ISSN 0972-3099

Environment Conservation Journal

Volume - 10, Number (3), 2009

An International Journal Devoted to Conservation of Environment

Action for Sustainable, Efficacious Development and Awarness (ASEA), India
www.environcj.com

Environment Conservation Journal

ISSN 0972-3099

Environment Conservation Journal

(ISSN 0972-3099)

An International Journal Devoted to Conservation of Environment

Volume 10, Number (3), 2009

Impact Factor: 0.156

Editorial Office
405, Vivek Vihar, Ranipur More,
Opposite Hotel Vinayak, Haridwar- 249 407
Uttarakhand, India

Published by: Action for Sustainable Efficacious Development and Awareness (ASEA)
Phone: 09897020147, 09412072917 **www.environcj.com** **E-mail: environcj@gmail.com**

INSTRUCTIONS TO AUTHORS

Aims and Scope: Environment Conservation Journal aims to publish original research/ review papers/ Book reviews/ Reports on conferences/ seminars/ important events, news of interest/ information on forthcoming seminar/ books on the environment related aspects. It encourages submission of two categories of papers. The first category comprises scientific papers and second category comprises engineering papers. The study of environment is inherently multidisciplinary. Therefore, the Journal publishes wide range of topics including.

Limnology	Environmental Modeling
Fish and Fisheries	Environmental Pollution
Toxicology	Conservation and Management of Natural Resources
EIA/ Environmental management	Environmental Legislations
Environmental Ethics	Occupational Safety and Industrial Hygiene
Environmental Microbiology	Mineralogy
Environmental Policies	Ethnobotany
Ethno Zoology	Ayurveda
Animal Physiology	Botany

Authors are requested to download the Consent to Publish and Transfer of Copyright form from the Website. Please send a completed and signed form by mail to the Environment Conservation Journal Office.
It supports a wide range of submission file formats, including MS Word, Adobe Pagemaker 5.0, RTF and GIF, JPEG for figures.
PDF is not the recommended format.

Manuscripts should be submitted to:

SUBMISSION@ENVIRONCJ.COM CC to Editor @ environcj.com

Manuscripts: Manuscript should be typewritten with double spacing and wide margins on high quality white paper. Subdivision of the paper into Abstract (50-100 words), Introduction, Materials and Method, Results and Discussion, Conclusion, Acknowledgements and References is recommended. In addition, section headings are often useful.
Page 1: of the manuscript should contain the Title of paper, Article type, Keywords for computer aided searching, Author(s) name, Affiliation(s), complete address for correspondence including electronic address, telephone and Fax number
Page 2: of the manuscript should contain the Abstract (50-100 words) and at least six keywords in alphabetical order.
Page 3: of the manuscript should contain Introduction, Materials and Method, Results and Discussion, Acknowledgement if any, References

References
These are to be cited in the text by the author's name and year of publication like Gautam, 1989 in between the sentence or (Gautam, 1989) at the end of the sentence. Reference should be listed alphabetically in an unnumbered list at the end of the paper in the following pattern.

Papers in Journals
Bhutiani, R. and Khanna, D.R., 2006. Ecological study of river Suswa: Modeling DO and BOD. ***Environmental monitoring and assessment***, 125:183-196.
Edited Books/ Authored Books
Gautam, Ashutosh (ed.) 1998. *Conservation and Management of Aquatic Resources,* Daya Publishing House, New Delhi.
Ph.D. Thesis, Dissertation and Reports
Bhutiani, R., 2004. Limnological status of river Suswa with reference to its mathematical modeling, Ph.D. Thesis submitted to Gurukul Kangri University, Haridwar, Uttaranchal, India.

Papers in edited works

Goel, P.K. and Autade, V.B., 1995. Ecological studies on the river Panchganga at Kolhapur with emphasis on biological components In. Ashutosh Gautam and N.K. Agarwal (eds.), Recent Researches in Aquatic Environment, Daya Publishing House, New Delhi. pp: 25-46.

Tables

Tables should be typed on a separate page bearing a short title and numbered sequentially throughout the text.

Illustrations

All photographs, graphs and diagrams should be referred to as a 'Fig.' and they should be numbered consecutively (1, 2, etc.). All illustrations should be submitted separately, in a form suitable for direct reproduction, Illustration should be designed to allow 50 % reduction. These should be numbered sequentially. Captions and legends should be on a separate sheet.

Proofs

Proofs will be sent to the corresponding author by e-mail (if no e-mail address is available or appears to be out of order, proofs will be sent by regular mail). Your response, with or without corrections, should be sent within 72 hours. Always quote the Mss. No. and Journal Code (ECJ) along with your proof in the subject field of your email.

Color Figures

On demand color figures or photographs will be published with nominal charge of Rs. 5000/- per page (U.S. $ 200)

Reprints

A reprints order form will accompany the acceptance letter. The purchase of 25 reprints is compulsory and corresponding author will not receive reprints free of cost and Nominal cost will be charged for reprints.

Authors will be asked, upon acceptance of manuscript, to transfer copyright of the manuscript to the Society. This will ensure the widest possible dissemination of information under copyright laws.

Two hard copies of manuscript in original (not Xeroxed) along with online submission are to be submitted to: **Prof. D.R. Khanna, Editor-in-Chief, Environment Conservation Journal,** 405,Vivek Vihar, Ranipur More, Haridwar, 249407, Uttarakhand, India. or to **Dr. Ashutosh Gautam, Executive Editor**, India Glycols Ltd. Bazpur Road, Kashipur 244713, U.K. India.

For enquiry please contact:

Environment Conservation Journal: 405, Vivek Vihar, Ranipur More, Haridwar, 249407 (Uttarakhand) India
Tel: +91-09897020147, +91-09412072917
environcj@gmail.com

Abstracted/Indexed in:

Pollution Abstracts (U.S.A.)	**Environment Abstract (U.S.A.)**
Zoological Records (U.K.)	**Paryavaran Abstracts (India)**
Toxicology Abstracts (U.S.A.)	**Environmental Engineering Abstracts (U.S.A.)**
CAB Abstracts (U.K.)	**Aquatic Sciences and Fisheries Abstracts (U.S.A.)**

In case you encounter any difficulties while submitting your manuscript online, please get in touch with the responsible Editorial Assistant by clicking on "CONTACT US" from the toolbar.

It is a condition of publication that manuscripts submitted for publication in Acceptance of an Article/Paper by The Journal, the Author(S) will be asked to Transfer the Copyright of the Article to the ASEA, that will Environment Conservation Journal have not been published or submitted for publication simultaneously elsewhere.

For More Details Please Visit our Website: www.environcj.com

Environment Conservation Journal 10(3) 1-8, 2009
(ISSN 0972-3099)

Wildlife surveillance technique for monitoring Tiger and Leopard population in Katerniaghat Wildlife Sanctuary (Dudhwa Tiger Reserve), U.P., India

Ramesh K. Pandey[1] and Ganesh S. Bhat[2]

Received: 16-03-2009 Accepted: 20-07-2009

Abstract

It is said that monitoring of carnivore population is as important as estimating their numbers. Till date all over country, the effort of the protected area managers is centered around estimating the number than monitoring them. In order to counter this trend, the wildlife surveillance has been taken up in Katerniaghat Wildlife Sanctuary which involves systematic collection of data on wildlife evidences in each of the beats. The information gathered by such an exercise is later used to develop occupancy maps for carnivore species. Such occupancy maps are used in prioritising the managerial interventions in the protected area management.

Keywords:- *Katerniaghat, Surveillance,Tiger, Leopord, Sanctuary, Dudhwa*

Introduction

Monitoring carnivores is a process in which the end product is not only the number of individuals but an indication that there has been a change in the numbers, with an understanding of the factors that have been responsible for the change. Scientific monitoring of carnivore population is necessary to evaluate the success or failure of management interventions. The present day census based approaches have many biological and statistical weaknesses (Karanth, 1987). Hence the figures from census based methods are mostly inflated or deflated. In many cases the authenticity of the census figures are being questioned (Ex. Sariska case). Since the inception of project tiger in 1972, millions of dollars have been invested on tiger conservation and over the years several methods have been developed for estimating the numbers and monitoring the same. Unfortunately, these monitoring methods though highly sophisticated, suffer from variety of limitations in the field situation. In this context, an attempt has been made to develop a user friendly monitoring technique for the field staff and park managers to monitor the large carnivores in protected area and to understand their occupancy and population dynamics for effective protection and conservation.

Objectives

1. To assess the proportion of protected area (PA) occupied by different carnivore species (Tiger and Leopard).
2. To study the distributional range occupied by individuals of a species, whether their range increasing or decreasing, if so what are those areas, *etc*.
3. To assess the areas occupied by productive breeding population.
4. To study the population trend of major carnivore species.

Study area

The wildlife surveillance technique for monitoring big cats is taken up in Katerniaghat Wildlife Sanctuary (KWS) located in the Terai region of Uttar Pradesh, India. The protected area is a part of Dudhwa Tiger Reserve (DTR) located in the Indo- Nepal border. The Katerniaghat Wildlife Division, spread over an area of 550.75 sq km with 38 beats and 6 ranges is situated between 28^0 24' N latitude and $81^0$19' E longitude (Fig. 1). The

Author's Address

[1]Regional Deputy Director, Wildlife Crime Control Bureau, (N.R.), New Delhi, India. ✉
[2]DFO, Ballia Forest Division, Ballia, U.P., India

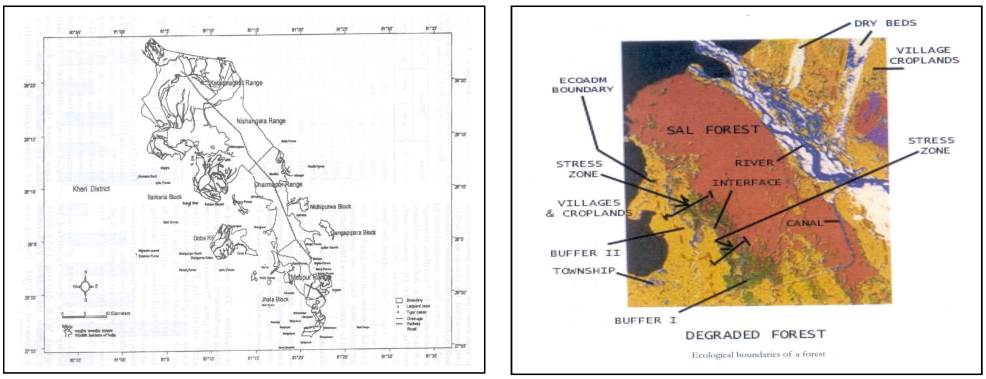


Fig. 1: Map of Katerniaghat Wildlife Sanctuary

Katerniaghat Wildlife Sanctuary of 400 sq km, together with the adjoining 150.75 sq km of reserve forest, which serve as buffer, constitutes one ecological unit. KWS is one of the most significant representatives of the Terai-Bhabhar bio-geographic sub division where combinations of grassland, wetland and dense forests are found. The sanctuary has strong connectivity with the Bardia National Park (Nepal) and Dudhwa National Park (India).

Climate

The protected area is subjected to extreme variations of heat and cold. The winter nights are very cold and foggy and heavy dews fall regularly. Heavy monsoon rains fall from then onwards until October. The average rainfall is about 1300 mm.

Geology, rock and soil

The protected area lies on the alluvium of Gangetic plain. In the low alluvial tract, soil is enriched in many places by a deposit of fine silt. The soil is alluvial with sandy to sandy loam texture.

Flora

The rich soil coupled with heavy monsoon result in immense floral diversity, which gives rise to a mosaic of diverse habitats. The main tree species are Sal (*Shorea robusta*), Asna (*Terminalia tomentosa*), Shisham (*Dalbergia sissoo*), Bel *(Aegle marmelos*), Kusum (*Schleichera oleosa*), Semal (*Bombax ceiba*) *etc*. The common grass species occurring in the area are Kaans (*Saccharam spontaneum*), Moonj (*Saccharam munja*) and Canes (*Calamus temas*).

Katarniaghat wildlife sanctuary has following forest types:- 1) Moist bhabar sal -3C/C2b
2) Light alluvium sal-3C/C2d(i)
3) *Terminalia tomentosa* forest- 3E1
4) Seasonal swamps- 4D/SS1
5) Dry plains sal -5B/C1b
6) Northern mixed dry deciduous forests- 5B/C2
7) *Aegle marmelos* forest– 5B/E6
8) Khair- Sissoo forest- 5B/S2;
9) Grasslands

Fauna

Katerniaghat Wildlife Sanctuary has diverse fauna. Besides tiger and leopard, the top predators, sanctuary houses five species of deer, namely Spotted deer (*Axis axis*), Sambar (*Cervus unicolor*), Barking deer (*Muntiacus muntjak*), Hog deer (*Axis porcinus*) and highly endangered Swamp deer (*Cervus duvaceli duvaceli*). The sanctuary also has a small population of elephant (*Elephas maximus*) and one horned rhinoceros (*Rhinoceros unicornis*). Amidst the dense forests of this PA flows the enchanting river Gerua. The crystal clear water of Gerua river has significant population of Gharial (*Gavialis gangeticus*), mugger (*Crocodilous paulostris*), Gangetic dolphin, Golden mahasheer and many species of turtles and tortoises. The protected area is also rich in avifauna (over 143 species) both of resident and migratory species.

Proforma-1

Date & time	Beat/ comp no.	Name of the staff	Physical features of the area	Animal sighted				Information from public	Remarks
				Signs*	Male	Female	Cubs		

Proforma-2

Date & time	Beat/ comp no.	Name of the staff	Physical features of the area	Pug mark details (cm)				GPS location
				PML	PMW	Step	Stride	

Proforma-3

Date	Beat/comp no.	Man eating	Mauling	Cattle depredation

Materials and Method

The beat of an administrative division is considered as a unit for the purpose of carrying out the wildlife surveillance. In each beat a preliminary survey is carried out to know the probable areas of tiger and leopard occupancy. Then, covering those areas surveillance routes are selected which may be forest roads, nalas, river banks, stream beds, gullies, bridle paths, etc. and same is delineated on beat and range map. Care is taken to choose surveillance routes in such a way that they best represent the entire area of the beat. In each of the routes Pugmark Impression Pads (PIPs) are prepared wherever necessary to get better and clearer signs. The pilot study was carried out between March 2005 and February 2009 and data were collected with the help of field staff.

Before taking up surveillance technique, the field staffs were given adequate training and mock exercises were conducted to get familiarized with the technique. Different proformas have been developed for recording the observation. In each of the surveillance routes beat staff goes on foot at least once in 2-3 days and records observations on direct sightings, indirect signs and information from public (Proforma-1). From March 2006 onwards efforts are being made to collect data pertaining to Pug Mark Length (PML), Pug Mark Width (PMW), step and stride along with GPS locations whenever pugmark trails of tiger/ leopard are available and same is recorded in Proforma-2. If there are any man eating, mauling and cattle lifting cases in a beat the information is recorded in Proforma-3.

The observation so recorded is compiled at range level on a weekly basis and on a monthly basis at division level. From these compiled information occupancy mapping is done on division map separately for tiger and leopard depicting the area of occupancy, areas occupied by breeding population *etc*.

Results and Discussion

Persual of previous six census figures (Table-1, Fig. 2) reveals that tiger population ranged from 40

to 67 and that of leopard from 7 to 32. Further the density ranged from 10.00 to 16.80 and 1.75 to 8.00 for tiger and leopard, respectively. The 2001 census showed a significant increase in tiger and leopard population as well as their densities. The wide ranging figure in a short span of time is the outcome of 'pugmark count' method, which is known to suffer from biological and statistical weaknesses. Hence, in the previous censuses in Katerniaghat Wildlife Sanctuary, the technical difficulty involved in 'overlapping elimination' cannot be denied altogether. Further, the shortcomings may also be attributed to the lack of technical know-how and the unexperience among the field staff.

In order to overcome the shortcomings associated with the 'pugmark count census method' wildlife surveillance has been carried out and the data has been compiled and presented in Table-2 and 3.

Persual of Table-2 and Fig. 3 indicates that the tiger sighting has been there through out the period of study with significantly better sightings in winter months as compared to summer months. This may be due to better accessibility of the area for staff, more uniform distribution of prey species and availability of water at number of places. Most importantly winter being the breeding season of big cats their increased movement and consequent frequent sighting is obvious. Poor sighting in summer months is justified due to concentration of prey species near water hole. In rainy season, due to water logging and closure of many parts of the protected area, the results are not consistent.

Table-1: Number and density of Tiger and Leopard during the last 6 census in Katerniaghat Wildlife Sanctuary

Year	Area (sq. km)	Tiger	Density (No/100sq km)	Leopard	Density (No/100sq km)
1995	400.00	40.00	10.00	7.00	1.75
1997	400.00	49.00	12.30	7.00	1.75
1999	400.00	49.00	12.30	18.00	4.50
2001	400.00	67.00	16.80	32.00	8.00
2003	400.00	61.00	15.30	25.00	8.00
2005	400.00	58.00	14.50	32.00	6.25

Table-2: Monthly sighting of Tiger and Leopard in Katerniaghat Wildlife Sanctuary

Month	Tiger			Leopard		
	Direct sightings	Indirect signs	Total	Direct sightings	Indirect signs	Total
March 05	14.00	17.00	31.00	8.00	4.00	12.00
April 05	16.00	34.00	40.00	14.00	5.00	19.00
May 05	4.00	93.00	97.00	16.00	43.00	59.00
June 05	17.00	33.00	50.00	11.00	18.00	29.00
July 05	18.00	43.00	61.00	5.00	17.00	22.00
Aug. 05	14.00	34.00	48.00	13.00	14.00	27.00
Sept. 05	12.00	41.00	53.00	11.00	19.00	30.00
Oct. 05	2.00	26.00	28.00	11.00	19.00	30.00
Nov. 05	17.00	48.00	65.00	7.00	27.00	34.00
Dec. 05	24.00	70.00	94.00	27.00	24.00	51.00
Jan. 06	15.00	132.00	147.00	23.00	29.00	52.00
Feb. 06	13.00	141.00	154.00	38.00	61.00	99.00

Table-3: Man eating, mauling and cattle lifting cases in Katerniaghat Wildlife Sanctuary

Year	Man eating	Mauling	Cattle kill
2003	2.00	3.00	5.00
2004	1.00	2.00	5.00
2005	2.00	3.00	32.00

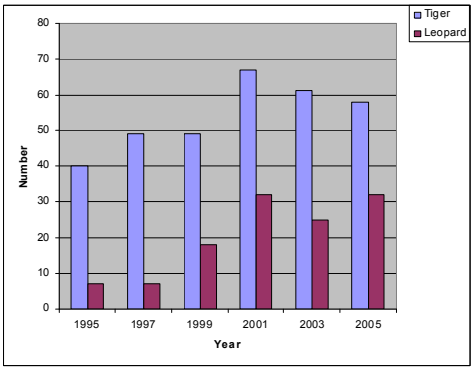


Fig. 2: Number of Tigers and Leopards in Katerniaghat Wildlife Sanctuary during the previous 6 census

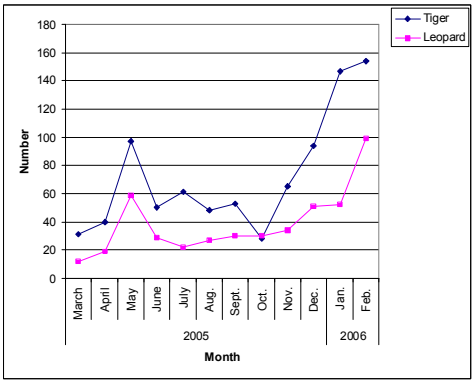


Fig. 3: Monthly sighting of Tiger and Leopards in Katernighat Wildlife Sanctuary

The monthly leopard sighting in Katerniaghat Wildlife Sanctuary follows the same trend as that of tiger. However, it is interesting to note that direct sighting of leopard is more than the indirect sightings in certain months. This may be attributed to their behavior as

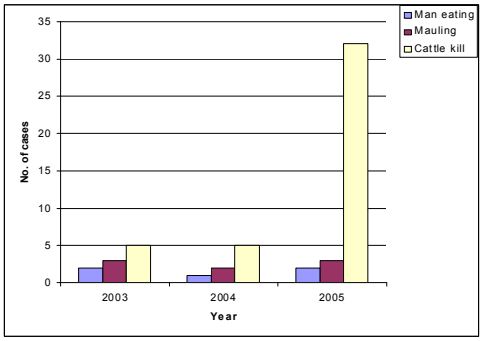


Fig. 4: Man eating, mauling and cattle lifting cases in Katerniaghat Wildlife Sanctuary

they generally do not adopt forest roads and PIPs and inhabits fringe areas.The cases of man eating, mauling and cattle lifting has been higher in the year 2005 compared to the previous years (Table-3, Fig. 4). The higher incidence of cattle lifting cases in the year 2005 is attributed to the increased surveillance. The information on man eating, mauling and cattle lifting cases has been found very useful in understanding the occupancy and distribution of big cats. For example, in the year 2005 a man has been killed in beat number 7 but there has been no report of tiger presence in that beat in the previous censuses. Thus man eating report has helped in establishing tiger occupancy in beat number 7.

Occupancy mapping

The beat wise monthly sighting of tiger and leopard has been presented in Annexure-1 and Annexure-2. During surveillance observation is also recorded on sighting on the sighting of tiger and leopard with their cubs.

Persual of beat wise monthly sighting of tiger and leopard indicates that leaving out 4 beats tiger has been sighted in all other beats at varying frequencies during the period of observation. Among the 33 beats the sightings have been exceptionally good in 8 beats indicating the hotspots. The 4 beats where tiger has not been sighted are the areas close to Indo Nepal border and these are the areas of illegal hunting by Nepali Mafia.

Similarly, leopard sighting has been consistent throughout the period in 29 beats. There have been

no sightings in 4 beats which are known to be tiger hotspots. Leopard absence in these four beats may be attributed to the interspecific competition in which tiger remains the winner. Leopard sighting has been prominent in several beats which are located in the fringe areas.

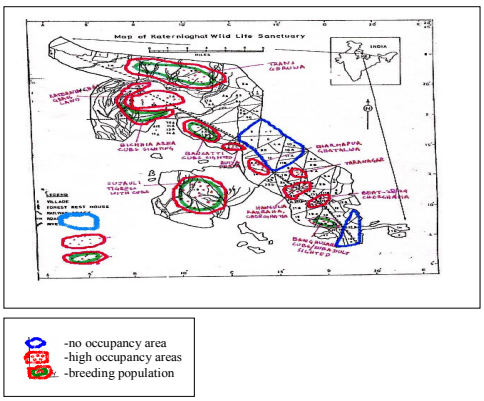


Fig. 5: Occupancy map of Tiger in Katerniaghat Wildlife Sanctuary

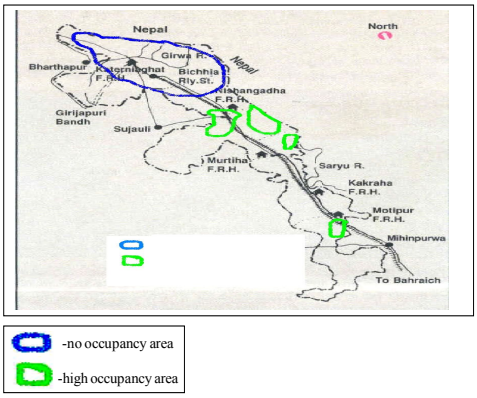


Fig. 6: Occupancy map of Leopard in Katerniaghat Wildlife Sanctuary

these areas the animal movement has drastically increased which is evident from the surveillance observation.

Plotting this information on the map (occupancy mapping) gave several interesting information (Fig. 5 and 6), like (a) The areas of occupancy of tiger and leopard; (b) Areas of high occupancy; (c) Breeding areas. This information definitely helps the protected area managers in deciding the areas which require high degree of protection and areas which require managerial interventions.

Future strategies

The present technique is useful in assessing the abundance of the carnivores in the PA. But, it will not give clear picture of the number of carnivore population. In order to get information on the exact no. of these population data on Pugmark detail (PML and PMW), step and stride along with their GPS location will be collected from March 2006 onwards.

The wildlife surveillance has been found very useful in knowing the impact of management intervention. For the last several years the movement of animals on the Northern side (Indo Nepal border) has been found negligible. But due to increased protection in this additional information is expected to be used in assessing the home range, territory as well as change in movement of any individual of a species.

Conclusion

Census is a number game. Many protected area managers are in a state of fix by the census figures. The present approach of wildlife surveillance will definitely be handy tool for us to overcome the weaknesses of the present day census methods. The present approach will also help the protected area managers in prioritizing the management interventions.

Reference

Karanth, K.U., 1987. In monitoring Tigers and Prey: Conservation needs and managerial constraints management plan, Katerniaghat Wildlife Division, 2006-2015.

Annexure-1: Beat wise monthly sighting of Tigers

Beat/ Month	March 05	April 05	May 05	June 05	July 05	Aug. 05	Sept. 05	Oct. 05	Nov. 05	Dec. 05	Jan. 06	Feb. 06
1A	-	3	10	5	4	1	2	2	3	6	11	14
1	4	2	10	4	5	8	7	3	6	2	16	27
2	1	2	5	2	1	3	1	2	5	2	8	8
3	1	1	3	3	1	0	1	0	0	2	2	4
4	-	5	6	3	3	2	3	1	6	4	4	5
5	2	5	9	11	11	6	4	1	5	18	6	4
6	-	0	0	0	0	5	0	0	3	0	3	4
6A	-	0	1	0	0	0	0	0	1	2	3	0
7	-	1	0	0	0	0	0	0	0	0	0	2
8	4	4	6	2	4	3	10	6	9	16	14	11
9	-	0	0	0	1	0	0	0	0	2	0	2
10	3	3	3	3	2	10	7	1	5	4	6	11
11	-	0	1	0	0	0	1	0	0	0	0	3
12	2	10	8	6	7	1	2	3	5	9	11	11
13	1	0	2	1	0	2	0	0	0	2	4	6
14	-	0	0	0	0	0	0	0	0	0	0	0
15	-	0	0	0	0	0	0	0	0	0	0	0
16	-	0	2	1	0	0	0	2	1	2	6	1
17	-	1	2	0	1	0	2	0	1	1	6	8
18	-	1	0	0	0	0	0	0	0	1	0	2
19	-	1	1	2	0	0	0	0	0	1	4	4
20	-	0	1	0	0	1	0	1	0	3	7	5
21	-	0	0	0	0	0	0	0	0	0	2	2
22	1	1	3	0	2	1	2	2	2	2	2	5
23	1	3	2	0	3	0	1	0	2	1	5	8
24	-	0	0	0	0	0	0	0	0	0	0	0
25A	-	0	0	0	0	0	0	0	0	1	4	1
25B	-	1	0	0	0	0	0	0	0	1	0	2
26	-	1	0	0	0	0	0	0	0	0	2	1
27	-	0	0	0	0	0	0	0	0	0	0	0
28	1	2	5	1	5	2	3	0	1	3	7	5
29	4	1	1	0	1	1	0	1	1	5	5	1
30	1	1	2	0	3	1	0	0	2	1	1	2
31	3	0	5	1	1	0	3	1	3	2	2	1
32	2	0	9	4	6	2	4	2	2	3	3	2
33	-	0	1	0	0	0	0	0	1	0	3	1

Annexure-2: Beat wise monthly sighting of Leopards

Beat/ Month	March 05	April 05	May 05	June 05	July 05	Aug. 05	Sept. 05	Oct. 05	Nov. 05	Dec. 05	Jan. 06	Feb. 06
1A	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	1	2	0	3	0	0	2	0	2	5
5	1	1	4	0	0	0	1	2	3	3	2	3
6	0	0	0	0	0	0	0	0	0	0	0	2
6A	0	0	0	0	1	0	0	0	0	0	1	5
7	0	0	1	1	0	1	2	0	0	1	1	3
8	1	2	2	4	2	2	0	1	4	2	2	5
9	0	0	4	2	2	1	2	1	0	1	3	6
10	2	0	1	3	0	0	0	0	1	1	0	2
11	0	1	0	2	2	3	3	0	3	5	3	4
12	0	0	0	3	0	0	0	0	0	0	0	0
13	0	0	0	1	0	1	0	0	0	0	0	0
14	0	0	1	0	1	0	1	3	3	4	2	2
15	1	1	1	0	0	0	1	1	0	0	1	3
16	0	0	1	0	0	0	0	0	0	0	0	1
17	0	1	1	2	2	0	1	0	0	1	2	4
18	1	0	3	0	0	1	3	3	3	7	8	15
19	2	1	0	1	0	1	0	0	1	0	4	6
20	2	2	1	3	0	2	3	2	1	6	8	7
21	0	0	1	0	0	0	0	0	0	2	1	2
22	0	0	0	0	0	0	0	0	0	1	1	2
23	0	4	1	0	1	0	0	1	0	1	0	1
24	0	0	0	0	0	0	0	0	0	0	0	2
25A	0	1	2	0	0	0	0	0	0	0	0	1
25B	0	0	0	0	1	0	0	0	0	0	0	0
26	0	0	0	0	1	0	0	0	0	0	0	1
27	0	1	6	0	2	2	1	1	1	1	1	1
28	0	0	7	0	0	3	4	2	3	3	2	3
29	0	0	0	0	2	3	0	1	3	2	4	4
30	0	2	1	1	1	1	0	1	0	3	2	3
31	1	0	4	1	0	0	0	0	0	0	0	1
32	1	1	7	7	4	1	4	8	3	1	2	3
33	0	0	1	0	0	0	0	0	0	0	0	2

Environment Conservation Journal 10(3) 9-13, 2009
(ISSN 0972-3099)

Effects of lead nitrate on oxygen consumption of fresh water prawn, *Macrobrachium dayanum* (Crustacea - Decapoda)

Kunwer Ji Tiwari[1], H.S. Lodhi[1], Sanjive Shukla[2] and U.D. Sharma[1]

Received: 20-03-2009 Accepted: 25-04-2009

Abstract

Freshwater prawn, *Macrobrachium dayanum* were subjected to acute concentration, 116.46 mg/l (96 hr LC_{50} value) and sub-acute concentration, 29.12 mg/l (25% of 96 hr LC_{50} value) of lead nitrate to evaluate its effects on oxygen consumption. Initial increase in oxygen consumption was noticed which was followed by gradual decrease up to 96 hr in acute exposure while significant ($F = 20.33$; $P < 0.001$) decrease in oxygen consumption was noticed through out the experiment during sub-acute exposure up to 30 days. Mechanism of lead intoxication and potential of oxygen consumption as bio-marker has been discussed.

Keywords:- *Crustacea, Freshwater, Lead nitrate, Macrobrachium dayanum, Oxygen consumption*

Introduction

Now a day's water pollution is a issue of great concern. Surface water, a limited commodity, is being continuously contaminated by various anthropogenic activities like industrial effluents, sewage, agricultural runoff containing insecticides, pesticides and various other chemicals. The load of contaminants is increasing day by day thereby deteriorating the life sustaining qualities of water bodies as well as adversely affecting aquatic flora and fauna (Jarup, 2003; Sharma and Agrawal, 2005). Among toxicants, heavy metals are lethal because of their long half life period, persistent accumulative and amplificative tendency in the food chain there by increasing the problem to many folds (Burman and Lal, 1994).

Among heavy metals, lead is a nonessential, ubiquitous environmental contaminant and belongs to the group of most toxic heavy metals in the biosphere. It produces cumulative toxic effects if taken in small doses and acute toxicity in higher doses (Sastry and Gupta, 1978). Lead enters into water bodies from industries and smelter discharges or dissolution of old lead plumbin (Moore and Rammamoorthy, 1984; Gupta and Salunke, 1985; De, 1996; Satake *et al*., 1997). Lead is considered as a non-specific poison affecting physiological systems and can cause brain damage, kidney damage, gastrointestinal distress and reproductive disorders (Campana *et al*., 2003; Kutlu and Summer, 1998).

Toxic effect of lead and other heavy metals on opercular beat and oxygen consumption has been mostly investigated in fishes (Hiltbran, 1971; Singh and Singh, 1979; Rao and Ramamurthi, 1987; Gill *et al*., 1988) but crustaceans despite being important member of food chain and having high economic and medicinal value are being documented less in reference to metal toxicity and oxygen consumption (Chinnaya, 1971; Ghate and Mulhelker, 1979; Papathanasiou and King, 1983; Tulasi and Rao, 1989; Reddy and Venugopal, 1993; Chinni *et al*., 2000; Jadhav and Ambore, 2007; Sen *et al*., 2008).

Considering the above facts, present work has been taken into account to evaluate toxic effects of lead nitrate on oxygen consumption of freshwater prawn, *Macrobrachium dayanum* (Crustacea-Decapoda), a potential animal for fresh water aquaculture.

Author's Address

[1] Prawn Research Centre, Deptt. of Zoology, University of Lucknow, Lucknow, India.
[2] Deptt. of Zoology, B.S.N.V. P.G. College, Lucknow, India. ✉

Materials and Method

Fresh water prawns, *Macrobrachium dayanum* (Henderson) (Sharma *et al*., 1997) were collected from river Gomti, Lucknow (U.P.), with the help of local fisherman and brought to the laboratory (N- 26° 5' 59" E- 80° 56' 17") in large plastic containers. The animals were maintained in glass aquaria of 20 liter capacity containing 10 liter dechlorinated water having physico-chemical characteristics as:- pH– 7.66 ± 2.67, Temperature- 27.66 ^{0}C ± 0.66, DO- 6.6 mg/l ± 0.74, Total alkalinity- 425.00 mg/l ±11.36, Total hardness- 268.00 mg/l ± 2.67 (Sharma and Shukla, 1990; APHA, 1998). Proper aeration was provided with the help of aerators and air diffusers.

Stock solution of lead (II) nitrate [$Pb(NO_3)_2$, M.W.- 331.21 gm/mole, A.R. Grade, manufactured by E - Merck (India) Ltd. Worli- Mumbai] was prepared by dissolving weighed amount of salt in double distilled water. Lead nitrate was dissolved in water by adding, 0.30 ml/l of concentrated nitric acid.

Adult inter-moult staged *M. dayanum* (Average length- 5.64 cm ± 0.42, weight- 3.261 gm ± 0.68) were used in experiments after 5-7 days acclimation to laboratory conditions. Acute exposure was carried out on 96 hr LC_{50} value (116.46 mg/l) for 24, 48, 72 and 96 hr while sub-acute exposure was carried out on 25% of 96 hr LC_{50} value (29.12 mg/l) for 10, 20 and 30 day respectively. One aquarium containing diluent water and 0.3 ml/l concentrated nitric acid only, served as control for each set. Feeding was suspended 24 hr before during acute exposure and through out experiment while change of exposure medium and food supply was maintained on alternate day during sub-acute exposure. Continuous air supply was provided by air diffusers and aerators in both control as well as experimental aquaria in both the experiments. Experiments were carried out under natural light and dark period. Both acute and sub-acute experiments were carried out according to guideline of APHA (1998). For oxygen consumption, prawns were kept in fully air tight and completely water filled containers of 5 liters capacity provided with stoppered outlets for collecting water samples. The respiratory rate was calculated hourly by monitoring of the falls in the concentration of dissolved oxygen after 24, 48, 72 and 96 hr in acute and 10, 20 and 30 days in sub-acute exposure respectively. For each control as well as exposed animals three replicate were maintained and dissolved oxygen (DO) was determined by using modified Winkler's method as per APHA (1998). The prawns were carefully weighed before being released into the control and toxic media. The oxygen consumption rate was determined as oxygen consumed (mg/l)/gm body wt/ hr. Experiment was replicated thrice and data were subjected to statistical analysis for student "t" test and ANOVA using MINITAB software on PC.

Results and Discussion

The rate of oxygen consumption of freshwater prawn, *M. dayanum* was studied after the acute and sub-acute exposure of lead nitrate. The results of acute exposure are summarized in Table-1 and Fig. 1. The prawns of exposed animals exhibited marked alterations in oxygen consumption from 24 to 96 hr than control ones. Exposed animals showed initial increase in oxygen consumption than control animals but declining trend in oxygen consumption was observed through out the experiment in exposed animals. A significant ($t = 5.13$; $P < 0.05$) increase in oxygen consumption of exposed animals (0.4686 ± 0.0135) was noticed after 24 hr of exposure than control ones (0.3684 ± 0.0142); thereafter a declining trend in oxygen consumption was observed in experimental

Table- 1: Effect of acute exposure of Lead nitrate on oxygen consumption of *M. dayanum*

Exposure duration (hr)	Oxygen consumption (mg/l)/gm body weight/hr (Mean±S.E)	
	Controlled	Exposed
24	0.3684±0.0142	0.4686±0.0135 *
48	0.3825±0.0081	0.4275±0.0082*
72	0.3634±0.0079	0.3339±0.0078^{NS}
96	0.3358±0.0078	0.2856±0.0078*

Note: *Denotes difference in means to be significant at P<0.05
NS Denotes difference in means to be insignificant at P<0.05

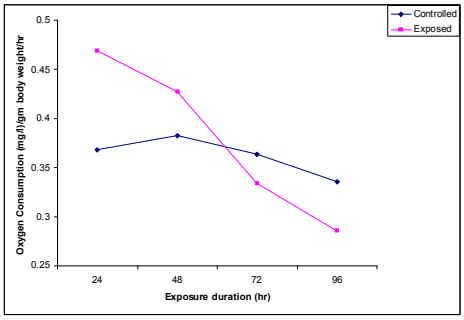


Fig. 1: Effect of acute exposure of Lead nitrate on oxygen consumption of *M. dayanum*

animals (0.4275 ± 0.0082) but it remained higher than control animals (0.3825 ± 0.0081) after 48hr exposure; the declining trend in oxygen consumption was continued in exposed animals (0.3339 ± 0.0078) and observed below than control animals (0.3634 ± 0.0079) after 72 hr exposure. Though the difference between control and exposed animals was found insignificant ($t = 2.66$; $P > 0.05$). Finally a significant ($t = 4.54$; $P < 0.05$) decrease in oxygen consumption was observed in experimental animals (0.2856 ± 0.0078) than controls (0.3358 ± 0.0078) after 96 hr exposure. The overall variations from 24 to 96 hr were found moderately significant in exposed animals ($F = 76.11$; $P < 0.001$) while insignificant in controls ($F = 3.91$; $P > 0.05$).

In sub-acute exposure experimental animals showed marked reduction in oxygen consumption through out the experiment from 10 to 30 days when compared with controls. The results of sub-acute exposure are summarized in Table-2 and Fig. 2. A significant ($t = 3.52$; $P<0.05$) decrease in oxygen consumption were observed in exposed animals (0.2943 ± 0.0077) than control (00.3489± 0.0135) after 10 day exposure. Thereafter a moderately significant ($t = 6.79$; $P < 0.001$) decrease in oxygen consumption was observed in experimental animals (0.2544 ± 0.0133) than control animals (0.3593± 0.0078) after 20 day exposure. Finally after 30 day exposure highly significant ($t = 13.89$; $P < 0.0001$) decrease in oxygen consumption was observed in exposed animals (0.2055 ± 0.0073) than control animals (0.3512 ± 0.0075). The overall variations from 10 to 30 days were found moderately significant in

Table-2: Effect of sub-acute exposure of Lead nitrate on oxygen consumption of *M. dayanum*

Exposure duration (Day)	Oxygen consumption (mg/l)/gm./ body weight/hr (Mean±SE)	
	Control	Exposed
10	0.3489 ± 0.0135	0.2943 ± 0.0077*
20	0.3593 ± 0.0078	0.2544 ± 0.0133**
30	0.3512 ± 0.0075	0.2055 ± 0.0073***

Note: Values are Mean±SE; N=5
*****Denotes difference in means to be highly significant at P<0.0001**
****Denotes difference in means to be significant at P<0.001**
***Denotes difference in means to be significant at P<0.05**

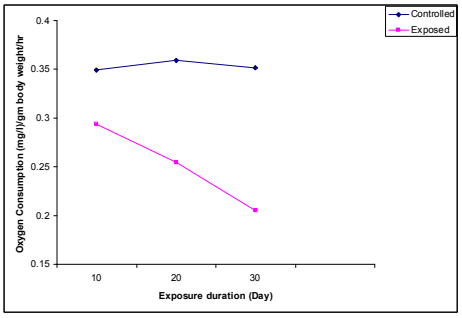


Fig. 2: Effect of sub-acute exposure of Lead nitrate on oxygen consumption of *M. dayanum*

exposed animals ($F = 20.33$; $P < 0.001$) while insignificant in controls ($F = 0.30$; $P > 0.05$).

The study revealed that lead caused continuous decrease in oxygen consumption of freshwater prawn, *M. dayanum* after sub-acute exposure while initial increase then continuous decreasing trend during acute exposure.

In crustaceans gills are the main respiratory structure and sites of gaseous exchange, comes in direct contact of surrounding environment hence are more susceptible to damage caused by various toxicants. Toxicants, particularly heavy metals in surrounding medium adversely affect the gills resulting in hypoxia and respiratory failure (Alazemi *et al.,* 1996; Jadhav and Ambore, 2007). Changes in oxygen consumption rate are a good index to measure altered metabolic activity

in organism exposed to various toxicants in surrounding medium. Continuous decrease in oxygen consumption, as observed in present study has also been reported in various crustaceans (Chinnaya, 1971; Ghate and Mulhelker, 1979; Tulasi and Rao, 1989; Papathanasiou and King, 1983; Reddy and Venugopal, 1993; Chinni *et al*., 2000; Jadhav and Ambore, 2007; Sen *et al*., 2008). Similar effects have also been reported in fishes (Gill *et al*., 1988; Hiltbran, 1971; Singh and Singh, 1979; Rao and Ramamurthi, 1987). Tasi (1979) reported exposure of metals precipitates gill secretion. Reduced oxygen consumption may be due to precipitated mucous coating on gill surface resulting in asphyxiation. Precipitated gill secretion inhibits the consumption of oxygen by the gill tissues and disrupts osmoregulation as reported in crabs and isopods (Thurberg *et al*., 1973; Jones, 1975; Carrea, 1987). The physiological, histological and ultra-structural studies have shown that metal ion interferes in respiration by disrupting the structure of gill cells by direct cytotoxic effects (Jones, 1975; Gill *et al*., 1988). Cytological damage in crab and shrimp species after heavy metal exposure which results in thickening of bronchial epithelium and profound changes in haemolymph pattern in the gill with concomitant increase in vacuolization and reduced haemolymph spaces causing perfusion stagnation (Spice and Weber, 1991). Hughes and Dutta Munshi (1979) reported a relationship exists between gill area and oxygen consumption. Mitochondrial damage and reduction in ability to synthesize the ATP in gills as reported in *Palaemon serratus* (Papathanasiou and King, 1983) after exposure of cadmium may also be a reason for reduced oxygen consumption in *M. dayanum* after lead exposure. Almost similar findings have been reported by Tulasi and Rao (1989) on oxygen equilibrium curve of the freshwater field crab, *Barytelphusa guerini* after organic and inorganic lead exposure. Recently, Sen *et al.* (2008) reported almost similar findings in *M. dayanum* after cadmium chloride exposure. It is evident from present findings that metallic pollutants, particularly lead exert adverse affects on oxygen consumption of freshwater prawn, *M. dayanum*. Oxygen consumption rate can be used as monitoring tools to asses worsening status of aquatic bodies in reference to metallic pollution, which is of global concern now days.

Acknowledgement

Authors are thankful to Prof. M. Srivastava, Head, Department of Zoology, University of Lucknow, Lucknow (U.P.) India for providing laboratory facilities.

References

Alazemi, B.M., Lewis, J.W. and Andrews, E.B., 1996. Gill damage in the freshwater fish *Gnathonemus petersii* (family:Morunyridae) exposed to selected pollutants : An ultrastructural study. ***Environ. Technol.***, 17(3)**:** 225-238.

APHA, 1998. *Standard Methods for the examination of water and waste waters*. 20thEdn. APHA, AWWA and WPCF Washington.

Burman, S.C. and Lal, M., 1994. Studies on the potential and properties of bioaccumulation of heavy metals (Zn, Cu, Cd and Pb) in soil and industrial polluted fields. ***J. Environ. Biol.***, 15: 107-115.

Campana, O., Sarasquete, C. and Blasco, J., 2003. Effect of lead on ALA-activity, metallothionein levels, on lipid peroxidation in blood, kidney and liver of the toad fish *Halobatrachus diadactylus*. ***Ecotoxicol. Environ. Saf.***, 55: 116-125.

Carrea, M., 1987. Physiological effect of metal toxicity on tropical freshwater shrimp, *M. carcinus* (L.1758). ***Environ. Pollut.***, 45: 149-155.

Chinnaya, G., 1971. Effect of heavy metals on the Oxygen consumption by the Shrimp *Cardina rajadhari* Bonvier. ***Indian J. Exp. Biol.***, 9: 277-278.

Chinni, S., Khan, R.N. and Yallapragada, P.R., 2000. Oxygen consumption, Ammonia– N excretion and metal accumulation in *Penaeus indicus* post larvae exposed to lead. ***Bull. Environ. Contam. Toxicol.***, 64: 144-151.

De, A.K., 1996. *Environmental chemistry*. New age Internat. Publ. (P) Ltd.,Co.,New Delhi, India.

Ghate, H.V. and Mulhelker, L., 1979. Histological changes in the gills of two freshwater prawn species exposed to copper sulphate. ***Indian J. Exp. Biol.***, 17: 838-840.

Gill, T.S., Pant, J.C. and Tiwari, H., 1988. Branchial pathogenesis in a fresh water fish *Puntius conchonius* Ham., chronically exposed to sub-lethal concentration of cadmium. ***Ecotoxicol. Environ. Saf.***, 12: 267-282.

Gupta, P.K. and Salunke, D.K., 1985. *Modern toxicology*, Volume II. The adverse effects of xenobiotics.

Hiltbran, R.C., 1971. Effect of Cd, Zn on Oxygen and Phosphate metabolism of blue gill live mitochondria. ***Jour. Wat. Contr. Fed.***, 43: 818-823.

Hughes, G.M. and Dutta Munshi, J.S., 1979. Fine structure of the gills of some Indian air-breathing fishes. ***J. Morph.***, 160: 169-194.

Jadhav, S.S. and Ambore, N.E., 2007. Effect of zine sulphate on the oxygen consumption of freshwater crab. *Barytelphusa guerini*. ***Aquacult.,*** 8(1): 85-85.

Jarup, L., 2003. Hazard of heavy metal contamination. ***Br. Med. Bull.***, 68: 167-182.

Jones, M.B., 1975. Synergistic effects or salinity temperature on the toxicity of mercury to marine and brackish water isopods (Crustacea). ***Estuarine Coastal Mar. Sci.***, 1: 425-431.

Kutlu, M. and Summer, S., 1998. Effects of lead on the activity of S-aminolevulinic acid dehydratase in *Gammarus pulex*. ***Bull. Environ. Contam. Toxicol.***, 60: 816-821.

Moore, J.W. and Rammamoorthy, S., 1984. *Heavy metals in natural waters applied monitoring and impact assessment*. Springer Verlag. New York, USA.

Papathanasiou, E. and King, P.E., 1983. Ultrastructural studies on the gills of *Palaemon serratus* (Pennant), in relation to cadmium accumulation.***Aquatic Toxicol.***, 3: 273-284.

Rao, R. and Ramamurthi, 1987. Effect of sub-lethal concentration of cadmium on oxidative metabolism in the freshwater teleost, *Tilapia mossambica*, ***Indian J. Comp. Anim. Physiol.***, 5(2): 71-80.

Reddy, S.L.N. and Venugopal, N.B.R.K., 1993. Effect of Cadmium on Acetyl cholinesterase activity and Oxygen Consumption in a Freshwater field crab, *Barytelphusa guerini*. ***J. Environ. Biol.***, 14(3): 230-210.

Sastry, K.V. and Gupta, P.K., 1978. Alteration in the activity of some digestive enzymes of *Channa punctatus* exposed to lead nitrate. ***Bull. Environ. Contam. Toxicol.***, 19: 549-555.

Satake M., Mido, Y., Sethi, M.S., Iqbal, S.A., Yasuhisa, H. and Taguci, S., 1997. *Environmental toxicology*. Discovery Publ. House, New Delhi, India.

Sen, P., Tiwari, K.J., Shukla, S., Shukla, R. and Sharma, U.D., 2008. Effects of cadmium on ventilation and oxygen consumption of freshwater prawn, *Macrobrachium dayanum* (Crustacea - Decapoda). ***Aquacult.***, 9(1): 95-100.

Sharma, R.K. and Agrawal, M., 2005. Biological effects of heavy metals: An overview. ***J. Environ. Biol.***, 26: 301-313.

Sharma, U.D. and Shukla, S., 1990. Behavioural dysfunction of fresh water prawn, *Macrobrachium lamarrei* (Crustacea: Decapoda) following exposure to synthetic detergent, Linear Alkyl Benzene Sulphonate. ***Biol. Mem.***, 16(12): 58–61.

Sharma, U.D., Shukla, S. and Lodhi, H.S., 1997. A report on *Macrobrachium dayanum* (Henderson) (Decapoda-palaemonided) from river Gomti, Lucknow (U.P.), India. ***Him. J. Env. Zool.***, 11: 21-24.

Singh, S.R. and Singh, B.R., 1979. Changes in Oxygen consumption of Siluroid fish, *Mystus vittatus* to different concentration some heavy metal salts. ***Indian J. Exp. Biol.,*** 1: 271-276.

Spice, J.I. and Weber, R.E., 1991. Respiratory impairment in crustaceans and molluscs due to exposure to heavy metals. ***Comp. Biochem. Physiol.***, 100C: 339-342.

Tasi, C.F., 1979. Survival, overturning and lethal exposure time for pearl dace, *Semoluis margaritus* exposed to copper solution. ***Com. Biochem. Physiol.***, 64: 1-6.

Thurberg, F.P. Dawson, M.A. and Collier, R.S., 1973. Effects of copper and cadmium on osmoregulation and oxygen consumption in two species of estuarine crabs. ***Mar. Biol.***, 23: 171-175.

Tulasi, S.J. and Ramana Rao, J.V., 1989. Effect of organic and inorganic Lead on oxygen equilibrium curves of the fresh water field crab, *Barytelphusa guerini*. ***Bull. Environ. Contam. Toxicol.***, 42: 247-253.

Environment Conservation Journal 10(3) 15-20, 2009
(ISSN 0972-3099)

A study of zooplankton diversity with special reference to their concentration in River Ganga at Haridwar

D.R. Khanna[1], R. Bhutiani[1], Gagan Matta[1], Dheeraj Kumar[1], V. Singh[1] and J. Ashraf[2]

Received: 25-06-2009 Accepted: 16-08-2009

Abstract

The purpose of this study was to assess the zooplankton abundance and their monthly variation in river Ganga water. Zooplankton could be the bio-indicator of health status of an aquatic system and their study. The out come of this study shows that the most abundant zooplankton species was *Ceriodaphnia* throughout the study period and total number of zooplankton is high during winter season when the temperature is relatively low.

Keywords:- *Zooplankton, Ganga river, Water quality, Abundance*

Introduction

Water plays a significant role in living environment. Water quality monitoring by different ways provide an avenue for meaningful participation of peoples and rivers are one of the easily accessible water source. Rivers are life line of human settlement but there are natural and anthropogenic factors which influence the water quality of river (Gupta and Chakrapani, 2007). Heavy exploitation of water resource and generation of large volume of waste water (Begum and Harikrishna, 2008) has given rise to a long list of challenging problems.

The major basins like Indus, Ganga and the Brahmaputra serve as the Water Towers of the Himalayas. River Ganga, the lifeline of north India originates from Gangotri glaciers and lastly terminates in the Bay of Bengal covering about 2,506.00 kms in India. The present study deals with different zooplankton species and their number observed in the Ganga river in Haridwar. For effective maintenance of water quality through appropriate control measures, continuous monitoring of large number of quality parameters is essential.

Author's Address

[1]Limnological Research Lab., Deptt. of Zoology and Environmental Science, Gurukula Kangri University, Hardwar ✉

2 Deptt. of Zoology, M.S. College, Saharanpur

Materials and Method

Haridwar is situated in the foothills of Shivaliks (Himalayas) along the bank of river Ganga at an elevation of 965 ft from sea level. The position of city on the globe is on latitude $29^0$58' N and longitude $78^0$13' E. Water samples were taken from five different sites in Haridwar district. The sampling sites are: Sati Ghat (Kankhal), Missharpur, Katarpur, Dhanpura (Azitpur) and Bhogpur.

The samples were taken in Borosil glass bottles of 300 ml capacity and plastic containers. The identification of phytoplankton was done according to Edmondson (1959), APHA (1998), Khanna and Bhutiani (2004).

