000	0.00	0.00
Nerium indicum	0.700	7.60	0.00	0.000	0.00	0.00
Ziziphus maurtiana	0.300	5.49	0.00	0.200	24.93	0.01
Calotropis procera	0.063	19.08	0.00	0.000	0.00	0.00
Ipomoea carnea	0.322	25.67	0.01	0.000	0.00	0.00
Woodfordia fruticosa	0.250	14.68	0.00	0.138	181.07	0.36
Randiatetra sperma	0.000	0.00	0.00	0.100	17.17	0.00
		299.99	0.24		300.00	0.44

A/F= Abundance/Frequency ratio, IVI= Importance Value Index

Table 4 –Diversity and distribution pattern of herbs

Herbs	Forest type-1			Forest type-2		
Name of Species	A/F Ratio	IVI	Simpson index	A/F Ratio	IVI	Simpson index
Cenchrus ciliaris	0.000	0.00	0.00	0.875	8.71	0.00
Paspalidium flavidum	0.100	4.96	0.00	0.175	25.69	0.01
Setaria gluca	0.408	17.25	0.01	0.450	17.71	0.00
S. sphacelta	0.756	10.22	0.00	0.000	0.00	0.00
Chrysopogon fulvus	0.867	16.88	0.01	0.425	21.29	0.01
Echinochloa colona	1.389	20.05	0.00	0.344	23.63	0.01
Eriophorum comosum	1.925	15.06	0.00	1.111	26.26	0.01
Cyprus niveus	0.000	0.00	0.00	0.825	26.62	0.01
Cynodon dactylon	0.924	31.87	0.01	0.648	35.32	0.01
Biden spilosa	0.506	17.47	0.00	2.100	47.85	0.03
Circium arvense	0.163	9.89	0.00	0.100	7.84	0.00
Conyza ambigua	0.522	10.91	0.00	0.100	4.66	0.00
C. bonariensis	1.425	10.99	0.00	0.000	0.00	0.00
Parthenium hysterophorus	0.569	24.46	0.01	0.156	11.43	0.00
Silybumm arianum	0.300	7.00	0.00	0.350	6.66	0.00
Sonchus asper	0.119	7.45	0.00	0.067	6.98	0.00
Taraxacum officinale	0.069	7.17	0.00	0.050	4.17	0.00
Achyranthes aspera	0.324	18.07	0.01	0.325	7.44	0.00
Amaranthus spinosus	0.081	10.49	0.00	0.000	0.00	0.00
A. viridis	0.084	10.83	0.00	0.000	0.00	0.00
Capsella bursa-pastoris	0.100	2.88	0.00	0.075	4.23	0.00
Cassia occidentalis	0.225	9.10	0.00	0.575	9.04	0.00
Silenecon oidea	0.260	16.05	0.00	1.200	4.46	0.00
Oxalis corniculata	0.875	8.09	0.00	0.000	0.00	0.00
Cassia tora	0.475	4.68	0.00	0.000	0.00	0.00
Sida cordifolia	0.150	3.15	0.00	0.000	0.00	0.00
Malvastrum coromandelianum	0.111	5.00	0.00	0.000	0.00	0.00
		299.97	0.05		299.99	0.09

A/F= Abundance/Frequency ratio, IVI= Importance Value Index

The communities which were present in the forest type -1, was dominated by *Acacia modesta* and under shrubs layer by *Euphorbia royleana, Carissa spinarum, Dodonaea viscosa, etc.* Champion *et al.,* (1965) also mentioned it as plain thorn forest which may also ascends up to subtropical forest. *Pinus roxburghii* was the dominant tree species of forest type -2 and it also showed some dominancy in forest type-1.The recorded species diversity value 0.096-0.38 is very low for Himalayan range (Pande, 2001; Mishra *et al.,* 2003. Sharma *et al.,* 2009). A slow rate of evolution of community and relatively drier climatic conditions can also responsible for low diversity value of subtropical forest as compared to high diverse tropical forest and temperate vegetation (Conell and Oris, 1964).

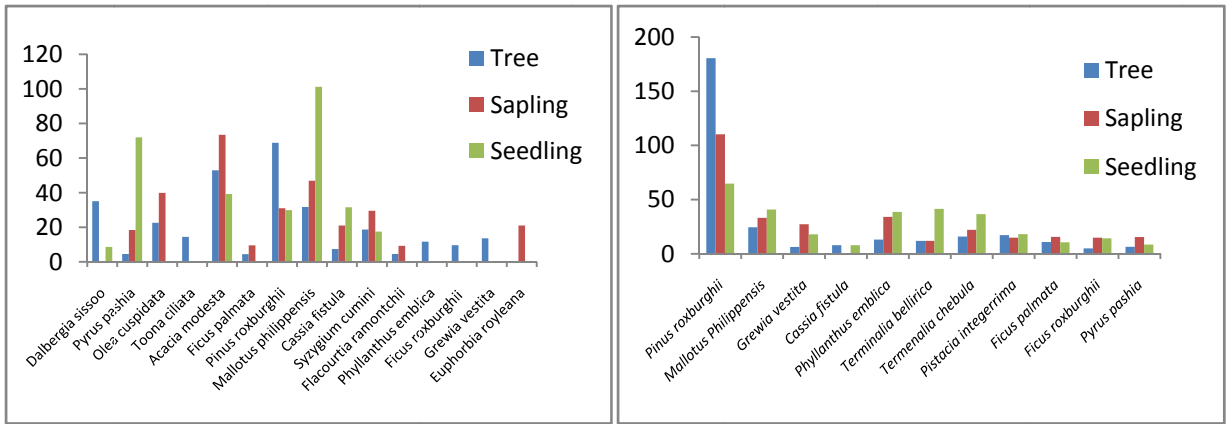

Fig.-1 Regeneration and diversity of tree in forest type-1Fig. -2 Regeneration status and diversity of forest type -2.

The regeneration status of trees in both the sites (Forest type-1 & 2**)** was studied by using following Koul*et al.*, 2008.). Good regeneration; if Seedling>Sapling>Adults; Fair regeneration, if Seedling > or ≤ Sapling ≤ Adults; poor regeneration if only by Sapling are present but no Seedlings. If only adult trees are present, it is considered as no regeneration. Inforest type-1of study area *Mallotus philippensis* had good regeneration and *Acacia modesta* showed fair regeneration, while *Pinus roxburghii* exhibited poor regeneration in forest type-1. Some species of forest type-1 had poor regeneration while other showed no regeneration (Table:1,2& Fig.1&2.). In forest type -2 *Pinus roxburghii* had fair regeneration. The plants like *Mallotus philippensis,Grewia terminalia* showed new regeneration (only Seedling and Sapling were reported from the study area and very rare adult plant).In the study area, most of the trees species exhibited contagious distribution. But species like *Dalbergia sissoo and Mallotus philippensis* showed random and regular distribution in forest type-1. Most of shrubs and herbs showed contagious distribution in each forest type. (Table 1, 2,3&4).The high intensity of anthropological disturbances regularly disturbs the natural balance of forest community, thus preventing them to reach climax stage of community maturity (Saxena *et al*., 1984). This phenomenon is evident from heavy grazing and tree felling in study sites and also collection of lower plants for other proposes such as medicinal importance. Consequently the grazing pressure shift to the surrounding forest reserves, creating a massive stress on the forest ground flora, shrubs and most important the seedling (Negi, 2009).

Conclusion

Hence, we may conclude that the study area needs a complete protection from biotic interferences, deforestation, grazing and human activities so that the natural vegetation may come up again. The Forest Department should take active action against the local inhabitants who are involved in cutting of forest for earning their livelihood.

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Impact of 30 days exposure of whole Paper mill effluent (WRPBILE) on nucleic acid profile in the liver and gonad of freshwater teleost *Mystus vittatus* during annual reproductive cycle

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Abstract

The present study has been undertaken to investigate the biochemical alterations in teleost fish *Mystus vittatus* after chronic exposure to sublethal concentrations of paper mill effluent for 30 days. a quantitative estimation of DNA and RNA material was made in liver and gonadal tissues throughout the reproductive cycle of the fish. The biochemical variables studied in the control fish showed the maximum values during the spawning phase as compared to other phases of the reproductive cycle of the fish. The changes produced in the nucleic acid content on account of chronic exposure of the fishes for 30 days to 0.4 (40%) and 0.8(80%) of 96 h LC_{50} of WRBBILE stress were found to be close dependent, being relatively much higher in case of 0.8 WRPBILE when compared to 0.4 WRPBILE. This phenomenon was observed during the three phases of the annual reproductive cycle of the fish. The DNA as well as RNA contents in liver, testis and ovary tissues showed a reduction in case of both the sublethal concentration of effluent in all the three phases of the reproductive cycle. The changes produced by WRPBILE stress were found to statistically very significant in all the phases except in the case of RNA content of testis during the post spawning phase of the fishes exposed to 0.4 WRPBILE. The present study concludes stress induced depletion might be due to degradation of cells, nuclear material and metabolic dysfunction in response to WRPBILE toxicity in the fish.

Keywords:*WRPBILE, stress-induced, spawning phase, annual reproductive cycle, chronic, exposure.*

Introduction

Pulp and paper mill effluents are major sources of pollution to aquatic habitats. In addition to producing bad taste and odor in receiving water, these discharges also cause such ecological hazards as oxygen depletion. Pulp and paper mill waste waters are known to be very toxic for fish population. Numerous studies have revealed significant effect of pulp and paper mill effluents on fish health and fish populations. Some of these effects observed were skin disruption, liver dysfunction, kidney damage, abnormal blood chemistry, effects on growth and reproduction, delayed sexual maturation (Whittle and flood 1977; Andersson *et al*. 1988; Harding *et al*.1988; Khan *et al*. 1992; Forlin *et al*.1995; Jeney *et al*. 1996; Mishra *et al*. 2011). The major components isolated from paper mill effluents include resin acids, ditespene alcohol, lignin degradation products, chlorophenols, furans, dioxins, and inorganic materials like sulfides, chlorides, phosphates, nitrates, calcium, sodium, organochlorine compounds and certain heavy metals, have also been extracted. Various workers have carried out the extensive research in order to understand the biochemical and physiological changes in a number of fishes under the effect of toxic paper mill effluent (Mcleay and Brown, 1974; Oikari *et al*.1984; Klocpper– sams *et al*.1994; Forlin *et al*.1995; Jeney*et al*.1996; Mishra *et al*. 2010). Liver being the chief metabolic centre and main detoxifying organ, particularly harmful for the body .Among other fish tissues, gonadal tissue is particularly important. Healthy gonads being vital tissue for reproductive success, any biochemical anomaly in their tissue would adversely affect the reproductive performance of the fishes and thus, threaten the natural survival of fish populations. The effects of WRPBILE on nucleic acid contents and other biochemical constituents in liver and gonads can vary between mills which adopt different pulping ,Bleaching and effluent treatment

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technologies. However, due to the unavailability of such published data on such effects, the correlation between the toxic components in WRPBLIE and the biochemical effects in liver and gonadal tissues of the stressed fish is much difficult.

The main objective of the present investigation was to examine the biochemical alterations in the liver and gonadal tissues of *Mystus vittatus* caused under the stress of paper mill effluent by exposing the fishes in whole mill effluent for 30 days .The biochemical affects of chronic exposure to sublethal concentrations of WRPBILE on the nucleic acid contents (DNA and RNA), of these tissues were observed through the annual reproductive cycle of the fish.

Material and Methods

Adult and healthy freshwater teleost *Mystus vittatus* (body lenth10.6 ± 0.28 cm and weight 55.3± 2.6 gm) of both the sexes were collected from a local uncontaminated freshwater resources in Basti city area, immediately brought to the research centre in open containers being field with sufficient quantity of water show that the stress produced by handling and transportation may be minimized .The fishes were acclimatized in 50 liter glass aquaria to laboratory condition for 3 to 4 week at natural temperature in the acclimation tanks field with dechlorinated tap water (pH 7.1-7.2; dissolved Oxygen 7.6 ppm ; free carbon dioxide 12.4 ppm; Total alkalinity 112.0 ppm). The fishes were fed upon dried earthworms and a mixture of equal parts of dried shrimps and roasted flour. The whole test effluent test sample was collected from Rayana Paper Board Industries Limited, Maghar, Santkabir Nagar Uttar Pradesh (India), for the study of toxicological responses the test samples were collected from 3 spots during the morning shift of the normal course of mill operation. the samples were mixed thoroughly and brought to the research centre in sealed polyethylene containers ,the chemical characteristics of effluent sample analyzed according to the procedures recommended by American Public Health Association (2005), with in 24h of collection ,every month (Table I). The acute toxicity of effluent to the perch was studied in terms of 96h – LC50 by using the static bioassay procedures as outlined by USEPA (1989) for each acute toxicity bioassay, a minimum of 8 concentration of test sample was used and 20 test fishes were used for each concentration. Controls were also run separately during experimentation, using normal dechlorinated tap water. No food was supplied to either the control or the experimental test fishes during the toxicity experiments. The toxicity test experiments were conducted every month of the annual reproductive cycle and 96h LC_{50} value were determined using regression analysis. For evaluating the effects on tissue biochemistry, the test fishes were exposed for a period of 30 days in two sublethal concentrations i.e. 0.4(40%) and 0.8(80%) of the 96 h LC_{50} determined during the mortality studies .The healthy test fishes, selected from the acclimation tank, were divided in three groups of 60 fishes each. The first group was exposed to 0.4 of 96 h LC_{50} and the second group to 0.8 of 96h LC_{50} WRPBILE sublethal concentration .The 3rd group was placed in unpolluted dechlorintedtapwater, and served as control. The experiments was repeated 5 times .after the completion of 30 days exposure period ,the fishes from all the 3 groups were taken out for the sampling of liver and gonadal tissue.Ten fishes were used for each determination the levels of deoxyribose nucleic acid (DNA)and ribose nucleic acid (RNA) in the liver ,testis and ovary tissues were estimated according to the standard method of Schneider (1957),using calf thymus DNA (standard) and Diphenylamine reagent for DNA ,and Yeast RNA hydrolysis (standard) and orcinol reagent for RNA estimation. Homogenates were prepared in 5% TCA (1 mg/ml W/V) at 90˚C , centrifuged at 5000 g for 20 min ,the supernatant being used for estimating the nucleic acid levels the nucleic acid concentration was measured in the 3 phases of the annual reproductive cycle of the fish and 10 were recorded in each spawning phase.

A Photocolourimeter (Systonics) was employed for biochemical colorimetric estimation. The standard deviation (± SD), and standard errs (±SE), were calculated and tested for significant according to the statistical methods outlined by Snedecor (1961). To test the significance of differences between the mean experimental and the corresponding mean control values, the Student's t-test was applied as described by Campbell (1974).

Results and Discussion

The DNA and RNA contents of liver ,Ovary testis of control *M. Vittatus* were found to rise during the spawning phase as compared to the pre-spawning and Post spawning phases of the annual

reproductive cycle of the fish .Chronic exposure to sublethal concentration (i.e.0.4 and 0.8 of 96h-LC_{50}) of WRPBILE produced a mark reduction in the DNA and RNA content of Liver Testis and ovary of *M .Vittatus* during all phases of annual reproductive cycle .The changes produced by WRPBILE stress in DNA and RNA amounts were found to be statistically very significant ($p<0.05$ or 0.0010 in all the phases of the fishes exposed to 0.4 WRPBILE.(Table I and II).Nucleic acid, especially RNA is initially associated with protein synthesis, usually in positive correlation, the tissues of fish (Love, 1980 b). Hence any increased in nucleic acid concentration would imply increased protein synthesis. It has been mentioned that a general build up of protenious material, leading to higher protein and amino acidlevels, in *M. vittatus* during spawning phase explains that protein is mostly synthesized in liver from where it is transported to o other organs(Mishra, *et al*. 2010). It is also known that a protein reserve is specially needed in the gonadal growth and gamete formation. Hence, and increased protein synthesis, as reflected by higher nucleic acid content would be mostly most likely to occurs in maturing gonad tissues. Thus the presently observed higher nucleic acid concentrations in the spawning *M. vittatus* would appear to reflecting an accelerated DNA-RNA synthesis which the spawning condition induces in these fishes. At the same time, DNA being the genetic material, its increase may be expected during gametogenesis.

Table I: Chemical characteristics of Rayana Paper Board Industries Limited, effluent), Maghar, Santkabirnagar (U.P.), India, samples to which *M. vittatus* were exposed for 30 days. Data based on the Samples taken during the morningshift of the normal course of mill operation (i.e. 8am).

Parameters	**Variable constituents through the reproductive phases (Mean values)**		
(mg/l)	**Pre-spawning phase (Feb-May)**	**spawning phase (June-Sept)**	**Post spawning phase (Oct-Jan)**
Color	Dark Brown	Dark Brown	Dark Brown
Sodium	350	320	351
Chloride	422	450	425.7
Sulphate	2.34	5.8	3.5
Nitrate	7.6	7.3	7.2
Nitrogen	1.8	6.5	3.8
Phosphate	0.78	0.64	0.69
pH	7.3	7.4	7.4
Alkalinity	162	175	170
Suspended solid	5021	4642	4257
Total solid	6136	5867	1015
Tem	23.5	28	26.5
BOD	552	538	497
COD	2370	2548	2326
Fe	9.6	13.5	10.4
Mg	1.9	1.65	1.28
K	8.6	6.5	4.4
Cu	0.12	0.15	-
Total Cr	-	0.078	0.069
Mn	0.34	0.072	0.52
CO	-	0.001	0.00
Zn	0.06	0.08	0.106
Cd	0.027	0.017	0.018

Table II: DNA content µg/l of the liver , Ovary and Testis of *M.Vittatus* exposed to sublethal concentrations of WRPBILE 0.4 and 0.8% of LC_{50} for 30 days during the different phases of annual reproductive cycle .Values expressed as mean ± S.E. of Ten observations ;test sample(Table I used)

Tissues	Pre-Spawning Phase 96h-LC_{50}:43.8 (% v/v)			Spawning Phase 96h-LC_{50}:38.7 (% v/v)			Post-Spawning Phase 96h-LC_{50}:50.8 (% v/v)		
	Exposure conditions			Exposure conditions			Exposure conditions		
	Control	0.4% of 96h LC_{50}	0.8% of 96h LC_{50}	Control	0.4% of 96h LC_{50}	0.8%of 96h LC_{50}	Control	0.4% of 96h LC_{50}	0.8% of 96h LC_{50}
Liver									
Mean	28.15	25.61*	17.61**	32.68	27.27**	18.99**	23.97	20.94**	17.21**
±SE	0.18	0.44	0.45	0.43	0.61	0.35	0.52	0.38	0.66
P.C.	-	-9.02	-37.43	-	-16.63	-41.92	-	-12.6	-28.2
Ovary									
Mean	26.83	23.65*	19.19**	30.31	25.14*	20.62**	21.74	18.28**	15.42**
±SE	0.81	0.54	0.31	0.79	1.18	0.67	0.434	0.29	0.64
P.C.	-	-11.9	-28.5	-	-17.09	-32.04	-	-5.8	-28.9
Testis									
Mean	24.6	18.20**	18.08**	26.57	18.08**	15.18**	20.25	17.15**	14.55**
±SE	0.41	0.72	0.43	0.66	0.85 -	1.21	0.46	0.42	0.62
P.C.	-	-26.02	-26.50	-	3.95	-42.9	-	-15.3	-28.15

P. C. : Percent change from corresponding control
***P< 0.05> ,**P<0,001> Student's 't'-test (Campbell,1974)**

Table III: R.N.A. content µg/l of the liver, Ovary and Testis of *M.Vittatus* exposed to sublethal concentrations of WRPBILE 0.4 and 0.8% of LC_{50} for 30 days during the different phases of annual reproductive cycle .Values expressed as mean ±S.E. of Ten observations; test sample (Table I used)

Tissue	Pre-Spawning Phase 96h-LC_{50}:43.8 (% v/v)			Spawning Phase 96h-LC_{50}:38.7 (% v/v)			Post-Spawning Phase 96h-LC_{50}:50.8 (% v/v)		
	Exposure conditions			Exposure conditions			Exposure conditions		
	Control	0.4% of 96h LC_{50}	0.8% of 96h LC_{50}	Control	0.4% of 96h LC_{50}	0.8%of 96h LC_{50}	Control	0.4% of 96h LC_{50}	0.8% of 96h LC_{50}
Liver									
Mean	32.95	30.48**	25.25**	35.99	30.41**	24.88**	28.15	25.5**	20.38**
±SE	0.28	0.46	0.13 -	0.33	0.44	0.35	0.31	0.31	0.44
P.C.	-	-7.8	23.4	-	-15.5	-30.9	-	-9.41	-27.6
Ovary									
Mean	38.08	35.83*	30.73**	41.6	38.63*	29.2**	31.55	30.54**	26.97**
±SE	0.213	0.19	0.15	0.15	0.14	0.13	0.93	0.35	0.1
P.C.	-	-5.81	-19.26	-	-7.14	-29.81	-	-3.2	-14.52
Testis									
Mean	29.82	25.84**	21.43**	33.16	25.62**	21.91**	24.24	19.83**	17.06**
±SE	0.36	0.44	0.39-	0.63	0.71	1.88	0.45	0.35	0.44
P.C.	-	-13.34	28.14	-	-22.74	-33.93	-	- 18.06	-29.51

P. C. : Percent change from corresponding control
***P< 0.05> ,**P<0,001> Student's 't'-test (Campbell,1974)**

The nucleic acid synthesis appeared to be greater in the ovary than in the tissues of these fish. The RNA:DNA ratio observed in control *M. vittatus* was found to be 1.25±0.03 in case of testis and 1.45±0.05 in case of ovary ,the difference between the two being statistically significant ($p<0.005$). so ,while the increase observed in the content of both the nucleic acid would be positioning at a general increase in cell number and size in the growing and dividing gonad tissues of spawning ,the comparatively greater rise in RNA concentration of the ovary could be a pointer to greater growth and accumulation on the material in the developing ova when compared to sperms .After chronic exposure for 39 days to both the sublethal concentration of WRPBILE, a dose- dependent reduction in DNA and RNA material in Liver, ovary and testis of *M. vittatus* was seen during all the phase of the annual reproductive cycle. The reduction in 0.8 sublethalconcentration was always generally higher as compared to 0.4 WRPBILE sublethal concentrations. There are many records of various environmental and other factors producing significant reduction in the nucleic acid amount of liver and gonads of fishes (Rath and Mishra ,1980; Shukla and Pandey ,1986; Kumar and Ansari ,1986; Pandey and Narain ,1990).A close parallelism was seen between protein level on one hand and DNA – RNA level on the other. Hence any reduction in the amount of nucleic acid would imply a reduced synthesis of protein (Buckley,1980; Barron and Adelman, 1984; Mishra , *et al* . 2010) .Reduced nucleic acid content could , infact, be a major cause for the under production of protein levels of these stressed fishes .regarding the causative factors involved in the lowering of nucleic acid level in *M. vittatus* ,both under production and loss could be contributing . Histopathological damage to tissues would naturally result in a loss of nucleic acid result in the destroyed cells. Possibility of stress that induced tissue damage in stressed *M. vittatus* could not be avoided. Under production of RNA would be inevitable in the event of DNA reduction because, as in the case of mammals, RNA synthesis in developing and growing fish tissues also depends upon the amount of available DNA template (Zeitoun, *et al*.1977). DNA molecule in particular seems to be susceptible to stress including environmental stress .Nucleic acid loss on account of damage to RNA and / or DNA materials, caused by stress –induced chromosomal abnormalities, has been reported in the tissues subjected to environmental poisons (Fowler, 1977; Adam's, *et al.* 1992; Marlasca, *et al*. 1998; Sumath, *et al*. 2001; Cavas and Gozukara, 2003). It is also suggested (Fowler, 1977), that stressed could inhibit DNA repair process as well, and thus lead to its dimunition.

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Preliminary investigation and antimicrobial screening of successive extracts of phytoconstituents from *Cassia fistula* of Haridwar region, India

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Abstract

***Cassia fistula* belongs to family leguminosae. It is a medium sized tree and its different parts are used in Ayurvedic medicine as well as in home remedies for common ailments. The plant is easily available in Haridwar region. The phytoconstituents of a same plant vary from region to region. In the present study bark of *Cassia fistula* is used. The material was collected (in Haridwar region, India), dried in shade; powdered and extracted successively with different solvents in an increasing order of polarity. Phytochemical investigation was performed using different identification tests. The different extracts were also screened for antimicrobial activity. For which both Gram positive and Gram negative bacterial strain were selected. Antimicrobial test was performed by agar well diffusion method. All the tests were performed in a triplicate. The different phytoconstituents present in the bark extract are responsible for such an appreciable activity against selected pathogens.**

Keywords: *Cassia fistula, successive extraction, phytochemical investigation and antimicrobial screening*

Introduction

Infectious disease caused by bacteria, viruses, fungi and parasites are still a major threat to public health, despite the tremendous progress in human medicine (Cosa *et al*. 2006). *Cassia fistula* L., Caesalpiniaceae (Leguminosae), a semi-wild Indian Labernum (also known as the Golden Shower), is distributed in various countries including Asia, South Africa, Mexico, China, West Indies, East Africa and Brazil. It is an ornamental tree with beautiful bunches of yellow flowers (Duraipandiyan and Ignacimuthu, 2007). As there are many climatic condition in India so as climatic condition varied, percentage of phytoconstituents also varied in same plant. Uttarakhand state of India is popular for its climatic diversity. A number of medicinal plants are cultivated in Uttarkhand region. *Cassia fistula* is one of the medicinally valued plant belonging to Caesalpiniaceae family habited also in Haridwar region. *Cassia fistula* is a moderate size deciduous tree, leaflets 8 to 12 pair, flowers yellow, long drooping racemes, pod cylindrical and pulpy, seeds light brown, hard shiny (Stephen). A rare study is done on the mature bark mainly by the exhaustive and sequentially technique. Also no work is reported specially for Haridwar region. So, this work present the different phyto constituents extracted successively by different solvent on increasing order of polarity and their antimicrobial activity specially from Haridwar region .

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Material and Methods

Plant Material:- Mature bark of *Cassia fistula* were collected from Haridwar locality in month of February 2011. The taxonomic identity of plant was confirmed by the Botanical Survey of India, (BSI), 192 Kaulagarh road, Dehradun. Two set of plant herbarium is deposited in Botanical Survey of India, Northern regional centre, Dehradun (BSD) in which one set of authenticated voucher specimens **Acc. No. – 113637** is received and deposit in the department of chemistry, Gurukul Kangri Vishwavidyalya, Haridwar, Uttarkhand. The mature bark was shade dried and grinded in to powder form in pestle mortar and stored in polybag until further uses.

Extraction of plant material :- 200 g of crushed bark of *Cassia fistula* were extracted sequentially and successively with solvent in increasing order of polarity as petroleum ether (40-60°C), Benzene, Acetone are concentrated at reduced pressure using

rotary vacuum evaporator. After concentration, solvent free extracts and were sealed in bottle and kept in refrigerator for phytochemical and anti-microbial screening.

Preliminary phytochemical screening:- The phytoconstituents present in different extract were analysed by using standard qualitative method (Kokate *et al*. 2006 and Harborne, 1984).

Antimicrobial study

Used bacterial strain: **-** Four bacterial strain were used in this work in which two were gram negative and two were gram positive human pathogenic bacterial strains. The test microorganisms used for present work are *Escherichia coli (***ATCC 433),** *Bacillus cereus* **(ATCC 11778),** *Bacillus licheniformis* **(ATCC 1483)** and *Salmonella typhi* **(ATCC 733)**. All the stock cultures in pure form were collected from S.G.R.R.I.T.S department of Life Sciences, Dehradun. All the bacterial strain were identified by standard methods.

