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Logo Description : It symbolizes an elephant within an ecological frame of peace and harmony moving towards prosperity and posterity. **Cover photo** (Anticlockwise from top) ; 1. *Euthalia aconthea, the* butterfly of Nandankanan, 2. Mangrove with strong root system along Puri shoreline, 3.Clockwise and clockwise hairworl in non-identincal twins 4. *Euryale ferox* Salib (Aquatic angiosperm) of Similipal, 5. *Vulpes bengalensis* in Paschim Medinipur, West Bengal, **Cover background photo** : *Vanda tessellata* of Similipal wildlife santuary, orissa, (By Mr. Bhabagrahi Mohanty).

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CONTENTS

BIO-TECHNOLOGY	Molecular characterization of endemic freshwater prawns, *Macrobrachium Lar* of Andaman	***S. N. Sethi, Nagesh Ram, V. Mahendran, Shalini Sethi and B. K. Das***	**01-05**
	Antibacterial assessment of flower extracts of *Butea monosperma* (Lam.) Taub.; Flame of forest	***K.Sahoo, S.Meher, N.K.Dhal and A.Nayak***	**06-08**
GENETICS	Hairwhorl in twins: An analysis	***P. K. Mohanty and S.N. Otta***	**09-13**
ECOLOGY	Commercialization of few wild medicinal plants from Deogarh district, Orissa, India	***S. C. Sahu, N. K. Dhal and R.C. Mohanty***	**14-16**
	Biodiversity of freshwater aquatic macrophytic vegetation of Similipal Biosphere Reserve, Orissa, India	***P.K.Dash, P.K.Mohapatra and M.Kar***	**17-25**
WILDLIFE	Distribution and status of the Indian fox (*Vulpes bengalensis*) in Paschim Medinipur District, West Bengal, India	***P. K. Pandit, V. K. Yadav and S. Basu***	**26-30**
	Butterfly diversity of Nandankanan Wildlife Santuary, Orissa, India	***S. Mishra, P.K. Mahapatra, S. Sinha, H.P. Nayak, A. K. Mishra, M.V. Nair, S.N. Mohapatra and S. Panda***	**31-37**
MERINE SCIENCE	Bichemical compositon of some edible portunidae crabs from Parangipettai coast	***M.Sudhakar, G.Ananthan, P.Sampathkumar and S S Jiban Dash***	**38-42**
	Fluvial and marine processes along Puri shoreline	***Smita Sucharita Nayak and B. M. Faruque***	**43-47**
PISCI CULTURE	Studies on growth performance rate of Indian common carp *(Cyprinus carpio carpio)* in certain sewage fed ponds of Banki, Orissa	***S. B. Mohapatra and A. K. Patra***	**48-54**

EDITORIAL

Global warming is the increase in the average temperature of Earth's near-surface air and oceans since the mid-20th century and its projected continuation.

It is caused due to enhanced concentration of green house gases like carbon dioxide, methane etc. The most notorious green house gas CO2 is the single biggest contributing factor to global warming. The major cause is burning carbon rich fossil fuels- coal, oil and gas. Methane comes from cattle, rice field, landfills etc. Since ages plants have been utilizing these carbons and acting as the biggest carbon sink. Over the years, rapid deforestation and significant developments in different sectors like industry, transport, power station, agricultural activities, fossil fuel retrieval etc. have led to an abundance of green house gases in the atmosphere. All these array of gases that come from human activities increase the atmosphere's ability to trap heat. Ozone layer depletion in the stratosphere through chlorofluorocarbon emission from refrigerators and air conditioners cause significant increase in ultra violet radiations reaching the earth's surface. It affects water sources, pattern of evaporation, precipitation, soil erosion etc. Climate change due to global warming affects every walk of life.

Although the initial impact is a rise in average temperature around the world - "global warming" - this also produces changes in rainfall patterns, rising sea levels, changes to the difference in temperatures between night and day, cyclones, flood, drought and so on. This more complex set of disturbances has acquired the label "climate change" - sometimes more accurately called "anthropogenic (human-made) climate change".

It has been one of the most talked about phenomena in recent times. The truth, however, is that there has been very little headway when it comes to acknowledging responsibilities, leave alone a paradigm shift in policies and ground rules. The most bizarre outcome has been a strange marriage of convenience between the developed and developing nations. The recently concluded Copenhagen summit saw the developed nations pledge $100 b annually for the developing nations by the year 2020. A substantial part of this fund has been earmarked for policies pertaining to climate adaptation e.g. construction of barriers to protect against rising sea levels, or conversion to crops capable of surviving high temperatures and drought. This has led prominent observers to ask a rather pertinent question- Is the global community left resembling an alcoholic who has earmarked hefty sums of money for a complicated liver surgery without even so much as cutting down on alcohol?

Recent controversies have also played a significant part in impeding the little momentum that had been built owing to years of relentless campaign. Worse still, they take the focus off core issues. In fact these days there is a new breed of climate change skeptics who disagree with the scientific consensus, and have provided their own projections of the economic cost of stricter controls. In fact the recent controversies that mired the IPCC must have cheered these climate change skeptics no end. Though it was certainly a bad mistake on part of the IPCC to cite a non verifiable source for such a dramatic claim, a closer look would suggest that the issue was clearly blown out of proportion by possible distracters. The fact that the Himalayan claim was not in the SPM (Summary for policy makers) is very important in judging how serious a mistake was its inclusion in the preliminary wider report.

Though there have been serious differences in opinion between various governments and a raging political and public debate continues regarding the legitimacy of global warming, the scientific community more or less stands united and confirms to the view that humans have played a significant role in causing climate changes. It is high time that serious measures be taken to halt the approach of this impending catastrophe. It therefore becomes even more important that the scientific community take on itself the task of envisaging strategies and spreading awareness amongst the masses. Concrete steps have to be taken towards formulating policies, building political consensus and laying stress on accountability. Let us all pledge to do our bit to fight and mitigate the menace of global warming.

(Dr. R.K.Samantaray)
Editor-in-Chief

e-planet 8 (1): 01 - 05

MOLECULAR CHARACTERIZATION OF ENDEMIC FRESHWATER PRAWNS, *Macrobrachium lar* OF ANDAMAN

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ABSTRACT

Macrobrachium genus is distributed globally across the tropical and sub-tropical regions and comprises over 200 described species . The greatest diversity of *Macrobrachium* species occurs in the Indo-pacific region, in particular on the Indian sub-continent and through out South East Asia. *Macrobrachium* prawns inhabit a wide variety of environments from mountain streams and lowland rivers to estuaries and coastal lagoons. A number of species are also adapted to more extreme environments such as acidic rain forest streams. Majority of *Macrobrachium* sp. inhabit fresh water, many species have extended larval life cycles over several months that require estuarine or marine environments, and several complete their entire life cycle in euryhaline environments. Many species demonstrates extremely wide distributions, particularly for 'freshwater species' M. *lar* is found from the east coast of the Africa to the central pacific islands. M. *lar*, popularly known as glass or rock/monkey prawn, is an indigenous freshwater prawn found only in streams of Andaman. In nature, the adult males are larger than females with narrow abdominal space and the male size varies from 86 mm to112 mm with weight of 32-40 gms . The rostrum is short, upturned distally before antennal flaps. First 2-3 rostral teeth are on the carapace. The rostral teeth formula is 6-8 / 2-4 (commonly 7-8 / 2-3). The first and second pair of pereiopods are chelated. Yellow spot are found both sides of abdominal segments except 3rd abdominal segments. M. lar stays in clear, transparent running water with rocky substrates. Dendrogram revealed that 30 different samples of M.*lar* species could be grouped into two major clusters namely I & II. The major cluster I has Bp7 which was collected from Betapur, middle Andaman located 200 km away from other locations. Major cluster II has further two clusters IIA, IIB; in this IIA having 18 sub groups from Shoal Bay, CARI stream, Burmanala and Cluster IIB has two samples from Shoal Bay and rest all from Betapur. This dendrogram revealed samples from Shoal bay and CARI Nallah interpreting with all the locations; this may be due to anthropogenic interferences and the stocks found from both the clusters having very good genetic variation, which may be utilized for selective breeding program further.

Key words : *Macrobrachium lar*, freshwater prawn, RAPD, Andaman.

INTRODUCTION

The Andaman and Nicobar Islands are located in the Bay of Bengal between 6° 45' N and 13° 41' N latitude and 92° 12' E and 93° 57' E longitude and are blessed with enormous of natural freshwater resources besides availability of large areas of brackish and open sea areas around it. The number of species in the genus *Macrobrachium* is approximately 125 worldwide, and these are widely distributed in fresh and brackish waters, mainly in subtropical and tropical areas. *Macrobrachium lar* is found from the east coast of the Africa to the central pacific islands. *M. lar*, popularly known as glass or rock/monkey prawn, is an indigenous freshwater prawn found only in streams of Andaman. In nature, the adult males are larger than females with narrow abdominal space and the male size varies from 86 mm to112 mm with weight of 32-40 gms (Tiwari, 1952; Sethi *et al*., 2009). Similarly female's size varies from 66-106 mm with weight of 14-20 gms. The rostrum is short, upturned distally before antennal flaps. First 2-3 rostral teeth are on the carapace. The rostral teeth formula is 6-8 / 2-4 (commonly 7-8 / 2-3). The first and second pair of pereiopods are chelated. Yellow spot are found both sides of abdominal segments except 3rd abdominal segments. It is a peculiar prawn in its habits, it can move from freshwater canals to peak of the mountains where streams originate, *M. lar* stays in clear, transparent running water with rocky substrates.

Selective breeding is a recent activity in aquaculture (fin fish and shell fish) which therefore holds great promise for genetic enhancement programmes. The use of molecular markers for enhancing selective breeding is an even newer activity, which is expected to be crucial for the development of disease resistant strains, for improved feed efficiency and product quality. Random amplified polymorphic DNA (RAPD) markers is a powerful genetic marker, useful in many areas of fish genetics and breeding. The analysis for RAPD markers is quick and simple, although results are sensitive to laboratory conditions. Polymorphic loci have been frequently applied to the analysis of genetic diversity, population genetic structure and genomic mapping. The markers have also been applied to the classification and systematic, parentage identification, germplasm conservation, and breeding programme of food fish. The aim of this work was to study the genetic variability within the population of *Macrobrachium lar* and to select the healthy brooders for breeding programs in Andaman and Nicobar islands.