Results and Discussion

The zooplankton in Indian rivers consists of diverse assemblage of major taxonomic groups. Many of these forms have different environmental and physiological assemblage. The number, type and distribution of these organisms present in any aquatic habitat provide a clue on the environmental conditions prevailing in that particular habitat. It is seen that many environmental factors interact to provide conditions for the growth of zooplankton both spatially and seasonally. Ray (1955) and Venkateswarlu and Menon (1979) recorded maximum values of total zooplankton during winter and minimum during rainy season. Lakshminarayanan (1965), Pahwa and Mehrotra (1966) observed the

total zooplankton maximum in river Ganga both in summer and winter.

In the present work it has been noted that the maximum average number of zooplankton were (568.03 unit/l ±259.48) in the month of March and minimum number were (55.68 unit/l ±18.71) found in the month of August. Observing the monthly variation in the number of zooplankton the maximum number observed was (856.62 unit/l ±26.45) at site-2 in the month of March and the minimum number (29.69 unit/l ±0.24) was found at site-3 in July month. Variation in the number of zooplankton at different site during the study period is tabulated in Table-1 and graphically shown in Fig. 1.

Table-1: Monthly variation in the number of zooplankton (2003-2004) at different sampling sites (Unit/l)

Month\ Site	Site-1	Site-2	Site-3	Site-4	Site-5	Average
January	347.85±26.23	436.52±36.24	434.78±30.78	189.48±10.08	627.30±9.08	407.19±158.89
February	304.14±38.27	320.00±34.72	390.89±33.24	334.50±22.54	647.65±8.15	399.44±142.56
March	450.90±39.57	856.62±26.45	503.56±28.12	229.54±18.46	799.53±12.65	568.03±259.48
April	425.11±41.19	621.34±33.90	507.89±16.45	352.67±12.51	558.71±11.08	493.14±106.43
May	274.47±26.24	526.10±27.16	279.55±14.35	357.62±21.24	311.74±10.21	349.90±103.92
June	97.15±11.38	196.25±12.51	100.36±10.24	214.72±14.61	89.08±1.22	139.51±60.72
July	40.03±8.19	84.60±8.54	29.69±0.24	92.06±8.47	34.21±5.21	56.12±29.75
August	49.68±7.16	87.21±2.44	37.64±0.28	49.11±1.46	54.75±3.68	55.68±18.71
September	103.23±12.15	95.27±8.67	120.08±1.28	58.14±1.24	115.92±4.82	98.53±24.65
October	146.82±15.27	132.16±11.45	162.38±5.54	70.77±1.71	166.60±9.52	135.75±38.79
November	181.83±21.21	125.00±10.24	197.83±7.73	73.66±0.87	257.07±10.07	167.08±70.28
December	214.03±25.30	362.00±21.08	317.60±11.21	137.77±0.21	389.27±12.25	284.13±105.56

The zooplankton number is governed by factors like humans activity, season of the year and values of water parameters. The increased turbidity reduces the plankton production (Khanna *et al*., 1993). In the present study it was noted that temperature showed a negative relationship with zooplankton. The zooplankton were higher in number when the temperature was generally low in the year. Eddy (1934) and Chandler (1940) pointed out that the zooplankton production is mainly influenced by temperature. The results indicated that the zooplankton were maximum in the winter month probably due to low temperature, high content of DO and low velocity. Similar study was made by Khanna and Bhutiani (2003) and Khanna *et al*. (2000).

During the study different species of zooplankton acknowledged were *Keretala valga*, *Ceriodaphnia*, *Arcella*, *Crustacia* and *Fillinia* sp. Monthly variation at different sampling site for *Keretala valga*, *Ceriodaphnia*, *Arcella*, *Crustacea* and *Fillinia* sp. is tabulated in Table- 2, 3, 4, 5 and 6. Study revealed that the maximum number (182.63 unit/l ±12.25) of *Keretala valga* was observed at site-2 in the month of January and minimum number (6.57 unit/l ±0.00) in the month of July in the same site. Highest average number (139.66 unit/l ±30.56) was observed in January month and minimum (13.59 unit/l ±4.83) in the month of July (Table-2 and Fig. 2).

Maximum average number (112.77 unit/l ±37.43) of *Ceriodaphnia* was found in the month of March and minimum average number (10.34 unit/l ±4.37) in the month of August. Observing site basis fluctuation in the number of *Ceriodaphnia* reveals that the maximum number (192.30 unit/l ±16.51) was found for site-5 in the month of April and minimum number (5.14 unit/l ±0.01) for site-4 in the month of August

Table-2: Monthly variation in the number of *Keretala valga* (2003-2004) at different sampling sites (Unit/l)

	Site-1	Site-2	Site-3	Site-4	Site-5	Average
January	105.00±2.24	182.63±12.25	149.65±12.24	145.00±13.09	116.00±13.51	139.66±30.56
February	85.54±0.87	157.00±11.21	119.50±9.45	62.14±1.56	76.84±15.25	100.20±38.10
March	124.52±1.21	172.65±10.27	114.62±10.29	104.32±7.45	112.67±8.24	125.76±27.18
April	108.65±1.37	110.36±12.85	112.40±8.90	106.05±1.88	105.00±6.46	108.49±3.04
May	82.15±0.46	74.21±1.24	72.00±3.41	62.05±0.84	97.42±5.76	77.57±13.21
June	52.24±0.12	14.00±0.08	30.02±0.96	42.24±0.34	46.65±1.29	37.03±15.25
July	18.00±0.11	6.57±0.00	10.61±0.06	16.08±0.12	16.70±0.12	13.59±4.83
August	25.64±0.13	10.16±0.00	14.24±0.00	35.14±0.22	20.86±0.08	21.21±9.80
September	35.00±0.21	32.62±0.64	32.51±0.05	25.00±0.06	25.62±0.03	30.15±4.53
October	20.20±0.00	34.00±0.84	40.00±0.51	20.10±0.07	20.35±0.07	26.93±9.43
November	38.52±0.27	52.62±0.64	45.62±0.21	35.52±0.11	37.49±0.56	41.95±7.08
December	40.80±0.46	94.00±2.54	85.73±1.82	50.10±0.60	63.70±0.88	66.87±22.71

Table-3: Monthly variation in the number of *Ceriodephnia* (2003-2004) at different sampling sites (Unit/l)

Month\ Site	Site-1	Site-2	Site-3	Site-4	Site-5	Average
January	78.50±3.24	106.00±10.65	21.05±0.24	68.20±2.54	116.60±13.24	78.07±37.46
February	64.24±1.49	115.64±9.08	15.64±0.05	50.10±2.08	106.92±10.41	70.51±41.32
March	86.00±2.40	149.00±10.51	150.00±12.94	66.00±3.46	112.84±12.52	112.77±37.43
April	106.00±8.64	107.20±5.81	16.72±0.09	86.00±4.85	192.30±16.51	101.64±62.70
May	85.00±2.48	78.35±2.85	64.71±4.27	65.00±4.06	53.00±0.20	69.21±12.59
June	15.62±0.59	21.71±0.18	35.40±0.65	25.62±0.85	17.00±0.10	23.07±7.95
July	6.81±0.01	12.00±0.00	11.00±0.12	16.81±0.10	5.85±0.25	10.49±4.40
August	8.14±0.51	15.52±0.85	14.20±0.08	5.14±0.01	8.70±0.01	10.34±4.37
September	32.00±0.87	30.25±1.80	25.67±0.84	12.00±0.00	52.50±0.85	30.48±14.59
October	62.00±0.56	42.80±1.46	30.27±0.40	12.00±0.00	65.00±1.41	42.41±22.17
November	72.15±0.18	68.40±5.16	48.16±1.21	52.10±0.84	85.02±2.07	65.17±15.11
December	56.52±0.07	97.24±4.46	85.60±1.81	46.12±0.12	97.22±2.45	76.54±23.79

(Table-3 and Fig. 3). Average number of *Arcella* showed highest value (33.21 unit/l ±6.92) in the month of February and lowest value (2.51 unit/l ±1.77) in August month. Site-3 showed the maximum number 56.72 unit/l ±10.01 in the month of October and minimum number 1.00 unit/l ±0.00 was shown by site-1 (Table-4 and Fig. 4) in August. This study regarding *Crustacia* reveals that the highest average value of this zooplankton species was (116.65 unit/l ±20.07) recorded in the month of March and lowest average value (5.38 unit/l ±1.97) recorded in July month. For *Crustacea* site-5 shown the lowest

Table 4: Monthly variation in the number of *Arcella* (2003-2004) at different sampling sites (Unit/l)

Month\ Site	Site-1	Site-2	Site-3	Site-4	Site-5	Average
January	15.10±1.08	17.00±1.00	12.61±0.88	12.10±0.61	17.56±1.52	14.87±2.48
February	26.20±2.42	39.68±2.12	37.25±2.24	25.20±1.85	37.70±2.29	33.21±6.92
March	32.00±2.21	28.00±1.01	23.82±1.16	22.00±0.00	45.00±13.42	30.16±9.15
April	15.61±0.85	16.53±0.98	15.64±0.78	15.01±0.38	15.62±8.09	15.68±0.54
May	10.00±0.52	12.62±0.14	1.62±0.03	10.65±0.46	16.00±0.00	10.18±5.32
June	2.15±0.06	14.68±0.28	15.20±1.08	3.10±0.13	3.25±0.21	7.68±6.65
July	4.00±0.00	2.93±0.05	2.33±0.01	5.00±0.00	1.80±0.05	3.21±1.29
August	1.00±0.00	3.26±0.01	5.24±0.25	2.00±0.00	1.08±0.01	2.51±1.77
September	5.62±0.08	7.16±0.42	7.81±0.16	6.60±0.05	6.70±0.03	6.78±0.80
October	15.36±0.21	32.80±3.45	56.72±10.01	12.30±1.04	16.20±1.58	26.68±18.61
November	3.16±0.01	4.63±0.07	8.00±0.00	2.15±0.01	4.32±0.82	4.45±2.21
December	8.56±0.35	34.32±2.24	28.54±2.37	5.16±0.05	9.40±0.61	17.20±13.25

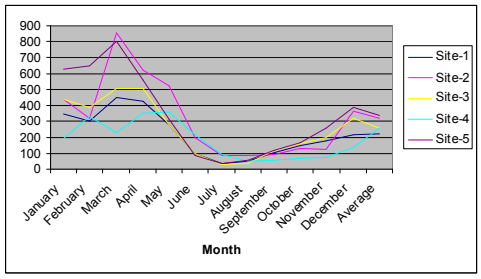


Fig. 1: Variation in the number of zooplankton during 2003-2004 at different sampling sites

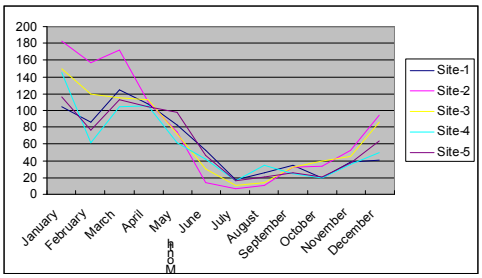


Fig. 2: Variation in the number of *Keretala valga* during 2003-2004 at different sampling sites

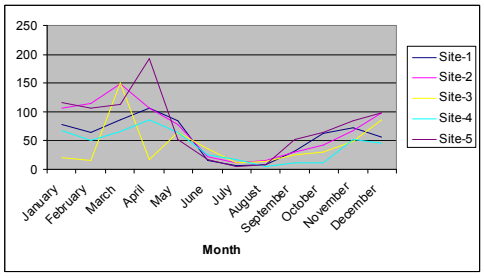


Fig. 3: Variation in the number of *Ceriodaphnia* during 2003-2004 at different sampling sites

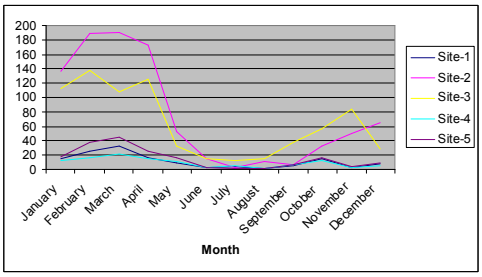


Fig. 4: Variation in the number of *Arcella* during 2003-2004 at different sampling sites

number (3.24 unit/l ±0.27) in July month and site-3 has showed the highest number (138.27 unit/l±16.34) in the month of March (Table-5 and Fig. 5). The *Fillinia* sp. recognized has shown the maximum average number 102.46 unit/l± 11.13 in the month of March and minimum average number 5.39 unit/l ± 2.93 in July month. *Fillinia* sp. was observed maximum (118.05 unit/l±14.28) in the month of March at site-5 and minimum (2.10 unit/l ±0.18) at site-5 in the month of July (Table-6 and Fig. 6).These findings are

Table 5: Monthly variation in the number of *Crustacea* (2003-2004) at different sampling sites (Unit/l)

	Site-1	Site-2	Site-3	Site-4	Site-5	Average
January	85.00±12.25	86.00±3.00	84.00±2.00	55.00±10.00	106.00±12.00	83.20±18.21
February	106.00±15.94	64.30±4.62	65.30±2.37	86.00±15.00	115.26±11.93	87.37±23.16
March	102.38±12.30	135.27±12.54	138.27±16.34	92.35±13.54	115.00±21.00	116.65±20.07
April	98.00±10.29	85.62±9.46	84.62±10.08	68.00±17.00	100.62±8.65	87.37±12.98
May	62.32±5.13	53.71±16.95	54.71±5.63	52.02±9.68	55.65±8.53	55.68±3.95
June	12.00±2.00	14.39±3.65	15.39±12.12	10.00±3.00	15.60±6.28	13.48±2.41
July	8.12±0.37	3.71±0.61	5.71±0.84	6.12±0.42	3.24±0.27	5.38±1.97
August	12.36±2.35	15.28±8.64	14.18±9.08	11.36±2.13	15.00±12.00	13.64±1.71
September	15.61±4.62	17.87±11.34	15.88±6.46	14.61±4.85	15.26±10.21	15.85±1.22
October	24.20±12.41	28.35±10.85	30.25±12.05	14.20±7.63	28.12±12.21	25.02±6.44
November	36.00±11.43	36.42±12.20	33.40±11.20	26.00±9.00	35.00±13.00	33.36±4.28
December	62.15±8.81	72.82±7.52	70.52±13.25	52.10±15.42	95.28±13.69	70.57±16.03

Table-6: Monthly variation in the number of *Fillinia* sp. (2003-2004) at different sampling sites (Unit/l)

	Site-1	Site-2	Site-3	Site-4	Site-5	Average
January	64.25±12.76	75.67±13.09	60.25±5.88	54.20±13.65	78.62±9.56	66.60±10.32
February	25.16±2.05	21.03±1.82	30.10±2.01	35.10±14.50	54.17±2.46	33.11±12.90
March	106.00±13.21	102.61±11.46	87.63±4.65	98.00±11.00	118.05±14.28	102.46±11.13
April	96.85±6.31	83.00±9.00	65.36±2.13	82.56±10.46	84.35±7.62	82.42±11.22
May	35.00±13.00	32.85±7.50	31.42±5.62	25.00±3.00	27.48±2.56	30.35±4.06
June	15.14±11.24	24.30±5.23	12.31±3.02	11.10±0.49	17.86±3.10	16.14±5.26
July	3.10±0.14	9.00±1.00	7.66±0.46	5.10±0.06	2.10±0.18	5.39±2.93
August	10.54±1.31	13.53±6.76	15.92±6.33	14.50±5.67	13.00±1.00	13.50±1.99
September	25.00±12.00	28.02±4.55	40.40±16.45	17.56±8.08	20.00±4.00	26.20±8.93
October	25.06±10.29	28.65±8.46	46.71±10.27	35.06±12.05	32.71±3.91	33.64±8.25
November	32.00±14.00	40.00±9.00	43.21±8.71	22.00±8.00	36.00±14.00	34.64±8.22
December	46.00±12.00	60.89±13.21	75.80±13.92	56.00±16.00	52.00±12.00	58.12±11.28

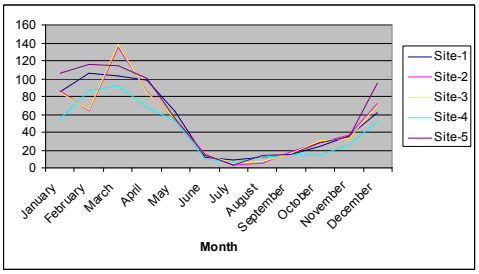


Fig. 5: Variation in the number of *Crustacea* during 2003-2004 at different sampling sites

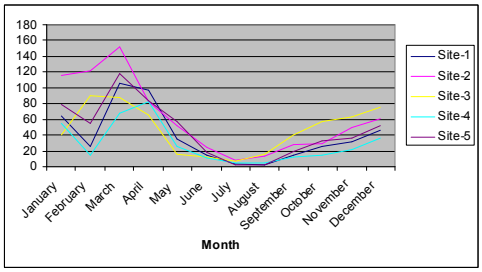


Fig. 6: Variation in the number of *Fillinia* sp. during 2003-2004 at different sampling sites

similar to that of Khanna (1993), Khanna *et al*. (2000), Prasad and Singh (2003) and Khanna *et al*. (2007).

References

APHA, AWWA, WPCF, 1998. *Standard methods for examination of water and waste water*. 20th Eds. American Public Health Association; 1015, Fifteen Street, New Washington. pp: 1-1134.

Begum, Abida and Harikrishna, 2008. Study on the quality of water in some stream of Cauvery River. ***E-Journal of Chemistry***, 5(2): 377-384.

Chandler, D.S., 1940. Limnological studies of western Eric. I : Plankton and certain physico-chemical Data of Bass Island region from September 1938 to November, 1939. ***Ohio, J. Sci.***, 40: 291-336.

Eddy, S., 1934. A study of the fresh water plankton communities. ***Illinois, Biol. Monyar***, 12(4): 1-93.

Edmondson, W.T., 1959. *Freshwater Biology*. Ed. Ward and Whippl, 2nd Edn, John Wiley Sons Inc, New Yark. pp: 95-189.

Gupta, Harish and Chakrapani, G.J., 2007. Temporal and spatial variations in water flow and sediment load in the Narmada river. ***Current Science***, 92 (5): 679-684.

Khanna, D.R., 1993. *Ecology and pollution of river Ganga*. Ashish Pub. House, N. Delhi. pp: 1-241.

Khanna, D.R., Badola, S.P. and Dobriyal, A.K., 1993. *Plankton ecology of river Ganga at Chandighat, Hardwar*. Advance in limnology. Ed. By H.R. Singh, Narendra Publishing House, N.Delhi. pp: 171-174.

Khanna, D.R. and Bhutiani, R., 2003. Ecological status of Sitapur pond at Hardwar (Uttaranchal), India. ***Indian J. Env. And Eco. Pl.***, 4(1-3): 109-122.

Khanna, D.R. and Bhutiani, R., 2004. *Water analysis at a glance*. ASEA Publication, pp: 1-115.

Khanna, D.R., Gautam, A., Chug, T. and Sarkar, P., 2000. Impact of abiotic factors on the planktonic population of a pond. ***Env. Cons. J.***, 1(1): 41-46.

Khanna, D.R., Singh, Vikas, Bhutiani, R., Chandra, K.S., Matta, Gagan and Kumar, Dheeraj, 2007. A study of biotic and abiotic factors of Song River at Dehradun, Uttarakhand. ***Environment Conservation Journal***, 8(3): 117-126.

Lakshminarayanan, J.S.S., 1965. Studies on phytoplankton of the river Ganges, Varanasi, India. ***Hydrobiological***, 25: 119-164.

Pahwa, D.V. and Mehrotra, S.M., 1966. Observations on fluctuations in abundance of plankton in relation to certain hydrological conditions of river Ganga. ***Proc. Nat. Acad. Sci.***, 36B(2): 157-158.

Prasad, B.B. and Singh, R.B., 2003. Composition , abundance and distribution of phytoplankton and zoobenthos in tropical water body. ***J. Not. Env. and Poll. Tech.***, 2(3): 255-258.

Ray, H.K., 1955. Plankton ecology of the river Hoogly at Palta. ***Ecology***, 36(2): 169-175.

Venkateshwarlu, T. and Menon, A.G.K., 1979. A list of fishes of river Ganges and its branches. ***Hydrobiologia***, 9: 46-70.

Environment Conservation Journal 10(3) 21-24, 2009
(ISSN 0972-3099)

Fish fauna of Lakkavalli lake, Karnataka with respect to environmental variables

Mawhoub Alkadasi Noman, E.T. Puttaiah and A. Shahnawaz

Received: 02-04-2009 Accepted: 05-08-2009

Abstract

The fish diversity of aquatic system plays a major role in our national economy. The present study was undertaken with the purpose of assessing water quality and fish diversity of Lakkavalli Lake, Shimoga, Karnataka. The fish diversity is correlated with physico-chemical variables which are the regulatory factor for the distribution and abundance of different aquatic fauna including fishes. In the present study 16 species have been recorded and majority of fishes are exploited by human consumption. For the proper sustainable management and utilization of this water resource, it is mandatory to take up the steps to monitor the lake regularly for sustainable fisheries.

Keywords:- *Chikmangalore District, Fish fauna, Lakkavalli Lake, Water quality variables*

Introduction

Fishes have been playing a crucial role in the human diet from time immemorial as it has got an excellent protein source. This protein has high digestibility and growth promoting value for human consumption. Nutritional studies have shown that fish proteins rank in the same class as chicken proteins and are superior to milk, beef protein and egg albumen. Inland fisheries in India have great potential of contributing to the food security of country. Wetlands are the main resources exploited for inland fisheries and understanding of fish faunal diversity is a major aspect for its development and the sustainable management. Wetlands in India support rich variety of fish species, which in turn support the commercial potential of the fisheries (Krishna and Piska, 2006). Thus, there is a wide scope for study in the fisheries sector of the country. The Chikmangalore District is one of the important districts of Karnataka state for the fish production and natural water resource. Considerable works have been done on the availability and distribution of reservoir fishes (Venkateshwarlu *et al*., 2002; Sakhare and Joshi, 2002; Dutta *et al*., 2003; Paik *et al*., 2003; Pawar *et al.,* 2003; Lohar and Borse, 2003). In the present study various physic-chemical parameters were studied to see the effect on the fish diversity in the Lakkavalli wetland. The findings will benefit the planning and management of sustainable fisheries and conservation of natural resources at national level.

Author's Address
Deptt. of Environmental Sciences, Kuvempu University, Shankarghatta, Shimoga, Karnataka ✉

Materials and Method

Study area

Lakkavalli lake of Chikmangalore District is one of the major perennial lakes and it receives rainwater during monsoon and river water from the Bhadra river through Bhadra channel. The water from the water body is extensively used for agriculture and aquaculture purposes. It is situated at an elevation of 601 m above mean sea level and located at latitude of 13° 40' N and longitude of 75° 36' E. The lake aquires land area of 0.8 square km and a depth of 2-3 m.

The study was conducted regularly for a period of one year (Oct. 2006 to Sep. 2007) and fishes were collected with the help of fisherman by repeated netting. Fish sampling was done by using a variety of fishing nets of varying mesh sizes *viz.* gill nets, cast nets and dragnets. After collection, fishes were examined and 5-10 specimens were preserved in 4% formalin for further laboratory analysis. The fishes were identified by using Jayaram (1999), Talwar and

Jhingran, (1991) and Dutta Munshi and Shrivastava, (1988). The physico-chemical variables were estimated at periodical intervals and analysis was done by following the standard procedures APHA, 1995 and Trivedi *et al*., 1998.

Results and Discussion

Besides providing the excellent protein source to human population, the fishes are also serving as indicators of water quality (Peter, 1987). The fish can be used to monitor the water quality for toxic substances and as bioindicators of water quality and environmental health of a water body (Seth *et al.*, 1967). The physico-chemical variations of the lake are summarized in Table 1. The monthly collected water samples showed variations in all parameters. The water temperature ranged between 18.00 to 33.00 °C which is the tolerance limit of most of the cultivable fishes. The total dissolved solids ranged between 100.00 to 235.00 mg/l. The high amount of total dissolved solids increase the density of water and resulting in elevation of osmoregulatory mechanism of aquatic biota. Dissolved Oxygen (DO) indicates physical, chemical and biological activities in a water body. DO affect the solubility and availability of many nutrients and therefore productivity of aquatic ecosystems (Wetzel, 1983). Significant fluctuations were recorded in monthly values of DO ranged between 1.90 to 7.20 mg/l, thus supporting the concept that lentic water bodies under natural conditions contains a high volume of DO ending with saturation point (Welch, 1952). The pH ranged between 7.10 to 8.20 and hence the water body showed alkaline nature throughout the year. The increase in pH values during summer or pre-monsoon period was due to increased concentration of bicarbonate alkalinity. Similar kind of findings were observed by Ramakrishnan (1991) and Ramakrishnan *et al.* (2000). The results are also in accordance with those of WHO (1984a, b). The high values of BOD (1.50 to 9.10 mg/l) show the high quantity of biodegradable materials and presence of non-biodegradable substances. The total alkalinity was observed in the range of 80.00 to 210.00 mg/l and the similar observations were made by Mahadevan and Krishnaswamy (1983) and Wagh (1998). It shows that Lakkavalli lake is high in salt concentration like carbonates, bicarbonates, phosphates, nitrates etc. The total hardness is mostly contributed by the amount of calcium and magnesium with the support of other ions. The present investigation shows the total hardness varied between 51.00 to 148.00 mg/l. The calcium and magnesium values ranged between 12.00 to 39.00 mg/l and 9.50 to 27.00 mg/l respectively. The optimum values of hardness ranges between 75 to 150 mg/l which supports the total fish productivity (Das, 1996). Hence, the water of the Lakkavalli lake is suitable for fishery purpose.

Table-1: Monthly variation of physico-chemical parameters of Lakkavalli lake (Oct 2006- Sep. 2007)

Parameters	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
Air temp. (°C)	26.00	24.00	23.00	21.00	23.00	26.00	29.00	31.00	30.00	29.00	28.00	26.00
Water temp. (°C)	24.00	23.00	21.00	18.00	20.00	24.00	28.00	30.00	33.00	27.00	27.00	24.00
pH	7.11	7.56	7.21	8.10	7.70	7.37	7.32	7.10	7.10	7.40	8.20	7.80
TDS (mg/l)	134.00	170.00	183.00	224.00	235.00	202.00	193.00	100.00	110.00	131.00	145.00	178.00
TH (mg/l)	68.00	82.00	90.00	101.00	110.00	119.00	134.00	148.00	93.00	75.00	51.00	60.00
TA (mg/l)	155.00	119.00	128.00	160.00	123.00	98.00	100.00	80.00	86.00	112.00	210.00	110.00
DO (mg/l)	4.50	5.10	3.50	6.40	5.10	1.90	2.30	2.60	3.50	5.50	7.20	7.10
BOD (mg/l)	6.10	4.50	8.30	7.70	8.20	7.10	9.10	8.10	4.60	2.50	1.50	1.50
Ca (mg/l)	15.10	17.80	20.40	22.10	25.20	26.80	27.00	39.00	20.00	16.00	12.00	14.00
Mg (mg/l)	12.90	15.60	16.90	19.20	20.60	22.50	25.90	27.00	18.00	14.00	9.50	11.00

Note:- TH- Total hardness, TA- Total alkalinity

Fish fauna

The fish fauna is an important aspect of fishery potential of a water body. The study of fish diversity serves as a guide to know the availability of fish fauna and further finding out the possibility of introducing new species that are not endemic to that area. Detailed study of fishes of an area forms the prerequisite for understanding any culture programme and to take up management policies. It has been observed that distribution and abundance of fish species is quite variable because of geographical and geological conditions. In the present study, 16 fish species (Table-2) have been recorded. On the basis of occurrence, the collected fish species are categorized as Rare (A-1), Common (A-2) common and Very common A-(3-4). Das (1996) was the first to record 23 fish species belonging to 7 families and 14 genera in river Tawi, in which family Cyprinidae was dominant. The results are also in confirmatory with those of Wakid and Biswas (2005) and Devi (1997). The same observations were also made by Venkateshwarlu *et al*. (2007). It is well known that the environmental conditions have its impact on fish species density. So in this regard, the environmental conditions would be favorable to Cyprinidae family to grow and flourish at higher levels than other families. The other factor would be genetic that the species belonging to this family possess the genetic make-up which is better than other families to cope up with the environmental stress and new adaptations. Almost all fishes recorded are useful as food fishes. As far as the feeding ecology of fishes is concerned, the fishes in Lakkavalli lake could be categorized in to herbivores, carnivores and omnivores. Herbivores fishes include *Labeo rohita, Labeo calbasu,* carnivores or predatory fishes include all cat fishes like *Notopterus notopterus, Mystus cavasius, Oreochromis mossambica,* etc. and omnivores includes *Clarias batracus, Cirhinus mrigala etc.*It has been shown that physico-chemical variables influence the distribution and abundance of aquatic life including fishes. Freshwater lakes show significant variation in different physico-chemical variables. Hydrobiological studies on freshwater lakes have shown that they have generally warmer water

Table-2: List of fish species with biodiversity status, abundance and size in Lakkavalli lake

Species	Vernacular/ Local name	Biodiversity status IUCN-1990	Abundance	Size (cm)
Labeo calbasu	Karae-Kolasa	LR nt	A-1	90.00 cm
Labeo rohita*	Rohu	LR nt	A-2	91.00cm
Puntius chola	Dodda-karsae	VU	A- (3-4)	12.00 cm
Glossogobius guiris	Bhangi-sidda	LR-nt	A- 1	30.00 cm
Cirhinus fulungee	Arja	LR -nt	A- (3-4)	30.00 cm
Cirhinus reba	Arja	VU	A- (3-4)	30.00 cm
Cirhinus mrigala	Mrigal	LR- nt	A-2	99.00 cm
Catla catla*	Catla	VU	A-2	182.00 cm
Cyprinus carpio	Gowri	LR -lC	A-2	28.00 cm
Mystus cavasius	Girlu	LR- nt	A- (3-4)	46.00 cm
Ompok bimaculatus	Godalae	EN	A-1	45.00 cm
Oreochromis mossambica*	Jilebi	NA	A- (3-4)	29.00 cm
Notopterus notopterus	Chappali	LR-nt	A- (3-4)	61.00 cm
Mastacembelus armatus	Haavu-meenu	LR nt	A- (3-4)	61.00 cm
Clarias batracus	Murugodu	VU	A-2	46.00 cm
Rasbora daniconius	Golai	LR-nt	A- (3-4)	7.00 cm

Note: Abundance: A-1-rare, A-2-comman, A-(3-4) - very common; EN= Endangered; LR- IC=Lower risk least concern; LR- nt = Lower risk-near threatened; VU= Vulnerable; NA = not assessed; *Introduced species

temperature, lower suspended solids, alkaline pH and significantly high DO and less CO_2. Jaya Raju *et al*. (1994) have also studied fish diversity with respect to physico-chemical variables. Our studies have shown that temperature and DO are the main controlling factors in the distribution of fishes. Our results are in confirmatory with those of Rajaram *et al*. (2004).

References

APHA, 1995. *Standard Methods for the Examination of Water and Wastewater*. 20th ed., American Public Health Association, USA.

Das, R.K., 1996. Monitoring of water quality, its importance in disease control. Paper presented in Nat. Workshop on fish and prawn disease, epizootics and quarantine adoption in India. October 9, 1996. CICFRI. pp: 51-55.

Dutta Munshi, J.S. and Shrivastava, M.P., 1988. *Natural history of fishes and systematics of freshwater fishes in India*. Narendra Publishing Co. Delhi, India. pp: 421.

Devi, B.S., 1997. Present status, potentialities, management and economics of fisheries of two minor reservoirs of Hyderabad, Ph.D thesis, Osmania University.

Dutta, S.P.S., Kour, H. and Zutshi, 2003. Ichtyofauna of river Tawi and its tributaries and important tributary of the river Chenab J&K State. ***J. Aquatic Biol.***, 18(2): 61-68.

Jaya Raju, P.B., Prasad Rao, G.D.V. and Sharma, S.V., 1994. Seasonal variations in physicochemical parameters and diversity in the flora and fauna of the river Munneru, a tributary to river Krishna, Andhra Pradesh, India. ***J. Aquatic Biol.,*** 9(1 & 2): 19-22.

Jayaram, K.C., 1999. *The freshwater fishes of the Indian region*. Narendra Publishing House, Delhi-06.

Krishna, M and Piska, R.S., 2006. Ichtyofaunal diversity in secret lake Durgamcheruvu, Ranga Reddy District, Andhra Pradesh, India. ***J. Aqua. Biol.***, 21(1): 77-79.

Lohar, P.S. and Borse, S.K., 2003. Diversity of fish fauna in river Tapi, Maharashtra. ***J. Aquatic Biol.,*** 18(2): 47-49.

Mahadevan, A. and Krishnaswamy, S., 1983. Chironomond population size as an index of pollution in the river Vaigai. ***Pollution res.***, 3(1): 35-38.

Paik, Tapas Kumar and Ckakraborty, S.K., 2003. Ichtyofauna of East Singhbhum District, Jharkhand, India. ***J. Aquatic Biol.***, 18(2): 50-60.

Pawar, S.K., Madlapure, V.R. and Pulle, J.S., 2003. The study on fish diversity in the Sirurdam near Mukhed, Nanded District (M.S.) India. ***J. Aquatic Biol.***, 18(2): 69-70.

Peter, T., 1987. Fish, fisheries, aquatic macrophytes and water quality in Inland Waters. ***Water quality Bull.***, 12(30): 103-129.

Rajaram, R., Srinivasan, M., Ajmal Khan, S. and Kannam, L., 2004. Ichthyofaunal diversity of Great Nicobar Islands, Bay of Bengal. ***J. Ind. Fish. Ass.,*** 31: 13-26.

Ramakrishnan, N. 1991. Primary production of two man-made freshwater reservoirs at Annamalai Nagar, Tamil Nadu, International on Land-Water interaction (8-13 December), NIE, New Delhi. pp: 61.

Ramakrishnan, N., Ganesan, N.C. and Thevanathan, R., 2000. Distribution of planktonic algae in three different freshwater bodies of Tiruvannamalai District, Tamil Nadu, Nat. Symp. On Phycology in the New Millennium Org. in CAS, Uni. Of Madras, Chennia (March 1-3). pp: 45.

Sakhare, V.B. and Joshi, P.K., 2002. Ecology of Palas NI Legaon in Osmanabad District, Maharashtra. ***J. Aquatic Biol.,*** 18(1): 17-22.

Seth, A.K., Srivastava, S.K., George, N.G. and Bewtra, J.K., 1967. Monitoring of certain toxic constituents in water supply by fish. ***Ind. J. Environ. Hlth.***, 9(1): 34-37.

Talwar, P.K. and Jhingran, A., 1991. *Inland fishes of India and adjacent countries*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2(19): 1158.

Trivedi, R.K., Goal, P.K. and Trishal, C.L., 1998. *Practical methods in Ecology and Environmental Science*. Enviro Media Publications, Karad, India.

Venkateshwarlu, M., Shanmugham, M. and Mallikarjun, H.R., 2002. The fish fauna of Bhadra reservoir Western Ghats. ***J. Aquatic Biol.***, 17(1): 9-11.

Venkateshwarlu, M. Jothi Srigowri and Asha Shree, H.M., 2007. Proceedings on "Diversity and Life processes from Ocean and Land". Goa University. Goa. pp: 156-159.

Wagh, N.S., 1998. Hydrobiological parameters of Hargal dam in relation to pollution. Ph. D. thesis, Dr. B.A.M.U. Aurangabad.

Wakid, A. and Biswas, S.P., 2005. Status and diversity of fish fauna in Dibru-saikhowa National park, Assam. ***J. Bom. Nat. Hist. Soc.***, 102(1): 50-55.

Welch, P.S., 1952. *Limnological methods*. Mc Graw Hill, New York, USA.

Wetzel, R.G., 1983. *Limnology*. 2nd edition. Saunders Coll. Publ. pp: 767.

WHO, 1984a. *Guidelines for drinking water quality*. Vol, I. Recommendations. WHO, Geneva.

WHO, 1984b. *Guidelines for drinking water quality*. Vol, II. Health criteria and other supporting information, WHO, Geneva.

Environment Conservation Journal 10(3) 25-30, 2009
(ISSN 0972-3099)

Integrated poultry cum fish farming in Central Himalaya

P. Bisht, B.P. Oli and Kumkum Shah

Received: 01-03-2009 Accepted: 07-07-2009

Abstract

The present communication deals with the experiment conducted on integration of poultry in fish farming in remote area of district Pithoragarh, Uttarakhand during Aug. 2006 to July 2007. Two ponds of equal area (100 m^2) were selected, one for experimental and another for control purposes. Five hundred fingerlings of Chinese carp in the ratio of Silver carp (40%), Grass carp (40%) and Common carp (20%) were introduced in both the ponds. Fifteen day old Croyler chicks were integrated with fishes. They were kept separately in a chicken shed which was constructed over the pond. Their droppings acted as food and fertilizer for fishes and ponds respectively. Various physicochemical and biological parameters were found to be in favorable conditions during experimental period in both the ponds. The integrated enterprise was found to be significantly viable in comparison to the non integrated systems in terms of its production and net return *viz.* – 81.00 kg of fishes along with 500 eggs and 18 kg Croyler meat worth Rs. 9200.00/- was obtained from experimental pond while 62.00 kg fishes worth Rs. 4,960.00/- was obtained from control pond. The system provides diversified products in the form of meat, eggs and fish hence, highly remunerable to fish farmers. Increased productivity gives higher income from the integrated pond. The result indicates that poultry cum fish farming has great scope in hilly areas of the country.

Keywords:- *Poultry, Fish culture, Chinese carp, eggs, Central Himalaya*

Introduction

Fisheries play an important role as it provides employment opportunities, rich protein diet to large section of rural population *etc*. Supplementary feeds and fertilizers play a vital role in increasing fish production in aquaculture operations, but as supplementary feeds are scarce and costly, the application of either organic or inorganic fertilizers is a low cost alternative for fish culture. If the farmers recycle their poultry wastes in fish ponds, they could reduce operating expenses to a minimum and at the same time increased fish production. The dropping of poultry is rich in nitrogen and phosphorous and is used as a fertilizer for fish ponds. Farmers would be able to produce diversified products in the form of milk, eggs, meat etc. Integrated Fish Farming (IFF) is proven environmentally sustainable and economically viable technology that encompasses rational utilization of available resources. IFF is an old practice extensively used in China, Hungary, Philippines, Taiwan, Japan, N. Korea, Malaysia, Indonesia, Vietnam, Pakistan and many other developing countries including India.

Much work had been done on IFF in foreign countries. This system recycles organic wastes such as weeds, by products from field wastes, from livestock and natural food production from photosynthesis within the farm itself. In this system substances that may otherwise be considered "wastes" are viewed as resource out of place and contribute to increase in fish production (NACA, 1989). The responses of feeding animal manures as direct feed for fish have been documented by Schroeder (1980), Sin (1980), Shevgoor and Edward (1994), Duan *et al.* (1998), Uddin *et al.* (1998), Little and Edwards (1999) *etc*. The fish yield ranging from 1,600.00-18,000.00 kg ha^{-1} yr^{-1} is reported from IFF. IFF has started becoming popular in India but not so far is a massive way like in China or Taiwan.

In comparison to other Asian countries, in India relatively fewer works have been done on IFF. Few of them are Jhingran and Sharma (1980), Anonymous (1985), Kumar and Ayyappan (1988), Sharma and Das (1988), Singh (1993), Dhawan and Sehdev

Author's Address
Deptt. of Zoology, L.S.M. Govt. P.G. College, Pithoragarh ✉

(1998), Rao and Singh (1998), Borah *et al.* (1998), Gupta *et al.* (1998), Mohanty *et al.* (2001), Sharma (2001), Mohanty (2002), Halder and Ali (2003) *etc*., have carried out initial trial on IFF and got the fish yield ranging from 4,000.00-7,000.00 kg ha^{-1} yr^{-1} besides additional production in the form of eggs, meat, milk *etc*. from livestock's.

In hilly regions of Uttarakhand information about IFF are few *viz*. Bisht, 2006 *etc*. The poor undernourished rural people of hills not only need a supplement of animal protein in their diet but also new resource of gainful employment and sustainable income. An economically viable low cost integrated fish farming system can complete the needs of farmers. Since a land holding of most of the farmers is quite small, this diversified system would yield better returns. Integrated poultry fish farming is a profitable farming system which is able to increase productivity. This system results in a more efficient use of resources than is possible with fish farming alone. Other benefits of diversification include additional sources of food in the form of egg, meat and extra income for farmers. The costs associated with fish culture operations are reduced by about 70% (Gupta 1987) when integrated with chickens, because fish farming recycles chicken wastes and spilled chicken feed as food and fertilizer for the fish. Consequently there is no need to provide supplementary feed or fertilizer.

Materials and Method

The study was conducted in the remote area of Simkhola village of district Pithoragarh, Uttarakhand. The area is bounded by 29^0 03' – 30^0 49' N and 79^0 48' – 81^0 02' E' and located at an altitude of 1,500.00 m above mean sea level. The experiment was started from August 2006 and completed on July 2007. Two fish ponds of equal size (100 m^2 area) were selected, one pond as experimental (E) and another as control (C). After proper treatment i.e. liming, manuring *etc*. 500 fingerlings of silver carp (40%), grass carp (40%) and common carp (20%) with an average size of 10.00 cm length were inducted in both the ponds. The length and weight of fishes were recorded during the time of induction. No supplementary feeding was done for fishes except green grass to grass carp with aquatic and terrestrial vegetation in experimental pond. Fifteen day old fast growing Croyler chicks were purchased from Block Poultry, Bin, Pithoragarh. These Croyler chicks were grown in wood shelter (3.00 m X 2.00 m X 1.50 m) which was made by using locally available materials such as bamboos and straw. Flooring was constructed using bamboo splits spaced at 1.5 cm internals, in order to allow chicken excreta to fall directly in to the adjoining area of the pond (Fig. 1). Chickens do not need elaborate houses since they remain in the pond embankment throughout the day hours for feeding etc. the poultry birds were also provided supplementary feed and kitchen wastes on regular basis i.e. once a day. The shed was covered by polythene sheet for protecting from rain and cold. Daily washing of poultry house with pond water was done and drained into pond directly. Care was taken for making a healthy poultry cum fish farming system. The whole pond was fenced by iron net/ poultry net to check the entry of predators - snakes, otters *etc.*

Fig.1: Poultry shed

Fig. 2: Entry of snakes may be checked using chicken net

(Fig. 2). Various abiotic (pH, DO, CO_2) parameters of pond water were assessed regularly following standard methods (APHA, 2002; Khanna and Bhutiani, 2004). Plankton were collected from both the ponds using plankton net made of nylon blotting silk cloth No. 2 (aperture size, 79 meshes linear cm^{-1}). Fifty liter of pond water was randomly filtered and plankton samples were transferred to the plastic bottles and preserved in 4% formaldehyde solution. The preserved samples were brought to the laboratory for further investigation and analyzed using standard methods (Ward and Whipple, 1959; Peenak, 1978; Anand, 1998; APHA, 2002). Observations on disease and growth of poultry birds and fishes were also carried out on regular basis. Regular medicines were provided to chickens. Harvesting of chickens and fishes were carried out after one year of rearing. Plants of *Ocimum sanctum* (Tulsi), *Mentha arvensis* (Pudina), *Coriandrum sativum* (Coriander) *etc*. were also transplanted around the pond to prevent the entry of snakes.

Results and Discussion

Some physico-chemical and biological parameters of water in both the ponds were found to be in optimum range throughout the experimental period. The water pH remained nearly neutral to slightly alkaline during the period of observation in both the ponds. It was ranged between 7.30-8.50 in experimental and 7.00-8.30 in control pond. The range of variation in DO content was markedly higher in the control pond (5.00-7.50 ppm) in comparison to experimental pond (4.50-6.20 ppm) (Table-1). It may be due to higher utilization of DO for decomposition of chicken manure or consumption by the phytoplankton and other aquatic organisms. In most studies it was found that bacteria and phytoplankton consume about 50% DO concentration (NACA, 1989). The CO_2 content was ranged between 1.20-2.50 ppm in control and 1.60-4.50 ppm in experimental pond.

Table-1: Mean values of different physico-chemical and biological parameters of the pond

Parameter		Month											
		Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July
pH	C	7.30	7.80	8.30	7.90	7.00	7.30	7.60	7.80	8.00	8.10	7.20	7.40
	E	7.50	8.10	8.10	8.20	7.30	7.90	7.90	8.20	8.50	8.30	8.10	8.20
DO (ppm)	C	5.70	5.80	5.00	6.00	6.80	7.50	7.00	7.10	6.10	6.00	5.90	6.20
	E	5.30	5.50	4.80	5.20	5.00	5.20	6.20	6.00	5.10	4.50	5.30	5.40
CO_2 (ppm)	C	1.30	1.50	2.00	2.50	2.00	1.20	1.80	1.20	1.50	1.80	2.00	1.20
	E	1.60	2.00	4.00	4.00	4.50	3.50	3.20	3.00	3.10	2.60	2.60	2.80
Plankton Abundance (unit/ l)	C	1678.00	2350.00	2590.00	2680.00	1015.00	1056.00	1588.00	1640.00	1589.00	1670.00	1706.00	1998.00
	E	1880.00	2630.00	2750.00	2856.00	1280.00	1389.00	1695.00	1875.00	1935.00	2171.00	1865.00	2395.00

Note:- C= Controlled; E= Experimental

The plankton populations in the experimental pond exhibit an increasing trend towards the progress of the experiment indicating enhancement in primary productivity which could be attributed largely to the poultry droppings recycling *etc*. and was ranged between 1,280.00-2,856.00μl^{-1} being minimum in the month of December 2006 and maximum during November 2006 (Table-1). In both the ponds the zooplankton was principally constituted of rotifers and represented mainly by *Brachionus* sp., *Philodina* sp., *Notholca* sp. Protozoa represented mainly by *Aspidisca* sp., *Vorticella* sp., *Actinospharium* sp., *Colpes* sp., *Paramecium* sp., *Centropyxis* sp. Copepods represented mainly by *Cyclops* sp., *Mesocyclops* sp. The rest of the zooplankton was constituted of Cladocerans with two species *i.e. Daphnia* sp., *Ilyocryptus* sp. and Gastrotrica with a single sp. *i.e. Chaetonotus* sp. composition. The prime contributor in phytoplanktonwas the Chlorophyceae represented principally by *Cosmarium* sp., *Netrium* sp., *Ulothrix* sp.,

Bacillariophycean species - *Navicula* sp., *Gyrosigma* sp., *Cymbella* sp. The Cyanophycae represented by *Nostoc* sp., *Anabaena* sp. The Euglenophyceae composed of *Phacus* sp., *Euglena* sp. The detritus formed by chicken excreta at the pond bottom would serve as substrate for microorganisms as well as food for zooplankton and fishes. Microbial community in detritus is known to provide essential nutritional requirements to the fish feeding on it (Newell, 1980; Schroeder, 1980). The increased level of plankton in ponds, manured with poultry dropping supports the above hypothesis.

The fish pond is able to convert animal excreta into high grade fish protein. The protein content of animal manure is low, 10%-20%, which makes it's recovery difficult. Only when protein content of animal manure reaches above 20%, as is often the case with chicken manners, can the manure be directly incorporated into feeds for other animals (Fang *et al*., 1986). It was estimated that approximately 40.00 gm of manure per day per young bird was produced. The poultry manure is thought to be complete fertilizer combining the characteristics of both organic and inorganic fertilizers and it has been observed that a large population of plankton which are the chief food organisms of fishes grows more quickly in chicken manure ponds than in ponds fertilized with animal manure (Jhingran and Sharma, 1980). The fishes were not given supplementary feed except grass carp, nor were the ponds fertilized with anything other than the chicken excreta falling into the ponds.

The rates of survival of different fish species were excellent in both ponds. It was found 60% in experimental pond while 62% in control pond. In both the ponds higher growth was exhibited by grass carp followed by silver carp and common carp respectively. The grass carp contributed highest share in the total fish production (i.e. 134.00 kg in experimental and 96.00 kg in control pond) (Table-2). The rate of fish production was higher (38.00 kg) in the experimental pond in comparison to the control pond. Such high rate of fish yield was attributed to the animal excreta, recycled in ponds which serve two most important purposes for enhancing fish production as direct feed and pond fertilizer. Similar results were also obtained by other workers in integrated systems e.g. Woynarovich, 1980; Sharma and Das, 1988 *etc*. Poultry fish farming is not only an efficient way of recycling farm wastes but also produces high economic returns. Hopkins and Cruz (1982) studied integrated animal fish farming system in the Philippines and concluded that livestock manure was a very important source of nutrients for fish cultivated in ponds. Chicken manure is a complete fertilizer with the characteristics of both organic as well as inorganic fertilizer and fish culture in this type of an integrated system uses free manure as a pond fertilizer. The economics of poultry cum fish farming have been studied on the basis of sale according to market value. The income from

Table-2: Details of stocking and production

Species	Initial Average weight (g)		Final Average weight (g)		Survival %		Production (kg)	
	(C)	(E)	(C)	(E)	(C)	(E)	(C)	(E)
Ctenopharyngodon idella (Grass Carp)	20.00	20.00	650.00	730.00	68.00	65.00	48.00	60.00
Hypophthalmicthis molitrix (Silver Carp)	25.00	25.00	380.00	410.00	62.00	60.00	28.00	49.00
Cyprinus carpio (Common Carp)	30.00	30.00	250.00	300.00	58.00	55.00	20.00	25.00
						Total	96.00	134.00

Note:- E = experimental and C = control

experimental pond was found to be Rs. 14,435.00/- where as from control pond it was only Rs. 8,350.00/-. This major difference in total income was due to integration of poultry with fishes and selling of diversified products in the form of eggs, flesh and fishes. The detailed information on economics of this system is given in Table-3.

Acknowledgement

The authors are thankful to Prof. K.K. Bhatt, Principal, L.S.M. Government Post Graduate College, Pithoragarh for providing necessary laboratory facilities and encouragement. Thanks are also due to Dr. R. Dobhal, Director U-COST for financial assistance.

Table-3: Production of eggs, flesh, fishes and economics of poultry cum fish culture

Particulars	Experimental pond		Control pond	
	Quantity	Expenditure (Rs.)	Quantity	Expenditure (Rs.)
(A) Input cost				
Poultry shed	1	250/-	-	-
Cost of croyler chick @ Rs. 15 per piece	9	135/-	-	-
Cost of fingerlings @ Rs. per 1 piece	500	500/-	500	500/-
Cost of lime, medicine, feed etc.	-	1080/-	-	750/-
Sub total of (A) Rs.		1965/-		1250/-
(B) Income				
Fish @ Rs. 100 per kg	134	13,400/-	96	9600/-
chicken eggs @ Rs. 2 per egg	750	1500/-	-	-
chicken flesh @ Rs. 100 per kg	15	1500/-	-	-
Subtotal of (B) Rs.		16,400/-		9600/-
(C) Profit (B-A)		**14,435/-**		**8,350/-**

References

Anand, N., 1998. *Indian fresh water micro algae*. Bishen Singh Mahendra Pal Singh, Dehradun.

Anonymous, 1985. Package of practices for increasing production, fish cum livestock farming, CIFRI, Barrackpore, India. Extension manual No. 5. pp: 12.

APHA, 2002. *Standard methods for examination of water and wastewater*. American Public Health Association, Washington D.C.

Bisht, Deepa, 2006. Parvartiya khetraun main samanvit matsya palan. ***Kheti***, 18-22.

Borah, B.C., Bhagowati, A.K., Baruah, U.K., Gogoi, H.K. and Nath, S., 1998. Integrated poultry pig fish farming. ***J. Inland Fish. Society India***, 30 (1) : 39-46.

Dhawan, A. and Sehdev, R.S., 1998. *Present status and scope of integrated fish farming in the N-W plains in integrated fish farming*. ed Mathias, Charles & Baotong. CRC press, New York. pp: 295-306.

Duan, DX, Liu, S-Y, Su, J.S, Zhou, G.S. and Zhang, G.P., 1998. *Fish farming integrated with livesock and poultry in China*. ed Mathias, Charles & Botany. CRC press, New York. pp: 73-82.

Fang, Y.X., Guo, X.Z. Wang, J.K., Fang, X.Z. and Liu, Z.Y., 1986. Effects of different animal manure on fish farming. *Proc. first Indian Fisheries Forum*, Manila, Philippines. 26-31 may 1986. pp: 117-120.