Bacterial culture media and inoculums: **-** Muller Hinton Agar (Hi-Media Pvt. Ltd., Bombay, India) is used to grow the culture of these test bacteria's. 30 g of Muller Hinton Agar was weighed out and dissolved in 800ml of distilled water in a conical flask and pH of the solution is maintained in between 4.5 to 5.5. This flask is kept in autoclave at 121°C for 15 minute. Muller Hinton Agar was poured on sterilized four petriplates and spreaded out. All these process were carried out in a laminar air flow. All the plates were kept in B.O.D. incubator at 37°C for culture growth for 24 hours. Culture is diluted in sterile normal saline solution and the turbidity of the suspension is adjusted equivalent to a 0.5 McFarland standard by adding more bacterial strain, so as to obtain the cell suspension between 10^5 to10^8 CFU/ml.

Preparation of test extract for microbial screening: - The solvent free extract of *Cassia fistula* bark is dissolved in 0.5 ml of sterilized and filtered DMSO (filtered with whatman filter of pore size 0.45 micron) to prepare a test solution of extract of desired concentration for microbial screening.

Antimicrobial assay: **-** The determination of antibacterial screening of different extract of *Cassia fistula* bark is carried out by agar well diffusion technique (Adeniyi *et al*.1996). Ofloxacin drug is used to as a standard drug.

Results and Discussion

***Yield of different extracts*:-** After complete extraction the extract is concentrated which gave yield and consistency of different extract. Table No. 1 shows the % yield (w/w) of different extract of bark of *Cassia fistula.* The percentage yield is in small amount in Petroleum extract i.e. small concentrations of phytoconstituents are present in petroleum ether extract. In the same way appreciable amount of phytoconstituents are present in acetone extract which shows higher value.

Table No. 1:- The percentage yield, colour and physical state of concentrated different extract of *Cassia fistula* bark.

Extracts	Weight of sample (gm)	Weight of extract (gm)	w/w % yield	Colour	Consistency
Petroleum ether	200	0.9	0.45	Yellowish	Waxy
Benzene	200	1.1	0.55	Yellowish	Waxy
Acetone	200	13.2	6.6	Reddish brown	Crystalline

Preliminary Phytochemical Screening: **-** The preliminary phytochemical investigation is carried out by their different test or specific test in each extract of *Cassia fistula* bark which show the bioactive secondary metabolic constituent as in Table no. 2. Acetone extract gave excellent result of different phytoconstituents while petroleum ether and benzene extract show comparatively moderate result. Steroid, carbohydrate, proteins, phenolic compound and tannin, cardiac glycosides are present in appreciable amount in acetone extract.Inulin are present in all extract while aleurone grains, amino acid, flavanol glycosides, gums and mucilage, naphthoquinones are absent.

Antimicrobial Screening

In this study microbial screening was also performed by the different extract of *Cassia fistula* bark against selected microorganism in which two Gram negative and two Gram positive human pathogenic microorganism were used to test its resistance activity.The screening performs excellent results against these bacterial strains.The zone of inhibition justify that this plant exhibited antimicrobial activity. The activity in terms of zone of inhibition is noted from petriplates and are presented in Table No. 3. The acetone extract exhibits the maximum zone of inhibition against *Bacillus cereus.*

Petroleum ether and Benzene extracts are weekly effective against bacterial strain. Fig No. 1 shows graphical representation of zone of inhibition of different extract of *Cassia fistula* bark against the selected human pathogens.

Table No. : - 2 The phytochemical tests are performed for the Petroleum ether, Benzene and Acetone extract.

Phytoconstituents and Test performed			**Extracts**		
			Petroleum ether	**Benzene**	**Acetone**
1. Aleurone grains			-	-	-
2. Alkaloids	*Mayer's Test*		-	-	-
	Wagner's Test		-	-	-
	Hager's Test		+	+	+
	Tannic acid Test		+	+	++
3. Carbohydrate	*Molisch's Test*		+	+	+
	Fehling's Test		-	+	+++
	Benedict's Test		-	-	+++
	Selivanoff's Test		-	-	-
4. Glycosides	***Anthraquinone glycosides***	*Borntrager's Test*	-	-	-
		Test for Hydroxy-anthraquinones	-	-	+
	Cardiac glycosides	*Keller-Killiani Test*	-	-	-
		Legal's Test	-	-	+++
		Baljet's Test	-	-	_
	Saponin glycosides	*Froth formation Test*	-	-	+
	Flavanol glycosides	*Mg and HCl reduction*	-	-	-
5. Inulin			+	+	++

6. Protein	*Heat Test*	-	-	-
	Biuret Test	-	-	+
	Xanthoproteic Test	-	-	+++
7. Amino Acid	*Ninhydrin Test*	-	-	-
8. Steroids and Triterpenoids	*Salkowski Test*	-	-	+++(s)
9. Fixed oils and Fats	*Spot Test*	+	+	-
	Saponification Test	-	-	-
10. Flavonoids	*Shinoda Test*	-	-	++
	Alkaline reagent Test	-	-	++
	Zinc hydrochloride Test	-	-	-
11. Phenolic compounds and Tannins	*Lead Acetate Test*	-	-	+++
	Ferric chloride Test	-	-	+++
	Test for Catechin	-	-	-
	Test for Chlorogenic acid	-	-	-
12. Gums and Mucilage		-	-	-
13. Naphthoquinone	*Juglone Test*	-	-	-
	Dam-Karrer Test	-	-	-

(s) = Steroids, (+++) = Appreciable amount, (++) = Moderate amount, (-) = Absence

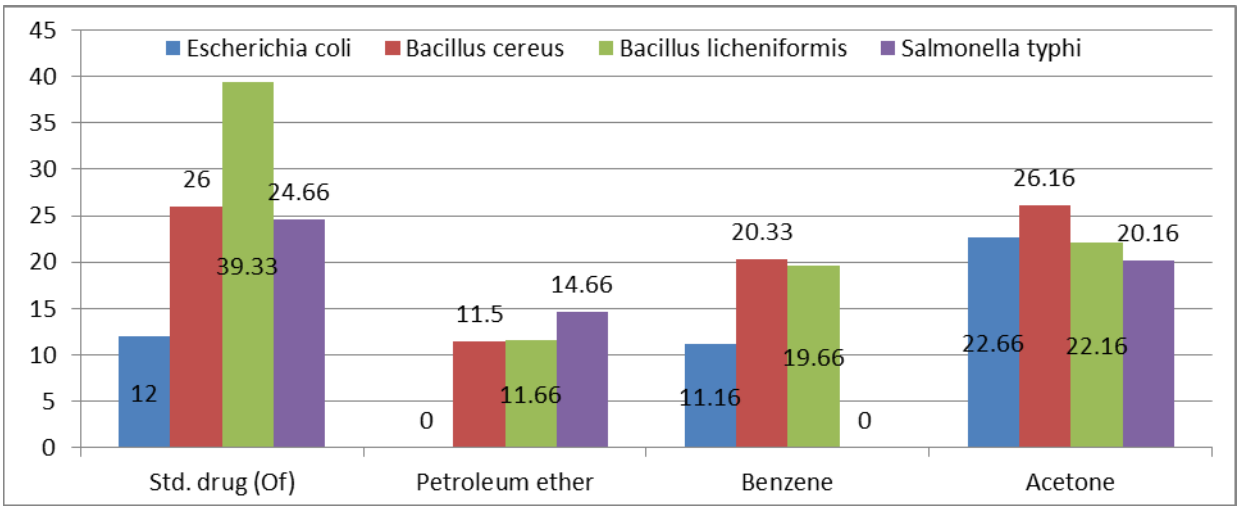
Table No. 3:- Antimicrobial investigation of different extract of *Cassia fistula* bark against selected microorganism. All the values are mean zone of inhibition ± SD

Bacterial strain	**Zone of inhibition in mm. (Mean ± SD)**			
	Std. drug (Of)	Petroleum ether	Benzene	Acetone
Escherichia coli	12 ± 1.00	-	11.16 ±1.04	22.66 ± 1.52
Bacillus cereus	26 ± 1.00	11.5 ± 1.32	20.3 ± 1.52	26.16 ± 0.76
Bacillus licheniformis	39.33 ± 1.15	11.66 ± 1.52	19.66 ± 1.52	22.16 ± 1.25
Salmonella typhi	24.66 ± 1.52	14.66 ± 2.51	-	20.16 ± 1.75

(-) = no zone of inhibition, Std. drug (Of) = Standard control drug Ofloxacin

A number of allopathic drugs are used to prevent the infection against human and animal pathogenic bacteria which are also having their side effects. The demand of herbal medicine shows that plant medicines are the part of human life which have no side effects. As Indian rural population are completely depending upon herbal medicine for their primary health care. The world health organization estimates that plant extract or their active constituents are used as folk medicine in traditional therapies of 80% of the world population. Over the years, the World Health Organization advocated that countries should interact with traditional medicine with a view to identifying and exploiting aspects that provide safe and effective remedies for ailments of both microbial and non-microbial origins (World Health Organization, 1978).

Fig. no.: - 1 Graphical representation of extracts against selected bacterial strains



In the present study the *Cassia fistula* bark against acetone extract showed excellent zone of inhibition for tested bacteria. The microbial activity of the *Cassia fistula* was due to the presence of various secondary metabolites (Nayan, 2011). Table No. 2 shows that a number of secondary metabolites are present in acetone extract as carbohydrate, cardiac glycosides, Inulin, protein, steroids, flavonoids, phenolic compounds and tannins which are responsible for their microbial activity. In recent years there has been a resurgence of scientific interest in the use of medicinal plants for the development of new phannacotherapeutic agents against different species of microorganisms including the resistance organisms (Hatano, 1999 and Palombo, 2002). Natural products of higher plants may give a new source of antimicrobial agents with possibly novel mechanisms of action (Runyoro, 2006 and Shahidi, 2004). Plants are rich in a wide variety of secondary metabolites such as tannins, terpenoids, alkaloids, flavonoids, glycosides etc, which have been found *in vitro* to have antimicrobial properties (Dahanukar, 2000 and Cowan, 1999).The above study confirms that a number of phytoconstituents in appreciable amount are present in acetone extract which may be responsible for their antimicrobial activity. Most of the phytoconstituents are hydrophilic in promising extract. Finally further researches on plant derived antimicrobials are needed so as to determine the identity of that particular compound in this plant by different technique and also to determine their full spectrum.

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Fungal disease complex in Balsam plant-A new record from Uttar Pradesh

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Abstract

During survey for foliicolus fungi in Bahraich the authors noted a fungal disease complex in Balsam plants *Impatiens balsamina* (L.) Balsaminaceae.The plants were found suffering from black stem rot as well as the same plant was infected with blight and powdery mildew of leaves. Microscopic examination of infected samples and cultural studies reveals that black stem rot was caused by *Fusarium oxysporum* whereas blight and powdery mildew was caused by *Rhizoctonia solani* and *Cercospora* sp.respectively.

Keywords:*Disease complex, Balsam plant, foliicolus fungi*

Introduction

Impatiens balsamina (**L.**) family-Balsaminaceae locally known as Gulmehndi is a very popular rainy season ornamental and ethnomedicinal plant. During survey for foliicolus fungi, author noticed the infection of aforesaid plants. The plants were suffering from black stem rot and the leaves of same plants showed two distinct symptoms. The infected specimens were collected and gone through for the detailed study for the disease symptoms as well as causal organism.

Material and Methods

Collected disease samples were brought to the laboratory. The laboratory processing for fungus were done by scrap mount, collodion, squash and hand cut section preparation. The causal organism were isolated on PDA medium supplemented with antibiotic and incubated for 6 days at 25±0°C after pouring serial dilution of 1 ml sample following (Ruinen 1961; Kanaujia 1972). For identification of fungi, a thorough survey of literature was done by going through different mycological papers, mycological memories and other relevant mycological monographs viz., Illustrated Genera of Imperfect Fungi, A manual of Soil fungi, DematiaceousHyphomycetes and the Genus Fusarium.

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Pathogenicity test was also done for the isolated pathogens as described by McCallum and Tekauz (2002).

Results and Discussion

The infected plants showed lesions on stem which begin as spherical, black water soaked spots (1.0-1.5 cm), which enlarged, coalesced and encircled around the stem and later turn black in colour. Symptoms of the fungus became apparent as the disease progressed. Black growth appeared on the outside of the stem with one-third area of the stem attacked. The progress of the disease was so rapid that the infeted spots collapsed completely after 7 days. Plants infected at the basal part of the stem exhibited dark black collapsed lesion that led to breakage of plant stem tissues become rotted.

Leaves of the same plant showed blight disease. The infection started from apex and developed inwards in the form of light brown water soaked areas. In advanced stages it become dark brown. Infected parts of leaf get brittle and curved inward.

Another symptoms which the leaves showed was powdery mildew. Leaves showed white, superficial colonies on both sides. Colonies showed heavy sporulation in form of thick white powdery mass. Infected tissue becomes distorted.Microscopic examination of the infected samples and morphological characters of culture of the isolated pathogens and consultation of monographs reveals that the stem rot is caused by *Fusarium oxysporum* whereas blight is caused by *Rhizoctonia solani*. The

leaves showing powdery mildew symptoms were due to the presence of *Cercospora* sp. Pathogenicity test by spray method was positive.

Screening of available literature reveals that the balsam black stem rot as well as leaf blight caused by *Fusarium oxysporum* and *Rhizoctonia solani* respectively is a new record because the same has not been reported hither to either from Bahraich or Uttar Pradesh.

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Aloe vera extract characterization and its protection against fenvalerate induced toxicity in *Heteropneustes fossilis*

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Abstract

Pesticides constitute the important group of environmental pollutants since they are potent metabolic inhibitor. It is gradually being recognized that by use of natural herbs and herbal preparations in aquaculture we can deal with pesticidal problems. The present study aimed to evaluate the characterization of ethanolic extract of *Aloe vera* (*A.vera*) by IR , SEM and to investigate its immunomodulatory, antidiabetic and anticholesterol activity in *H. fossilis* after giving sublethal doses of fenvalerate. As blood is patho-physiological indicator, this study was performed to begin an assessment of the effect of fenvalerate on biochemistry of blood serum. In present study three sublethal doses of fenvalerate [0.25, 0.50 and 0.75 (p.p.m)] were given to test fish, *H. fossilis* for 15 days. After 15 days same fishes were given *A.vera*leafextract [(*A.vera* A) 250, (*A.vera* B) 500 and (*A.vera* C) 1000 (mg/kg of body wt.)] for 30 days to find its protection after intoxication of fenvalerate. Fenvalerate found harmfull in all the three doses and *A.vera* was protective against doses of fenvalerate.

Keywords*: Aloe vera, blood, fenvalerate, heteropneustesfossilis, infrared spectroscopy, SEM*

Introduction

On one hand technological improvement improved quality of life, on the other hand it has created a number of hazards. One of the main effects of the application of pesticides and herbicides in agriculture is the pollution of aquifers (Anderson, 1982) because the pesticide is carried by irrigation water or rain along the soil profile (leaching).Fenvalerate is an insecticide that has been in use since 1976. It is a mixture of four optical isomers which h*A.vera*e different insecticidal activities. It is an ester of 2-(4-chlorophenyl)-3-methylbutyric acid and alpha-cyano-3-phenoxybenzyl alcohol,but lacks a cyclopropane ring. However, in terms of its insecticidalbeh*A.vera*iour, it belongs to the pyrethroid insecticides. It is most commonly used to control insects in food, feed, and cotton products, and for the control of flies and ticks in barns and stables.Several workers observed the effects of fenvalerate in invertebrates and vertebrates**.**

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Bradburyand Coats (1982) noticed effects of fenvalerate in brain and liver of bobwhite quail (*Colinus virginianus*). It also has harmful effects on protein metabolism (Reddyand Bashamohideen, 1988) and blood of *Cyprinus carpio*(Reddy *et al*., 2006).Ill effects by its deposition in lamb tissues were emphasized elaborately by Wszolek *et al*. (1981a).

Toxic chemicals discharged in environment gets into food chain and by entering into biological system they disturbed biochemical processes leading to health abnormalities. So it is very essential to develop uses some natural plant or animal products in aquaculture to minimize the contamination and also can be used to control various diseases.

A.vera is widely distributed Liliaceae plant in tropical regions and its le *A.vera*, fresh juice, pulp, root are used for medicinal purpose. Several herbal preparations that can enhance the body's immune status are extensively being used in the indigenous system of medicines (Pittman, 1992) and also have been investigated for its antioxidant property.Khan, and Haleem (2006) noticed its protective effects on lindane induced hepatotoxicity and genotoxicity. Many studies were also carried out to investigate

the hypoglycemic effect of some plants used traditionally to treat diabetes beside identification of active ingredients, mode of action and safety (Grover *et al*., 2002). Can, *et al*, (2004) saw effect of *A.vera* leaf gel and pulp extracts on the liver in type-II diabetic rat models.Also synthetic hypoglycemic drugs cannot fully control glucose level as well as cause side effects prompting the patients stop taking the medication, *A.vera*is claimed to reduce blood glucose level and improve immune system against infection without toxicity(Ghannam and Kingston, 1986).

A clinical trial in diabetes mellitus patients has been done by Bunyapraphatsara *et al*. (1996)to observe antidiabetic activity of *A.vera*.Increased cholesterol level is also problem today as it causes heart and kidney diseases also medication are not fully worked. *A. vera* has positive effects on cholesterol control (Joshi and Dixit, 1986). Therefore, the present study was conducted to investigate the immunomodulatory,hypoglycemic and anticholesterol activity of an *A.vera e*xtract after toxicity of fenvalerate in *H. fossilis.*

Material and Methods

Le *A.vera*es of *A.vera* werewashed, epidermis was selectively removed and pulp in the center of the leaf was separated and homogenized and further extracted with 500 ml of ethyl alcohal. The filtrate was collected and evaporated to dryness under reduced pressure in a rotary evaporator. The residue was stored in dry sterilized containers at 4 ^{o} until further used.Characterisation of *A.vera* has been done to observe the characteristic properties by Infrared Spectroscopy (IR) and Scanning Electron Microcope (SEM) in UGC-DAE, Atomic Research Centre, Devi AhilyaVishw*A.vera*idyalaya (D*A.VERA*V), Indore, [M.P], India.Live and healthy *H. fossilis* were collected from pond near santer near (MHOW). The fishes of *A.vera*erage length 23$\pm$ 3 and weight 100$\pm$10 gm were used. Brought them in laboratory, washed with 1% KMnO4 sollution for 5 minutes. After acclimatization of 15 days, 36 fishes were selected for experiment, irrespective of their sex. Prior to experiment, toxicity tests were conducted to determine the LC50 and safe concentration values of fenvalerate for 96 hours. The physico-chemical analysis of water was done according to standard methods published by A.P.H.A (1992).-Four aquarium were used, three of fenvalerate and fourth was of control group. Three different doses of fenvalerate in acetone as 0.25 p.p.m 0.50 p.p.m and 0.75 p.p.m were given to 9 fishes per acquaria for 15 days. Both control and treated fishes were sacrificed at time intervals and blood was collected serving caudal peduncle using a sharp knife. Blood was used for calculating W.B.C. Count by the *Neubauer* hemocytometer and serum was separated from the formed elements through the centrifugation at 3000 rpm for 15 minutes for Glucose estimation by GOD-POD method of Trinder.-Herbal extract doses for fishes were given by mixing with fish food, fenvalerate treated fishes were cured by three different does of *A.vera* as [(*A.vera* A) 250, (*A.vera* B) 500 and (*A.vera* C) 1000 (mg/kg of body wt.)] for 30 days in three separate acquaria.Both parameters were again taken to observe the therapeutic effects of *A.vera.*

Results and Discussion

Results of the analysis are given in table no. 1-4 while IR and SEM are dipicted in figures 2-9.Table 1 shows results of Fenvalerate intoxication and (Table 2, 3 and 4) *A.vera* treatment. WBC count decreased after administration of fenvalerate but increased after *A.vera* treatment, glucose values decreased as concentration of fenvalerate increased and continuous decrease in all values were observed to greater extent after *A.vera* treatment. Decrease in cholesterol after *A.vera* treatment noticed after fluctuations in fenvalerate doses in treated group.Health and disease are parameters of the effectiveness with which human and animals alike adapt to their environments. The herbals occupied a distinct place in life right from the primitive period till today. Recent upsurge in identifying non-dietary natural products associated with high degree of safety margin in cancer and hepatoprotective agents has been hailed by many investigators to be practically beneficial when the carcinogenic or hepatotoxic insult is mild to moderate. Our environment abound with lots of substances which can induce diseases include foodstuff, house whole chemicals, pesticides, industrial and agro-chemicals etc. This has made the screening of such chemicals necessary in order to monitor the degree of human exposure and how their in vivo toxic effects may be caused and prevented by use of animal or plant products. It is gradually being recognized that only by use of

natural herbs and herbal preparations in aquaculture we can deal with these problems. Treatments of bacterial diseases with various herbs *A.vera*e been safely used widely in organic agriculture, veterinary and human medicine (Direkbusarakom, S. 2004).

Table 1: Effect of three doses of fenvalerate [0.25, 0.50 and 0.75 (p.p.m)] for 15 days

Parameters	**Control**	**0.25 p.p.m**	**0.50 p.p.m**	**0.75 p.p.m**
WBC count (per cumm)	4.800	3.130	2.980	1.990
Glucose (mg/dl)	48.5	36.4	29.7	24
Cholesterol (mg/dl)	210	303	198	240.2

Table 2:Effects of *A.vera* extract as [(*A.vera* A) 250, (*A.vera* B) 500 and (*A.vera* C) 1000 (mg/kg of body wt.)] for 30 days after 15 days Fenvalerate intoxication (0.25 p.p.m).

Parameters	**Control**	**Fen (0.25)**	***A.vera* (A)**	***A.vera* (B)**	***A.vera* (C)**
WBC Count (percumm)	4.80	3.130	3.74	4.440	5.680
Glucose (mg/dl)	48.5	36.4	32.2	27.4	25.1
Cholesterol (mg/dl)	210	303	198	195	191

Table 3:Effects of *A.vera* extract as [(*A.vera* A) 250, (*A.vera* B) 500 and (*A.vera* C) 1000 (mg/kg of body wt.)] for 30 days after 15 days Fenvalerate intoxication (0. 50 p.p.m).

Parameters	Control	Fen (0.50)	*A.vera* (A)	*A.vera* (B)	*A.vera* (C)
WBC Count (percumm)	4.800	2.980	4.530	4.970	5.790
Glucose (mg/dl)	48.5	29.7	26.4	22.1	19.3
Cholesterol (mg/dl)	210	198	195	192	188

Table 4:Effects of *A.vera* extract as [(*A.vera* A) 250, (*A.vera* B) 500 and (*A.vera* C) 1000 (mg/kg of body wt.)] for 30 days after 15 days Fenvalerate intoxication (0.75 p.p.m).

Parameters	Control	Fen (0.75)	*A.vera* (A)	*A.vera* (B)	*A.vera* (C)
WBC Count (percumm)	4.800	1.990	2.680	4.990	6.840
Glucose (mg/dl)	48.5	24	22	19.7	18.2
Cholesterol (mg/dl)	210	240.2	222	304	182

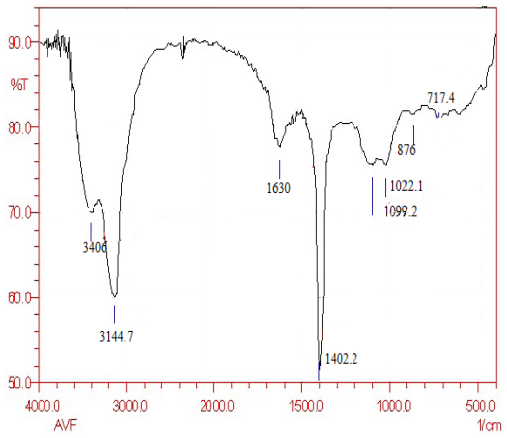

Fig.1: IR Spectroscopy results of*A.vera*h*A.vera*ing peak values in certain regions.