Random Amplified Polymorphic DNA (RAPD) fingerprinting has been successfully employed to determine genetic diversity in *P. vannamei* and *P. monodon* (Tassanakajon *et al*., 1997) for population genetic studies of *penaeid species*. Genetic diversity of the giant tiger shrimp, *P. monodon* was examined by RAPD and mitochondrial DNA (16S ribosomal DNA and intergenic COI-COII) polymorphism. He also studied the genetic diversity during 2000 of three mud crabs, *Scylla serrata* (Forskal), *S. oceanica* (Dana) and *S. tranquebarica* (Fabricius) of Thailand was examined by RAPD-PCR. Large genetic differences between species were found, whereas those between populations within each species were much lower. Random Amplified Polymorphic DNA assay has been used by to generate species specific markers in a study in four Indian major carps such as Rohu, Catla, Mrigal and Kalbasu and also to quantify the genetic variation and construct the phylogenetic dendogram for the six *Labeo species* viz dycheilus, rohu, kalbasu, bata, fimbriatus and gonius. Randomly Amplified Polymorphic DNA was used to study the genetic diversity and assay polymorphisms of *Macrobrachium rosenbergii* in Malaysia (See *et al*., 2008)

MATERIALS AND METHODS

Isolation of DNA

Specimens of *M. lar* were collected from four (BP: Betapur, SB: Shoal Bay, CA: CARI Nallha, and BN: Burma Nallha) different locations of Andaman. A total of 30 prawn samples were collected for RAPD analysis, thirty five 10-base primer were used for amplification. Pleopod muscle of the prawns were collected and kept in absolute ethanol during transportation. Specimens were stored in –80^{o}C until required. DNA was extracted from fine tissue (Pleopod) following the method described by Tassanakajon *et al*. (1997).

Purity of isolated genomic DNA influences all downstream applications. Therefore, it is very important to ensure the quality and quantity of isolated DNA before it is further used. This can be performed ideally in a spectrophotometer. DNA/RNA absorbs UV lights at 260nm whereas protein at 280nm. The ratio of absorbance at 260nm to 280nm for a sample is an indicator of quality of the isolated DNA. The pure DNA should have optical density ratio (260:280) equal to 1.8. Qualitative analysis of the DNA was also performed using 0.8% agarose. 2 ml of DNA sample was loaded into the slot of 0.8% agarose gel containing 0.5% ethidium bromide. The electrophoresis was carried out until the dye migrates approximately 1-2 cm from the well. The DNA band was estimated by visually on the UV transilluminator. (Table.1).Primers used for RAPD analysis in *M. lar*

PCR amplification and agarose gel electrophoresis:

PCR amplifications was carried out in a total reaction of 25 mL containing 1 U of Taq DNA polymerase, 200 mM dNTPs and 10 pmol of random primer, 2.5 mL of 10X Taq DNA polymerase buffer and 40 ng of genomic DNA. The final reaction mixture was placed in a thermal cycler. The PCR programme included an initial denaturation step at 94°C for 4 minutes followed by 45 cycles with 94°C for 1 minutes for

DNA denaturation, annealing at 36° C for 1 minute, extension at 72°C for 2 minutes and final extension at 72°C for 10 minutes were carried out. The samples were cooled at 4° C. The amplified DNA was mixed with 6X gel loading dye (2ml) and run on 1.5% agarose gel using 1X TAE running buffer system. The ethidium bromide (10 mg/ml) stained gel was visualized under UV transilluminator connected to the gel documentation.

RESULTS AND DISCUSSION

Only twenty-one primers produced amplified bands. Eight primers that showed reproducible RAPD patterns. A total of 42 scorable bands, range in size from 500 to 5000 bp. RAPD patterns of samples were determined by direct comparison of the amplified DNA electrophoresis profile and with the use of BIO 1D++ system software. Fragments were scored as 1 if present or 0 if absent based on a molecular weight standard marker, and the data obtained were analyzed as binary variables. Each band was considered to be an allele of a locus. The number and frequencies of polymorphic loci gene diversity indices and unbiased genetic distances were estimated using NTSYS 2.02 system software. Clustering was performed by the unweighted pair-group method of analysis (UPGMA) with statistical support.

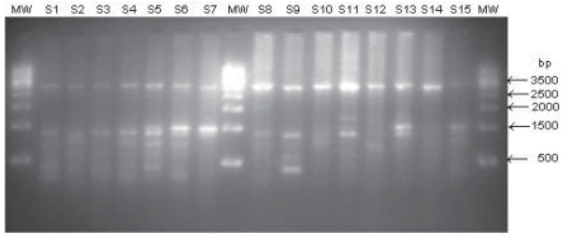
Table 1 : Primers used for RAPD analysis in *Macrobrachium* lar.

Primer No.	5' ⟶ 3' nucleotide sequence	GC content (%)	No. of bands	Polymorphic bands	Percentage of polymorphism
1	GCGCCTGGAG	80	1	1	0
2	AACGGGCAGG	70	3	3	100
3	GGCTGCGGTA	70	4	2	50
4	GCGGAGGTCC	80	4	1	25
5	CGACGCCCTG	80	8	7	87.5
6	GCGCCTGGAG	80	6	6	100
7	AACGGGCAGG	70	6	6	100
8	GGCTGCGGTA	70	5	5	20

Table 2 : Four populations of Macrobrachium lar used for RAPD fingerprinting and their sources in Andaman.

Prawn population	Collection site/source	Abbreviation
Betapur Stock	Middle Andaman	BP
Shoal Bay Stock	Middle Andaman	SB
CARI Nallha Stock	South Andaman	CA
Burma Nallha Stock	South Andaman	BN

Fig.1 : Freshwater rocky / monkey prawn, M. lar of Andaman & Nicobar Islands.



RAPD patterens obtained from primer no: 3 on 15 different samples of MACROBRACHIUM LAR.

S1- S2 = Samples of MACROBRACHIUM LAR from different location.
MW = Molecular Weight Marker.

Fig.2 : RAPD fingerprints pattern obtain from 4 different primers with the samples of Freshwater prawn, M. lar

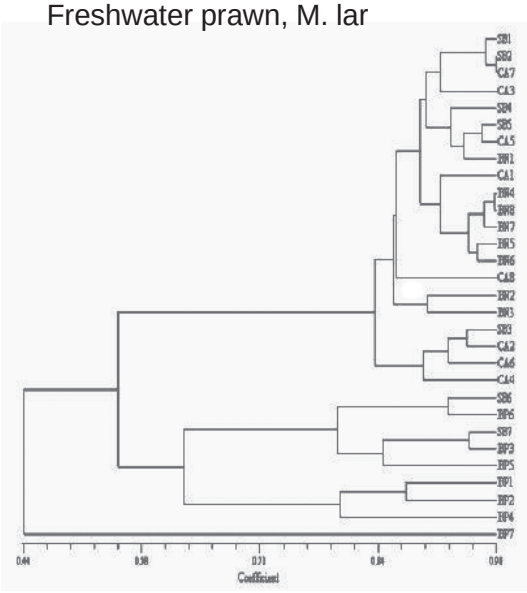


Fig.3 : Dendogram of genetic similarity among the species of 4 different locations from Andaman based on UPGMA Method.(BP: Betapur, SB: Shoal Bay, CA: CARI Nallha, and BN: Burma Nallha) The UPGMA dendrogram revealed the relationship between 30 different samples of *M. lar* species could be grouped into two major clusters namely I and II. The major cluster I has BP7 which is collected from Betapur, middle Andaman, it is located 200 km away.

RAPD can be an efficient tool to differentiate geographically and genetically isolated populations, and has been used to verify the existence of locally adapted populations within a species that may have arisen either through genetic selection under different environmental conditions or as a result of genetic drift Fuchs *et al*., (1998). Populational genetic differentiation can be driven by ecological, evolutionary and historical factors. In *Barbus neumayeri*, genetic differentiation among sampling sites that presented different oxygen rates could represent the effects of selective pressure (Chapman *et al*., 1999). The well-developed homing instinct of salmonid fish seems to be a decisive factor leading to strong population subdivisions (Ryman, 1983). An evolutionary unit can be identified for each tributary, with particular genetic traits possibly related to local adaptation and/or to inbreeding. In *Oncorhynchus nerka*, genetic differences were found between two populations inhabiting regions with distinct environmental conditions (Hendry *et al*., 2000). Furthermore, some river or lake systems contain metapopulations composed of distinct breeding units (Carvalho, 1993; Hansen and Loeschcke, 1994).

In the present study, the dendrogram revealed that 30 different samples of *M. lar* species could be grouped in to two major clusters namely I & II. The major cluster I has Bp7 which was collected from Betapur, Middle Andaman located 200 km away from other locations. Major cluster II has further two clusters IIA, IIB; in this IIA having 18 sub groups from Shoal Bay, CARI stream, Burmanala and Cluster IIB has two samples from Shoal Bay and rest all from Betapur. This dendrogram revealed samples from Shoal bay and CARI Nallah interpreting with all the locations which may be due to anthropogenic interferences and the stocks found from both the clusters having very good genetic variation, which may be utilized for selective breeding programme further.

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ANTIBACTERIAL ASSESSMENT OF FLOWER EXTRACTS OF *Butea monosperma* (Lam.) TAUB.; FLAME OF FOREST

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ABSTRACT

Methanol, petroleum ether, chloroform, hexane and aqueous extracts of the flowers of *Butea monosperma* (Lam.) Taub. were screened for antimicrobial activity against some clinical pathogens such as *Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Staphylococcous aureus* and *Proteus* sp. by disc diffusion method. Methanol and chloroform extracts showed potential antibacterial activity where as petroleum ether and aqueous extracts did not show any activity against all the test pathogens. Among the five solvents used, methanol and chloroform extracts showed maximum antibacterial response against *P. aeruginosa* and Proteus sp. respectively. The paper highlights that the active extracts such as methanol and chloroform of the above species can be used for curing several pathogenic diseases.

Key words: *In vitro* antimicrobial assay, methanol extract, *Butea monosperma*

INTRODUCTION

Different parts of medicinal plants have been used to cure specific diseases in India. Due to indiscriminate use of antimicrobial agents, drug resistant phenomenon is commonly observed and is posing a serious problem for the clinician. Newly developed antibiotics remain effective for a shorter duration and hence search for new effective antimicrobial drugs is continued. Plant oil and extracts have been used for a wide variety of purposes for many thousands of years. In particular, the antimicrobial activity of plant extracts have formed the basis of many applications, including raw and processed food preservation, pharmaceuticals, alternative medicine and natural therapies (Kalorey *et al*., 2003). The potential of higher plants as source for new drugs is still largely unexplored. On a global basis, at least 130 drugs, all single chemical entities extracted from higher plants or modified further synthetically, are currently in use, though some of them are now being made synthetically for economic reasons (Newman *et al.,* 2000). Plants are used medicinally in different countries and are a source of many potent and powerful drugs. A wide range of medicinal plant parts is used for extract as raw drugs and they possess varied medicinal properties.

Butea monosperma (Lam.) Taub, known as Flame of forest, belongs to the family Fabaceae. It is locally called in many different names such as palas, palash, mutthuga etc. and distributed, throughout India. Various medicinal properties are ascribed to flowers, leaves, bark and roots of this plant. The leaves are used to cure boils. The roots are useful in elephantiasis and in curing night blindness. Flowers are reported to possess astringent, depurative, aphrodisiac and tonic properties. The decoction of the bark is traditionally used in cold, cough, fever, various forms of hemorrhages, menstrual disorders and in the preparation of tonics and elixirs. The stem bark is reported for having antitumor, antiulcer, antifungal and antidiarrhoeal activities (Carey *et al.,* 2007). Considering the vast potentiality of plants as sources for antimicrobial drugs, a systematic investigation was undertaken to screen the flowers of *B. monosperma* for antibacterial study using different solvents such as methanol, chloroform, hexane, petroleum ether and water.