Gupta, M.V., Sollows, J.D., Majid, M.A., Rahman, A. Hossain, M.G. and Dey, M.M., 1998. Integrated aquaculture with rice farming in Bangladesh. Feasibility and economic viability. Its adoption and impact. *ICLARM Tech. Rep. No. 55*. pp: 90.

Gupta, M.V., 1987. *Prospects of integrated fish farming in Bangladesh*. In : Trainers training manual on integrated fish farming, Mymen Singh, Bangladesh. pp: 7-9.

Halder J.D.A. and Ali, M., 2003. High stocking densities and *Azolla* integration. A means to increase fish production and income from integrated rice fish culture. ***J.Inland Fish. Society India***, 30(2): 1-16.

Hopkins, K.D. and Cruz, E.M., 1982. The ICLARM- CLSU integrated animal fish farming project technical report.

Jhingran, V.G. and Sharma, B.K., 1980. *Integrated livestock farming in India*. In Pullin, R.S.V. and Shehadeh, Z.I.I. (eds), Proc. of the ICLARM-SEARCA conference on Integrated

Agriculture Farming System. August 1979; Manila, Philippines. pp: 135.

Khanna, D.R. and Bhutiani, R., 2004. *Water analysis, at a glance*. Pub. Action for sustainable efficacious development and awareness (ASEA). pp: 1-108.

Kumar, K. and Ayyappan, S., 1988. *Current practices in integrated aquaculture*. Working Paper No. 2, Cen. Institute of Freshwater Aquaculture, Kausalyaganga, Bhubhneshwar.

Little, D.C. and Edwards, P., 1999. Alternative strategies for livestock fish integration with emphasis on Asia. ***Ambio***, 28(2) : 188.

Mohanty, R.K., Verma, H.N. and Brahmanand, P.S., 2001. Rice fish integration for enhancing land and water productivity. ***Ann. Report WTCER, India***. pp: 70-74.

Mohanty, R.K., 2002. *Studies on soil fertility, productivity and ecosystem as influenced by introduction of fish and prawn in rice fish integration system*. In Aquatic Environment and Toxicology. Daya Publishing House, Delhi. pp: 63-69.

NACA, 1989. *Integrated Fish Farming in China*. NACA Technical Manual, Thailand.

Newell, R. 1980. The role of detritus in the nutrition of two marine deposits feeders. *Proc. Zool. Soc*. London. pp: 25.

Peenak, R.W., 1978. *Freshwater invertebrates of the United States*. 2nd Ed. John Wiley Sons, New York.

Rao, A.P. and Singh, R., 1998. *Rice fish farming system*. In Ahmad, S.H. (ed), Advances in Fisheries and Fish production. Hindustan Publishing Corporation, New Delhi, India. pp: 309.

Schroeder, G.L. 1980. Fish farming in manure loaded ponds. *In* Pullin R.S.V. and Zaid H. Shehadeh (eds), *Proc. ICLARM-SEARCA,* Manilla, Philippines. pp: 73-86.

Sharma, R.K., 2001. Studies on performance of duck cum fish under integrated system of farming. MVSc Thesis, Ranchi Veterinary College, Kanke, Ranchi.

Sharma, B.K. and Das, M.K., 1988. *The first Indian fisheries forum. In* Asian Fish, Joseph, M.M. (ed). Soc. Indian Branch, Mangalore. pp: 27-30.

Shevgoor, L.K. and Edward, P., 1994. An assessment of the role of buffalo manure for culture of *Tilapia*. ***Aquaculture***, 12(1-2): 107.

Sin, A.W.C., 1980. Integrated animal fish husbandry system in Hong Kong with special case studies on Duck-Fish and Goose-Fish system, *In* Pullin, R.S.V. and Shehadeh, Z.H. (eds) *Proc. ICLARM-SEARCA conference on Integrated Agriculture Farming system.* 6-9 Aug. 1979. Manila. Philippines. pp: 113.

Singh, A.K., 1993. Fish cum pig farming, boon for tribal areas. ***Fishing Chimes***, 12(10): 47.

Uddin, M.S., Das, G.B. Hossain, A., Rahman, M.A., Mazid, M.A., and Gupta, M.V., 1998. *Integrated poultry fish farming– A way to increase productivity and benefit*. ed. Mathias, charles and Baotong. CRS press, New York. pp: 65-72.

Ward, H.B. and Whipple, G.C., 1959. *Fresh water Biology*. 2nd Edn. John Wiley Sons, New York.

Woynarovich, F., 1980. Uttilization of piggery wastes in fish ponds, *In* Pullin, R.S.V. and Shehadeh, Z.H. (Eds), *Proc. ICLARM-SEARCA* Conf. on Integ. Agri- Aqua. Fmg systems Manilla, Phillipines. pp: 125-128.

Environment Conservation Journal 10(3) 31-34, 2009
(ISSN 0972-3099)

Impact of socio-biological activities on Gomti River flowing through Lucknow

Archi Shukla[1], A.K. Sharma[1] and Krishna Gopal[2]

Received: 08-03-2009 Accepted: 15-08-2009

Abstract

Gomti River is the lifeline for Lucknow and is a major source of water for domestic use. Over the years extensive urbanization in Lucknow city has changed the characteristics of Gomti River due to disposal of untreated wastes, which mainly include sewage, solid sludge and hospital wastes. This has caused the degradation of Gomti River resulting in aquatic pollution. The river water is extensively used for washing, bathing, recreational and religious activities. In the present paper we are presenting the findings pertaining to different physico-chemical and microbiological parameters, which have been assessed to determine the impact of socio-biological activities on the quality of river water. For this sampling of water has been done from six different sites at three points of every site, in the month of June, 2006 from Gomti River. Hardness of water samples ranged from 315.00-643.00 mg/l. the pH values of water ranged from 8.60- 8.90. The total dissolved solids varied from 230.40-530.50 mg/l and the dissolved oxygen of water varied between 0.00-4.80 mg/l. The chloride concentration varied between 99.30- 224.30 mg/l and the alkalinity of water samples ranged between 307.70-480.00 mg/l, the nitrate of water samples varied from 11.8- 18.6 mg/l. The fluoride concentration water sample was 0.58- 1.15 mg/l. The bacteriological examination of water yielded the results that >1600/100 ml of coliform 1600-> 1600/ 100 ml of fecal coliform were present in the water samples. These results have been clearly shown that the water of Gomti River is severely affected by various socio-biological activities around sampling site.

Keywords:- *Physico-chemical parameters, Urbanization, Sociobiological, Microbiological parameters, Gomti River*

Introduction

Water is the most essential and prime necessities of life. No one can live without water (Kesre *et al.,* 2007; Khanna, 2007). Although about 73 percent of world's surface area is covered by water i.e. mainly in ocean, lakes, river and on the land. The quantity of fresh water in comparison to marine is quite less. Fortunately, India is a land which has been blessed with a large number of big and small rivers. The Gomti River also known as the Gumti or Goamti is a tributary of the Ganga. The Indian city Lucknow is located on the bank of Gomti River. About 90% pollution load in river is due to human activities. Water pollution occurs as a result of the presence of any objectionable or waste material capable of damaging the water quality. (FEPA, 1991). Gomti water in the Lucknow city is severely polluted by industrial effluent, domestic waste and socio-biological activities such as mass bathing, washing of clothes, animal bathing and disposal of industrial effluent and by the discharge of untreated sewage from residential area. An attempt has been made to evaluate the quality of Gomti water by microbiological and physico chemical analysis of water samples collected from different points having socio-biological importance.

Author's Address

[1]Protozoology Lab Department of Zoology, University of Lucknow ✉

[2]Indian Institute of Toxicology Research, Lucknow

Materials and Method

The water samples collected from six different sites, owing to having sociobiological activities like bathing, washing, recreational and religious gathering at Gomti River flowing through Lucknow city were designated as S_1, S_2, S_3, S_4, S_5 and S_6 (Fig.1). The water samples were collected in plastic cans for physico-chemical analysis, for microbiological study water samples were collected in sterilized glass bottles. Sampling was done in the month of June (2006) and the samples were

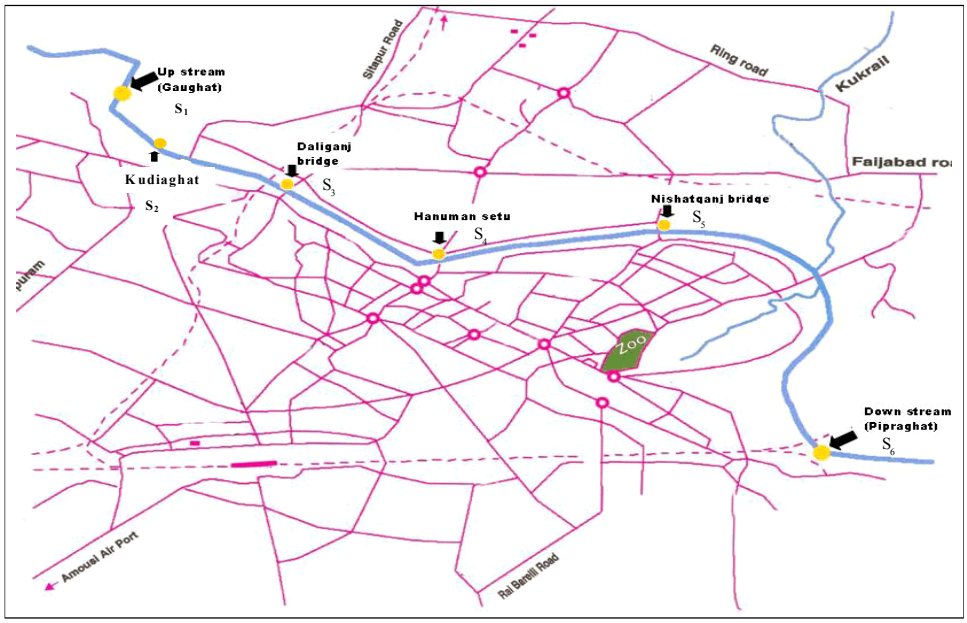


Fig. 1: Map showing location of different sampling sites in Gomti River

analyzed using standard methods (APHA, 2005; Khanna and Bhutiani, 2004).

Results and Discussion

The data presented in Table-1 shows that the temperature recorded was 34.00^{0}C at all the sampling sites. The pH of water samples was found between 8.60- 8.90, crossing the desirable limits. pH has no direct adverse effect on the human health. Total hardness ranged between 315.00- 643.00 mg/l. Although hardness has no known adverse effect on human health; however some evidence has indicated its role in cardiac disorders. The hard water is also not suitable for domestic use in washing, cleaning and laundering (Trivedi and Goel, 1986). The total alkalinity of water samples ranged between 307.70-480.00 mg/l. A number of bases i.e. carbonate bicarbonate, hydroxides, phosphate and nitrates, silicates and borates *etc.* contributed to alkalinity (Garg *et al.*, 1998; Sakhare and Joshi, 2002). A higher value of alkalinity was observed at site S_6. Dissolved oxygen of water ranged from 0.00-4.80 ppm. In any aquatic ecosystem the level of dissolved oxygen depends on the factors like the concentration of dissolved solids and biological activities of all life. (Khatavakar *et al*., 2004). Depletion of dissolved oxygen may be due to disposal of sewage and industrial effluent into natural water bodies and resulting into an increase of BOD in the water (Kriubauathy *et al*., 2005).

The desirable limit of total dissolved solids is 500.00 mg/l, in this study the concentration of total dissolved solid (TDS) ranged from 230.40-530.50 mg/l. Higher concentration of total dissolved solid may be attributed to the presence of colloidal or finely suspended matter, which does not settle in the water. The presence of colloidal or fine matter may be due to the direct discharge of solid wastes (Rajurkar *et al*., 2003). Total dissolved solid values exceeding may cause gastrointestinal irritation (Kaushik *et al*., 2004).

Chloride concentration ranged between 99.30-224.30 mg/l. Chloride have been found to be associated with pollution and its higher value is attributed to the sewage contamination and organic pollutants (Mishra *et al*., 2003). Higher concentration of chloride in drinking water may cause disease of heart and kidneys. Sulphate concentration varied between 316.70- 640.00 mg/l. It is maximum at S_4, S_5 and S_6 stations. Nitrate concentration varied between 11.80-18.60 mg/l. Nitrate is the oxidized form of nitrogen in water. It is most important source of biological oxidation of nitrogenous organic matter origin which includes domestic sewage, agricultural runoff and effluent from residential or industrial areas (Saxena, 1998).

Fluoride concentration varied between 0.58-1.15 mg/l. It was higher at S_4 and S_6 stations. Total organic carbon in water samples varied between 44.51 to 68.74 ppm. Organic contaminants (natural organic substance, insecticides, herbicides and other agricultural chemical) enter water ways in rainfall runoff. Domestic and industrial waste water also contribute organic contamination in various amounts. A high organic content means an increase in the growth of microorganisms which contributed to the depletion of oxygen supplies. Coliform present in water is >1600/ 100ml. Fecal Coliform in water is 1600->1600/100ml. Fecal contamination of natural drinking water source is a most serious danger to human health by causing various water born diseases. Coliform and Fecal Coliform are established indicators of fecal contamination in aquatic environment. According to WHO guidelines for drinking water, there should be <10 Coliform and no fecal coliform or fecal streptococci in 100 ml of any potable water samples (WHO, 2004).

Table-1: Physico-chemical parameter of Gomti River at different sites in Lucknow City

Parameter	S_1	S_2	S_3	S_4	S_5	S_6
pH	8.60	8.60	8.60	8.70	8.60	8.90
Temperature (°C)	34.00	34.00	34.00	34.00	34.00	34.00
DO (ppm)	0.00	2.00	2.00	1.00	3.00	4.80
TDS (mg/l)	230.40	274.10	300.10	392.00	443.70	530.50
Hardness (mg/l)	315.00	383.00	445.00	481.00	509.00	643.00
Alkalinity (mg/l)	307.70	346.30	353.00	363.30	387.00	480.00
Chloride (mg/l)	99.30	124.70	146.00	164.30	183.70	224.30
Sulphate (mg/l)	316.70	340.00	376.60	426.70	503.30	640.00
Nitrate (mg/l)	11.80	12.50	13.70	14.80	17.50	18.60
Fluoride (mg/l)	0.58	0.67	0.74	0.94	0.87	1.150
Total organic carbon (ppm)	44.51	54.84	56.97	60.63	63.22	68.74
Coliform (/100ml)	>1600	>1600	>1600	>1600	>1600	>1600
Fecal Coliform (/100ml)	1600	1600	>1600	1600	1600	>1600

Conclusion

The findings of this study have proved that Gomti River water is indeed polluted through various socio-biological activities. We have also been able to show that bacterial population has contributed to the contamination of Gomti water. All physico-chemical parameter were found to cross the desirable limits and some of them crossed the maximum permissible limit according to Bureau of Indian Standard. The results of different physicochemical parameters have shown that the water of Gomti River is severely affected by various socio-biological activities at different sampling sites. The implication of these findings may be that people dependent on this water for domestic use including cooking, drinking and washing may be exposed to some of these hazards.

References

APHA, 2005. *Standard methods for examination of water and waste water analysis* (21st Ed). American Water Association and Water Pollution Centre federation Washington, D.C.

FEPA, 1991. *Guidelines and Standards for environmental Control in Nigeriapublished* by the federal Environmental Protection Agency Lagos. pp: 15-34.

Garg, V.K., Sharma, S.I. and Bishnal, S.M., 1998. Fluoride in under ground waters of Uklana town, district Hissar, Haryana. ***Pollution Res***., 17: 149-152.

Kaushik, A., Kumar, A., Sharma, I.S. and Sharma, H.R., 2004. Ground water quality assessment in different land use area of Faridabad and Rohtak cities Haryana using deviation Intec. ***J. Environ. Biol.***, 25(2): 173-180.

Kesre, Vivek, Mudgal, L.K., Khanna, D.R., Matta, Gagan and Kumar, Dheeraj, 2007. Study of physico-chemical parameter for a reservoir at Khandwa District (M.P.). ***Environment Conservation Journal***, 8(3): 127-132.

Khanna, D.R. and Bhutiani, R., 2004. *Water analysis at a glance*. Pub. Action for sustainable efficacious development and awareness (ASEA). pp: 1-108.

Khanna, D.R., Singh, Vikas, Bhutiani, R., Chandra, Kumar Satish, Matta, Gagan and Kumar, Dheeraj, 2007. A study of biotic and abiotic factors of Song River at Dehradun, Uttarakhand. ***Environment Conservation Journal***, 8(3): 117-126.

Khatavakar, R.S. Shah, N.V., Rao, K.R. and Navale, R.A. 2004. Variation in physico-chemical parameters in fresh water tanks in and around Solapur city, Maharastra. ***J. Aqua Biol.***, 19: 111-114.

Kriubauathy, A., Kavitha, B.S., Mariamma, N. and Rajammal, T., 2005. Assessment of water quality of Orathupalayaum reservoir, Erode district, Tamil Nadu. ***J. Ecophysiol. Occup. Hlth.***, 5: 53-54.

Mishra, P.C. Pradha, K.C. Patel, R.K. 2003. Quality of water for drinking and agriculture in and around mines in Konjhar district Orissa. ***Indian J. Environ Helth***, 45(3): 213-220.

Rajurkar, N.S., Hongbri, B. and Patwardhan, A.M. 2003. Physicochemical and biological investigation of river Umshyrpi at Shillong Meghalaya, ***Indian J. Environ Helth.*** 45(1): 45-92.

Sakhare, V.B. and Joshi, P.K., 2002. Ecology of Palas-Nilegaon Reservoir in Osmanabad district, Maharastra. ***J. Aqua. Biol.***, 18: 17-22.

Saxena, S., 1998. Settling Studies on pulp and paper mill waste waters. ***Ind J. Environ. Hlth.***, 20(3): 273-280.

Trivedi R.K. and Goel P.K. 1986. *Chemical and Biological methods for water pollution Studies*. Environ, Publ.Karod, Maharashtra.

WHO, 2004. Guidelines for drinking water**,** (3rd Ed). World Health Organization, German.

Environment Conservation Journal 10(3) 35-40, 2009
(ISSN 0972-3099)

Fish diversity of Sogane and Santhekadur tanks, Shimoga, Karnataka

M. Venkateshwarlu, K. Honneshappa, A. Shahnawaz and N.V. Cinchana

Received: 01-03-2009 Accepted: 18-09-2009

Abstract

The present investigation was undertaken to study the fish diversity of Sogane and Santhekadur tanks, Shimoga. About 17 fish species were identified in these tanks which were represented by 4 orders, 11 families and 14 genera. The family Cyprinidae dominated the other groups of fish in both the tanks. The study of fish fauna of an aquatic body is useful for planning of fisheries development. The water quality analysis of these tanks was analyzed to study its influence on fish.

Keywords:- *Fish diversity, Species, Protein, Economically, Karnataka*

Introduction

The nature has endowed with a wealth i.e., biodiversity and its environment, which is vital for the life to sustain on this earth. Biodiversity is the variety and variability of plants, animals and microorganisms in its environment. India is endowed with a vast expanse of open inland water. There are about 31,53,366 hectare reservoirs, 2,02, 213 hectare lakes, 2200, 000 hectare ponds, besides 29, 000 km length of rivers (Sugunan, 1999). India represents about 11.72% of fish species including 23.96% genera, 57% families and 80% orders of the world (Barman, 1998). There are about 2,500 species of fishes in India, of which 930 belong to freshwater, 1,570 species are marine (Debashish, 2005).

Fishes exhibit enormous diversity in terms of their morphology, habitat and biology (Harmer, 1999). Fish can be used for ecological assessments at all levels of biological organization, assessment procedures are available at the levels of ecosystem, populations, individuals, organs and at the cellular and molecular levels (Harris, 1995). Besides to these credits, fishes are considered as one of the important protein rich food source among the aquatic fauna (Sukla and Upadhyay, 2000). In India, fish culture is practiced mostly in ponds/tanks because pond diversity is represented by a number of aquatic plants and animals including vegetation, plankton, weeds and various bottoms dwelling forms. Freshwater ponds and reservoirs comprise a vital component of the ecosystem in developing countries since they provide a high level of public interface. For the last two to three decades several investigators have studied the hydrobiological profiles of varied lentic bodies (ponds, reservoirs, lakes) with the intent to assess the water quality (Singh, 2000; Shastri and Pendse, 2001; Islam *et al*., 2001). Recently, Arunachalam *et al*. (1997); Venkateshwarlu *et al*. (2002 and 2005); Shahnawaz *et al*. (2008) reported fish diversity in some rivers of Karnataka. But as far as pond/tank fish diversity is concerned, little information is available. Venkateshwarlu *et al.,* 2003, reported biodiversity of fish fauna of Mudigodu tank and Venkateshwarlu *et al.,* 2007 reported diversity of fish fauna in Keladi pond, Karnataka. Therefore, it is the need of the hour to study the fish diversity in order to increase our national economy on scientific basis. Keeping the above in view, the present study has been undertaken.

Materials and Method

Santhekadur and Sogane tanks are situated at Latitude of 13° 52' N, Longitude 75° 45' E and Latitude of 13° 55' N, Longitude 75° 50' E in the Shimoga city at the distance of 6 and 10 km respectively. Field investigation was carried out for a period of one year from February 2007 to January 2008. Fishes were collected by using monofilament and multifilament gill nets of various mesh sizes ranging from 6-15 mm,

Author's Address
Deptt. of Applied Zoology, Kuvempu University, Shankarghatta, Shimoga, Karnataka ✉

dragnets, scoop nets and cast nets. Fishes were examined, counted and few specimens (5-10) which were preserved in buffered formalin (10%) and transported carefully to the laboratory for further analysis. Fishes were identified based on the keys for fishes of the Indian subcontinent (Jayaram, 1999; Talwar and Jhingran, 1991).

The water sampling was carried out during morning hours between 9.00 10.30to A.M. For physico-chemical analysis, water samples were collected in 1000 ml plastic bottles. The water temperature was recorded at the sampling site itself. Dissolved oxygen was fixed on the spot itself in BOD bottles. Various parameters like free CO_2, alkalinity, BOD, phosphate, nitrate, total hardness, Ca, Mg, TDS and Chloride were estimated as per the standard methods (APHA, 1995).

Results and Discussion

Fish fauna

A total of 17 species of fishes represented by 4 orders, 9 families and 14 genera were recorded in the Santhekadur and Sogane tanks (Table-1). Out of 17 fish species, 8 species belong to order Cypriniformes, 5 species to order Siluriformes, 3 species to order Perciformes and remaining 1 species to order Osteoglossiformes respectively. The family Cyprinidae dominated the other groups in the fish fauna in both the tanks. The results are in confirmatory with those of (Wakid and Biswas, 2005). The same observations were also made by Venkateshwarlu *et al*., 2007.

Table-1: List of fishes recorded from Santhekadur and Sogane Tanks

Order: Osteoglossiformes	
Family: Notopteridae	
1	*Notopterus notopterus* (Hamilton-Buchanan)
Order: Cypriniformes	
Family: Cyprinidae	
Subfamily: Cyprininae	
2	*Cyprinus carpio cummunis* (Linnaeus)
3	*Cirrhinus fulungee* (Sykes)
4	*Catla catla* (Hamilton-Buchanan)
5	*Labeo rohita* (Hamilton-Buchanan
6	*Cirrhinus reba* (Hamilton-Buchanan)
7	*Labeo calbasu* (Hamilton-Buchanan)
8	*Cirrhinus mrigala* (Hamilton)
9	*Puntius chola*
Order: Siluriformes	
Family: Bagridae	
10	*Mystus cavasius* (Hamilton-Buchanan)
Family: Siluridae	
11	*Ompok bimaculatus* (Bloch)
12	*Ompok pabo* (Hamilton-Buchanan)
Family: Claridae	
13	*Clarias batrachus* (Linn)
Family: Heteropneustidae	
14	*Heteropneustes fossilis* (Bloch)
Order: Perciformes	
Family: Cichlidae	
15	*Oreochromis mossambica* (Peters)
Family: Gobidae	
16	*Glossogibius guiris* (Hamilton-Buchanan)
Family: Mastacembelidae	
17	*Mastacembelus armatus* (Lecepede)

The four major species of carps were found like *Catla*, *Rohu*, *Mrigal* and *Cyprinus*. Based on the fish size, the collected fish species can be divided into large fish, medium fish and small sized fish. Inthe fish assemblage the large fishes are Cyprinus *carpio,* (2.00 kg and

Table-2: Fishes of Santhekadur and Sogane Tanks with vernacular name, occurrence, abundance biodiversity status and economic status

Species	Vernacular/ Local Name	Occurrence	Abundance	Biodiversity Status	Economic status
Notopterus notopterus (Hamilton-Buchanan)	Chappali	1 and 2	A (3-4)	LR-nt	Less
Cyprinus carpio cummunis (Linnaeus)	Gowri	1	A2	LR-Ic	High
Cirrhinus fulungee (Sykes)	Arja	1and 2	A (3-4)	LR-nt	High
Catla catla (Hamilton-Buchanan)	Catla	1and 2	A2	VU	High
Labeo calbasu (Hamilton-Buchanan)	Karae-kolasa	1and 2	A2	LR-nt	Less
Labeo rohita (Hamilton-Buchanan)	Rohu	2	A2	LR-nt	High
Ompok pabo (Hamilton-Buchanan)	Godalae	1and 2	A2	NA	Less
Cirrhinus reba (Hamilton-Buchanan)	Arja	1and 2	A (3-4)	VU	Less
Mystus cavasius (Hamilton-Buchanan)	Girlu	1and 2	A (3-4)	LR-nt	Less
Ompok bimaculatus (Bloch)	Godalae	1	A2	EN	High
Cirrhinus mrigala (Hamilton)	Mrigal	1and 2	A2	LR-nt	High
Clarias batracus (Linn)	Murugodu	1	A2	VU	Less
*Heteropneustes fossili*s (Bloch)	Chaelu	1and 2	A (3-4)	VU	Less
*Oreochromis mossambica** (Peters)	Jilebi	1and 2	A (3-4)	NA	High
Glossogibius guiris (Hamilton-Buchanan)	Bhangi-sidda	1and 2	A2	LR-nt	Less
Mastacembelus armatus (Lecepede)	Haavu-meenu	1and 2	A (3-4)	LR-nt	Less
Puntius chola (Hamilton-Buchanan)	Dodda-karsae	1and 2	A2	VU	Less

Note: 1= Santhekadur Tank, 2 = Sogane Tank; Abundance: A2-abundant, A (3-4) - Most abundant; EN= Endangered; LR- Ic=Lower risk least concern; LR- nt = Lower risk-near threatened; VU= Vulnerable; NA = not assessed; * Introduced species

above), *Labeo rohita, Catla catla, Cirrhinus mrigala* and *Clarias batracus.* In the medium category fishes include are (1 kg and below) *Cirhinus fulungee, Ompok bimaculatus, Cirhinus reba, Ompok pabo, Mystus cavasius, Notopterus notopterus, Glossogibius guiris, Labeo calbasu, Oreochromis mossambica* and *Mastacembelus armatus.* The small fish includes *Puntius chola* of size about 3-100 gm.

Fish species abundance and occurrence is shown in the Table-2. Out of 17 species recorded from both the tanks, 14 are indigenous and remaining 3 species are exotic including *Catla catla*, *Labeo rohita* and *Oreochromis mossambica*. Among the fish composition 8 species (*Notopterus notopterus, Cirhinus fulungee, Cirrhinus reba, Mystus cavasius, Heteropneustes fossili*s, *Oreochromis mossambica, Channa punctatus and Mastacembelus armatus)* were found to be the most abundant and rest of the species were abundant and rarely found in the water bodies. *Oreochromis mossambica* was found dominant in the fish catch in Santhekadur tank followed by *Catla catla* and *Labeo rohita* respectively. The Sogane tank is natural and constantly gets water from the Bhadra channel, where *Catla catla* and *Labeo rohita* percentage catch was less. In this tank *Mystus cavasius* was predominant followed by *Notopterus notopterus* respectively. The fish species recorded so far were all economically important and having high commercial importance.

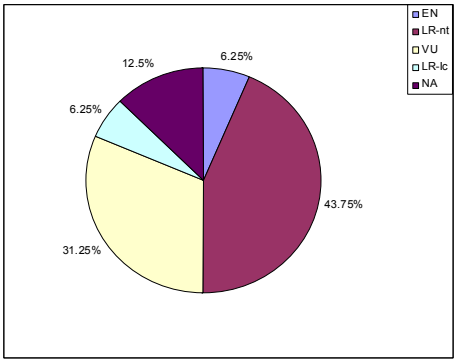


Fig. 1: Biodiversity status (IUCN) of fishes collected during present study

Note: EN= Endangered; LR- lc=Lower risk least concern; LR- nt = Lower risk-near threatened; VU= Vulnerable; NA = not assessed.

The fish species recorded so far were all economically important and having high commercial importance. Kumar (1990) reported 51 fish species of 9 families in Govindsagar reservoir, Himachal Pradesh, out of which almost all were commercially important. The present fish study has also shown that most of fish species recorded were predatory in nature.

Table-3: Vegetation communities abundance and distribution in the Santhekadur and Sogane tanks

Plant species	Santhekadur tank	Sogane tank
Lemna	+	+
Eichornia	-	+
Azolla	+	+
Pistia	+	+
Hydrilla	+	+
Chara	+	-
Nymphae	+	+
Typha	+	-
Ipomea aqqutica	+	-

Sukumaran and Das (2005) have also made the same observation and stated that majority of the reservoirs of Karnataka state have a large population of predatory fish species. As far as biodiversity status (IUCN, 1994) is concerned, out of 16 species, one species is endangered (6.25 %), eight species as lower risk-near threatened (43.75 %), vulnerable five species (31.25%), lower risk least concern is one (6.25 %) and remaining two (12.5 %) are included under the category of not assessed (Fig. 1).

Physico-chemical parameters

The physicochemical variables of both the water bodies showed positive correlation and were rich in organic substances, because of elevation in sedimentation amount, then directly promote the growth of macrophytic vegetation (Table-3). This resulted in reduction in water holding capacity and decrease depth of water in pond. Therefore, it is indicated that both the water bodies are suitable for fish culture. The physico-chemical properties of Santhekadur and Sogane tanks are summarized in

Table-4: Seasonal variation of Physico-chemical parameters of Santhekadur tank

Parameters	Pre-monsoon (Feb-May)	Monsoon (Jun-Sep)	Post-monsoon (Oct-Jan)
Air Temp(°C)	31.00	27.00	25.50
Water Temp. (°C)	28.50	25.00	24.50
pH	8.10	7.40	7.47
TDS (mg/l)	45.00	30.60	49.76
EC (µmho/s)	84.20	59.20	77.75
DO (mg/l)	8.10	9.21	8.20
BOD (mg/l)	2.41	2.00	2.35
CO_2 (mg/l)	4.80	3.40	2.90
Chloride (mg/l)	38.80	14.18	18.34
Calcium (mg/l)	14.10	12.28	6.69
Magnesium (mg/l)	5.92	0.96	3.33
T. Hardness (mg/l)	60.00	34.60	30.50
T. Alkalinity (mg/l)	28.50	30.00	31.20
T. Acidity (mg/l)	20.00	10.00	10.00
Phosphate (mg/l)	2.90	5.15	2.00
Nitrate (NO_3) (mg/l)	0.52	0.20	0.20
Sulphate (mg/l)	15.00	9.60	14.29

Table-5: Seasonal variation of Physico-chemical parameters of Sogane tank

Parameters	Pre-Monsoon (Feb-May)	Monsoon (Jun-Sep)	Post Monsoon (Oct-Jan)
AirTemp(°C)	31.00	30.00	27.00
Water Temp. (°C)	29.00	27.00	24.50
pH	7.30	6.47	7.20
TDS (mg/l)	72.00	60.00	69.46
EC (µmho/s)	140.00	90.20	67.72
DO (mg/l)	6.48	9.30	5.20
BOD (mg/l)	2.42	1.21	2.35
CO_2 (mg/l)	3.90	2.50	3.50
Chloride (mg/l)	14.76	28.36	8.14
Calcium (mg/l)	10.94	21.05	4.69
Magnesium (mg/l)	1.14	8.32	2.12
T. Hardness (mg/l)	32.00	80.00	20.10
T. Alkalinity (mg/l)	29.10	28.30	32.40
T. Acidity (mg/l)	5.10	5.20	5.02
Phosphate (mg/l)	2.10	4.50	2.80
Nitrate (NO_3) (mg/l)	0.35	0.20	0.25
Sulphate (mg/l)	10.20	14.00	11.50

Table-4 and 5. Ambient temperature and water temperature ranges from 24.50-31.00 respectively. Mean water temperature is observed to be lower than ambient temperature which is attributed to less heating of the ponds. The pH values (6.47-8.10) didn't show a definite seasonal surge and high value was recorded during February and low in September in both the ponds. This may be because of turbidity of water which in turn reduce photosynthetic activity of algae leading to accumulation of CO_2 and hence reduction of pH (Adibisi, 1980). Dissolved Oxygen (DO) indicates physical, chemical and biological activities in a water body. It is an important indicator of water quality. DO affect the solubility and availability of many nutrients and therefore productivity of aquatic ecosystems (Wetzel, 1983). In the present study, DO values were found to be more than 5.00 mg/l, which shows that both the wetlands are optimal for aquatic life. The low values of BOD indicate the low levels of biodegradable materials and absence of non-biodegradable substances. The chloride varied between 8.14-38.80 mg/l, which indicates that water appears to be suitable for irrigation purposes. A decrease trend in the chloride content in both the ponds during winter season may be related to the absence of dilution effect of water. Biologically important nutrient, Phosphate (PO_3^-) varied between 2.00-5.15 mg/l and showing its maximum range during rainy season indicating the influx of rain water containing fertilizers from the surrounding agricultural fields.Sulphate concentration of the ponds was found to be under permissible limits and variation in sulphate content in ponds might be due to variable organic input. Total hardness (mg/l $CaCO_3$) and total alkalinity were found to be low and ranged from 20.10 to 80.00 mg/l and 28.30 to 32.40 mg/l respectively and such water bodies can be considered as soft. Acidity variate from 5.02 to 20.00 mg/l and phosphate variate from 2.00 to 5.15 mg/l during the study of both the tanks. The concentration of NO_3^- fluctuate from 0.20 to 0.52 mg/l and variation in the contentration of SO_4^- observed was 9.60 to 15.00 mg/l.

References

Adibisi, A.A., 1980. The Physicochemical Hydrology of Tropical seasonal Uppar Ogun River. ***Hydrobiologia***, 79: 157-165.

APHA, 1995. *Standard Methods for the Examination of Water and Wastewater*. 19th ed. American Public Health Association, New York, 1143.

Arunachalam, M., Johnson, J.A. and Shankaranarayanan, A., 1997. Fish diversity in rivers of northern Karnataka Western Ghats. ***International Journal of Ecology and Environmental Science***, 23: 327-333.

Barman, R.P., 1998. Fish faun of Tripura, (North East India). ***J. Bombay Nat. His. Soc.***, 91: 37-46.

Debashish, K., 2005. Biodiveristiy in Northeast India with a note on their conservation. ***Him. J. Env. Zool.***, 19(1): 41-45.

Harmer, S.F., 1999. *Classification of fishes*. Discovery Publ. House, New Delhi, India.

Harris, J.H., 1995. The use of fish in ecological assessments. ***Aus. J. Ecol.***, 20: 65-80.

Islam, A.M., Choudry, A.N. and Zaman, M., 2001. Limnology of Fish Ponds in Rajshahi, Bangladesh. ***Ecol. Envir. Conserve***, 7**:** 1-7.

IUCN., 1994. Red List of Threatened Animals**.** *IUCN*, Gland.

Jayaram, K.C., 1999. *The freshwater fishes of the Indian region*. Narendra Publishing House, New Delhi.

Kumar, K., 1990. Management and development of Gobindasagar reservior. A case study. ***Proc. Nat. Workshop reservoir fish.***, 13-20.

Shahnawaz, A., Venkateshwarlu, M., Somashekar, D.S. and Santosh, K., 2008. Fish diversity with relation to water quality of Bhadra River of Western Ghats (INDIA). ***Environ Monit Assess.***, (DOI 10.1007/s10661-008-0729-0).

Shastri, Y. and Pendse, D.C., 2001. Hydrobiological study of Dehikhuta reservoir. ***J. Environ. Biol.***, 22**:** 67-70.

Singh, D.N., 2000. Seasonal variation of zooplankton in a tropical lake. ***Geobios***, 27: 100.

Sukla, A.N. and Upadhyay, 2000. *Economic Zoology*. Rastogi Publication, Meerut. pp: 199.

Sukumaran, P.K. and Das, A.K., 2005. Limnology and fish production efficiencies of selected reservoirs of Karnataka. ***Indian J. Fish.***, 52(1): 47-53.

Sugunan, V.V., 1999. Review. *Fishing Chimes*, 19: 7-10.

Talwar, P.K. and Jhingran, A., 1991. *Inland fishes of India and adjacent countries*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2(19): 1158.

Venkateshwarlu, M., Jothi, Srigowri and Asha Shree, H.M., 2007. Proceedings on "*Diversity and Life processes from Ocean and Land"*. Goa University. Goa. pp: 156-159.

Venkateshwarlu, M.M. Shanmugam and Chinchana, N.V., 2003. Biodiversity of fish fauna of Mudogodu Tank, Rangenahalli. ***Ecol. Env***, 21(1):161-164.

Venkateshwarlu, M., Shanmugham, M. and Mallikarjun, H.R., 2002. The fish of Bhadra reservoir Western Ghats. ***J. Aquatic Biol.***, 17(1): 9-11.

Venkateshwarlu, M., Somashekar, D.S., Jothi Srigowri and Asha Shree, H.M., 2005. Proceedings of State Level Seminar on, *Biodiversity and Conservation*, Haveri, Karnataka, 22-25.

Wakid, A. and Biswas, S.P., 2005. Status and diversity of fish fauna in Dibru-saikhowa National park, Assam. ***J. Bom. Nat. Hist. Soc.***, 102 (1), 50-55.

Wetzel, R.G., 1983. *Limnology*. 2nd edition. Saunders Coll. Publ. pp: 767.

Environment Conservation Journal 10(3) 41-44, 2009
(ISSN 0972-3099)

A preliminary study on zooplankton diversity in Nal Damayanti (Simbhora) Dam, Morshi, Amravati

U.W. Fule[1], S.S. Nimghare[1], P.M. Telkhade[2], S.B. Zade[3] and N.R. Dahegaonkar[2]

Received: 15-01-2009 Accepted: 10-09-2009

Abstract

The present paper reports the zooplankton diversity in Nal Damayanti (Simbhora) dam in Morshi Taluka of Amravati district, Maharastra State. Nal-Damayanti reservoir constructed on river Wardha, having an area of 1335 hectares and 9729 hectares of total catchment area. The samples were collected during October-2007 to March-2008. The sample analysis showed great diversity in zooplankton consisting 39 species belonging to five groups. Rotifera were dominant by contributing 21 species followed by Cladocera 11 sps., Copepoda by 5 sps., Protozoa by 5 sps. and Ostracoda by 3 sps.

Keywords:- *Nal Damayanti, Simbhora, Zooplankton, Diversity*

Introduction

Zooplankton community of fresh water bodies constitute an extremely diverse assemblages of organisms represented by most of the invertebrate phyla. Zooplankton has been used as an indicator for monitoring the water quality, trophic status and pollution level.

Zooplanktor is a major link in energy transfer to the higher trophic level. They form an integral component of aquatic ecosystem and comprises of microscopic animal life that passively float or swim freely. Taxonomic groups of Protozoa, Rotifera, Cladocera and Copepoda represents the prinicipal components of zooplankton in lentic environment. Zooplankton incorporates primary and partly secondary micro faunal consumer operative system. This serves the functional role of harvesting primary and partly secondary microfaunal consumer operative system. This serves the functional role of harvesting primary production and grazing the bacterial biomass on the detrital spectrum in water (Rao, 2005).

Author's Address

[1]Hutatma Rashtriya Arts and Science College, Ashti, Distt. Wardha (M.S.)

[2]Arts, Commerce and Science College, Tukum Chandrapur (M.S.)

[3]Deptt. of Zoology, R.T.M. Nagpur University, Nagpur ✉

Several workers, Arora (1964), Rao *et al.* (1981), Khanna *et al.* (1993) Katiyar (1995), Ejsmont (1996),Witek (1998), Bini *et al.* (1997) and Kesre *et al.* (2007) have studied zooplankton of various lakes and reservoirs and opined that limnological characteristics of any water body alter the zooplankton diversity inhibiting in it.

Materials and Method

The samples were collected once in a month for a period of 6 months from October-2007 to March-2008 from the Dam. The plankton net of mesh size 56.00 µm made up of Bolting silk cloth swept through subsurface and samples were collected during 8.30 A.M. to 9.30 A.M. Collected samples were preserved in 4% formalin and identified using pertinent literature, Edmondson (1959), Dhanapathi (2000), Kodarkar (1992) and Khanna and Bhutiani (2004).

Results and Discussion

In the present investigation, zooplankton studied under five groups *viz*. Protozoa, Rotifera, Cladocera, Copepoda and Ostracoda. Among the five groups, maximum number of species (21 species) belongs to Rotifera (Table-1). Similar findings has been reported by Ferneska and Lewkosiez (1966) and Schindler and

Noven (1971). They have noted the enormous growth of rotifers in the lakes and reservoirs at Ontario. Jyoti and Sehgal (1979) have reported the most diversified species and rich Rotifera groups in reservoirs. Pandey *et al*. (2007) reported that rotifers occur more predominantly than cladocerans and copepods. Alikunhi (1957), Michael (1964) and Singh and Sahai (1978), has also reported dominance of rotifers than other groups.

Among rotifers, *Brachionus* and *Keratella* species showed their dominance. Mahajan (1981) recorded dominance of *Brachionus* species in zooplankton showed similar observation. Hutchinson (1967) observed that the *Brachionus* species are very common in temperate tropical waters. Somani and Pejaver (2003) stated that Rotifera is quite a diverse group of organism and large generic variety is observed in various lentic environments all over India. However, *Brachionus* and *Keratella* are the most commonly recorded genera in Indian lakes. Devi (1994) and Malathi (1999) recorded *Keratella tropica* as common eutrophic perennial forms in lakes of Hyderabad.

The Group Cladocera represented by 11 species among the total Cladocerans recorded (Table-2). *Moina brachiata, Moinodaphnia, Chydorus* species showed their dominance over other species. Cladocera groups was at second position in the present investigation, such lower contribution of Cladocerans was also recorded by Dutta Munshi and Dutta Munshi (1995).

The copepods are mainly dominated by *Cyclops* and *Diaptomus*. They showed their dominance during the month of October and in the month of March. Prabhawati and Sreenivasan (1977), observed maximum peak of copepods and cladoceron in the month of September and October. No definite period is observed to be suitable as January and February observed by Subbamma and Ramasarma (1992), March reported by Malathi (1999). Water rich in organic matter support higher number of cyclopoids.

Table-1 : Rotifera diversity

1	*Asplanchna brightwelli*
2	*Brachionus calcyciflorus*
3	*B. plicatilis*
4	*B. quadridentata*
5	*B. bidentata*
6	*B. falcatus*
7	*B. caudatus*
8	*Polyarthra indica*
9	*Epiphanes senta*
10	*Filinia longiseta*
11	*F. opaliensis*
12	*Trichocerca cylindrica*
13	*T. longiseta*
14	*Rotaria citrinus*
15	*Keratella tropica*
16	*K. varga*
17	*Hexarthra mira*
18	*Lepadella ovalis*
19	*Monostyla bulla*
20	*Lecane luna*
21	*Platyias polyacanthus*

Table-2: Cladocera diversity

1	*Alona monocantha*
2	*Alona affinis*
3	*Acroperus harpae*
4	*Bosmina longirostris*
5	*Ceriodaphnia laticaudata*
6	*Chydorus sphericus*
7	*Moinodaphnia macleayil*
8	*Moina brachiata*
9	*Dadaya macrops*
10	*Leydigia acanthocercoides*
11	*Simocephalus vetulus*

Table-3: Copepoda diversity

1	*Diaptomus gracilis*
2	*Diaptomus breweri*
3	*Cyclops viridis*
4	*Eucyclops agilis*
5	*Mesocyclops edax*

Subbamma and Ramasarma (1992) suggested their preponderance in higher trophic state of water.

The group protozoa was represented by 5 species (Table-4) and the group follows Copepoda in species diversity. In protozoa, *Arcella polypora* and *Difflugia urceolata* are dominant than others. Similarly, observed by Sawane *et al*. (2006) in Erai river at Erai dam site District Chandrapur Maharashtra.

In the present investigation, only three species of *Ostracoda* are recorded (Table-5). Pailwan (2005) recorded 3 species of *Ostracoda* from perennial tanks of Kolhapur District. Environmental factors like temperature, salinity, DO and sediment composition seem to influence cummulatively on the distribution of *Ostracoda*. *Ostracoda* abundance is also dependent upon the availabililty of food as opined by Swain (1955), Engel and Swain (1967) and Joy and Clark (1977).

Table-4: Protozoa diversity

1	*Amoeba proteus*
2	*Paramecium caudatum*
3	*Arcella polypora*
4	*Platyophrya vorase*
5	*Difflugia urceolata*

Table- 5: Ostracoda diversity

1	*Cypris subglobosa*
2	*Cyclocypris globosa*
3	*Stenocypris fontinalis*

References

Alikunhi, 1957. Fish culture in India. FM. Bull. Indian Coun. ***Agri. Res.***, 20: 144 - 150.

Arora, H.C., 1964. Studies on Indian Rotifera [part-III]. ***J. Zoo. Soc. India.***, 16 (1-2) : 1-6

Bini, L.M., Tundisi, J.G, Tundisi, T.M. and Metheus, C.E., 1997. special variation of zooplankton groups in a tropical resevoir (Broa Reservoir, Sao Paula State Brazil). ***Hydrobioliogia***, 357(1-3): 89-98.

Devi, M.J., 1994. Seasonal variation and population density of rotifers in three Lakes of Hyderabad. A.P. ***India. J. Aqua. Biol.***, 9(1-2): 41-44.

Dhanapathi, M.V.S.S.S., 2000. *Taxonomic notes on the Rotifera from India*. IAAB, Hyderabad. pp: 1-178.

Dutta Munshi, J. and Dutta Munshi, J.S., 1995. *Fundamentals of freshwater Biology*. Narendra Publishing House, New Delhi.

Edmondson, W.T., 1959. *Freshwater Biology*. Ed. Ward and Whippl, 2nd Edn, John Wiley Sons Inc, New Yark. pp: 95-189.

Ejsmont, K.J., 1996. Long term changes in the abundance and structure of the communityof planktotn rotifera in a humain lake, as a result of liming. ***Ekolpolska***, 54(1-2): 39-51.

Engel, P.L. and Swain, F.M., 1967. Environmental relationship of recent Ostracods in Mesquite, Aransas and Copano bays, Texas Gulf Coast. ***Trans. Gulf. Coast Assoc. Geol. Soc.***, 17: 249-253.

Ferneska, M. and Lewkosiez, S., 1966. Zooplankton in pond in relatioin to certain Chamical factors. ***Acta. Hydrobiol.***, 8: 127-153.

Hutchinson, G.E., 1967. *A treatise on Limnology*. II. Introduction to the Lake biology and the lomnoplankton. John Wiley and Sons, Inc., New York, London.

Joy, J.A. and Clark, L.D., 1977. The distribution ecology and systematics of the benthic Ostracoda of central Arctic ocean. ***Micropaleontology***, 23: 129-154.

Jyoti, M.K. and Sehgal, H.S., 1979. Ecology of rotifers of Surnisar, a subtropical freshwater Lake in Jammu (J&K), India. ***Hydrobiologia***, 65(1): 23-32.

Katiyar, S.K., 1995. Limnological studies on Bhopal lakes: Freshwater protozoan communities as indicators of organic pollution. ***J. Environ Biol.***, 18 (3): 271-282.

Kesre, Vivek, Mudgal, L.K., Khanna, D.R., Matta, Gagan and Kumar, Dheeraj, 2007. Study of physico-chemical parameter for a reservoir at Khandwa District (M.P.). ***Environment Conservation Journal***, 8(3): 127-132.

Khanna, D.R., Badola, S.P. and Dobriyal, A.K., 1993. Plankton ecology of River Ganga at Chandighat, Hardwar. In: Advances in Limnology, Ed. H.R. Singh. pp: 171-174.

Khanna, D.R. and Bhutiani R., 2004. ***Water analysis at a glance***. ASEA Publication House, Rishikesh. pp :1-172.

Kodarkar, M.S., 1992. *Methodology for water analysis, physico-chemical, biological and micro-biological*. Indian Association of Aquatic Biologists, Hyderabad. Publ. pp: 2-50.

Mahajan, C.L., 1981. Zooplankton as Indicators for Assessment of water pollution, presented at WHO workshop on Biological Indicators and Indices of Environmental Pollution, 1981. Cent.Ed. Prev. cont. Poll. Osmania. University, Hyderabad, India. pp: 135 -148.

Malathi, D., 1999. Ecological studies on Lake Hussain Sagar with special reference to the zooplankton communities– Ph.D. Thesis Osmania University, Hyderabad.

Michael, R.G., 1964. Diurnal variation in physico-chemical factors and zooplankton in surface layers of three tropical freshwater ponds. ***J. Fish***, 13: 48-81.

Pailwan, I.F., 2005. Limnology and Fisheries potential of perennial Tanks of Kolhapur Distt. Ph. D. Thesis submitted, Shivaji University, Kolhapur.

Pandey, B.N., Ambasta O.P., Jha, A.K. and Shambhu, K., 2007. Seasonal variation in physico-chemical and biological properties of river Panar (Bihar). E***nv. Cons. J.***, 8(3): 133-153.

Prabhawati, G. and Sreenivasan, A., 1977. *Ecology of warm freshwater plankton of Tamilandu*. Proc.symp. Warm Fresh, Water Zool. UNESCO/NIO. Goa, Spl. Pub. pp: 319-329.

Rao, M.B., Mukhopadhaya, S.K., Muley, E.V. and Siddiqi, S.Z., 1981. Species diversity in zooplankton community as an indicator of organic and industrial pollution in Hussain Sagar, Hyderabad. ***Proc. Zool. surv. India***, 4(1): 61-66.

Rao, S.I., 2005. *Zooplankton Limnology in the, Indian subcontinent*. Ukaaz Publication, Hyderabad. pp: 209-227.

Sawane, A.P., Puranik, P.G. and Lonka,r A.N., 2006. Preliminary study on the seasonal distribution of plankton in Irai river at Irai dam site, District Chandrapur, Maharashtra. ***Indian J. Environ. and Ecoplan***, 12(1): 207-212.

Schindler, D.W. and Noven, D., 1971. Vertical distribution and seasonal abudance of zooplankton in two shallow Lakes of the experimental Lake area, North Western Ontario. ***J. Fish Res. Bd. Canada***, 28: 245 -256.

Singh, S.B. and Sahai, R., 1978. Seasonal fluctuation of zooplankton population in relation to certain physico-chemical factors of a pond. ***Geobios.***, 5: 228 - 230.

Somani, V. and Pejaver M., 2003. Rotifer diversity in Lake Masunda, Thane (Maharashtra). ***J. Aqua. Biol.***, 18(1): 23-27.

Subbamma, D.V. and Ramasarma, D.V., 1992. Studies on the water quality characteristics of a temple pond near Machilipatnam, Andhra Pradesh. ***J.Aqua Biol.***, 7: 22-27.

Swain, F.M., 1955. Ostracods of San Antonia Bay, Texas. ***J. Paleont.***, 929: 561-646.

Witek, M., 1998. Annual changes of abundance and biomass of planktoniceiliates in the Gdansk Basin, Southern Baltic. ***Int. Rev. Hydrobiol.***, 83(1): 163-182.

Environment Conservation Journal 10(3) 45-52, 2009
(ISSN 0972-3099)

Physico-chemical characteristics of raw water of River Tawi, near Sitlee water treatment plant, Jammu

Meenakshi Khajuria and S.P.S. Dutta

Received: 17-04-2009 Accepted: 10-09-2009

Abstract

The present study was carried out to assess the drinking quality of raw water of the river Tawi, near Sitlee water treatment plant, water characteristics like temperature, turbidity, pH, electrical conductivity, free carbon dioxide, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, carbonate, bicarbonate, chloride, calcium, magnesium, total hardness, sodium, potassium, sulphate, silicate, nitrate, phosphate, iron, copper, zinc, lead and chromium, were conducted for a period of two years. Monthly range of these physico-chemical parameters is within the permissible limits of drinking water standards, except for turbidity and COD, during different months, during both the years.