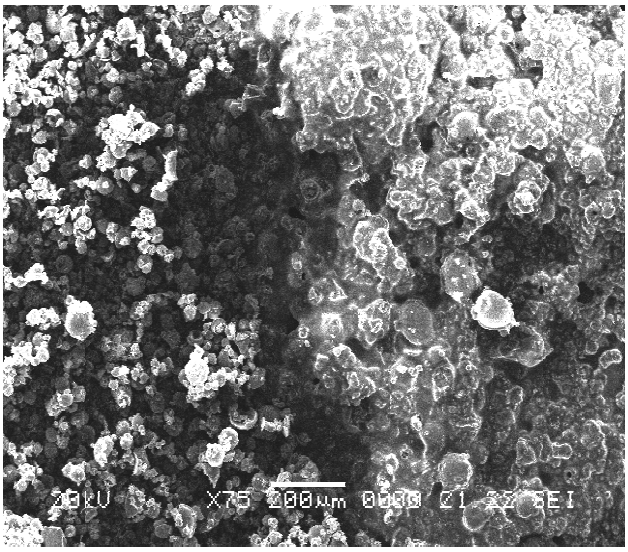

Fig. 2

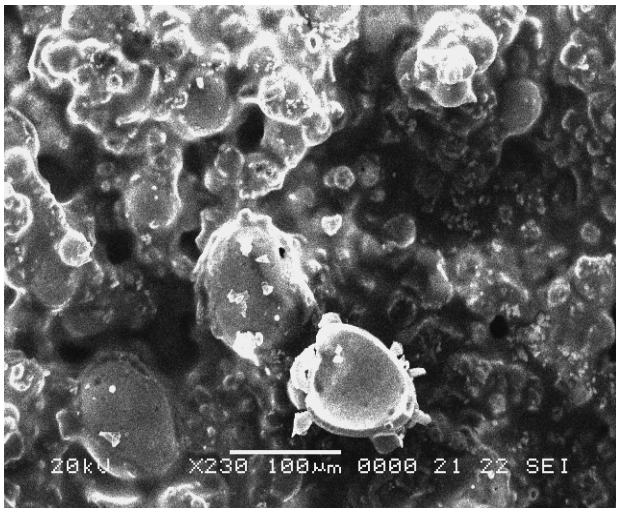

Fig. 3

Fig. 4

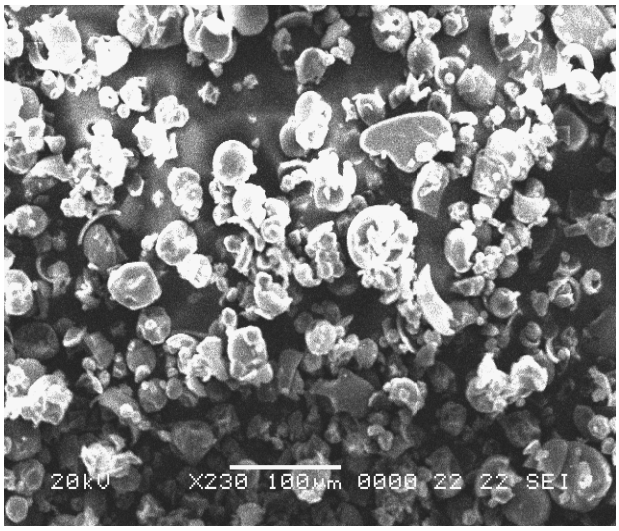

Fig. 5

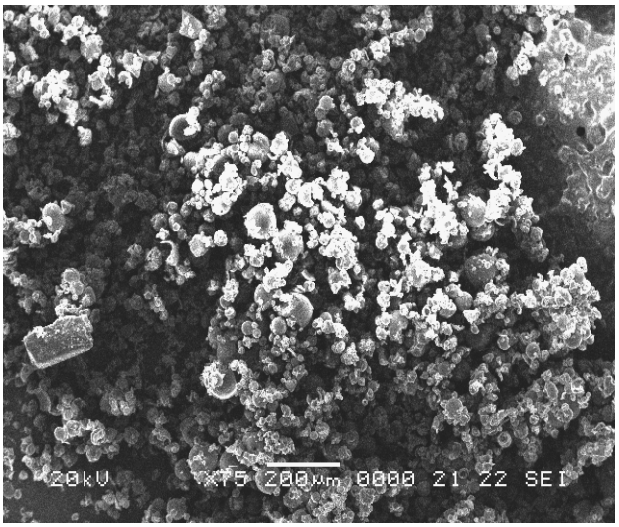

Fig. 6

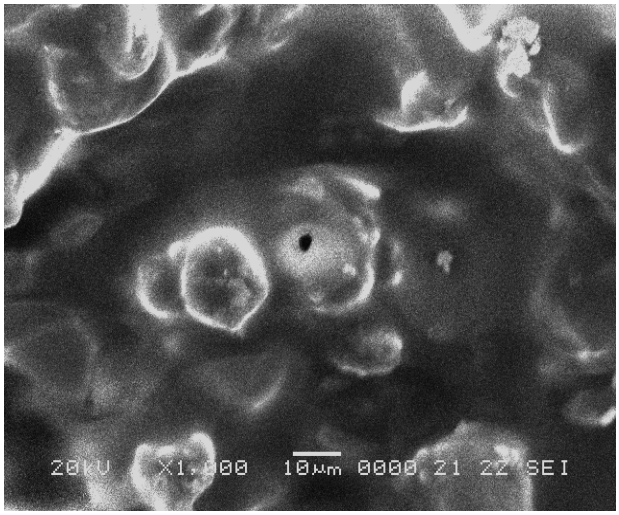

Fig.7

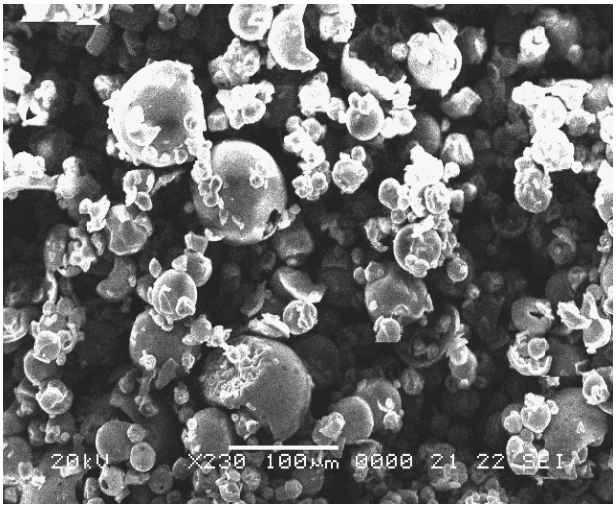

Fig. 8

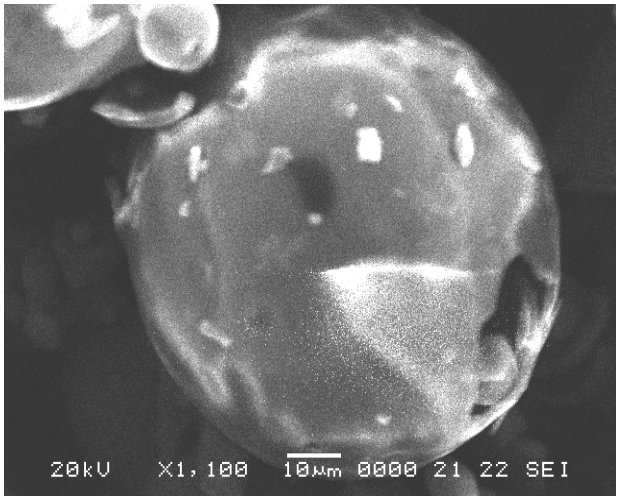

Fig. 9

Fig. 2-9 shows SEM structure of *A.vera.*

Infrared spectroscopy exploits the fact that molecules absorb specific frequencies that are characteristic of their structure. These absorptions are resonant frequencies, i.e. the frequency of the absorbed radiation matches the frequency of the bond or group that vibrates. Peak values of IR absorption pattern showed that *A.vera* contained phenolic –OH (alcoholic) and C=O (carbonyl) functional groups. The absorbtion pattern at 3406 and 3144.7 confirm the presence of OH functional group and at 1630, C=O is confirmed.SEM shows irregular and permeable round structure of *A.vera*that helps in react actively due to cell breaking with particle size range in between 50-700 nm.Decreased W.B.C Count due to fenvalerate concentration may be due to hypochromic microcytic anaemia lead to weak immune system. The present experiments revealed that *A.vera* extract has immuno-stimulatory action, stimulates the proliferation of stem cells as increased number of W.B.C found after *A.vera* treatment. *A.vera* is used as an adjuvant in conditions of immunodeficiency in cancer and to a limited extent in acquired immunodeficiency syndrome. Aloe contains a D-isomer polysaccharide called Acemannan which interjects itself into all cell membranes results in an increase in the fluidity and permeability of themembrane allowing toxins to flow out and nutrients to enter the cell results inimproved cellular metabolism throughout the body and an overall boost in energy production. Acemannan also has direct effects on the cells of the immune system, activating and stimulating macrophages, monocytes, antibodies and T-cells and act as ant-leukamic agent (Sheets. *et al* 1991). It has been shown in laboratory studies to act as a bridge between foreign proteins and macrophages, facilitating phagocytosis (Stepanva *et al*.1977). This receptor site activation is a key component in boosting cell-mediated immunity which is deficient in HIV infection. A mixture of amino acids derived from Aloe enhanced the depressed phagocytic function of the white blood cells (Yagi , 1987). Alexin B, a specific molecule species derived from Aloe, was shown to possess anti-cancer activity against lymphocytic leukemia. (Suzuki, 1979)Additional investigations revealed that another molecular species derived from Aloe, Aloctin-A, had anti-tumor activity, but the action was to bolster the immune system rather than a direct anti-tumor activity (Imanishi *et al*., 1981). Whatever the cause, low immunity and low white blood cell counts prevent the body from being able to h*A.vera*e an optimum response to infections and illness.In present investigation, decreased level of glucose (hypoglycemia) in fenvalerate treated fishes may be due to acute stress reaction , severe pancreatic and liver diseases or adreno cortical deficiency.*A.vera*doses also decreases the glucose but effect of *A.vera*ethanolic extract on glucose level is positive.Theantihyperglycaemic activity of *A.vera*was associated with an increase in plasma insulin, suggesting that the antihyperglycaemic activity of *A. vera* could be due to an insulinogenic activity of the extract. The increased levels of insulin observed in the present study indicate that the *A.vera*extract stimulates insulin secretion from the remnant b-cells and/or from regenerated b-cells. It increase carbohydrate utilization or enhancement of glucose uptake by muscles and increase activity of insulin secreting pancreatic B. cells as *A.vera* be h *A.vera*es like insulin. So when destruction of B. cells of islet of pancreas causes diabetes mellitus, *A.vera* is boon to reduce glucose. Fenvaleratetreatment results in cholesterol fluctuation. Decrease in cholesterol was due to its utilization to cope with energy demand to compensate the effect of toxicological stress. 60-80% of the total cholesterol is in esterified form. As esterification occur mainly in liver, the proportion of esterified cholesterol (so as total cholesterol) decrease in parenchymatous liver disease. According to Gupta (1974) cause of

hypocholesterolaemia was intestinal obstruction and of hypercholesterolaemia according to (Murrey, 1990) wasdue to impairment of liver and inhibition of enzymes, which converts cholesterol into bile acid. *A.vera* helps in lowering of cholesterol. Hypercholesterolemia commonly associated with coronary heart disease is correlated with an increase in the plasma LDL-cholesterol and a decrease in HDL- cholesterol concentration. Reduction in serum cholesterol caused by administration of *A.vera* can be attributed to a reduction in LDL+VLDL–cholesterol(that choke-heart). *A.vera* administration also increased the serum HDL-cholesterol (good cholesterol) ratio which is associated with a reduced incidence of atherosclerosis in humans (Joshi and Dixit, 1983). It thus seems to be an interesting agent which could be of use in the treatment of hypercholesterolemia. It improves and rebalance the quality of the blood and also contains B-sitosterol, which blocks cholesterol absorption in the body.

Conclusion

During investigations to modify the chemical structures of natural pyrethrins, a certain number of synthetic pyrethroids were produced with improved physical and chemical properties and greater biological activity.When pesticides enter aquatic systems, the environmental costs will be high. At times, pesticides are solely blamed for fish kills; however, in many cases, the indirect effects of pesticides, such as causing dissolved oxygen depletion, are the reason for the kill. Unintentional pesticide-related fish kills occur in India. Minimizing such contamination is possible by adjusting the maximum dose of pesticide and prior using a pesticide. Farmer should use pesticide only when necessary, wes should try to use less toxic pesticides. Human beings can be cured by various remedies but this is not possible in fishes due to speeking difference. Indirectly pesticides are taken by human beings by eating fishes as food.

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A list of ethno-medicinally important trees of Ramnagar forest division in Kumaon

Shikha Pant

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Abstract

The present study deals with ethno-medicinal uses of trees in the Ramnagar forest Division of Kumaon. The study records 50 species of tree belong to 25 different families are used to cure different ailments by the local people. The currently accepted botanical name, family, local names, parts used and the medicinal uses of those parts are given.

Keywords:*Ailments, bhabar, ethno-medicine, kumaon, Ramnagar, traditional*

Introduction

Ramnagar Forest Division is an important forest division in Kumaon region of western circle of the forests of Uttarakhand. It is located between 28˚52' and 29˚27' 15'' N latitude and 78˚46'15" and 79˚33' E longitude covering an area of 3944.33sq. km. The forest area is about 60 km long and 10km broad, ranging in altitude from 300m to 1100m above the sea level. It mostly occupies the Bhabar area with low Siwalik hills in some parts. Bhabar is a waterless area composed of bed of boulders and conglomerates. The area has a wide variety in its vegetation. The Sal forests are dominant in the area. Some deciduous species are associates with Sal forest. These deciduous riverian forest of *Dalbergia sissoo*and *Acacia catechu* on sandy and gravelly deposits along the rivers and streams. Deciduous miscellaneous forests of riverian type also occur in the area. Composed of many different species including *Mallotus philippinensis*, *Bombax ceiba*, *Haldina cordifolia*, *Lagerstromi aparviflora*, *Holarrhena pubescens*, *Cassia fistula* etc.

These forests constitute an integral part of social life of the local people and tribes as they entirely or partly depend on these forests. These people depend on forest plants, especially on trees for various uses (*viz.* - food, fodder, fuel, and medicine).

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They have names in their own dialect and identification practice for every tree and rely on the medicinal uses of these plants because of their effectiveness and for negligible side effects. An attempt has been made to enlist the ethno-medicinal uses of some important trees of the area.

As the review of literature shows that a lot of research work have been done for the systematic of the higher altitudinal region of Kumaon *i.e.* (Watson, 1882), (Duthie, 1903-1929), (Champion, 1923), (Osmaston, 1927), (Gupta, 1962-1968) and (Jain, 1977-1996). Also a good number of worker have contributed a lot to the ethno-botany of higher region i.e. (Shah, 1971-1980), (Kalakoti and Pangtey, 1988), (Pangtey and Samant, 1989), (Uniyal, 1997), (Pande,1984) (Pande and Joshi, 1996-1999), (Joshi 1993). But a little (Pant, 1976) has been done for the lower altitudinal area. So, the present study is a step to fill up that lacuna.

Material and Methods

Theextensive field surveys were organized during the period of 2007-2009 for collecting the plant specimen and the area was frequently surveyed. Several attempts were made for collection/ study in different seasons. The work was conducted among the local people, local vaidyas, priests, villages heads, local tribes, farmers and middle aged women's to know their local name and local uses, because they have been using these plants for ages in their day to day life to cure different ailments. During survey the information gathered on the basis of prepared questionnaire viz., local name, mode of

preparation, medicinal parts and parts used etc. Standard methods were followed for the collection of plant materials, mounting, preparation and preservation of plant species (Jain & Rao, 1978).
The preliminary identification was done with the help of manuals and floras and later confirmed after matching with the authentic specimens present in the herbaria of Northern Circle of Botanical Survey of India, Dehradun (BSD) and Forest Research Institute, Dehradun (DD). Out of these an alphabetical list including the plant name, local name, family, parts used and medicinal uses were also made (Table 1).

Results and Disscussion

The present study records 50 species of ethno-medicinally important trees belongs to 25 families. Among the documented medicinal species, the family Moraceae was most frequently represented with a total of (5 species), followed by Combretaceae and Caesalpiniaceae with (4 species each), Mimosaceae, Fabaceae, Apocynaceae, Meliaceae and Euphorbiaceae (3 species each), Verbenaceae, Rubiaceae, Anacardiaceae and Rhamnaceae, Lauraceae (2 species each); besides these 12 families (1 species each) were found to be used by the local communities for medicinal purposes. The species are arranged in alphabetical order followed by the local name, family, parts used and the medicinal uses of those parts (Table 1). While on the basis of plant parts used by the local people, it was observed that the leaves of 21 species, roots of 15 species, Bark of 28 species, fruits of 13 species, Seeds of 7 species, flowers of 3 species and gum, latex, whole plant and leaf bud of 1 species each were used to cure different ailments (Fig. 1). The most widely used remedies are derived from bark followed by leaves and root indicates that these parts have strong medicinal properties. Regarding different disease categories, the majority of species are related to diarrhea, dysentery, skin disease, cough, cold, fever, piles, constipation, urinary troubles and body aches.

The present study has been designed to explore the ethno-medicinal significance of the trees of this region. The traditional knowledge about the these plant has been transmitted orally from one generation to other for centuries is becoming extinct, due to change in traditional culture or introduction of modern knowledge. Hence these traditional practices need proper documentation and along with documentation these plant species also need protection and conservation as they are depleting day by day due to various socio human activities and changes in the climate.

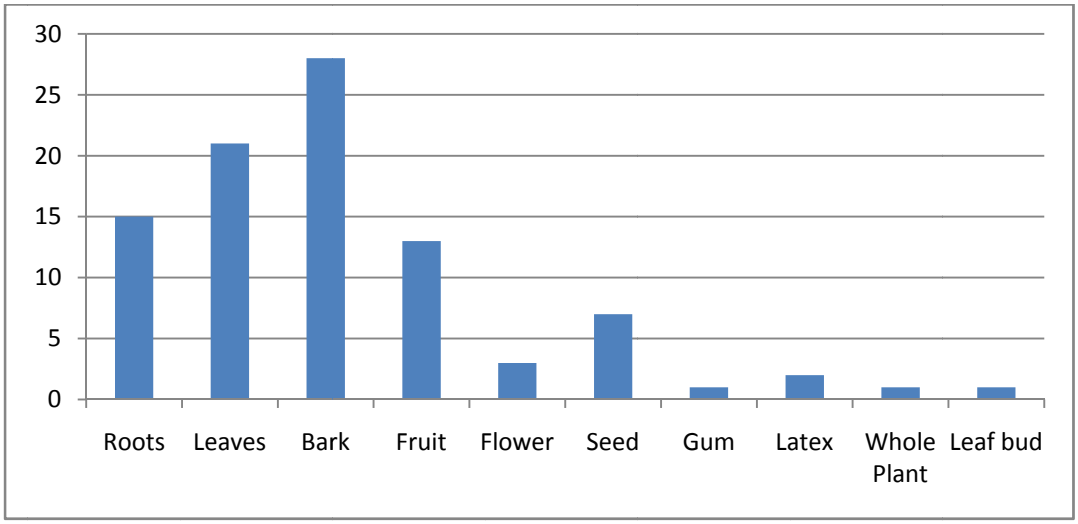
Table 1: List of Ethno-Medicinally Important Trees and Their Uses

S. No	Botanical Name	Local Name	Family	Parts used	Uses
1.	*Acacia nilotica*(L.) Willd. ex Del.	Babul	Mimosaceae	Leaves and Root	Leaves are used to cure diarrhea and bruised leaves are poultice and used to treat ulcers. Roots are used to cure tuberculosis also said to cure impotence.
2.	*Acacia leucophloea*(Roxb.) Willd.	Kikar	Fabaceae	Root bark	Root bark with water used to cure diarrhea, dysentery, wounds and skin diseases.
3.	*Acacia farnesiana*(L.) Willd.	Kachraud	Mimosaceae	Leaves, Bark, Flowers and Root	Roots chewed to treat sore throat. Decoction of Bark with ginger used as astringent wash for teeth and for bleeding piles. Bruised leaves with water given for gonorrhea and lotion made from leaves are used for skin diseases.
4.	*Aegle marmelos* (L.) Corr.	Bel	Rutaceae	Leaf and Fruit	Leaves and unripe fruit decoction of the plant is taken for diarrhea, cholera and jaundice.
5.	*Ailanthus excelsa* Roxb.	Gokul	Simaroubaceae	Bark	Used to cure dysentery.

6.	*Alstonia scholaris* (L.) R.Br.	Chitvan	Apocynaceae	Bark and Latex	Decoction of bark is used to cure diarrhea and malaria. The latex is applied to cure ulcers and also for the skin diseases.
7.	*Azadirachta indica*A.Juss.	Neem	Meliaceae	Leaves, Flowers and Seeds	Used as an anti bacterial and antiviral; Cures skin infections.
8.	*Albizia lebbeck* L.	Kalasiris	Mimosaceae	Stem Bark	Used to cure various allergic conditions and skin diseases.
9.	*Bauhinia purpurea* L.	Khairwaal	Caesalpiniaceae	Root and Bark	Decoction prepared from roots given for abdominal disorders. Bark used for diarrhea and gall bladder stone.
10.	*Bauhinia variegata*L.	Kachnar	Caesalpiniaceae	Root and Flowers	Roots used for diarrhea and dysentery. Fresh flowers used to treat high blood pressure.
11.	*Bombax ceiba* L.	Semal	Bombacaceae	Root, Leaves and Bark	Paste of leaves is used over wound. Crushed root extract soup is given for pneumonia and women diseases. Decoction of stem bark is useful in diarrhea.
12.	*Butea monosperma* (Lam.) Taub.	Dhak	Fabaceae	Bark, Leaf and Seeds	Used in night blindness, cures piles and dysentery.
13.	*Broussoneti apapyrifera* (L.) Vent.	Paper malwari	Moraceae	Bark, Fruits and Leaves	Leaf juice is used in dysentery and for skin diseases. Fruit is used for stomachache.
14.	*Bischofia javanica*Blume.	Paanisemal	Euphorbiaceae	Leaves	Leaves juice is used for sores.
15.	*Cassia fistula* L.	Amaltas	Caesalpiniaceae	Root, Fruit and Seeds	Fruit pulp is used in constipation. Powder of seeds is used in abdominal pain.
16.	*Cinnamom umtamala*(Buch.-Ham.) Nees&Eberm.	Tejpatta	Lauraceae	Leaf, Bark	Bark is used in gonorrhea. Leaves used as stimulant, carminative and useful in colic, diarrhea and for diabetes.
17.	*Casearia tomentosa*Roxb.	Chilla	Flacourtiaceae	Root	Decoction of root is given for diabetes.
18.	*Dalbergia sissoo*Roxb.	Shisham	Fabaceae	Root	Decoction of root is useful in diarrhea.
19.	*Ficus benghalensis* L	Bargad	Moraceae	Leaf Bud	Used to treat leprosy.
20.	*Ficus glomerata*Roxb.	Gular	Moraceae	Stem bark	Extract of stem bark with water is used to cure diarrhea.
21.	*Ficus religiosa* L.	Peepal	Moraceae	Leaves, Bark, Seeds, Fruit, Latex and Root	Leaves are useful for bleeding wounds, constipation, dysentery, boils and mumps. Fruit is used to treat dehydration. Roots are useful for the treatment of. Gout. Bark is used to heal wounds and for jaundice.
22.	*Gmelina arborea*Roxb.	Kamhaar	Verbenaceae	Root, Fruits and Leaves	Paste of leaves is used for headache. Roots are used to cure sexual debility in males and for habitual abortion in females. Fruits are used in dysentery.
23.	*Gardenia turgida*Roxb.	Thanela	Rubiaceae	Fruits	Fruits are used to cure dysentery and diarrhea.
24.	*Haldina cordifolia*(Roxb.) Ridsdale	Haldu	Rubiaceae	Bark	Bark is used as antiseptic to heal wounds.
25.	*Holarrhena pubescens*(Buch.-Ham.) Wall. ex G. Don	Kuda	Apocynaceae	Bark and Seed	Decoction of bark is used in amoebic dysentery and diarrhea and also useful in piles.
26.	*Holoptelea integrifolia*(Roxb.) Planch.	Kanju	Ulmaceae	Bark and Seed, Leaves	Bark is used for rheumatism. Paste of seed and bark is used for treating ringworm.Bark and leaves are used to cure diabetes, leprosy and other skin diseases.
27.	*Kydiaca lycina*Roxb.	Pula, Patta	Malvaceae	Leaves	Paste of leaves is applied in body pains and also for skin diseases.

28.	*Litsea chinensis*Lam.	Maida	Lauraceae	Bark	Paste of bark is used for sprains, bruises and rheumatic and gouty joints. Powdered bark, with honey is prescribed internally in sprains, fractures, rheumatic affections and in sciatica.
29.	*Lager stroemia parviflora*Roxb.	Dhauri	Lythraceae	Leaves	Leaves are useful to control blood pressure, urinary dysfunctions and also in the treatment of diarrhea.
30.	*Madhuca indica*J.F. Gmel.	Mahuwa	Sapotaceae	Bark	Bark is used to cures ulcers and bleeding gums.
31.	*Mallotus philippinensis*(Lam.) Muell.-Arg.	Rohini	Euphorbiaceae	Fruits	Powder of ripe fruit is mixed with ghee to cure wounds and it is adapted for the expulsion of tape worm.
32.	*Mangifera indica*L.	Aam	Anacardiaceae	Bark and Leaves	Extract of bark is used to cure diarrhea. 2-3 drops of fresh leaf juice is used in earache.
33.	*Meliaazedarach*L.	Bachain	Meliaceae	Root	Paste of root is applied on headache.
34.	*Nyctanthes arbor-tristis*L.	Harsingar	Oleaceae	Leaves	Decoction of leaves is used to cure sciatica.
35.	*Oroxylum indicum*(L) Vent.	Arlu	Bignoniaceae	Bark, Fruits and Seeds	Bark is used in diarrheaand dysentery. It stimulates igestion, cures fevers, cough andother respiratory disorders.
36.	*Phyllanthus emblica*L.	Amala	Euphorbiaceae	Bark and Fruit	Cures blood dysentery, hair falling, piles anemia. Very useful for pregnant ladies before and after delivery.
37.	*Spondia spinnata*Kurz.	Jungliaam	Anacardiaceae	Dried fruits, Leaves and Bark	Juice of leaves is used in earache. Bark is used to cure diarrhea and dysentery. Fruits are given for ulcers and burning sensation
38.	*Shorea robusta*Gaertn.	Sal	Dipterocarpaceae	Whole Plant	Used in healing wounds and cures chest pain.
39.	*Syzygium cumini*(L.) skeels.	Jamun	Myrtaceae	Bark	Extract of bark is used to cure diarrhea.
40.	*Terminalia alata* Heyna ex Roth.	Sain	Combretaceae	Bark	Bark is used in diarrhea and dysentery.
41.	*Terminalia chebula Retz.*	Harad,Haritaki	Combretaceae	Bark, Fruit and Root	Used as disinfectant; cures diarrhea and skin diseases. Roots boiled with water used to check abortion or miscarriage.
42.	*Terminalia arjuna Roxb. ex DC.*	Arjun	Combretaceae	Bark and Leaves	Leaves are used as a cover for sores and ulcers. Juice of fresh leaf is used in earache. Bark is used in heart diseases as cardiac tonic.
43.	*Terminalia bellirica* (Gaertn.) Roxb.	Bahera	Combretaceae	Fruits	It is used for headache, leucorrhoea, liver diseases and gastrointestinal problems.
44.	*Tamarindus indica*L.	Imli	Caesalpiniaceae	Bark, Leaf and Fruit	Used in diarrhea, asthma, ulcers and in urinary problems.
45.	*Trema orientalis* (L.) Blume.	Jivanti	Moraceae	Leaf	Cures epilepsy and blood flow to urine.
46.	*Tectona grandis*L. f.	Sagon	Verbenaceae	Bark	Decoction of bark is useful in diarrhea.
47.	*Toona ciliata*Roem.	Tun	Meliaceae	Gum	Gum obtained from bark is used to cure fever and diarrhea
48.	*Wrightia tomentosa*Roem. &Schult.	Indrajaw	Apocynaceae	Bark, Leaves and Root	Bark is used as anti-dysenteric and for menstrual disorders. Leaf and root is used for toothache and fever.
49.	*Ziziphus jujuba Lam.*	Ber	Rhamnaceae	Root	Powder of root is used to cure dysentery.
50.	*Ziziphus nummularia*W.&A.	Kathber	Rhamnaceae	Root	Powder of root is used to cure diarrhea.

Fig. 1:Plant partwise Ethno-medicinal Uses



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Nutrient dynamics in relation to discharge of sewage in Winganga River water at Pauni, District Bhandara (M.S.), India

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Abstract

The significant sources of organic pollution enhance nutrient contents in the river water. Nitrogen, phosphorous and silicates play very important role in the biological activities of aquatic environments, such as the abundance of vegetation and faunal status. The Wainganga river water at Pauni town is analyzed for nutrient concentrations their inputs and rate of assimilation by organisms. Phosphate concentration ranged from 0.91 mg/l to 2.29 mg/l, ammonia nitrogen ranged from 0.32mg/l to 1.48 mg/l , nitrate nitrogen ranged from-, nitrite from 2.88 mg/l to 7.64 mg/l.

Keywords*:Phosphate, Nitrates, Oxygen, river water*

Introduction

Dissolved nutrients in water play a very important role in the metabolism of aquatic fauna. Nutrients in a lotic system originate from the geological and metrological pathways. In addition to it the sources of organic pollution in the water bodies' builds major nutrient input system in to the running waters. In natural waters phosphorus occurs principally as inorganic orthophosphate. During summer, the phosphate split in to two parts. In the waters biological activity is intense resulting in depletion of orthophosphate phosphorus. However, the deeper water gain phosphate, as phosphate is richly present in detritus falls and is decomposed by bacteria. In water phosphorus occurs in a numerous forms such as particulate form, active phosphate, orthophosphate and organic phosphates in both soluble and insoluble fractions. In polluted water bodies the organic phosphates plays main role in the biological activities.Though the less concentration of phosphorus is one of the important nutrients limiting growth of autotrophs and so biological productivity of the system. Phosphorous as such is not harmful to the organisms. The quality criterion for phosphorus in water is only to Check nuisance growths of algae and process of eutrophication, (Balls *et al.*, 1996).

Nitrogen forms a major constituent of atmosphere. It occurs I small amount in water due to low solubility of molecular nitrogen in biosynthesis. Beside this nitrogen is also found in small quantity in water, in bounded forms such as ammonia, nitrates, nitrites and organic nitrogen such as urea, amino acids, nucleic acids etc. Nitrate is the most highly oxidized form of nitrogen compound, commonly present in natural waters, because it is the product of nitrogenous organic matter. (Ajmal, 1985).Ammonia is liberated in the water as an end product of decomposition of nitrogenous organic matter and also as an excretory product of some aquatic animals. Domestic wastes are generally rich in nitrogenous organic matter. Many industrial effluents add to the ammonia load in water, resulting in toxic levels at certain times. The ammonia released by bacterial action o0n organic matter may be used by plants directly to produce plant proteins. The excess of ammonia released is oxidized by autotrophic nitrifying bacteria, which convert ammonia to nitrites under aerobic conditions.

Material and Methods

The river water is continuously polluted mainly due to human activities on the bank of river and input of domestic sewage. Though the activities are limited

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at any one specific spot, the pollution caused does not remain confined to the spot, but contaminates whole stretch of river. In view of various domestic activities and drainage points of municipal channels in the river, four stations are selected. Station S1 is located far away from the localities of the town and considered to be pollution free, while station S1, S2 and S3 receives the pollutants in river water. The all parameters are performed with the standard methods given by NEERI, (1986).