MATERIALS AND METHODS

The fresh flowers of *Butea monosperma* (Lam.) Taub. were collected from the Sonepur, Orissa (Latitude :- 20^0 49'47" N, Longitude :- 83^0 55'12"E) and identified in IMMT, Bhubaneswar, referring Flora of Orissa, Vol. I-IV (Saxena and Brahman,1994-96). A voucher specimen no:- 5198 (Fig.1) has been deposited in the herbarium of the Natural Product Department, IMMT. The flowers were air dried for one

week and pulverized using a mechanical grinder and the powdered part was used for further study .

The powdered of air dried flower were extracted with organic solvents such as methanol, petroleum ether, chloroform and hexane, using soxhelet apparatus for 24 hrs. The collected extracts were filtered and then evaporated by rotary evaporator. The weight of each dried extracts were noted down. The dried material was dissolved with required solvents and stored at 4^0C for further work. All the bacterial cultures such as *Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa,* Proteus sp. and *Staphylococcous aureus* were obtained from Hi-Tech Medical College, Bhubaneswar and were maintained on nutrient agar slants, subcultured regularly (every 30 days) and stored at 4^0 C.

Fig.1 : Overview of Butea monosperma

Screening of extracts for antibacterial potentiality was done by the disc diffusion method (Bauer et al., 1996). The test bacterial cultures were inoculated into Nutrient broth of 3-4 ml and incubated at 37^0C for16-18 hrs. Bacterial inoculums were swabbed on Nutrient agar plate in order to get a uniform microbial growth on control, standard and sample plates. The discs were placed at equidistant points on the agar surface. Filter paper discs loaded with known quantity (50µl.) of each extract, which were placed in the surface of NA plates. Then plates were incubated at 37 ^{0}C±0.5 ^{0}C for 24 hours for antibacterial activity. The diameter of inhibition zone formed around the disc was observed and recorded. A control set and a standard set of experiments was also carried out with the solvent i.e. methanol, petroleum ether, chloroform, hexane and the synthetic antibiotic i.e. Gentamycin respectively. Same procedures were followed for all four solvent for the comparative study.

RESULTS AND DISCUSSION

In case of methanol extract of the flower, it showed antibacterial activity against all test pathogens used. Maximum antibacterial activity was found against *S.aureus* i.e. 1.6 cm and minimum was found against *K.pneumonia* i.e. 0.8 cm at 0.243mg/ml conc (Fig.2).

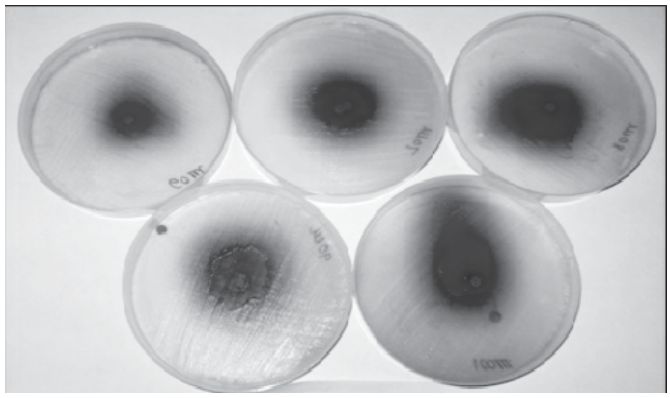

Fig. 2 : Antibacterial activity of methanol extract

In control plate, a inhibition of 1.7cm and 0.7cm where as in standard plate, a inhibition of 0.9cm and and 2.1cm was found against *S.aureus* and *K.pneumonia* respectively. In case of chloroform extract, maximum activity was found against *E.coli* i.e. 1.4cm and minimum activity was found against minimum activity was found against *K.pneumonia* i.e. 1.0cm at 0.215 mg/ml conc. (Fig.3).

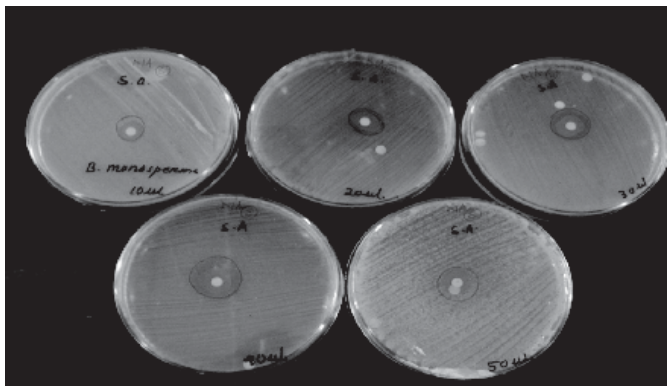

Fig.3 : Antibacterial activity of chloroform extract

In control plate, a inhibition of 1.1cm and 1.4cm where as in standard plate, a inhibition of 2.5cm and 1.6cm were found against *S.aureus* and *K.pneumonia* respectively. Hexane extract did not show any activity against most of the organisms where as a inhibition of 0.9cm and 1.4cm was recorded against Proteus sp. and *E.coli* at 0.212 mg/ml conc. Petroleum ether and water extracts did not show any activity against all the test pathogens used for the study (Table.1).

Table1. Antibacterial activity of provision of B. monosperma flower

Solvents	Diameter of zone of inhibition in cm					
	Ec	Kp	Proteus sp.	Pa	Sa	
Methanol (0.243mg/ml)		0.9	0.8	1.2	1.0	1.6
Chloroform (0.215 mg/ml)		1.4	1.0	1.3	1.2	1.4
Hexane	1.4	Nil	0.9	Nil	Nil	
Petroleum ether	Nil	Nil	Nil	Nil	Nil	
Water	Nil	Nil	Nil	Nil	Nil	
SD (Gentamycin 5mcg per disc)		1.2	2.1	1.0	1.5	0.9

B. monosperma has been reported for the treatment of many diseases like, the leaves are used to cure boils, the roots are useful in elephantiasis and in curing night blindness, and flowers are reported to possess astringent, depurative, aphrodisiac and tonic properties. All the solvent extracts obtained from *B. monosperma* flower possess antibacterial activity except petroleum ether and water which may be due to better solubility of most of the compounds in the solvents such as methanol, chloroform and hexane.

CONCLUSION

Plant extracts have greater potential against microorganisms as they contain antimicrobial compounds and that can be used in the treatment of various infectious diseases. The flower extracts of *B. monosperma* in different solvents such as methanol, chloroform showed activity against pathogens such as *E.coli, K.pneumoniae, P.aeruginosa,* Proteus sp.*, S.aureus.* which may cause different diseases such as skin infection, gastroenteritis, urinary tract infections, neonatal meningitis, immunosuppresant diseases, blood infections etc. Methanol and chloroform extract showed potential activity against all the test pathogens. Further studies need to be done on preparation of drugs using the active extracts such as methanol and chloroform of the flowers of *B.monosperma* which can be used for curing several pathogenic diseases.

ACKNOWLEDGEMENT

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HAIRWHORL IN TWINS: AN ANALYSIS

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ABSTRACTS

Hairwhorl is a characteristic feature of all human beings. In the present study, hairwhorls of 103 twins have been analysed out of which 51 pairs were non-identical(dizygotic) and 52 pairs were identical(monozygotic). It is observed that the twin pairs exhibit different types of hairwhorls like clockwise, anticlockwise, paired clockwise distantly located, paired clockwise closely located, paired anticlock and clockwise distantly located, paired anticlock and clockwise closely located, paired clock and anticlockwise distantly located, paired clock and anticlockwise united and paired anticlock and clockwise united. The percentage of concordance in hairwhorls of identical twins is comparatively more than in non-identical twins. This indicates more genetic identicality in identical twins than in non-identical twins. The hairwhorls of an individual may provide clue in the genetic identicality, heredity and embryonic significance.

Key words : Hairwhorl, identical twin, non-identical twin, crown, clockwise, anticlockwise, paired closely located, paired distantly located, united

INTRODUCTION

Hairs are specialized, elongated threadlike and cylindrical outgrowths of the mammalian epidermis. Some of the notable uses of hairs are (i) imparting colour and camouflage, (ii) forming an insulating sheath by trapping air which presents undue loss of heat from the body, (iii) forming a kind of portable blanket infurred for survival in cold, (iv) acting as tactile receptors (vibrissae), (v) preventing dust particles by eye lashes and hairs in and around nostrils and (vi) helping in getting rid of flies and other harmful insects by long tail hairs of cow or horse (Parker and Haswell, 1898; Sedgwick,1908) .

The hair provides evidences for individual as well as racial identification. Although the general structure of all human hairs is similar, some variation occurs among ethnic groups. The hair of scalp has been studied more exhaustively than hair of other regions of the body, because of its greater abundance and accessibility. Its length, thickness, colour and texture are gross characteristics seen with the naked eye, which are useful to anthropologists in distinguishing ethnological group (Goetz,1973). However, hairwhorl is a characteristic feature of all human beings (Altenburg,1957; Wunderlick and Heerema, 1975; Novitski,1977; Segal, 1990). Whorl is defined as circular arrangement of any object in the form of a whorl. The description of the whorl with respect to spinning, fingerprint and flowers are available in literatures but literature is silent on scientific account of hairwhorl of human beings.

Hairwhorl, formed by hair is present on the rear side (crown) of the head since the birth of human babies. This hairwhorl is usually singular in each individual which may be of clockwise or anticlockwise orientation. But rarely the structure, number and orientation of this hairwhorl show certain variation. The hairwhorl may also be noticed in paired or fused form. In paired condition, similar hairwhorl or dissimilar hairwhorls are present and they may be located closely or distantly or unitedly. In this study, the detailed account of hairwhorls in human twins has been reported.

MATERIALS AND METHODS

For the analyses of hairwhorls of twins, 51 pairs of non- identical and 52 pairs of identical twins of Orissa State have been taken into account and analysed during 1999 to 2005. Hairwhorls of the samples were observed, photographed and analysed. Basing on the similarities and dissimilarities in orientation of the hairwhorls between the members of twins, the percentage of concordance and discordance in hairwhorls have been calculated respectively.

RESULTS AND DISCUSSION

Of 51 pairs of non-identical twins, it is analysed that 72.55 per cent of non-identical twins have concordance in their hairwhorls (Table 1 and Fig. 1), out of which 68.63 per cent show clockwise hairwhorls on the same position of the rear (crown) of the head . The rest 3.92 per cent of non-identical twins exhibit anticlockwise orientation of hairwhorls in the similar position of the rear side of the head. Moreover, 27.45 per cent of non-identical twins show discordance in their hairwhorls (Table 1 and Fig. 1). Out of 27.45 per cent of non-identical twins, 13.73 per cent show a single anticlockwise hairwhorl and a clockwise hairwhorl on the rear side of the head of the first and the second member respectively . Further, 3.92 per cent of non-identical twins show distantly located paired clockwise hairwhorls and a single clockwise hairwhorl on the rearside of the head of first and second member of each twin respectively. Out of 5.88 per cent of non-identical twins, a single member shows a clockwise hairwhorl and whereas the other member, in each twin pair shows distantly located paired clock and anticlockwise hairwhorls on the rear side of the head .