Keywords:- *Physico-chemical, River Tawi, Sitlee water treatment plant*

Introduction

Water is the basis of life, a universal solvent and one of the most precious commodities required for survival of any form of life (Singh *et al.*, 2006). It is a primary natural resource required for various purposes like agriculture, forestry, urbanization and many other activities which satisfy human needs. Exponential population growth of man and his innate characteristics have brought severe constraints upon the water. Various kinds of natural and manmade activities like industrial, domestic and agriculture and others create water pollution particularly in fresh water systems and render the water unsuitable for consumption and other uses. In order to evaluate the quality of river Tawi water for drinking purposes, present study was undertaken near Sitlee water treatment plant. The river Tawi originates in the middle Himalayas, below Seoj Dhar peak at Kalikund, near Bhaderwah (Fig. 1). From there it passes through Chenani, where its water feeds to Udhampur, Jhindrah, Surinsar, Nagrota and Jammu, where it bifurcates into Nikki Tawi and Badi Tawi and finally meets Chenab in Pakistan and a hydroelectric project. For Jammu, it is a major source of potable water supply as well as through lift irrigation scheme at Bahu for irrigation purposes.

Author's Address
Department of Environmental Sciences, University of Jammu, Jammu ✉

Materials and Method

Sterilized and clean plastic bottles of 2 litre capacity were used for the collection of water samples for physico-chemical analysis of water by standardized methods (APHA, 1998 and Khanna, 1993). Various trace metals like iron, copper, chromium, zinc and lead were determined by standardized Atomic Absorption Spectrophotometer (ECIL, model 4139). The Water Quality Index was calculated for assessing the suitability of water for drinking purposes (ICMR, 1975 and Kaushik *et al.*, 2002) by the following equation:

$$WQI = {}^{15}\Sigma_{n=1}\ q_n.W_n$$

Results and Discussion

The results of various physico-chemical characteristics of water, for a period of two years, have been tabulated in Table-1 and depicted in Figs. 2a–2v.

Due to lotic conditions, water temperature (10.5, January- 31.0 °C, June/ 11.5, January- 30.0 °C, August) closely followed air temperature (9.5, January- 33.5 °C, May/ 10.0, January, February- 34.0 °C, June) and is in accordance with the findings of Negi *et al.* (2008). Seasonally, water temperature remained high during March-October/ March-September and coincided with increased photoperiod. Decreased photoperiod may explain November-

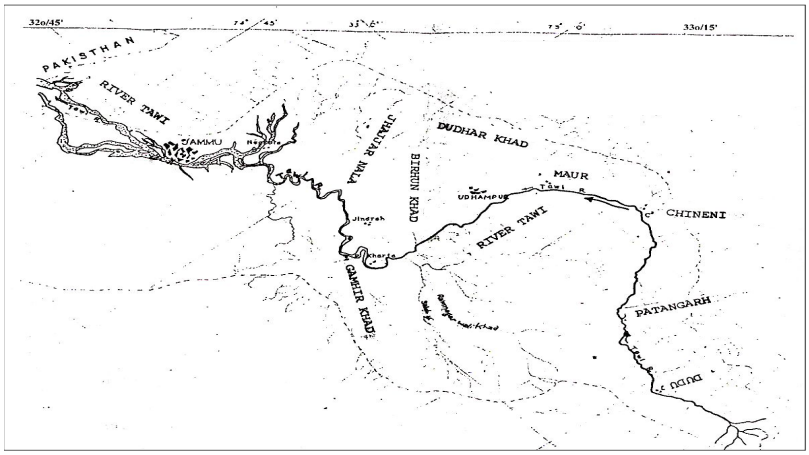


Fig. 1: Map of Tawi river catchment (J&K State)

February/ October-February decrease in water temperature (Dhanapakiam *et al.*, 1999). Turbidity varied between 3.0 (October) and 420.0 NTU (June) / 7.0 (January) and 487.5 NTU (August). It recorded March, May-August/ February, March, May-August increase and is caused by soil erosion during monsoon (June-August) and winter (February, March, 2000-2001/ March, 2001-2002) rains (Table-1).

pH, ranged between 7.83 (June) and 8.51 (November, January)/ 7.36 (June) and 8.35 (February). It remained low in the month of February, April and June/ December, January and May-July, when free carbon dioxide was present. An inverse relationship of pH and free carbon dioxide is already known (Wetzel, 2001) and may explain June lowest record of pH, during both the years, when free carbon dioxide was maximum.

Electrical conductivity fluctuated between 0.162 (April) and 0.475 µS/ cm (August)/ 0.141 (July) and 0.333 µS/ cm (September) and recorded increase from July to October/ August to October increase.

Dissolved oxygen varied between 3.85 (April) and 10.78 mg/l (December)/ 5.36 (May) and 7.82 mg/l (February) and showed winter (December-February/ November-February) increase and summer (March-May) decrease. Summer decrease in dissolved oxygen is attributed to high temperature (Jhingran, 1991; Shivanikar *et al.*, 1999; Hutchinson, 2004); high organic load (Koshy and Nayar, 2000); biodegradation and decay of vegetation and restricted flow of river water (Jayaraman *et al.*, 2003). BOD and COD, during the year 2001– 2002, varied between 0.19 (February) and 4.91 mg/l (August) and 4.8 (September, October) and 42.0 mg/l (July), respectively. Seasonally, BOD remained comparatively low during post-monsoon (September, October) and winter (November-February) and high during summer (March-May) and monsoon (June-August). COD observed post-monsoon (September, October) and early winter (November, December) low and late winter (December-February), summer (March-May) and monsoon (June-August) high record. Inflow of dead organic matter from catchment may explain monsoon rise in BOD (Jayaraman *et al.*, 2003) and COD (Koshy and Nayar, 2000 and Jayaraman *et al.*, 2003).

Bicarbonate (54.90, April - 220.75 mg/l, November / 81.20, June - 204.29 mg/l, September), calcium (16.66, April - 33.94 mg/l, December, 23.64, May - 41.87 mg/l, October), magnesium (4.67, June - 18.86 mg/l, January/ 2.85, April - 22.83 mg/l, October, November) Water Quality Index (WQI) ranged between 29.92 (December) and 154.53 (June) / 43.32 (November)

Table-1: Monthly variation in physico-chemical parameter at the River Tawi, near Sitlee water treatment plant, Jammu

Months / Parameters	AT (°C)	WT (°C)	Turb. (NTU)	pH	EC (µS/cm)	FCO2 (mg/l)	DO (mg/l)	BOD (mg/l)	COD (mg/l)	$CO_3^{=}$ (mg/l)	HCO_3^{-} (mg/l)	Cl^{-}(mg/l)	Ca^{++} (mg/l)	Mg^{++}(mg/l)	TH (mg/l)	Na^{+} (mg/l)	K^{+} (mg/l)	$SO_4^{=}$ (mg/l)	$SiO_3^{=}$(mg/l)	NO_3^{-} (mg/l)	$PO_4^{=}$ (mg/l)	Fe^{+++}(mg/l)	Cu^{++}(mg/l)	Zn^{++} (mg/l)	Pb^{++} (mg/l)	Cr^{++}(mg/l)
Aug, 2000	25	26.5	268	8.25	0.475	A	4.56	NA	NA	3.84	120.24	8.5	31.39	9.2	116.16	5.5	1	5.5	6.9	0.25	0.18	0.2	*	*	*	*
Sep.	23.5	25.5	6	8.24	0.427	A	5.59	NA	NA	3.64	123.17	9.71	29.36	13.49	128.78	5	1	6.75	7.1	0.25	0.14	0.2	*	*	*	*
Oct.	22.5	21.5	3	8.34	0.32	A	5.61	NA	NA	4.05	140.13	10.75	28.3	17.18	141.41	4.5	0.05	4.75	6.8	0.25	0.01	*	*	*	*	*
Nov.	18	12	6	8.51	0.294	A	4.63	NA	NA	3.77	220.75	8.84	30.53	17.88	148.74	13.5	1	5.25	5.6	0.25	0.05	0.2	*	*	*	*
Dec.	18.5	17	6	8.42	0.266	A	10.78	NA	NA	3.7	217.65	9.63	33.94	16.16	151.16	8.5	1	6.75	3.4	0.25	0.02	*	*	*	*	*
Jan.	9.5	10.5	6	8.51	0.25	A	6.71	NA	NA	18.58	207.89	8.62	31.53	18.86	156.24	15.5	1.5	7	4.7	0.25	0.04	*	*	*	*	*
Feb.	12	15	7.5	8.2	0.263	2.38	6.77	0.25	NA	A	183.53	10.02	24.86	15.55	126	19.5	1	7.25	6.2	0.25	0.04	0.2	*	*	*	*
Mar.	25	21	36	8.32	0.269	A	6.01	0.28	NA	4	140.08	6.59	25.85	11.28	110.9	11	1	5	2.9	2.75	0.06	*	*	*	*	*
Apr.	24	26	8	7.97	0.162	2.49	3.85	0.36	10.64	A	54.9	6.15	16.66	5.34	63.56	4.5	1	4.25	4.2	1	0.1	*	*	*	*	*
May	33.5	28.5	50	8.27	0.265	A	5.6	1.84	4.8	2.29	100.49	8.94	25.49	8.91	100.24	6.5	1	4.75	6.1	1	0.3	1	*	*	*	*
Jun.	33	31	420	7.83	0.192	5.29	6.01	1.9	24	A	113.87	5.48	21.2	4.64	72.11	7	2.5	9.5	7.9	2	0.24	*	*	*	*	*
Jul.	27	28	77.5	8.26	0.331	A	5.86	2.2	28.8	4.82	181.36	6.31	33.38	9.82	125.7	17	2.5	21	9.8	3	0.3	*	*	*	*	*
Aug, 2001	31.5	30	487.5	8.33	0.286	A	6.04	4.91	32.76	2.82	157.82	5.42	41.33	6.59	130.21	15.5	3.5	6.75	7.7	1.5	0.22	*	*	*	*	*
Sep.	28.5	26	8	8.31	0.333	A	6.03	0.62	9.6	11.07	204.29	7.75	36.79	22.29	183.49	19	3.5	7.25	7.4	2	0.24	*	*	*	*	*
Oct.	18	16.5	12.5	8.29	0.308	A	7.56	0.59	4.8	4.1	179.33	6.75	41.87	22.83	198.42	16	2.5	6.5	6.9	2	0.18	*	*	*	*	*
Nov.	18.5	13	9	8.24	0.265	A	7.24	0.34	4.8	3.28	193.79	6.83	39.78	22.8	198.2	15.5	3	6.75	6.5	2	0.16	*	*	*	*	*
Dec.	17	12.5	7.5	8.21	0.216	4.92	6.56	0.67	14.4	A	192.12	7.71	37.69	21.57	182.75	17	3.5	14.5	5.7	1	0.02	*	*	*	*	*
Jan	10	11.5	7	7.97	0.18	1.6	7.48	0.29	22.78	A	203.08	8.32	35.06	12.3	138.05	17.5	3.5	13.5	5.2	0.75	0.02	*	*	*	*	*
Feb.	10	12	27.5	8.35	0.184	A	7.82	0.19	25.68	6.54	189.76	7.72	31.37	14.53	138	14.5	2.5	15.5	6.3	1.5	0.02	0.2	*	*	*	*
Mar.	24	20	27.5	8.28	0.181	A	6.66	0.52	27.6	4.14	144.32	10.46	35.38	7.14	117.64	9.5	1	8.5	4.5	2	0.41	*	*	*	*	*
Apr.	22	22	16	8.23	0.146	A	5.92	0.92	26.64	2.36	111.84	5.94	25.94	2.85	76.47	7	1	11.5	2.8	2	0.23	0.2	*	*	*	*
May	32.5	28	36	8.08	0.198	3.27	5.36	0.7	21.48	A	143.44	6.55	23.64	12.89	112.02	10.5	2	3	7.1	1.5	0.2	0.2	*	*	*	*
Jun	34	29	397.5	7.36	0.142	9.44	6.17	0.7	21.48	A	81.2	7.39	25.67	7.44	94.65	14	3.5	38.5	8.6	3.75	0.27	*	*	*	*	*
Jul, 2002	30	27	472	7.81	0.141	4.21	6.12	0.26	42	A	102.15	10.14	25.17	6.53	89.68	17.5	2.5	27.5	4	0.5	0.04	*	*	*	*	*

Note: A- Absent; NA- Not analysed; *- Below detectable limit

and total hardness (63.56, April - 156.24 mg/l, January / 76.47, April- 198.42 mg/l, October) observed post-monsoon (September, October) and winter (November-February) high and summer (March-May) and monsoon (June-August) low record, during both the years of study. Post-monsoon and winter increase in bicarbonate, calcium, magnesium and total hardness may be due to decreased photoperiod and low consumption by primary producers. Increased flush from springs, present along the sides of the river Tawi, may also account for the post-monsoon increase in these nutrients. In summer good consumption by primary producers, due to increased photoperiod, may account for low record of these nutrients. In monsoon fluctuation in bicarbonate, calcium, magnesium and total hardness is attributed to the effect of rains and soil erosion in catchment. Due to absence of pollution (sewage / industrial effluents/ agricultural) upstream the present site of analysis, chloride remained low and observed narrow fluctuation between 5.48 (June) and 10.75 mg/l (October)/ 5.42 (August) and 10.46 mg/l (March). Chloride remained comparatively high during summer (March-May) and monsoon (June-August). Sodium fluctuated between 4.5 (October, April) and 19.50 mg/l (February)/ 7.0 (April) and 19.00 mg/l (September) and showed winter (November-February) increase and summer (March-May) decrease. During monsoon (June-August), it recorded wide fluctuations (Table-1). Potassium, during the first year, observed narrow fluctuations between 0.05 (October) and 2.50 mg/l (June, July) and showed monsoon (June and July) highest record. In the subsequent year, it varied from 1.00 (March, April)- 3.50 mg/l (August, September, December, January, June) and showed monsoon (June-August), post-monsoon (September, October) and winter (November-February) increase. Rains may account for the monsoon increase in sodium and potassium.

Sulphate varied from 4.25 (April) - 21.00 mg/l (July)/ 3.00 (May) - 38.50 mg/l (June). It recorded monsoon (June-August), post-monsoon (September, October) and winter (November-February) increase and summer (March-May) decrease, during the first year of study. In the subsequent year, sulphate remained high during early monsoon (June and July) and winter (December-February) and low during late monsoon (August), post-monsoon (September, October), early winter (November) and summer (March-May). Increased flush from springs may account for the post-monsoon increase in sulphate (Hutchinson, 2004). Silicate fluctuated between 2.90 (March) and 9.80 mg/l (July)/ 2.80 (April) and 8.60 mg/l (June) and observed summer (March-May) low and monsoon (June-August), post-monsoon (September, October) and winter (November-February) high record. Monsoon increase may be attributed to the rains. Increased flush from springs may also account for the post-monsoon increase in silicate. Nitrate varied from 0.25 (August – February) and 3.00 mg/l (July) / 0.50 (July) to 3.75 mg/l (June). It remained high during summer (March-May), monsoon (June-August) and post-monsoon (September, October) and low during winter (November-February). Summer increase in nitrate may be due to the decomposition of dead organic matter. Monsoon and post-monsoon increase is attributed to the rains (Jhingran, 1991; Horne and Goldman, 1994). Phosphate fluctuated between 0.02 (December) and 0.30 mg/l (May), / 0.02 (December-February, May) to 0.41 mg/l (March), during the first/ second year of the analysis. It recorded winter (November-February) decrease and summer (March-May) and monsoon (June-August) increase. Summer increase in phosphate is attributed to the environmental temperature, pH of the water (Jhingran, 1991); increased rate of organic decomposition (Hutchinson, 2004). Monsoon increase may be due to the rains (Jhingran, 1991).

Iron was observed in the month of August (0.20), September (0.20), November (0.20), February (0.20) and May (1.00)/ February (0.20), April (0.20) and May (0.20), during the first/second year of study and remained below detectable limit during greater part of the year. Other trace elements like copper, zinc, lead and chromium remained below detectable limit during both the years of study.

Comparison of the various physico-chemical characteristics of water, with National and International Standards (ISI, 1974; ICMR, 1975; BIS, 1991; WHO, 1992) reveals that all the parameters remain within permissible limits of drinking water standards (Table-2) except for turbidity and COD, during different months, during both the years.

Table-2: Comparison of water quality of the river Tawi near Sitlee water treatment complex, Jammu with National and International standards

Parameters↓	River Tawi		Standards						
			WHO		BIS	ICMR		ISI tolerance limit	
	1st year	2nd year	Ac	Al		Ac	Al	Ac	Mp
Turb. (NTU)	3.0 - 420.0	7.0 - 487.5	5	25	5	5	25	10	25
pH	7.83 - 8.51	7.36 - 8.35	7.0 - 8.5	6.5 - 9.2	6.5 - 8.5	7.0 - 8.5	6.5 - 9.2	6.0 - 8.5	6.5 - 9.2
EC (µS/cm)	0.162 - 0.475	0.141 - 0.333	--	300	--	--	300	--	300
FCO_2 (mg/l)	2.38 - 5.29	1.6 - 9.44	--	--	--	--	--	6	--
DO (mg/l)	3.85 - 10.78	5.36 - 7.82	5	--	5	--	--	4	6
BOD (mg/l)	0.25 - 2.2	0.19 - 4.91	3	5	3	--	--	--	
COD (mg/l)	4.8 - 28.8	4.8 - 42.0	10	20	--	--	--	--	
$CO_3^{"}$ (mg/l)	2.29 - 18.58	2.36 - 11.07	--	--	--	--	--	--	--
$HCO_3^{'}$ (mg/l)	54.9 - 220.75	81.2 - 204.29	30	150	--	--	120	150	300
$Cl^{'}$ (mg/l)	5.48 - 10.75	5.42 - 10.46	250	1000	250	200	1000	250	1000
Ca^{++} (mg/l)	16.66 - 33.94	23.64 - 41.87	75	150	75	75	200	75	200
Mg^{++} (mg/l)	4.64 - 18.86	2.85 - 22.83	50	150	30	50	200	30	150
TH (mg/l)	63.56 - 156.24	76.47 - 198.42	300	600	300	200	600	300	600
Na^{+} (mg/l)	4.5 - 19.5	7.0 - 19.0	175	200	--	--	--	20	--
K^{+} (mg/l)	0.05 - 2.5	1.0 - 3.5	--	--	--	--	--	--	--
$SO_4^{"}$ (mg/l)	4.25 - 21.0	3.0 - 38.5	200	400	150	200	400	200	400
$SiO_3^{"}$ (mg/l)	2.9 - 9.8	2.8 - 8.6	--	--	--	--	--	20	
$NO_3^{'}$ (mg/l)	0.25 - 3.0	0.5 - 3.75	50	100	45	20	100	20	50
$PO_4^{"'}$ (mg/l)	0.02 - 0.30	0.02 - 0.41	0.1	1	--	--	--	0.1	
Fe^{+++} (mg/l)	* - 1.0	* - 0.2	0.3	1	0.3	0.1	1.0	0.3	1
Cu^{++} (mg/l)	*	*	1	1.5	--	1.0	3.0	0.05	1.5
Zn^{++} (mg/l)	*	*	5	15	--	5.0	15.0	5.0	10.0
Pb^{++} (mg/l)	*	*	0.05	0.1	--	0.1		0.1	
Cr^{++} (mg/l)	*	*	0.05	--	--	0.05		0.05	

Note: Ac- Acceptable; N- Nill; Al- Allowable; Mp- Maximum permissible

Table-3: Water Quality Index (WQI) of various physico-chemical characteristics at the river Tawi, near Sitlee water treatment complex, Jammu

Months	River Tawi
Aug., 2000	107.79
Sep.	41.36
Oct.	40.79
Nov.	47.21
Dec.	29.92
Jan.	42.28
Feb.	39.38
Mar.	49.7
Apr.	48.62
May	61.9
Jun.	154.53
Jul.	80.15
Aug., 2001	194.02
Sep.	50.63
Oct.	44.46
Nov.	43.32
Dec.	49.93
Jan.	46.02
Feb.	54.25
Mar.	56.93
Apr.	56.71
May	59.94
Jun.	139.34
Jul., 2002	166.61

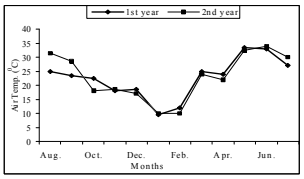


Fig. 2a

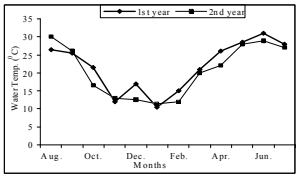


Fig. 2b

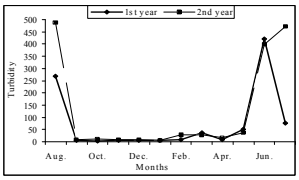


Fig. 2c

Monthly variation in air and water temperature and trbidity of River Tawi

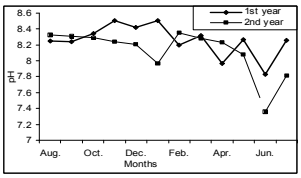


Fig. 2d

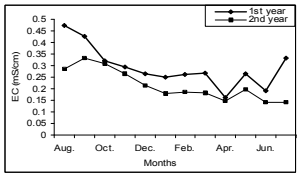


Fig. 2e

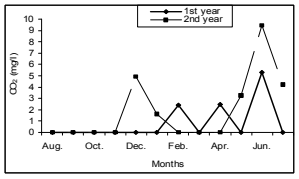


Fig. 2f

Monthly variation in pH, electrical conductivity and free CO_2 of River Tawi

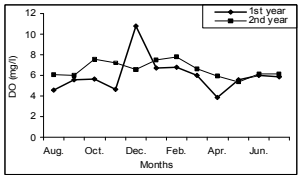


Fig. 2g

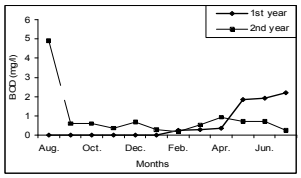


Fig. 2h

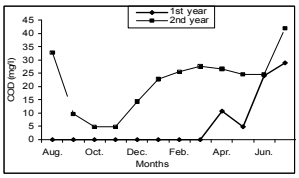


Fig. 2i

Monthly variation in DO, BOD and COD of River Tawi

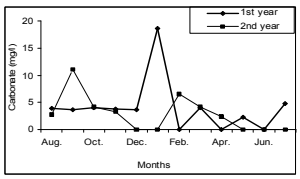


Fig. 2j

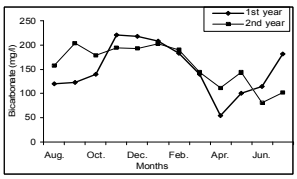


Fig. 2k

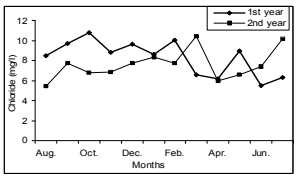


Fig. 2l

Monthly variation in carbonate, bicarbonate and chloride of River Tawi

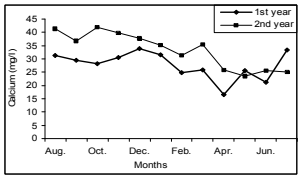


Fig. 2m

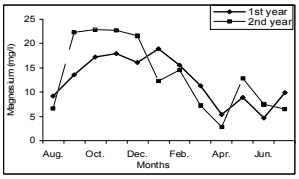


Fig. 2n

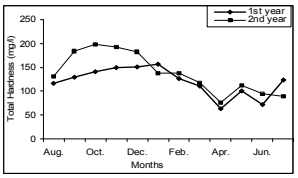


Fig. 2o

Monthly variation in calcium, magnesium and total hardness of River Tawi

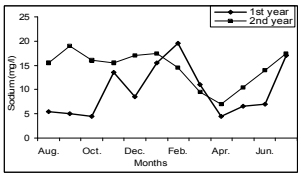


Fig. 2p

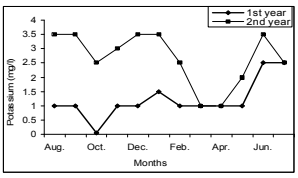


Fig. 2q

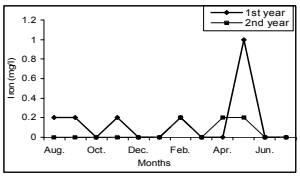


Fig. 2r

Monthly variation in sodium, potassium and iron of River Tawi

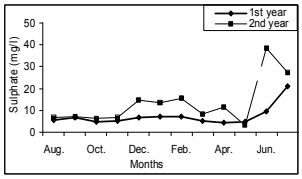


Fig. 2s

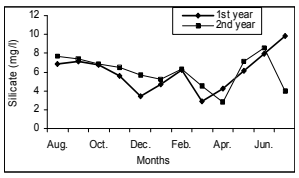


Fig. 2t

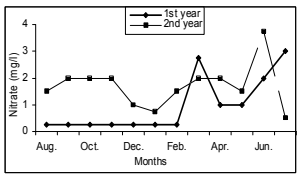


Fig. 2u

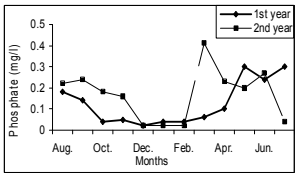


Fig. 2v

Monthly variation in sulphate, silicate, nitrate and phosphate of River Tawi

and 194.02 (August), during the first / second year indicates that raw water is unsuitable (Table-3).

Acknowledgement

We are highly thankful to the Department of Environmental Sciences, University of Jammu, Jammu for providing necessary facilities.

References

APHA, 1998. *Standard Methods for the Examination of Water and Wastewater* 20th edn. American Public Health Association. 1015 Fifteenth Street, NW Washington, DC 20005– 2605.

BIS: 10500, 1991. *Indian standard specification for drinking water* IS: 10500 - 91 (Bureau of Indian Standards) New Delhi: 1–4.

Dhanapakiam, P., Sampoorni, V. and Kavitha, R., 1999. Assessment of water quality of the river Cauvery. ***J. Environ. Biol.***, 20(4): 347–352.

Horne, A.J. and Goldman, C.R., 1994. *Limnology*, 2nd edn. Mc Graw Hill Inc., New York.

Hutchinson, G.E., 2004. *A Treatise on Limnology*, Vol. I (2). *Chemistry of Lakes*. John Wiley and Sons, Inc.

ICMR, 1975. *Manual of Standards of Quality for Drinking Water Supplies*. Indian Council of Medical Research, Special Report, No. 44:27.

ISI, 1974. *Tolerance limits for inland surface water when used as water for public water supplies and bathing ghats*. Indian Standards Institute, New Delhi, IS: 2296.

Jayaraman, P.R., Devi, T.G. and Nayar, T.V., 2003. Water quality studies on Karamana river, Thiruvananthapuram district, South Kerala, India. ***Poll. Res.***, 22(1): 89–100.

Jhingran, V.G., 1991. *Fish and Fisheries of India*, 3rd edn. Hindustan Publishing Corporation, India: 666.

Kaushik, A., Kumar, K., Kanchan, Taruna and Sharma, H.R., 2002. Water quality index and suitability assessment of urban ground water of Hisar and Panipat in Haryana. ***J. Environ. Biol.***, 23(3): 325–333.

Khanna, D.R., 1993. *Ecology and pollution of River Ganga*. Ashis publishing house, New Delhi. pp: 1-241.

Koshy, M. and Nayar, T.V., 2000. Water quality of river Pamba at Kozhencherry. ***Poll. Res.***, 19(4): 665–668.

Negi, R.K., Negi, T. and Joshi, P.C., 2008. Study on physico-chemical parameters of Hinval fresh water stream and Ganga river water at Shivpuri in the Garhwal region. ***J. Env. Bio. Sc.***, 22(2): 203–212.

Singh, J.P., Sakun, Singh and Khanna, D.R., 2006. Water quality status of river Ganga in respect of physico-chemical and microbial characteristics at AnupShahar, Dist., Bulandshar (U.P.), India. ***Env. Cons. J.***, 7(1-2): 29-34.

Shivanikar, S.V., Patil, P.M., Vaidya, D.P. and Bandela, N.N., 1999. Environmental temperature fluctuation determine dissolved oxygen level in Godavari river water. ***Poll. Res.***, 18(4): 415–418.

Wetzel, R.G., 2001. *Limnology: Lake and River Ecosystems*. Publ. by Academic Press, a Harcourt Science and Technology Company, USA.

WHO, 1992. *International Standards for Drinking Water*, World Health Organization, Geneva, Switzerland.

Environment Conservation Journal 10(3) 53-55, 2009
(ISSN 0972-3099)

Avifaunal diversity of Junona Lake District Chandrapur, Maharashtra

P.J. Khinchi[1], N.R. Dahegaonkar[2], P.M. Telkhade[2], S.B. Zade[3] and L.H. Rohankar[4]

Received: 27-04-2009 Revised: 20-07-2009 Accepted: 23-08-2009

Abstract

Junona lake is a fresh water and historical lake of Chandrapur district. The lake is surrounded by dense Chichpalli forest and contains rich treasure of flora and fauna. It harbours varieties of birds including migratory birds. The avifaunal survey of lake and its surrounded area was carried out by field observations during 2006-2007. Total 19 species were observed, among which 07 species were of Order Ciconiiformes, 4 of Charadriiformes, 3 of Gruiformes, 2 of Falconiformes and one each of Pelicaniformes, Anseriformes and Cuculiformes. A good congregation of Black ibis, Little cormorant and Kingfisher observed and regularly found in the surroundings of the lake.

Keywords:- *Avifauna, Junona lake, Migratory*

Introduction

The Junona lake is 7.00 km away from Chandrapur city. Basically, it was constructed by Gond Raja in his regime for the purpose of hunting. The lake is situated 676.00 feet above MSL and is at 79° 23' E longitude and 19° 55' N latitude. Birds play major role in ecosystem as potential pollinators and scavengers and are rightly called as bioindicators. Birds are the part of the natural habitat of the Indian sub-continent. In India, there is no off season for birds. India harbours 1200 sp. of birds (Ali and Repley (1983). In India birds have extensively studied by Ali (1939, 1940), Majumdar (1984), Ghoshal (1995), Yardi *et al.* (2004) and Kulkarni *et al.* (2005).

Materials and Method

Monthly survey and identification of birds were done in morning hours, i.e. 6.00 to 9.00 AM. Birds were observed by using binocular, photographed by using Digital Camera Pentax with Tele lense. The identification was done with the help of standard text of Ali and Ripley (1983) and Ali (1996).

Author's Address

[1]Janata Mahavidyalaya, Chandrapur (M.S.)
[2]Arts Commerce and Science College, Tukum, Chandrapur (M.S.)
[3]Deptt. of Zoology, R.T.M. Nagpur University, Nagpur ✉
[4]R.D. Science College, Aheri, Distt. Gadchiroli (M.S.)

Results and Discussion

In the present study, total 19 species of birds were identified belonging to 7 Orders and 13 Families (Table-1). Among which 4 were resident, occasional; 8 were of resident, common; 3 were of resident, uncommon; one each of winter visitor, common; winter visitor, occasional; resident, winter visitor, uncommon and one was residential.

Prakash (1999) described 12 species of aquatic birds from Bahadur Sagar (Jhabua, M.P.). Kumar and Bohra (2002) recorded 103 species of birds belonging to 43 Families and 13 Orders from Udhuwa lake, Jharkhand. Yardi *et al.* (2004) reported 64 species of birds in Salim Ali lake, Aurangabad. Kulkarni *et al.* (2005) reported 151 species of birds in and around Nanded city in Maharashtra. Kulkarni *et al.* (2006) recorded 93 species of birds belonging to 39 Families and 16 Orders among which 51 species are of resident, 32 species resident migrant, 11 species winter migrant, 7 species migrant, 01 species breeding migrant and 02 species passage migrant from Shikhachi Wadi Reservoir District Nanded, Maharashtra.

In the present investigation, Saras Crane is found to be residential and considered as a special feature of the lake surrounding. The birds like Indian pond Heron, Asian open bill stork, Black ibis, Black shoulders kite, Common coot, Pheasant tailed Jacana, Red wattled lapwing and Asian Koel were common in all the seasons of the study.

Table-1: Avifaunal diversity of Junona lake, Distt. Chandrapur

Name of the Species	Common Name	Order	Family
Phalacrocoraxmiger (Vieillot)	Little Cornorant	Pelecanformes	Phalacrocoracidae
Ardea cinerea (Linnaeus)	Grey Heron	Ciconiiformes	Ardeidae
Casmerodius albus (Linnacus)	Eastern Large Egret	Ciconiiformes	Ardeidae
Ardeola grajii (Sykes)	Indian pond-Heron	Ciconiiformes	Ardeidae
Anastomus oscitans (Boddaert)	Asian open bill stork	Ciconiiformes	Ciconiidae
Threskiornis melanocephalus	Oriental white lbis	Ciconiiformes	Threskiornithidae
Pseudibis papillosa (Temminck)	Black lbis	Ciconiiformes	Threskiornithidae
Platalea leucorodia (Linnaeus)	Eurasian spoon bill	Ciconiiformes	Threskiornithidae
Dendrocygna javanica (Horsfield)	Lesser whistling- Duck	Anseriformes	Anatidae
Eagle species	-	Falconiformes	Accipitridae
Elanus caeruleus (desfontaines)	Black shouldered kite	Falconiformes	Accipitridae
Grus antigone (Linnacus)	Saras crane	Gruiformes	Gruidae
Porphyrio porphyrio (Linnaeus)	Purple moorhen	Gruiformes	Rallidae
Fulica atra eti (Linnaeus)	Common coot	Gruiformes	Rallidae
Hydrophasianus chirurgus (Scopoli)	Pheasant-tailed Jacane	Charadriiformes	Jacanidae
Vanellus indicus (Boddaert)	Red-wattled lapwing	Charadriiformes	Charadriidae
Actitis hypoleucos (Linnaeus)	Common sandpiper	Charadriiformes	Scolopacidae
Himantopus himantopus (Linnaeus)	Black-winged still	Charadriiformes	Recurvirostridae
Eudynamys scolopacea (Linnaeus)	Asian Koel	Cuculiformes	Cuculidae

Little cormorant, Gray Heron, Purple Moorhen, Black winged still are occasionally observed during the study period. Oriental white ibis, Eurasian spoon bill, Common sandpiper were observed during winter season. In the present study, good congregation of Black ibis, Black shoulder kite, Common coot, Asian Koel and Kingfisher observed and regularly found in surrounding of the lake.

Acknowledgement

The authors are thankful to Dr. M.M. Wankhede, Principal, A.C.S. College, Tukum, Chandrapur and Dr. M. Subhash, Principal, Janata Mahavidyalaya, Chandrapur. (M.S.) for their kind co-operation during the present research work.

References

Ali, S., 1939. The birds of Central India Part I. ***J. Bombay Nat. Hist. Soc.***, 41(1): 82-106.

Ali, S., 1940. The birds of Central India Part II. ***J.Bombay Nat. Hist. Soc.***, 41(3): 470-488.

Ali, S., 1996. *The book of Indian birds*. Bombay Natural History Society, Mumbai. pp: 1-101.

Ali, S. and Ripley S.D., 1983. *A pictorial guide to the birds of the Indian sub-continent*. Bombay Natural History Society (BNHS), Mumbai. pp: 1-354.

Ghosal, D.K., 1995. *Aves fauna of conservation area No. 7, fauna of Kanha Tiger Reserve* Z.S.I.: 63-91.

Kulkarni, A.K., Kanwate V.S. and Deshpande V.D., 2006. Check list of birds of Shikhachi wadi Reserovir, Distt. Nanded, Maharashtra. ***J. Aqua. Biol.***, 21(1): 80-85.

Kulkarni, A.N., Kanwate V.S. and Deshpande, V.D., 2005. Birds in and around Nanded city, Maharashtra. ***Zoos. Print. Journal***, 20(11): 2076-2078.

Kumar, A. and Bohra, C.J., 2002. *Faunistic composition communities structure population dynamics and ethology of the birds of Udhuwa lake (Santhal pargana) and the strategies for the conservation in new millennium*. In: Ecology and Conservation of lakes, Reservoirs and Rivers vol. II. (Ed. A Kumar) ABD Publisher, Jaipur. pp: 411- 434.

Majumdar, N., 1984. On a collection of birds from Bastar District (M.P.). Record Zoology Survey of India. Occ. Paper No. 59:54.

Prakash, M.M., 1999. *Impact of anthropogenic activites on the aquatic birds population at Bahadur Sagar (Jhabua. M.P.)*. In: Advances in fish and wild life ecology and biology (ed. B.I. Kaul). Daya Publishing house. New Delhi. 2: 174-178.

Yardi, D., Patil S.S. and Auti, R.G., 2004. Diversity of Avian Fauna from Salim Ali Lake of Aurangabad. Paper presented in 21st meet of birds lovers of Maharashtra held at Nanded on 3rd, 4th April.-2004.

Environment Conservation Journal 10(3) 57-62, 2009
(ISSN 0972-3099)

Water quality assessment of River Ganga for conservation of Gangetic dolphins (*Platanista gangetica*) at Garhmukteshwar

Anupama Gaur[1], Pratima Akolkar[2] and M.P. Arora[3]

Received: 26-02-2009 Revised: 21-05-2009 Accepted: 28-07-2009

Abstract

82 km stretch of River Ganga from Garhmukteshwar to Narora has been declared as Ramsar site because it inhabits rare and endangered Gangetic dolphins (*Platanista gangetica*). Dominance of Molluscs and Annelida communities of benthic macroinvertebrates provide proper feeding habitat for dolphins at more than 10-20 meter depth in River Ganga. Gangetic dolphin preferred a high level of flow velocity in River Ganga at Garhmukteshwar. Dolphins were commonly observed in biological water quality of moderate pollution (Class 'C'). Habitat degradation due to construction of dams/ barrages, extraction of water, siltation, pollution due to hazardous chemicals and other human activities are the main causes of its decline in the river.

Keywords:- *Habitat, Benthic macro-invertebrates, Endangered, Bio-monitoring*

Introduction

The Gangetic dolphin (*Platanista gangetica*) is one of the most rare and endangered species. The Ganga Action Plan had a mandate of conserving the rare and endangered species of River Ganga. The population of the animal distribution from tidal zone to foothill of the Himalayas, is declining very fast. Besides direct exploitation of the animal, the habitat degradation due to construction of dams/barrages, extraction of water, siltation, pollution due to hazardous chemicals (heavy metals, organochlorine pesticides) are the main causes of its decline in the river. A survey of dolphin population in River Ganga, has shown increase in number of Dolphins from 20 to 42 during Year 1993 to 2005 (Behera, 1995; WWF, 1999) in the stretch of River Ganga from Garhmukteshwar to Narora. Recently, 82 km river stretch from Garhmukteshwar to Narora has been declared as Ramsar site because of its bio-diversity and wise used concept. A 295 km stretch of River Ganga between Rishikesh and Narora where WWF-India has been co-ordinating the Dolphin conservation programme. This wetland area covered under the study is about 16,780 kms in U.P. and Uttarakhand states. 82 km river stretch from Garhmukteshwar to Narora inhabit not only rare and endangered Gangetic Dolphins but some of the migratory and resident birds have also been observed in the stretch of river Ganga at Garhmukteshwar. Rising from the icy caves of Gangotri glacier at the height of 4255 m above mean sea level, River Ganga starts its long journey to join River Alaknanda and becomes Ganga near Devprayag. Ganga is the longest river (2,525 km) and has largest river basin (861,404 km^2) in India. The main stretch of River Ganga runs from Haridwar to Allahabad through over Nagal, Bijnor, Garhmukteshwar, Hasanpur, Anupshahar, Narora, Sahaswan, Kasgang, Ptiali, Kampil, Kaimgang, Fatehgarh, Kannauj, Bihaur, Brahmavart, Kanpur and finally Allahabad. At Allahabad it joins with a major tributary River Yamuna and thereafter passing through Banaras, Patna. At Ganga sagar in West Bengal, it joins Bay of Bengal.

Garhmukteshwar is a holy place situated on the banks of holy river Ganga in Ghaziabad district in Uttar Pradesh, India. River Ganga is considered as holy and sacred and is subjected to flow of pilgrims

Author's Address

[1]504-Imperial Block, Supertech Estate, Sector 9, Vaishali,Ghaziabad ✉

[2]Central Pollution Control Board, Ministry of Environment & Forest (Govt. of India), East Arjun Nagar, Shahadara, Delhi

[3]Head, Deptt. of Zoology, MMH College, Ghaziabad

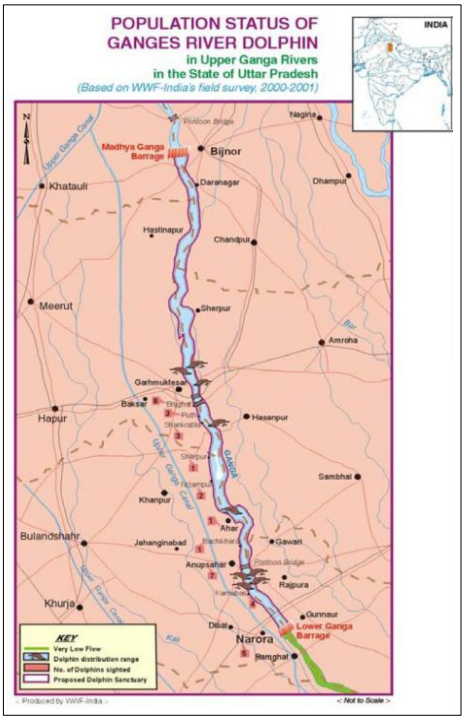
through out the year, who not only take bath but also dump the things like flowers, ash and bones of dead bodies *etc.* affecting the water quality.

Haridwar is a well known pilgrim-place and is situated in Uttarakhand, around 200 kms from Delhi. During mass bathing on religious occassions like Kumbh, Ardh Kumbh mela *etc.*, huge amount of bleaching powder is added for chlorination of river water for disinfection during bathing. The analysis report for various samples found residual chlorine in the range 35.30 to 35.88 mg/l (PCRI report, 1998). Chlorine input has a definite role in formation of Dioxine and Furan therefore, minimization of chlorine input is required. The levels of PCDD and PCDF in Indian fishes, meat and wildlife samples have been found in the order: Country chicken<Fat bodies of goat/lamb<Fishes<River Dolphins<Predatory birds. Due to hydrophobic properties and scarce water solubility, dioxin and furans remain adsorbed on the surface of suspended particles, which settle fast to bottom substrate (CPCB, 2004) and consumed by dolphins through feeding on benthic animals. The method of bio-monitoring is based upon proper establishment of biological communities of benthic macro-invertebrates on natural substratum of river (Hellawell, 1978). Unlike fish, benthos cannot move around much so they are less able to escape from the effects of sediment and other pollutants that diminish the water quality. Therefore, benthos can give us reliable information on river water quality at various habitats of Gangetic Dolphins in River Ganga.

Materials and Method

Five locations namely, Rishikesh, Hardwar, Bijnor, Garhmukteshwar and Narora, have been selected on a 295 km stretch of River Ganga for present study (Map 1). Based on substratum composition of river bed of River Ganga (Fig. 5), various sampling devices were used for collection of benthic macro-invertebrates.

Stony River bed: At Rishikesh and Hardwar, the river bed substratum composed of mainly, boulders, cobbles, pebbles and gravels. Benthic macro-invertebrates were collected by picking up large boulders and cobbles randomly from the fast flowing shallow



Map 1:- Different sampling site

stream and placing the sampling net firmly on the stream bed against the flow and kicking up the stream bed by foot for collection of animals in the net.

Sandy, mud and silty bed: At Bijnor, Garhmukteshwar and Narora, grab samples were picked up by shovel, from the river bed and the samples were washed in the sieve, by river water.

Water Plants: At Garhmukteshwar downstream and Narora barrage, the floating and submerged plants were uprooted and collected into sampling net and placed on sieve for collection of benthic invertebrates.

Benthic macro-invertebrates were identified up to family/genus level for Saprobic score and Diversity Score for water quality evaluation using Biological Water Quality Criteria (LATS/13/1998-99).

The MINARS data of physico-chemical parameters was collected for the study (MINARS/14/2001-2002, 1998), (MINARS/24/2006-07, 2004).

Results and Discussion

The Ganges river dolphin is a unique endangered freshwater cetacean, which is completely blind. The only designated protected area for these dolphins, the Vikramshila Gangetic Dolphin Sanctuary in Bhagalpur, Bihar. It is possibly one of the few places in the Ganges river system where an almost intact assemblage of Gangetic floodplain vertebrates is still seen. The Vikramshila Sanctuary is a 65 km river stretch lies in Bhagalpur and Khagaria districts in Bihar. The nearby towns of Sultangang and Kahalgaon are places of Pilgrimage for Hindus. Dolphins can be easily viewed from the Barari bridge or from the Sultanganj and Kahalgaon ghats (Kelkar, 2009). Habitat of Gangetic Dolphin, has been recently identified in River Ganga at Garhmukteshwar. Presence of benthic macro-invertebrates in the gut content of dolphin suggested its feeding habit dependence on benthic invertebrates. The seasonal variation in habitat of benthic invertebrates at river bed substratum of Ganga, varied with respect to sampling locations. Maximum number of benthic macro-invertebrates was collected during winter and summer at Patna and lowest at almost entire stretch during post-monsoon. Among all the taxa of benthic macro-invertebrates, Oligochaetes were found in highest abundancy in winter compared to summers. Among Arthropods, abundancy of insects increases during winter and Gastropods and Pelycypods and Polychaetes increased during summer Buxar, Patna and Rajmahal were most suitable locations on River Ganga, for habitat of crustaceans in winter and summer (Fig. 1). However, Fig. 2 indicated dominance of arthropods in the upper stretch of River Ganga from Rishikesh to Narora Barrage. In this stretch, dolphins were observed only at Garhmukteshwar having comparatively lower dominance of arthropods. The arthropod communities significantly lowered from Buxar to Farakka.

Distribution of major taxa of benthic macro-invertebrates from entire stretch of River Ganga from Rishikesh to Farakka indicated dominance of Arthropods gradually reduced from upstream to downstream. On the contrary, percentage of molluscs and annelids increased from upstream to downstream reaches of River Ganga (Fig. 2).

A comparison in physico-chemical water quality of River Ganga at Garhmukteshwar indicated lowering in BOD and increase in COD values whereas pH and DO values remained unchanged from year 1998 to 2008 (Fig. 3). DO values of 5.60-8.40 mg/l and BOD values of 1.70-15.50 mg/l in 1986 has been compared with DO values of 4.70-8.60 mg/l and BOD of 1.00-5.50 mg/l in 2005, for water quality on main stream of River Ganga under Ganga Action Plan (Annual report, 2005-06).

Heavy metals only contributed traces of Iron and Zinc to water quality and sediments of River Ganga at Garhmukteshwar. Studies have indicated that there was significant reduction in Coliform count in River Ganga at Garhmukteshwar during 2004 to 2006. Reduction in saprobic score and increase in diversity score from 2004 to 2009 indicated increased abundancy of tolerant benthic macro-invertebrate at Garhmukteshwar (Table-1). Present studies have indicated that Dolphins were commonly observed in biologicalwater quality of Moderate pollution (Class 'C').

Gangetic Dolphin preferred a high level of flow velocity in River Ganga at Garhmukteshwar. The flow in river was lowest at upstream Narora due to barrage (Fig. 4).

From Haridwar downstream the river bed substratum was mostly sandy and macrophytic vegetation dominated near the barrage area at Narora (Fig. 5).

The taxonomic composition of River Ganga at Garhmukteshwar indicated dominance of Arthropod communities compared to molluscs and annelids (Table-2).

Depth of water body at Garhmukteshwar was more than 20 meter only at a small stretch where the dolphin has been observed compared to other habitats of dolphins in River Ganga such as Patna. At Patna where the maximum dolphins have been counted, the composition of benthic macro invertebrates indicated dominance of Molluscs and Annelids compared to rest of the locations. Highest number of Oligochaetes at Patna during winter and

Table-1: Bio-monitoring of River Ganga for water quality status of Gangetic Dolphins at wetland of Garhmukteshwar (January-February, 2009)

Location of River Stretch/ Date of Sampling	Temperature (^{0}C)		pH	Saprobic Score	Diversity Score	BWQC	Biological Water Quality
	Air	Water					
Muni ki reti near water intake point, Rishikesh	-	12.50	7.00	7.10	0.66	A	Clean
Saptrishi ghat, near Jaiguru shri Ramanandacharya ghat, Hardwar	-	15.50	8.00	6.50	0.43	B-C	Slight to Moderate pollution
Downstream of bridge, Bijnore	-	14.00	7.00	5.77	0.42	C	Moderate pollution
Upstream of Brijghat,Garhmukteshwar	17.00	18.00	7.00	4.40	0.85	C	Moderate pollution
Downstream Brijghat,Garhmukteshwar	18.00	18.00	7.00	5.34	0.629	C	Moderate pollution
Upstream of Ch. Charan Singh Barrage, Narora	20.00	19.00	7.50	5.29	0.81	C	Moderate pollution
Ramghat, downstream barrage, Narora	24.00	19.00	6.00-7.00	5.46	0.61	C	Moderate pollution

Table-2: Taxonomic composition of River Ganga at wetland of Garhmukteshwar

% Taxa	Rishikesh	Hardwar	Bijnore	U/s Garhmukteshwar	D/s Garhmukteshwar	U/s Narora	D/s Narora
Arthropoda (81.25%)	100.00	94.11	88.88	66.66	80.00	70.58	66.66
Annelida (2.08%)	0.00	0.00	11.11	0.00	0.00	5.88	0.00
Mollusca (16.66%)	0.00	55.88	0.00	33.33	20.00	23.52	33.33
Platyhelminthes (0%)	0.00	0.00	0.00	0.00	20.00	0.00	0.00

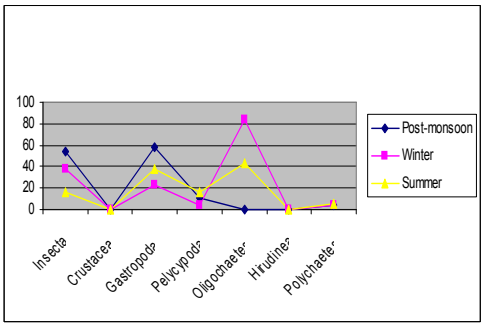


Fig. 1: Seasonal variation in % distribution of benthic macro-invertebrates of River Ganga

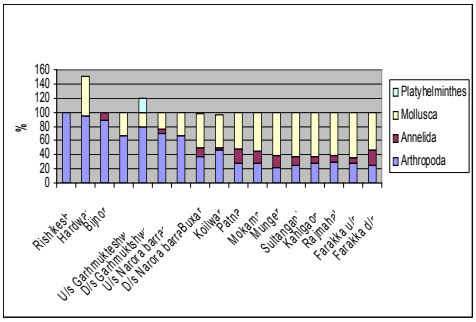


Fig. 2: Distribution of benthic macro-invertebrate texa in River Ganga

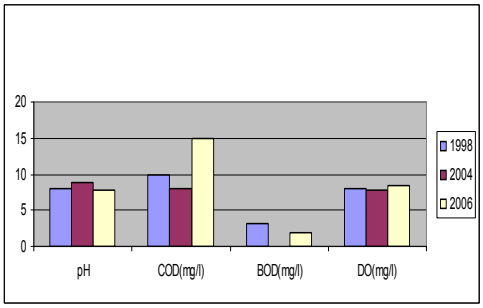


Fig. 3: Average physico-chemical characteristics of River Ganga at Wetland of Garhmukteshwar

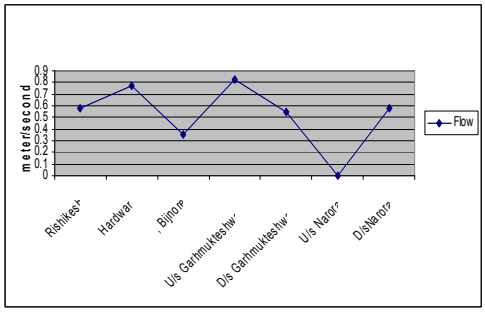


Fig. 4: Flow variation in River Ganga at wetland of Garhmukteshwar

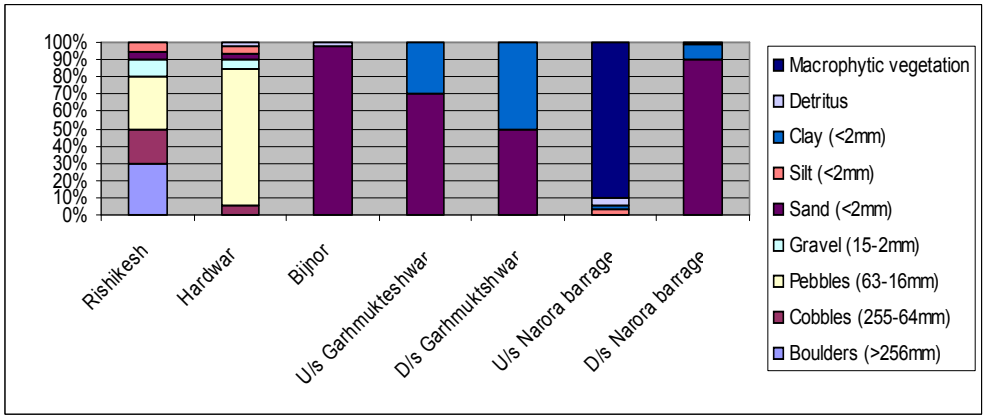


Fig. 5: Substratum composition of River Ganga for Gangetic Dolphins at Wetland of Garhmukteshwar

summers. Normally, Gastropods appeared during summer and postmonson specially in downstream reaches from Munger to Farakka but Koilwar was the most preferred habitat for gastropods during winter season. Palycypods are distributed throughout the stretch but maximum abundance has been observed at Sultangang and Rajmahal during summer season.