Results and Discussion

Ammonia

Biological degradation of organic matter results in to the production of ammonia in river water. However, during winter, the reduced activities of nitrifying bacteria due to low temperature of water, causes max values of ammonia in water. In the months of rainy season, the large quantity of water in river basin dilutes the biodegradable wastes' hence the lower values are recorded,(Muller & Kirchesch, 1990).The data recorded during the summer reveals that the concentration of biodegradable organic matter in river water is more in summer. High tempt of water enhance the decomposition activities of microbes. On the other hand activity of nitrifying bacteria also increased due to increased tempt. of water in summer, which converts the ammonia in to inorganic nitrogen and causes the reduction of values on some extent.Anaerobic decomposition of bottom organic matter and dissolved organic matter by microbial population and increased activities of denitrifying bacteria in the lower temperature of river water during winter increase the values of ammonia and hence the max values were obtained in winter, (Bandela *et al*, 1999).High tempt of water dissociates the most of ammonia dissolved in water in summer thus ammonia evolved find its way to atmosphere. Hence the lower level of ammonia is recorded in the summer as compared to the values obtained in winter.Municipal discharge at station S2 and S4, domestic activities performed by localities at station S3 and S4 and discharge ofdecaying leaves and flowers from temples and dead bodies contributes the organic matter in river water. However, the sewage discharge at station S2 showed the impact of pollution at station S3 due to less distance between these stations.The max permissible level of ammonia in water for domestic use is 0.5 Mg /l. in Wainganga river water it is well above the permissible level.

Phosphates

Phosphates and nitrates are the contents of domestic sewage. Present study of Wainganga river water reveals that the concentration of phosphate is maximum in the month of summer and winter, while minimum during the rainy season. The municipal sewage, domestic wastes and temple wastes constitutes the source of organic matter in the river water and enhance the microbial activities. It leads in to the concentration of phosphates.,Koshy and Nayar, (2000) has recorded similar findings.The domestic activities on the bank of river by locality, results in to the increase of phosphate concentration. In river basin farming the use of cow and pig dung manure during summer season pollute the river and constitute the sources of phosphate in river water at station S2 and S3, (Verga *et al.*, 1990).During winter season the lower level of phosphate may attribute to abundance of phytoplankton in river water.

Assimilation of phosphates by phytoplankton population is responsible for the decrease in the level of phosphate in winter. In the months of rainy season dilution of pollutants lowers the concentration of phosphates. At station S4 increases the concentration of phosphates. The phosphate concentration in Wainganga river increase from upstream station S1 to down stream station S4.

The permissible potability level of phosphates led down by WHO is 0.1 Mg/l in the present investigation it is observed that the phosphate level is above the permissible limit.

Nitrates

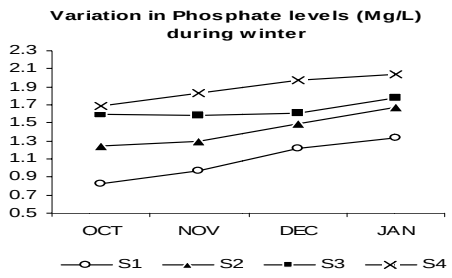
As a result of present study it is concluded that the concentration of nitrate remains maximum during summer season and minimum during rainy season, (Sharma & Pande, 1998). The pertinacious organic matter present in the sewage and other wastes, on decomposition result in to the formation of ammonia. The increased activity of nitrifyingbacteria in a high temp of river water causes the increase inthe values of nitrates during summer season, (Rath *et al.*, 2000). Due to discharge of sewage and domestic wastes and less flow of water in the river results in to the turbidity. This may influence some extent to the

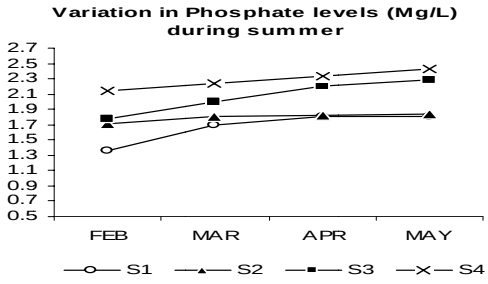
photosynthetic activities of up take of nutrients by phytoplankton.The abundance of phytoplankton population and activities of denitrifying bacteria causes the lower values of nitrates during winter. Subsequently the relatively more quantity of water in river in the months of winter dilutes the pollutants to some extent and the decreased activities of microbes in lower temp of water are the reasons of decreased levels of nitrate in river water.

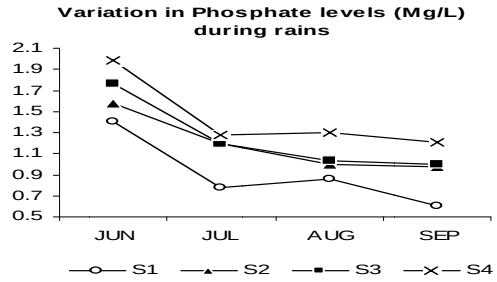
Similarly during rainy season dilution of sewage and wastes in more quantity of river in the flooded water decrease the level of nitrates.Since there is no significant source of pollutants at upstream station the nitrate concentration is min at these stations. In Wainganga water the concentration of nitrates increased from up stream station to down stream station with increasing load of pollutants. At station S4 many sources of organic pollutants leads to increase the levels of nitrates.

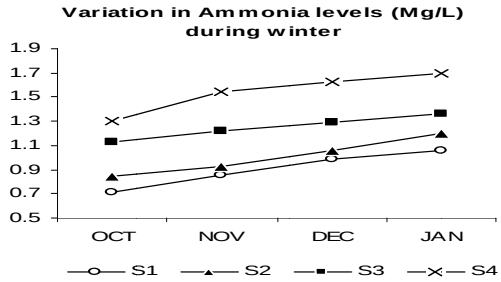
Table: 1 : Mean values of nutrient and Dissolve gases concentration in Wainganga river

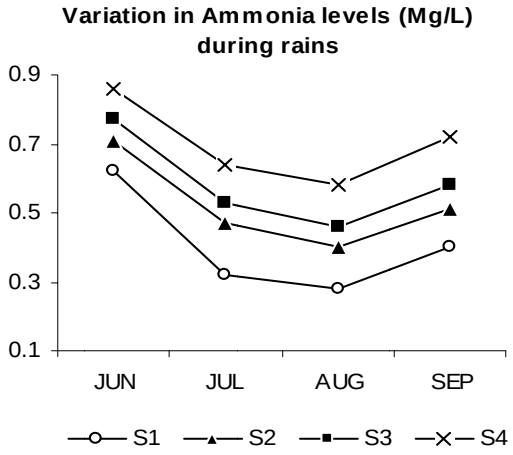
		S1	S2	S3	S4
Phosphates	Summer	1.66 ± 0.41	1.8 ± 0.31	2.07 ± 0.2	2.29 ± 0.31
	Winter	1.09 ± 0.17	1.43 ± 0.29	1.64 ± 0.21	1.89 ± 0.31
	Rains	0.91 ± 0.38	1.13 ± 0.2	1.25 ± 0.3	1.44 ± 0.35
Ammonia	Summer	0.5 ± 0.06	0.63 ± 0.04	0.75 ± 0.04	0.91 ± 0.07
	Winter	0.84 ± 0.05	0.95 ± 0.06	1.28 ± 0.13	1.48 ± 0.12
	Rains	0.32 ± 0.03	0.45 ± 0.02	0.5 ± 0.06	0.58 ± 0.05
Nitrates	Summer	3.31 ± 0.26	7.08 ± 0.42	7.29 ± 0.73	7.64 ± 0.66
	Winter	2.97 ± 0.28	6.12 ± 0.36	6.49 ± 0.78	6.55 ± 0.83
	Rains	2.88 ± 0.25	5.03 ± 0.36	5.2 ± 0.4	5.32 ± 0.45
D.O.	Summer	5.23 ± 0.34	4.9 ± 0.54	3.95 ± 0.61	3.63 ± 0.46
	Winter	7.93 ± 0.25	6.1 ± 0.3	5.0 ± 0.23	4.7 ± 0.48
	Rains	5.78 ± 0.3	5.05 ± 1.1	4.55 ± 0.52	4.38 ± 0.48
CO_2	Summer	9.14 ± 0.86	14.37 ± 1.1	16.24 ± 1.4	22.97 ± 2.6
	Winter	7.77 ± 1.3	10.21 ± 1.9	14.8 ± 2.24	21.1 ± 1.99
	Rains	3.75 ± 1.1	5.69 ± 0.69	11.97 ±1	19.7 ± 1.12

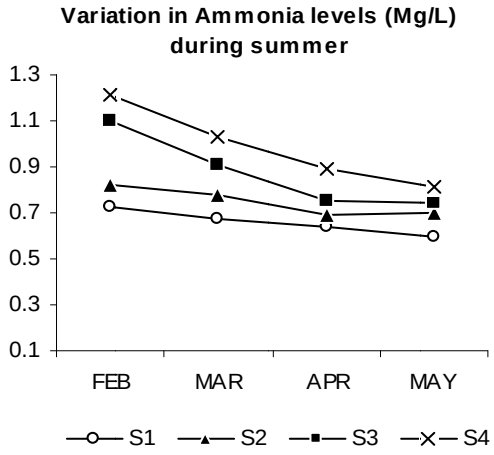


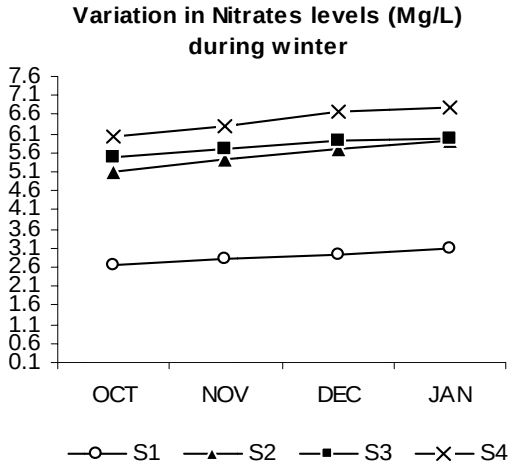


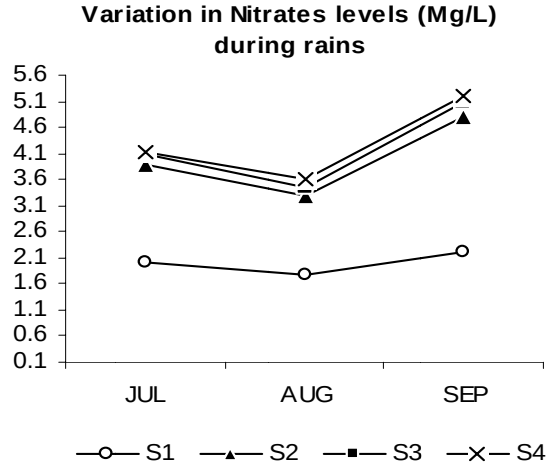


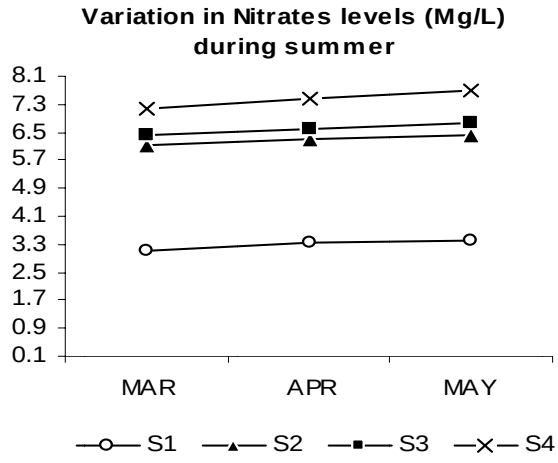












Since there is no significant source of pollutants at upstream station the nitrate concentration is min at these stations. In Wainganga water the concentration of nitrates increased from up stream station to down stream station with increasing load of pollutants. At station S4 many sources of organic pollutants leads to increase the levels of nitrates.

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Abstracted and Indexed

Studies on flora and faunal diversity in Hirekalgudda state forest, Arasikere, Hassan, Karnataka, India

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Abstract

The present study is an attempt to enumerate the flora and fauna distributed in selected areas of Hirekalgudda state forest near Arasikeretaluk situated in the northern region of Hassan district of Karnataka state. A field survey of the study areas was carried out to document the flora and fauna accruing in that area. 201 plant species belonging to 71 families have been reported. With regard to species diversity, trees are represented by 76 forms, followed by shrubs (70 forms), herbs (45 forms), twinners (5 forms) and climbers (5 forms). Ten endangered and 36 medicinal plants were recorded. Twenty five faunal species were identified in the study areas. The study was undertaken to observe and record the diversity of plants and animal fauna of this area.

Keywords:*Biodiversity, fauna, flora, Hassan, Hirekalgudda state forest,*

Introduction

Biological diversity is an entity, which encircles different types of animals and plants. Biodiversity is not consistent across the earth. It is consistently rich in the tropics and it is less rich in polar regions where conditions support much less biomass (Philomena *et al*. 2011). A complex relationship exists among the different diversity levels. Rapid environmental changes typically cause extinctions (Drummond and Strimmer, 2001). Biodiversity is the resource upon which families, communities, nations and future generations depend. It is the link between all organisms on earth, binding each in to an interdependent ecosystem, in which all species have their role. Put simply, reduced biodiversity means millions of people face a future where food supplies are more vulnerable to pests and disease, and where freshwater is in irregular or short supply.Biodiversity has declined by more than a quarter in the last 35 years.In general terms, population growth and over consumption are the reasons for this enormous loss. Specifically, habitat destruction and wildlife trade are the major causes of population decline in species.

Biodiversity conservation is the protection, preservation and management of wildlife and natural resources such as forests and water. Through the conservation of biodiversity the survival of many species and habitats which are threatened due to human activities can be ensured (Kannaiyan and Gopalan, 2007). In-situ biodiversity conservation includes the conservation of habitats, species and ecosystems where naturally occur. The conservation of element of biodiversity out of the context of their natural habitats is referred to as ex-situ biodiversity conservation.The study was undertaken to observe and record the diversity of plants and animal fauna of Hirekalgudda state forest of Arasikeretaluk of Hassan district of Karnataka state.

Study area: The study area Hirekalgudda state forest is located away from Arasikeretaluk of Hassan district. It lies between 15^0 6' to 76^0 75' Eastern latitude and 13' 4^0 to 13' 5^0 northern latitude. This forest consists of a mass of rocky hills raising more or less 3100 mt. above the surrounding area. The study area is divided in to 6 forest beats for the convenience of administration as shown in Table-1.

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Material and Methods

The survey was initiated in August 2005 and carried out till the end of August 2007. The survey of the biodiversity was undertaken with active coo-operation of officials of the forest department. Pre-survey discussions were held with the forest officials and available information was collected.

During the period of investigation quadrate methods were used for analyzing the vegetation. Quadrate of 10 mt. X 10 mt. was placed in each forest beat. The plant specimens were collected after drying. The herbarium sheets were prepared and identified (Diwakar and Sharma, 2000; Naik, 1998; Sharma *et al*., 1996; Singh *et al*., 2001). The authenticity of the identified plant specimens were checked by referring the recent monographs and through comparison with authentic herbarium specimens at Madras Herbarium, Botanical survey of India, Sri Krishnadevaraya University Herbarium, Anantapur (SKU), Regional Research Centre, Bangalore (RRCBI) and Manasagangotri, Mysore(MGM).

During the study period, direct observation of animals could not be carried to the expected level. However, the presence of animals could be made out using pugmarks, faecal matter and non decaying body parts of the dead animals. The forest officials who are familiar with these evidences helped in identifying the animals from these indirect evidences.

Table-1: Name of the beats

S No.	Name of the beats	No. of Hectares
1	Tirupathi Beat (TB)	356.91
2	Jajur Beat (JB)	390.00
3	Puralehalli Beat (PB)	488.56
4	Jannavara Beat (JnB)	401.07
5	Nagapuri Beat (NB)	3561.28
6	Aggunda Beat (AB)	408.00

Source -Forest office Arasikere

Results and Discussion

Floral composition

The present investigation deals with the floristic composition of Hirekalgudda state forest located in the northern region of the Arasikeretaluk of Hassan district. The studied forest is rich with different species of herbs, shrubs and trees.

A total of 201 plant species are recorded which come under 71 families, out of which 66 families are dicotyledons and 5 families belonging to monocotyledons (Table-2). Species habitat diversity showed a maximum of trees (76), followed by shrubs (70), herbs (45), twinners (5) and climbers (5). Relative abundance of flora showed maximum of Caesalpinaceae (6.467%) followed by Apocynaceae (6.407%), Papilionaceae (4.477%), Asclepidaceae (3.980), Mimoceae (3.980%), Verbenaceae (3.980) and Rubiaceae (3.482%). Out of 71 families, 33 families were represented by a single species each (0.497).

Widely distributed Caesalpiniaceae members include, *Tamarindus indica, Bauhinia variegate, Cassia absus, Cassia auriculata, Cassia fistula, Cassia siamea, Cassia sophera, Cassia suffruticosa, Cassia tora, Pterolobiumh exapetalum, Bauhinia malabarica and Delonix regia.* Among the generic form Cassia is represented by 07 species namely *Cassia absus, C. auriculata, C. fistula, C. Siamea, C. Sophera, C. Suffruticosa* and *C. tora. Ficus* is represented by*Ficus benghalensis, F. racemosa, F. religiosa, F. hispida* and *Ficus exasperate*. *Syzygium includes S. hemisphericum, S. jambus, S. laetum, S. occidentale* and *S. zeylanicum.*

The endangerad flora are represented 10 species in the study area namely *Butea superba, Cappris div aricata, Clematis gouriana, Diospyros sylvatica, Ficus racemosa, Gardenia gummifera, Ipomoea obscura, Rauvolfia serpentine, Vitexal tissima* and*Santalum album.*

As many as 36 medicinal plants have been identified and collected from this area of which the important ones include *Abrus pulchellus, Acacia nilotica, Achyranthes aspera, Adhato davasica, Argemone mexicana, Azadirachta indica, Bauhunia variegata, Calotropis procera, Carissa carandas, Cassia auriculata, Cassia fistula, Clerodendrum inermi, Ocimum americanum, Santalum album,* and *Wrightia tinctoria.*

Table. 2: Distribution of flora in the Hirekalgudda state forest

Sl.No.	Name of the plants/Habit	Families	Name of the Beats/ No. of Species					
Trees			**PB**	**TB**	**JnB**	**JB**	**NB**	**AB**
1.	*Sapindus emarginatus*	Sapindaceae						√
2.	*Anacardium occidentale*	Anacardiaceae		√				
3.	*Mangifera indica*							√
4.	*Semecarpus anacordium*						√	
5.	*Butea monosperma*	Fabaceae						√
6.	*Dalbergia latifolia*				√			
7.	*Saraca asoca*	Caesalpiniaceae		√				
8.	*Tamarindus indica*			√				
9.	*Bouhinia variegate*						√	
10.	*Bauhinia malabarica*			√				
11.	*Cassia fistula*						√	
12.	*Cassia siamea*				√			
13.	*Delonix regia*			√				
14.	*Acacia ferruginea*	Mimosaceae		√				
15.	*Acacia leucophloea*					√		
16.	*Ficus exasperata*					√		
17.	*Acacia nilotica*				√			
18.	*Alibizia lebbeck*						√	
19.	*Dichro stachyscinerea*					√		
20.	*Prosopis juliflora*							√
21.	*Anogeissu slatifolia*	Combertaceae					√	
22.	*Terminalia alata*						√	
23.	*Terminalia bellirica*						√	
24.	*Terminalia chebula*						√	
25.	*Terminalia pamiculata*				√			
26.	*Careya arborea*	Lecythidaceae			√			
27.	*Lagerstromea parviflora*	Lythraceae	√					
28.	*Haldinia cordifolia*	Rubiaceae			√			
29.	*Diospyrosmelonoxylon*		√					
30.	*Diospyros sylvatica*	Ebenaceae					√	
31.	*Diospyros montana*			√				
32.	*Micheliach ampaca*	Magnjoliaceae					√	
33.	*Dillenia pentagyna*	Dilleniaceae						√
34.	*Kidiaca lycina*	Malvaceae	√					
35.	*Thespesia lampas*				√			
36.	*Bombax ceiba*	Bombacaceae			√			
37.	*Salmalia malabarica*		√					
38.	*Sterculia guttata*	Sterculiaceae	√					
39.	*Sterculia villosa*						√	
40.	*Mollotus philippensis*	Euuphorbiaceae			√			
41.	*Helicianil agirica*	Proteaceae			√			
42.	*Aegel marmelos*	Rutaceae					√	
43.	*Atalanta monophylla*				√			
44.	*Limonia acidissima*		√					
45.	*Boswellia serrata*	Burseraceae			√			
46.	*Madhuca indica*	Sapotaceae	√					

47.	*Madhuca longifolia*				√			
48.	*Garuga pinnata*					√		
49.	*Azadirachta indica*	Melliaceae	√					
50.	*Melia dubia*				√			
51.	*Toona ciliate*						√	
52.	*Cochlo spermumreligiosum*	Bixaceae					√	
53.	*Annona reticulate*	Annonaceae	√					
54.	*Alstonia scholaris*	Apocynaceae					√	
55.	*Wrightia arborea*					√		
56.	*Wrightia tinctoria*					√		
57.	*Tecom astans*						√	
58.	*Carallia brachiata*	Bignoniaceae			√			
59.	*Ficus benghalensis*	Moraceae				√		
60.	*Ficus religiosa*						√	
61.	*Ficus hispida*					√		
62.	*Salix tetrasperma*	Salicaceae				√		
63.	*Ficus racemosa*	Moraceae	√					
64.	*Syzygium hemisphericum*	Myrtaceae					√	
65.	*Syzygium jambos*						√	
66.	*Syzygium laetum*		√					
67.	*Syzygium occidenatale*		√					
68.	*Syzygium zeylanicum*		√					
69.	*Olax wightiana*	Olacaceae					√	
70.	*Santalum album*	Santalaceae	√					
71.	*Dendro phthoetrigona*	Loranthaceae	√					
72.	*Tectonagrandis*	Verbenaceae			√			
73.	*Vitex negundo*				√			
74.	*Vitex altissima*				√			
75.	*Dolichandrone atrovirens*	Bignoniaceae			√			
76.	*Trema orientalis*	Ulmaceae					√	
Shrubs								
77.	*Scuti amyrtina*	Rhamnaceae		√				
78.	*Ziziphus mauritian*				√			
79.	*Ziziphus oenoplia*		√					
80.	*Ampelocis sustomentosa*	Vitaceae					√	
81.	*Dodonaea viscose*	Sapindaceae				√		
82.	*Abruspul chellus*	Papilionaceae			√			
83.	*Butea superba*		√					
84.	*Crotalaria retusa*			√				
85.	*Desmodium pulchellum*						√	
86.	*Cassia auriculata*	Caesalpiniaceae		√				
87.	*Cassia sophera*						√	
88.	*Cassia suffruticosa*		√					
89.	*Pterolobiumhexapetaluma*				√			
90.	*Acacia sinuate*	Mimosaceae			√			
91.	*Passiflora foetida*	Passifloraceae					√	
92.	*Opuntia cochenillifera*	Cactaceae					√	
93.	*Opuntia stricta*		√					
94.	*Canthium parviflorum*	Rubiaceae					√	
95.	*Chasaliaophi oxyloides*						√	

96.	*Gardenia gummifera*			√				
97.	*Gardenia latifolia*					√		
98.	*Ixoracoccinia*		√					
99.	*Clematis gouriana*	Ramanculaceae					√	
100.	*Naravelia zeylanica*				√			
101.	*Stephania japonica*	Manispermaceae					√	
102.	*Tinospora cordifolia*			√				
103.	*Cadaba fruticosa*	Capparaceae					√	
104.	*Capparis divaricata*				√			
105.	*Capparis zeylanica*		√					
106.	*Bixa orellana*	Bixaceae	√					
107.	*Abutilon hirtum*	Malvaceae					√	
108.	*Hibiscus aculeatus*						√	
109.	*Helictere sisora*	Sterculiaceae	√					
110.	*Grewia abutilifolia*	Tiliaceae			√			
111.	*Aspidopterys indica*	Malpighiaceae					√	
112.	*Euphorbia antiquorum*	Euphorbiaceae					√	
113.	*Murraya koenigii*	Rutaceae	√					
114.	*Toddalia asiatica*		√					
115.	*Annona squamosa*	Annonaceae	√					
116.	*Carissa carandas*	Apocynaceae	√					
117.	*Ervatamia heyneana*						√	
118.	*Holorrhena pubescens*						√	
119.	*Holorrhenaanti dysenterica*				√			
120.	*Ichnacarpus frutescens*				√			
121.	*Rauvolfia serpentine*				√			
122.	*Nerium indicum*						√	
123.	*Calotropis gigantea*	Asclepiadaceae			√			
124.	*Calotropis procera*				√			
125.	*Cynanchum callialata*		√					
126.	*Sarcestemma acidum*		√					
127.	*Wattakakavo lulubilis*					√		
128.	*Ipomoea Staphylina*	Convolulaceae					√	
129.	*Argyreia nervosa*						√	
130.	*Datura stramonium*	Solanaceae					√	
131.	*Barleria buxifolia*	Acantheceae	√					
132.	*Nilgirianthus heymeamus*					√		
133.	*Rhinacanthus nasutus*							√
134.	*Melies mapimata*	Sabiaceae						√
135.	*Celosia argentea*	Amaranthaceae						√
136.	*Ochna obtusata*	Ochnaceae				√		
137.	*Embelia ribes*	Myrsinaceae				√		
138.	*Ximenia americana*	Olacaceae						√
139.	*Carnona retusa*	Boraginaceae					√	
140.	*Callicarpato mentosa*	Verbenaceae	√					
141.	*Clerodendrum inerme*		√					
142.	*Duranta repens*		√					
143.	*Lantana camara*				√			
144.	*Lantana indica*					√		
145.	*Canthium angustifolium*	Rubiaceae	√					

146.	*Ardisinia*					√		
Herbs								
147.	*Crotalaria calycina*	Papilionaceae		√				
148.	*Crotalaria juncia*			√				
149.	*Cassia absus*	Caesalpiniaceae		√				
150.	*Cassia tora*			√				
151.	*Bergia ammannioides*	Elatinaceae						√
152.	*Mimosa pudica*	Mimosaceae		√				
153.	*Drosera burmannii*	Droseraceae						√
154.	*Trianthem adecandra*	Aizoceae	√					
155.	*Diplocyclo spalmatus*	Cucurbitaceae				√		
156.	*Thalictrumd alzellii*	Rananculaceae	√					
157.	*Cymbopo gonnardus*	Poaceae				√		
158.	*Nelumbo nucifera*	Nelumbonaceae		√				
159.	*Argemone mexicana*	Papaveraceae	√					
160.	*Cleome gynandra*	Capparaceae			√			
161.	*Cleome monophylla*						√	
162.	*Polygala javana*	Polygalaceae					√	
163.	*Polycarpaca corymbosa*	Caryophyllanceae					√	
164.	*Abelmoschus angulosu*	Malvaceae					√	
165.	*Biophyyum sensitivum*	Oxalidaceae	√					
166.	*Oxalis corniculata*						√	
167.	*Acalypham alabarica*	Euphorbiaceae					√	
168.	*Croton bonplandianus*						√	
169.	*Parthenium hysterophrus*	Asteraceae			√			
170.	*Pistia straliotes*	Araceae			√			
171.	*Catharanthus pusillus*	Apocynaceae	√					
172.	*Catharanthus roseus*						√	
173.	*Asclepias curassavica*	Asclepiadaceae				√		
174.	*Canscora decussate*	Gentianaceae					√	
175.	*Canscora perfoliata*						√	
176.	*Ipomoea obscura*	Convolulaceae					√	
177.	*Nicandra physalodes*	Solanaceae					√	
178.	*Cleome viscosa*						√	
179.	*Solanum khasianum*				√			
180.	*Solanum nigrum*				√			
181.	*Withania somnifera*							√
182.	*Adhato davasica*	Acanthaceae						√
183.	*Adhatoda zeylanica*							√
184.	*Ecbolium viride*					√		
185.	*Achyranthes aspera*	Amaranthaceae						√
186.	*Anisochilus carnosus*	Lamiaceae						√
187.	*Ocimum americanum*							√
188.	*Bacopa monnieri*	Scrophulariaceae			√			
189.	*Amischophacelus axillaries*	Commelinaceae	√					
190.	*Amischophacelus culcutta*		√					
191.	*Cyanotis tuberose*						√	
Twinners								
192.	*Dioscorea oppositifolia*	Dioscoreaceae			√			

193.	*Gymnema sylvestrae*	Asclepiadaceae	√					
194.	*Argyreia cuneata*	Convolulaceae					√	
195.	*Aspidoptery scordate*	Malpighiaceae	√					
196.	*Teramnusmollis*	Papilionaceae			√			
Climbers								
197.	*Cissampelo spateiira*	Manispermaceae		√				
198.	*Cycleapeltata*					√		
199.	*Smilax perfoliata*	Smilacaceae					√	
200.	*Hemidesmus indicus*	Asclepiadaceae					√	
201.	*Hiptage benghalensis*	Malpigianaceae					√	

PB-Puralehalli Beat, TB-Thirupathi Beat, JnB-Jannavara Beat, JB-Jajur Beat, NB-Nagapuri Beat, AB-Aggunda Beat

Faunal composition

In the present investigation, 24 species of fauna were identified in their natural habitats (Table-3). However the remaining fauna could not be identified because most of the vertebrates are shy in nature and move away from the vicinity with slightest sound or scent. Thus it is possible to record a few animals by direct observations. The occurrence of most of the fauna were identified through indirect evidences viz., by the presence of pugmarks, patter of disposal of faecal matter, contents of faecal matter and non decaying body parts of dead animals.