Table 1 : Percentage of concordance and discordance in hairwhorls of non-identical twins

Sl No	Type of hairwhorls present on the backside of the head (crown)		Number of twins observed	Number of twins showing similarity	Percentage of concordance	Number of twins showing dissimilarity	Percentage of discord
	One member of the twins	Other member of the twins					
1	CW	CW	51	35	68.63	Nil	Nil
2	AW	AW		02	3.92	Nil	Nil
3	AW	CW		Nil	Nil7	7	13.72
4	CW –CW (Distantly located)	CW		Nil	Nil2	2	3.92
5	CW (Distantly located)	CW- AW		Nil	Nil3	3	5.88
6	AW-CW (United)	CW		Nil	Nil1	1	1.96
7	CW -AW (United) (Closely located)	CW –CW		Nil	Nil1	1	1.96
	Total		51	37	72.55	14	27.44

CW-Clockwise, AW-Anticlockwise, CW-CW – Paired clockwise , AW-CW -Paired anticlock and clockwise and CW-AW- Paired clock and anticlockwise

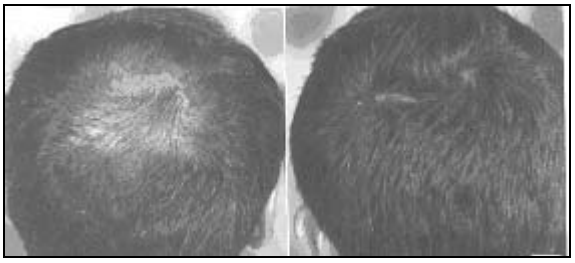
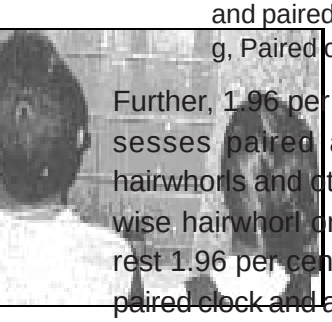


Fig. 1 : Hairwhorls in non-identical twins. a, Clockwise and clockwise; b, Anticlockwise and anticlockwise; c, Anticlockwise and clockwise; d , Paired clockwise distantly located and a singular clockwise; e, Clockwise and paired distantly located clock and anticlockwise , f , Paired anticlock and clockwise united and clockwise; g, Paired clock and anticlockwise united and paired clockwise closely located.



Further, 1.96 per cent of twins, single member possesses paired anticlock and clockwise united hairwhorls and other member shows a single clockwise hairwhorl on the rear side of the head and in rest 1.96 per cent of twins, single member possess paired clock and anticlockwise united hairwhorls and other member shows paired closely located clockwise hairwhorls .

Further, in hairwhorls of 52 pairs of identical twins, it is found 80.77 per cent of identical twins have concordance (Table 2 and Fig. 2) in their hairwhorls. Out of 80.77 per cent of identical twins, 76.92 per cent show clockwise hairwhorls on the similar position of the rearside of the heads and rest 3.85 per cent of identical twins exhibit anticlockwise orientation of hairwhorls in the similar position. It is also calculated that 19.23 per cent of identical twins show discordance in their hairwhorls (Table 2 and Fig. 2). Out of 19.23 per cent of twins, 13.46 per cent show an anticlockwise and a single clockwise hairwhorl on the rearside of the head of first and second member respectively and 1.92 per cent of twins show distantly located paired clockwise hairwhorls and a single clockwise hairwhorl on the rearside of the head of first and second member respectively of each twin pair . There after, 1.92 per cent show distantly located paired anticlock and clockwise hairwhorls in one member whereas the other member shows a single anticlockwise hairwhorl on the rearside of the head . In 1.92 per cent of twins, a single clockwise hairwhorl and closely located paired anticlock and clockwise hairwhorl on the rearside of the head of first and second member of each twin pair are seen respectively .

Thus, twins show clockwise, anticlockwise, paired clockwise distantly located, paired clockwise closely located, paired anticlock and clockwise distantly located, paired anticlock and clockwise closely located, paired clock and anticlockwise distantly located, paired clock and anticlockwise united and paired anticlock and clockwise united hairwhorls on the crown of the heads (Table 3 and Figs . 1 and 2).

Table 2 : Percentage of concordance and discordance in hairwhorls of identical twins

Sl No	Types of hairwhols present on the backside of the head (crown)		Number of twins observed	Number of twins showing similarity	Percentage of concord	Number of of twins showing dissimilarity	Percentage of discord
	One member of the twins	Other member of the twins					
1	CW	CW	52	40	76.92	Nil	Nil
2	AW	AW		02	3.85	Nil	Nil
3	AW	CW		Nil	Nil	7	13.47
4	CW –CW (Distantly located)	CW		Nil	Nil	1	1.92
5	AW -CW (Distantly located)	AW		Nil	Nil	1	1.92
6	CW	AW-CW (Closely located)		Nil	Nil	1	1.92
	Total		52	42	80.77	10	19.23

CW-Clockwise, AW-Anticlockwise, CW-CW - Paired clockwise and AW-CW - Paired anticlock and clockwise

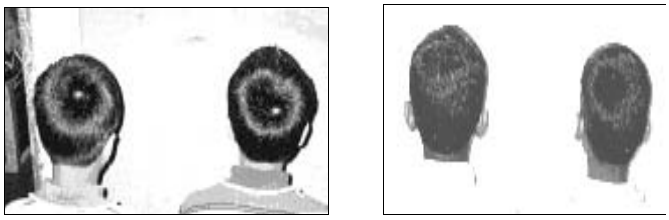


Fig.2 : Hairwhorls in identical twins.a, Clockwise and clockwise; b , Anticlockwise and anticlockwise; c, Anticlockwise and clockwise; d ,Paired clockwise distantly located and clockwise; e, Paired anticlock and clockwise distantly located and a singular anticlockwise, f , A singular clockwise and paired anticlock and clockwise closely located.

CONCLUSION

In twins nine types of hairwhorls have been identified and recorded such as clockwise, anticlockwise, paired clockwise distantly located, paired clockwise closely located, paired anticlock and clockwise distantly located, paired anticlock and clockwise closely located, paired clock and anticlockwise distantly located, paired clock and anticlockwise united and paired anticlock and clockwise united . Analysis shows that the percentage of concordance in hairwhorls of identical twins (80.77 %) is more than non-identical twins (72.55 %). This idicates more genetic identicality in identical twins than that of non-identical twins. The percentage of clockwise hairwhorls are more in both identical and non-identical twins. But paired hairwhorls are observed in rare cases in both categories of twins. This hairwhorl seems to be significant to establish genetic identicality, inheritance and cleavage pattern during embryonic development.

Table : 3 Types of hairwhorls in twins

Sl No.	Hairwhorl	Location on head	Figures of hairwhorls
1.	Clock wise	Front or rear of both	
2.	Anticlockwise	Front or rear or both	
3.	Paired clock wise distantly located	Front or rear or both	
4.	Paired clockwise closely located	Front or rear or both	
5.	Paired anticlock wise and clockwise distantly located	Front of rear or both	
6.	Paired anticlock and clockwise closely located	Front of rear or both	
7.	Paired clockwise and anticlockwise distantly located	Front or rear or both	
8.	Paired clock and anticlockwise united	Front or rear or both	
9.	Paired anticlock and anticlock and clock wise united	Front or rear	

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COMMERCIALIZATION OF FEW WILD MEDICINAL PLANTS FROM DEOGARH DISTRICT, ORISSA, INDIA

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ABSTRACT

The knowledge of medicinal plants and their uses in health care has inventoried from pre-historic periods. But its sustainable use and commercialization for economic development and conservation of medicinal flora is a recent trend. Since the demand of herbal medicines is increasing day by day, it is urgent to look into proper management, sustainable utilization and conservation of this valuable bioresource. The ongoing trend towards commercialization has resulted in overharvesting of some impotant medicinal plant species, many of which are coming under threatened category. The tribal people who collect the medicinal plants represent the poorest economic link in the trade chain. It is due to the lack of market and market information, for which the tribal people dispose the material at a throw away price. The present paper highlights seventeen species of wild medicinal plants along with their local names, botanical names, parts used, medicinal uses and average market price/kg.

Key words : Commercialization, medicinal plants, Deogarh district, Orissa

INTRODUCTION

'Herbal cure' a kind of treatment of illness using various plant parts is now gaining importance among the people of developed countries. Nearly 80 % of the world population depends upon traditional system of health care. Allopathic drugs have brought a revolution throughout the world but the plant-based medicines have its own unique status. The global herbal market is currently estimated to be $60 billion which is growing at the rate of 7 % per year. The agro-climatic conditions in our country and more particularly in the state of Orissa have offered vast scope for potential utilization of the medicinal plants through large-scale cultivation. India is one of the few countries that are capable of producing most of the important plants used both in modern and traditional systems of medicines due to the availability of wide variations of climate, soil, altitude and latitude (Lambert *et al.*, 1997). Most of the plants used by the drug industries, especially from high altitudes are harvested from wild. This led to the depletion of resources and extinction of some of the species. Orissa, which forms a part of the Eastern Ghats, harbors a vast number of medicinal plants. Deogarh district, one of the floristically rich district is the repository of many important medicinal plants. The medicinal plants of this district are yet to be catalogued and commercially exploited. The worldwide herbal medicine market is around US$ 30-60 billion which is likely to touch US$ 100 billion within next five years. In Germany and France, herbal medicines are sold as prescription drugs and covered by National Health Insurance. Germany has published monographs of 300 medicinal plants and China has generated data for the use of 800 medicinal plants. But Indian figure is dismal with only few monographs and no organized report. The judicious exploitation and commercialization of the important medicinal plants of Deogarh district should go hand in hand and people concerned should get economic incentives for cultivation of medicinal plants. This way the plants will be conserved and the villages will become economically self-reliant. However, no effort has so far been made for exploitation, commercialization and development of agro-techniques for organized farming. Now, there is a need for cultivation of these species in commercial scale and attention should be given for sustainable harvesting of wild medicinal plants.

METHODOLOGY

Deogarh district is located between longitude 84º 28' - 85º 15' N and latitude 21º 11' - 21º 43' E with a total area of 6702 sq. kms. towards the north-west part of Orissa. The topographical sequence ranges from 250 mt. to 700 mt. from the MSL, thus harbouring a vast range of flora and fauna and providing an ample scope for medicinal flora diversification. The study involves intensive explorations and critical study of specimens for 2 years. Regular field trips were made

in such a way so as to cover all the areas of the district at regular intervals in different seasons from 2006 to 2008. Plant specimens have been collected in sets of four both in flowering and fruiting stages. Field observations on phenology, habit, habitat, local names, local uses a method adopted by Jain, (1995) etc. have been recorded in the field at the time of collection and the supportive plant specimens of folklore claims were collected, processed, critically studied, identified consulting the flora of Haines (1921-25), Mooney (1950), Gamble (1915-36), Saxena and Brahmam (1994-96) and preserved in the herbarium of IMMT. Details of species covering 13 families, 16 genera and 17 species shown in Table - 1.