Acknowledgement

Authors are thankful to Central Pollution Control Board, Delhi for providing technical and scientific assistance. We are also grateful to Shri Alok Trivedi for his invaluable suggestions at diverse occasion.

References

Annual report, 2005-06. *Wetland Coservation*. Ministry of Environment and Forests, pp: 109.

Behera, S.K., 1995. Working with communities to conserve the Ganges rive dolphin and the ecosystem, *Ph.D. Thesis*.

CPCB, 2004. Dioxin (PCDDs) And Furan (PCDFs)- Critical Persistent Organic Pollutants (POPs). *Parivesh Newsletter*.

Hellawell, 1978. *Biological Surveillence of Rivers*. Water research center, Medmenham.

Kelkar, Nachket, 2009. RUNNIG OUT OF BREATH, Dolphins of the Vikramshila Sanctuary, Bihar, ***Call of the wild Sanctuary*** *ASIA* Vol.XXIX No.2

LATS/13/ 1998-99. "Application of artificial substratum for bioassessment of water bodies." Central Pollution Control Board Delhi. *LATS*/13.

MINARS/14/ 2001-02. Water Quality-Status & Statistics(1998). Central Pollution Control Board, Ministry of Environment & Forests. *Monitoring of Indian Aquatic Resources Series.*

MINARS/24/ 2006-07. Status of Water Quality in India -2004, Central Pollution Control Board, Ministry of Environment & Forests. *Monitoring of Indian Aquatic Resources Series.*

PCRI report, 1998. Assessment of impact due to mass bathing on River Ganga during Kumbh -1998 at Hardwar. Sponsored by Central Pollution Contro Board, Ministry of Environment & Forests, New Delhi. *Pollution Control Research Institute*, BHEL, Hardwar.

Sinha, R.K., 1996. Bio-conservation of the Gangetic Dolphin *Platanista gangetica.*

Final Technical Report (April-March 1996) No.J-39011/5/91-GPD. Sponsored by National River Conservation Directorate, Ministry of Environment and Forests, Government of India, New Delhi.

WWF-India, 1999. *Ganges River Dolphin Survey Report.*

Environment Conservation Journal 10(3) 63-66, 2009
(ISSN 0972-3099)

On a new species of the genus *Senga* (Dollfus, 1934) (Cestode: Ptycobothridae, Luhe, 1902) from fresh water fish *Mastacembelus armatus*

Hemlata Wankhede and Yogesh Reddy

Received: 04-03-2009 Accepted: 29-07-2009

Abstract

The present paper deals with a new species of the genus *Senga* (Dollfus, 1934) from freshwater fish *Mastacembelus armatus* (L.) Kaigaon toka, Dist Aurangabad (M.S) India, in the month of March 2007. It differs from all the earlier reported species in having scolex triangular, anterior end pointed, rounded and posterior end broad., hooks 36 in number, mature segment broader than longer, test 285-295 in number, cirrus pouch pre-ovarian, obliquely placed.

Keywords:- *Senga, Mastacembelus armatus*

Introduction

The genus *Senga* was established by Dollfus (1934) with its type species *S. besnardi* from *Betla splendens*, the Siamese fighting fish in an aquarium at Vincennes, France, *S. ophiocephalina* Tsengeshen (1933) as *Anchistrocephalus ophiocephalina* from *Ophiocephalus argus* at Tsinan, China and identified as *Anchistrocephalus polyptera* (*Anchistrocephalus Monticelli Anchistrocephalus*) from *Ophiocephalus straiatus* in Bengal, India *S.pycnomerus* Woodland (1924) as *Bothriocephalus pycnomerus* from *Ophiocephalus marulius* at Allahabad, India. *S. lucknowensis* (Johri, 1956) from *Mastacembelus armatus* in India, Fernando and Furtando (1963) recorded *S. malayana* from *Channa striatus*, *S. parva* and *S. filiformis* from *Channa micropelles* at Malacca. Ramadevi and Rao (1966) reported the plerocercoid of *Senga* sp. from *Panchax panchax*. Furtado and Chau-lan (1972) reported *S. pahangensis* from *Channa micropeltes* at Tasek Bera. Shinde (1972) redescribed *S.besnardi* from *Ophiocephalus gachua* in India and Ramadevi (1977) reported another species *S. visakhapatnamensis* from *Ophiocephalus punctatus* at Visakhapatnam, India. Ramadevi (1976) described the life cycle of *S. visakhapatnamensis* from *Ophiocephalus punctatus* in a lake at Kondakaria, Andhra Pradesh, but they do not agree with Tadros' statement. Wardle *et al.* (1974) put Senga as a distinct genus in the family Ptychobothridae. Later on Shinde and Deshmukh (1980) added *Senga khami* from *Ophiocephalus marulius;* Shinde and Jadhav (1980) added two new species of the genus Senga, i.e. *Senga godavari* and *Senga aurangabadensis* from *Mastacembelus armatus, Senga paithanensis* was reported by Kadam *et al.* (1981) from *Mastacembelus armatus. Senga gachuae* reported by Jadhav (1991) from *Channa gachua*. Jadhav (1991) described *Senga maharastrii* from *Mastacembelus armatus*. Hasnain (1992) described *Senga chauhani* from *Channa punctatus*. *Senga armatusae* was reported by Hiware (1999) from *Mastacembelus armatus.* Later on Patil and Jadhav (2003) added *Senga tappi* from *Mastacembelus armatus*. Recently Bhure *et al.* (2007) added *Senga jadhavae* from *Mastacembelus armatus.*

Author's Address
Deptt. of Zoology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (M.S.) ✉

Materials and Method

Twenty cestode parasites were collected from the freshwater fish *Mastacembelus armatus* (Lacepede) from Kaigaon toka, Dist. Aurangabad (M.S.) India, in the month of March 2007. Out of 20 cestodes, four worms are stained with Harris

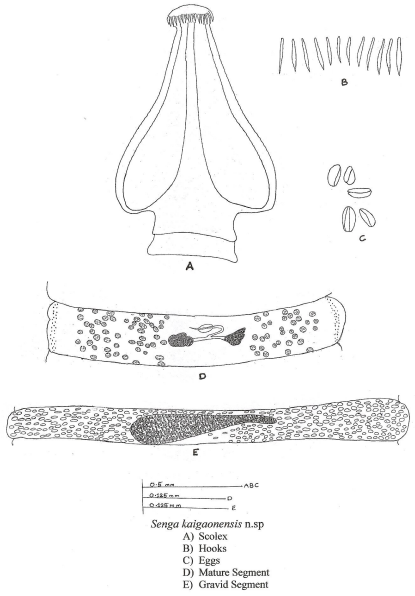
haematoxylin stain and on closer observations it has been found that they belongs to the genus *Senga* (Dollfus, 1934).

These cestodes were flattened, preserved in 4 % formalin, stained with Harris haematoxylin, passed through various alcoholic grades, cleared in xylol, mounted in D.P.X. and whole mount slides were prepared, for further anatomical studies. Drawings were made with the camera lucida and all measurements are in millimeters.

Description

The complete strobilae measure 86-145 mm in length and 3.8 – 4.4 mm in width. The scolex is triangular shaped being broader at the base. It measures 1.22 - 1.25 mm in length and 0.32–0.33 mm in width, it contain two bothria which is narrow at the anterior and broader at the posterior end which measures 1.18-1.20 mm in length and 0.28-0.29 mm in width. The rostrellum is disc like, bears a crown of 36 hooks, the apical disc measures 0.3-0.35 by 0.19-0.21 mm in size. The larger hook measures 0.065 – 0.085 mm by 0.01-0.012 mm in size and the smaller hooks measures 0.031-0.035 mm by 0.01-0.01 mm in size. All the segments, right from the base of the scolex up to the end of the strobila are much broader than long, including immature segments and partly mature segments. In immature segments there is no trace of any reproductive organ and in the partly mature segment besides the developing ovary, vitelline follicle are observed which arranged in the lateral fields of the proglottids. In more differentiated segment, the vitelline follicles appear to be arranged in clusters at the lateral fields and the testes appear to occupy the meduallary region around the ovarian lobes.

In most of the mature segment which lie just after the partially mature segments are three times broader than longer which measures 0.15 mm in breadth and 0.024 mm in length, the vitelline follicle are well distinct from the testes being arranged separately i.e. of the segment. The testes 285-295 in numbers which measures 0.03-0.04 mm by 0.01-0.014 mm, they are arranged in two lateral fields. The ovary is differentiated into bilobed structure with a long thin and strip like isthmus between the two lobes is median in position, each lobe consist of 5 acini and it measures 0.09-0.12 by 1.25-1.45 in size. The gravid segments are broader then longer and measures 0.20 mm in breadth and 0.01776 mm in length, tubular uterus is present in these segments which measures 0.075 mm in breadth and 0.0155 mm in length, greater space is occupied by the uterine sacs, which are transversely elongated in accordance with the shape of the proglottids. The eggs are oval to elongated, thin-shelled and non-operculated and measures 0.00- 0.00774 in size.



Senga kaigaonensis n.sp
A) Scolex
B) Hooks
C) Eggs
D) Mature Segment
E) Gravid Segment

Fig. 1: Sections of different segement of *Senga kaigaonensis* n.sp.

Results and Discussion

Dollfus erect the genus Senga in 1934 as a type species S. *besnardii* from *Betta splendens*. Later on the following species are added to this genus. The present cestode comes closer to *S. lucknowensis* (1956), *S. khami* (1971), *S.*

aurangabadensis Jadav *and Shinde* (1980) and *S. maharashtrii* Jadhav (1991), but the same differ from *S. khami*, in the shape of scolex (triangular vs rectangular) in the number of hooks (36 vs 55-57). The present cestode differs from *S. aurangabadensis* in the shape of scolex (triangular vs oval) and arrangement of follicles (4-5 rows vs 2-3 rows). The present parasites worm differs from *S. godavari* in the shape of scolex (triangular vs pear shaped), arrangement of hooks (circular vs semi- circular), in the shape of ootype (round vs oval) and vitellaris (follicular vs granular). The present worm differs from *S. paithanensis* in the number of rostellar hooks (36 vs 54), in the number of testes (45-50 vs 130-135) and position of vagina (anterior vs posterior). The present tapeworm differs from *S. maharashtrii* in the shape of scolex (triangular vs oval), in the number of testes (45-50 vs 80-90) and the position of the genital pore (in the anterior half of the segment vs in the posterior half of the segment). The present worm differ from *S. maharashtri,* in the shape of the scolex (Triangular vs Oval), in number of hooks (36 vs 45-47), and in the number of testes (45-50 vs 90). The present worm differs from *S. chauhani* in the shape of the scolex (Triangular vs Oval), in the number of hooks (36 vs 40-44), in the number of testes (45-50 vs 300-310). Neck is present. The present worm differs from *S. armatusae* in the number of hooks (36-40), testes (distributed in two lateral field vs. densely distributed). The present worm differs from *S. tappi* in the number of hooks (36 vs 40), in numbers of testes (45-50 vs 285-295). These distinct characters are more than enough to erect a new species from this genus and hence the name *Senga kaigaonensis* n.sp is proposed as it is reported from Kaigaon Toka, Dist Aurangabad, (M.S.) India.

Genus : Senga Dollfus (1934)
Species: Senga kaigaonensis n. sp
Type host: *Mastacembelus armatus* (L.)
Locality: Kaigaon Toka. Dist Aurangabad (M.S.) India
Date: March 2007.

References

Bhure, D.B., Padwal, N.D. and Jadhav, B.V., 2007. A new tapeworm *Senga jadhavae* n.sp. (Cestoda: Pseudophyllidea) from *Mastacembelus armatus* at Aurangabad. ***Proc. Zool. Soc. India***., 6(2): 45-52.

Dollfus, P.H., 1934. Sur un cestode Pseudophyllidae parasite de poisson d' ornament. ***Bull. Soc. Zool. France***, 59: 476-490.

Fernando, J.I. and Furtando, J.I., 1963. Helminth parasites of some Malayan freshwater fishes. ***Bulletin National Museum state of Singapore***, 132: 45-71.

Furtado, J.I. and Chau-lan, L., 1972. Two new helminth species from the fish *Channa micropeltes* Cuvier (Ophiocephalidae) of Malaysia. ***Folia parasitol***, 18: 365.

Hasnain, Monzer, 1992. On a new cestode *Senga chauhani* Sp. Nov from a fish host *Channa punctatus* from Jamshedpur. ***Indian Journal of Helminthology***, 60(2): 123-127.

Hiware C.J., 1999. On a new tapeworm, *Senga armatusae* n.sp from freshwater fish, *Mastecembelus armatus* at Pune M.S India. ***Rivista Di Parasitologia*** 16(60) - N, I.

Jadhav, B.V., 1980. On a new cestode *Senga paithanensis* (Cestode: Ptychobothridae) from *Mastacembelus armatus*. ***Bioresearch***, 5(1): 95-96.

Jadhav, B.V., 1991. A new tapeworm *Senga gachua* n.sp. from the fresh *Channa gachua* at Aurangabad. ***Ibid***, 3(1): 39-41.

Jadhav, B.V. and Shinde G.B., 1980. On a new cestode *Senga aurangabadensis* n.sp. from the fish *Mastacembelus armatus*. ***Bioreasearch***, 4: 25-27.

Johri, G.N., 1956. A new cestode *Senga luknowensis* from *Mastacembelus armatus* (Lacep). ***Supplement to Current Science***, 25: 193-195.

Kadam, S.S., Jadhav, B.V. and Shinde, G.B., 1981. *Senga paithanensis* Sp.Nov (Cestoda: Ptychobothridae) from *Mastacembelus armatus*. ***Bioresearch***, 5: 95-96.

Patil, D.N. and Jadhav, B.V., 2003. On a new species of the *Senga* Dollfus, 1934 Cestoda- Ptychobothridae Luhe, 1902 as *S. tappi* n.sp. from the Shripur Dist. Dhule (M.S.) India. ***J. Comp. Tox. Physiol***., 1: 68-72.

Ramadevi, P., 1973. On *Senga visakhapatanamensis* n.sp. Cestode Pseudophyllidea from the intestine of the freshwater fish *Ophiocephalus punctatus* (Bloch). ***Rivista di. Para***., 34(4): 281-286.

Ramadevi, P., 1976. The life cycle of *Senga visakhapatnamensis*, Ramadevi and Hanumantha Rao, 1973 (Cestode: Pseudophyllidea***). Riv.Parasit***., 37: 79-90.

Ramadevi, P. and Rao, K.H., 1966. Pleurocercoid of *Senga* sp. (Pseudophyllidea, Ptychobothridae) from the fish Panchax panchax (Ham and Buch). ***Curr. Sci.***, 35: 226-227.

Shinde, G.B., 1972. Studies on Indian cestode, redescription of *Senga besnardi* Dollfus, 1934. ***Marathwada University J. of Sci***., 1(40): 39-40.

Shinde, G.B. and Deshmukh, R.A., 1980. On a new cestode *Senga Khami* n.sp. from freshwater fish. ***Indian Journal of Zool.***, 8: 28-32.

Shinde, G.B. and Jadhav, B.V., 1980. On a new tapeworm *Senga godavari* from *Mastacembellus armatus*, Aurangabad. ***J. Biology***, 2(4): 46-48.

Tsengeshen, 1933. Studies on some cestode from fishes. ***J.Sci. Nat***. Univ, Shantung, Tsingtao, China. 2: 1-21.

Wardle, R.A., McLeod, J.A. and Radinousky, S., 1974. *Advances in the zoology odf tapeworms, 1950-1970*. Univ. Minnesota. Minnetoba Press, Minneapolis. 1-274.

Woodland, W.N.F., 1924. On a new *Bothriocephalus* and a, new genus of Proteocephalidae from Indian fresh water fishes. ***Parasit***., 16: 441-451.

Environment Conservation Journal 10(3) 67-71, 2009
(ISSN 0972-3099)

Ethnobotanical information of medicinal plants in Haridwar District

Anubha Arora

Received: 27-02-2009 Revised: 23-07-2009 Accepted: 01-08-2009

Abstract

An ethnobotanical survey of plant species are used as folk medicines by various Ayurvedic Doctors Vaidhya's or Hakim's, rural and common peoples in Haridwar district. Information on the names of plants parts used and methods of preparation was collected through a questionnaire which was administered to herbalists, traditional healers and rural dwellers. In the present paper information about 61 medicinal angiospermic plant species belonging to 38 families and 60 genera, which are useful in different ailments are presented.

Keywords:- *Ethnobotanical, Medicinal plants, Folk medicines, Ayurveda*

Introduction

Many ethnobotanical research have been performed for collecting useful information on which every project focused, through the surveying in local markets Pei *et al.*(1990).
Medicinal plants continue to play a central role in the healthcare system of large proportions of the world's population (Akerele, 1988). This system of medicine is as old as the Indian history itself, because it formed an integral part of the Indian traditions since time immemorial. Duthie (1903-1929) has worked on the flora of Upper Gangetic Plain. Jain (1965) has studied on medicinal plant of the tribals of Bastar. Gaur (1999) has studied the flora of district Garhwal, North West Himalaya with ethnobotanical notes. Mitaliya *et al.* (2001) worked on medicinal values of some selected stem bark used by tribals and rural folk in Gujarat. Shukla *et al.* (2001) also conducted an ethnobotanical surey for certain wild edible plants of district Bilaspur. Tomar and Singh (2005) worked on folk medicinal uses of some indigenous plants of Bagpat district of U.P. Tomar and Singh (2006) have worked on ethno-therapeutics of some medicinal plants from Khatauli blocks of Muzaffaranagar district (U.P).

Author Address
Deptt. of Botany, D.N. College, Meerut, C.C.S. University, Meerut

Materials and Method

Haridwar district covering an area of about 2360 km^2 is the Southwestern part of Uttarakhand state of India. Its latitude and longitude are 29.96° N and 78.16° E respectively. Haridwar is situtated at height of 249.7 meters from the sea level between Shivalik hills in the north and northeast and Ganga River in the south.
Field surveys were undertaken across the various blocks of Haridwar district. The survey of folk medicinal plants was conducted from 2007-2008 of various blocks of Haridwar district. A semi structured survey was conducted among traditional Vaidyas- practitioners of Ayurvedic medicine. The purpose of the survey was to document their knowledge of preparing various herbal formulations. The survey also gathered information about the local names of medicinal plants, plant parts used in treatment. The plant species were identified with the help of available floras Hooker (1872 -1897); Duthie (1903-1929) and Maheshwari (1962).

Results and Discussion

Medicinal plants enumerated here (Table-1) are arranged alphabetically with their botanical names followed by family name, local name, plant part used and medicinal uses.
It has been realized that medicinal plants are going to play an important role for future in social health

Table-1: Characteristic of folk medicinal plants in Haridwar district

Botanical names	Family	Local name	Parts used	Ethnomedical Preparation and uses
Abrus precatorius (Linn.)	Fabaceae	Gomchi	Root	Root powder is taken orally along with cow's milk to treat scraping sting and snake bite.
Abutilon indicum (Linn.) Sweet	Malvaceae	Kanghi	Leaf/Root	Leaf Juice and root are taken orally to treat dental problems
Abroma augusta (Linn.) Lt.	Sterculiaceae	Utal Kambal	Leaves	Leaf juice is applied for skin disease and ring worm.
Achyranthes aspera (Linn.)	Amaranthaceae	Chirchita	Leaf	Leaf paste is applied topically to treat cuts and wounds. Dried aerial parts are taken orally in case of diabetes.
Acorus calamus (Linn.)	Araceae	Bach	Rhizome	Juice is used in mental disorder fever and cough.
Adhatoda vasica (Nees.)	Acanthaceae	Vasa	Leaf	Leaves are ground with the flowers of *Hibiscus rosa sinensis* and taken orally to treat asthma.
Aegle marmelos (Linn.)	Rutaceae	Bel	Leaf	Leaf paste is applied topically to heal the wounds and Juice is extracted from fresh leaves and administered orally on an empty stomach in case of diabetes.
Albizia lebbeck (Linn.) benth	Mimosaceae	Siras	Stem	Stem paste is applied and bandaged with wet cloth and change once a hour in case of sprams.
Allium ccpa (Linn.)	Liliaceae	Piyaz	Extract	Onion juice with mustard oil is applied as a liniment over painful joints.
Allium sativum (Linn.)	Liliaceae	Lahsun	Bulb	Decoction of 3-4 bulbs is given in the dose of two drops in ear twice a day for 4 days.
Aloe barbadensis (Mill.)	Liliaceae	Gheekwar	Leaf	The fleshy portion of the leaf is used for treating bum and sun burns.
Alstonia scholaris L. (R.Br)	Apocynaceae	Chitvan	Bark	Fresh bark is cutted into small pieces and decoction is prepared which is later filtered, concentrated and dried in shade out of this small pills use in asthma.
Amaranthus spinosus (Linn.)	Amaranthaceae	Katili Chauali	Root	Root paste is used as an external application.
Andrographis paniculata (Nees.)	Acanthaceae	Kalmegh	Leaf	Powdered leaf is mixed with cow and goat's milk and taken orally to treat diabetes.
Argemone mexicana (Linn.)	Papaveraceae	Peeli kateli	Latex	Latex is taken orally along with milk in case of urinary disorder.
Asparagus racemosus (Wild.)	Liliaceae	Satawar	Leaves	Dried leaves are powdered and are taken orally to cure stomach ache and urinary disorder.

Cont...

Azadiruchta indica (A.Juss.)	Meliaceae	Neem	Leaf & Twig	Leaf paste is applied topically on the body to treat small pox and skin diseases the young twig are used as tooth brush.
Barleria prionitis (Linn.)	Acanthaceae	Kalabansa	Root	2-3 teaspoons of decoction made of 15 gm of root is taken daily twice for one week in case of bronchitis.
Bauhina variegata (Linn.)	Caesalpiniaceae	Kachnar	Bulbs	Fresh buds of these plants are given to patient in case of diarrhoea.
Boerhavia diffusa (Linn.)	Nyctaginaeeae	Santh	Root	Root paste is applied topically to treat Hydrocele.
Brassica campestris	Brassicaceae	Peeli Sarson	Seed	Oil of sarson seeds are applied on skin eruption.
Butea monosperma (Lam.)	Fabaceae	Dahk/Palash	Bark	Juice extracted from bark is applied cuts and wounds and bark juice is given orally to get rid of intestinal worms.
Catharanthus roseus G. Don	Apocynaceae	Madagascar	Whole Plant	Whole plant is powered and mixed with cow's milk and taken orally to treat diabetes.
Calotropis procera (Ait) R.Br	Asclepiadaceae	Aak	Flowers	Flowers buds are mixed with about 20 gm gur and given one time a day for 3-4 days in case of malaria.
Cannabis sativa (Linn.)	Cannabinaceae	Bhang	Leaves	A poultice of leaves is applied externally around the anus for one mouth to cure piles.
Carica papaya (Linn.)	Caricaceae	Papita	Latex	Small quantity of milky juice is given in stomachache.
Cassia fistula (Linn.)	Caesalpiniaceae	Amaltas	Fruits	Soup is prepared with fruit pulp and taken twice a daily in a day in the case of constipate.
Cymbopogon citralus (Slaf.)	Poaceae	Lemon Grass	Leaves	A paste of the leaves made with butter milk is administered for expelling ring worms.
Convolvulus prostratus (Forsk)	Convolvulaceae	Shankhpushpi	Whole Plant	About 100ml plant juice is mixed with 1000ml water and used for insomnia.
Curcuma domestica (Vahl)	Zingiberaceae	Haldi	Powder	100ml of boiled milk mixed with Haldi and sugar is given for cold and pain.
Coriandrum sativum (Linn.)	Umbelliterae	Dhaniya	Fruits	Dried fruits are powdered and taken orally to cure fever.
Cinnamonum tamata (Buch-Hom) Nees & Eberm	Lauraceae	Tejpat	Bark & Leaves	Leaf used in diarrhoea and leaves used in cold and cough.
Cynodon dactylon (L.) pers	Poaceae	Doob	Whole plant	Decoction of whole plant is taken orally to keep the body cool.
Datura metal (Linn.)	Solanaceae	Dhatura	Leaf/seed	Leaf paste applied local in pain and skin. Few drops of leaf juice are poured in to ear to treat earache. A seed soaked in water is taken orally initially in case of asthma.
Emblica officinalis (Gairtn.)	Euphorbiaceae	Amala	Fruits	Fruits eaten to procure scurvy. gastric indigestion and vermifuge.
Euphorbia hirta (Linn.)	Euphorbiaceae	Dudhi	Latex	The milky latex is applied topically to treat wounds and lip cracks.
Hibiscus rosa sinensis (Linn.)	Malvaceae	Gudhal	Leaves	Paste of fresh leaves is applied on the hair for healthy and black hair.
Hemidesmus indus (L.)R.Br.MuIL	Asclepiadace	Indian Impecacuanna	Whole plant	Juice extracted from the whole plant is taken internally to keep the body cool.
Lantana camara (Linn.)	Verbenaceae	Lantana	Flowers	A hand full of flower is ground with coconut oil and applied topically on the head to get relief from headache.
Lawsonia inermis (Linn.)	Lythraceae	Mehndi	Leaf	Leaf powder is mixed with coconut oil and applied topically to treat cuts and wounds.
Mangifera indica (Linn.)	Anacardiaceae	Aam	Latex	The latex from leaf and stem bark is used to treat heel cracks.
Mentha pipertia (Linn.)	Lamiaceae	Pudina	Leaves	The leaves decoction is used in the treatment of jaundice.
Mimosa pudica (Linn.)	Mimosaceae	Chui-mui	Leaf	Pinch of leaf paste is applied topically to treat cuts and wounds.
Nerium oleander (Sol.)	Apocynaceae	Kaner	Stem	Juice prepared from the stem bark is boiled with gingelly oil and two drops are poured in ear to treat ear pain.
Ocimum sanctum (Linn.)	Lamiaceae	Tulsi	Leaves	Leaves are crushed with onion bulbs and the juice is taken orally to treat cough, cold and headache.
Plumeria alba (Linn.)	Apocynaceae	Frangipani	Root	Root decoction taken orally for intestinal worm.

Cont...

Piper longum (Linn.)	Piperaceae	Piple	Fruits/root	Crushed fruit mixed with jaggery and ginger powder is boiled and is taken thrice daily before food for curing malaria.
Punica granatum (Linn.)	Punicaceae	Anar	Fruits/root	The juice of fruits and leaves is given to patient in case of dysentery.
Rauwolfia serpentina (Benth.ex.kurz)	Apocynaceae	Sarpagandha	leaf	Leaf juice is taken orally or washed leaves are tied on the breast to increase secretion of milk in women.
Ricinlls communis (Linn.)	Euphorbiaceae	Arandi	Leaf	Oil coated leaves used for dressing blistered surface and ulcers.
Rosa centifolia (Linn.)	Rosaceae	Gulab	Flowers	Rose water of flowers is used as eye troubles. Used as an excellent uterine tonic.
Saraca asoca (Roxb.) Dewilde	Caesalpiniaceae	Ashok	Leaf	Used as an excellent uterine tonic.
Solanum nigrum (Linn.)	Solanaceae	Makoi	Whole plant	Whole plant parts are taken as food to treat cough. Powdered fruits are given orally to reduce fever.
Stevia rebaudiana (Bertoni.)	Asteraceae	Stevia	Leaf	Powder of leaves is used as a sugar free substitute by diabetic patients.
Tabernaemontana divaricata (L.) R.Br	Apocynaceae	Chandni	Latex	Latex is applied twice daily to prevent cavity formation.
Terminalia arjuna (Roxb.)Ex.Dc.Wight & Am	Combretaceae	Arjun	Fruit	Fruit paste is applied topically on wounds.
Tinospora cordifolia (Miers.)	Menispermaceae	Giloy	Leaf	Leaf paste is applied topically to treat wounds.
Vitex negundo (Linn.)	Verbenaceae	Nirgundi	Leaves	Leaves are boiled in water and vapor is inhaled twice a day to get relief from headache, fever, cold and fever.
Withania somnifera (Linn)	Solanaceae	Ashwagandha	Root	About 5 gm root powder of the plant is given with goat's milk for about 2 months in case of Arthritis.
Wrightia tinctoria (Roxb)R.Br.	Apocynaceae	Indrajau	Seeds	Juice of seeds taken orally to treat indigestion.
Zingiber officinale (Rose.)	Zingiberaceae	Adrak	Rhizomes	Milk boiled with adrak and sugar given for treating cold.

system. Now the people are accepting indigenous or Ayurvedic medicine system, which have no side effect and easily available with minimum cost by (Ayurvedic medical practitioners) Vaidya or Hakim.

It was observed that out of 61 medicinal plant species, vulnerable and endangered categories, used for various ailments by the folk people. Plant parts used in the local medicines include root, bark, latex, leaves, flowers, fruits and seeds. The present study involves field work and interviews. Oral interviews were held in villages and new information recorded at the spot and medicinal plants was collected and preserved for the future use. Majority of the plant of the family are useful to treat cold, cough, fever, diabetes, cut and wound healing, asthma as well as wormicidal agents.

Acknowledgement

The author present heartiest thankfulness to Mr. Manish Arora; who helped during field work. The villagers of the district are acknowledged for their cooperation for bringing all these informations regarding uses of plants parts and respective ailments with remedies.

References

Akerele, O., 1988. Medicinal plants and primary health care: An agenda for action. ***Fitoterapia***, 59: 355-363.

Duthie, J.F., 1903-1929. *Flora of Upper Gangetic Plain and of the Adjacent Siwalik and Sub- Himalyan tracts*. Calcutta.3 vols.

Gaur, R.D., 1999. Flora of District Garhwal North West Himalaya with Ethnobotanical Notes.*Trans Media*. Srinagar Garhwal, India.

Hooker, J.D., 1872-1897 The Flora of British India. London 7 Vols.

Jain, S.K., 1965. Medicinal Plant Lore of the Tribals of Bastar. ***Eco Bot.***, 19(3): 236-250.

Maheshwari, J.K., 1962. Studies on the Naturalized Flora of India. Proc. Summer School of Botany, Darjeeling. pp: 156-170.

Mitaliya, K.D., Bhall, D.C., Patel, D.M. and Joshi, P.N., 2001. Medicinal values of some selected stem bark used by tribals and rural folk in Gujrat. ***Adv Plant Sci***., 14(1): 191-195.

Shukla, K.M.L., Khan, A.A., Khan, Shabina and Verma, Ashok Kumar, 2001. An Ethnobotanical Survey for certain wild edible plants of district Bilaspur (MP), India. ***Adv Plant Sci***.,14(1): 57-60.

Pei, S., Li, Yanhui and Shuze, Yin, 1990. The challenge of Ethnobiology in the 21st century: Proceeding of the second international congress of Ethnobiology. pp: 150-169.

Tomar, A. and Singh, H., 2005. Folk Medicinal Uses of Some Indigenous Plants of Baghpat District of Uttar Pradesh, India. ***Journal of Non Timber Forest Products***, 12(3): 167-170.

Tomar, A. and Singh, H., 2006. Ethno- Therapeutics of Some Medicinal Plants from Khatauli Block of Muzaffaranagar District (U.P). ***Plant Archives***, 6(2): 639-641.

Environment Conservation Journal 10(3) 73-75, 2009
(ISSN 0972-3099)

Influence of environmental factors on the development of *Colletotrichum gloesporioides* rot (Anthracnose) of Mango Fruits

D.P. Gadgile, A.M. Chavan, R.B. Kakde, A.D. Hatti, P.P. Pangrikar and R.S. Gaikwad

Received: 26-03-2009 Accepted: 10-07-2009

Abstract

The present paper deals with the study of the impact of environmental factors like temperature and relative humidity (R.H.) on severity of disease, spore germination, cellulase and pectinase enzyme activity of *Colletotrichum gloesporioides*. Development of anthracnose (*Colletotrichum gloesporioides* rot) was found to be very less at low temperature (10^0 C) and low R.H. (30%) whereas; it was highest at 25 ^{0}C and at 100% R.H.

Keywords:- *Anthracnose, Cellulase activity, Disease severity, Mango fruits, Pectinase activity, Relative Humidity, Temperature*

Introduction

Anthracnose (*C.gloesporioides* rot) is presently recognized as the most important field and post harvest disease of mango worldwide. It is an important cause of loss in mangoes all over the world (Susamma, 2002). It is the major disease, limiting fruit production in all countries where mangoes are grown, especially where high humidity prevails during the cropping season. The post harvest phase is the most damaging and economically significant phase of the disease worldwide (Chrys, 2006).

Environmental factors such as temperature and relative humidity (R.H.) play an important role in the development and spread of post–harvest fungal diseases of fruits (Thakur, 1972; Gupta and Nema, 1979; Patel and Pathak, 1995; Mehrotra *et al.*, 1998; Bagwan and Yeole, 2003; Bagwan and Meshram; 2003; Chrys, 2006; Cherian and Mani, 2007). However, there is very less information about the effect of temperature and R.H. in respect to *Colletotrichum gloesporioides* rot of mango fruit. Hence attempts were made to determine the impact of these environmental factors on anthracnose of mango fruits.

Author's Address

Seed Pathology and Fungal Biotechnology Laboratory, Deptt. of Botany, Dr. Babasaheb Ambedkar Marathwada, University, Aurangabad (M.S.) ✉

Materials and Method

Healthy mango fruits of Alphanso variety were collected from Aurangabad fruit market. Mango fruits were surface sterilized with 0.1 % $HgCl_2$, Pricked to a depth of 2mm and washed with sterile distilled water. The injured fruits were dipped in spore suspension (106 spore/ml) of *Colletotrichum gloesporioides* for 2min. Then the fruits were placed in sterilized polythene bags as on fruit per bags.

These polythene bags containing mango fruits were incubated to different level of temperature and RH percentage adjusted level were maintained by the method recommended by Buxton and Mellanby (1934). Severity of rot was recorded on 8th day of incubation on the basis of percent fruit area infected. Effect of temperature and R.H. on spore germination of *C.gloesporioides was* examined by placing spores on glass-slide placed to different levels of temperature and R.H. Effect of temperature and R.H. on action of cellulase and pectinase enzyme of the *C.gloesporioides* was investigated by incubating inoculated fruits at different temperature and R.H. at 25^{0}C. On 8th day of inoculation 5gm of rotted tissue was macerated with distilled water and 0.5N NaCl. The extract was filtered and filtrate was centrifuged at 4000 rpm for 25 min and the supernatant was used as enzyme sample. Pectinase was assayed gives in 2ml of enzyme sample, 5.00 ml of 1% pectin dissolved in buffer solution (pH- 4.5), 1.8 ml of phosphate citrate buffer solution (pH-4.0) and 1.5 ml of distilled water.

The cellulolytic were assayed using 2ml of enzyme sample, 5.00 ml of 1% CMC (Carboxy Methyl Cellulose), dissolved in buffer solution (pH-4.5), 1.8 ml of sodium citrate buffer (pH-4.8) and 1.8 ml of distilled water.

The enzyme action was assayed by determining loss in viscosity of the reaction mixture after 120 min at 30 ^{0}C following the method of Bell *et al.* (1955). The data were statistically analyzed for C.D. following Panse and Sukhatme (1978).

Results and Discussion

Anthracnose severity was highest at 25 ^{0}C and 100% R.H. severity was absent at 10 ^{0}C and at 30% R.H., so at this physical environment there is a very less rotting of mango fruits. Severity was increased from 30 to 100% R.H. (Table-1 and 2). The spore germination did not occur at 10 ^{0}C up to 24 hours of incubation. Cellulase and pectinase activities were highest at 25 ^{0}C and 100% R.H. and lowest at 10 ^{0}C and 30% R.H. (Table-1 and 2).

Chrys (2006) reported that at 95 % R.H. and 25-30 ^{0}C temperature was favorable for spore germination of *C.gloesporioides*. Fatima *et al.* (2006) found that the temperature between 20^{0}C-30^0 C and R.H. at 95-97% was favorable for *C. gloesporioides* rot. Prabakar *et al.* (2003) investigated that the optimum temperature for the anthracnose development was 25 ^{0}C and it was least at 13 ^{0}C. Sharma (2000) observed a temperature of 25 ^{0}C and R.H. more than 95 percent has been considered favorable for anthracnose development of post harvest mango fruits. Temperature between 25 to 30 ^{0}C and 90 percent R.H. was favorable for *C. gloesporioides* rot. Maximum (>32^{0}C) was found unfavorable for anthracnose disease (Patel and Rathod, 2005).

The present research findings reveals that optimum temperature and R.H. for *C. gloesporioides* rot was 30 ^{0}C and 100% respectively and the pathogen did not show any symptoms at 10 ^{0}C. Hence it can be concluded at low temperature (10 ^{0}C) and low humidity (30%), anthracnose is not developed in mango fruits. Whereas, at room temperature (25-30 ^{0}C) and high humidity (100%), *C. gloesporioides* rot is severe. It can be also concluded that diseases severity, spore germination cellulase and pectinase action of *C. gloesporioides* were directly proportional to the R.H. level.

The finding suggests that storage of mango fruits at low R.H. and low temperature will reduce the spoilage by anthracnose of mango fruit during harvesting, loading, transportation, unloading, storing etc. So, low temperature and low humidity storage conditions are recommended to avoid spoilage of mango fruits by *C. gloesporioides*.

Table-1: Influence of temperature on disease severity, spore germination, cellulase and pectinase enzyme activity of *C. gloesporioides* rot of mango fruits

Temp. (^{0}C)	Disease severity %	Spore germination % after 24 hours	Enzyme Activity	
			Cellulase	Pectinase
10	0.00	0.00	14.40	13.60
25	59.30	80.40	69.20	67.30
30	48.70	73.20	61.30	58.70
40	38.40	62.40	44.20	38.40
C.D. (p=0.05)	35.40	50.50	33.30	32.70

Note:- Enzyme activity values are expressed in viscosity loss % after 120 min.

Table-2: Influence of Relative humidity on disease severity, spore germination, cellulase and pectinase enzyme activity of *C. gloesporioides rot* of mango fruits

R.H. (%)	Disease severity %	Spore germination % after 24 hours	Enzyme Activity	
			Cellulase	Pectinase
30	22.40	19.50	15.40	14.30
50	26.70	42.80	18.30	16.90
80	54.20	73.20	57.20	48.70
100	65.40	78.70	70.40	65.60
C.D.(p=0.05)	28.80	37.80	38.00	34.30

Note:- Enzyme activity values are expressed in viscosity loss % after 120 min.

Acknowledgement

Firstly author acknowledge to UGC, New Delhi for giving financial support in the form of UGC Meritorious Fellowship. Authors are thankful to Professor and Head Dept of Botany, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, for giving research facilities. Authors are also thanks to

Prof D.S. Mukadam, Dept of Botany Dr. B.A.M. University, Aurangabad for their constant guidance and motivation to research in plant pathology.

References

Bagwan, N.B. and Meshram, B.M., 2003. Effect of temperature and relative humidity of on post- harvest rots of banana fruits. ***J.Mycol.Pl.Pathol.***, 33(2)**:** 299-300.

Bagwan, N.B. and Yeole, R.D., 2003. Effect of temperature and relative humidity on incidence of post- harvest rot of mango. ***J.Mycol.Pl.Pathol.***, 33(1): 136-137.

Bell, T.A., Etchells, J.L. and Jones, I.D., 1955. *A method for testing Cucumber salt Stock brine for softening activity* . U.S.dept.Agri.Res.Serv. pp: 72-75.

Buxton, P.A. and K., Mellanby, 1934. The measurement and control of humidity. ***Bull.Ent.Res.***, 25: 171-175.

Cherian, T.T. and Mani Varghese, K.I., 2007. Effect of tempreture, relative humidity and injury on development and spread of post- harvest rot of banana. ***Indian Phytopath.***, 60(1): 112-114.

Chrys, N. Akem., 2006. Mango anthracnose disease: Present status and future research priorities. ***Plant Pathology Journal***., 5(3): 266-273.

Fatima, Sumia, Zafar, Javeed and Ade, Avinash, 2006. *Post harvest rots of fruits.* Discovery publishing house, New Delhi. pp:10-14.

Gupta,Om and Nema, K.G., 1979. Effect of temperature and relative humidity on the development of fruit rots of Papaya caused by Botryodiplodia theobromae Colletotrichum papayae. ***Indian Phytopath.***, 32: 106-107.

Mehrotra, R.S., Aggarwal Ashok and Navneet, 1998. Post-harvest diseases of fruits and vegetables and their control. In. Sharma Neeta and Maskaoor Alam (eds.), Post harvest diseases of Horticultural perishables, International Books distributing co., Lucknow. pp: 57.

Panse, V.G. and Sukhatme, P.V.**,** 1978. *"Statistical methods for agricultureworkers".* ICAR, New Delhi.

Patel K.D. and Pathak V.N.**,** 1995. Developments of *Botrydiplodia* rot of Guava fruits in relation to temperature and humidity. ***Indian Phytopath.***, 48: 86-89.

Patel, R.L. and Rathod, N.K., 2005. Epidemiology of Anthracnose of Mango (*Mangifera indica*) caused by *Colletotrichum gloeosporioides.* ***Indian J. Mycol. Pl. Pathol.***, 35(3): 492.

Prabakar, K., Muthulakshmi, P., Raguchander, T. and Parthiban., 2003. Influence of temperature and relative humidity on anthracnose pathogens growth and diseases development in mango under in vitro. 90: 7-9.

Sharma, S.K., 2000. Post harvest diseases of mango. In. V.K. Gupta (eds.), diseases of fruit crops. pp:215.

Susamma Philip., 2002. *Fruits crops: Diseases in the field and storage.* Kalyani Publishers, Ludhiana. pp: 49.

Thakur, D.P., 1972. Factors influencing storage rot of certain fruits and vegetables caused by three species of *Rhizopus.* ***Indian Phytopath.***, 25: 354-358.

Environment Conservation Journal 10(3) 77-79, 2009
(ISSN 0972-3099)

Effect of chromium sulphate amendment on soil mycobiota

Sandeep Kumar[1] and Kalyani Srinivasan[2]

Received: 08-06-2009 Accepted: 14-10-2009

Abstract

Effect of chromium sulphate solution of different concentrations (0.25%, 1.0%, 1.5%, 2.0% and 3.0%) on soil mycobiota was studied. Up to a certain 1evel; the fungal diversity improved as a result of amendment with chromium sulphate solution. However, higher concentration (3%) led to marked decrease in the number of isolates. *Aspergillus flavus, A. niger, A. terreus. A. fumigatus, A. luchuuensis, Fusarium* spp., *Periconia byssoides* and a species of *Penicillium* could be isolated from soil treated with 3% chromium sulphate solution. Out of these, *A. fumigatus* and *Fusarium* spp. together accounted for more than 94% of isolates and may be tried for removal of chromium from industrial effluents.

Keywords:- *Tannery effluents, Chromium sulphate, Bioremediation*

Introduction

Indiscriminate disposal of industrial effluent leads to undesirable effects on the environment including the soil microbiota as well as growth, yield and chemical composition of various crops (Sharma and Habib, 1995). Effluents of leather tanneries are no exception (lyer *et al*., 1952; Padmani, 1976). More and more tanneries are now shifting to chrome tanning resulting in increased quantities of chromium sulphate in the effluents. Hence, the effect of chromium sulphate on the soil mycobiota needs to be studied not only to get better understanding of the impact of effluents emanating from chrome-tanning units on the environment, but also to search those fungal strains, which can tolerate and remove chromium from tannery waste water (Raman *et al*., 2002). The present study was undertaken to study the effect of chromium sulphate amendment on soil mycobiota.

Materials and Method

Approximately 75 gm of air-dried, sieved soil was taken in each of 48 disposal plastic pots with a small hole at the bottom of each, 8 pots were kept saturated with 0.25%, 1.0 %, 1.5%, 2%.and 3% solutions of chromium sulphate. The pots treated with distilled water served as control. After 20 days, 4 pots were randomly picked from control sets as well as each of the treatment sets. The soil from all the four pots taken from a given set was mixed thoroughly aseptically in a fresh polythene bag. In this way, 6 composite samples were prepared, which were analyzed for fungal mycobiota. Dilution plate method as followed earlier by Singh and Charaya (1975) was adopted in present study. Twenty grams of soil from each sample were suspended in sterilized water to give a dilution of 1: 10. From this, further dilutions of 1: 100, 1: 1000 and 1: 10000 were prepared. One-ml. aliquots of each of last of the 3 dilutions were added aseptically to four Petridishes each. Sterile and cooled Czapek's agar medium was added to the plates, which were incubated at 25±2 °C for 5-8 days for identification. For the purpose of calculation of frequencies of fungi, each petri dish was treated as a quadrat. The frequency class was expressed as mention by Saksena (1955).

Results and Discussion

In all, 28 species of fungi were isolated from the

Author's Address
[1]Deptt. of Botany and Microbiology, Gurukul Kangri University, Haridwar ✉
[2]Germplasm Conservation Division, National Bureau of Plant Genetic Resources, lARI, Pusa Campus, New Delhi

Table-1: Frequency (F), total number of isolate (T I) and percentage isolates (P I) of fungi colonizing soil amended with chromium sulphate solution of different concentrations (Values are means of three replicate of each treatments)

Fungal species	Control			Soil amended with Chromium sulphate solution														
				0.25 %			1.00 %			1.50 %			2.00 %			3.00 %		
	F	T1	P1	F	T1	P1	F	T1	P1	F	T1	P1	F	T1	P1	F	T1	P1
A. flavus	I	1	0.46	II	2	0.75	II	2	0.62	II	6	1.50	II	5	2.22	I	1	0.71
A. humicola	-	-	-	-	-	-	-	-	-	I	2	0.50	-	-	-	-	-	-
A. niger	IV	29	13.3	II	3	1.13	IV	29	9.03	III	16	4.01	III	5	2.23	II	6	4.31
A. terreus	II	3	1.38	-	-	-	III	8	2.49	II	7	1.75	II	3	1.33	I	1	0.71
A. fumigatus	III	8	3.66	III	10	3.76	III	22	6.85	IV	68	17.04	V	59	26.2	V	62	44.6
A. luchuensis	II	2	0.92	-	-	-	II	4	1.25	II	4	1.00	I	3	1.33	I	1	0.71
A. funiculosus	-	-	-	I	7	2.63	-	-	-	I	3	0.75	-	-	-	-	-	-
A. versicolor	I	1	0.46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. flavus sclerotial	V	-	-	-	-	-	II	8	2.49	-	-	-	-	-	-	-	-	-
Alternaria citri	-	-	-	-	-	-	I	1	0.31	-	-	-	-	-	-	-	-	-
Fusarium sp.1	I	168	77.1	V	238	89.5	V	217	67.6	V	265	66.42	IV	130	57.8	IV	56	40.29
Fusarium sp.2	-	1	0.46	-	-	-	I	1	0.31	I	1	0.25	-	-	-	-	-	-
Fusarium sp.3	I	-	-	I	2	0.75	-	-	-	-	-	-	-	-	-	-	-	-
Fusarium sp.4	-	1	0.46	-	-	-	I	1	0.31	-	-	-	-	-	-	-	-	-
Emericella rugulosa	-	-	-	I	1	0.38	-	-	-	II	2	0.50	-	-	-	-	-	-
Papulospora sp.	I	-	-	-	-	-	I	1	0.31	II	6	1.50	II	3	1.33	-	-	-
Pycnidial sp. uniden	I	1	0.46	-	-	-	II	2	0.63	-	-	-	-	-	-	-	-	-
Periconia byssoides	I	1	0.46	I	1	1	-	-	-	-	-	-	I	4	1.78	II	7	5.03
Penicillium sp.1	-	-	-	-	-	-	III	15	4.67	II	15	3.75	II	7	3.11	II	2	1.43
Penicillium sp.2	-	-	-	-	-	-	I	4	1.25	_	-	-	-	-	-	-	-	-
Penicillium sp.3	-	-	-	-	-	-	II	2	0.62	-	-	-	-	-	-	-	-	-
Penicillium sp.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium sp.5	-	-	-	-	-	-	-	-	-	II	2	0.50	-	-	-	-	-	-
Myrothecium sp	-	-	-	-	-	-	-	-	-	II	2	0.50	-	-	-	-	-	-
Cladosporium sp	-	-	-	II	2	0.75	I	1	0.31	-	-	-	-	-	-	-	-	-
Verticillium sp	-	-	-	-	-	-	II	2	0.62	-	-	-	II	2	0.89	-	-	-
S. communis	-	-	-	-	-	-	I	1	0.31	-	-	-	-	-	-	-	-	-
Sporotrichum sp.	-	-	-	-	-	-	-	-	-	-	-	-	I	4	1.78	II	3	2.15
Total	216			266			321			399			225			139		

control soil samples as well as from those treated with chromium sulphate solution of different concentrations (Table-1). The number of species isolated from treated with 0.25%, 1.0 % and 1.5 % chromium sulphate solution were higher than that isolated from control soil. The numbers of species isolated from the soil treated with 2% chromium sulphate solution were equal to these isolated from control. However, the number of species decreased in the soils treated with 3% chromium sulphate solution. Thus, in general, an increase in the concentration of chromium sulphate solution resulted in increase in the fungal diversity up to 2% concentration. In the soil treated with 0.25% concentration solution, of course, lesser number of species was isolated. However, at this stage there was preponderance of *Fusaria*. This is in contrast with observations of Rai *et al.* (1995) that the treatment with chromium chloride, up to 200 ppm, *in-vitro*, markedly inhibited the growth of *Fusarium*. In the present study, the population of *Fusarium* sp-L, exhibited increasing trend with increase in the concentration of chromium sulphate solution up to 1.5% concentration. *A. flavus, A. niger, A. terreus, A. fumigatus, A.luchuensis, Fusarium* sp.l, *Periconia byssoides* Sporotrichum sp, and species of *Penicillium* could be isolated from soil treated with 3% chromium sulphate solution. Out of these, *A. fumigatus* and *Fusarium* sp.l together accounted for more than 94% of the isolates reflecting their tolerance to chromium. In their studies with chromium chloride, Rai *et al.* (1995) found that *Penicillium rugulosum* and *Fusarium oxysporum* are least affected by low concentration of chromium. It appears that these fungi has the ability to detoxify chromium.

Raman *et al.* (2002) have found that the fungi *Laccaria laccata* and *Suillos bouinus* show increased protein content when exposed to high doses of chromium, they believed that there was increased production of phosphatase enzyme to overcome stress. Stress alleviation through metal accumulation in polyphosphate granules in the hyphae of *Pisolithus tinctorius* have been found copper and zinc (Tam, 1995). It would be worthwhile to find out whether this happened with chromium sulphate also. In any case, the present investigation has revealed that *Fusarium* species are also highly tolerant to chromium sulphate through slightly lesser than *A. fumigatus*. *A. fumigatus* is already grown on chrome waste to leach out chromium (Kamtni *et al.,* 1999). It would beworthwhile to try *Fusarium* species or a combination of both of them for the same purpose.

References

Iyer, C.R., Rajgopalan, R. and Pillai, S.C., 1952. Soil condition as affected by tannery waste water. ***J. Ind. Inst. of Science***, 34(2): 163-178.

Kamtni, N.R., Hemachander, C., Mala, G.S. and Puvanakrishnan, R., 1999. Microbial enzyme technology as an alternative to conventional chemicals in leather industrv. ***Current Science***, 77: 81-86.

Padmini, K., 1976. Effect of Tannery effluents on soil microflora and well water. Ph.D. Thesis, Madras University.

Rai, B., Chandra, A. and Singh, S.K., 1995. effect of heavy metals on growth of some pathogenic and non-pathogenic soil microflora. ***J. Ind. Bot. Soc.***, 74: 35-39.