Table-3: List of animals recorded from Hirekalgudda state forest

Sl. No.	Common name	Vernacular name	Scientific name	Identification methods
01	Tiger	Huli	Pantheratigris Lin.	Pm + Fr
02	Leopard	Chirathe	Pantherapardus Lin.	Pm + Fr
03	Elephant	Ane	Elephusmaximus Lin.	Pm + Fr
04	Sambar	Kadave	Cervus unicolor Kerr.	Pm + Fr
05	Porcupine	Mulluhandi	Hystrixindica Kerr.	R
06	Jungle cat	Kadubekku	FelischausGuld.	Do
07	Bear	Karadi	Melursusursinus Show.	Pm + Fr
08	Wild dog	Kadunayee	Cuonalpinus Pallas	Pm
09	Langur	Uddabalada	Presbytis entellus Dufresne	Do
10	Squirrel	Alilu	Ratufaindica Var.	Do
11	Indian hare	Mola	LepusnigracolusCuv.	Do + Fr
12	Paddy bird	Kokkare	Ardeacincrea Lin.	Do
13	Peacock	Navilu	Pavocristatus Lin.	Do + Fr
14	Indian myna	Myna	AcridotherestristisVeli.	Do
15	Pigeon	Parivala	Columba liviaBriss.	Do
16	Jungle fowl	Kadukoli	Falco biarmicusTemm.	Do
17	Little cormorant	Neerukage	Phalacrocoraxloiger Lin.	Do
18	Jungle crow	Kadukage	CovusmacrorhynchosDaud.	Do
19	Calotes	Othikatha	Calotesvercicolor Lin.	Do
20	Chameleon	Gosumbe	Chameloncolcaratus Lin.	Do
21	Python	Hebbavu	Python molurusDaud.	Do
22	Naja	Nagarahavu	NajanajaBriss.	Do
23	Flying fox	Bat	PteropusgiganteusCuv.	Do
24	Frog	Kappe	Bufomelanstictus Lin.	Do

Pm-Pugmark, Fr-Faecal remains, Do-Direct observation, Ff-Fallen feathers

Species diversity of fauna showed maximum of Mammalia (12), followed by Avia (7), Reptilia (4) and Amphibia (1). Mammalian species include *Panthera tigris, Panther epardus, Elephus maximus, Hystrix indica, Melursus ursinus and Lepus nigracolus.* Avian

species include *Pavo cristatus*, *Acridotherestristis*, *Falco biarmicus*, *Phalacrocoraxoliger* and *Covus macrorhynchos*.

The present study area is very rich in biodiversity which comprises both lower and higher plants and animals. Now-a-days, biodiversity is under sever ecological stress. Increased human disturbances and encroachment all around the study area by farmers for agricultural activities reduce the biodiversity of the Hirekalgudda state forest.

The concerned authorities should initiate afforestation programs in order to develop green belt in and around the study area. So that lot of greening could be maintained which intern benefits the mankind for ever?

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Physico-chemical and microbial aspects of Mansi Ganga water

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Abstract

Physico-chemical and microbial characteristics of water of Mansi Ganga at Goverdhan (District Mathura) were studied during July 2009 to June 2010. Three sites of the reservoir were selected for sampling. The water was found to be severely polluted. The parameters like pH, BOD, COD and ammonical contents were found to be very high but the microbial population and DO was far below the expected.

Keywords:*Pollution, Pollutants, D.O., B.O.D., C.O.D., Fecal coliform, Effluents, Ammonical contents*.

Introduction

Water is a prime necessity of life. It is used for a number of purposes like drinking, bathing, cooking and disposal of waste and sewage. Due to increasing population,industrialization,urbanization and other developmental activities most of our water bodies such as ponds,lakes, sarovars, rivers and streams have become polluted. Today every water body receives high amount of effluents, sewage and domestic wastes. These pollutants cause degradation of water quality.Mansi Ganga at Goverdhan (Mathura) is a holiest reservoir of 'BrijKshetra'. It has great religious importance. So, it is visited every year by millions of pilgrims from every corner of world and performs various religious activities like 'Snan', Dhyan, 'Parikrima', 'Achmana', 'Darshan', 'Pooja', 'Archana' *etc*. These religious activities make the water of Mansi Ganga polluted. Furthermore, the domestic and industrial effluent from the town is also being drained into it and makes it severely polluted.

Materials and Method

The water sampling was done in the first week of each month in glass bottle with capacity 300 ml. The physico-chemical characters of the water were determined on the spot, with the help of 'Portable water detection kit' (Model no. CK-710, Manu. by 'Century Instruments Pvt. Ltd., Chandigarh).

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The temperature was measured on the spot by using temperature sensitive electrodes of the portable kit. Other parameters were determined in the laboratory. For the estimation of microbial population, the 'Most Probable Number' (MPN) technique was used. The results were compared with standard permitting parameters (APHA, 1992; WHO, 1984). The correlation between physico-chemical and microbial population was also determined by using Karl Pearson's coefficient of correlation method.

Results and Discussion

Temperature is one of the most important physical factors which regulate the natural processes in the environment. It was found in accordance with the seasonal changes. It ranged between 14.2-33.0^{o}C. It was higher in May, June and July and lower during winter months.Turbidity is one of the common ways to measure the extent of pollution. It is generally caused by untreated and un-decomposed organic matter, sewage and industrial waste. It was very high in November, December and June because of the AghoiAshtami, Deepawali and BhaiyaDooj festivals when there is a mass gathering in the town and millions of pilgrims take bath in the Mansi Ganga. It ranged between 124 NTU to 191 NTU. pH is an important valuable indicator, which shows the acidic or alkaline nature of water. The water of Mansi Ganga was found slightly alkaline. It ranged between 7.5 – 8.7. Itshowed positive correlation with all the parameters except the D.O.(Dakshini and

Soni,1979; Khan and Khan, 1985; Singh *et al*., 1988).

Dissolved Oxygen

Oxygen is the important factor that supports the aquatic life. It is equally essential for the decomposition of chemical waste and dead matter. D.O. showed highly fluctuating trend. It was maximum in winter but lower in summer. It ranged between 1.80-11.90 mg/l.

Table1: Physico- chemical parameters of Mansi Ganga

Parameters	Rains				Winters				Summers				Max	Min	Avg
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun			
Temp.	31.0	30.5	27.7	27.3	24.9	19.5	14.2	17.4	22.3	28.0	30.2	33.0	33.0	14.2	25.50
Turbidity	124	151	152	178	191	155	139	151	145	161	149	161	191.0	124.0	154.75
pH	8.3	7.8	7.9	7.9	8.4	8.5	8.5	8.6	8.0	7.5	8.5	8.7	8.7	7.5	8.22
D.O.	1.8	2.5	4.9	4.0	2.1	4.5	8.6	8.9	7.7	11.9	8.6	1.8	11.9	1.8	5.61
B.O.D.	55.0	35.5	34.5	45.5	68.1	35.0	17.2	14.3	28.0	19.2	24.1	52.2	68.1	14.3	35.72
C.O.D.	72.3	44.3	27.9	51.0	62.1	37.9	21.4	16.0	33.3	15.4	17.9	48.8	72.3	15.4	37.36
Ammonia	2.33	1.41	0.91	2.31	3.11	2.74	3.42	3.33	1.90	1.45	2.84	2.01	3.4	0.9	2.31

All parameters are in mg/l except pH, Temp (^oC), and Turbidity (NTU)

BOD is the direct measure of the extent of pollution in the water body. It is the amount of O_2 required by living aquatic organisms for their physiological process and also for bio-degradation. It was found very high in summer and comparatively low in winter. It ranged between 14.30 – 68.10 mg/l.It is the amount of oxygen required for the decomposition of chemical waste. A high value of COD shows a higher accumulation of organic waste in the river. It was found high during summer and low during winter. It was maximum (72.30 mg/l) in the month of June and July (Singh and Gupta, 2003; Shankar *et al*., 1986). Organic nitrogenous matter is destroyed by microbial activity with the production of ammonia. Higher concentration of ammonia shows a high degree of sewage pollution. The values of ammonia exhibited tremendous fluctuations. It ranged between 0.91 – 3.42 mg/l. Ammonia represents the negative trend with the dissolved oxygen. This is due to the fact that ammonia production takes place from non-oxidised accumulated garbage (Sharma *et al*., 1983; Shekhar, 1985).

Total Coliforms and Fecal Coliforms

Coliforms are Gram negative bacteria, which are lactose fermenting, rod shaped and usually inhabit the gastro-intestinal tract. The Coliforms which are present in the fecal waste are called the Fecal Coliforms. Fecal and Non-fecal Coliforms are together called Total Coliforms. A high number of coliforms indicate a high degree of sewagepollution.The highest population of total Coliforms was 93546units/L and thelowest was 12532 units/L. The highest population of Fecal coliforms was 84524 unit/L and lowest was 29745 units/L. Presence of large population indicates a very high degree of fecal pollution. These values

are very high and indicate high pollution in the river. The population of Coliforms exhibited the positive trends with temperature, turbidity, BOD, COD and ammonia but no significant relationship was observed with pH. The reason for the high degree of positive relation with temperature is quite obvious. The temperature causes the accumulation of waste by enhancing the evaporation of water, which promotes the growth of coliforms. The Coliforms represent a strong negative relation with dissolved oxygen probably because, the absence of oxygen leaves the waste untreated which is again favorable for the bacterial growth (Aranzo*et al*., 1998; Doctor *et al*., 1998; Kumaresan and Bhagwati, 1996; Manian*et al*., 1989).

Table1: Physico- chemical parameters of Mansi Ganga

Micro-organism	Rains				Winters				Summers				Max	Min	Avg
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun			
Total coliforms	14121	86265	69524	63125	93546	12532	53265	60121	49213	55214	74556	90102	93546	12532	60132
Fecal coliforms	84524	61254	44564	40125	61254	83589	32789	41587	29745	33546	54912	59451	84524	29745	52278
Euglena	133	121	131	139	141	131	131	117	152	109	95	106	152.0	95.0	125.5
Paramecium	69	89	121	153	132	99	152	105	141	133	114	83	153.0	69.0	115.9
Ulothrix	291	267	274	233	254	298	222	264	271	261	291	307	307.0	222.0	269.4

Euglena is solitary and free living fresh water flagellate. Its body is elongated, tapering and provided with long flagella. The population of *euglena* was found to be ranging between 95 units/L and 152 units/L. The organism exhibited positive relationship with DO. The negative relation was observed with BOD, COD and Ammonia. With pH and hardness no significant relationship could be observed. *Paramecium* is a ciliated protozoan. Its population highest was 153 units/L and lowest was 69 units/L. Its population was high when there was less pollution in river. It showed a strong positive relationship with DO. But a negative trend was noticed with BOD, COD, ammonia and turbidity.*Ulothrix* is a filamentous alga. Broadly the population was as higher as 307 units/L and as lower as 222 units/L.*Ulothrix* represented a positive relationship with BOD, COD, ammonia and turbidity and no significant relationship with temperature and pH.

Summary and Conclusion –

From the above observations it has been concluded that the water of Mansi Ganga is grossly polluted. The use of water may cause skin diseases and gastro-intestinal problems. Remedial measures are required immediately to sustain the good quality of water and to save the life of livestock.

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The histopathological effects of detergent 'Tide' on foot and mantle of the fresh water snail, *Bellamya bengalensis* Lamarck

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Abstract

In this study the fresh water snail (*Bellamyabengalensis*) one of the most abundant gastropod of river Godavari, was investigated to determine the histopathological effects of detergent "Tide" on the foot and mantle under laboratory conditions. The exposure of the snails to sub-lethal concentrations of the detergents resulted in prevalence of desquamation of the epithelial cells, changes in the number of mucocytes, disruption of glandular cells and atrophy of the columnar muscle fibres in the foot and mantle tissues of snails. The results are discussed, particularly in comparison to those of other aquatic organisms.

Keywords:*Bellamya bengalensis, detergent tide, foot, histopathological alterations, mantle*

Introduction

The detergent components are subject to variable effects based on habitat characteristics and other modifying factors. The histopathological studies are indicative of the pollution induced stress, it is gradually gaining popularity among toxicologists (Hinton *et al*. 1973). Exposure to moderate concentrations of detergent can produce recognizable effects. Those are morphological changes, inhibiting effects and behavioural changes. Besides the above, histomorphological change is considered to be an useful bio-assay tool in toxicity studies, as its application demands a high degree of competence and skill to make correct diagnosis (Warner 1967). Detergent toxicity studies on gastropod molluscs are comparatively very inadequate when compared to the fishes. Pathological disturbances in aquatic organisms like fishes due to detergent toxicity were well documented by Chellan *et al*. (2003). Structural changes caused by detergent may occur at any level of the biological organizations literally from molecule to mammals (Glaister 1986). Due to the of detergents important organs like kidney, liver, gill, digestive system and nervous system are damaged. The effect of the cationic surfactant lauryl trimethyl ammonium chloride (C_{12}-TMAC) was investigated on growth, reproduction, cellulolytic enzyme activity, and larval colonization of Asiatic clams, *Corbicula fluminea* (Belanger *et al.*, 1993). *Lymnae aperegra* is highly sensitive to the anionic surfactants, sodium lauryl sulfate (SLS) with a 96 hrs LC_{50} of 0.54mg/L (Jose and Oliva 1987).The effects of heavy metals, insecticides and pesticides on the snails are extensive than detergents. Panwar *et al*. (1982) studied the toxicity of some chlorinated hydrocarbon and organophosphorous insecticide was investigated in *Viviparus bengalensis*. Pathological and biochemical disturbances of pesticide toxicity in *Vivipara bengalensis* is well documentedby Muley and Mane (1990). The present study is devoted to evaluate the toxicological effects of detergents on *Bellamya bengalensis*.

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Material and Methods

B.bengalensis were collected from river Godavari and divided into 5 groups of 10 individuals. One group consisted of control snails while the other four groups were exposed to 96 hrs LC_{50} concentration of detergents. The concentration of detergents which caused 50% mortality to test

organisms during a specified time expressed in terms of LC_{50}. The lethal concentrations were calculated by using probit analysis. For histological and histochemical studies both the control group and those of experimental groups that survived at the end of 96 hrs exposure were fixed in Susa, dehydrated in alcohol grades and were embedded in paraffin wax. The animals were cut at 6 - 8µ and take serial sections of the animal and stained with Heidenhain's Azan.

Result and Discussion

Results were expressed in LC_{50} values for 96hrs. The LC_{50} values obtained have shown that the detergent Tide has affected the mantle and foot of *B.bengalensis* when compared with their respective controls (Fig. 1 to 4). The foot considered to be the strongest part of the animal is also not spared by the detergents.The normal foot in control experimental snail consists of dorsal and ventral ciliated columnar epithelium, epidermal mucocytes, mucous gland cells, muscle fibres and connective tissue. The epithelium of the foot directly in contact with the polluted water shows desquamation at different concentrations of detergent. The foot shows severe damage at highest concentrations and congestion was severe at 213.7, 263, 316.2 mg. Disruption of muscle fibres and desquamation of epithelial layers can be seen at 69.18 mg (96 hrs). The glandular cells were affected after 96 hrs exposure different parts of foot were affected severely i.e damaged connective tissue, shrunken epidermal cells, broken basement membrane and faintly stained degenerated cells.The mantle is a thin surface which lines the shell and forms the roof of the body cavity. The normal mantle consists of outer and inner columnar epithelial layers, muscle fibres, connective tissue, aggregates of glandular cells and epithelial mucocytes. These cells are damaged after exposure to acute toxicity of detergent (Tide).The mantle edge being directly in contact with the polluted waters accumulated considerable amounts of surfactants in their cells and produce toxic effects like hypertrophy of the epithelial cells with vacuolation and disorganization of cell walls leading to necrosis. After 96 hrs exposure the tissue of mantle showed the desquamation of epithelial cells, atrophy of muscle fibres, necrosis and disruption of shell glands. Pollution is the chief wrecker of the declining of molluscan population. At the banks of the rivers, lakes, canals and streams washer men are active. Much of the detergent thus let into the water make a study of the sub-lethal effects on *Bellamya bengalensis*.The present study has shown several degeneration changes in the histological structure of the mantle and foot of *B. bengalensis* exposed to 96 hrs LC_{50} of the detergents.

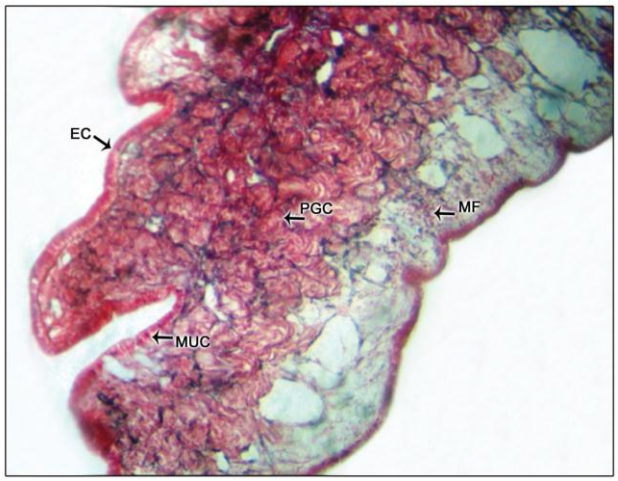

Fig. 1 Sagittal section of foot (Azan) Normal
PGC - Pedal Gland Cells
VC- Vacuolated Cells
CT - Connective Tissue
EM - Epithelial Mucocytes

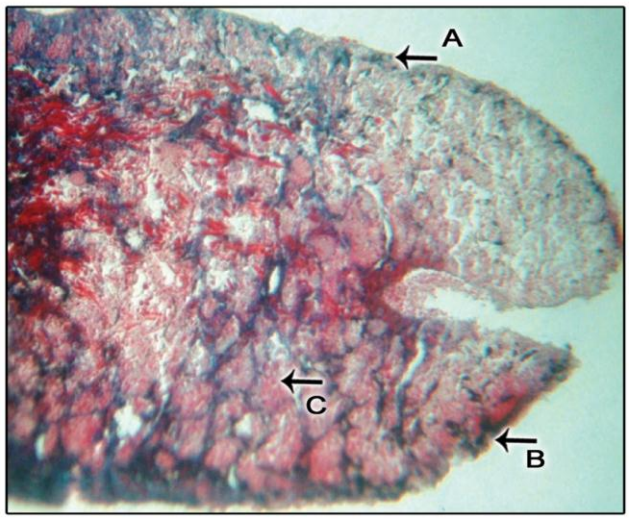

Fig. 2 96 hrs of foot showing
(A) Desquamation of epithelial cells
(B) Broken basement membrane
(C) Shrunken pedal gland cells

In the present study it is interesting to note that histopathological changes induced by detergent are more intense. But there is no information on the histopathological effects of detergents on the tissues of molluscans. Similar degenerative changes were shown in the histological structure of the mantle and foot of *B.dissimilis* exposed pesticides (Jonnalagadda and Rao, 1996).

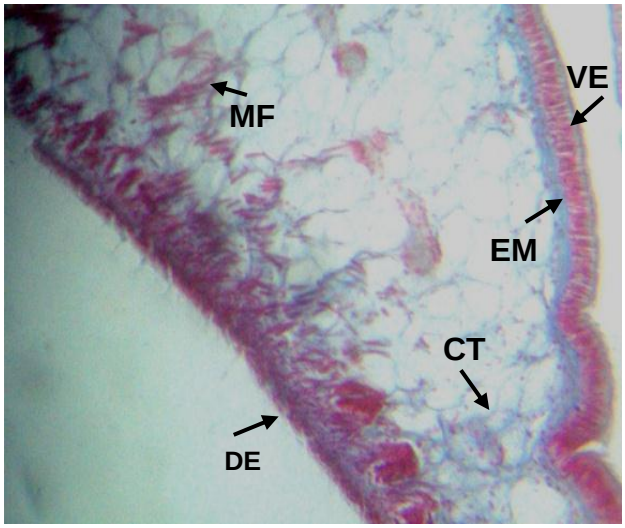

Fig. 3 Sagittal section of mantle (Azan) Normal
DE- Dorsal Epithelium
VE - Ventral Epithelium
MF - Muscle Fibres
CT - Connective Tissue
EM - epithelial mucocytes

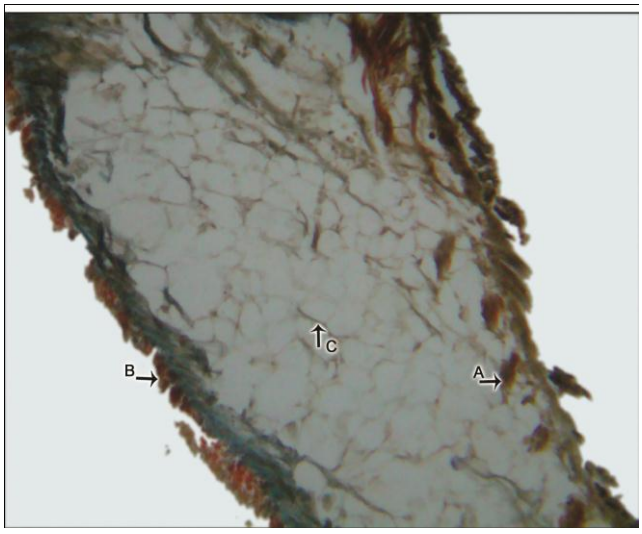

Fig. 4 96 hours mantle showing
(A) Epithelial mucocytes appeared empty with collapsed cell walls
(B) Desquamation of epithelial cells
(C) Atrophy of muscle fibres

Otludil *et al*. (2004) observed similar histopathological changes like desqumation of the epithelial cells, change in the number of mucocytes and atrophy of the columnar muscle fibres were observed in the foot and mantle of great ramshorn snail *Planorbarius corneus* treated with endosulfan. Vijayakumar (2010) reported the similar histopathological alterations exposed with paraquaton *Lymnae aluteola.* Gupta *et al*. (2006) reported the damage in the mantle of the present snail *Viviparus bengalensis* was exposed to sub lethal concentrations of pentachlorophenol and sodium pentachlorophenate resulting in the formation of intercellular spaces, the shrinkage and elongation of epithelial cells, enlargement of nuclei, shrinkage of the basement membrane and loss of shape of polygonal cells of connective tissue.

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Some common wild fodder weeds used by Gujjar tribe of district Rajouri (J&K)

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Abstract

The present study deals with some common wild fodder weeds used for rearing livestock by Gujjar tribe of district Rajouri (J&K).The study was conducted during Jan.2010 to July 2011. During the course of field study the authors have selected 05 important blocks densely inhabited by Gujjar tribe in district Rajouri i.e. Nowshera, Kalakote, Thanamandi, Budhal, Darhaletc.Four sites were selected in each block for the collection of fodder weeds on the basis of extensive and intensive field surveys.During this period the authors have reported a total of 57 fodder weeds belonging to 3 monocot and 19 dicot families.Out of total 22 angiospermic families of fodder weeds reported from the study area, the predominance was shown by monocot family Poaceae containing 14 fodder weeds followed by family Fabaceae and Asteraceae each having 08 and 06 fodder weeds respectively.

Keywords:*Fodder weeds, gujjar tribe, livestock*

Introduction

Jammu and Kashmir State is one of the hilly states of India having 22 districts, out of which district Rajouri is most important agricultural district having **7** blocks. It is located at western part of Jammu division in the foot hill of Pirpanjal range between 32^0-58'& 33^0-35'latitude and 74^0-81' longitude at an elevation range of 370 – 6000 msl covering an area of 2630 sq.km. Out of the seven blocks of district Rajouri 05 blocks i.eNowshera, Kalakote, Thanamandi, Budhal, Darhal etc. are densely inhabited by gujjartribes.Weeds are unwanted obnoxious plants growing in places where they are undesirable (Dangwal*et al.* 2010). Most of the weeds are thought to be of negative value; however, some weeds are of economic importance used by man as food, fodder, medicines and othermiscellaneous purposes (Patil*et al.* 2007). Fodder is any agricultural food stuff used to feed domesticated livestock. It refers to the food given to animals rather than that they forage for themselves. Livestock population has been an important source for various products therefore, rearing the cattle has been a genuine concern to various soceties.These grazing animals are dependent on vegetation which also contains a high proportion of weeds. (King 1966).Gujjar tribeconstitutes a major proportion of local population of district Rajouri.They are the tribal race of Jammu and Kashmir leading a nomadic lifestyle.Their primary occupation is rearing of cattle (Goat, sheep, buffalo horses etc.) and migrates from one place to another over different altitudinal zones of Himalaya for providing better fodder opportunities for their cattle. In order to do so they rely on forest plants and wild weeds as a source of fodder. It has been observed that among these tribe men folk has wider knowledge about fodder weeds as compared to their women folk. (Gaur *et al.*2010). Gujjar tribe stays inside the huts in forests which are locally known as shappers.Being economically poor they practice farming and are dependent on these cattle and forest products for their livelihood. Their economy is based on selling milk, dairy products, eggs, wool etc. On an average one Gujjar family has 3-5 buffaloes and more than 100 sheep and goats, relatively better families may own 8-10 buffaloes

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and more than 250 goats and sheep. On an account of their routine requirements of fodder they are dependent on forest plants as well as wild weeds found in forests and nearby fields.A scientific study of fodder weeds is important for pinpointing the resources that can be utilized for meeting the increasing demand of fodder during the time of droughts or during normal days. Keeping this in view the present study was conducted as first ever attempt from the study area to explore and identify the fodder weeds that can be used to feed the livestock. This will ultimately help the farmers in reducing the number of weeds from their fields as these weeds are used for the purpose of fodder.