Table 1 : Market price of medicinal plants and their uses NB : (Fam. - Family, T – Tree, H – Herb, C – Climber and S- shrub)

Sl. No.	Common name/ Maturity period	Botanical Name and Family	Parts Used	Average Price (Rs./Kg)	Medicinal Uses
1	Amla (T) After 4th year	*Phyllanthus emblica* L. Fam: Euphorbiaceae	Fruit	Rs 50/kg	Vitamin – C, Cough, Diabetes, cold, Laxative, hyper acidity.
2	Ashok (T) 10 years onward	*Saraca asoca* (Roxb.) de Wilde Fam : Caesalpinaceae	Dry Bark	Rs 125/kg	Menstrual, Pain, uterine disorder, Diabetes.
3	Aswagandha (H) One year	*Withania somnifera* (L.) Dunal Fam: Solanaceae	Root	Rs100/ Kg	Restorative Tonic, stress, nerves disorder, aphrodisiac.
4	Bael / Bilva (T) After 4-5 year	*Aegle marmelos* (L.) Corr. Fam: Rutaceae	Fruit, Bark	Rs 60/ kg	Diarrrhoea, Dysentry, Constipation
5	Bhumi Amla (H) within one year	*Phyllanthus amarus* Schum. & Thonn. Fam : Euphorbiaceae	Whole Plant	Rs 30 / Kg	Anemic, jaundice, Dropsy.
6	Brahmi (H) One year	*Bacopa monn*ieri (L.) Pennel Fam: Scrophulariaceae	Whole plant	Rs 60 /kg	Nervous, Memory enhancer
7	Gudmari (C) After Four year	*Gymnema sylvestre* (Retz.) R. Br.ex Schult. Fam: Asclepiadaceae	Leaves	Rs 50 –75/ kg	Diabetes, hydrocil, Asthma.
8	Guluchi / Giloe (C) Within one year	*Tinospora cordifolia* (Willd.) Hook.f. & Thoms. Fam: Menispermaceae	Stem	Rs20 –25/ kg	Gout, Pile, Fever, Jaundice
9	Calihari (C) Five years	*Gloriosa superba* L. Fam: Liliaceae	Seed, tuber	Rs 60/kg	Skin Disease, Labor pain, Abortion
10	Kalmegh (H) Within one year	*Andrographis paniculata* (Burm.f.) Wall.ex Nees Fam : Acanthaceae	Whole Plant	Rs12 – 20/kg	Fever, weakness, release of gas.
11	Sarpa Gandha (H) After 2 year	*Rauvolfia serpentina* (L.) Benth.ex Kurz Fam: Apocynaceae	Root	Rs 125/ kg	Hyper tension, insomnia.
12	Satavari (C) After 2-3 year	*Asparagus racemosus* Willd. Family: Liliaceae	Tuber, root	Rs 60/ kg	Enhance lactation, general weakness
13	Kochila (T) After 15 yrs	*Strychnos nuxvomica* L. Fam: Loganiaceae	Seed	Rs 70/ kg	Nervous, Paralysis, healing wound.
14	Harida (T)	*Terminalia chebula* Retz. Fam: Combretaceae	Seed Powder	Rs. 80 / Kg	Wound, ulcer, leprosy, inflammation, Cough.
15	Bahada (T)	*Terminalia bellirica* (Gaertn.) Roxb. Fam: Combretaceae	Seed,Fruit Bark Powder	Rs20/kg Rs 100/kg	Cough, Insomnia, Dropsy, Vomiting, Ulcer
16	Bacha (H) 1 yr	*Acorus calamus* Linn. Fam : Araceae	Rhizome	Rs 40/Kg	Sedative, analgesic, epilepsy, hypertensive.
17	Kurai (S)	*Holarrhena antidysenterica* Wall.ex A.DC. Fam: Apocynaceae	Bark, Seed	Rs 50/Kg	Scabies, Antipyretic, Amoebic dysentery.

Note: All above quoted prices are approximate and are subjected to deviation with the market –trend.
Source: CIMAP Records; Chemical Weekly.

RESULTS AND DISCUSSION

Proper exploitation and commercialization of medicinal plants is necessary for economic development of Orissa. The people of Deogarh district collect the medicinal plants randomly without knowing the proper techniques of harvesting. This is a great loss to the floral diversity of medicinal importance. After collection of medicinal plants, they are selling it at a very low price as compared to India and world market. Recently in the news paper one article has highlighted that in Pallahara and other forest pockets of Deogarh Forest division, people are collecting the bark of *Oroxylum indicum* (L.) Vent. and root of *Cycas circinalis* L. from forest and after drying, they are selling it at the cost of Rs.7/kg to the herbal traders of Kolkata. This results in loss of valuable medicinal plants of the state. In this context, proper marketing strategy should be adopted by the pharmaceutical companies, so that the general people will get the proper price for the raw materials they collect. Large-scale cultivation of medicinal plants is a profitable source of income for the tribal people. In the sector of medicinal plants cultivation, there is a serious lack of awareness among the people regarding its scope and importance (Haridasan *et al.*, 2003). To popularize the matter, some steps like workshops, seminars, exhibitions, field demonstrations etc should be organized involving all the stakeholders in this region. Government agencies, NGOs and community based organizations could play active role in this direction. Cultivation of medicinal plants is a specialized task and the local communities who have for generations nurtured the resources in their natural habitat are best equipped for this task (Anon, 1997). The continuous exploitation of several medicinal plant species from the wild have resulted in population decline of many high valued medicinal plant species. Some of them are coming under rare, endangered and threatened category. Therefore suitable conservation strategies should be formulated in order to preserve the threatened species as soon as possible.

CONCLUSION

Commercialization of medicinal plants and their products form a profitable avenue to improve the socio-economic condition of the people of Deogarh district as well as the state. There is a lack of market and market information among tribal people, for which they dispose the material at a throw away price. With sufficient available of market information, producers should get proper prices of their raw materials. The Government should establish linkages with markets, so that the cultivation of medicinal plants become market-driven, with assured income security for tribal families. Immediate attention should be given for conservation and propagation of threatened medicinal plants through in situ, ex situ or latest biotechnological approaches like tissue culture, conservation of seeds and conservation of DNA, etc.

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BIODIVERSITY OF FRESHWATER AQUATIC MACROPHYTIC VEGETATION OF SIMILIPAL BIOSPHERE RESERVE, ORISSA, INDIA

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ABSTRACT

An extensive field survey and plant collection revealed the presence of 128 species of aquatic macrophytes belonging to 71 genera and 36 families in Similipal Biosphere Reserve (SBR). Out of them 13 families, 39 genera and 66 species are monocot; 20 families, 28 genera and 56 species are dicot and 04 families, 04 genera and 06 species are pteridophytes. Regarding the endemic plant wealth, the biosphere reserve does not show any significant position in the list of the endemic plant species of the country. However, *Apanogeton natans* and *Coix aquatica* are the 2 plant species found in Similipal are mentioned as endemic to India. *Nymphoides parvifolia*, a rooted floating hydrophyte was found to be new record for the Biosphere Reserve.

Keywords : Aquatic flora, wetland, pteridophytes, endemic, Similipal

INTRODUCTION

Aquatic macrophytes are aquatic photosynthetic organisms, large enough to see with the naked eye, that actively grow permanently or periodically submerged below, floating on, or growing up through the water surface. Aquatic macrophytes are represented in seven plant divisions: Cyanobacteria, Chlorophyta, Rhodophyta, Xanthophyta, Bryophyta, Pteridophyta and Spermatophyta which are represented by 33 orders and 88 families with about 2,614 species in Ca. 412 genera (Chambers *et al.*, 2008). Taxonomic data about aquatic plants are particularly critical for conservation because plants are the structural species that form the framework of the environment, create habitats and provide resources used by other organisms (Thomas, 1999). As a functional group, aquatic macrophytes are of central importance in the structuring of aquatic ecosystem (Mckee *et al*., 2002). Aquatic plants can provide food and shelter for other organisms that live in and close to the water (Haggard *et al*., 2001), and also can provide spatial habitat complexity and refuge potential from predation for phytoplankton grazing invertebrates, stabilize sediment and are immediately involved in nutrient cycling (Van Donk *et al.,* 1993; Engelhardt and Ritchie, 2001; Mckee *et al.,* 2002). Macrophytes contribute to the general fitness and diversity of a healthy aquatic ecosystem (Flint and Madsen, 1995) by acting as indicators for water quality and aiding in nutrient cycling (Carpenter and Lodge, 1986). In addition aquatic plants are important because of their ecological roles and their economic importance (Blanca Leon, 1996). However, the aquatic macrophytes and their communities have been among the most neglected components in the ecological studies of aquatic ecosystems even though they play an important role in regulating the structure and functions of aquatic systems (Wetzel, 1984). Last but not the least aquatic plants are also used for subsistence of human livelihood supported by several thousands of rural families in developing countries (Gichuki *et al.*, 2001; Ghosh, 2005). Recently the aquatic and wetland plants are used for various socio-economic purposes in India (Bala and Mukharjee, 2007) and herbal medicines for different therapeutic uses in many parts of the country (Sing and Gupta, 2006; Jain, *et. al*., 2007; Sanilkumar and Thomas, 2007). Similipal biosphere reserve lies between 21º28'-22º08'N latitude and 86º04'-86 º 37' E longitudes considered as the biodiversity treasure of Orissa harbouring 1107 indigenous species of vascular plants which includes 713 species of dicotyledons under 123 families, 328 species of monocotyledons under 24 families, 3 species of

gymnosperms and 61 species of pteridophytes under 27 families (Rout, 2008). It is the richest water shed in the state of Orissa giving rise to many perennial rivers like Budhabalanga, Kharkhai, Khairi, Bhandan, West Deo, Salandi Sanja and Palpala. These rivers are the life lines of the people of Mayurbhanj, Keonjhar, Balasore and Bhadrak districts of Orissa. Several research groups have taken initiative to characterize the biodiversity of Similipal. However, most of them propose to work on angispermic flora and faunal diversity; non have so far studied the aquatic plant life, their diversity pattern in various water bodies within the biosphere reserve and possible economic uses of aquatic plant species. The ecological and taxonomic status of aquatic flora is lacking in many parts of the state so also in Similipal Biosphere Reserve. In view of the above, the present study on aquatic plants of Similipal Biosphere Reserve was undertaken.

MATERIALS AND METHODS

Extensive field surveys were made in Similipal during the period from 2004 to 2008 to collect aquatic and wetland plants in core, buffer and transition zones of the biosphere reserve. The study sites include 10 perennial rivers, numerous hill streams, rice fields, ponds, rivulets and nalas within Similipal. The data were recorded in the field notebook in connection with locality, habit, flowering, frequency, status, distribution and socio-economic uses etc. by interviewing with the tribals and by own observation. The plants were collected and preserved in the form of herbaria and housed in the herbarium of Dept. of Botany, Utkal University, Bhubaneswar, Orissa. The specimens were identified as per Flora of Orissa (1994-96), The Botany of Bihar and Orissa (1921-25), Flora of Simlipal (1989) and Flora of British India (1877).

RESULTS AND DISCUSSION

In total 128 species of aquatic plants belonging to 71 genera and 36 families were encountered in Similipal Biosphere Reserve (SBR). Out of them 13 families, 39 genera and 66 species are monocot; 20 families, 28 genera and 56 species are of dicot and 04 families, 04 genera and 06 species are of pteridophytes (Table 1). The aquatic plants of Similipal are classified with regard to their relation to aquatic environment into (i) Free floating hydrophytes (ii) Rooted hydrophytes with floating leaves (iii) Rooted submerged hydrophytes and (iv) Rooted emergent hydrophytes also known as helophytes or amphibious (Table 2).