Raman, N., Srinivasan, V. and Rani, M., 2002. Effect of chromium on the Axenic growth and phosppatase. Activity of Ectomycorrhizal fungi Laccaria laccata and Suillus bov.ines. ***Bull. Environ. Toxicol.***, 68: 569-575.

Saksena, S.B., 1955. Ecological factors governing the distribution of soil microfllpgi in some forest soil of sagar. ***J. Ind. Bot. Soc.***, 34: 262-298.

Sharma, B.K. and Habib, Iqbal, 1995. Differential bioaccumulation of Mg, Pb, Cr and Zn in some Rabi crops and elemental bioaccumulation. Metabolite concentration in component part of Cicer arientnum var C-235 under irrigational impact of rubber factory effluent. ***J. Ind. Bot. Soc.***, 74: 197-204.

Singh, P.N. and Charaya, M.D., 1975. Soil fungi of sugarcane field at Merrut. ***Geobios***, 2: 40-43.

Tam, P.L.F., 1995. Bioaccumulation of aluminium and chromium by ectomycorrhizal fungus Pisolithus tinctorius. Ph.D. Thesis University of Madras, India.

Environment Conservation Journal 10(3) 81-85, 2009
(ISSN 0972-3099)

Seasonal fluctuation of zooplankton in relation to industrial pollution in Irai river water, Dist. Chandrapur, (M.S.), India

A.P. Sawane[1], P.G. Puranik[2] and A.D. Bobdey[3]

Received: 12-03-2009 Accepted: 18-07-2009

Abstract

With the view to investigate the various changes in hydrobiological features during summer, winter and rainy season and to correlate the same with zooplankton productivity, the limnological survey of Irai river Dist. Chandrapur was undertaken during the year 2003-2004. The parameters such as temperature, conductivity, TDS, pH, CO_2 DO have been studied. In the present investigation zooplankton showed low inverse correlation with temperature and pH, while moderate positive correlation with conductivity, turbidity, TDS, CO_2. However, dissolved oxygen showed strong inverse correlation with temperature, CO_2 and conductivity. In present investigation, among zooplankton *Rotifera* was the dominant group throughout the study. The highest count of zooplankton was recorded at sampling station D in winter season. The correlation coefficients between each pair of parameter for all possible correlation have been discussed in this paper.

Keywords:- *Limnology, Physico-chemical, Zooplankton, Industrial pollution*

Introduction

Zooplankton are microscopic organism, which do not have power of locomotion and move at the mercy of water current. Zooplankton occupy a central position between the autotrophs and other heterotrophs and are important link in food web of freshwater ecosystem. The occurrence and abundance of zooplankton depend on its productivity, which in turn is influenced by physico-chemical parameters and level of nutrients in water. The zooplankton belong to four main groups, *Rotifera*, *Cladocera*, *Ostracoda* and *Copepoda*. The relevant studies on various aspects of zooplankton were made by Shankar and Hosmani (2002) and Patra and Datta (2004), Gupta and Sharma (2007), Khanna *et al*. (2007) Shazia and Raja (2007), Rajkumar *et al.* (2007) But in lrai river, studies on the zooplankton characteristic are very less in number. The present study was therefore undertaken to study the zooplankton characteristic especially in relation to industrial pollution and their correlation with physico-chemical parameters.

Materials and Method

For the present investigation four sampling stations A, B, C and D were selected along the course of Irai river.

Sampling station A: The area located near the water supply pumping station of Chandrapur Super Thermal Power station (CSTPS), on Irai Dam was selected as sampling station A.

Sampling station B: The area selected as station B is about 20.98 km. away from the station A and is located at the junction of channel coming from Chandrapur Super Thermal Power Station. Apart from thermal wastes this channel also carries domestic waste from the locality settled on the bank of the channel.

Sampling station C: The area chosen as sampling station C is about 2.7 km from station B and is located near the water supply pumping station near the bridge of road coming from Ramnagar, Chandrapur.

Author's Address

[1]Department of Zoology, Anand Niketan College, Warora-442914, Dist. Chandrapur (M.S.) ✉

[2] Former Principal, Sevadal Mahila Mahavidyalaya, Nagpur

[3] Department of Zoology, Shri Shivaji College, Akot-(M.S.), India

Sampling station D: About 1.2 km away from station C, near the junction of channel coming from Chandrapur MIDC (Datala), selected as sampling station D. This channel is seasonal and flows from monsoon to winter.

For physico-chemical and zooplankton analysis surface water samples were collected fortnightly for 12 months from Sep. 2003 to Aug. 2004 between 8.00 AM to 11.00 AM in clean plastic bottle (1500 ml) as per the standard procedure. Collected samples were analyzed in the laboratory as per the methods describe by NEERI (1986), Trivedy and Goel (1986) and Ramesh and Anbu (1996). For zooplankton analysis water sample of maximum 40 liters was collected from each station and was passed through the plankton collecting net made up of silk bolting cloth No.25. The concentrated sample collected at the bottom tube of plankton net was preserved in 5% formalin. The preserved sample was gently stirred to obtain the uniform suspension and with the help of wide mouth pipette the sample was quickly drawn and transported to the Sedgwick Rafter counting cell. The zooplankton were counted in entire Sedgwick Rafter cell as per the methodology of Michael (1973) and Michael (1986). The observations were presented in the form of the minimum and maximum numbers of plankton per liter.

Results and Discussion

The seasonal variation of physico-chemical characteristics and total number of zooplankton per liter are given in the Table-l while Table-2 depicts the list of zooplankton in Irai river at different sampling stations. The correlation coefficients ('r' values) between each pair of parameter for all possible correlation is computed and listed in Table-3.

Temperature is one of the most important physical parameter which affects the chemical and biological reactions in water. According to Prasad (1956), temperature is the determining factor in the seasonal distribution of aquatic organisms. Shukla *et al.* (1991) stated that temperature affects not only the metabolic activities of plankton but also their proliferation. In the present study maximum numbers of zooplankton were recorded during winter season at sampling station D. The temperature showed weak negative correlation with zooplankton and significant negative correlation with DO. However, pH, CO_2, TDS, turbidity and conductivity showed moderate positive correlation with temperature. George (1962) reported that temperature is the main factor regulating the production of zooplankton. Danilove (1963) and Hynes (1970) had reported that the plankton were maximum during summer and minimum in winter.

Conductivity is the capacity of water to carry on electric current and varies both with number and types of ions. Most dissolved inorganic substances in water are in the ionised form and hence contribute to conductance. Conductivity of Irai river water shows variations according to type of pollution discharge at different sampling stations. Discharge of industrial wastes from Chandrapur MIDC in river water resulted into high values of conductivity at Station D. However, at sampling station B values of conductivity were recorded in high ranges in summer due to discharge of thermal effluents and less flow of river water which offer less dilution of pollutants. The conductivity showed moderate positive correlation with zooplankton and strong positive correlation with CO_2, TDS and Turbidity while, strong negative correlation with DO.

The colloidal matter present in water impart turbidity of water. The turbidity in water may be due to clay and silt particles, organic matter, sewage, industrial effluents and presence of microorganisms. In present investigation maximum values of turbidity recorded at sampling station band D, was due to industrial effluents. The moderate positive correlation of turbidity is observed with pH, CO_2, TDS and zooplankton and moderate negative correlation with DO.

Minerals and some organic substances present in water are referred to total dissolved solids. The TDS contents varied according to seasons as well as with the increasing load of pollution. In Irai river water TDS values were well above the permissible limit throughout the study period at sampling station B and at sampling station D only during the winter season. The strong positive correlation of TDS is observed with CO_2, week positive correlation with pH and zooplankton and strong negative correlation with DO. The CO_2 content of any aquatic body is the best single

Table-1: Seasonal mean value of different parameters from Irai river water samples during the years 2003-2004

Seasons	Parameters	Station A	Station B	Station C	Station D
Winter	Temperature (°C)	24.50	28.90	26.10	27.50
	Conductivity (µmho)	250.00	1263.00	508.00	1749.00
	Turbidity (JTU)	0.90	51.80	24.30	33.50
	TDS (mg/l)	109.00	704.00	317.00	1337.00
	CO2 (mg/l)	4.70	37.10	20.20	37.70
	pH	7.90	8.50	8.00	6.60
	DO (mg/l)	8.30	4.80	5.90	4.90
	Zooplankton (unit/l)	181.00	164.00	166.00	214.00
Summer	Temperature (°C)	27.40	33.70	31.20	30.50
	Conductivity (µmho)	471.00	2045.00	736.00	412.00
	Turbidity (JTU)	1.44	134.90	28.40	22.20
	TDS (mg/l)	127.00	1107.00	513.00	441.00
	CO2 (mg/l)	8.20	51.10	28.90	18.50
	pH	7.60	8.70	8.30	7.70
	DO (mg/l)	6.50	2.90	4.80	4.10
	Zooplankton (unit/l)	163.00	150.00	121.00	148.00
Rainy	Temperature (°C)	25.50	29.80	28.20	28.50
	Conductivity (µmho)	211.00	1001.00	412.00	892.00
	Turbidity (JTU)	13.50	85.50	54.50	85.20
	TDS (mg/l)	225.00	605.00	418.00	508.00
	CO2 (mg/l)	2.70	35.50	20.60	27.80
	pH	7.50	8.30	7.60	7.30
	DO (mg/l)	7.80	4.10	5.50	5.20
	Zooplankton (unit/l)	151.00	163.00	122.00	136.00

index to decide the suitability of water for animal and other living being. It may be present in the form of gas or in combined form with other substances (Tamlurkar and Ambore, 2006). On the basis of data collected from the study carried out, it is observed that increase level of CO_2 was recorded during summer season at all sampling station except sampling station D. At sampling station D maximum values were recorded in winter season. In present investigation CO_2 shows weak positive correlation with zooplankton and strong negative correlation with dissolved oxygen. pH considered as an important ecological factor and is the result of the interaction of various substances in the water and also of numerous biological phenomenon's (Tamlurkar and Ambore, 2006). Das and Shrivastav (1956) observed that high pH values coincided with plankton peak. In the present investigation the pH of Irai river water was alkaline throughout the study period except sampling station D where pH was acidic during winter season. This decrease in pH may be attributed to the industrial sewage from MIDC area as the concentration of sewage is more in winter season as compare to the rainy season. In present study pH showed weak negative correlation with both zooplankton and DO. However, Salaskar and Yeragi (2003) reported the positive correlation between pH and zooplankton. Dissolved oxygen play an important

role in supporting life in running water but is susceptible to slight environmental change. In present investigation the concentration of dissolved oxygen was found to be maximum in winter season at sampling station A, may be due to the absence of any significant source of pollution at this station. However, minimum values of DO recorded during summer season at sampling station B. At this station the higher temperature of the water may be due to discharge of thermal effluents which may result into enhancement of microbial activities in river water resulting in depletion of DO. These observations corroborate with the findings of Fulekar and Dave (1989) in Yamuna river, Jankovic (1990) in Sava and Velica tributaries of Danube river and Wasnik (1995) in Kanhan river. In present investigation DO shows weak positive correlation with zooplankton.

Table-2: List of zooplankton of Irai River

Rotifers	Cladocerans	Copepods	Protozoa	Ostracoda
Brachionus calciflorus	Chydorus	Cyclops	Difflugia	Cypris
Brachionus fulcatus	Moina	Diaptomus		

Table-3: Simple correlation coefficient between zooplankton and physico-chemical parameters

Parameters	Temp.	Conductivity	Turbidity	TDS	CO_2	pH	DO
Zooplankton	-0.12	0.31	0.21	0.23	0.04	-0.25	0.01
DO	-0.96	-0.82	-0.57	-0.89	-0.94	-0.38	
pH	0.51	0.27	0.21	0.26	0.41		
CO_2	0.97	0.94	0.68	0.95			
TDS	0.88	0.95	0.58				
Turbidity	0.61	0.72					
Conductivity	0.84						

References

Danilove, I.E., 1963 The seasonal dynamics of phytoplankton of the gidigich reservoir according to 1963 data. In information on 4th Conf. Young scient. Maldiva 196 Kisinev. 50-53

Das, S.M. and Shrivastava, V. K., 1956. Quantitative studies on fresh water plankton. Correlation between plankton and hydro-biological factors. ***Proc. Nat. Acad. Sci. India***, 26 B(4): 243-253.

Fulekar M.H. and Dave J.M., 1989. Leaching or fly ash constituents along stream bed flow to Yamuna River, New Delhi. ***IJEP,*** 9(10): 773-777.

George, M.C., 1962. Diurnal variation in two shallow ponds in Delhi. ***Hydrobio1.***,l8(3): 263-273.

Gupta, M.C. and Sharma L.L., 2007. Trophic status and zooplankton of Amarchand reservoir, Udaipur, Rajasthan. Proceeding of DAE-BRNS National Symposium on Limnology. February 19-21. Uaipur (Raj.), 114-118.

Hynes, H.B.N., 1970. *The ecology of running waters.* Toronto University of Toronto Press. pp: 555.

Jankovic, 1990. Effect of warm wastewater from Thermal Power Stations on ecosystems of the Sava and Velika Morava, tributaries of the Danube. ***Wat. Sci. Tech.***, 22(5) : 155-160.

Khanna, D.R., Singh, Vikas, Butiani, R., Chandra, Kumar Satish, Matta, Gagan and Kumar, Dheeraj, 2007. A study of biotic and abiotic factors of Song River at Dehradun, Uttarakhand. *Environment Conservation Journa*, 8()3M: 117-126.

Michael, P., 1986. *Ecological methods for field and laboratory investigations.* Tata McGraw Hill Publishing Co. Ltd. pp: 131 - 145.

Michael, R.G., 1973 A guide to the study of Fresh water organisms. Journal, Madurai Univ., Suppl. I. pp: 185.

NEERI, 1986. *Manual On Water And Waste Water Analysis.* National Environmental Engineering Research Institutte, Nehru marg, Nagpur, India.

Patra, S.B. and Dutta, N.C., 2004. Seasonal fluctuations of different zooplanktonic group of a rainfed wetland in relation to some abiotic factors. ***Indian J. Environ and Ecoplan.***, 8(1): 7 - 12.

Prasad, R.R., 1956. Further studies on plankton of the in shore water s of Mandapam. ***Ind. J. fish.***, 3(1): 1-45.

Rajkumar, Sharma, B.K., Sharma, L.L., Upadhyay, B. and Niranjan, Sarang, 2007. Planktonic diversity in the reservoir Daya, Udaipur, Rajasthan. Proceeding of DAE- BRNS

National Symposium on Limnology. February 19-21. Uaipur (Raj.) 239-243.

Ramesh Rand Anbu M., 1996 *Chemical Mehods For Environmental Analysis*. First Published 1996, MacMillan India Limited, ISBN - 033392 281 6.

Salaskar P. B. and Yeragi S. G. 2003 Seasonal fluctuations of plankton population correlated with physic-chemical factors in Powai Lake, Mumbai, Maharashtra. ***J. Aqua. BioI.***, 18 (1), 19-22.

Shankar P. and Hosmani. 2002 Phytoplankton zooplankton relationship in four fresh water bodies of Dharwar. Indian J. Environ and Ecoplan, 6 (1): p.p. 23 -28.

Shazia Ansari and Wasim Raja 2007 Zooplankton diversity in fresh water bodies of Aligarh region. Proceeding of DAE-BRNS National Symposium on Limnology. February 19-21. Uaipur (Raj.) 170-175

Shukla, S. N., Bais, V. S. and Agrawal, N. C. 1991 Planktonic spectrum of the Bila reservoir in relation to physic-chemical characteristics. Environ. Pollution and Resources of land and water. 351-358.

Tamlurkar H. L. and Ambore N. E. 2006 Correlation coefficients of some physic- chemical characteristics of Alisagar dam water, District Nizamabad (A. P.) India. J. Aqua. BioI., Vol, 21(2), 115-118.

Trivedi R. K. and Goel P. K. 1986 *Chemical And Biological Methods For Water Pollution Studies*. Corrected Reprint: 1986, Environmental Publication, Karad.

Wasnik H. D. 1995 *Studies on environmental factors at thermal power plants and their effects on process water quality and remedial measures*. Ph. D. Thesis, Nagpur university, Nagpur.

Environment Conservation Journal 10(3) 87-92, 2009
(ISSN 0972-3099)

Toxic effect of *Euphorbia tirucalli* (Pencil tree) sap on *Tilapia zillii* fingerlings

L.E. Akpa[1], M.N.O. Ajima[1], C.D. Nwani[2] and C.A. Onu[1]

Received: 13-04-2009 Revised: 28-06-2009 Accepted: 22-07-2009

Abstract

Fingerlings of *Tilapia zillii* (5.20 gm ±0.03) were exposed to sap extract of *Euphorbia tirucalli* at concentrations of 6.00, 3.00, 1.50, 0.75 and 0.38 mg-1 with control as 0.00 mg-1 for 96 hours. The static bioassay showed that the 96-hour LC_{50} was 1.20 mg-1 with lower and upper confidence limits of 0.78 and 1.85 mg-1 respectively. Erratic swimming, loss of balance, respiratory distress, air gulping was observed before eventually death of the fish. Opercular ventilation and tail fin counts increased with increasing concentrations of the sap extract. Histopathological examination of the gills and liver revealed damages to these organs which were directly proportional to the concentration of the sap extract while those in the control tanks remained unchanged. Phytochemical analysis of the sap extract showed the presence of alkaloid, tannin, saponin, cardiac glycoside, rotenone, phenols, volatile oil, balsam and steroids. Water quality parameters monitored showed no significant difference (P>0.05) in temperature and pH while there was significant difference (P>0.05) in values obtained in dissolved oxygen, free carbon oxide and alkalinity. The implications of the findings as they affect the exposed fish and the aquatic ecosystem are discussed.

Keywords:- *Euphorbia tirucalli, Toxicity, Fingerlings, Tilapia zillii*

Introduction

In developing countries, crude extracts from plants are applied indiscriminately to water bodies with little or no regard to their detrimental effects caused to the aquatic organisms, livestock and humans. However, Kroupova *et al.* (2005) documented that the deliberate introduction of toxicants into aquatic ecosystem could eventually lead to disruption of multiple physiological disorders such as ion regulatory, respiratory, cardiovascular, endocrine and excretory processes and these could ultimately reduce their productivity capabilities. Respiratory distress as a result of fish in polluted water bodies have been reported by several authors; however, Banerjee (2007) observed that congestion of blood capillaries, periodic lifting and sloughing of respiratory epithelia of the secondary lamellae causing haemorrhage, extensive fusion of secondary lamellae and hyperplasia of the respiratory epithelia due to uncontrolled regeneration are the major causes leading to asphyxiation and eventually death of the fish if exposure is prolonged excessively.

The plant *Euphorbia tirucalli* which belongs to the family euphorbiaceae is commonly known as Barki-thohar. This plant is a native of America but has become acclimatized and grow freely in all parts of the world. It is a common medicinal plant of India (Satyarvati and Gupta, 1987). Pisicidaln activities of aqueous extracts of *Euphorbia tirucalli* were very well established, but their ultimate mode of action on fish metabolism was not yet known. Tiwari and Singh (2006) reported that exposure of fishes over 24 hr or 96 hr to sub-lethal doses (40% and 80% of LC_{50}) of aqueous extract of *E. tirucalli* stem-bark and latex, significantly (P<0.05) altered the level of total protein, total amino acids, nucleic acids, glycogen, pyruvate, lactate and activity of protease, alanine aminotransferase, aspartate aminotransferase, acetylcholineasterase and cytochrone oxidase enzyme in liver and muscle tissues of freshwater fish *Channa punctatus*. The alterations in all these biochemical

Author's Address
[1]Department of Zoology, University of Jos, Jos, Nigeria
[2]National Bureau of Fish Genetic Resources Canal Ring Road, P.O Dilkusha, Lucknow ✉

parameters were significantly ($P<0.05$) time and dose dependent. The authors documented that aqueous extracts of *E. tirucalli* adversely affect respiratory pathways of fish and cause energy crisis during stress by suppressing ATP production and that the reversibility of the action of the aqueous extracts would be additional advantage in their use. In this research the effect of *Euphorbia tirucalli* on *Tilapia zillii* was investigated under laboratory condition.

Materials and Method

Experimental fish

Fingerlings (mixed sex) of *Tilapia zillii* mean weight (5.20 gm ±0.03) were collected from Renaji Integrated Fish Farm in Rayfield Jos, Plateau state. They were transported to University of Jos Fisheries Research Laboratory with the aid of well aerated oxygen bag. The fish were held in plastic tanks and acclimated to laboratory condition for a period of two weeks.

Experimental design

Euphorbia tirucalli (pencil tree) was obtained from the rocks along Bauchi Ring Road Angwarukuba area Jos plateau state. The plant was identified by the Botany Department, University of Jos, Nigeria. The plant sap was collected by means of an incision into the stem and the sap was collected into small clean transparent plastic bottles. Based on the preparation and preliminary tests, serial dilutions were made and the concentrations of the extracts used were 6.00, 3.00, 1.50, 0.75 and 0.38 mg^{-1} while dechlorinated tap water without sap extract (0.00 ml^{-1}) served as the control. For the set up of the experiment, eighteen circular plastic tanks (40cm x 5cm x 24cm) were used as each concentration was in triplicate in order to minimize experimental errors.

The fish were not fed for 48 hours prior to and during the exposure period. Dechlorinated well aerated municipal tap was used. Each tank was stocked with ten fish. The tanks were examined on a daily base and dead fish were removed and recorded immediately from test solutions to avoid polluting the test media.

Phytochemical analysis to determine the active ingredients present in the extract was performed using the procedure described by Sofowora (1982). The physico-chemical analysis of the test water; temperature, dissolved oxygen, alkalinity, free carbon dioxide, pH were determineded using analytical method described in APHA (1995) and Khanna and Bhutiani (2004). The 96-hour LC_{50}, lower and upper confidence limits were estimated using the method for acute toxicity tests as recommended by UNEP (1989). Histopathological examinations of the gills, liver and kidney after exposure period were done using method described by Buck and Wallington (1972). The results obtained from this investigation were subjected to statistical analysis using two-way analysis of variance (ANOVA) to test for level of significant between the various levels of the sap extract of *E. tirucalli* concentrations.

Results and Discussion

The result of the physico-chemical parameters of the experimental media (Table-1) indicated a significant difference ($P<0.05$) in the values obtained for dissolved oxygen content, free carbon dioxide and alkalinity with the control while there were no significant different ($P>0.05$) between the values of temperature and pH with the control. The result indicated a reduction in level of dissolved oxygen content and an increase in alkalinity of the test media. The abnormal behavior observed in fish exposed to the extract before death included respiratory distress, loss of balance, gulping of air, settling at the bottom motionless, sluggish movement and erratic swimming. The abnormal behaviors displayed by the exposed fish increased with increasing concentrations of the sap extract.

The mortality rate of *Tilapia zillii* exposed to *E. tirucalli* sap extract showed l00% mortality at 6.00 mg^{-1} concentration, 90% at 3.00mg^{-1}, 70% at 1.50 mg^{-1}, 40% mortality at 0.75 mg^{-1} concentration. No mortality was observed in the group of fish in the control group experiment and 0.38 mg^{-1} concentration during the exposure period. Observed mortality increased with increasing concentration of the sap extract, showing both time as well as dose dependent relationship. The first 24-hr of the exposure was critical for the survival of the fish as most of mortalities were recorded during the period. No fish survived

Table-1: Mean values of Physico-chemical parameters measured during 96 hour exposure of various concentrations of sap extract of *E. tirucalli* to *Tilapia zillii*

Parameters	Concentrations (mg/l)					
	6.00	3.00	1.50	0.75	0.38	0.00
Temperature (^{o}C)	23.28±0.12	23A5±0.05	23.55±0.15	23.56±0.25	23.40±0.15	23.83±0.36
DO (mg/l)*	2.32±0.22	2.87±0.33	4.29±0.28	4.69±0.25	5.00±0.16	6.20±0.16
pH	6A6±1.02	6.55±1.32	6.60±1.22	6.89±1.l0	6.63±1.20	7.50±.1.04
FCD (mg/l)**	5.35±0.26	4.27±0.30	3.75±0.13	3.60±0.32	3.39±0.38	3.30±0.24
Alkalinity (mg/l)	13.93±0.12	l2.58±0.3l	10.68±0.63	7.73±0.71	l2.35±0.85	4.78±0.35

Note:- *Dissolved oxygen, ** Free Carbon dioxide

longer than 48 hr during exposure to 3.00 mg^{-1} and above. The mean value of 96 hr LC_{50} of the sap extract to the test fish was calculated to be 0.87 mg^{-1} with lower and upper confidence limits of 0.60 and 2.40 mg^{-1} respectively (Fig. l). The dead fish in all the sap extract concentration showed grey red coloration of the skin with brownish gill. The exposed fish exhibited higher opercular ventilation rate and tail frequency compared to the values obtained for the control group (Table-2). The result obtained from this research from water quality (dissolved oxygen) of the test media is not sufficient for the survival of living organism. At the concentrations used in this investigation, the extract led to the significant reduction in the dissolved oxygen and an increase in alkalinity of the test media. The air gulping observed in the exposed fish during exposure period was an indication of insufficient amount of dissolved oxygen in the experimental media. This can be attributed to the adverse effects of concentration of sap extract in the media. Stickney (1979) had reported that insufficient amount of dissolved oxygen is one of the contributing factors to mortality and poor growth of freshwater fish species. The general oxygen starvation can lead to the gasping behavior as observed in this investigation as a result of the introduction of the sap extract of *E. tirucalli* in the experimental media. Aggergaard and Jensen (2001) reported similar observation n when they exposed nitrite to difference fish species. The behavioral changes which were characterized -respiratory distress, loss of balance, settling at the bottom motionless and erratic swimming as reported in this investigation compared favorably with the observation of Pascual *et al.* (1994), Kroupova *et al.* (2005), Svecevicius (2006), Jain *et al.*(2007) when they exposed some species of fish to different toxicants.

Respiratory distress noticed in exposed fish could be caused by mucous precipitation and neurological

Table-2: Mean values of opercular ventilation rate per minute of *Tilapia zillii* exposed to varying concentrations of sap extract of *E. tirucalli* for 96 hours

Concentration (mg/l)	Exposure period (h)				
	Start (0)	24	48	72	96
6.00	l40.00±0.20	l40.00±1.05	-	-	-
3.00	138.00±0.06	136.00±1.l0	128.00±0.28	l24.00±0.10	l22.00±0.01
1.50	132.00±0.02	l26.00±1.20	l18.00±0.40	115.00±0.14	107.00±0.23
0.75	l28.00±1.21	l22.00±0.06	110.00±0.33	102.00±0.22	100.00±0.12
0.38	112.00±0.58	110.00±0.08	109.00±0.02	105.00±0.13	92.00±0.02
0.00	86.00±0.02	85.00±0.01	87.00±0.07	88.00±0.04	89.00±0.08

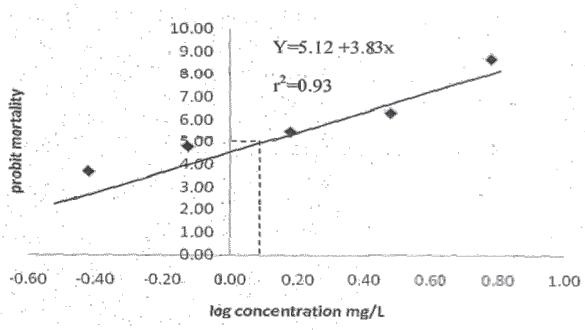
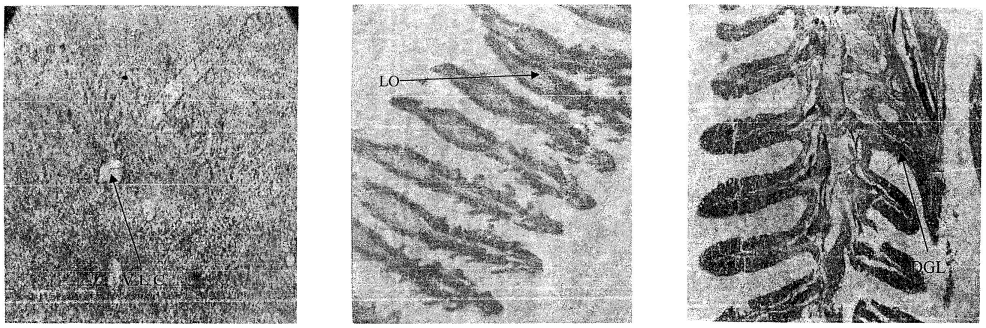


Fig. 1: Linear relationship between probit mortality and log concentration of sap extract of *E. tirucalli* exposed to *T. zillii* for 96



A **B** **C**

Fig. 2: Histopathological section of liver and gill (x 100) of *Tilapia zilli* exposed to different lethal concentrations of *T. tirucalli* for 96 hours. (A) and (B) exposure to 6.00mg/L (C) exposure to 3.00mg/L (VLC = Vacuolation ofliver cell, LO = Lamellar oedema, DOL = Degeneration of gill lamellar)

dysfunction of gill epithelia in response to the toxicant which resulted in high respiratory rate as reported by Lin and Lin (1990) and Banerjee (2007). The effectiveness of the gill epithelium not only as an organ of respiration but as the mediator of osmoregulation and associated processes may be severely impaired by the sub-lethal quantities of toxic substances David *et al.* (1976). Generally, fish and crustaceans in response to either environmental hypoxia or impaired dissolved oxygen diffusion at the gills are to increase ventilation rates (Morris *et al.*, 2005). A hyperventilation in response to sap extract of *E. tirucalli* exposure to *T. zillii* may be a survival mechanism to endure severe degradation of water quality and consequent impairment of dissolved oxygen uptake. Increased ventilation rate could be as the result of the toxicant in the test media as it reduced the amount of oxygen present in the media. The fish could have increased ventilation rates in an attempt to make up for the loss in oxygen content in the gill. High opercular ventilation has been reported by Sprague (1993) as an index of stress when fish come in contact with an unfavorable environmental condition. Therefore, sap extract of *E. tirucalli* induces significant hyperventilation in *Tilapia zillii*. The 96-hour LC_{50} which was estimated as 1.20 ml^{-1} with upper and lower confident limits of 1.85 and 0.78 mg^{-1} means that the concentration of the extract

which is close or in excess of 1.20 mg^{-1}, can cause mortality to *T. zillii*.

Histopathological examination of the test fish showed some pathological disruptions (Fig. 2). The liver cells revealed necrosis and vacuolation of the liver cells while gills showed oedema of the gill lamellar. The histopathological disruption done to the Tsed fish as observed in this investigation are harm caused by the *E. tirucalli.* Cardoso *et al.* (1996)) and Cengiz *et al.* (2001) reported that histopathological studies of fish exposed to pollutants revealed that organs were efficient indicators of water quality. This is because gills are important organs in fish for respiration, osmotic regulation, acid base balance and nitrogenous waste excretion. The damage done to these organs as the result of the toxicant correlates with the concentrations of the toxicant in each experimental tank. The phytochemical analysis of the leaf extract revealed the presence of alkaloid, tannin, saponin, cardiac glycoside, rotenone, steroids, balsam, phenol and volatile oil. Francis (2001) reported that these chemical substances affect the productivity and health of fish. Rotenone in aquatic environment can reduce amount of dissolved oxygen in water. Robertson and Smith-vaniz (2008) observed that when fish are poisoned with rotenone, they swim erratically and move to shallower water or come to the surface gasping for air. After that, their ventilation rate slows and they sink to the bottom where they remain until death. From the data obtained from this investigation, it is evident that *E. tirucalli* is toxic to *Tilapia zillii* and could possibly affect other aquatic animals. However fishermen should be discouraged and also be enlightened on the effect of using this plant on fish. Relevant authorities should be adequately informed to set quality criteria on the wise use of plants especially *E. tirucalli* in the aquatic ecosystem.

Acknowledgement

The authors acknowledge the assistance rendered by the Department of Zoology, University of Jos, Jos Nigeria for the provision of equipment and reagents used for the investigation. The data reported herein forms part of the Degree research project undertaken by Mr. C.D. Onu.

References

Aggergaard, S. and Jensen, F.B., 2001. Cardiovascular changes and physiological response during nitrite exposure in rainbow trout. ***J. of Fish Biol.***, 59: 13-27.

APHA, 1995. *Standard methods for the treatment of water waste APHA/* AWW*A/WPCE/* American Public Health Association Washington DC.

Banerjee, T.K., 2007. Histopathology of respiratory organs of certain air-breathing fishes of India. ***J.Fish Physiol. and Biochem.***, 33: 441-454.

Buck, D. and Wallington, R.A., 1972. *Some histological techniques applicable to fish tissues*. In. Maudeshy Thomas B.E.(eds), Disease of fish proceeding of symposium No 30 Zoology Society of London academic Press and Zoological Society of London.

Cardoso, E.I., Chiarini-Garcia, H., Ferreira, R.M.A. and Poli, C.A., 1996. Morphological changes in the gills of *Lophiosilurus alexandri* exposed to unionized ammonia. ***J. of Fish Bioi.***, 49: 778-787.

Cengiz, E.I.,Unlu, E. and Balci, K., 2001. The histopathological effects of Thiodan on the liver and gut of mosquito fish, *Gambusia affinis*. ***J. of Environ. Sci. and Hlth.***, 36:75-85.

David, L.B., Robert, W.B. and Moti, L.S., 1976. Respiratory stress in yellow perch induced by subtoxic concentrations of Diquat. ***Ohio J. of Science***, 2: 76-87.

Francis, G., 2001. Effect of important nutrients in some commonly used alternative fish feed ingredients. ***Aquaculture***, 199: 197-227.

Jain, K.L., Gupta, R.K., Mitta1, Vinta and Kumar, Dushant., 2007. Chronic toxicity of arsenic in combination with cobalt and nickel in *Cirrihinus mrigal*. ***J. Ecophysiol. Occup. Hlth.***, 7: 1-4.

Khanna, D.R. and Bhutiani, R., 2004. *Water analysis at a glance*. Pub. ASEA. pp: 1-115.

Kroupova, H., Machova, J. and Svobodova, Z., 2005. Nitrite influence on fish: a review. ***Vet. Med.-Czech***, 50: 461-471.

Lin, C.C. and Lin, C.I., 1990. *Test for ammonia toxicity of cultured hybrid Tilapia*. Asian Fisheries Society Manila, Philippines. pp: 457-459.

Morris, S., van Aardt, W.J and Ahem, M.D., 2005. The effect of lead on the metabolic and energetic status of the Yabby, *Cherax destructor,* during environmental hypoxia. ***Aquatic Toxicology***, 75: 16-31.

Pascual, F.C., Tayo, G.T. and Cruiz-lacierda, E.R., 1994. Acute toxicity of formalin to sea Bass *(Lates calcarifler)* fry. *Asian fisheries Society* 346-348.

Robertson, D.R. and Smith-vaniz, W.F., 2008. Rotenone: An essential but demonized tool for assessing marine fish diversity. *Bioscience,* 58,165-170.

Satyarvati, G.V and Gupta, D.K., 1987. Medicinal plants of India. I.C.M.R. New Delhi.

Sofowora, E.A.,1982. Medicinal plants and traditional medicine in Africa. John Wiley and Sons New York 405pp.

Sprague, J.B. 1993. Measurement of pollutant toxicity to fish. (111). Sub-lethal effects and safe concentration. ***Water Research,*** 5: 245-266.

Stickney, R.R., 1979. Principle of warm water Agriculture New York. John Wiley and Sons Incorporate U.K. pp: 350.

Svecevicius, G., 2006. The use of fish avoidance response in identifying sublethal toxicity of heavy metals and their mixtures. International conference on ecotoxicology trends and perspectives 17-20 September 2006 Wilsa Poland.

Tiwari, S. and Singh, A., 2006. Biochemical stress response in freshwater fish *Channa punctatus* induced by aqueous extracts of *Euphorbia tirucalli* plant. ***Chemosphere,*** 64: 36-42

UNEP., 1989. Estimation of pollutants to marine fish and invertebrates. United Nations Environmental Program, Reference methods for marine pollution studies. No 43.

Environment Conservation Journal 10(3) 93-95, 2009
(ISSN 0972-3099)

Population dynamics of Caryophyllidean tapeworms from freshwater fish *Clarias batrachus*

B.V. Jadhav[1], D.B. Bhure[1], N.D. Padwal[1] and S.S. Nanaware[2]

Received: 28-03-2009 Revised: 30-06-2009 Accepted: 28-07-2009

Abstract

The present investigation deals with the population dynamics of Caryophyllidean tapeworms from freshwater fish *Clarias batrachus* from different places of Western Maharashtra during Jan., 2006 to Dec., 2006. Total 242.00 (57.61%) cestode parasites were recovered from 420.00 fishes. This report summarizes the percentage of incidence, intensity, density and index of infection. The high incidence was occurring in summer season as compared to other season due to the effect of environmental factors.

Keywords:- *Population dynamics, Caryophyllidean tapeworms, Clarias batrachus, Western Maharashtra*

Introduction

Fishes are important animals in ecosystem. They are useful item of human food as well as the source of income. The fish farming remains a high risk investment mainly due to the disease problems caused by helminthic infection. The present investigation deals with population dynamics of Caryophyllidean tapeworms from *Clarias batrachus* for three seasons i.e. monsoon, winter and summer during the year of January, 2006 to December, 2006.

Materials and Method

The freshwater fishes including the genus *Clarias batrachus* were collected from different places of Western Maharashtra. The Caryophyllidean tapeworms were collected, preserved, processed to a permanent slide and identified under a compound microscope, drawings are made with the aid of camera Lucida and identified by Prof. B.V. Jadhav.

Population dynamics of Caryophyllidean tapeworms are determined by following formulae.

1. Incidence of Infection $= \frac{\text{Infected hosts}}{\text{Total hosts examined}} \times 100$

2. Intensity of Infection $= \frac{\text{Number of parasites collected in a sample}}{\text{Number of infected hosts}}$

3. Density of Infection $= \frac{\text{Number of parasites collected in a sample}}{\text{Total hosts examined}}$

4. Index of Infection $= \frac{\text{No. of hosts infected x No. of parasite collected}}{(\text{Total hosts examined})^2}$

Author's Address
[1]Helminth Research Lab., Department of Zoology, Dr. B.A.M. University, Aurangabad ✉
[2]Department of Zoology, Yeshwant College, Nanded

Results and Discussion

The result of present study are given in Table-1and Fig. 1-4. The present investigation indicates that out of 420 freshwater fishes, 168 were infected with Caryophyllidean tapeworms. A total 242, tapeworms were collected, out of these 138 parasites belong to genus *Lytocestus* (32.85%) and 104 parasites genus *Lytocestoides* (24.76%).

The seasonal variation of Caryophyllidean tapeworms showed the maximum infection i.e. 126 parasites occur in summer seasons (30%) followed by 82 parasites in winter season (19.52%) whereas lower infection 34 parasites in monsoon season

(8.09%). The development of parasites should be needed high temperature and sufficient moisture. Environmental variations are reflected in seasonal difference in the incidence of diseases. Hence high incident occured in summer season followed by winter season.

The genus *Lytocestus* (Cohn, 1908) includes *L. marathwasensis*, *L. alii*, *L. clariasae* (Jadhav and Gavhane, 1991), *L. shindei*, *L. nagapurensis*, *L. clariae* and *L. heteropnaustii*. where as the genus *Lytocestoides* (Baylis, 1928) includes *L. aurangabadensis* and *L. aurangabadensis minor* (Shinde, 1970), *L. paithensis* and *L. mackiewiezi*, *L. ajanthii* (Hiware, 2000) and *L. mrigali* (Hiware, 2003).

The present investigation showed that the occurrence of infection were host specific because the morphological, physiological and ecological factors

Table-1: Population dynamics of caryophyllidean tapeworms of freshwater fishes from Western Maharashtra during January 2006- December 2007

Month	No. of hosts examined	No. of hosts infected	Total No. parasites collected	Incidence %	Intensity %	Density %	Index of Infection	Name of parasites	Locality
January, 2006	35	19	26	54.28 %	1.36 %	0.74 %	0.40 %	L1 – 14 L2 – 12	Shirur, Pune, Satara
February, 2006	35	20	28	57.14 %	1.40 %	0.80 %	0.45 %	L1 – 16 L2 – 12	Kolhapur, Pune, Satara
March, 2006	35	20	31	57.14 %	1.55 %	0.88 %	0.50 %	L1 – 16 L2 – 15	Pune, Mulsi
April, 2006	35	21	32	60.00 %	1.60 %	0.91 %	0.54 %	L1 – 18 L2 – 14	Satara, Kolhapur
May, 2006	35	23	35	65.71 %	1.52 %	1.00 %	0.65 %	L1 – 20 L2 – 15	Pune, Kolhapur
June, 2006	35	02	04	05.71 %	2.00 %	0.11 %	0.006 %	L1 – 03 L2 – 01	Satara
July, 2006	35	01	02	02.85 %	2.00 %	0.05 %	0.001 %	L1 – 02	Pune
August, 2006	35	10	13	28.57 %	1.30 %	0.37 %	0.10 %	L1 – 08 L2 – 05	Mulsi, Pune
September, 2006	35	10	15	28.57 %	1.50 %	0.42 %	0.12 %	L1 – 09 L2 – 06	Kolhapur, Pune
October, 2006	35	12	15	34.28 %	1.25 %	0.42 %	0.14 %	L1 – 08 L2 – 07	Pune, Satara, Kohapur
November, 2006	35	14	18	40.00 %	1.28 %	0.51 %	0.20 %	L1 – 10 L2 – 08	Satara, Pune
December, 2006	35	16	23	45.71 %	1.43 %	0.65 %	0.30 %	L1 – 14 L2 – 09	Kolhapur, Pune
Total	**420**	**168**	**242**	**40.00%**	**1.44 %**	**0.57 %**	**0.23 %**	**L1 – 138 L2 – 104**	

L1- Lytocestus sp. ***L2- Lytocestoides sp.***

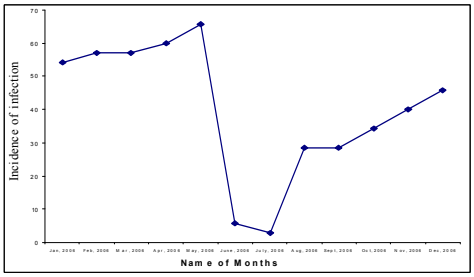


Fig. 1: Incidence of infection

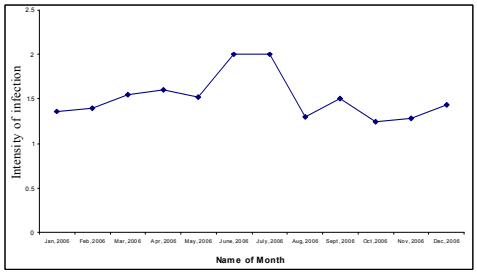


Fig. 2: Intensity of infection

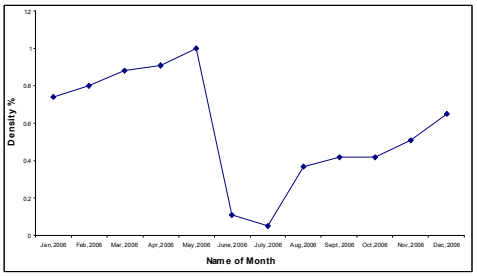


Fig. 3: Density of infection

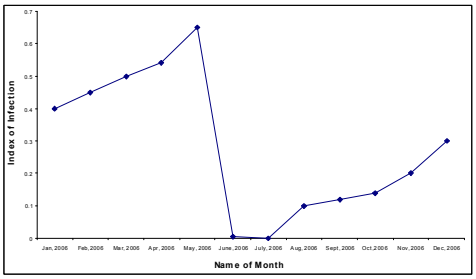


Fig. 4: Index of infection

affects the host specificity. The morphological factors are those which like a parasite with its host at the site of attachment. The ecological factors meansdistribution and environment of the host and Physiological factors means the diet and mode of feeding (Kenndy, 1976). Jadhav and Bhure (2006a, b) also explained the distribution of parasites are host specific. This type of result indicates that the morphological, physiological and ecological factor affects the distribution of parasites.

Acknowledgement

The authors are thankful to U.G.C., New Delhi for sanctioning the major research project No. 30-193/ 2004 (SR) dated 10/11/2004 for financial assistance.

References

Baylis, H.A., 1928. Some parasitic worms from lake Tanganyika. ***Ann. Mag. Nat. Hist. ser.***, 10(1): 552-562.

Cohn, 1908. Die amatomiarines heian Fischcestoden. Central Vakt. ***Farasitenk***, 46: 134-139.

Jadhav, B.V. and Bhure, D.B., 2006a. A revision of the genus *Lytocestoides* Baylis, 1928 freshwater fishes in Maharashtra. ***Flora and Fauna***, 12(1): 9-16.

Jadhav, B.V. and Bhure, D.B., 2006b. Population dynamics of helminth parasites in freshwater fishes from Marathwada region (M.S.) India. ***Flora and Fauna***, 12(2): 143-148.

Jadhav, B.V. and Gavhane, A.V., 1991. Two new cestode from Caryophylleidae at Aurangabad. ***Ind J. Zool and. Aqu. Biol.***, 3(1) 28-31.

Hiware, C.J., 2000. A new species of the genus *Lytocestoides* Baylis, 1928 from freshwater fish, *Clarias batrachus* (Linnaeus). ***J. Para. Dis.***, 24(2): 183-185.

Hiware C.J., 2003. On a new species of the genus *Lytocestoides* Baylis, 1928 (Cestoda – Caryophylllidea Lytocestidae) from freshwater fish *Cirrhina mrigala* (Ham.). ***Proc. XVI th Nat. Con. Of Para***, pp: 124-131.

Kenndy, C.R., 1976. *Ecological aspect of Parasitology*. North Holand publishing. Company. Amsterdam 10 X Ford.

Shinde, G.B., 1970. A. new species and two new varieties of the genus *Lytocestoides* Baylis, 1928 in freshwater fishes in Maharashtra, India. ***Marath Uni. J. Sci.***, 14: 233-234.

Environment Conservation Journal 10(3) 97-100, 2009
(ISSN 0972-3099)

In-vitro antibacterial effect of medicinal plants against *Neisseria gonorrhoeae*

Shivani[1], Navneet[1] and Anita Pandey[2]

Received: 16-05-2009 Revised: 10-07-2009 Accepted: 25-08-2009

Abstract

The bark of *Ficus religiosa* L., *Ficus benghalensis* L., *Ficus gloomerata* L., *fruits of Tribulus terrestris* L. *and roots of Saussurea lappa* Clarke. were investigated for *in vitro* antibacterial activity. The various solvent extracts like petroleum ether, chloroform, aqueous and methanol of plants were screened against *Neisseria gonorrhoeae* isolated from the patients suffering from vaginitis. The extracts were subjected for antibacterial activity against the pathogen at 200mg/ml concentration by agar well diffusion and agar disc diffusion method. The results of antibacterial activity revealed that methanol extracts of all the plants exhibits good activity as compared to petroleum ether, chloroform and aqueous extracts. The antibacterial activities of extracts were compared with standard antibiotic cefotaxime. The MIC of the methanol extract of all the plants was also calculated against the pathogen.

Keywords:- *Agar disc diffusion method, Agar well diffusion method, Medicinal plants, N. gonorrhoeae, Vaginitis*

Introduction

Humans are the only known host of *Neisseria gonorrhoeae*, an organism that is commonly called the gonococcus and is the cause of gonorrhea and other types of disease i.e. vaginitis. *N. gonorrhoeae* is a gram negative bacteria, aerobic but may grow anaerobically also but it is essential to provide 5-10% CO_2. Vaginitis is an inflammation of the vagina that can result in discharge, itching and pain. Excessive vaginal discharge which is purulent in character is a common complaint, especially in sexually active women.

In India, the use of different parts of several medicinal plants to cure specific ailments has been in vogue from ancient times (Bhattacharjee, 1998). Medicinal plants continue to be an important therapeutic aid for alleviating the ailments of human kind. Contrary to the synthetic drugs, antimicrobials of plant origin are not associated with many side effects and have an enormous therapeutic potential to heal many infectious diseases (Iwu *et al*., 1999). India has a treasure of medicinal plants and a number of herbs are traditionally used for the treatment of many diseases. Thus, in recent years there has been a phenomenal rise in the interest of scientific community to explore the pharmacological activities of medicinal plants (Chah *et al.,* 2006).

Ficus religiosa (Pipal), *F. benghalensis* (Bargad) and *F. gloomerata* (Gular), belongs to the family Moraceae. Their bark have been used for diarrhoea, dysentery, leucorrhoea, menorrhagia, for vaginal and other urogential disorders. *F. benghalensis* is used in Ayurveda for treatment of diarrhoea, piles, teeth and skin disorders (Warrier *et al*., 1995). All the *Ficus* species are distributed throughout India. *Tribulus terrestris* (Gokhru) is a flowering plant belongs to family zygophyllaceae. Its fruits are used in folk medicine as tonic, analgesic, astringent, stomachic, anti-hypertensive, diuretic and urinary anti-infective (Ody, 2000). *Saussurea lappa* (Kustha) belongs to family Asteraceae. The root has a pungent taste and a peculiar fragrant aromatic odour. Root has been used in cough, asthma, chronic rheumatism and skin diseases, fever and dyspepsia and used as an ingredient in stimulating mixtures for cholera. The present paper deals with the antimicrobial activity of *Ficus religiosa, Ficus benghalensis, Ficus gloomerata, Tribulus terrestris, Saussurea lappa* against *Neisseria gonorrhoeae.*

Author's Address
[1]Deptt. of Botany and Microbiology, Gurukul Kangri University, Hardwar
[2]Deptt. of Microbiology, Subharati Institute of Medical Sciences, Meerut ✉

Materials and Method

Plant Material

The bark of the three *Ficus* sp. were collected from the plants growing wild in Hardwar (U.K.), the fruits of *Tribulus terrestris* were collected from the plants growing in the botanical garden of Patangali Yog Peeth, Hardwar and the roots of *Saussurea lappa* were collected from Shivalik range of Himalayas and identified at Botanical Survey of India, Dehradun, Uttarakhand. Fresh plant materials were washed under running tap water, shade dried at room temperature and then homogenized to get a coarse powder and used for further successive extraction.

Preparation of Plant Extracts

The plant extracts were prepared by immersing 200 gm of dried powder in 600ml of solvents i.e. petroleum ether, chloroform, methanol and water by Soxlet assembly. At the end of extraction each extract was passed through Whatmann Filter Paper No 1. The extracts were concentrated by using vacuum evaporator at 30°C and stored in sterile bottles at 4°C until further use.

Microorganism

The pathogenic organism was selected for the study on the basis of its clinical pharmaceutical importance as well as for its potential to cause infection. *Neisseria gonorrhoeae* was isolated from infected females suffering from vaginal infections in Subharati Institute of Medical Sciences, Meerut and was identified according to the published guidelines by Burneti *et al.* (1994).

Agar well diffusion method

This method was given by Perez *et al*., 1990**.** It depends upon the diffusion of the tested material to such an extent that growth of the added microorganism is prevented entirely in a zone around the hole containing a solution of tested material (Ahmad *et al.,*1998). Chocolate agar media was inoculated with 10^5 cfu/ml of 24 hours old culture of test organisms and shaked. Wells of 8mm diameter were punched into the agar medium and filled with 45 µl (200 mg/ml) of plant extract, solvent blanks and antimicrobial drug. The antibiotic Cefotaxime was used. The plates were incubated for 18-24 hours at 37 ºC in the presence of 5-10% CO_2. The results were obtained by measuring the diameter of zone of inhibition in millimeters (mm). All the tests were done in triplicate.

Agar disc diffusion method

This method was given by Bauer and Kirby, in 1966. The disc of 6mm was saturated with 45µl (200 mg/ml) of the plant extract, solvent blank and antimicrobial drug, allowed to dry and was introduced on the upper layer of the seeded agar plate using a flamed forcep and gently pressed down to ensure contact. All the solvents served as negative control. The plates were then incubated for 18 to 24 hours at 37 ^{0}C and microbial growth was determined by measuring the diameter of zone of inhibition in millimeters (mm). All the tests were done in triplicate.

Minimum Inhibitory Concentration (MIC)

The MIC of the methanolic extract was determined according to the broth dilution test (NCCLS, 1992). Standarized suspensions of the test organism was inoculated into a series of sterile, disposable 24 well polystyrene microtitre plate containing two fold dilutions of the extract and incubated for 18 to 24 hours at 37 °C. The MIC was read as the lowest concentration of the plant material inhibiting the development of visible growth after a period of time.