Material and Methods

The present study deals with some common wild fodder weeds used for rearing livestock by Gujjar tribe of district Rajouri(J&K).Extensive and intensive field trips were made during Jan.2010 to July 2011 in order to survey the inhabiting areas of the Gujjar tribe in district Rajouri (i.e. block Nowshera,Kalakote,Thanamandi,Budhal,Darhal etc.).Four sites were selected in each block for the present study. The questionnaire was planned for the collection of data regarding thefodder weeds. During this course 6 informants of different age groups were interviewed from each site about fodder weeds their available vernacular names, flowering and fruiting seasons etc. The fodder weeds from each site were collected, pressed, dried, preserved and properly identified with the help of available literature, monographs by Sharma and Kachroo (1983), Swami and Gupta (1998), Kaul (1986) and confirmed from the authentic regional herbaria *i.e.* Botanical Survey of India, Northern Circle (BSD), Dehradun and Forest Research Institute Herbarium (DD), Dehradun and deposited them in the H.N.B. Garhwal Central University Herbarium, Department of Botany, S.R.T. Campus, Badshahithaul, Tehri Garhwal, Uttarakhand, India.

Results and Discussion

During study period (Jan.2010 to July 2011), authors have reported a total of 57 fodder weeds belonging to 3 monocot and 19 dicot families from the study area. Out of total 22 angiospermic families reported from 5 blocks of district Rajouri, The predominance was shown by monocot family Poaceae containing 14 fodder weeds followed by family Fabaceae and Asteraceae having 08 and 06 fodder weeds respectively.The family Amaranthaceae contained 04 fodder weeds while the families Brassicaceae and Cyperaceae were represented by 03 fodder weeds each.The families Polygonaceae, Commelinaceae and Euphorbiaceae contained 02 fodder weeds each. The remaining families i.e. Aizoaceae, Malvaceae, Solanaceae, Caryophyllaceae, Oxalidaceae, Fumariaceae, Primulaceae, Nyctaginaceae, Caesalpiniaceae, Lamiaceae, Ranunculaceae, Onagraceae and Chenopodiaceae contained 01 fodder weed.District Rajouri is one of the hilly district of J&K state whose boundaries are attached to district Poonch in north, district Jammu in south, Udhampur in east and Mirpur (Pakistan) in the west. District Rajouri has two regions with characteristic topography and climate *i.e.* the temperate and sub-tropical. The temperate region comprises of the blocks Thanamandi, Darhal, Budhal and some part of Rajouri and sub-tropical region comprises of areas like Nowshera, Kalakote and Sunderbani etc. These physiographic diversities resulted in a rich diversity of the district. Gujjar tribe constitutes the major proportionof local population leading a nomadic lifestyle. They graze their herds of sheep, goats and cattle from south of Pir- panjal range to alpine pastures of the greater Himalayan ranges in north. They keep the herds of buffaloes and goats for milk, sheep for wool and flesh, horses for carriage purposes. The dung of these cattle is used as manure in the farming practices, therefore, cattle healthcare and their proper feeding has been a genuine concern to them because their economy is based on these cattle. In order to provide better fodder to their pets these tribe rely on forest plants as well as wild weeds that grow inside the forests and nearby fields. In the study area these tribes are using about 57 weed species to meet the daily requirements of fodder for their cattle. Some of the fodder weeds like *Taraxacum officinale, Sonchusasper, Sonchus oleracus, Lathyrus aphaca, Avena fatua*, *Phalaris minor* and *Echinochloa colonum* etc. Increases the milk yielding capacity when given to cattle. The spiny weeds like *Amaranthus spinosus* and *Silybum marianum* etc. are given to cattle in young stage (before emergence of spines), at maturation stage these weeds are sun dried, grinded and then given to cattle.

Table 1.Showing 57 Fodder Weeds along with their Families, Botanical names, available Vernacular names and Flowering and fruiting seasons.

S.No.	Family	Botanical Name	Vernacular name	Flowering and fruiting season
1.	Aizoaceae	*Trianthema portulacastrum* L.	Kulfa	Jul.-Dec.
2.	Amaranthaceae	*Amaranthus spinosus*L.	Chelari	Sept.-Oct.
		*Amaranthus viridis*L.	Ganar	Jan.-Dec.
		*Celosia argentea*L.	-	Aug.-Dec.
		Digea muricata (L.) Martius	-	Aug.-Oct.
3.	Asteraceae	*Bidens pilosa*L.	Saryala	Mar.-Dec.
		Gallinsoga parviflora(Cav.) icon	Phooli	Throughout the year.
		*Silybumm arianum*L.	Kandyari	Jan.-Apr.
		Sonchus asper(L.) Hill.	BadiAand	Apr.-Oct.
		Sonchus oleraceus L.	-	Mar.-Apr.
		*Taraxacum officinale*Weber	Aand	Feb.-Oct.
4.	Brassicaceae	*Capsella bursa-pastoris*Medik.	Jangalisarson	Jan.-Mar.
		*Coronopus didymus*L.	Jangaliajavian	Jan.-Mar.
		Lepidium virginicum L.	-	Apr.-May
5.	Caesalpiniaceae	*Cassia occidentalis*L.	-	May-Nov.
6.	Caryophyllaceae	*Stellaria media* L.	Neela	Feb.-Mar.
7.	Chenopodiaceae	*Chenopodium album* L.	Bathua	Mar.-Apr.
8.	Commelinaceae	*Commelina benghalensis* L.	Ghass	Aug.-Oct.
		Cynotis vaga Lour	Ghass	Jul.-Oct
9.	Cyperaceae	*Cyperus difformis*L.	-	Sept.-Oct.
		Cyperus iria L.	-	Sept.-Oct.
		Cyperus rotundus L.	-	Jul.-Dec.
10.	Euphorbiaceae	*Euphorbia hirta*L.	Shotidoodi	Sept.-Oct.
		*Euphorbia prostrata*Aiton	Doodal	Jan.-Dec.
11.	Fabaceae	*Lathyrus aphaca* L.	Jangalimatar	Feb.-Mar.
		Medicago denticulata Willd.	Serari	Oct.-May
		Medicago lupulina L.	Sesrari	Mar.-Apr.
		*Melilotus indica*L.	Jangalimethi	Mar.-Apr.
		Trifolium repens L.	Jangalistal	Apr.-Oct.
		Trifolium tomentosum L.	Jangalistal	Mar.-Apr.
		Vicia hirsuta (D) S. F. Gray	Phali	Mar.-Apr.
		Vicia sativa L.	-	Mar.-Apr.
12.	Fumariaceae	*Fumaria indica* Haussk	-	Jan.-May
13.	Lamiaceae	*Lamium amplexicaule* L.	-	Mar.-Apr.
14.	Malvaceae	*Malva parviflora* L.	Soonchal	Jan.-Mar.
15.	Nyctaginaceae	*Boerhaavia diffusa* L.	-	Jul.-Dec.
16.	Onagraceae	*Oenothera rosea* W. Ait.	-	Jul.-Aug.
17.	Oxalidaceae	*Oxalis corniculata*L.	Khattiamal	Throughout the year
18.	Poaceae	*Avena fatua* L.	Gandial	Mar.-May
		Cynodon dactylon (L.) Pers	Dheela	Apr.-Jul.
		Digitaria ciliaris Retz.	Ghass	Aug.-Nov.
		Echinochloa colonum L.	Ghass	Jul.-Sept.

Some common wild fodder weeds

		*Echinochloa crus-galli*L.	-	Sept.-Oct.
		Eleusine indica (L.) Gaertn.	-	Aug.-Oct.
		Heteropogon contortus L.	Saryalaghass	Aug.Nov.
		Lolium temulentum L.	-	Mar.-Apr.
		Paspalidium flavidum Retz.	-	Jul.-Dec.
		Phalaris minor Retz.	Sitti	Mar.-Apr.
		Setaria geniculata Lam.	-	Aug.-Oct.
		Setaria glauca P. Beauv	-	Jul.-Sept.
		Seteria verticellata L.	Chichra	Aug.-Oct.
		Sorghum halepense (L.) Pers.	Barun	Sept.-Nov.
19.	Polygonaceae	*Rumex acetocella* L.	Arphali	Aug.-Sept.
		Rumex nepalnesis Spreng	Arphali	Aug.-Oct.
20.	Primulaceae	*Anagallis arvensis* L.	Neel krishna	Mar.-Apr.
21.	Ranunculaceae	*Ranunculus arvensis*L.	Chuchumba	Mar.-Apr.
22.	Solanaceae	*Solanum nigrum* L.	Kachmach	Aug.-Sept.

1. *Echinochloa colonum*

2.*Celosia argenta*

3.*Chenopodium album*

4. *Commelina benghalensis*

5.*Taraxacum officinale*

6.*Gallinsoga parviflora*

7. *Eleusine indica*

8.*Cynodon dactylon*

9.*Avena fatua*

Some common wild fodder weeds

10. *Trifolium repens* 11. *Oxalis corniculata* 12.*Lathyrus aphaca*

Plates 1-12. Showing Fodder Weeds used by Gujjar tribes of district Rajouri

13. Buffalo 14.Gujjar tribe 15.Herd of goats

Plates 13-15. Showing photograph of Gujjar tribe and their cattle capture during the course of study.

The weeds like *Sorghum halepense* and *Heteropogon controtus* etc. are dried and stored, these weeds are given to cattle in winters (during the period of drought).However some of the weeds reported from the study area i.e*Cynodon dactylon, Taraxacum officinale, Sonchus asper, Silybumm arianum, Commelina benghalensis, Euphorbia hirta* etc. are of medicinal importance used in phermaceuticalindustries.The weeds like *Chenopodium album, Taraxacum officinale, Lathyrus aphaca ,Trianthema portulacastrum* etc. are used in some cooking racepies in the study area.The fruits of *Solanum nigrum* are also edible.

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Effect of Nickel ion on Stem of *Hydrilla verticillata* L.

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Abstract

The study sought to evaluate the potential of *Hydrillaverticillata L.* in the absorption of Nickle(Ni) ion and possible variations in its tissues after 7 days of exposure to this metal. *Hydrilla verticillata* L. were cultured in Hoagland medium supplemented with various Ni ion concentrations (as 3,5,7,9 and 11 mg/ml) and were separately harvested after 3, 5 & 7 days. In the anatomical analysis, disorganization of epidermal cells, degeneration of cortical cells and pith, highlights the variation resulting from Ni ion toxicity. However these variations were not sufficient to damage the development of an individual. *Hydrilla verticillata* L. showed high capacity of extraction and storage of the metal, being food alternative to aquatic environments, with high concentration of Ni ion.

Keywords:*Anatomical variations, aquatic environment, hoagland medium, Hydrillaverticillata L., Ni ion toxicity, stem*

Introduction

Heavy metals at high concentration in substrate when taken up by the plants develop toxic characters, which becomes expressed with anatomical alterations or even malformations. Although some heavy metals are essential trace elements for plant life, at relatively high concentrations they are toxic since they interfere with enzyme function (Krupa *et al*., 1993). Nickel has many visible and adverse effects on environment. The foremost adverse effect is Skin allergy. The other detrimental effects are Nickle compounds are carcinogenic as well as cause asthma. Hence, its removal is of major concern.Moreover, very little research has been conducted on the mechanisms of Ni phytotoxicity. In general, heavy metals severely inhibit root growth (Bennet, 1987 and Punz, 1993). Furthermore, several studies have indicated that Ni inhibits plant photosynthesis (Bishnoi, *et al*. 1993, Clijsters and Assche 1985. and Krupa *et al*. 1993). Bio avaibility of heavy metal in soil, uptake of heavy metal at phytotoxic level,growth retardation, effects on palisade and spongy parenchyma cells in leaves (Ahmed,2003 and Ladygein and Sharma 2004) collated deposition in the vascular bundles and change in vacuoles with electron dense material along the walls of xylem and phloem vessel (Ladygein and Semenova, 2003).Therefore, in the present study, the effects of high Ni ion concentrations on the stem of *Hydrilla verticillata L* were studied in order to determine the structural features of Ni ion toxicity and their potential physiological implications in response to Ni toxicity.

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Material and Methods

Plant Material

Hydrillaverticillata L. plants were collected from the pond at Harani, Vadodara (Fig. A). They were allowed to acclimatize for 15 days. Plants were grown and propagated for 4 weeks in quarter strength Hoagland's solution (Hoagland and Arnon1938).In the pilot scale experiment, after determining LC 50 value mg/ml 254 hours, the test plants were exposed to wide range of the metal ion concentrations i.e. 3, 5, 7, 9 and 11 mg/ml. Nutrient solution devoid of trace element served as a control. Both the control and the treated solutions were maintained at pH 5.5 using dilute HCl or NaOH. After each experimental period, harvestedplants

were washed in running tap water and rinsed with deionized water.

Microscopy

To observe anatomical changes in Ni exposed cells of *Hydrilla verticillata* L.following technique was used: The control and 11 ppm cd treated cells of the test plants were preceded for microtechnique (Johansen, 1940) method. Measurements and photographs were taken using a Leica DM1000 binocular light microscope with a Leica DFC280 camera.Observations were made on organization of epidermal cells, cells of cortical layer and central cylinder (pith) in the control and treated cells of *Hydrilla verticillata*L.

Results and Discussion

Anatomical studies on *Hydrilla verticillata L* plants showed that the stem in cross section exhibits an oval profile (Fig C). On examination of control stem of *Hydrilla verticillata* L revealed that uniformly distributed radially narrow epidermal cells (Fig. B), no conspicuous cuticle over epidermis, well organized cells of cortical layer with compactly arranged parenchyma cell interrupted by arenchyma cells (Fig. C). At the center of the central cylinder was a large lecuna (Fig. D).The stem of *Hydrilla verticillata* L. growing in excess of Nickle ion exhibits anatomically number of differences compared to the control stem (Fig.F).

Thus, the stem profile is much larger, a fact principally due to the increase of the volume of pith. Disturbance in arrangement of epidermal cells (Fig. E), cortical cells are disintegrated forming a dark zone (Fig. F) and pith does not remain any longer compact, but its concentration region becomes disorganized resulting in an open cavity (Fig. G) were major observation in Ni treated cells. In the present study, anatomical studies on stem cross sections of *Hydrilla verticillata L.*revealed that the histological components which appeared significantly affected by Ni toxicity were the epidermis, cortex, and pith. The relative volume of the cortex became reduced in treated plant as compare to control due to disorganization of the parenchyma tissues (Panou-filotheou *et al*. 2006 Sridhar, *et al*., 2007). The volume of pith region increased through the development of larger central cavity formed by tearing apart of the pith cells. (Panou-filotheou *et al*. 2006).

The formation of dense pubescence in the stems of oregano plants grown in high Cu-concentrations is rather attributed to the stress conditions developed by Cu toxicity, as in other relevant cases (Barcelo *et al*., 1988 and Panou-Filotheou *et al*. 2001).

Fig. A: Collection site

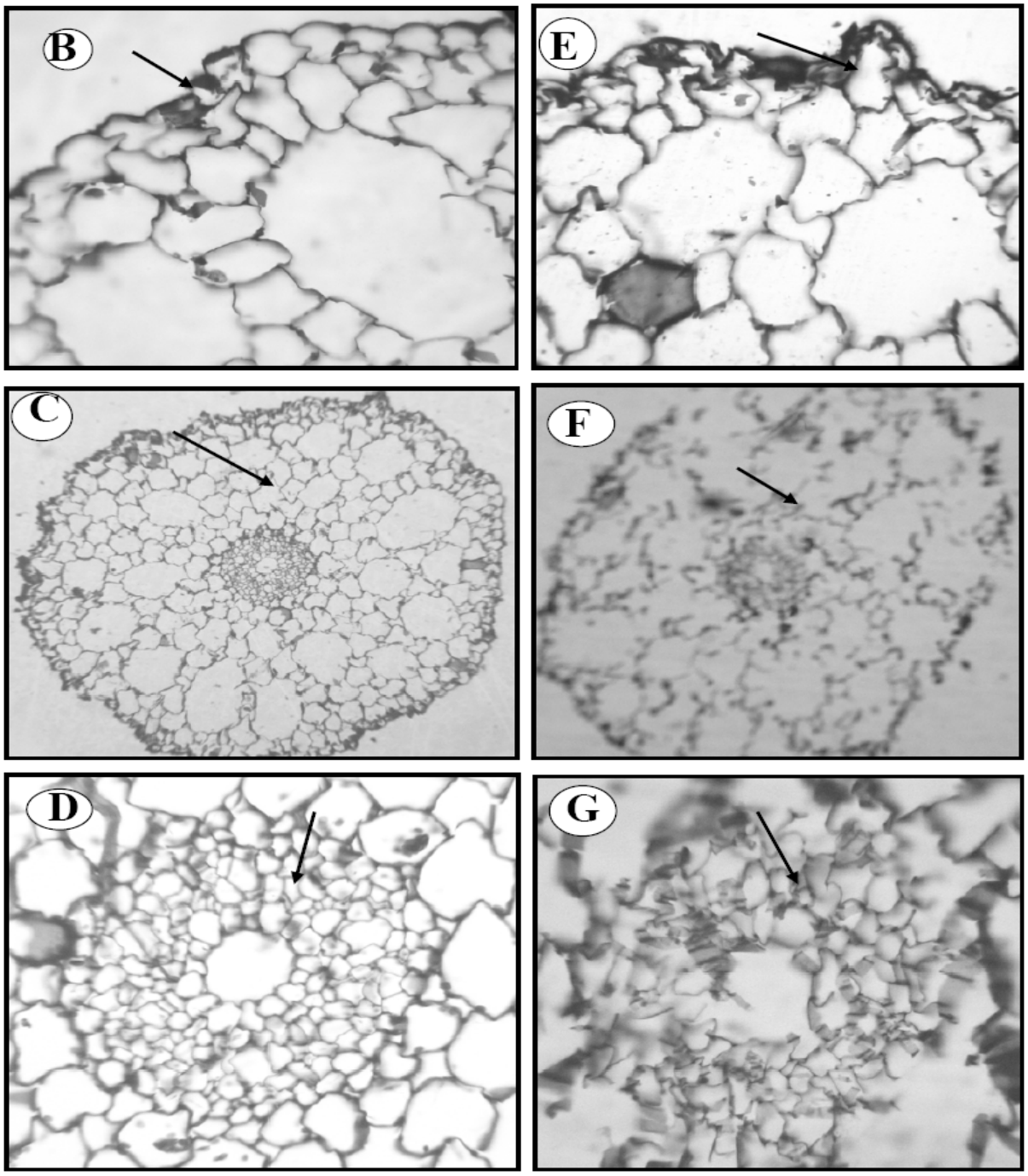

Fig. B: Intact outer epidermis
Fig. C: Transverse section of stem of control plant
Fig. D: Pith of control plant

Fig. E: Disorganization in cells of epidermis
Fig. F: Degeneration of parenchyma cells of cortical layer
Fig. G: Disintegration of pith cells.

Considering the specific alterations (under Ni stress) in *Hydrilla verticillata L.* stem structure and their evaluation by morphometric assessments, it could be suggested that increasing Ni concentrations have a toxic effect on stem. This effect becomes anatomically expressed by a disorganization of a great amount of parenchymatic tissue in the stem cortex and pith. Additional physiological studies (endogenous gibberellic acid and other phytohormones, phenoloxidase and other enzymes, saps of vessels and sieve tubes, etc.) would strengthen structural data and provide grounded interpretations as to the manner of toxic action of Ni.

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Bioremediation of diesel contaminated soil through microbial flora

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Abstract

Microbial degradation of spilled oil is one of the major routes of the natural removal of contaminants from the environment. Biodegradation gradually destroy oil spills by the help of microorganisms. In the present work the indigenous microorganisms from the oil contaminated area were isolated. Contaminant compounds transformed by these isolates through reactions that take place as a part of their metabolic process were studied. The result of the present study showed the bioremediation of hydrocarbon contaminated soils, which exploits the ability of micro organisms to degrade and/or detoxify organic contaminations.

Keywords:.*Bioremediation, oil spills, microorganism, degradation, diesel, contaminants.*

Introduction

The quality of life on earth is linked inextricably to the overall quality of the environment (Vidali, 2001). Petroleum products are used as fuels, solvents and feedstock in the textile, pharmaceutical and plastic industries; Petroleum is a complex mixture of hydrocarbons and other organic compounds, including some organometallo-constituents. Petroleum constituents represent: saturates, aromatics, resins and asphaltenes (Harayama *et al*. 2004). Petroleum derived diesel is composed of about 75% saturated hydrocarbons (primarily paraffins including n, iso and cycloparaffins and 25% aromatic hydrocarbon (including naphthalenes and alkylbenzenes). The average chemical formula for common diesel is $C_{12}H_{33,}$ ranging from approx $C_{10}H_{20}$ to $C_{15}H_{28}$ (Riser-Roberts, 1992). Petroleum continues to be used as the principle source of energy; however, despite its important usage, petroleum hydrocarbon also poses as a globally environmental pollutant (Plohl *et al*., 2002). Oil spills especially in soil contamination have prompted research on cost-effective, environmentally benign clean upstrategies (Margesin and Schinner, 2001). Microbial degradation of spilled oil is one of the major routes of the natural removal of contaminants from the environment (Prince, 1993). Microbial degradation of petroleum is influenced by a number of factors, including seasons, history of previous exposure of the given environment to oil, temperature, sediment type and medium used for the isolation of organisms (Calomiris *et al*., 1976; Colwell and Walker, 1977). Microbial degradation appears to be the most environmental friendly method of removal of oil pollutant since other methods such as surfactant, washing and incineration lead to introduction of more toxic compounds to the environment (Oboh *et al*., 2006). This study was aimed at assessing the hydrocarbon utilizing bacterial species in an effort to develop active microbial species with characteristics that could be of relevance in bioremediation of petroleum contaminated oil spills.

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Material and Methods

Sampling

Survey of city was done and heavily contaminated diesel site was selected. Freshly collected soil samples were collected from four different locations from different depths, with the help of sterilized instrument. The soil samples were brought to laboratory under ice cold conditions.

Soil microbial counts (APHA, 1985)

Heterotrophic plate count (HPC) was done by standard pour plate dilution agar technique using R_2A medium.

Identification of bacterial isolates (Mac Faddin, 1980)

The bacterial isolates were identified on the basis of morphological, cultural and biochemical characteristic with the help of the Bergey's Manual of Systematic Bacteriology (Krieg and Holt, 1984) and Probabilistic Identification of Bacteria (PIB) computer kit (Bryant, 2003).

Screening of diesel degrading bacterial isolates microtiter plate count method (Medhi and Giti, 2008; Bento *et al*., 2005)

Microtiter plate assay was used to screen out diesel degrading bacterial isolated and analyzed with the help of ELISA reader (Thermoelectron corporation multiskan Ex.) at 450 nm using a UV spectrophotometer.

Assessment of potential of screened bacterial species (Whyte *et al*., 1998)

To determine the range of alkanes utilized by bacterial isolates, the growth of the organisms on different concentration of diesel fuel, containing 1-8% diesel oil were observed spectrophotometrically at 660 nm using a UV spectrophotometer (Systronics, model no. 118).

Results and Discussion

The morphological and biochemical characterization of the bacterial isolates obtained from different sites revealed the following genera: *Micrococcus varians, M. agilis, M. mucilaginosis, Staphylococcus saprophyticus, S. epidermidis, Celibiosococcus* spp., *Streptococcus anguis*. All the isolates were non-motile, cocci shaped and gram positive. Most were Vogesprouskauer positive, urease and citrate utilizers.Out of 25 isolates, 5 isolates with highest Optical Density value were screened out. These isolates were *Stapylococcusxylosus* (BGCC#753), *Micrococcus agilis* (BGCC#764), *Micrococcus varians* (BGCC#766), *Staphylococcus saprophyticus*-3 (BGCC#768) and *Celibiosococcus*spp. (BGCC#775).Diesel hydrocarbon utilization potential of five bacterial isolates was checked at different concentrations (1 to 10%) of diesel hydrocarbon in the medium (Fig. 1). *Staphylococcus xylosus* (BGCC#753) showed maximum growth on 1% diesel oil while *Micrococcus agilis*(BGCC#764) and *Micrococcus varians* (BGCC#766) on 8% diesel oil. *Staphylococcus saprophyticus* (BGCC#768) and *Celibisococcus* spp. (BGCC#775) did not exhibit proper growth at 5%, 8% and 10% but showed maximum growth at 1% of diesel oil.The results showed that *Micrococcus agilis* (BGCC#764) could utilized a higher percentage of diesel oil while high percentage decreased the growth of all the other isolate. The pH change in the culture growing medium was also studied for each isolates. The results showed pH decrease from 7.2 to 6.29 (Fig. 2).

Fig: 1 Change in total viable count during the growth in Bushnell Hass media containing different concentration of dieseloil

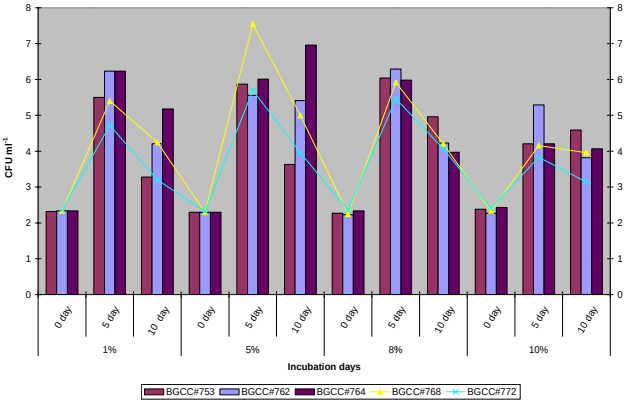
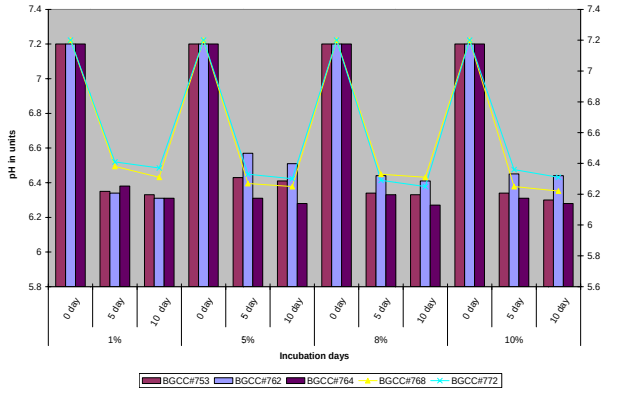


Fig: 2 pH change during the growth of diesel utilizing bacterial isolates grown in Bushnell Hass medium containing different concentration of diesel oil



Since all the bacteria in the present study was isolated from a petroleum contaminated oil sample, some of them survived and adapted the oil-contaminated environment very easily as also reported by other authors (Rahman *et al*., 2003; Das and Mukherjii, 2007).Twenty five bacterial isolates were obtained from diesel contaminated soil samples. The predominant flora was composed of *Micrococcus* spp., *Staphylococcus* spp., and *Celibiosococcus* spp. Bacteria belonging to these genera have been described as petroleum degraders or even as hydrocarbon degraders by (Marin *et al*., 1996).Soil bacterial diversity, as estimated by phylotype richness and diversity of all the soil variables examined, soil pH was, by far the best predictor of both soil bacterial diversity and richness. The lowest level of richness was observed in acidic soil.Microtiter plates have been already extensively used in applied research. Microbial diversity offers an immense field of environment friendly options for mineralization of contaminants or their transformation into less harmful non-hazardous compounds.

Conclusion

The overall results show that the bioremediation of diesel is an important process which improves the soil fertility by minimizing the toxic effect of it. The organisms evaluated in this work showed *Micrococcus* sp. were able to utilize hydrocarbons as the sole carbon source. Based on the results obtained from the laboratory study, biodegradation could be considered as a key component in the clean-up strategy developed in the future for the treatment of oil-sludge contamination. Some of the pure culture were versatile and persisted throughout the utilization process. Further studies are necessary on more interesting bacterial species and strains. However, it is advantageous and profitable to use native microorganism cultured from areas with historical contamination for degradation of hydrocarbons. This approach is likely to reduce or eliminate the initial lag phase, which can be long and optimize overall process time.