Table 1 : Taxonomic status of aquatic plants of similipal

Sl. No	Plant type	Family	Genus	Species
(i)	Dicotyledon	19	28	56
(ii)	Monocotyledon	13	39	66
(iii)	Pteridophytes	04	04	06
Total	36	71	128	

Table 2 : Categories of different growth forms of aquatic and wetland plants of Similipal

Sl. No	Growth forms	No. of species	% in respect to total species
(i)	Rooted emergent	75	59.54
(ii)	Rooted submerged	18	13.74
(iii)	Rooted floating	24	18.32
(iv)	Free floating	11	8.39

Regarding growth forms, rooted emergent with 75 species is the most diversified group followed by rooted floating with 24 species and rooted submerged with 18 species. Cyperaceae was found to be the dominant family with 19 species followed by Poaceae and Scrophulariaceae with 15 and 14 species respectively. There are 105 species commonly found in the study area, 17 species occurring occasionally and 9 species are rare to the biosphere reserve in terms of their frequency of occurrence. Similarly 81 species of aquatic plants were encountered in the selected 10 water bodies out of the 128 species and rest 47 species were collected from ponds, pools, rice fields, etc. during the study period. The checklist of the aquatic flora of Similipal is given in Table 3.

Table 3 : Enumeration of aquatic and wetland plants of Similipal Biosphere Reserve with details of their economic uses.

Class	Family	Genus	Species	Groth forms	Status
A. Dicotyledon					
	Acanthaceae	*Hgrophilla*	*Hygrophilla difformis* L.	RE	O
		Justicia	*Justicia diffusa* Willd.	RE	C
			Justicia nilgherrensis (Nees) Clarke	RE	C
			Justicia quinquangularis Koenig ex Roxb.	RE	C
		Enhydra	*Enhydra fluctuans* Lour.	RE	O
	Boraginaceae	*Coldenia*	*Coldenia procumbens* L.	RE	C
	Caryophyllaceae	*Ceratophyllum*	*Ceratophyllum demersum* L.	RS	C
	Convolvulaceae	*Ipomoea*	*Ipomoea aquatica* Forssk.	RF	C
			Ipomoea carnea Haines.	RE	C
	Droseraceae	*Drosera*	*Drosera burmanii* Vahl.	RE	R
			Drosera indica L.	RE	R
	Euphorbiaceae	*Homonoia*	*Homonoia riparia* Lour.	RE	C
	Haloragaceae	*Myriophyllum*	*Myriophyllum aquaticum* (Vell.) Verdc.	RE	C
			Myriophyllum oliganthum (Wight & Arn.) F.V. Muel. Fragm.	RS	C
			Myriophyllum spicatum Roxb.	RS	C
	Hydrophyllaceae	*Hydrolea*	*Hydrolea zeylanica* (L.) Vahl.	RE	C
	Lentibulariaceae	*Utricularia*	*Utricularia aurea* Lour.	RF	O
			Utricularia gibba L.subsp.*exoleta* (R.Br.)P.Taylor	RF	R
			Utricularia stellaris L.f.	RF	R
	Lythraceae	*Ammania*	*Ammania baccifera* L.	RE	C
		Rotala	*Rotala densiflora* (Roth ex Roem.) Koeh.	RE	C
			Rotala indica (Willd.) Koeh.	RE	C
			Rotala macrandra Koeh.	RE	O
			Rotala rotundifolia (Poir.) Cook	RE	C
	Menyanthaceae	*Nymphoides*	*Nymphoides hydrophylla* (Lour.) Ktze.	RF	C
			Nymphoides indicum (L.) Ktze.	RF	C
			Nymphoides parvifolia (Griseb.) Ktze.	RF	R
	Mimosaceae	*Neptunia*	*Neptunia oleracea* Lour.	RE	C
	Nymphaeaceae	*Euryale*	*Euryale ferox* Salib.	RF	O
		Nelumbo	*Nelumbo nucifera* Gaertn.	RF	C
		Nymphaea	*Nymphaea nouchalli* Burm.f.	RF	C
			Nymphaea pubescens Willd.	RF	C
	Onagraceae	*Ludwigia*	*Ludwigia hyssopifolia* (Don.) Excell.	RE	C
			Ludwigia octovalis (Jacq.) Rven.	RF	C
			Ludwigia perennis L.	RF	C
			Ludwigia adescendens (L.) Hara.	RF	C
	Podostemaceae	*Polypleurum*	*Polypleurum filifolium* (Raman & Joseph) Rao & Hazra.RS	R	
	Polygonaceae	*Polygonum*	*Polygonum barbatum* L.	RE	C
			Polygonum glabrum Willd.	RE	C
			Polygonum plebium R.Br.	RE	O
			Polygonum serrulatum Lagasc.	RE	O

Class	Family	Genus	Species	Groth forms	Status
	Scrophulariaceae	*Dopatrium*	*Dopatrium junceum* (Roxb.) Buch-ham.	RE	C
		Limnophila	*Limnophila aromatica* (Lam.) Merr.	RE	O
			Limnophila heterophylla (Roxb.) Benth.	RE	C
			Limnophila indica (L.) Druce.	RE	C
			Limnophila sessiliflora (Vent.) Bl.	RS	C
			Limonophilla conferta Benth.	RE	C
		Limnophyton	*Limnophyton obtusifolium* (L.) Miq.	RE	C
		Lindernia	*Lindernia anagallis* (Burm.f.) Pennel.	RE	C
			Lindernia angustifolia (Benth.) Wettst.	RE	C
			Lindernia antipoda Sensu. Philcox.	RE	C
			Lindernia crustacea (L.) Muell.	RE	C
			Lindernia rotundifoli (L.) Alston	RE	C
		Scoparia	*Scoparia dulsis* L.	RE	C
	Sphenocleaceae	*Sphenoclea*	*Sphenoclea zeylanica* Gaertn.	RE	O
	Trapaceae	*Trapa*	*Trapa natans* var. *bispinosa* (Roxb.) Makino	RF	O
B. Monocotyledon					
	Alismataceae	*Sagittaria*	*Sagittaria sagittifolia* auct. non L.	RS	C
			Sagittaria trifolia L.	RS	C
	Amaryllidaceae	*Crinum*	*Crinum defixum* Ker. Gawl.	RE	C
			Crinum amoenum Roxb.	RE	C
	Apanogetonaceae	*Apanogeton*	*Apanogeton natans* (L.) Engl. & Krause	RF	R
			Apanogeton undulatus Roxb.	RF	R
	Araceae	*Colocasia*	*Colocasia esculenta* (L.) Schott.	RE	C
		Pistia	*Pistia stratiotes* L.	FF	C
		Acorus	*Acorus calamus* L.	RE	C
	Cyperaceae	*Cyperus*	*Cyperus castaneus* Kern.	RE	C
			Cyperus compressus Willd.	RE	C
			Cyperus cuspidatus Kunth	RE	C
			Cyperus difformis L.	RE	C
			Cyperus iria L.	RE	C
			Cyperus haspan L.	RE	C
			Cyperus nutans Vahl.	RE	C
			Cyperus pilosus Vahl.	RE	C
			Cyperus platistylis R.Br.	RE	C
			Cyperus tenuiculmis Boeck.	RE	O
			Cyperus tenuispica Steud.	RE	C
		Eleocharis	*Eleocharis dulcis* (Burm.f.) Henschef.	RE	C
		Fimbristylis	*Fimbristylis aestivalis* (Retz.) Vahl.	RE	C
			Fimbristylis dichotoma (L.) Vahl.	RE	C
			Fimbristylis ovata (Burm. f.) Kern.	RE	C
		Mariscus	*Mariscus paniceus* (Rottb.) Vahl.	RE	C
		Scirpus	*Scirpus articulatus* L.	RE	C
			Scirpus grossus L. f.	RE	C
			Scirpus squarrosus (Vahl.) Poir.	RE	C
	Eriocaulaceae	*Eriocaulon*	*Eriocaulon quinquangulare* L.	RE	C
	Hydrocharitaceae	*Blyxa*	*Blyxa echinosperma* (Clarke) Hook.f.	RE	O

Class	Family	Genus	Species	Groth forms	Status
	Elodea	*Elodea canadensis* Michx.		RS	C
		Hydrilla	*Hydrilla verticillata* (L.f.) Royle.	RS	C
		Ottelia	*Ottelia alismoides* (L.) Pers.	RS	C
		Vallisneria	*Vallisneria natans* L.	RS	C
			Vallisneria spiralis L.	RS	C
		Nachamandra	*Nachamandra alternifolia* (Roxb.) Thw.	RS	C
	Lemnaceae	*Lemna*	*Lemna gibba* L.	FF	C
			Lemna minor L.	FF	C
		Spirodella	*Spirodella polyrhiza* (L.) Schleid.	FF	O
		Wolffia	*Wolffia arrhiza* (L.) Horkel ex Wimmer	FF	C
			Wolffia microscopica Griff. ex Wimmer	FF	C
			Wolfia globosa (Roxb.) Hartog & Plas	FF	C
	Najadaceae	*Najas*	*Najas graminea* Del.	RS	C
			Najas indica (Willd.) Cham	RS	C
			Najas minor All.	RS	C
	Poaceae	*Coix*	*Coix aquatica* Roxb	RE	C
		Echinochloa	*Echinochloa colon* (L.) Link.	RE	C
			Echinochola stagnina (Retz.) Beauv.	RE	C
		Eragrostis	*Eragrostis japonica* Thunb.	RE	C
		Hackelochloa	*Hackelochloa granularis* (L.) Kuntze	RE	C
		Hygroryza	*Hygroryza aristata* (Retz) Nees ex Wight	RF	C
		Isachne	*Isachne globosa* (Thunb.) Ktze.	RE	C
		Leersia	*Leersia hexandra* Sw.	RE	O
		Oplismenus	*Oplismenus compositus* (L.) Beauv.	RE	C
		Paspalidium	*Paspalidium germinatum* (Forssk.) Stapf.	RE	C
		Paspalum	*Paspalum scrobilatum* L.	RE	C
		Saccharum	*Saccharum spontaneum* L.	RE	C
		Sacciolepis	*Sacciolepis myosuroides* (R. Br.) Camus	RE	C
			Sacciolepsis interrupta (Willd.) Stapf.	RE	C
	Pontederiaceae	*Eichhornia*	*Eichhornia crassipes* (Mart.) Solms.	FF	C
		Monocharia	*Monocharia hastata* Solms-Laub.	RF	C
			Monocharia vaginalis (Burm.f.) Prest.	RF	C
		Pontederia	*Pontederia cordata* L.	RE	R
	Potamogetonaceae	*Potamogeton*	*Potamogeton crispus* L.	RF	C
			Potamogeton nodosus Poir.	RF	C
	Typhaceae	*Typha*	*Typha angustata* L.	RE	O
C. Pteridophytes					
	Azollaceae	*Azolla*	*Azolla pinnata* R.Br	FF	C
	Marsileaceae	*Marsilea*	*Marsilea quadrifolia* L.	RF	C
			Marsilea minuta L.	RF	C
	Pteridaceae	*Ceratopteris*	*Ceratopteris thalictroides* (L.) Brongn.	RS	O
	Salviniaceae	*Salvinia*	*Salvinia natans* (L.) All	FF	C
			Salvinia cuculata Status.	FF	C

RS- Rooted emergent, RS- Rooted submerged, RF- Rooted floating, FF- Free floating, WP- Wetland plant, C- Common, O-Occasional, R- Rare

Considering the zonation of aquatic plants in the biosphere reserve, it was noted that the emerged group such as *E. dulcis* grew at the shallow water near the edges whereas some species such as *N. nucifera*, *N. cristata* and *Trapa natans* var. *bispinosa* grew at deeper zone up to 2 m deep at Panasia and Palpala. The submerged groups such as *U. aurea, Blyxa echinosperma, Vallisneria spiralis, H.verticillata* and *N. indica* grew below the water surface from shallow water to about 1.5 m deep and were rarely found in deeper water, whereas *Najas minor* and *Chara vulgaris* could grow from 50 cm deep to a depth of up to 2.5 m observed from the distribution value of aquatic plants.