Results and Discussion

Depending on the nature of the infecting microorganism, the condition may vary from minor ailments to major health concern. The results indicated differential activities of the plant extracts against the growth of bacteria (Table-1). All the plant extracts showed significant antimicrobial activity against the microorganism at a concentration of 200 mg/ml. Considering the need of an eco- friendly approach to control the plant pathogens, it was considered worth while to screen the antimicrobial effects of locally available flora. The need of the hour is to screen the plants for promising biological activity or the treatment of diseases and ailments. In the present work different extracts of five traditionally used Indian medicinal plants have been tested against *Neisseria gonorrhoeae.* Methanol

Table-1 : Antibacterial effect of *Ficus religiosa, Ficus benghalensis, Ficus gloomerata, Tribulus terrestris, Saussurea lappa* extracts (mm) against *Neisseria gonorrhoeae*

Plants	Agar well diffusion method (Zone of inhibition in mm)				Agar disc diffusion method (Zone of inhibition in mm)			
	P	*C*	*M*	*W*	*P*	*C*	*M*	*W*
Ficus religiosa	12	14	15	13	09	11	13	10
Ficus benghalensis	12	13	16	12	09	10	12	12
Ficus gloomerata	13	15	17	14	11	13	13	12
Tribulus terrestris	13	16	18	15	09	13	14	12
Saussurea lappa	12	13	13	11	08	11	11	10

Note:-P : Petroleum ether ; C : Chloroform ; M : Methanol ; W : Water and Average of three replicates

extract of all the plants showed good antibacterial activity against *Neisseria gonorrhoeae* followed by aqueous, chloroform and petroleum ether extract in both the methods. In agar well diffusion method maximum activity was shown by *Tribulus terrestris* (18 mm) followed by *Ficus gloomerata* (17 mm), *Ficus benghalensis* (16mm), *Ficus religiosa* (15 mm), *and Saussurea lappa* (13 mm) while in agar disc diffusion method maximum activity was shown by *Tribulus terrestris* (14mm) followed by *Ficus gloomerata* and *Ficus religiosa* (13mm), *Ficus benghalensis* (12 mm), *and Saussurea lappa* (11 mm). Among all the plants *Tribulus terrestris* was found to be the best plant showing significant antibacterial activity against the pathogen because more chemical compounds were found to be present in it and least activity was shown by *Saussurea lappa.* The antibiotic Cefotaxime showed 28 mm zone of inhibition when performed by agar well diffussion method and 22 mm when done by agar disc diffusion method. MIC of the methanol extract was also calculated of all the plants. *N.gonorrhoeae* was more susceptible to the methanol extract of *T.terrestris,* MIC (1.56 mg/ml) followed by *F. benghalensis and F.* religiosa (3.125 mg/ml) and *F. gloomerata* and *Saussurea lappa* (6.125 mg/ml).

Seeds of *Saussurea lappa* have considerable antifungal activity especially against pathogenic fungi (Ray and Majumdar, 1976). The aqueous extract of *Saussurea lappa* did not show any antimicrobial activity against *B. cereus, S. epidermidis, E. aerogenes, P. vulgaris, S. typhimurium* (Parekh and Chanda, 2007). The aqueous extract of *Ficus benghalensis* did not show activity against the *P.aeruginosa* ATCC 27853 and *P. mirabilis* NCIM 2241 (Nair and Chanda, 2007). The aqueous extract of *Ficus religiosa* showed low activity against *B. cereus* ATCC 11778 and high activity was shown in ethanol extract against it. The aqueous extract did not show any activity against *A. fecalis* ATCC 8750 whereas low activity was shown in ethanol extract against it. The aqueous extract showed no activity against *S. typhimurium* ATCC 23564 and low activity in ethanol extract (Nair and Chanda, 2007).

In the present work the antimicrobial activity of the extracts was quantitatively assessed by the presence or absence of the zone of inhibition and the plants selected are potentially a rich source of antimicrobial agents. Medicinal plants possess antimicrobial properties that support their value in herbal medicine for the treatment of diseases and ailments. Our preliminary findings on these medicinal plants indicate a promising antimicrobial activity against

N. gonorrhoeae. Lastly to conclude the extracts were found to inhibit the growth of microorganisms and the methanolic extract was comparably more effective to inhibit the growth of microbes than petroleum ether, chloroform and aqueous extracts.

Acknowledgement

The authors are thankful to Dr. Pradeep Durgapal, Lecturer in Govt. P.G. College, Gopeshwar (Chamoli) and Dr. Amit Kumar Jain, Lecturer in J.V. College, Baraut, Baghpat (U.P.) for helping in the completion of the work.

References

Ahmad, I., Mehmood, Z. and Mohmmad, F., 1998 .Screening of some Indian medicinal plants for their antimicrobial properties. ***Journal of Ethnopharmacology***, 62: 183-193.

Bauer, A.W. and Kirby, W.M., 1966. Antibiotic susceptibility testing by a standardized single disk method**.** ***Ame. J. Clin. Pathol.***, 45: 493-496.

Bhattacharjee, S.K., 1998. *Handbook of medicinal plants***.** Pointer Pub, Jaipur-03, India. pp: 1-6.

Burneti, R.W., Haber, M.H., Hackel, E., Hanson, C.A., Keron, D.F. and Lee Lewandrowski, E., 1994. *Clinical laboratory medicine***,** eds.Williams & Wilkins, Philadelphia U.S. pp: 1113-1120.

Chah, K.F., Eze, C.A., Emuelosi, C.E and Esimone, C.O., 2006. Antibacterial and wound healing properties of methanolic extracts of some Nigerian medicinal plants. ***Journal of Ethnopharmacology,*** 104: 164-167.

Iwu, M.W., Duncan, A.R. and Okunji, C.O., 1999. *New antimicrobials of plant origin. In: Janick J. Perspectives on New Crops and New Uses*. ASHS Press, Alexander, VA. 457-462.

National Committee for Clinical Lab. Standards (NCCLS) 1992. Proposed standard document. M- 27.

Nair, R. and Chanda, S., 2007. Antimicrobial activities of some medicinal plants of the Western region of India. ***Turkish J. Biol.***, 31: 231-236.

Ody, P., 2000. *The Complete Guide of Medicinal Herbal*. London : Dorling Kindersley. pp: 223.

Parekh, J. and Chanda, S., 2007 . Antimicrobial and Phtyochemical studies on twelve spp. of Indian medicinal plants. ***African Journal of Biomedical research,*** 10: 175-181.

Perez, C., Pauli, M. and Bazerque, P., 1990. An antibiotic assay by the well agar diffusion method. ***Acta Biol. Et. Med. Exper.,*** 15: 113-115 .

Ray, P.G. and Majumdar, S.K., 1976. Antimicrobial activity of some Indian medicinal plants. ***Journal of Economic Botany***, 30(4): 317-320.

Warrier, D.K., Nambiar, V.P.K. and Ramankutty, C., 1995**.** *Indian Medicinal Plants*. Orient Longman Ltd, Madras., pp: 1-5.

Environment Conservation Journal 10(3) 101-104, 2009
(ISSN 0972-3099)

In-vitro antibacterial activity of *Juniperus communis* L. against bacterial pathogens

Pankaj Kumar[1], Rajendra Prasad[1], Harish Chandra[1], R.P. Bhatt[2] and O.P. Sati[3]

Received: 18-06-2009 Revised: 22-08-2009 Accepted: 25-09-2009

Abstract

The present study was conducted to investigate antimicrobial activity of *Juniperus communis* against seven bacterial species. Aqueous extract either cold or water does not have any activity against all tested bacteria strains. However methanolic, ethanolic, chloroform, petroleum ether was active against *Micrococcus luteus*, *Pseudomonas aeruginosa*, *Listeria monocytogenes*, *Escherichia coli* and *Staphylococcus* but has no activity against *Salmonella typhi* and *Klebsiella pneumoniae*.

Keywords:- *Juniperus communis, Antimicrobial, Pathogens*

Introduction

Juniperus communis L. belong to family *Cupressaceae* grows well in heavy clay soils, tolerates a pH range from 4 to 8, succeeds in light woodland but dislikes heavy shade. Established plants are very tolerant of drought (Beckett and Beckett, 1979). Although the fully dormant plant is cold-tolerant throughout Britain, the young growth in spring can be damaged by late frosts. All parts of the plant are very aromatic (Genders, 1994). Juniper is a very polymorphic species that has a long history of culinary and medicinal use (Phillips and Foy, 1990). It is frequently grown in the ornamental and herb garden. Juniper fruits are commonly used in herbal medicine, as a household remedy, and also in some commercial preparations.The fully ripe fruits are strongly antiseptic, aromatic, carminative, diaphoretic, strongly diuretic, rubefacient, stomachic and tonic (Chiej, 1984; Launert, 1981; Lust, 1983; Uphof, 1959; Chopra *et al*., 1986). They are used in the treatment of cystitis, digestive problems, chronic arthritis, gout and rheumatic conditions. They can be eaten raw or used in a tea, but some caution is advised since large doses can irritate the urinary passage. Externally, it is applied as a diluted essential oil, having a slightly warming effect upon the skin and is thought to promote the removal of waste products from underlying tissues (Chevallier, 1996). It is, therefore helpful when applied to arthritic joints etc. The fruits should not be used internally by pregnant women since this can cause an abortion. The fruits also increase menstrual bleeding so should not be used by women with heavy periods (Chevallier, 1996). The plant has a variety of local uses. The dried fruit is used as flavouring in sauerkraut, stuffing and it is an essential ingredient of gin. The fruit is generally used in herbal medicine as a household remedy. They are especially useful in the treatment of digestive disorders, kidney and bladder problems (Grieve, 1984). The ripe fruits are used in the treatment of cystitis, digestive problems, chronic arthiritis, gout and rheumatic condition. It is applied as diluted essential oil, having a slightly warming effect upon the skin and is thought to promote the removal of waste products from underlying tissues.

In present study antibacterial activity of different fraction of *J. communis* leaves were tested against seven bacterial strains i.e. *Micrococcus luteus, Pseudomonas aeruginosa, Salmonella typhi, Klebsiella pneumoniae, Listeria monocytogenes, E. coli* and *Staphylococcus sp.*

Author's Address
[1]Deptt. of Microbiology, Gayatri College of Biomedical Science, Dehradun ✉
[2]Deptt. of Botany and Microbiology, H.N.B. Garhwal University, Srinagar, Garhwal
[3]Deptt. of Chemistry, H.N.B.Garhwal University Srinagar, Garhwal

Materials and Method

Collection of plant material

The leaves of *J. communis* was collected from Alkapuri base region of Garhwal Himalayas, Uttarakhand and identified by Botanical Survey of India, Dehradun. Leaves are shade dried and powdered using mortar pestle.

Extraction of plant material

100 gm of air dried powdered leaves were extracted with different solvent i.e methanol, ethanol, chloroform, petroleum ether, cold water and hot water. After extraction process was completed filtrate, which was obtained by the extraction, were concentrated in Rotary Evaporator (Butchi Type) till all the solvent evaporates. If it is not possible then extract were taken out in preweighed beaker (100 ml) and evaporate under water bath with porcelain particle or glass bead to avoid bumping of solvent and temperature should be maintained under boiling temperature of the solvent. Before putting the antibacterial activity all plant extract methanolic, ethanol, petroleum ether, ethyl acetate, chloroform, cold water and hot water extract were stored at the temperature of 4 °C. Bring out all the extract at room temperature when required at the time of antibacterial activity.

Antibacterial Assay

Bacterial strains

A total seven bacterial strains were used for this study i.e. *Micrococcus luteus*, *Pseudomonas aeruginosa, Salmonella typhi, Klebsiella pneumoniae, Listeria monocytogens, E. coli and Staphylococcus aureus* were obtained from IMTECH, Chandigarh.

Preparation of Inoculum

The ideal inoculum after overnight incubation gives the even semi confluent growth. Too heavy inoculum may reduce the size of inhibition zone by many antimicrobial agents from plant source. Using a straight wire touch 5-10 well isolated colonies of particular microorganism against which antimicrobial activity to be tested. Inoculate on the Nutrient Broth Medium. Incubate at 35-37°C for 4 – 6 hour. The density of the inoculums is adjusted to 10^8 cfu/ml by comparing with that of 0.5 Mc Farland Standard.

Agar well diffusion

0.1 ml of the original cultures (about10^6-10^7 cells) were added into sterile duplicate sets of Petri dishes and 25 ml of the molten (45° C) Mueller Hinton Agar (HiMedia, Ltd.) was poured into Petri dishes. The methanol extract (0.1 ml) were placed in wells (8 mm diameter) cut in the agar media and plates were incubated at 37 °C. The resulting inhibition zones obtained with bacteria were recorded after 24 hour.

Results and Discussion

Result of antibacterial activity is given in Table-1 aqueous extract either cold or water does not have any activity against all tested bacteria strains. However methanolic, ethanolic, chloroform, petroleum ether are active against *M. luteus*, *Ps. aeruginosa*, *L. monocytogens*, *E.coli* and *Staphylococcus* but has no activity against *Salmonella typhi* and *Klebsiella pneumoniae.*

Most active fraction in all the extract was methanolic followed by chloroform, ethanol and petroleum ether. Many author reported the antibacterial and antifungal activity of *Juniper* sp. against bacterial pathogen. Karaman *et al.* (2003), reported the antifungal and antibacterial activity of *J. communis* against 56 bacterial species and 31 isolates of 5 fungi species based on the inhibition zone using the disc-diffusion assay, minimal inhibition concentration (MIC) and minimal bactericidal concentration (MBC) values. The aqueous extract of Juniper sp. had no antimicrobial effect against the test microorganisms whereas the methanol extract had inhibitory effects on the growth of 56 strains of 24 bacterial species in the genera of *Acinetobacter, Bacillus, Brevundimonas, Brucella, Enterobacter, Escherichia, Micrococcus, Pseudomonas, Staphylococcus*, and *Xanthomonas*. In addition 11 *Candida albicans* isolates at a concentration of 31.25-250 micro g/ml were also inhibited. Earlier investigations on *J. procera* leaves and stem bark have yielded several antimicrobial diterpenes, including totarol, ferruginol, 4-*epi*-abietic acid, 4-*epi*-abietol, *E*-communic acid and *Z*-communic acid, of

Table-1: Effect of Different fraction of *J. communis* leaf against Bacterial species

Microorganism	Zone of Inhibition (in mm)					
	MeOH	EtOH	$CHCl_3$	PtEt	CW	HW
M. luteus	18.50±0.40	18.00±0.60	18.50±0.40	17.50±0.90	NA	NA
Ps. aeruginosa	16.50±0.30	16.00±0.20	16.50±0.20	14.50±0.60	NA	NA
S. typhi	NA	NA	NA	NA	NA	NA
K. pneumoniae	NA	NA	NA	NA	NA	NA
L. monocytogenes	16.00±0.60	16.10±0.10	17.00±0.50	17.50±0.20	NA	NA
E. coli	15.50±0.50	15.20±0.80	15.50±0.40	16.50±0.40	NA	NA
S. aureus	15.50±0.20	15.50±0.20	15.50±0.40	14.00±0.20	NA	NA

which totarol and ferruginol exhibited potentiating activities of INH against four typical mycobacteria: *M. intracellulare*, *M. smegmatis*, *M. xenopei* and *M. chelonei* (Mossa *et al.*, 1992, 2004; Muhammad *et al.*, 1992, 1995, 1996). Stefanovic *et al.* (2007), studied the antibacterial and antifungal activity of *J. communis* essential against *Agrobacterium tumefaciens, Bacillus subtilis, E. coli* and *P. fluorescens* and showed that essential oil of *J. communis* L. possess significant antibacterial activity in vitro, that can be attributed to the presence of various substances, mainly the phenolic monoterpene. The potential for developing antimicrobials from higher plants appear rewarding as it will lead to the development of phytomedicine to act against microbes. Plant based antimicrobials have enormous therapeutic potential as they can serve the purpose with lesser side effect that are associated with synthetic antimicrobials (Iwu, 1999). A scientific evidence has brought about the possibility of the utilization of plant extracts in the treatment of fungal and bacterial infections and the development of antibacterial and antifungal products (Famsworth, 1984). Furthermore, antimicrobial activity has also made a better understanding of the use of traditional medicine as potential drugs in addition to contemporary drugs (Cooposamy and Magwa, 2007). India is perhaps the larger producer of medicinal herbs and is rightly called the botanical garden of the world. There are very few medicinal herbs of commercial importance which are not found in this country. India officially recognizes over 3000 plants for their medicinal value. It is generally estimated that over 6000 plants in India are in use in tradition, folk and herbal medicine, representing about 75% of the medicinal needs. More research should be done to find other plant sources to combat the treatment of deadly diseases.

In conclusion *J. communis* leaf extracts possess a broad spectrum of activity against a panel of bacteria responsible for most common bacterial disease.

References

Beckett, K. and Beckett, G., 1979. *Planting Native Trees and Shrubs*. Jarrold & Sons Ltd, Norwich.

Chevallier, A., 1996.*The Encyclopedia of Medicinal Plants* Dorling indersley. London.

Chiej, R., 1984. *Encyclopaedia of Medicinal Plants*. MacDonald.

Chopra, R. N., Nayar, S. L. and Chopra, I.C., 1986. *Glossary of Indian Medicinal Plants (Including the Supplement)*. Council of Scientific and Industrial Research, New Delhi.

Coopoosamy, R.M. and Magwa, M.L., 2007. Traditional use, antibacterial activity and antifungal activity of crude extract of *Aloe excelsa*. ***African Journal of Biotechnology***, 6 (20): 2406-2410.

Farnsworth, N.R., 1984. *The role of medicinal plants in drug development. Natural products and drug development*. In: Krogsgaard-Larsen, P., S.B.Christensen and H.Kofod (Eds.). Munksgaard International Publisher Ltd, Copenhagen, Denmark. pp: 17-30.

Genders, R., 1994. *Scented flora of the world*. Robert Hale, London.

Grieve**.** 1984. *A Modern Herbal*. Penguin, London.

Iwu, M.W., Duncan, A.R. and Okunji, C.O.,1999. *New antimicrobials of plant origin*. In: Ianick J. (Ed). Perspectives on new crops and new uses, Alexandria, V.A: ASHS Press, pp: 457-462.

Karman, I., Sahin, F., Gulluce, M., Ogutcu, H., Sengul, M. and Adiguzel, A., 2003. Antimicrobial activity of aqueous and methanol extracts of *Juniperus oxycedrus* L. ***J. of Ethanopharmacology***, 85: 231-235.

Launert, E., 1981. *Edible and Medicinal Plants.* Hamlyn, London

Lust. J., 1983. *The Herb Book.* Bantam books, New York.

Mills, S.Y., 1985. *The Dictionary of Modern Herbalism*. Wellingborough: Thorsons

Mossa, J.S., El-Feraly, F.S. and Muhammad, I., 2004. Antimycobacterial constituents from Juniperus procera, Ferula communis and Plumbago zeylanica and their in vitro synergistic activity with isonicotinic acid hydrazide. ***Phytother Res.***, 18: 934-937.

Mossa, J.S., Muhammad I., El-Feraly F.S. and Hufford, C.D., 1992. 3â-12-dihydroxyabieta-8,11,13-triene-1-one and other constituents from *Juniperus excelsa* leaves. ***Phytochemistry***, 31: 2789–2792.

Muhammad I., Mossa J.S., Al-Yahya, M.A., Ramadan, A.F. and El-Feraly, F.S., 1995. Further antibacterial diterpenes from the bark and leaves of *Juniperus procera* Hochst. ex Endl. ***Phytother Res.***, 9: 584-588.

Muhammad, I., Mossa, J.S. and El-Feraly, F.S., 1992. Antibacterial diterpenes from the leaves and seeds of *Juniperus excelsa* M. Bieb. ***Phytother Res.***, 6: 261-264.

Muhammad, I., Mossa, J.S. and El-Feraly, F.S., 1996. Additional antibacterial diterpenes from the bark of Juniperus procera. ***Phytother Res.***, 10: 604-607.

Phillips, R. and Foy, N., 1990. *Herbs*. Pan Books Ltd. London.

Stefanovic, O., Stanojevic, D., Comic, L.J., Matovic, M. and Curcic, S., 2007. Chemical Composition of Essential Oil from *Juniperus communis* L. and Influence on Growth and Metabolism of Certain Bacteria. eCAM, 4(S1): 55-58.

Uphof, J.C., 1959. Th. *Dictionary of Economic Plants.* Weinheim 1959. An excellent and very comprehensive guide but it only gives very short descriptions of the uses without any details of how to utilize the plants.

Environment Conservation Journal 10(3) 105-108, 2009
(ISSN 0972-3099)

Nutrient analysis of different types of vermicomposts and their impact on nursery grown seeds and seedlings

Sangeeta Madan[1], Bharti Tyagi[2] Prashant Tyagi[2] and J. Ashraf[3]

Received: 20-08-2009 Accepted: 23-09-2009

Abstract

Impact of two types of vermicomposts on the nursery grown seeds and seedlings have been studied. Seven parameters were taken into consideration were organic matter, calcium, magnesium, pH, potassium, phosphorus and nitrogen. The comparative nutrient value and the impact of two types of vermicomposts on various seeds and seedlings were studied.The values of all the parameters analysed were more for the vermicompost produced from the cowdung than the vermicomposts of municipal solid wastes.Seeds of *Eucalyptus, Acer* and *Anthocephalus* and seedlings of *Leucaena leucoeephala* and *Cassia fistula* were taken to observe the impact of vermicomposts. Overall study revealed the better germination percentile and growth of these seeds and seedlings when the vermicompost of cow dung was used. It was inferred that the vermicompost of cow dung is more nutrient rich than the vermicompost of municipal solid waste.

Keywords:- *Vermicompost, Germination percentile, Municipal solid waste, Cowdung*

Introduction

Soil (Latin "Solumn") is a floor natural product formed from weathered rock by action of climate on living organism. Chemical fertilizers primarily boost up the growth and yield of crop by nutrient supply but its continuous use leaves, plenty of detrimental effects on soil by disturbing natural composition of soil nutrients, soil flora and fauna. Vermicomposting appears to be the most promising as high value biofertilizer which not only increases the plant growth and productivity by nutrient supply but also is cost effective and pollution free. The biodegradation of organic matter like rural waste, household garbage, cow dung, sewage sludge by earthworm activity is called vermicomposting. Vermicompost is a mixture of worm casting, organic material, live earthworms, cocoons and other microbes (Singh *et al*., 2004). Vermicompost is a highly valued soil conditioner. Vermicompost is a rich source of macro and micronutrients, vitamins, enzymes, antibiotics and immobilized microflora (Kale *et al*.,1982). Composting worms also tolerate a wide range of environmental conditions, which helps in adaptability.The most suitable earthworm species for vermicomposting is *Eisenia foetida* because of its rapid growth rate, reproductive substrate in nature (Kaushik and Gerg 2003). An important feature is that during the processing of the waste (manure) by earthworms, many of the nutrients they contain are changed to the forms which are more readily taken up by plants, such as nitrate nitrogen, exchangeable phosphorus and soluble potassium, calcium and magnesium. Worm worked soil is relatively water-stable and will resist soil compaction and run off due to rains (Prabha *et al*., 2005). Thus the objective of the present study was to access the nutrients content of two types of vermicomposts and their impact on nursery grown seeds and seedlings.

Materials and Method

In the present study two types of vermicomposts were taken and analysed for nutrients. First sample of vermicompost was produced from the cow dung and second sample was produced from the municipal solid waste. The samples were taken in plastic bags and brought to the laboratory for the analysis of the given

Author's Address
[1]Deptt. of Environmental Sciences, Kanya Gurukula Mahavidyalaya, Haridwar ✉
[2]Deptt. of Zoology and Environmental Sciences, Gurukula Kangri University, Haridwar
[3]Deptt. of Zoology, M.S. College, Saharanpur

parameters. Organic matter, calcium, magnesium, pH, potassium, total kjeldahl nitrogen, phosphorus. All the experiments were held in between the first week of January to the last week of February. The selected site is vermicomposting unit at Ecology and Environment Division F.R. I. Dehradun. F.R.I is located at a distance of 4 Kms. from the clock tower of Dehradun. Geographically the Forest Reasearch Institute (F.R.I.) is situated in the globe on Longitude-30° 22' N, Latitude-78° 2' 30" E. The methods of analysis of certain physicochemical parameters were adopted as per Trivedy and Goel (1986) and Walkley and Black (1934). To observe the impact of both types of vermicomposts on the germination percentile of seeds, three types of seeds were taken. Six sets of polybags full of nursery manure were prepared. In first two poly bags, *Eucalyptus* seeds were sown, in another two polybags, seeds of *Acer* were sown and in the last two polybags seeds of *Anthocephalus* were sown. In the same manner six sets of polybags full of nursery manure and vermicomposts produced from municipal solid waste were taken. In the ratio of 1:1 and six sets of polybags full of nursery manure and vermicomposts produced from the cow dung in the ratio of 1:1 were prepared. In which three types of seeds were sown in the same manner as described above. The impact of both type of vermicompost on the shoot length and number of leaves of two types of seedling were also observed, these were *Leucaena leucocephala* and *Cassia fistula*.The data were stastically analysed. To observe the significance of the difference in the mean of each parameter for both types of vermicomposts student (t-test) test value was calculated.

Results and Discussion

Use of vermicompost promotes soil aggregation and stabilizes soil structure. This improves the air-water relationship of soil thus increasing the water retention capacity and encouraging extensive development of root system of plants. The mineralization of nutrients is observed to be enhanced, therefore results into boosting up of crop productivity. The vermicomposts have a higher base exchange capacity and more exchangeable calcium, magnesium, potassium and available phosphorous than the soil in which the worms live. The results of the analysis of two types of vermicomposts are shown in Table-1. Nitrogen in the vermicompost produce from cow dung was found 0.906% while nitrogen present in the vermicompost produced from municipal solid wastes was 0.814%. Suthar (2007) got the same results by using composting earthworm *Perionyx sansibaricus*

Table-1: Showing the comparison between the values of various parameters of the two types of vermicompost

Parameters (%)	Vermicompost Produced from Cow Dung	Vermicompost Produced from Municipal Solid Waste
Nitrogen %	0.906 ± .011	0.814 ± 0.04
pH %	7.646 ± 0.018	7.122 ± .0048
Phosphorus %	0.1766 ± 0.029	0.1206 ± 0.036
Organic Matter %	3.822 ± 0.32	3.602 ± .307
Magnesium %	0.114 ± 0.006	0.090 ± 0.022
Calcium %	2.849	1.70
Potassium %	0.79 ± 0.050	0.77 ± 0.050

Observation of Kale *et al.* (1982) was almost same. The pH in the vermicompost produced from cow dung is 7.64 and pH of the vermicompost produced from municipal solid wastes is 7.12. Magnesium present in vermicompost produced from cow dung is 0.114% and in the vermicompost produce from municipal solid waste is. 0.0907% . Parthasarthi and Ranganathan (2000) also came to the same conclusion. The amount of phosphorus in the vermicompost produced from cow dung was 0.176% and in the vermicompost produced from municipal solid waste was 0.120%.This has also been revealed by More (1994) while working on the effect of farm wastes and organic manures on soil properties, nutrient availability and yield of rice-wheat grown. The amount of calcium present in the vermicompost produced from cow dung was 2.849% while in case of vermicompost produced from municipal solid waste was 1.70%. Garg *et al.* (2006) revealed the same thing while working on vermicomposting of different types of waste using *Eisenia foetida.* The amount of potassium present in both type of vermicompost is successively 0.79% (cow dung) and 0.77% (municipal solid waste). Basker *et al.* (1992) showed almost same results. Organic matter is a special

constituent of soil. Organic matter in the vermicompost produced from cow dung is 3.82 % while organic matter present in the vermicompost produced from municipal solid waste is 3.602 %. These results are in accordance with the results showed by Edwards (1998) while working on the breakdown of animal, vegetable and industrial organic wastes by earthworms. Thus we observed that vermicompost produced from cow dung is more nutrient rich than the vermicompost produced from municipal solid waste. Thus it can be concluded that cow dung is purely organic, it means that organic content is present in much amount in cow dung. The vermicompost of cow dung also remains organic in nature. While in case of municipal solid waste organic as well as inorganic contents are present. Municipal solid wastes also contain a huge amount of toxic substances, metals, non degradable fraction which cow dung does not contain. So usually the vermicompost of cow dung remains more nutrient rich than the vermi compost produced from municipal solid waste. In our results we have also observed that the percentage of almost all the nutrients like nitrogen, potassium, phosphorus, calcium, magnesium *etc.* are more in the vermicompost of cow dung. Organic matter in the vermicompost of cow dung is more than the vermicompost of municipal solid wastes because of the presence of humus in the cow dung. Percentage of carbon is also more in the vermicompost of cow dung due to the same reason.Vermicompost of cow dung is more alkaline than the vermicompost of municipal solid wastes due to the presence of calcium, magnesium, potassium and phosphorus much amount. The results showing the impact of both the vermicomposts on the number of leaves and the height of two types of seedlings namely *Leucaena leucocephala* and *Cassia fistula* are given in Fig. 1 to 3. The results of the impact of vermicomposts on the germination percentile of the seeds are shown by the Table-2. As we have applied student (t-test) test to observe the significance of the difference in the mean of each parameter for both types of vermicomposts and the results were showing that calculated value of t is 0.21 at degree of freedom 11(p= 0.83).Here calculated value 0.21 is smaller than the tabulated value (1.796) at p= 0.83. Hence it is obvious that the difference between the means of various parameters of both types of vermmicomposts is significant.

Table-2: Showing the comparison of Impact of two types of vermicomposts and control on the germination of nursery grown seed

Seeds	Total Seeds sown in one set	Average germination in control	Average germination in cow dung	Average germination in the vermicompot produced from MSW	Germination in the seeds sown in vermicompost produced from Cow dung	Germination in the seeds sown in vermicompost produced from MSW
Eucalyptes	20	8	18	16	225%	200%
Acer	20	10	18	12	180%	120%
Anthocephalus	20	2	5	3	250%	150%

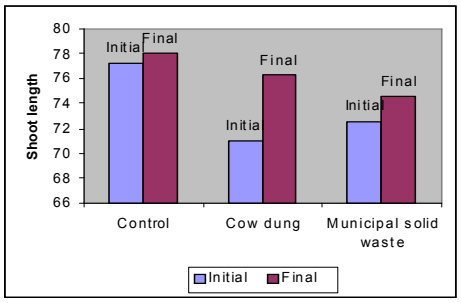


Fig. 1: Showing the comparative impact of Nursery manure and various vermicomposts on the shoot length of *Leucaena leucocephala*

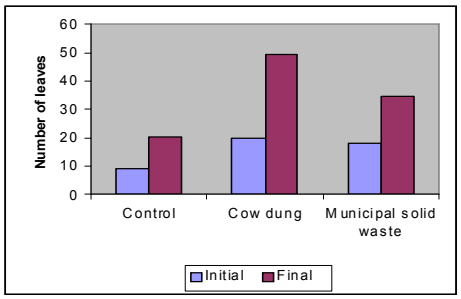


Fig. 2: Showing the comparative impact of Nursery manure and various vermicomposts on number of leaves of *Leucaena leucocephala*

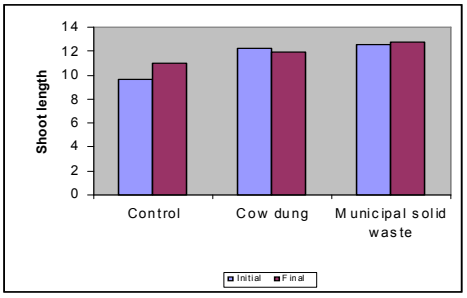


Fig. 3: Showing the comparative impact of Nursery manure and various vermicomposts on the shoot length of *Cassia fistula*

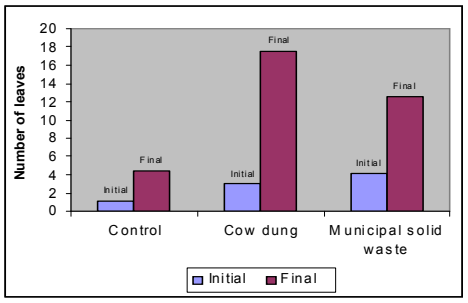


Fig. 4: Showing the comparative impact of Nursery manure and various vermicomposts on the number of leaves of *Cassia fistula*

References

Basker, A., Mac Gregor, A.N. and Kirkman, J.H., 1992. Influence of soil ingestion by earthworms on the availability of K in soil- an incubation experiment. ***Biol. Fertil. Soils.***, 14: 300-303

Edwards, C.A., 1998. *Breakdown of animal, vegetable and industrial organic wastes by earthworms.* – In: Edwards, C.A. & Neuhauser, E.F. (eds.): Earthworms in waste and environmental management. SPB Academic Publishing, Hague. pp: 21-31.

Garg, P.; Gupta, A. and Satya, S., 2006. Vermicomposting of different types of waste using *Eisenia foetida*: A comparative study. ***Bioresource Tech.***, 97: 391-395.

Kale, R.D., Bano, K. and Krishnamoorthy, R.V., 1982. Potential of *Perionyx excavatus* for utilization of organic wastes. ***Pedobiologia***, 23: 419-425.

Kaushik, P. and Garg, V.K., 2003.Vermicomposting of mixed soil textile mill sludge and cow dung with the epigeic earthworm ***Eisenia foetida. Biores. Technol.***, 90: 311-316.

More, S.D., 1994. Effect of farm wastes and organic manures on soil properties, nutrient availability and yield of rice – wheat grown. ***Sodic Vertisol Indian Soc. Sci.***, 42(2): 253-256.

Parthasarathi, K. and Ranganathan, L. S., 2000. Aging effect on enzyme activities in pressmud vermicasts of *Lampito mauritii* (Kinberg) and *Eudrilus eugeniae* (Kinberg). ***Biology and Fertility of Soils***, 30: 347-350.

Prabha, L.M., Jayraaj I.A. and Jeyaraaj, R., 2005. Macro and Micronutrient changes in vermicomposting of vegetable wastes using Eudrilus eugeniae. ***South Asian Journal of Socio-Political Studies***, 2: 129-130.

Singh, N.B. Khare, A.K., Bhargava, D.S. and Bhattacharya, S., 2004.Optimum moisture requirement during vermicomposting using *Perionyx excavatus*. ***App. Ecol. Environ.Res.***, 2(1): 53-62.

Suthar, S., 2007. Production of vermifertilizer from guargum industrial waste by using composting earthworm *Perionyx sansibaricus* (Perrier). ***Environmentalist***, 27(1): 329-335

Trivedy, R.K. and Goel, P.K., 1986.*Chemical and Biological methods for water pollution studies*, Environmental publication, Karad, India.

Walkley, A. and Black, I.A., 1934. An examination of the Degtjareff method for determining soil organic matter and prepared modification of the chronic acid titration method.*Soil Sci.* 34, 29-38. ***Int. J. Environ. Sci. Tech.***, 5(1): 99-106, Winter 2008 105.

Environment Conservation Journal 10(3) 109-113, 2009
(ISSN 0972-3099)

Physiological observation on activity recovery of mercury exposed fresh water fish by using aquatic weed

Seema Trivedi[1], Aarti Sharma[1], S. Shrivastava[2] and A. Shukla [2]

Received: 21-04-2009 Revised: 29-07-2009 Accepted: 02-09-2009

Abstract

Physiological observation on activity recovery of mercury exposed fresh water fish were done by using aquatic weeds. Five weeds constitute two floating weeds *Eichhornia* and *Salvinia* in surface layers, *Chara* and *Hydrilla* in the column layer and *Vallisneria* in bottom layer. Five experimental groups constituting five selected weeds were subjected to establish fish lethal concentration of mercury for a period of 48h, 96h, 144h, 192h and 240h to facilitate mercury absorption. All the data shows that mercury removal efficiency increases with increased time exposure. The present results indicate that maximum quantity of mercury was accumulated by weeds of IAMB rapidly up to 144h of exposure.

Keywords:- *Detoxification, Eichhornia, Fish, Freshwater, Heavy metal, Macrophyte*

Introduction

Heavy metals are present in all phases of the environment- air, water and land, when these substances are released in the water phase of the environment, they are transported by the fluid motion, and transferred to the atmosphere and bed, are subject to various physico-chemical and biochemical reactions and are assimilated by all levels of the aquatic food chains. They are also transmitted by direct ingestion through the food chain to higher organisms and ultimately to humans. Between the naturally occurring and the industrial pollutants mercury is highly toxic to both human and animals. The aquatic weed plants absorb and incorporate the dissolved materials (both inorganic and organic compound) into their own body tissues so rapidly and effectively that they are now considered for use in waste treatment (Wolverton *et al.*, 1975; Chaphekar and Mhatre 1981; Kaiser, 1993). Shrivastava and Rao (1997) proposed an Integrated Aquatic Macrophyte Base (IAMB) system in which combination of weed groups constituting different types of weeds *viz.* floating, emergent and submerged types were used. This IAMB system recorded better results when compared to using individual weed plant. This study aims to assess mercury detoxification by IAMB system based on fish activity recovery observed by relative physicochemical factors of the stored tap water, fish mortality, fish behaviour, and oxygen consumption rate of fish in different experimental groups.

Author's Address

[1]Govt. Madhav Science College, Vikram University, Ujjain ✉

[2]School of Studies Zoology Vikram University, Ujjain

Materials and Method

The fish *Oreochromis mossambicus* was selected as test animal, these fishes were collected from Government Fisheries Department, Ujjain (M.P.) Ten test animals were kept in each aquarium containing 10 litres of water. IAMB system was designed and assembled in the laboratory, constituting two floating weeds *Eichhornia, Salvinia* in the surface water layers, *Chara* and *Hydrilla* in column layer and *Vallisneria* in bottom layers. The five weeds used for different experimental groups were 20 gm for 10 litres of toxicant. Mercuric chloride was used as toxicant material. The LC-100, concentration of mercuric chloride to fish were obtained with earlier experiments. Lethal concentration 1.00 ppm of mercuric chloride was selected as toxicant

concentration for all the experimental groups. Five experimental groups constituting five selected weeds were subjected to established fish lethal concentration of mercury for a period of 48 h, 96 h, 144 h, 192 h, and 240 h to facilitate mercury absorption. The fishes were then introduced. The details of experimental groups are as per details given under:-

1. Control Group:- Equal weight of five weeds (20 gm each), tap-water and fishes.

2. Lethal Concentration Group:- LC-100 concentration of $HgCl_2$, tap-water and fishes

3. Experimental Group 1:- Equal weight of five weeds (20 gm exposed for 48 h) in LC-100 concentration of $HgCl_2$, tap-water and fishes.

4. Experimental Group 2:- Equal weight of five weeds (20 gm exposed for 96h) in LC-100 concentration of $HgCl_2$, tap-water and fishes.

5. Experimental Group 3:- Equal weight of five weed (20 gm, exposed for 144 h) in LC-100 concentration of $HgCl_2$, tap-water and fishes.

6. Experimental Group 4:- Equal weight of five weeds (20 gm, exposed for 192 h) in LC-100 concentration of $HgCl_2$ tap-water and fishes.

7. Experimental Group 5:- Equal weight of five weeds (20 gm, exposed for 240 h) in LC-100 concentration of $HgCl_2$ tap-water and fishes.

The mercury detoxification study was based on physicochemical characteristics of stored tap water, fish mortality, fish behaviour and oxygen consumption rate of fish of different experimental groups. Fish mortality rate was observed at 12 h up to 96 h of experimentation. Oxygen consumption rate was determined by Winkler's method.The analysis of physicochemical parameters of experimental water were made according to method of APHA (1998) and Khanna and Bhutiani (2004).

Results and Discussion

Experiment as per details described above were set up in stored tap water. The physico-chemical characteristics of selected tap water is given in Table-1. Fish mortality, oxygen consumption were recorded as given in Table-2 and Table-3 and Fig.1 respectively.

Shrivastava and Rao (2000) proposed integrated aquatic macrophyte base system (IAMB) in which two floating weeds *Eichhornia* and *Salvinia* in surface layers, *Chara* and *Hydrilla* in column layer and *Vallisneria* in the bottom layer provides efficient mechanism of metal absorption through their roots and recorded better result when compared to using individual weed plant. The fish *Oreochromis mossambicus* was subjected to its lethal concentration

Table-1: Showing the Physico-chemical parameters of experimental water

Physico-Chemical Parameters of Experimental Water	Reading
Water Temperature (° C)	25.00
pH	8.40
Carbonate alkalinity (mg/l)	12.00
Bicarbonate alkalinity (mg/l)	240.00
Chloride (mg/l)	50.99
Calcium (mg/l)	16.83
Hardness (mg/l)	166.00
Dissolved Oxygen (mg/l)	8.00

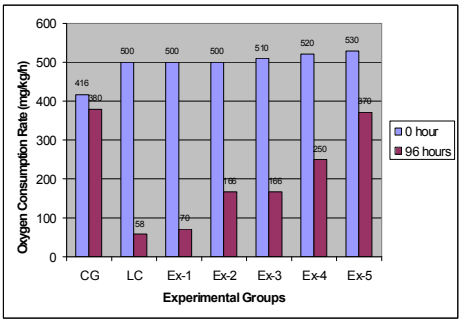


Fig. 1: Showing oxygen consumption rate in different experimental groups of an Integrated Aquatic Macrophyte Base System

of mercuric chloride (1ppm) recorded 100% mortality of fish at 96 h of experimentation. The same concentration was used in all experimental set up

Table-2: Showing the mortality responses of *O. mossambicus* in $HgCl_2$ at 96 h. of experimentation under an Integrated Aquatic Macrophyte Base System

Experimental Group	Time in Hour										
	00	12	24	36	48	60	72	84	96	(%) Mortality	(%) Recovery
Control Group	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	-
Lethal Conc. Group	10	05	10	20	10	05	10	20	10	100%	Nil
Experimental Group 1	10	10	10	Nil	Nil	Nil	Nil	Nil	Nil	30%	70%
Experimental Group 2	05	10	10	Nil	Nil	Nil	Nil	Nil	Nil	25%	75%
Experimental Group 3	10	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	10%	90%
Experimental Group 4	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	100%
Experimental Group 5	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	100%

Table-3: Showing the oxygen consumption rate in different experimental groups of an Integrated Aquatic Macrophyte Base System

Experimental Group	Experimental Time (Hours)	
	0 hour	96 hours
Control Group	416	380
Lethal Concentration Group	500	58
Experimental Group 1	500	70
Experimental Group 2	500	166
Experimental Group 3	510	166
Experimental Group 4	520	250
Experimental Group 5	530	370

(Table-2). Experimental group 1, 2 and 3 yielded low mortality rate 30%, 25% and 10% respectively in IAMB which were exposed for 48 h, 96 h and 144 h of experimentation. IAMB system which was exposed for 192 h and 240 h (Experimental Group 4 and 5) has shown no mortality at 96 h of experimentation. The present study indicates 100%, 90%, 75% and 70% fish mortality recovery in experimental group 5,4,3,2 and 1 which was exposed for 240, 192, 144, 96 and 48 h. All data show that mercury removal efficiency increases with increaseing time exposure.

The experimental animals within a short period of their introduction to the experimental tanks exhibits signs of distress. The gulping of air by hanging on the surface with the hind part of the body turned downwards was very evident even when sufficient amount of dissolved oxygen available in the water. This was however, not at all seen in the control group and experimental groups 4 and 5. Visible signs of poisoning were manifested by periodic bursts of erratic swimming, rapid opercular movements, surfacing and gulping of air. Disorder of central nervous system were observed when the fish in the lethal concentration, loss their sense of equilibrium and turned with their belly upward making jerky movements. Finally they sank to the bottom before death occurred. The symptoms of acute mercury poisoning in fish include rigidness of body, spread out fins, slow movement of the hind part of the body turned downwards (Boetius, 1960). These symptoms are followed by the loss of balance and finally sinking to the bottom before death occurs. All these symptoms were clearly visible in the test fish during the present study. One of the underlying problems with mercury pollution is the effect it provides to the nervous system by attacking the centre in the brain of human beings and other mammals (Suzuki, 1960). Whether such damage also occurs in the aquatic organism has not been clearly demonstrated. However, similar effect seems to prevail in fish also because some of the functions which are controlled by nervous system such as the maintenance of equilibrium have already been demonstrated to get disturbed with low concentration of mercury in the fish (Lindhal and Schwanbom, 1971).

Oxygen consumption rate of fish was observed in different experimental group (Table-3 and Fig.1). The effect of various pollutants on the respiratory physiology of fishes have been investigated in recent years by several workers, *viz*. Waiwood and Jonson, 1974; Kawastski and Mc Donald 1974; Hughes, 1975; Munshi *et al*., 1976; Singh and Singh, 1979; Kumar and Pandey, 2002; Gibson and Mathis, 2006; The recovery of oxygen consumption rate in the present study under IAMB system and mercuric chloride exposed fish revealed that 5 weed containing control group was having highest recovery 380 mg/kg/h. In experimental group 5, oxygen consumption rate was 370 mg/kg/h recorded. Experimental group 4 it is 250 mg/kg/h; experimental group 2 and 3 it is 166 mg/kg/h; experimental group 1, 70 mg/kg/h and lethal concentration group 58 mg/kg/h come next in order.

The present result indicates that maximum quantity of mercury was accumulated by weeds of IAMB system with greatest rapidly upto 144 h of exposure. After the critical period of 144 h, the rate of toxicant absorption suddenly reduces and becomes negligible. It is therefore suggested that moderate required plant growth after 144 h period can be harvested regularly, each time allowing the regrowth of a new crop, so that the IAMB water purification system becomes a continuous process. This study demonstrated that IAMB system performed very well in treating water contaminated with mercury. The IAMB system based biotechnologies are ideal for treating large quantities of industrial waste water.

References

APHA, 1988. Standard method for the estimation of water and waste water. 20th Edn, New York, American Public Health Association, American Water Works Association And Water Pollution Control 1998.

Boetius, J., 1960. Lethal action of mercuric chloride and Phenylmercuric acetate on fishes. ***Meddr. Danm. Fisk oge Havunders***, 3: 93-115.

Chaphekar, S.S., and Mhatre, G.N., 1981. Role of aquatic plants in Water Pollution Control.

Gibson, A.K. and Mathis, A., 2006. Opercular beat rate for rainbow dartes (*Etheostoma caerulenus*) exposed to chemical stimuli from conspecific and heterospecific fishes. **J. fish Biology**, 69(1);224-223.

Hughes, G.M., 1975 Coughing in the rainbow trout(*Salmo gairdneri)* and the influence of pollutants. ***Revne Suissee Zool.***, 82: 47-64.

IAWPC. TECH ANNUAL 8: 108-115.

Kaiser, Jamil, 1993. The role of macrophytes in aquatic ecosystem. ***J. Fresh Water Biol.***, 5(2): 141-145.

Kawastski, J.A. and M.C. Donald, M.J.J., 1974. Effect of 3-triflu romcrhyal 4-nitro phenolon *in vitro* tissues respiration of four species of fish with preliminary notes on its *in vitro* bio-transformation. ***Com Gen Pharmaco***, 5: 67-70.

Khanna, D.R. and Bhutiani, R., 2004. *Water analysis at a glance*. Pub. ASEA. pp: 1-115.

Kumar, V. and Pandey, P.K., 2002. Oxygen consumption of parasitised fresh water air breathing fishes *Channa punctatus* (Bloch) of Kurhadhar, Parbatta (Khagaria) Bihar. ***Indian Journal of Environment and Ecoplanning***, 6: 53 - 56.

Lindhal, P.K. and Schwanbom, 1971. Methods for the determination and quatitative estimation of sub lethal poisoning in fish. ***Oikas***, 22:210.3, 33.

Munshi, J.S.D., Sinha, A.L. and Ojha, 1976. Oxygen uptake capacity of gills and skin in relation to body weight of the air breathing siluroid fish, *Clarius batrachus* (Linn). ***Actophysicological Acadimic Scientiarum Hugaricae***, 48: 23-33.

Shrivastava, S. Rao, K.S., 1997. Observation on the utility of An Integrated Aquatic Macrophyte Base System for mercury toxicity removal. ***Bull. Environ. Contam. Toxicol.***, 59: 777-783.

Shrivastava, S. and Rao, K.S., 2000. Observations on experimental assessment of optimal exposure time for mercury detoxicification by An Integrated Aquatic Macrophyte Base System. ***Bull. Environ. Contam. Toxicol.***, 65: 91-97.

Singh, S.R. and Singh, B.R., 1979. Changes in oxygen consumption of allaroid fish, *Mystus vittatus* put to different concentrations of some heavy metal salts. ***Ind. J. Expt.***, 17: 274-276.

Suzuki, T., 1960. Neurological Symptoms from concentration of mercury in the brain .In *Chemical Fall out* M .V. Miller and G.G.Baug spring fielf III, Charies, C. Thomes publisher. pp: 245-256.

Waiwood, K.G., and Jonson, P.H., 1974. Oxygen consumption and activity of the white sucker (*C. Commersoni*) in lethal and sublethal levels of the oranochloride insecticide, *Methoxychloro*.***Wat Res***., 401-406.

Wolverton, B.C., Barlow, R.M., and McDonald, R.C., 1975. Application for vascular aquatic plants for pollution removal, energy and food production in biological system. *NASA TECHNICAL MEMORANDUM TM* – 62726: 1-5.

Environment Conservation Journal 10(3) 115-118, 2009
(ISSN 0972-3099)

Green marketing: A new lifeline for the MNC's

Pankaj Madan[1], Uday Khanna[2], Manish Kumar[2] and Rupa Khanna Malhotra[2]

Received: 19-08-2009 Revised: 31-09-2009 Accepted: 25-10-2009

Abstract

We invoke all supporting earth sitting at ease or rising up, standing or going on our way with our right foot and with our left we will not reel upon the earth's thus began the journey of the civilized man of the yore on the planet earth. But somewhere on the way, he somehow lost that bhaya and bhakti and instead, arrogated to him the right to slit opens the earth, despite its known adverse impact on the other flora and fauna, for mining her hidden treasure. The study clearly depicts that the companies who emerges as the clear winner are those who are concerned for their planet as they believe in the philosophy that 'green and steady wins the race.'

Keywords:- *Environmental sustainability, Competitive advantage, Greener balance sheets*

Introduction

Green marketing incorporates a broad range of activities, including product modification, changes to the production process, packaging changes, as well as modifying advertising. Green marketing offers business bottom line incentives and top line growth possibilities. While modification of business or production processes may involve start-up costs, it will save money in the long term. For example the cost of installing solar energy is an investment in future energy cost savings. Companies that develop new and improved products and services with environmental impacts in mind give themselves access to new markets, substantially increase profits and enjoy competitive advantages over those marketing non-environmentally responsible alternatives.

The issue of green marketing presents both a problem and an opportunity to the marketer. This presents a problem to the marketer because so much attention has been given to environmental issues that if a company does not properly get "involved" it will lose out on many business opportunities. In addition, the company receives a poor company image from consumers by failure to be environmentally involved.

Author's Address

[1]Faculty of Management, Gurukula Kangri Vishwavidyalaya, Haridwar ✉

[2]Deptt. of Management Studies, Graphic era University, Dehradun

In the past few years, some companies have been boycotted by consumers and various environmental organizations. Boycotts can be detrimental to a company's image, especially if the boycott receives media attention.

Companies that are not participating in green marketing have received negative media attention and this further degrades the company's image. Exxon's oil spill is a good example of a company that suffered as a result of being environmentally irresponsible. Even though Exxon made all possible efforts to "clean up" its mess, its reputation suffered as did its pocketbook. Exxon had to spend billions of dollars in an effort to regain public approval, and even this tremendous effort did not reinstate full public approval. Between the media and active environmental organizations, Exxon received so much negative attention that even today the company is still trying to overcome the consequences of its mistake (Oil spill Case Histories, 1976-1991).

Now a days, firms marketing goods with environmental characteristics have realized a competitive advantage over firms marketing non-environmentally responsible alternatives. There are numerous examples of firms who have strived to become more environmentally responsible, in an attempt to better satisfy their consumer needs.

"The belief that companies must choose between doing good and being profitable is outdated; they

increasingly understand that their responsibility to investors means being accountable to the society and environment in which they operate. Today being a good corporate citizen requires more than business as usual – it requires investments in society and the environment (Clinton, 2009). We are all shareholders in our children's future and the future of our planet, and by working together we can build an economy in which everyone can benefit from the free markets. By investing in communities growth and welfare, a corporation empowers tomorrow's customers and creates a strong brand with a more loyal following. It can thereby weather economic downturns, ensure greater long term profits, and attaract more investors. To increase sales of green products, companies must make sure that consumers understand the returns—both financial and environmental—on their investment. When consumers find it easy to track their savings from using a product, they are more willing to try new green products—especially those that cost more. They also feel more confident about their eco-friendly purchases when they understand how the products help the environment.