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Effluent quality assessment of different drains in SIDCUL industrial Area at Haridwar (Uttarakhand)

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Abstract

In the industrial era, the untreated effluents of various industries can alter the properties of surface water and may increase the pollution load in soil system and ultimately contaminate the local ground water aquifer. The SIDCUL industrial zone has been developed very fast by establishing the major industries at Haridwar in Uttarakhand. The present paper deals with the identification and estimation of the physico-chemical variables of effluents from different major industries in SIDCUL industrial area at Haridwar. The parameters, TSS, BOD and COD of the many effluents were recorded with higher values in comparison to standards. The composite effluents of different industries have contribute significantly for the degradation of surface water and soil quality of adjoining areas of industrial zone at Haridwar. The present study shows an assessment of qualitative and quantitative pollution load in the effluents drained from the different industries in the vicinity of industrial zone.

Keywords:*Wastewater, industrial effluent, water pollution, NEQS, SIDCUL*

Introduction

Recently, the rapid growth of industrialization has created negative impact on every component of environment because most of the industries have discharged their effluent without any adequate treatment. Industrial effluents contain toxic chemicals, colours, hazardous compounds, suspended solids and non-biodegradable materials. A wide variety of both inorganic and organic pollutants are present in effluents drained by various industries (Malik *et al.,* 2006). These chemicals are one of the major polluting sources, which are discharged by industries mostly without any treatment (Sial, *et. al.* 2006). When the raw materials are used in industries for the manufacturing of products than after reduction they come out as unwanted product and are released from the industries with out any dilution or treatment. Many pharmaceutical, detergent and cosmetics industries released effluent in low quantity but it is very toxic to discharge openly and when this water meets with surface water, firstly pollute the surface water after that it can pollute ground water by leaching process. The process of leaching of water depends on the types, textures of soil and substratum of soil profile. Chemical pollutants from a variety of sources including industrial wastewater, sewage, indiscriminate solid waste disposal and accumulation of waste water on surface water leached by capillary network of soil profile, ultimately degraded the quality of ground water of adjoining areas of industrial zones (Tyagi and Budhi, 2000).

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Material and Methods

State Industrial Development Corporation Uttarakhand Limited (SIDCUL) is newly established industrial area at Haridwar and developed under the newly emerging Govt. industrial policy of Uttarakhand. The SIDCUL industrial area at Haridwar was selected on the basis of large number of industries established recently very close to BHEL, Haridwar and other urban, semi-urban and rural residential areas. Geographically, Haridwar city is situated at longitude 78.13°E and latitude 29.58°N at 1550 msl in the foothills of lesser Shivalik Himalaya.

Effluent samples were collected from four different effluent drains and two sites for each drain (S-1 and S-2) were selected as upper and down parts of drainage consisting composite industrial effluents.

Effluent samples F1, F2, F3 and F4 were collected and analyzed in water testing laboratory according to standard methods as Trivedi and Goel (1984) and APHA (2005) and results were compared with the NEQS (National Environmental Quality Standards).

Results and Discussion

The results of various Physico-chemical parameters observed during course of study are given in fig. 1 & 2. The main source of water pollution in industrial area is discharge of untreated industrial effluents directly into the surface water bodies and injecting into ground water table resulting in serious surface and ground water pollution (Nasrullah, *et. al.* 2006). Physico-chemical characteristics impart a major role in determining the quantity of effluents. The observations were made for four wastewaters F1, F2, F3 and F4 at S-1 and S-2 SIDCUL for the physico-chemical parameters in winter and summer season.Temperature was recorded 19.9-20.8°C and 28.4-29.1°C of S-1 and S-2 during winter and summer season respectively. All the observed values of temperature come under the permissible limit according to standards given by NEQS. If the temperature increases in water body, the solubility of oxygen and carbon dioxides gas etc. have been affected and influences the chemical reactions in the water column. The variation in water temperature may be due to different timing of input load of heated industrial effluents and some effects of seasonal variations (Jayaraman*et al*., 2003). Total dissolved solids were observed 2172.8-2247.0 and 3006.4-2935.4 mgL^{-1} at S-1 and S-2 during winter and summer season. All the observed values of TDS come under the permissible limit. Total dissolved solids concentration usually associated with high concentration of ion that increased the conductivity of the water. Total suspended solids observed 240.9-263.2 and 293.2-273.5 mgL^{-1} at S-1 and S-2 in winter and summer season respectively. The observed values of TSS were high in all samples in comparison to NEQS standards. Total Suspended Solids inhibits the light penetration and responsible for depleting the dissolved oxygen level in aquatic system. The turbidity of all samples at S-1 and S-2 during winter and summer season was recorded 25.8-25.0 and 29.0-27.1 NTU respectively. High value of turbidity represents the high values of TDS and TSS in all samples. On both sites pH value of all samples during winter and summer season were recorded 8.0-8.3 and 8.7-8.6 respectively. Water with extreme high or low pH (below 3 or above 11) deadly effected the survival of living organisms in aquatic system (Krull*et al.* 2004). Total Hardness of samples at S-1 and S-2 during winter and summer were observed 644.5-598.7 and 587.3-579.0 mgL^{-1} respectively. Hardness parameter is determine the quality of drinking water, uses in industrial processes of water and increases the boiling point of water. Hardness is due to the presence of divalent metallic cations like Calcium, Magnesium, Strontium, Ferrous iron and Manganese ions. Ferric iron and Aluminum ions can also contribute to rich hardness, but the concentration is normally negligible due to their limited solubility (Sundary*et al.,* 2008). The values of Calcium in all samples at S-1 and S-2 during winter and summer season were observed 393.9-373.6 and 378.0-339.3 mgL^{-1} respectively. Generally, Calcium and magnesium maintain a state of ionic equilibrium in water column. Magnesium in the samples was recorded 252.3-256.1 and 209.5-264.6 mgL^{-1}at S-1 and S-2 during summer and winter season respectively. Alkalinity of the samples at S-1 and S-2 during summer and winter season was observed 389.1-325.3 and 393.5-397.6 mgL^{-1} respectively. Alkalinity is a measure of the capacity of water to neutralize acids. Alkalinity of water is due to the presence of bicarbonate, carbonate and hydroxide ions and strongly correlated with pH value, if pH of any sample is high than alkalinity is also high and pH value is low than alkalinity will be low or nil (Phiri*et al.,* 2005). The dissolved oxygen values of samples at S-1 and S-2 during winter and summer season were observed 2.6-2.5 and 2.0-1.9 mgL^{-1} respectively. Dissolved oxygen level of all samples found very low at both site. DO is one of the most important parameter to assessing water quality and reflect physical, chemical and biological characteristics prevailing in the water bodies (Nanda and Tiwari, 2001). BOD values of waste water samples were recorded 418.8-370.1 and 574.2-568.8 mgL^{-1} at S-1 and S-2 during winter and summer season respectively. BOD represents the amount of oxygen required for the microbial decomposition of organic matter in water. BOD value of the waste water samples was high in comparison to standards given by NEQS and showed high organic matter load in industrial effluent as also reported high value of BOD and

COD in composite industrial effluents (Hasmi, 2005). COD value represents the amount of oxygen required for the chemical decomposition of organic matter in water. The COD values of all samples at S-1 and S-2 during winter and summer season were observed 883.7-761.1 and 962.0-889.5 mgL^{-1} respectively. COD values are found very high in comparison to standard given by NEQS. The most common toxicity is from chloride in the irrigation water. Chloride occurs naturally in all types of waters. In natural freshwater, however chloride's concentration remains quite low. The most important source of chloride in water is the discharge of domestic sewage and liquid waste. Therefore, the chloride concentration has served as an indicator of pollution by sewage industries are also important source of chloride in water (Malik and Bharti, 2010). The Chloride values of both sites were observed 367.1-395.4 and 402.9-326.5 mgL^{-1} during winter and summer season respectively. Oil and grease has mixing with industrial effluents due to use of lubricants, grease in different machinery parts of industries and intermixing with water used in industrial processes. The other sources of these oily liquids are automobile industry, washing and repairing of commercial vehicles. These oil and grease contents makes a thin layer on the surface of wastewater and industrial effluents and contribute a lot for degrading the water quality and dreadful role for the survival of aquatic organism in the existing ecosystem. The oil and grease values of all samples at S-1 and S-2 during winter and summer season were observed 6.2-5.7 and 6.4-6.8 mgL^{-1} respectively. Observed values of oil and grease

Fig.-1: Few physico-chemical parameters of industrial effluents.

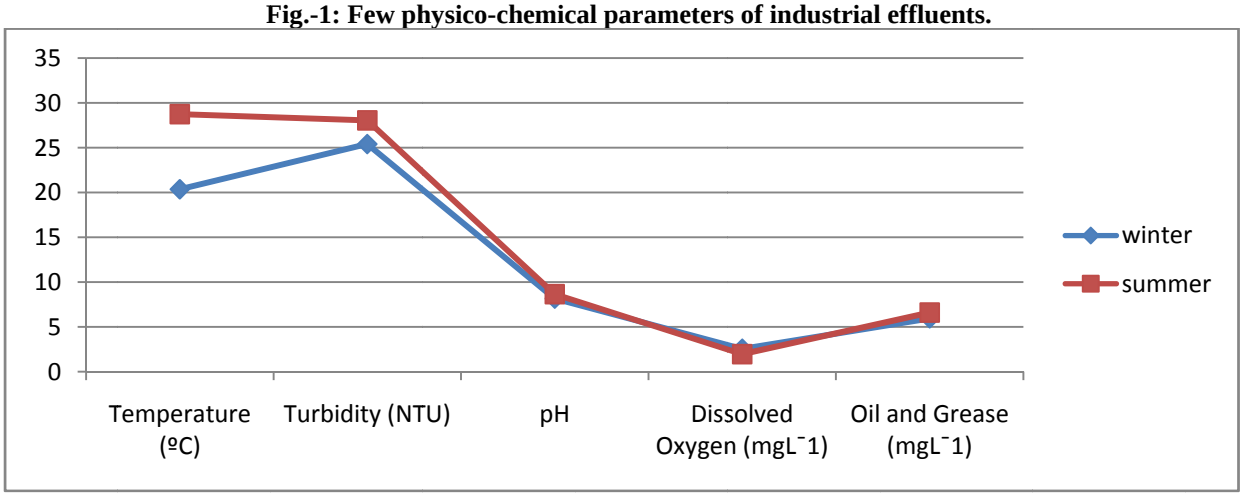
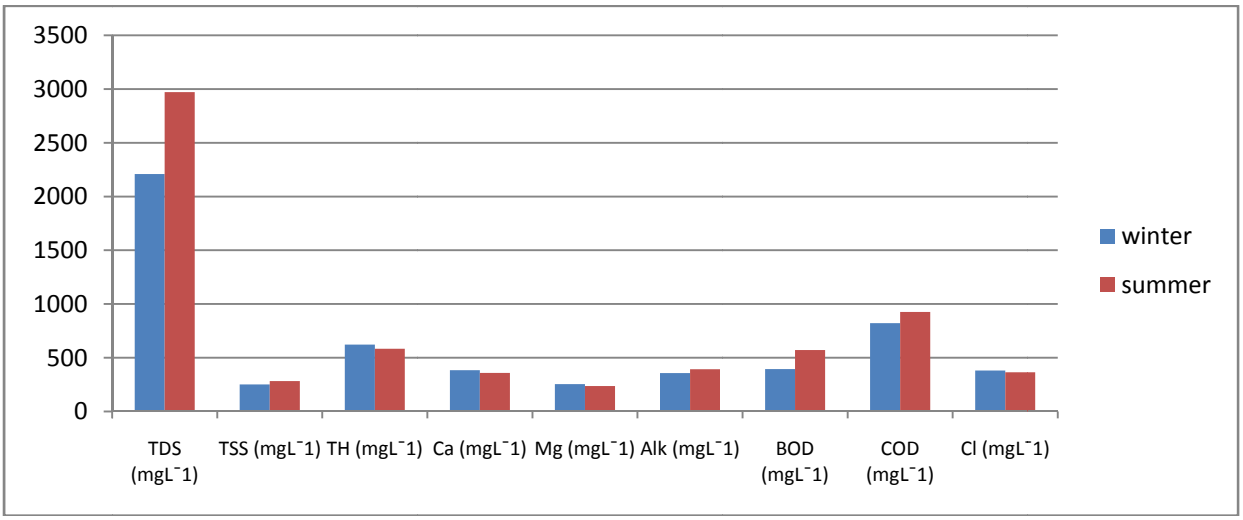


Fig.-1: Few physico-chemical parameters of industrial effluents.



come under the standard values given by NEQS.

The surface water as well as ground water quality has degrading continuously in terms of foul smell, taste, colour and other characteristics of drinking water quality. This loss of water quality is causing health hazards in human beings, livestock and aquatic organisms and adverse effects on agricultural soil quality of agricultural fields in surrounding rural areas. This problem is aggravated by lack of installation of common treatment plant and implementation of environmental laws prescribed by different govt. agencies as CPCB, MOEF and especially state pollution control board. The results of present study concluded that although the characteristics of effluents of industries have changing very fast on negative scales as per the safe limits of NEQS. But toxic level of harmful materials can mix up with surface water by coagulation process if no precautionary measures taken in future for treatment of industrial effluents in SIDCUL industrial area at Haridwar. It created serious problems as high level of surface water pollution as well as ground water problems in the industrial area of Haridwar.

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Seasonal variation in physico-chemical characteristic status of River Yamuna in Doon Valley of Uttarakhand

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Abstract

During the last few decades there has been an increasing demand for monitoring water quality of many rivers by regular measurements of various water quality variables. River Yamuna in Uttarakhand requires the same qualitative and quantitative aspects of monitoring for predicting the steady state water quality conditions. In the present work various physico chemical parameters i.e. , Temperature, transparency, velocity, turbidity, conductivity, TS, TDS, TSS, pH, total alkalinity, total hardness, calcium, magnesium, chloride, free CO_2, DO, BOD, COD, phosphate, nitrate, sodium and potassium were analyzed for various seasons; Summer, Monsoon, Winter, for the period (April, 2011-March, 2012) in surface water of river Yamuna. Our results showed that TS, TDS and TSS were maximum in monsoon and temperature and Dissolved Oxygen was found to be maximum in winter. Velocity was found to be maximum in monsoon followed by summer and winter. The observations implied that the physico- chemical conditions of River Yamuna was good in all the three seasons however change in seasonal conditions had a great effect on hydrological parameters.

Keywords*: Correlation, physico-chemical, seasonal, River Yamuna*

Introduction

Rivers are the most important freshwater resource for man. Social, economic and political development has been largely related to the availability and distribution of freshwaters contained in riverine systems. Water quality problems have intensified through the ages in response to the increased growth and concentration of populations and industrial centres (Arora and Mehra, 2003). Water quality parameters provides current information about the concentration of various solutes at a given place and time Khanna and Singh (2000). These parameters provide the basis for judging the suitability of water for its designated uses and to improve existing conditions. The Yamuna sometimes called Jamuna or Jumna is the largest tributaryriver of the Ganges (Ganga) in northern India. It is perennial in nature as it receives all the three types of water inputs *i.e*., snowmelt runoff, rainfall runoff and groundwater (Mane *et al*. 2005). However, the three components vary in space and time. The extent of human activities that influence the environment particularly the freshwater has increased dramatically during the past few decades (Kulshrestha and Sharma, 2006); Khanna*et al.* (2006). The scale of socio-economic activities, urbanizations, industrial operations and agricultural production has a widespread impact on water resources (Kurbatova, 2005). As a result, very complex inter-relationships between socio-economic factors and natural hydrological and ecological conditions have developed. A considerable work on Physico-chemical parameters has been done by many eminent limnologists in India and abroad (Mathivanan*et al*. 2007; Kannan and Job 1980; Ismael and Dorgham 2003; Khanna*et al*. 2007, 2010; Valecha and Bhatnagar 1988; Epstein 1972). The present study was designed to monitor seasonal variation in water quality parameter to investigate limiting factors, which could adversely affect the plants and animals, including fish production in this important river.

Study area

Dehradun or Doon Valley is the capital city of the State of Uttarakhand in North India. It is surrounded by the Himalayas in the north, Shivalik Hills in the south, the River Ganges in the east and the River Yamuna in the west. It is located between

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29 ° 58 'and 31 ° 2' 30 "north latitude and 77 ° 34 '45" and 78 ° 18' 30 "east longitude. The River Yamuna originates from the Yamunotri Glacier at a height 6,387 mtrs., on the south western slopes of Banderpooch peak (38^0 59' N $78^0$27'E) in the Mussoorie range of lower Himalayas at an elevation of about 6320 meter above mean sea level in Uttarkashi district of Uttaranchal. It travels a total length of 1,376 kilometers (855 mi) and has a drainage system of 366,223 km^2, 40.2% of the entire Ganges Basin, before merging with the Ganges at TriveniSangam, Allahabad, the site for the KumbhaMela every twelve years.

Material and Methods

The present study was conducted on River Yamuna covering a stretch of approximately 20 km from upstream (S1) at Kalsi to downstream (S2) at Dakpathar. The study was carried out for a time period of one year from April 2011-March 2012 on monthly basis. Seasonal relation was later found to know the effect of different environmental conditions on river water. Water samples were collected every month early in the morning in sterilized sampling bottles and were analysed for twenty two important physical and chemical parameters. Few physico-chemical parameters like Temperature (^{0}C), transparency (cm), velocity (m/s), pH, free CO_2 (mg/l), and dissolved Oxygen (mg/l) were performed on spot and other parameters like turbidity (JTU), electric conductivity (µmho/cm), total Solids (mg/l), TDS (mg/l), TSS (mg/l), total alkalinity (mg/l), total hardness (mg/l), calcium (mg/l), magnesium (mg/l), chloride (mg/l), BOD (mg/l), COD (mg/l), phosphate (mg/l), nitrate (mg/l), sodium (mg/l) and potassium (mg/l) were analysed in laboratory by following the methodology of APHA (1998); Khanna and Bhutiani (2004); Trivedi, and Goel (1986); Wetzel and Likens (1991). Temperature, transparency, velocity was measured by using Celsius thermometer (0–110 ^{0}C), Secchi disc and flow meter. turbidity, conductivity and pH were measured by using Jackson turbidity meter, Conductivity meter and digital pH meter. Total solids TDS, TSS were measured by volumetric analysis. total alkalinity, total hardness, calcium, magnesium, chloride, free CO_2, DO BOD and COD were analysed by titration method. Phosphate and nitrate were analysed by using UV-VIS Spectrophotometer and sodium and potassium by Flame photometer.

Results and Discussion

The physico-Chemical parameter (Avg.± SD) values obtained in different seasons of River Yamuna are given in table 1. From the results the temperature showed a great variation in all the three seasons and was recorded maximum in summer (20.0±1.82) and followed by monsoon (19.5±1.29) minimum in winter (15.75±1.25). The variation in the water temperature may be due to different timing of collection and influence of season (Parashar, *et al*., 2006). Same study was made by Khanna *et al.* (2011) in river Ganga at Haridwar. Velocity was recorded highest in monsoon followed by summer and minimum in winter. But the main source to this river is precipitation that it receives and has a great velocity in its flow during monsoons. The pH of water is important because many biological activities can occur only within a narrow range. Thus, any variation beyond an acceptable range could be fatal to a particular organism. Zafer and Sultana (2007) reported pH of 7.6 and 7.55 respectively for monsoon season. In present study the pH recorded in monsoon was (8.2±0.08 at S2 and 8.05±0.05 at S1) and (8.25 ± 0.12 at S1 and 8.4±0.08 at S2) in summer. Turbidity is a major problem in the river water of all states. The turbidity value (660.0 ± 421.9 at S1and (701.25±439.1 at S2) was found higher during monsoon season. The transparency was found maximum in summer (167.5 ± 255.03 at S1 and 141.2±206.0 at S2) and was found lowest monsoon period.TDS and TSS were found maximum in monsoon and minimum in winter and showed a wide variation in all the three seasons. Khanna*et al*. (2003) in Ganga water showed wide variation in TDS in different months on different sites. Total solids cause ecological imbalance in the aquatic ecosystem by mechanical abrasive action. Higher values of total solids may cause deterioration of the surviving conditions of aquatic organisms. Same conditions were shown by Khanna*et al.* (2001).Alkalinity of water is a measure of weak acid present in it and of the cation balanced against them.Alkalinity plays an important role in controlling enzyme activities.

Table 1 showing average seasonal variation in physico-chemical parameters in river Yamuna for the year April 2011 to March 2012

Parameters	Summer		Monsoon		Winter	
	S1	S2	S1	S2	S1	S2
Temperature (°C)	18.7 ± 1.70	20.0±1.82	19.2± 0.95	19.5±1.29	15.75±1.25	16.0±0.81
Transparency (cm)	29.8 ± 18.47	39.57±22.53	5.55± 4.03	5.80±4.03	22.32±4.17	42.47±12.62
Velocity (m/s)	1.38 ± 0.16	1.67±0.17	2.28 ± 0.64	2.73±0.14	1.15±0.07	1.61±0.11
Turbidity (JTU)	167.5 ± 255.03	141.2±206.0	660.0 ± 421.9	701.25±439.1	28.87±5.00	32.50±6.45
Conductivity (µmhocm^{-1})	0.224± 0.03	0.169±0.03	0.183±0.008	0.214±0.02	0.179±0.006	0.16±0.01
T.S (mg/l)	400.0 ± 141.4	575.0±170.7	825.0±170.7	950.0±251.6	300.0±81.64	350.0±129.0
TDS (mg/l)	225.0± 125.8	300.0±81.64	400.0±141.42	450.0±100.0	175.0±95.74	200.0±81.64
TSS (mg/l)	175.0 ± 50.0	275.0±150.0	425.0±95.74	500.0±200.0	125.0±50.0	150.0±57.73
pH	8.25 ± 0.12	8.4±0.08	8.05±0.05	8.2±0.08	8.12±0.09	8.07±0.09
Total alkalinity (mg/l)	181.0± 5.88	141.7±16.60	186.75±8.13	145.0±6.48	159.5±6.85	150.5±4.65
Total Hardness (mg/l)	81.50 ± 2.88	70.75±3.94	97.75±8.34	88.50±2.64	94.75±21.10	86.5±7.93
Calcium (mg/l)	44.57 ± 1.65	34.49±5.45	45.00±5.18	35.67±7.13	47.37±6.11	38.22±3.44
Magnesium (mg/l)	9.00± 0.49	8.84±2.10	12.86±0.79	12.88±1.15	11.55±3.68	11.77±1.49
Chloride (mg/l)	29.23 ± 2.58	35.29±5.65	33.63±2.80	38.16±5.17	26.67±2.48	35.06±1.97
Free CO_2 (mg/l)	1.39 ± 0.09	1.39±0.06	1.56±0.04	1.74±0.21	1.32±0.11	1.44±0.08
D.O (mg/l)	10.51 ± 0.67	10.44±0.18	10.20±0.66	10.30±0.32	11.96±0.32	10.87±0.50
B.O.D (mg/l)	2.85 ± 0.28	2.74±0.14	3.14±0.12	2.89±0.10	2.63±0.30	2.51±0.19
C.O.D (mg/l)	5.18 ± 0.78	4.98±0.80	5.74±0.37	5.46±0.48	4.52±0.29	4.47±0.17
Phosphates (mg/l)	0.57 ± 0.05	0.52±0.03	0.59±0.06	0.63±0.07	0.51±0.05	0.49±0.04
Nitrates (mg/l)	0.59 ± 0.09	0.50±0.04	0.49±0.05	0.55±0.01	0.46±0.07	0.49±0.02
Sodium (mg/l)	0.27 ± 0.06	0.37±0.02	0.30±0.06	0.34±0.03	0.35±0.07	0.27±0.04
Potassium (mg/l)	0.42 ± 0.06	0.36±0.04	0.34±0.05	0.34±0.02	0.31±0.03	0.42±0.04

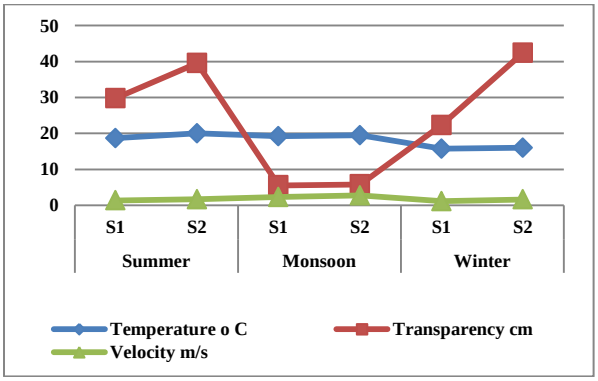

Fig1 Showing average seasonal variation in Temp., Transparency and velocity inriver Yamuna

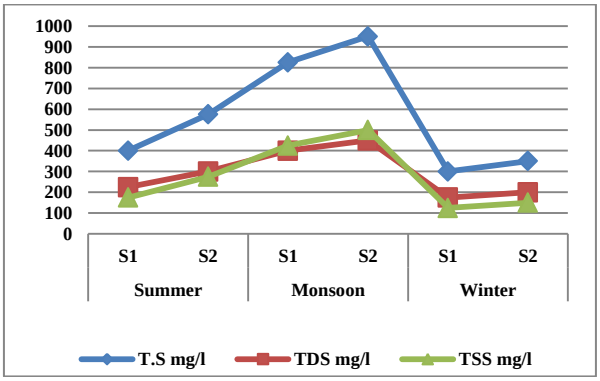

Fig3 Showing average seasonal variation in TS, TDS and TSS in river Yamuna

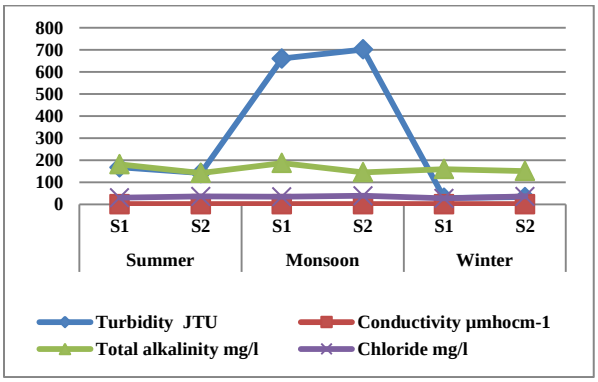

Fig2 Showing average seasonal variation in Turbidity, Conductivity, total Alkalinity andChloride in river Yamuna

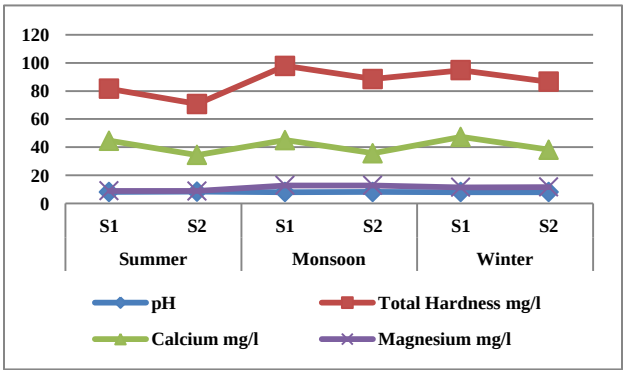

Fig4 Showing average seasonal variation in pH, Total Hardness, Calcium and Magnesium in river Yamuna

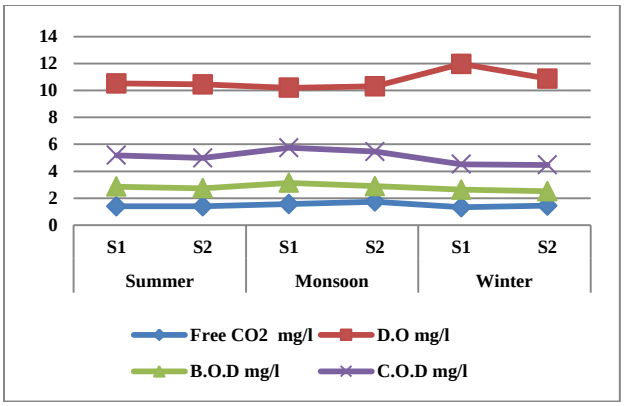

Fig 5 Showing average seasonal variation in FreeCO_2, DO, BOD and COD in river Yamuna