The present study showed emergents outnumbered submerged and floating species. The number of aquatic macrophyte species was higher during the winter followed by summer and lower during the rainy. Emergents were the most dominant form throughout the year. This can be attributed to the emergents' high tolerance for fluctuation of water level (Van Donk *et al*., 1993). Among emergents, *Leersia hexandra* was the most dominant in the summer and winter whereas *Cyperus platistylis* in the rainy. Among the submerged species, *Ceratophyllum submersum*, *Hydrilla verticillata* and *Ceratophyllum demursum* were observed to be the most dominant species throughout the year. The vigorous year-round growth of *H. verticillata* indicates its ability to adapt in diverse conditions. This may be due to the transportation of silt, organic matter and litter from the catchment area at the time of flooding.. *Homonoia riperia* was found to be the most dominant species followed by *Hydrilla verticillata*, *Ceratophyllum demersum*, *Eriocaulon quinquangulare* and *Lirsea hexandra*.

Regarding the endemic plant wealth, the biosphere reserve does not show any significant position in the list of the endemic plant species of the country. However, *Apanogeton natans* and *Coix aquatica* are the 2 plant species found in Similipal are mentioned as endemic to India (Cook, 1996). *Nymphoides parvifolia* (Griseb.) Ktze., a rooted floating hydrophyte was found to be new record for the Eastern Ghats of India. Ten species such as *Pontederia cordata* L., *Apanogeton natans* (L.) Engl. and Krause, *Apanogeton undulatus* Roxb., *Eriocaulon quinquangulare*., *Drosera burmanii* Vahl., *Drosera indica* L.*, Polypleurum filifolium* (Raman and Joseph) Rao and Hazra., *Utricularia exoleta* R. Br., *Utricularia stellaris* L.f., *Nymphoides parvifolia* (Griseb.) Kutz. were found to be rare species to Similipal in respect to their occurrence. The current study is baseline information on aquatic flora of Similipal and may be useful for the future monitoring of the biodiversity in the biosphere reserve.

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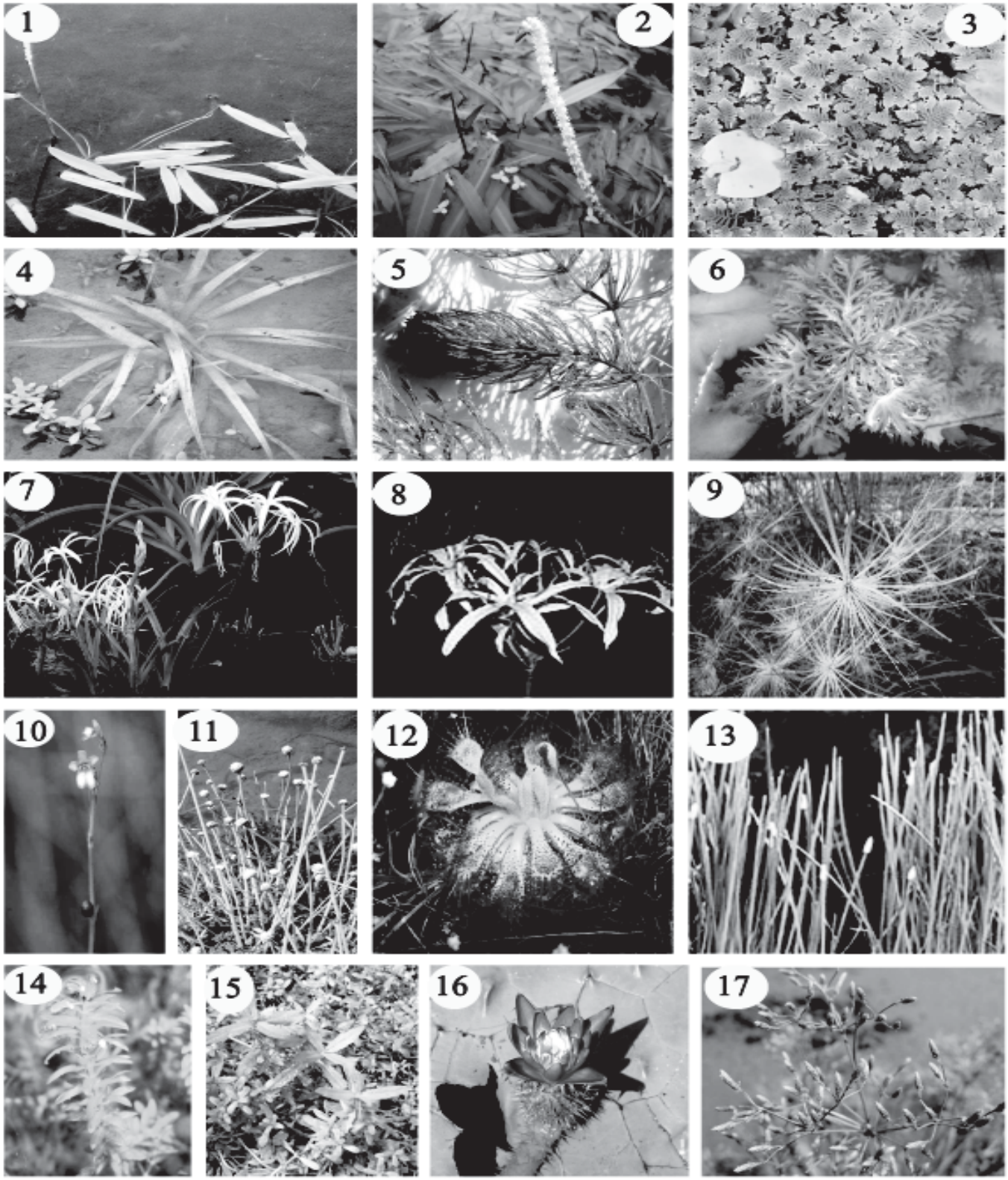

Fig. 1 to 17 : Aquatic angiosperms of Similipal
[Fig1: *Apanogeton natans* (L.) Engl. & Krause, Fig.2: *Apanogeton undulatus* Roxb., Fig.3: *Azolla pinnata* Braun, Fig.4: *Blyxa echinosperma* (Clarke) Hook.f. ,Fig.5: *Ceratophyllum demersum* L., Fig.6: *Hygrophilla diformis* L., Fig.7: *Crinum defixum* Ker. Gawl., Fig.8: *Crinum amienum* Roxb., Fig.9: *Cyperus haspan* L., Fig.10: *Dopatrium junceum* (Roxb.) Buch-ham., Fig.11: *Eriocaulon quinquangulare* L., Fig.12: *Drosera burmanii* Vahl., Fig.13: *Eleocharis dulcis* (Burm.f.) Henschef., Fig.14: *Elodea canadensis* Michx., Fig.15: *Enhydra fluctuans* Lour. , Fig.16: *Euryale ferox* Salib., Fig.17: *Fimbristylis aestivalis* (Retz.) Vahl.]