This does not mean that all firms who have undertaken environmental marketing activities actually improve their behavior. In some cases, firms have mislead consumers in an attempt to gain market share. In many other cases firms have jumped on the green bandwagon without considering the accuracy of their behavior, their claims or the effectiveness of their products. This lack of consideration of the true "greenness" of activities may result in firms making false or misleading green marketing claims.

Many firms are beginning to realize that they are members of the wider community and therefore must behave in an environmentally responsible fashion. This translates into firms that believe they must achieve environmental objectives as well as profit related objectives. This results in environmental issues being integrated into the firm's corporate culture. Firms in this situation can take two perspectives: 1) they can use the fact that they are environmentally responsible as a marketing tool; or 2) they can become responsible without promoting this fact.

Efforts

There are examples of firms adopting both strategies. Organizations like the Body Shop heavily promote the fact that they are environmentally responsible. While this behavior is a competitive advantage, the firm was established specifically to offer consumers environmentally responsible alternatives to conventional cosmetic products. This philosophy directly ties itself to the overall corporate culture, rather than simply being a competitive tool (The Body soap beauty, 2008).

An example of a firm that does not promote its environmental initiatives is Coca-Cola. They have invested large sums of money in various recycling activities, as well as having modified their packaging to minimize its environmental impact. While being concerned about the environment, Coke has not used this concern as a marketing tool (Glick, 2008). Thus many consumers may not realize that Coke is a very environmentally committed organization. Another firm who is very environmentally responsible but does not promote this fact, at least outside the organization, is Walt Disney World (WDW). WDW has an extensive waste management program and infrastructure in place, yet these facilities are not highlighted in their general tourist promotional activities (Glick, 2008).

The world's largest and finest handset mobile company Nokia is ready to share its concern for the environment awareness programme. The company is all ready to expand its worldwide phone recycling initiatives to the Indian subcontinent as part of Nokia's integrated strategy of innovation in environment sustainability (Andrew, 2009). The company is barking on the print media, outdoor ads and radio spots and station vans in residential vans to make people aware about the benefits of the recycled handsets. The company has put special bins in retail stores and trains the employees to inform customers about their contribution in the green initiative programme.

A pilot programme in India collected some 68000 pieces of equipments in 45 days and now the plan is being rolled out to cover more than 15 cities. The company is also distributing small appreciation gifts like mugs, bags, t-shirts to change the behavior of the customer to persuade him to get the old handsets out

of the drawer into the recycle bins. For every recycled phone, Nokia plants a tree on behalf of the customer. It is well said that good beginning is half done. Till this write up, the company has already planted 3000 trees with the support of NGO's. The company even informed the customers about the location of the trees through the text messages. These greener efforts by Nokia will definitely helps the company to enhance their image in the eyes of the Indian customer to make the next purchase from the basket of Nokia (Andrew, 2009).

In 2005, GE launched "Ecomagination," an initiative with the broad objective of meeting environmental challenges such as the need for clean water, renewable energy, and reduced emissions. Ecomagination covered GE's efforts to enhance its investment in sustainable technologies and increase its revenues from sustainable products such as lower-emission aircraft engines, efficient lighting, wind turbines, and water purification technology. (George and Regani, 2007) As part of the Ecomagination campaign, GE also undertook efforts to make its own operations more environmentally sustainable. One of the results of the program is that GE successfully kept its greenhouse gas emissions flat even as the revenues took a good leap (George and Ragni, 2007).

Another major force in the environmental marketing area has been a firm's desire to maintain its competitive position. In many cases, firms observe competitors promoting their environmental behaviors and attempt to emulate this behavior. It is only in some instances that this competitive pressure causes an entire industry to modify and thus reduce its detrimental environmental behavior. For example, it could be argued that Xerox's "Revive 100% Recycled paper" was introduced a few years ago in an attempt to address the introduction of recycled photocopier paper by other manufacturers. In another example when one tuna manufacture stopped using driftnets, the others followed suit.

Companies use Green Marketing not only to increase consumer approval, but also to cut costs. McDonald's used recyclable materials for wrappers and reduced its environmental waste by 60 percent; their 'give a tree away' day led the way for other fast foods companies to follow suit. All of McDonald's napkins and tray liners in the restaurants are made from recycled paper, as are the carry-out drink trays and even the stationery used at the headquarters McDonald's saved one million pounds of waste per year by making its drinking straws twenty percent lighter,. Besides using Green Marketing in its own products, McDonald's buys recycled materials for remodeling and building its restaurants. McDonald's also challenges its suppliers to supply and use recycled products and materials. The effective use of Green Marketing has made the public awared that McDonald's Corporation is an environmentally concerned company and this has generated not only public consumer approval but additional sales as well (Ottoman *et al.*, 1999).

The success of compact fluorescent lightbulbs (CFLs) rightly proves that the green energy saver product can do wonders if taken at the right time and in the right attitude. In 2005, sales of CFLs accounted for less than 5 percent of the total lightbulb market. But only two years later, in 2007—the year that the public woke up to the looming threat of climate change—CFLs captured an estimated 20 percent of the lightbulb market, according to the U.S. (Bonini and Oppenheim, 2008) Environmental Protection Agency (EPA). Companies that sell CFLs, like General Electric Co. (GE) have increased their revenues, enhanced their brands, and strengthened their competitive positions in the market.

Conclusion

The study clearly depicts that the green life line emerges as the clear winner for the companies who are genuinely interested in transforming this planet from the industrial to the greener one. The future lies in investing in the greener efforts which could reap better results in terms of fattier and greener balance sheets and to make this planet a better place to live in for the golden days ahead.

References

Andrew, Connell O', 2009. Using gifts and trees to make recyclers of Indian consumers. ***Harvard Business Review***, 4(9): 52.

Bonini, S. and Oppenheim. J., 2008. Cultivating the green consumer. *Stanford Social Innovation Review*.

Clinton, Bill., 2009. Fifth annual meeting of the Clinton Global Initiative: Creating value in an economic crisis. ***Harvard Business Review***, 4(9): 54-55.

George, S.S. and Regani, S., 2007. "Ecomagination' at Work: GE's Sustainability Initiative," *ICFAI Center for Management Research case study*.

Glick Shayna, Coco Cola going from red to Green, Feb 20 2008, Slash food.

Oil Spill Case Histories 1976– 1991, Report No. HMRAD 92-11. Seattle: National Oceanic and Atmospheric Administration

Ottoman, Jacquelene and Miller, Edmond Shoaled, 1999, Green marketing Opportunities for innovation. Mc Graw Hill, New York.

The Body Shop finds new way to beauty, Aug. 26, 2008 Brand Week.

Environment Conservation Journal 10(3) 119-123, 2009
(ISSN 0972-3099)

Assessment of noise levels in institutional and commercial units of Bishnah Town, Jammu (J&K) India

Rajkumar Rampal and Deepak Pathania

Received: 07-05-2009 Accepted: 28-10-2009

Abstract

The present study has been made to evaluate indoor and outdoor noise levels at different institutional and commercial units of Bishnah Town, Jammu. The observed values of noise levels in all the institutional and commercial units of the study area were found to be higher than the noise level values prescribed by the Central Pollution Control Board.

Keywords:- *Noise pollution, Indoor, Outdoor, Commercial*

Introduction

Modern life has given rise to a new form of pollution, called noise pollution. The increased rate of urbanization and industrialization has aggravated the noise problem. The development of society has led to more and more sources giving higher and higher noise levels. Noise is a ubiquitous accessory of mechanical age in our environment. Noise doubles every ten years in pace with our social and industrial progress. This geometric progression wise growth of noise could be mind boggling in view of the ever-increasing pace of technological growth. Bhatnagar and Srinivas (1992) in Chandigarh, Dhillon *et al.* (1994) in Ludhiana, Singh and Jain (1995) in Delhi, Ravichandran *et al.* (1997) in Hosur, Joshi (1998) in Indore, Pandya and Shrivastava (1999) in Jabalpur City, Mishra (2004) in Rewa Town, M.P. and Rampal and Rasool (2004) in Jammu City also studied noise levels in various institutional and commercial areas.

Materials and Method

Noise levels were recorded with the help of Digital Sound Level Meter. Model, 8928 with slow response. The noise levels in Class Rooms, Principal Offices and Staff Rooms in Schools; OPD, In-Patient Wards and Laboratories in Hospitals, Restaurants, Post Offices. Banks, Tea Shops, Kiryana Stores. Cosmetic Shops, Beauty Parlours, Vegetable Market, Bus Stand and Mini Buses in the study area were recorded.

During each sampling of noise 20 readings of SPL (Sound Pressure Level) were recorded at an interval of 30 seconds in a period of 10 minutes. At the end of 10 minutes minimum and maximum SPL (Sound Pressure Level) were recorded with the help of Sound Level Meter.

From the 20 readings of SPL following noise indices were calculated.

i) Leq (Equivalent Noise Level) :-

$$L_{eq} = 10 \text{Log} \left(\sum^{n} fi \ 10^{Li/10} \right) \text{dB(A)}$$

where.

fi= fraction of time for which the constant SPL persists.

i= time interval

n= number of observations

Li= sound intensity

ii) L_{10}(The noise level that exceeded 10% of time)

iii) L_{50} (The noise level that exceeded 50% of time)

iv) L_{90} (The noise level that exceeded 90% of time)

Results and Discussion

The analysis of noise level data of various institutional units revealed that during working hours. the maximum value of average indoor L_{eq} (10 minutes) of 65.99 ± 7.19 dB(A) was observed in the School located in a street, whereas the minimum value of average L_{eq} (10 minutes) of 62.31 ± 6.39 dB(A) was

Author's Address

Deptt. of Environmental Sciences University of Jammu, Jammu (J&K) ✉

observed in School located on Main Road with high traffic (Table-I). This was the surprising observation that the schools located in area with high outdoor noise level exhibited low indoor noise and those located in low outdoor noise level exhibited higher indoor noise. From this it can be concluded that sometimes exterior sources of noise are not responsible for increase in indoor noise level and increase in indoor noise level was because of indoor sources like noise of students, gossiping, noisy fans, open doors and windows and congested building etc. During non-working hours, the average indoor L_{eq} in the Schools ranged from 48.29 ± 4.09 dB (A) in the School located in a street to 52.22 ± 6.11 dB(A) in the School located on Main Road with low traffic (Table-1). But the maximum average outdoor noise level L_{eq} of 71. 79 ± 6.89 dB(A) was observed in the School located on Main Road with high traffic and minimum of 56.65 ± 3.83 dB(A) was observed in School located in a street during working hours. whereas during non-working hours School located on Main Road with high traffic exhibited maximum average outdoor of 62.05 ± 3.41 dB(A) and School located in street with no traffic exhibited minimum average outdoor L_{eq} of 51.25 ± 3.09 dB(A) (Table-1). The average indoor L_{eq} was observed to be higher [71.44 ± 2.44 dB(A)] in Banks than that [65.42 ± 9.44 dB (A)] of Post Offices during working hours. However, Post Offices recorded a higher [62.11 ± 10.35 dB (A)] value of average indoor L_{eq} than that [56.07 ± 6.85 dB (A)] of Banks, during non-working hours. The average outdoor L_{eq} (10 minutes) was observed to be higher in Banks as compared to that of Post Offices during working as well as non-working hours (Table-1).

Table-1: Average L_{eq} in the institutes located in the study area, Bishnah Town, Jammu

	Duration	Min		Max		L_{eq}	
		INDOOR	OUTDOOR	INDOOR	OUTDOOR	INDOOR	OUTDOOR
School on main road with high traffic	W.H.	47.70	54.60	77.60	87.70	62.31±6.39 57.08±69.45	71.79±6.89 63.88±76.56
	N.W.H.	35.00	42.50	59.90	73.30	50.36±3.65 46.45±53.68	62.05±3.41 58.88±65.66
School on road with low traffic	W.H.	47.40	48.20	77.60	78.80	62.87±6.54 57.07±69.11	66.52±5.19 61.51±71.87
	N.W.H.	35.00	35.00	64.50	64.30	52.22±6.11 47.35±59.08	55.88±2.47 53.14±57.93
School in street with low traffic	W.H.	51.30	47.50	78.60	66.10	65.99±7.19 57.68±70.36	56.65±3.83 54.42±61.07
	N.W.H.	35.00	35.00	61.00	64.30	48.29±4.09 43.71±51.61	51.25±3.09 48.48±54.59
Avg. noise levels in schools	W.H.	47.40	47.50	78.60	87.70	63.72±1.98 62.31±65.99	64.99±7.69 56.65±71.79
	N.W.H.	35.00	35.00	64.50	73.70	50.29±1.97 48.29±52.22	55.47±6.79 51.25±62.05
Bank in market	W.H.	70.60	53.60	76.30	67.70	73.16	60.95
	N.W.H.	45.40	56.60	56.70	65.70	51.22	62.00
Bank on main road	W.H.	59.90	59.10	78.40	84.30	69.71	73.07
	N.W.H.	56.80	64.50	65.00	78.60	60.91	72.02
Avg. noise levels in banks	W.H.	59.90	53.60	78.40	84.30	71.44±2.44 69.71±73.16	67.01±8.57 60.95±73.07
	N.W.H.	45.40	56.60	65.00	78.60	56.07±6.85 51.22±60.91	67.01±7.08 62.00±72.02
Post office in market	W.H.	35.00	48.00	67.30	66.40	58.74	58.66
	N.W.H.	44.50	53.60	58.80	67.70	54.79	60.12
Post office on main road	W.H.	53.60	55.40	83.40	80.20	72.09	71.81
	N.W.H.	46.40	51.00	81.60	77.40	69.43	68.83
Avg. noise levels in post offices	W.H.	35.00	55.40	83.40	80.20	65.42±9.44 58.74±72.09	65.24±9.29 58.66±71.81
	N.W.H.	46.40	53.60	81.60	77.20	62.11±10.35 54.79±69.43	64.48±6.16 60.12±68.83

Note : All the sound level were measured in dB(A)

The analysis of noise level data further revealed the average indoor L_{eq} of 57.53 ± 6.19 dB (A) and average outdoor L_{eq} of 56.55 ± 5.22 dB(A) in Hospital of Study Area (Table-2).

Table-2: Average L_{eq} in a Hospital located in the study area, Bishnah Town, Jammu

	Indoor	Outdoor
Min.	43.20	40.00
Max.	71.10	68.80
L_{eq}	57.53±6.19 52.80±64.55	56.55±5.22 51.73±62.09

Mukthopadhyay and Ramanathan (1967) in Calcutta, Sargent *et al.* (1980), Tiwari and Ali (1988) in Rourkela, Bansal and Grewal (1990) in Ludhiana, Bayo *et al.* (1995), Ravichandran *et al.* (1997) in Hosur and Rampal and Rasool (2004) in Jammu City also observed the higher values of noise levels in institutional area as compared with noise level values prescribed by Central Pollution Control Board.

Analysis of average L_{eq} in Mills of Study Area showed that Rice Mills exhibited average indoor L_{eq} of 80.34 ± 1.42 dB(A) which was close to 80.08 ± 4.98 dB(A) of Flour Mills. The average L_{eq} (10 minutes) ranged from 56.39 ± 3.24 dB(A) during non-working hours to 81.73± 1 3. I 3 dB(A) during working hours in Saw Mills (Table-3).

Table-3: Average L_{eq} in Mills located in the study area, Bishnah Town, Jammu

Mills		Min.	Max.	L_{eq}
Rice mill in market	Indoor	57.00	84.50	79.33
	Outdoor	58.50	72.40	68.71
Rice mill in street	Indoor	78.60	87.90	81.34
	Outdoor	56.30	69.60	61.72
Avg. noise levels in rice mills	Indoor	57.00	87.90	80.34±1.42 79.33±81.34
	Outdoor	56.30	72.40	65.22±4.94 61.72±68.71
Flour mill on main road	Indoor	81.60	85.70	83.60
	Outdoor	66.50	73.60	69.92
Flour mill in street	Indoor	73.00	79.10	76.55
	Outdoor	60.20	74.50	67.15
Avg. noise levels in flour mills	Indoor	73.00	85.70	80.08±4.98 76.55±83.60
	Outdoor	66.50	74.60	68.54±1.96 67.15±69.92
Saw mill on road with low traffic	Working hours	71.40	82.60	79.51
	Non working hours	45.80	63.40	58.69
Saw mill on road with high traffic	Working hours	82.40	87.00	83.94
	Non working hours	35.00	60.40	54.10
Avg. noise levels in saw mills	Working hours	71.40	87.00	81.73±3.13 79.51±83.94
	Non working hours	35.00	63.40	56.39±3.24 54.10±58.69

The critical analysis of the data of noise levels of Commercial Units of Study Area revealed the maximum indoor average L_{eq} of 72.71 ± 2.28 dB(A) at Tea Stalls and the minimum average L_{eq} of 58.55 ± 5.80 dB(A) at the Karyana Stores of Study Area (Table-4).

The maximum average outdoor L_{eq} of 68.03 ± 1.46 dB(A) was observed at Tea Shops and the minimum average outdoor L_{eq} of 61.77 ± 3.41 dB(A) was observed at Beauty Parlours of Study Area (Table-4).

Table-4: Average L_{eq} in different shops located in the study area, Bishnah Town, Jammu

Site	Min.		Max.		L_{eq}	
	Indoor	Outdoor	Indoor	Outdoor	Indoor	Outdoor
Tea shop at bus stand	65.00	6.050	77.00	73.30	72.05	66.49
Tea shop in market	58.20	60.40	79.60	73.60	70.83	68.20
Tea shop on main market	48.20	53.60	77.60	78.60	75.25	69.39
Avg. noise levels in the tea shop	48.20	53.60	79.80	78.60	72.71±2.28 70.83±75.25	68.03±1.46 66.49±69.39
Karyana store on main road	55.10	57.40	73.30	79.80	64.49	71.67
Karyana store in market	45.90	56.60	64.90	73.00	58.26	68.86
Karyana store in street	45.00	48.40	59.20	65.80	52.89	56.11
Avg. noise levels in the Karyana store	45.00	48.40	73.30	79.80	58.55±5.80 52.89±64.49	65.55±8.29 56.11±71.67
Cosmetic shop in the market	52.50	54.20	73.60	71.70	67.21	65.18
Cosmetic shop at bus stand	55.10	56.80	78.80	76.10	67.24	69.66
Cosmetic shop in market	51.30	51.60	77.40	75.90	66.06	65.35
Avg. noise levels in the Cosmetic shops	51.30	51.60	78.80	76.10	66.84±0.67 66.06±67.24	66.73±2.54 65.18±69.66
Restaurant in market	62.00	52.00	74.20	72.80	68.40	66.35
Restaurant on main road	67.10	55.40	82.30	74.40	76.74	67.48
Avg. noise levels in the restaurant	62.00	52.00	83.30	74.40	72.57±5.89 68.40±76.77	66.92±0.79 66.35±67.48
Beauty parlour in market	64.00	51.80	74.60	68.70	71.87	61.73
Beauty parlour in main road	45.10	55.50	68.40	69.30	62.79	65.20
Beauty parlour in street	52.20	35.00	69.60	64.80	65.41	58.39
Avg. noise levels in Beauty parlours	45.10	35.00	73.60	68.70	66.69±4.67 62.79±71.87	61.77±3.41 58.39±65.20

The Vegetable Market and Bus Stand of Study Area exhibited same value of L_{eq} of 54.86 dB(A) during morning hours, whereas Bus Stand exhibited a higher value of L_{eq} [73.73 dB(A)] as compared to that of Vegetable Market [68.29 dB(A)], during afternoon hours but Vegetable Market exhibited a higher value of L_{eq} of 70.52 dB(A) as compared to 68.98 dB(A) of Bus Stand during evening hours. On an average Bus Stand exhibited a higher value of average L_{eq} [65.86 ± 9.82 dB (A)] as compared to (64.56 ± 8.47 dB (A) of Vegetable Market during day (Table-5).

The average outdoor and indoor L_{eq} of 94.98 ± 2.05 dB (A) and 82.86 ± 1.57 dB (A) respectively were observed in Mini Buses plying in the Study Area (Table-6).

Bhatnagar and Srinivas (1992) in Chandigarh, Pandya and Srivastava (1999) in Jabalpur City, Bhattacharya and De (2000) in Durgapur, Rajamohan (2000) in Madurai and Singh *et al.* (2000) in Dhanbad also observed higher values of noise levels in commercial areas as compared with the values prescribed by Central Pollution Control Board. Dhillon *et al.* (1994) in Ludhiana, Singh and Jain (1995) in Delhi, Joshi (1998) in Indore, Moses *et al.* (2000) in Tamil Nadu, Ravichandran *et al.* (2000) in Pudukkottai and Lalitha *et al.* (2002) in Tiruchirappali and Mishra (2004) in Rewa Town, M.P also observed higher value of noise levels in the residential, institutional and commercial areas as compared with the values prescribed by Central Pollution Control Board.

Table-5: Average L_{eq} at vegetable market and bus stand located in the study area, Bishnah Town, Jammu during different time periods

Time	Sites	Min.	Max.	L_{eq}
Morning time (0600-0800 hrs)	Vegetable market	44.70	64.50	54.86
	Bus-stand	44.00	64.50	54.86
Afternoon time (1400-1600 hrs)	Vegetable market	60.00	78.00	68.29
	Bus-stand	56.00	79.00	73.73
Evening time (1800-2000 hrs)	Vegetable market	62.16	76.60	70.52
	Bus-stand	59.90	73.90	68.98
Average Noise Level	Vegetable market	44.70	78.00	64.56±8.47 54.86±70.52
	Bus-stand	44.00	79.00	65.86±9.82 54.86±73.73

Table-6: Average L_{eq} in mini buses plying in the study area, Bishnah Town, Jammu

Noise levels	Indoor	Outdoor
Min.	68.60	68.00
Max.	88.20	106.60
L_{eq}	82.86±1.57 81.54±84.59	94.98±2.05 93.47±97.32

References

Bansal, A.S. and Grewal,P.S., 1990. *Noise Pollution: Its Awareness and Control. In: Environmental Management* (Eds. G.S. Dhaliwal and V.K. Dilawari). Punjab Agricultural University, Ludhiana. pp: 5-11.

Bayo, M.V., Garcia, A.M. and Garcia, A., 1995. Noise levels in an Urban Hospital and Workers Subjective Responses. ***Arch. Env. Health***, 50: 247-252.

Bhatnagar, V.S. and Srinivas, M.S.N., 1992. Analysis of Noise Levels in Commercial areas of Chandigarh. ***Indian.J. Env. Health***, 34(l): 5-14.

Bhattacharrya, S. and De, A., 2000. Noise Study Comparison at two Different Road Intersections in the Street City of Durgapur. ***Indian.J. Env. Prot.***, 20(8): 573-583.

Dhillon, M.K., Gupta, R. and Dhaliwal, G.S., 1994. Vehicular Intensity and Prediction of Noise Levels in Ludhiana City. ***Indian.J. Ecol.***, 21(1): 60-66.

Joshi, G., 1998. The Ambient Noise Levels at Indore, Madhya Pradesh. ***Poll. Res.***, 17(1):75-77.

Lalitha, M., Bhanumathy, V. and Rao, N.S., 2002. Traffic Noise Pollution Analysis at Selected Sites in Tiruchirappalli City. ***Indian.J. Env. Prot.***, 22(6): 671-676.

Mishra, B.K., 2004. Status and Assessement or Noise Pollution Level at Rewa Town. M.P. ***J. Curr. Sci.***, 5(1): 623-628.

Moses, A.A., Ravichandran, C., Sagila., J.C., Sangeetha., R., Srinivasan, K., Andrews, J. and Raja, R.E., 2000. Noise Pollution Assessment in Chidambaram, Erode and Thanjavur Towns in Tamil Nadu. ***Indian.J. Env. Prot.***, 20(l 2): 881-884.

Mukhopadhyay, R.N. and Ramanathan, N.L., 1967. Vehicular Noise in Quiet Zone in Calcutta. ***Indian.J. of Occupl. Health.***, 10: 117.

Pandya, M. and Shrivastava, R.K., 1999. Analysis of Noise Levels and its Health Effects in Commercial Areas of Jabalpur city: Part 1 Analysis of Noise Levels. ***Indian .J. Env. Sci.***, 3(2): 197-200.

Rajamohan, S., 2000. Noise Pollution at Madurai Corporation Area: A case Study. ***J. Ecotoxicol. Env. Monit.***, 10(3) : 211-214.

Rampal, RK. and Rasool, N., 2004. Assessment of Noise Levels in Various Government Hospitals of Jammu City (J&K). ***J.Curr.. Sci.***, 5(2): 629-634.

Rampal, R.K. and Pathania, D., 2008). Assessment of Noise Levels in Households of Bishnah Town, Jammu (J&K). India. ***PolI.Res.***, 27(1): 69-72.

Ravichandran, C., Chandrasekaran, G. and Venkatasubramanian, R., 1997. Status of Noise Pollution in *Hosur.* ***Indian J. Env. Prot.***, 17(4): 278-280.

Ravichandran, C., Chandrasekaran, G. and Vijaya, M., 2000. Noise Pollution Assessmerit in Pudukkottai. Tamil Nadu. ***Poll. Res.***, 19(13): 431-434.

Sargent, J.W., Gidman, M.l., Humphreys, M.A. and Utley, M.W., 1980. The Disturbance Caused to School Teachers by Noise. ***J. Sound Vibr.***, 70(1): 557-572.

Singh, B.B. and Jain, V.K., 1995. A Comparative Study of Noise Levels in Some Residential. Industrial and Commercial Areas of Delhi. ***Env. Monit. Asses.***, 35(1): 1-11.

Singh, P.K., Prasad, S.S. and T.N .Singh, T.N., 2000. Status of Noise Pollution in Dhanbad Muncipal Area. ***Indian J. Env. Prot.***, 20(1): 11-14.

Tiwari, T.N. and Ali, M., 1988. Survey of noise pollution in Rourkela: 111Noise in government offices. ***Indian J. Env. Prot.***, 8(10): 724-728.

Environment Conservation Journal 10(3) 125-128, 2009
(ISSN 0972-3099)

Protection by zinc against mercury toxicity in the intestine of a Catfish-*Heteropneustes fossilis*-A Biochemical study

Sangeeta Pal, J. Bhoraskar and S. Dubev

Received: 11-05-2009 Accepted: 12-10-2009

Abstract

Present study deals with the investigation of toxic effects of Mercury and zinc and the role of zinc in the simultaneous treatment of mercury and zinc, in the intestine of a catfish *H. fossilis*. Biochemical studies had shown decrease in glucose and protein level and increase in alkaline phosphatase due to Hg (0.0l mg/l) treatment for 30 days. When treated with Hg and Zn simultaneously, values for all these parameters were comparable to that of control group, suggesting protective role of Zn against Hg toxicity.

Keyword:- *Mercuric chloride, Zinc sulphate, Intestine, Toxi*

Introduction

Environmental pollution due to heavy metals as a result of rapid industrialization has been reported in different parts of globe including India (Ansari *et al*., 1991; Long *et al.*, 1991; Adrienne and Resmissan, 1998; Govil *et al.,* 1999). The toxicity of mercury was known as early as 16th century and it has been fovnd highly toxic to both humans and animals (Clarkson, 1997). Mercury is widely used in electrical apparatus, chlorine industry, caustic soda and caustic potash industry, chloro-alkali industry, in ayurvedic medicines and also in dentistry (Margarat *et al.*, 2001

Accumulation of mercury in different tissues in various fishes has been reported (Dhanekar *et al.*, 1987; Mason *et al.*, 2000; Lima *et al.*, 2005). Hg is corrosive to the intestinal tract and can damage liver, kidney, if taken in sufficient amount (Gold water, 1971; Hommond, 1971).

Protection against heavy metal toxicity by herbal compound (Geed, 1992; Kothari *et al.*, 1999), essential metal (Bhoraskar and Kothari, 1993; Chen *et al.*, 2001) antioxidants (Potdar, 2007) has been reported. Zn is an essential metal and its pretreatment is known to provide protection against Cadmium (Peter, 1984). With this view in mind, present study was undertaken to assess protective role of zinc against mercury toxicity in the intestine of *Heteropneustes fossilis*.

Author's Address

Deptt. of Zoology, Govt. Autonomous Holkar Science College, Indore ✉

Materials and Method

Living and healthy specimens of *H.fossilis* were purchased from local market of Indore. Fish were acclimatized to laboratory conditions for 7 days. Analytical grade mercury chloride (BDH) and zinc sulphate (BDH) were used. 96 hrs LC_{50} for mercury chloride and zinc was found to be 0.5 mg/l and 600 mg/l respectively. Fishes were divided into four groups. Group 1st served as control group. Details of experimental groups are given in Table-1.

Table-1: Experimental groups of Fish

Group No.	Treatment
I	Control (without Poison)
II	Exposed to 0.01 mg/l $HgCl_2$
III	Exposed to 10 mg/l $ZnSO_4$
IV	Exposed to 0.01 mg/l $HgCl_2$ + 10 mg/l $ZnSO_4$

The duration of experiment was 30 days. The water of all aquariam was changed every 4th day and heavy metal salts were introduced into 2nd 3rd & 4th groups immediately after the water was renewed. Chopped prawns were given daily at a fixed time. No artificial aeration was done during experiment. Fishes from each group tissue was used for assaying level of total

protein (Lowery *et al.*, 1951), total glucose (Trinder, 1969) and alkaline phosphatase (ALP) activity (Wooton, 1964). Student "t" test was used to determine statistical significance of protein, glucose and ALP.

Results and Discussion

During this study reduced protein level was recorded due to mercury as compared to the control group in the intestine of *H. fossilis*. Zn alone enhanced the protein level, while Hg and Zn in combination maintained protein level near normal level (Table-2 Fig. 1). Depletion in protein content under the mercury stress has been reported earlier (Ramalingam and Ramalingam, 1982; Sharma, 1997) finding of this study are in accordance with the earlier reports.

Table-2: Protein concentration (mg/ml) in intestine of *H. fossilis*

Groups	Organ
	Intestine
I	7.13±0.41
II	3.98±0.20[a]
III	8.91±0.43[c]
IV	8.01±0.81[x]

Note: Data are means ±SEM. (n=7); x, p <0.001 as compared to the respective values of Hg group; a, p <0.001 and c, p <0.05 as compared to the respective control values; NS= Non significant I Vs III

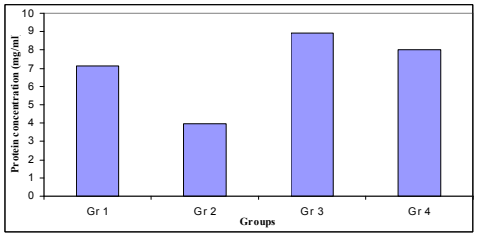


Fig. 1: Protein concentration (mg/ml) in intestine of *H. fossilis*

Reduction in protein level may be attributed to the impairment of food intake (Neff, 1985) and interference in protein synthesis due to mercury poisoning like other heavy metals (Suverson, 1977) and utilization of endogenous protein for maintenance of energy supply (Ramalingam and Ramalingam, 1982). Similar to protein, glucose level also significantly fell down due to Hg intoxication but increased in the presence of low concentration of Zn in group-III. In group-IV (Hg + Zn treated) glucose content in tissue, reached almost near to the normal level (Table-3, Fig. 2), suggesting protective role of Zn against Hg intoxication.

Table-3: Glucose concentration (mg/ml) in intestine of *H. fossilis*

Groups	Organ
	Intestine
I	15.20±0.60
II	10.20±0.41[a]
III	18.31±1.02[c]
IV	13.98±0.88[y]

Note: Data are means ±SEM. (n=7); y, p<0.01 as compared to the respective values of Hg groups; a, p<0.001; b and c, p<0.05 as compared to the respective control value

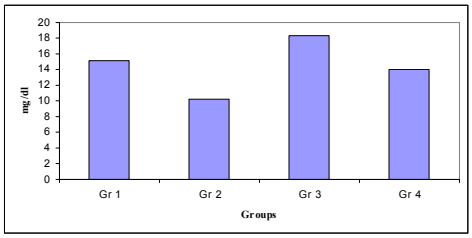


Fig. 2: Glucose concentration (mg/ml) in intestine of *H. fossilis*

Depletion in glucose content in intestine may be attributed to depletion of normal food intake due to Hg poisoning (Geed, 1992) and disturbed carbohydrate metabolism. Depletion in the level of glucose due to Zn (Kothari and Soni 2004) has been reported in the past. Protective effect of Zn against Hg toxicity also been reported by Fukino *et al.*, 1986 in rats.

During this study Hg enhanced the ALP activity, while exposure to Zn inhibited enzyme activity. However catfish exposed to Hg and Zn simultaneously was able to maintain ALP activity near normal (Table-4, Fig-2).

Duration dependent effect of Hg poisoning on ALP activity has been reported in intestine of *H. fossilis*. Both rise in ALP activity due to Hg in fish (Potdar,

Table-4: Alkaline phosphatase (KA unit) activity in intestine of *H. fossilis*

Groups	Organ
	Intestine
I	1.33±0.05
II	2.01±0.12[a]
III	0.99±0.04[a]
IV	1.30±0.08[x]

Data are means SEM. (n=7).

x, p<0.001 and y, p<0.01 as compared to the respective values of Hg group.

a, p<0.001; b, p<0.01 and c, p<0.05 as compared to the respective control values

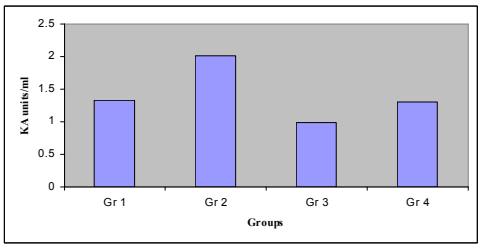


Fig. 3: Alkaline phosphatase (KA unit) activity in intestine of *H. fossilis*

2007) and fall in ALP activity due to Zn poisoning (Kothari and Soni, 2004) are known to occur. Findings of this study are in accordance with the earlier reports. It is known that alkaline phosphatase in intestinal brush border plays a critical role in the absorption of various macromolecules from the lumen to the tissue interior (Sinha, 1979; Chakrabarty and Sinha, 1982). Both the loss (Rodin and Crowson, 1962) and increase (Jeelani and Shaffi, 1986) in the ALP activity have associated with tissue necrosis and structural damage. The result of this study clearly revealed that alteration in the value of protein, glucose & ALP activity caused due to mercury intoxication were maintained near normal in the presence of zinc sulphate. This suggests that zinc provided protection against mercury caused disturbances in biochemical parameters.

References

Adrienne C.J., Resmissan, Larcocque, P.E., 1998. An overview of trace metals in the environment: mobilization to remediation. ***Environmental Geology***, 33: 85-91.

Ansari, A.A., Singh, L.B. and Tobschell, H.J., 1991. Status of anthropogencially induced metal pollution in the Kanpur Unnao Industrial Region of the Ganga Plain, India, ***Environmental Geology***, 38: 25-33.

Bhoraskar J. and Kothari, S., 1993. Toxicity of mercury and zinc in the liver of a catfish Clarias batrachus (ljrm.iin: recent advances in freshwater biology. Eds. K.S. Rao. Anmol Publ. New Delhi, (India). pp: 1:285-299

Chakrabarty, P. and Sinha, G.M.,1982. Detection and localization of alkaline and acid phosphatase in the digestive system of the adult Catla catla (Ham.) an Indian freshwater major carp by histochemical method. ***Morph.J.B.***, 128: 799- 808.

Chen, Y. W., Belzile, N., Gum, J.M., 2001. Antagonistic effect of selenium on mercury assimilation by fish population near Sudbury metal smelters. ***J. Limnol. Oceanoger***, 46(7): 814-8.

Clarkson, T.W., 1997. Thetoxicology of mercury. ***Crit. Rev. Clin. Lab. Sci.***, 34: 369-403.

Dhanekar, S., Shrivastav, S., and Roo, K.S., 1987. Experimental studies on accumulation of mercury in different fish tissues. Perspective in Hydrobiology. (Ed.) Rao K.S. and Shrivastav S. Set 111(18): 87-89.

Fukino, H. Hirai, Hsuch, M., Moriyasu, Y.M., Yamane, S., 1986. Mechanismof protection by zinc against $HgCl_2$ toxicity in rats. Effects of zinc and mercury on glutathionine metabolism (GSH). ***J. ToxicoI.Environ. and Health***, 19(1):75-89.

Geed, S., 1992. Iiv-52 Protection against $HgCl_2$ toxicity in liver and gills of a catfish Heteropneustes fossilis (Bloch): A histological and Biochemical study M.Phil. Thesis Vikram university Ujjain, pp: 1-77.

Gold water, L., 1971. Mercury in the environment. ***Sci. Am.***, 224(5): 15-21.

Govil, P.K. Reddy, G.L.N. and Gnaneswara Roo, T., 1999. Environmental pollution due to heavy metal and radiogenic elements in nacharam lake. ***Indian Journal of environmental health***, 61: 23-29.

Hammond, A.L., 1971. Mercury in the environment: Natural and human factors science. 171:788-789.

Jeelani, S. and Shaffi, S.A., 1986. Heavy metal toxicity on visceral acid and alkaline phosphatase in three freshwater teleosts. International workshop on surface water management, Bhopal. Jan. 17-18 PP.38(Abstr.)

Kothari, S. Pandya, C. and Mahajan, P., 1999. Role of a drug "Essential" against Cadmium toxicity in the intestine of *O. mossambicus* (Frewavas). The 4th Indian fisheries forum proc., 24-28, Nov, 1996, Kochi. 135-137.

Kothari, S. and Soni, R., 2004. Role of polyunsaturated fatty acids against zinc sulphate toxicity in the gills of a catfish Heteropneustes fossiis (Bloch). ***Journal of tissue Research***, 4 (2): 253-256.

Lang. H.E, Ha. D. Xie. Q. and Che, X., 1999. An approach to studying heavy metal pollution Caused by Modern City Development in Nanjing China. ***Environmental geology***, 38: 223-228.

Lima,A.P., Sarkis, J.E., Shihomalsu,H.M., and Muller, R.C., 2005. Mercury and selenium concentration in fish samples from caclocira do Piria Municipality, Para state, Brazil. ***Environmental. Res.,*** 97(3):236-244.

Margarat, A., Jagdeesan, G. and Sathupathy, S., 2001. Comparative effect of penicillamine and taurine on mercury poisoned mice, Mus musculus. ***Pollut. Res.***, 20(1): 1-4.

Mason, R.P., Laprote, J.M. and Andres, S., 2000. Factors controlling the biaccumulation of mercury, methyl mercury, arsenic, selenium and cadmium by freshwater invertebrates and fish. ***Arch. environ. Contain. Toxicol.***, 38: 283-297.

Neff, J.M., 1985. Use of biochemical measurement to detect pollutant mediated damage to fish ASTM spec. ***Tech. Publ.***, 854: 155-183.

Peter L. Goering and Curtis D. Klavarseen, 1984. Zinc induced tolerenceto cadmium hepatotoxicity. ***Toxicology and applied pharmacology***, 74: 299-307.

Potdar, N., 2007. Efficacy of vitamin C and vitamin E in liver and kidney of *Heteropneustes fossil* (Bloch) challenged with mercuric chloride M.Phil. Thesis, DAV Indore, M.P. 1-122.

Ramalingam, K. and Ramalingam, C.K., 1982. Effect of sublethal level of DPT, malathion and mercury on tissue proteins of sarotherodon *Mossambicus.* ***Proc.Indian Acad. Sci. Anim. Sci.***, 91(6): 501-506.

Rodin, A.E. and Crowson, C.N., 1962. Mercury nephrotoxicity in rat.II investigation of intracellular cite of mercury nephrotoxiciy by correlated serial time histologic and histoenzymatic studies in the kindney. 2nd ed. Brenner, B.M. and Rector, F.C., Pub. W.B. Saunders Co. Toronto.

Sharma, S.K., 1997. Role of essential phospholipids against mercury induced toxic effect in a freshwater teleost Oreochromos mossambicus, (Trewavas) Ph. D. thesis, Vikram University, Ujjain. pp: 1-109.

Sinha, G.M., 1979. Histochemical localization of alkaline and acid phosphate in the alimentary tract of hatchling of teleost fish, *Cirrhinus mrigala* (Ham.). ***Mikroskopie***, 35: 101-107.

Suverson, T.L.M., 1977. Effect of methyl mercury as in vivo protein synthesis in isolated cerebral and cerebellar neurons, Neuropathol. ***Appl. Neurobiol.***, 3:225-236.

Trinder, P., 1969. Determination of blood glucose using an oxidase peroxidase system with a non-carcinogenic chromogen. ***J. Clin. Pathol.***, 22:158-161.

Wooton, J.D.P., 1964. Microanalysis in medical biochemistry London (J and A Churchill Ltd.)

Environment Conservation Journal 10(3) 129-131, 2009
(ISSN 0972-3099)

Fluoride induced alterations in the arginase activity of freshwater catfish, *Clarias batrachus* (Linn)

J. Achyutha Devi and Ravi Shankar Piska

Received: 14-12-2009 Accepted: 21-12-2009

Abstract

Fluoride induced alterations in arginase activity in liver, muscle, kidney, gill and brain of freshwater cat fish, *Clarias batrachus* (Linn.) were carried out. The effect of fluoride was observed in different concentrations like 1, 10, 20 and 30 ppm in 1, 30 and 60 days of exposure. The arginase activity was found increased in all the tissues, throughout the exposure span. Maximum activity was observed on 60th day of exposure in 30 ppm of fluoride concentration. In most of the cases the elevation of arginase activity significantly differed from the controls. Gill showed maximum activity followed by liver, brain, kidney, and muscle. The increase in arginase activity indicates production of urea or ornithine.

Keywords:- *Clarias batrachus, Fluoride, Toxicity, Arginase*

Introduction

Fluoride levels in unpolluted freshwater generally range from 0.01-0.3 mg/l. Fluoride ions can be removed from aquatic phase by the precipitation of calcium carbonate , calcium phosphate, calcium fluoride and magnesium fluoride (Camargo, 2004). Fluoride ion must be considered as a serious pollutant since, it's concentration in many aquatic systems is significantly increasing as a consequence of man's activity (Camargo and Lawpoint, 1995). Fluoride containing pesticides and plants manufacturing bricks, ceramics and fluoride chemicals are however leading to increased local fluoride levels up to 100 times the natural background level(Camargo, 2003). Important anthropogenic sources of fluoride to the aquatic environment include waste waters and effluents from fertilizer producing plants and aluminum refineries (Gigure and cambell 1985).

Fluoride toxicity increases with increasing fluoride concentration, exposure time, and water temperature (Angelovic *et al.*, 1965, Wright, 1977). The effect of fluoride on living systems have been considered at various levels of cellular tissue organisation. The wide range of responses in enzymes have been observd to an increased concentration of fluoride (Iwase, 1972). Jenkins *et al.,* 1972). Fluoride inhibits many enzymes through different mechanisms. Fluoride induced enhancement of ammonia levels were observed by Devi (1988). Not much information is available on fluoride induced metabolic alterations on arginase activity in fishes, especially in *Clarias batrachus*. The main objective of the study is to know the effect of different concentrations of fluoride on arginase activity of freshwater cat fish, *Clarias batrachus* in different exposure spans.

Materials and Method

Clarias batrachus fish was obtained from the Kaikaluru fish farms, Krishna district, Andhra Pradesh, carried to the laboratory in aerated polythene water containers from their natural habitats. Animals of weighing about 75-100 gm and measuring about 20-25 cm were used for experiment. They were left in the water tanks for acclimatization as suggested by Klontz and Smith (1969) for 20 days. During acclimatization fish were fed with fish feed and egg albumen. Fish of same sex and weight were selected and transferred to plastic containers. The experimental tubs were set up in parallel with control. Feed was given to the both experimental and control fish and water was renewed. The feeding was stopped 24 hours prior to experiment to avoid metabolic

Author's Address

Deptt. of Zoology, College of Science, Osmania University, Hyderabad ✉

differences if any due to differential feeding.
Sodium fluoride was added in 1, 10, 20, 30 ppm and the fish were exposed to different exposure spans of 1, 30 and 60 days. After the exposure period, the fish were dissected and various organs like liver, kidney, gill, muscle and brain were used for estimation by modified method of Archibald (1944), Vanslyke and Archibald (1946). The statistical tests were employed as per Bailey (1959).

Results and Discussion

Arginase activity was increased in all the tissues throughout the exposure span (Fig. 1 to 5). Time dependent percent enhancement was recorded. Maximum arginase activity was observed on 60th day of exposure in 30 ppm of fluoride concentration. Gill showed maximum activity (+91.83%; P<0.001), followed by liver (+64.78%; P<0.001); brain (+44.35%; P<0.001, kidney (37.38%; P<0.001) and muscle (+25.94%; P<0.001). All tissues showed statistically significant values over controls. However on first day of exposure at 1 ppm concentration, all tissues showed statistically insignificant values.

Discussion

During urea cycle arginase converts L-arginine into L-ornithine. This L-ornithine is then utilized in different pathways in liver (a) by ornithine carbomyl transferase in the urea cycle, (b) by ornithine transaminase to form glutamate semialdehyde ultimately converted in to either glutamate or L-proline and (c) for formation of polyamines by ornithine carbamylase (Bolkenius and Sieler, 1981; Matsui and Pegg, 1982).
In the present investigation, arginase found increased in all the tissues throughout the exposure span. The elevation is progressive and reached maximum in 60th day of exposure. Liver and gill showed maximum activity followed by brain, kidney and muscle. However, the percent enhancement was more marked in all the experimental tissues at all exposure spans.

Little is known about arginase activity in different fishes. The increase in arginase activity indicates production of urea or ornithine. Conversion of ammonia to urea is significant in the detoxification of ammonia (Krebs, 1952). The enhancement of arginase activity

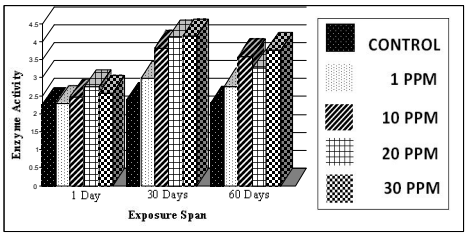


Fig. 1: Arginase activity(µ moles of urea/ mg protein/ hr) in liver of *Clarias batrachus* exposed to various concentration of fluoride

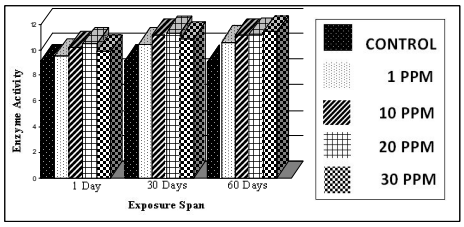


Fig. 2: Arginase activity(µ moles of urea/ mg protein/ hr) in muscle of *Clarias batrachus* exposed to various concentration of fluoride

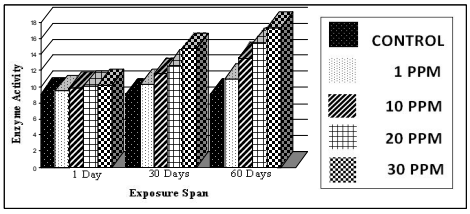


Fig. 3: Arginase activity(µ moles of urea/ mg protein/ hr) in kidney of *Clarias batrachus* exposed to various concentration of fluoride

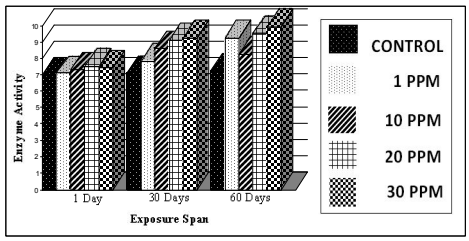


Fig. 4: Arginase activity(µ moles of urea/ mg protein/ hr) in gill of *Clarias batrachus* exposed to various concentration of fluoride

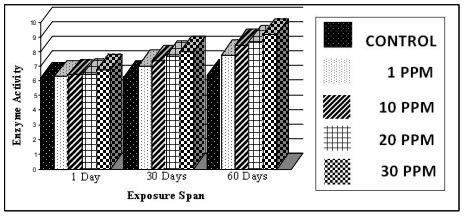


Fig. 5: Arginase activity(µ moles of urea/ mg protein/ hr) in brain of *Clarias batrachus* exposed to various concentration of fluoride.

indicates the increased utilization of ammonia towards urea synthesis, to avoid ammonia toxicity. The inconsistency in the activity levels of arginase were reported in the fish model (Geethanjali, 1988) and this inconsistency attributed the defect in the ornithine cycle at some level by inhibiting the enzyme systems.

References

Angelovic, J. W., Sigler, W.F and New Hold J.W., 1965. Temparature and flurosis in Rainbow trout. ***J. water. Pollut. Control. Fed.***, 33: 371 - 381.

Archibald, R.M., 1944. Determination of citrulline and Allontoin and demonstration of citrulline in blood plasma. ***J. Biol. Chem.***, 156;121.

Bailey, N.T.J., 1959. *The statistical methods in biology*. The ECBS and English unix press Ltd.,Great Britain 1959).

Bolkenius, F.N. and Sieler, N., 1981. Acetyl derivatives as intermediate in polyamine catabolism. ***Int. J. Biochem.***, 13:287-292.

Camargo, 2004. J.A Bull. Environ. Contam. ***Toxicol***, 72: 579-585.

Camargo, 2003. J.A. ***Chemosphere***, 50(3): 251-264.

Camargo, 1995. J.A, T.W. Lawpoint. ***Arch. of Environ. Contam. Toxicol***, 29: 159-163.

Devi, J.A., 1988. Fluoride induced alterations in the protein metabolism of fresh water fish Clarias batrachus. Ph.D. thesis Osmania university, Hyderabad.

Geetanjali, 1988. Alterations in nitrogen metabolism during BHC intoxication in fresh water fish Channa punctatus. Ph.D. thesis Osmania university, Hyderabad.

Gigure, A. and Cambell, P.G.C. Fluoride Toxicity towards fresh water organisms and hardness effects. ***Rev. Sci. Env.***, 17(3): 373-393.

Iwase,1972. Studies on the Glycogen and phosphorylase variations on myocardiym, skeletal muscle and liver in experimental fluorosis influence of fluorine on, phosphorylase part II Shikoku ***Acta Medica,*** 12: 624-669.

Jenkins, G.N., Venkateswarlu, P.P. and Zipkin, I., 1972. *Effects physiologiques de faibles does de fluorures*. In fluor et sante . WHO monographes, 59: 167-135.

Klontz, G.W. and Smith, L.S., 1975. *Methods of using fish as biological research I*. Methods of animal experimentation.3rd ed. Gar, W.I. pp: 323-385. Makay *et al*. Academic press, Newyork (1969).

Krebs, H.A., 1952.*The enzymes*. Academic press, New York. pp: 2: 866

Matsui, I. and Pegg, A.E., 1982. Induction of spermidine N'acetyl transferase by dialkyl nitrosamines. ***Cancer.Res***., 42: 2990-2995.

Nachlas, M.M., Margulus, S.P. and Seligann, A.M., 1960. Sites of electron transfer to tetrozolium salts in the succino oxidase system. ***J.Biol.Chem.***, 235;2735.

Vanslyke, D.D. and Archibald 1946 gasometric and photometric measurement of arginase activity. ***J. Biol. Chem.,*** 165; 293 - 309.

Wright, D.A, 1977Toxicity of fluoride on brown trout fry (Salmo trutta) Environ pollute12;57-62.

Membership Information

Membership of Action for Sustainable Efficacious Development and Awareness (ASEA), INDIA is open for all those interested in the field of environment. There are two types of membership's available *i.e* Annual Membership and Life[#] Membership. All Members are entitled to get Environment Conservation Journal free and are entitled to submit their papers/ articles for publication in the journal.

MEMBERSHIP FORM/ SUBSCRIPTION FORM

Name .....

Designation .....

Qualification .....

Organisation .....

Address .....

.....

Electronic Address.....

Telephone ..... Fax Number.....

Type of Membership Annual [ ] Life[#] [ ]

Attach Biodata along with this application.

Recommended by at least two life members of the society :-

	Names	**Membership number**	**Signature**
1.			
2.			

Membership Fee

	India		**Abroad**	
	Annual (In Rs.)	**Life[#] (In Rs.)**	**Annual (In US$)**	**Life[#] (In US$)**
Individual	600	5000	75	500
Institutional	1500	15000	120	1000

All remittance should be paid by DD in the name of **Prof. D.R. Khanna,** Editor-In-Chief Environment Conservation Journal, Payable at Haridwar (U.K.) **India**, and be sent to **Prof. D.R. Khanna, 405-Vivek Vihar, Ranipur More Haridwar, 249407 (Uttarakhand), INDIA.** For and queries or enquiries you may contact us on **environcj@gmail.com**

[#]**Note: Life membership is for 10 years**

Xerox of this form may be used if required

Website: www.environcj.com