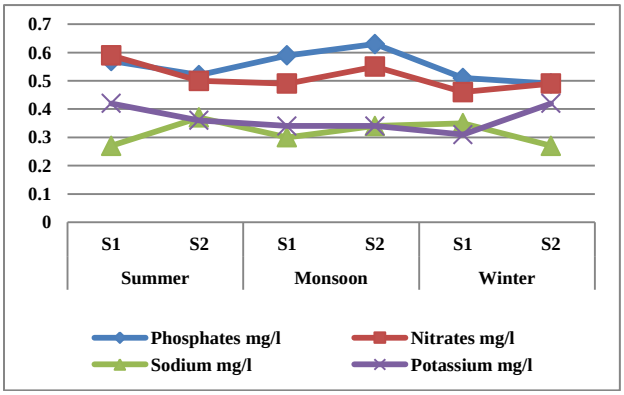

Fig 6 Showing average seasonal variation inhosphate, Nitrate, Sodium and Potassium in river yamuna

Maximum and minimum values of alkalinity in different seasons were found in the present study. Venkateswarlu (1969) attributed that there is an indication to suggest that alkalinity concentration is affected directly by rainfall. Similar effect has been noticed in the present investigation immediately often the onset of rains. The total alkalinity was found highest in monsoon (186.75±8.13 at S1 and 145.0±6.48 at S2) and minimum in winter. Bhatt *et al*. (1999) observed that the hardness of river increases in the polluted waters by the deposition of calcium and magnesium salts. Since the study area is free from industrial pollution, the hardness was observed fairly within the limits, which might be due calcium and magnesium salts coming from the mountain area. Total hardness was maximum in monsoon followed by winter summer. Calcium and magnesium are important contributors of water hardness. In present study both calcium and magnesium were found within the permissible limits. Chloride concentration in water indicates presence of organic waste particularly of animal origin (Thresh *et al*., 1949)**.** In the present studythe concentration of chloride varied greatly in all the seasons. It was found highest in monsoon (38.16±5.17) and lowest in winter (26.67±2.48).Dissolved oxygen data are valuable in determining the water quality criteria of an aquatic system. In the system where the rates of respiration and organic decomposition are high, the DO values usually remain lower than those of the systems where the rate of photosynthesis is high. Temperature also plays an important role in determining DO in an aquatic body. The DO recorded in present study was maximum in winter (11.96±0.32) and minimum in monsoon (10.20±0.66) indicating goo water quality and effect of seasonal change. This trend was also observed by Khanna and Bhutiani, (2003) in river Ganga at Haridwar. BOD has been used as a measure of the amount of organic materials in an aquatic solution which support the growth of microorganisms (Ciaccio, 1971). BOD determines the strength or polluting power of sewage, effluents and other polluted waters and provides data on the pollution load in natural waters. Higher values of BOD indicate a higher consumption of oxygen and a higher pollution load. In present study BOD (3.14±0.12) was found highest in monsoon and lowest (2.63±0.30) in winter. COD determines the amount of oxygen required for chemical oxidation of organic matter using a strong chemical oxidant, such as potassium dichromate under reflux conditions. The minimum COD values were found in winter (4.52±0.29 at S1 and 4.47±0.17 at S2) whereas minimum COD values were found in monsoon (5.74±0.37 at S1 and 5.46±0.48 at S2). Similar pattern was reported by Khanna and Chugh, (2004). Phosphate determination is useful in measuring the water quality since it is an important plant nutrient and may play a role of a limiting factor among all other essential plant nutrients (Dugan 1972) whereas Nitrate represents the end product of oxidation of nitrogenous matters and its concentration may depend on the nitrification and denitrification activities of micro-organisms (Sinha, *et al*., 2000). Phosphate, Nitrate, Calcium and Magnesium showed a slight variation in all the seasons and were found within permissible limits. In the present study all the three seasons had a great effect on the concentration of various physical and

chemical factors and showed a positive relation with the change in seasons.

Conclusion

The present study revealed that the physico-chemical conditions of river Yamuna were fairly good in all the seasons, however the slight variations were observed in river water in the monsoon season due to run-off of organic matter into river from foothills and river basin. The concentrations of various nutrients and other water quality parameters undergo seasonal changes and the values showed a slight variation in all the seasons. The problem of pollution was not serious in the water but the management efforts should be made for the conservation of River Yamuna in Doon Valley other wise it will turn into the state that would affect its physico-chemical status that may not be fit for human consumption as well as the growth and survival of aquatic life present in it.

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Ichthyofaunal diversity of Wardha river and Nirguda river in selected stretch of Wani, Dist. Yeotmal, (M.S.), India

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Abstract

Wani area, being a part of the Wardha river basin having rich fish fauna and blessed with vast inland water in the form of rivers with an excellent ecological condition for the propagation of fishes. Different types of small indigenous fishes are abundant in the water bodies in Wani area. These fishes are favorite and popular for their taste having an importance of their food value. The attempt has been made to study ichthyofaunal diversity of Wardhariver and Nirguda river in selected stretch of Wani during November 2008 to October 2009. During study, survey, collection and identification up to species level has been done with standard keys and books. In total 37 species of 24 different genera, 14 families and 7 orders were recorded from the Wani area.

Keywords:*Ichthyofauna, river, d iversity*

Introduction

India is an agro-based country and blessed with vast inland water. This provides excellent ecological condition for the propagation of fish. Lake, reservoir and riverine fishery is important in India from socio-economical point of view, as it has potential of providing employment to large number of people and also plays an important role in augmenting food supply and raising nutritional level. But, still potential of capture and culture fishery is yet to be fully explored and exploited.

Biodiversity is essential for stabilization of ecosystem, protection of overall environmental quality for understanding intrinsic worth of all species on the earth (Ehrlich, and Wilson, 1991). Hence it is a need of hour to conserve the fish biodiversity. But due to rampant mining activities, cement and thermal power project and urbanization there is every possibility of severe decline in fresh water fish fauna. Therefore an attempt has been made to investigate fish diversity and to prepare check list of local fishes from two water bodies, in particularWardha river and Nirguda river in Wani area, District Yeotmal (M.S.). The relevant studies on fish diversity in fresh water bodies of India are made by Pawar*et al*., (2003), Sakhare and Joshi, (2003), Meshram and Meshram, (2005), Jayabhaye *et al.,* (2006), Kadam and Gayakwad, (2006), Krishna and Piska, (2006), Muley and Patil, (2006), Battul*et al*., (2007), Kamble and Mudkhede, (2009),Shinde *et al.,* (2009) and Thirupathaiah*et al*., (2010) Atkare *et al.*, (2011).

Material and Methods

For the study firstly survey of water bodies in Wani area was done. The two spots on Wardhariver and two spots on Nirguda river were selected, where fishing activities were frequently carried out. Fishes were collected from these selected spots with the help of local fishermen and also from local fish markets. Fish collection was done during the period from November 2008 to October 2009, twice in every month. Fishes were identified up to the species level with the help of standard keys and book, (Day, 1967; Qureshi and Qureshi, 1983; Jhingran, 1997; Daniels, 2002 and Gupta and Gupta, 2006). Immediately after fish collection, photographs were taken with the help of digital camera, on graph paper to know the measurement

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of fish. Fishes were brought to laboratory and preserved in 10% formalin solution.

Result and Discussion

In the present survey, 37 species of 24 different genera, 14 families and 7 orders were recorded form the Wani area. The members of the order cypriniformes were dominated by 18 species followed by siluriformes and perciformes with 8 species each and osteofromes, anguilliformes and cyprinodontiformes with 1 species each (Table-I). Out of 37 species, 10 species are most abundant, 17 species are abundant, 8 species are less abundant and 2 species are rare. To avoid the species loss and restore habitat these river systems should be given an urgent priority in the management planning.

Table-I: Fish diversity in Wani area (Wardh river and Nirguda river)

S.N.	Order	Family	Scientific Name	Local Name	Common Name	Status
	Osteoglossiformes	**Notopteridae**				
1			*Notopterus notopterus*	Patola	Feather backnife fish	++
	Anguilliformes	**Anguillidae**				
2			*Anguilla bengalensis*	Tambu	Indian long-fin Eel	-
	Cypriniformes	**Cyprinidae**				
3			*Salmostoma bacaila*	Chal	Large razor belly minnow (Silver fish)	++
4			*Barilius barna*	Batri	River carp baril	+++
5			*Cyprinus bendelisis*	Zora	Hamilton's baril	+
6			*Rasbora daniconius*	Gana	Black line Rasbora	+
7			*Cyprinus mola*	Nawari	Mola	+++
8			*Osteo bramacotio*	Bhondu	Cotio	++
9			*Punctius dorsalis*	Kodsi	Long snouted barb	++
10			*Punctius sarana*	Karwadi	Olive barb	++
11			*Punctius sophore*	Karwadi	Spot fin barb	++
12			*Punctius ticto*	Tepri	Fire fin barb	++
13			*Punctius curmuca*	Bhurungi	Kolas (Buchanan's carp)	++
14			*Punctius amphibius*	Ghuruti	Scarlet-banded barb	++
15			*Garra mullaya*	Mahir	Stone sucker	++
16			*Cirrhinus mrigala*	Mrigal	Mrigal	+++
17			*Catla catla*	Katla	Catla	+++
18			*Labeo calbasu*	Karoti	Kalbasu	+
19			*Labeo rohita*	Rohu	Rohu	+++
20			*Cyprinus carpio*	Cipla	Cipla	+++
	Siluriformes	**Bagridae**				
21			*Rita rita*	Bhokhi	Rita	+
22			*Mystus cavasius*	Katwa	Gangaticmystus	++

23			*seenghala*		fish	+
S.N.	**Order**	**Family**	**Scientific Name**	**Local Name**	**Common Name**	**Status**
	Siluriformes	**Siluridae**				
24			*Ompok bimaculatus*	Barangi	Indian butter cat- fish	++
25			*Ompok pobo*	Waddi	Pabda	+
26			*Wallago attu*	Sawda	Shark cat-fish	++
		Claridae				
27			*Clarius batrachus*	Mangur	Magur	++
		heteropneustidae				
28			*Heteropneustes fossilis*	Ingur	Stinging cat-fish	-
	Cyprinodontiformes	**Belonidae**				
29			*Xenentodon cancilla*	Chocha	Needle fish	+
	Perciformes	**Ambassidae**				
30			*Ambasis nama*	Zanjad	Indian glassy fish	++
31			*Ambasis ranga*	Zanjad	Indian glassy fish	++
		Nandidae				
32			*Nandus nandus*	Dukkar	Leaf fish	+++
		Cichlidae				
33			*Tilapia mossambicus*	Telabi	Egyptian mouth breeder	+++
		Gobidae				
34			*Glossogobius girus*	Kaddu	Tank gobi	+
		Channidae				
35			*Channa punctatus*	Mallar	Spotted snake head	+++
36			*Channa striatus*	Dhadak	Banded snake head	+++
37	Synbranchiformes	**Mastacembelidae**				
			Mastacembelus armatus	Bamb	Spiny Eel	++

+++: Most abundant, ++: Abundant, +: Less abundant, -: Rare

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Zooplankton diversity in three water bodies of Satara District (M.S.) India

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Abstract

The present study deals with the diversity of zooplankton and physico-chemical parameters of fresh water bodies from the Satara district. The present work is carried out for 2 years from June 2006 to May 2008. A total of five major groups of zooplankton namely rotifers > copepods >cladocearans>protozoan >ostracods were reported during course of study. The study reports 66 species of zooplankton where rotifers dominates all other groups.

Keywords: *Plankton, water body, rotifer, diversity.*

Introduction

The reservoirs play an important role in maintainces of ecological balance. They need to be investigated for their biological parameters. Zooplankton plays a key role in transferring energy from one trophic level to other in the aquatic habitat. Zooplankton comprising of rotifers, cladocerans, copepods and ostracods are considered to the most important in terms of population density, biomass productivity grazing and nutrient generation in any ecosystem. Their diversity and density is mainly controlled by availability of food as favorable water quality (Chandrasekhar and Kodarkar, 1997). In recent years reservoirs have received their attention because of environmental crises. Zooplankton has been considered as indicators of organic pollution of reservoirs. From point of view, enlisting of the species of zooplankton is interesting.

Material and Methods

The selected fresh water bodies receive about 6,226 mm rainfall annually. The present investigation reports on physico-chemical parameters such as pH, E.C., BOD, DO., COD, hardness, alkalinity and biodiversity of zooplankton of three reservoirs from Satara district. The water from these reservoirs is used for drinking, domestic purpose, irrigation, power generation and aquaculture practices. The selected reservoirs are located Kas(N 17º43 05 º 90; E73 º 46 42 º 61), Kanher (N17 º 44 16 º 02: E 73 º 53 43 º 10) and Mahadare(N17 º 40 58 º 43: E 73 º 58 22 º 92) reservoir from Satara district. From these reservoirs, water samples were collected for analysis of physic-chemical parameters and diversity of zooplankton.

Zooplankton samples were collected with plankton net and preserved by using 0.5 ml of formalin in 50 ml sample collected after filtration of 50 liters of water. The water samples were brought to the laboratory for physic-chemical analysis in separate plastic cans. The phytoplankton was studied under the microscope and micrographs were taken using Nikon L-20camera. They were identified using standard literature such as APHA (1992), Fritsch (1965), Hutchinson (1957), Biswas (1980), and Edmondson (1963). The physico- chemical parameters were studied by using APHA (1992) and Trivedy and Goel (1986).

Result and Discussion

In the present study 66species of zooplankton were found. Out of these 29 belong to rotifers, 9 belong to copepods, 18 belong to cladocearans, 07 belong to protozoan, 3 belong to ostracods table 2. The zooplankton diversity is highest at Mahadare and lowest at Kas reservoir. Summer abundance of rotifers was observed with *B. falcatus*, *B. calcyciflorus*, and *Lecane species* were pollution indicator mostly dominated in Mahadare reservoir

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as compared to Kas and Kanher reservoir. Summer peak of copepods was due to diatoms and blue green algae where winter peak of cladocerans was due to stable water conditions, favorable conditions and availability of food material (Edmondson 1963).The highest pH is recorded at Mahadare (6.51), the highest E.C. is recorded at Mahadare (0.28 ohms/ cm), the highest DO is recorded at Kanher (9.44 mg/l), the highest BOD is recorded at Kanher (13.99 mg/l), the highest COD is recorded at Mahadare (16.46 mg/l), highest alkalinity is recorded at Mahadare (136 mg/l), The highest totalhardness is recorded at Mahadare (98 mg/l). The highest free CO_2 (9.25 mg/l).& chloride is recorded at Mahadare (47.62 mg/l). The highest nitrate is recorded at Kanher dam (25.19 mg/l). The highest total dissolved solids are recorded at Mahadare (1581 mg/l) Table 1. From the investigation, it was found that some of the parameter like pH, dissolved oxygen, hardness and chloride are within permissible limits but others like TDS, BOD, exceeded slightly above permissible limits laid by WHO (1983) &ICMR (1975). The results indicate excellent status of water body. But in future there is a need by municipal corporation and state government authorities to take some concrete steps for maintaince of reservoir for better health of people residing in that area. The reservoirs show rich zooplankton diversity due to stable water condition, availability of food material and favorable pH and temperature.

Table .1 Records the physico-chemical parameters of three water bodies

Parameters	Kas reservoir	Kanher dam	Mahadare reservoir
pH	6.02±0.015	6.16±0.02	7.38±0.24
E.C.	0.02±0.001	0.13±0.001	0.28±0.001
DO	6.51±0.011	6.23±0.025	9.44±0.761
Free CO_2	6.53±0.030	6.31±0.184	9.25±0.030
Acidity	8.06±0.871	7.22±0.13	23.70±1.286
Alkalinity	32.83±1.607	55.03±6.98	136.33±1.527
Hardness	38.22±0.344	67.02±4.02	98.00±2.000
Calcium	7.43±1.258	8.03±0.64	24.66±2.427
Magnesium	4.35±0.902	12.05±0.97	8.68±2.452
BOD	8.43±0.278	13.99±1.895	10.32±0.09
COD	8.10±0.091	12.83±0.08	16.46±0.413
Chloride	27.11±1.124	35.01±0.69	47.62±2.083
Hydrogen Sulphide	3.04±0.175	4.59±0.13	4.12±0.251
Sodium	6.33±0.081	11.07±0.60	24.63±3.42
Nitrate	5.96±0.646	25.19±1.19	12.45±0.101
Total dissolved solids	705±7.424	1211±35.062	1581±12.666

All parameters are in mg/l except pH and E.C. (μmhos/cm)

Similar type of work has been reported by no. of workers. Hujare (2005) reported absences of any seasonal trend in ostracads on the basis of their work on Talsande&Attigare reservoir. Pawar and Pulle (2005) recorded 60 species of zooplankton from Prthwadaj dam of Nanded. Pai and Berde reported 48 & 50 species of zooplankton from Sadoba pond of Kolhapur district and Santacruzlake from Goa respectively. Kamble and Meshram 2005) recorded11 species of zooplankton from Khatijapur tank from Amaravati district. Pailwan*et al*., (2008) recorded 35 species of zooplankton from 3 fresh water Tanks of Kolhapur. Rajagopal*et al*., (2010) recorded 47 species of zooplankton inChinnapperkovil pond, 39 sp. in Nallanchettipatti pond & 24 in Kadabamkulam pond of Tamilnadu. Shaikh*et al*., (2010) recorded 26 species of zooplankton in fresh water bodies around Aurangabad.

Table . 2. Diversity of zooplankton in three reservoirs of Satara district.

S.no.	Plankton	Kas	Kanher	Mahadare
	A. Rotifers			
1	*Brachionus angularis*	+	+	+
2	*Brachionus bidentata*	+	-	-
3	*Brachionus caudatus*	-	-	+
4	*Brachionus calafertus*	+	+	+
5	*Brachionus clayciforus*	+	+	+
6	*Brachionus diversicornis*	+	+	-
7	*Brachionus durgae*	-	-	+
8	*Brachionus falcatus*	-	-	+
9	*Brachionus forficula*	-	+	+
10	*Brachionus pallas*	+	+	+
11	*Brachionus quadridentata*	+	+	+
12	*Brachionus rubens*	+	-	-
13	*Euchlanis dilatata*	+	+	-
14	*Filinia bory*	+	-	-
15	*Filinia terminales*	-	-	+
16	*Filinia longistea*	+	-	+
17	*Keratella bory*	+	+	+
18	*Keratella cochleraris*	+	-	-
19	*Keratella procurca*	+	-	-
20	*Keratella quadrata*	-	-	+
21	*Keratella tropica*	+	+	+
22	*Lecane sp.,*	-	-	+
23	*Lecane closterocerca*	+	+	+
24	*Lecane hamata*	+	+	+
25	*Lecane luna*	+	-	-
26	*Lecane stichaea*	-	+	-
27	*Natholca acuminate*	+	+	+
28	*Polyarthra vulgaris*	+	+	-
29	*Trichocera porcellus*	+	+	-
	B. Copepods			
30	*Argulus foliceous*	-	-	+
31	*Cyclops sp.,*	+	+	+
32	*Dioptomus sp.,*	-	-	+
33	*Heleodiaptomus vidaus*	-	-	+
34	*Mesocyclops*.sp,	+	+	+
35	*Mesocyclops leukartii*	+	+	-
36	*Microcyclops sp.,*	+	-	-
37	*Nauplius larva*	+	+	+
38	*Phyllodiaptomus blanci*	-	-	-
	C. Cladocerans			
39	*Alona sp.,*	-	-	+
40	*Alona pulchella*	-	+	+
41	*Bosminia sp.,*	+	+	+
42	*Bosminia deiteri*	+	-	-
43	*Bosminia longirostris*	+	-	
44	*Ceriodaphnia cornuta*	+	+	+
45	*Ceriodaphnia laticaudata*	-	-	+
46	*Daphnia longirimis*	+	+	+
47	*Daphnia lumholtzi*	+	-	+
48	*Daphnia pulex*	+	+	+

49	*Daphnia vosea*	-	-	+
50	*Diaphnas amaexcisum*	-	-	+
51	*Indialonagana pati*	+	+	-
52	*Monia sp.,*	-	+	+
53	*Monia brachiatajurine*	-	+	+
54	*Monia macrocopa*	+	+	-
55	*Monia mircrura*	+	+	+
56	*Sida crystallina*	-	-	+
	D. Ostracods			
57	*Cypris sp.,*	+	+	+
58	*Cyclocypris globosa*	+	+	+
59	*Stenocypris sp.,*	-	+	+
	E. Protozoans			
60	*Amoeba sp.,*	+	+	-
61	*Amoeba radiosa*	+	+	+
62	*Arcella sp.,*	+	+	-
63	*Diffugia sp.*	-	+	+
64	*Paramecium sp.,*	+	+	-
65	*Trinema sp.,*	+	+	-
66	*Vorticella sp.,*	+	+	+

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Threatened wetland birds at Sirpur tank, Indore (M.P.)

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Abstract

Threatened species of wetland birds at Sirpur tank (Sirpurlake) Indore has been observed from October 2004 to September 2007. In this category 7 birds has been identified and reported. Their monthly count, migratory status, stay period has been studied and described the same along with some recommendations to protect them.

Keywords: *Wetland, waste water, threatened, lake*

Introduction

In India 2175 natural and 65254 man-made wetlands occupy 1.4 and 2.85 million hectares area respectively(Kulshrestha, 2002).However, according to the diversity of Asia Wetlands, wetlands in India occupy some 58.2 million hectares and some 93 wetlands meet the crises under the Ramsar Convention. Waterfowl i.e. aquatic birds are conspicuous elements of the wetlands fauna, readily identified, censuses and studied (Belsare, 1994). Waterfowl are playing an important role in the wetlands ecosystem because they belong to consumer level in food chain of such ecosystem (Prakash and Shinde, 1999). They are often regarded as an important indicator of changes in the aquatic environment (Eriksson, 1984; Koskimies and Poyasa, 1985; Koskimes, 1987 and Belsare, 1994).Several of the threatened waterfowl at West Asia has been the subject of detailed studies and are currently receiving a considerable amount of attention from nation and International conservation bodies. IUCN and Bird International also listed the endangered species of India and other. Looking to the important of endangeredspecies in the present study we have studied the Water fowl of Sirpur tank and listed those one which are endangered.

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Methodology

Sirpur tank is also known as Sirpur Lake. It is man-made shallow tropical lake constructed in 1868. This lake is located at the Sirpur village (Tehsil and District, Indore, M.P.) on the left side of Indore-Dhar Road (NH 59) about 8 KM West from the Indore city. Geographically, the village is situated at $22^0$40'N latitude and $74^0$45'E longitude. The MSL is 421 meter.Sirpur tank was regularly surveyed at interval of 15 days between 6 am to 9 am from October 2004 to September 2007. Identification of waterfowl was done with the help of books of Ali and Riplay (1983), and Ali (2002). Waterfowl were manually counted by walking on Lake Bank or boating from one comer of the tank to otherwith the help of high power binocular.

Results and Discussion

Several of the threatened waterfowl at West Asia have been the subject of detailed studies, and are currently receiving a considerable amount of attention from national and international conservation bodies. Many waterfowl species occurring in South and West Asia are threatened with extinction (Green 1993). The IUCN (1988) red list of threatened animal includes 14 species of birds which are dependent on wet lands in West Asia.It grouped globally threatened species of birds into critically endangered, Endangered, Vulnerable, Conservation dependent, Data deficient and near

threatened category. Out of these six categories, two were observed in the present water body. In Vulnerable category only one *species-Grusanto gone*(Sarascrane) was observed, while in Near threatened category four species viz. *Arhin garufa*(*Darter*), *Mycteria leucocepala*(*Painted* stork), *Threskiornis aethiopiea*(*Oriented* white ibse) and *Athyanyroca* were observed. *Gallicrex cinera*(*Water* cock) and *Anser indicus*(*Bar* headed goose) were also reported endangered by Sridhar and Srinivasan (1993) and Bhupathy*et al.,* (1993). These two birds were also observed in the present study (table 1).The interesting observation noted for *M. leucocephalic* was that this bird described by Ali and Ripley (1987) as in resident category. But in the present two years study this bird was observed only from October to March.Thus as for as this wetland is concerned this bird can be put under the resident migratory category.According to Bird LifeInternational (2001) there are 78 globallythreatened birds' species in India.Among these 27are restricted range species, 25 are endemic and two are found in secondary areas. The key habits forthreatened species are wetlands (29 species).Collar *et al.* (1994) described only three categories of threatened species i.e. critically endangered, Endangered and Vulnerable. Asian waterfowl census 1994-96 (Lopez and Mundkar, 1997) following the status of Collar *et al.,* (1994) included *A.nyroca* under vulnerable category. This species of waterfowl was also observed in the present study. However, waterfowl censes conducted during January throughout India between 1987-81 (Sridhar and Shrinivasan (1993) revealed nine resident species to be endangered in India viz. Greater Adjutant Stork (*Leptoptilus dubius*),Lesser Adjustant Stork (*Leptoptilus javenius*),Water Cock (*Gallicrex cinerea*),Black necked Stork (*Epnippiorhynchus astiaticus*),Black bellied Tern (*Sterna malanogester*), Spot bil Pelicans (*Pelicanus philisppensis*),Oriental Darter (*Anhingam elanocephala*) and Large whistling teal (*Dendro cygnabicolour*).Out of these endangered birdsonly one species of Water Cook *(Gallicrex cinera) was*

Table-I: Annual count of endangered waterfowl observed at Sirpur tank, Indore.

S.No.	Species	Common name	O	N	D	J	F	M	A	M	J	Total stay in months	Relative Status (Ali &Replay, 1987)
1	***Arhingarufa* (Pennat)**	Darter	4	5	5	8	5	10	7	5	4	9	RM
2	***Mycteria lencocephala* (Pennant)**	Painted Stork	No	No	No	12	12	10	No	No	No	3	RM
3	***Threskiomis acthiobica* (Latham)**	White Ibis	4	4	3	4	4	4	No	No	No	6	R
4	***Anserindicus* (Latham)**	Ban headed gouse	No	No	No	4	4	4	No	No	No	3	RM
5	***Avthya nyroca* (Guidemstadt)**	White eyed Pacharas	No	45	50	403	494	498	250	No	No	6	RM
6	***Grusantigone* (Linnaeus)**	Saras Crane	6	6	6	6	6	4	4	4	4	9	R
7	***Gakkucrex cuberea* (Gnelin)**	Water Cock	10	10	10	15	15	12	10	10	10	9	R

observed in the present investigation. Bhupathy *et al*. (1993) described Barheaded Goose (*Anserindicus*)as endangered species present in the Keolodeo National Park, Bharatpur during winter from 1985-89. This species was also observed during the present study. Thus presence of endangered species in the studied water body highlights its National and International importance. In the present study Sirpur tank (lake) was found threatened by a number of factors and main factor was poaching because it is not at all protected. Other factors like uncontrolled fishing, domestic pollution, unfriendly anthropogenic activities and extensive trapa culture were also found disturbing the stay of not only endangered species but other waterfowl too. Therefore, adequate protection from the habitat destruction and hunting is urgently required.

Recommendations

This water body needs protection from-

(i) The habitat destruction and hunting.

(ii) Fishing and Trapa culture activity.

(iii) Negative anthropogenic activity like:

(a)Bathing and Washing of cloth and cattle etc.

(b)Dumping of pollution creating material, and

(c)Need more detail and regular study on migratory bird's population, habitat distribution and association with habitat etc.

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