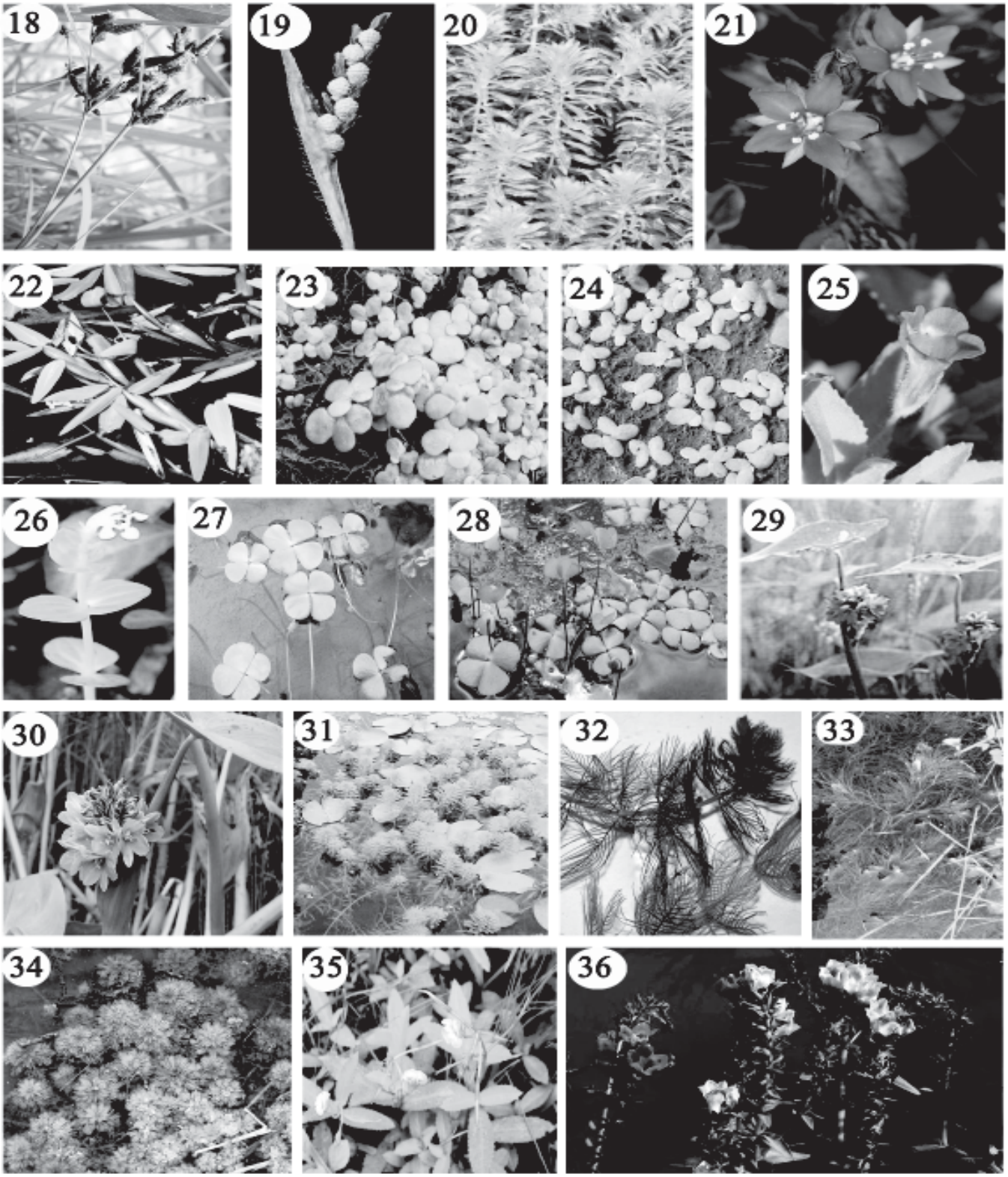

Fig. 18 to 36 : Aquatic angiosperms of Similipal
[Fig.18: *Fimbristylis dichotoma* (L.) Vahl., Fig.19: *Hackelochloa granularis* (L.) Kutze, Fig.20: *Hydrilla verticillata* (L.f.) Royle., Fig.21: *Hydrolea zeylanica* (L.) Vahl., Fig.22: *Hygroryza aristata* (Retz) Nees ex Wight, Fig.23: *Lemna gibba* L., Fig.24: *Lemna minor* L., Fig.25: *Limnophila aromatica* (Lam.) Merr., Fig.26: *Lindernia rotundifolia* (L.) Alston , Fig.27: *Marsilea minuta* L., Fig.28: *Marsilea quadrifolia* L. , Fig.29: *Monocharia hastata* Solms-Laub., Fig.30: *Monocharia vaginalis* (Burm.f.) Prest., Fig.31: *Myriophyllum aquaticum* (Vell.) Verdc., Fig.32: *Myriophyllum spicatum* Roxb., Fig.33: *Najas minor* All., Fig.34: *Limnophila indica* (L.) Druce., Fig.35: *Lindernia antipoda* Sensu. Philcox., Fig.36: *Limnophila heterophylla* Benth.]

e-planet 8 (1): 26 - 30

DISTRIBUTION AND STATUS OF THE INDIAN FOX (*Vulpes bengalensis*) IN PASCHIM MEDINIPUR DISTRICT, WEST BENGAL, INDIA

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ABSTRACT

Indian fox *(Vulpes bengalensis)* is endemic to Indian subcontinent with relatively wide distribution ranging from foot hill of Himalayas to southern most part (Andhra Pradesh and Karnataka) of India. A yearlong study was conducted in 4 forest divisions of Paschim Medinipur District, West Bengal to get information on the distribution of Indian fox. Direct sighting, indirect evidences, interviewing forest staff as well as villagers and Joint Forest Management Committee (JFMC) members were formed to document information. During the study period, total 37 direct or indirect evidences were recorded and 62 Indian foxes were sighted. It transpires from the study that Indian fox exhibited habitats like open forest land, plantation sites, crop field etc. Extensive anthropogenic activities like hunting, conversion of open vested or fallow land to agricultural land and habitat loss seems to be the major threats for long term survival of Indian fox.

Key Words : Indian fox *(Vulpes bengalensis)*, distribution and status, Paschim Medinipur District

INTRODUCTION

Indian fox (*Vulpes bengalensis*) belonging to the Family - Canidae, Order - Carnivora, Class - Mammalia, Phylum – Chordata is a medium size fox, endemic to Indian sub continent, having relatively wide distribution, ranging from the foothills of Himalayas to southern part (Andhra Pradesh and Karnataka) and have no sub species (Pocock, 1936; Prater, 1971). It is omnivorous, monogamous, nocturnal and opportunistic animal. The diet may include insects, crabs, termites, birds, eggs, small rodents, lizards, mice, rat snakes, small mammals, fruits (*Ficus spp, Ziziphus spp, Azadirachta indica, Mangifera indca, Syzigium cumini*, etc), melons, etc (Johnsingh,1978; Manakadan and Rahmani, 2000; Johnsingh and Jhala, 2004, 2008; Vanak, 2005).

Distribution of Indian fox ranges quite wide with relatively high numbers reported from bio geographic zone 3 (Desert); 4 (Semi arid) and 6 (Decan peninsula) (Rodgers *et al*, 2000) and may be encountered in semi arid, scrub, grassland and even in open crop fields near human settlements (John Singh and Jhala, 2004).

Indian fox is one of the important faunas of West Bengal. Though, studies on Indian fox have been done in South India on their distribution, status, ecology and behaviour etc. but limited scientific information exist regarding the status, distribution and biology of this species of West Bengal. The present paper is a study on the status and distribution of Indian fox in Paschim Medinipur District (PMD) of West Bengal.

STUDY AREA

Paschim Medinipur District (PMD) with a total geographical area of 9787 sq km is situated in the south western district of the West Bengal (WB) bordering with Jharkhand and Orissa States in the western and south western parts respectively. The district lies between latitude 22° 57'10" to 21°36'35" North latitude and longitude 88°12'40" to 89°33'55" East (Anon,2005) (Fig 1).

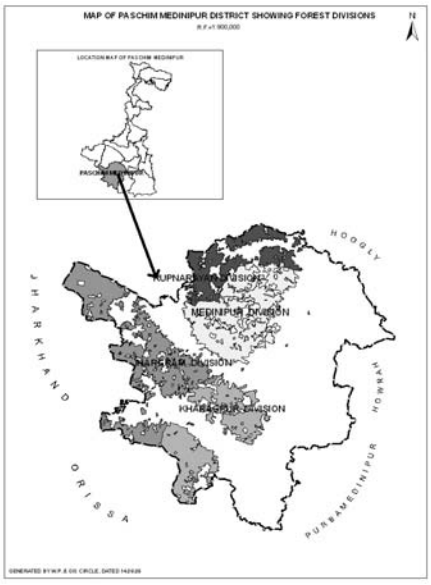

Fig.1 : Map of Paschim Medinpur District showing forest divisions.

The major rivers of the district are Kangsabati, Subarnarekha and Silabati. Average annual rainfall is 1390 mm. PMD is characterised by laterite plains and hillocks covered with mixed dry deciduous forests. Forest type is northern tropical dry deciduous forests where sal (*Shorea robusta*) is the predominant species (Anon, 2001).

Major fauna found in PMD is wolf (*Canis lupus*), Indian fox (*Vulpes bengalensis*), jackal (*Canis aureus*), common mongoose (*Herpestes edwardsi*), pangolin (*Manis crassicaudata*), Indian small mongoose (*Herpestes auropunctatus*), striped hyena (*Hyaena hyaena*), common langur (*Presbitis entellus*), common palm civet (*Paradoxurus hermaphroditis*), three striped squirrel (*Funambulus palmarum*), Indian wild boar (*Sus scrofa*), Indian pipistrelle (*Pipistrellus coromandra*), Indian mole rat (*Bandicota bengalensis*), common house rat (*Rattus rattus*), bat (*Rousettus leschenaulti*). Besides, major reptiles includes yellow monitor (*Varanus flavescens*) , common skink (*Mabuya carinata*), common garden lizard (*Calotes varsicolor*), northern house gecko (*Hamidactylus flaviviridis*), common rat snake (*Ptyas mucosus*), cobra (*Naja naja*), Russel's viper (*Vipera russelli*), common Indian krait (*Bangarus caeruleus*), common green whip snake(

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animal out from day resting sites. Indirect evidences such as dens sites, abandoned den sites, calls, paw mark trails and stools were recorded to confirm their presence. Few villages where villagers confirmed direct or indirect evidences of Indian foxes was selected and surveyed for all the ranges of 4 Forest Divisions. Before starting survey, range level meeting was organised with Joint Forest Management Committee (JFMC) members. Secondary information was collected like interviewing JFMC members, aged person and others in the said meeting. Direct sighting and indirect evidences and vehicular spot light survey were also done. Total as many as 37 sites (Table-1) in 55 villages were surveyed in four divisions on the basis of informations collected. The visibility was generally good in open forests and village proximity (Fig. 3). Local villagers, forest staff and JFMC members helped in this exercise. Their dens were easily identified by the size of the holes. Sighting done by villagers, JFMC members and forest staff during study period was also taken into consideration. At dusk, sighting the animals was better. Evening and night time were preferred with spotlight surveys deploying motorcycles or jeeps along the survey area. Range, beat, habitat, number, water sources etc were recorded during study.

Fig.2 : Indian fox den at Dhadika under Rupnarayan division

Fig.3 : Indian fox is characterised by their black tipped tail.

Table 1 : Distribution of Indian Fox in Paschim Medinipur District, West Bengal

	Range	Beat	Village	Habitat	Evidence	Number	Water Source
Division Kharagpur							
	Nayagram	Nayagram	Baura	Crop Field	Sighting by villagers, call	02	River (Temporary)
		Kalmapukhuria	Panchpoati	Crop Field	Sighing by villagers	01	Pond
	Kalaikunda	Kalaikunda	Pathri	Sal Plantation	Sighting by Forest Staff	02	Canal
	Hijli	Hijli	Kuchlachati	Eucalyptus & Akashmoni Plantation	Direct sighting	01	Temporary
			Gobradan	Eucalyptus Plantation	Sighting, Active den, Droppings	01	Temporary
			Nachna	Crop Field	Abandoned Den, Droppings		Pond
			Rangamatia	Eucalyptus Plantation	Abandoned Den		Pond
	Chandabila	Patina	Tapoban	Sal forest	Sighting by villagers	02	Stream
	Keshorekha	Baligera	Baligeria	Sal forest	Sighting by villagers (seen: Dec.-Jan)	02	Pond
	Belda	No information could be collected					
Division Rupnarayan							
	Mahalisai	Mahalisai (I)	Kerumara	Crop Field	Sighting by villagers	01	Pond
			Singla	Sal forest	Sighting by villagers	02	Pond
			Hatia	Crop field	Sighting by villagers	02	Pond
	Amlagorah	Raskundu	Dhalma	Plantation forest	Sighting by Forest staff	01	Small earthen dam (ED)
	Hoomgarh	Hoomgarh	Chhotodhadhika	Sal forest	Sighting by Forest staff	02	Pond
	Garbeta	Dhadika	Kuilibandh(Dhanshole)	Akashmoni Plantation	Large active den, Pugmarks, Droppings, Sighting by villagers	4 (2 adult + 2 cub)	Pond, ED
		Nohari	Benachapra	Mango Plantation	Sighting by villagers	02	River
	Goaltore	No information could be collected					
Division Jhargram							
	Manikpara	Kusumghati	Rajabasa Thakurthan	Plantation Forest	Sighting by villagers (seen : Dec.'07)	02	Pond
		Balivasa	Radheshyampur Jungle Khas 681	Plantation	Sighting by Forest staff	01	Pond
	Lodhashuli	Lodhasuli	Murakati- Gobindapur	Sal forest	Sighting by Forest staff	01	Stream
	Banspahari	Banspahari	Laljal, Pataghar, Jodam	Sal forest	Sighting by villagers, Forest staff	02	Pond, ED
	Gopiballvpur	Kendugari	Urabhanga	Sal forest	Sighting by villagers, Abandoned den	02	Pond
			Adjacent to Kendugari beat		Sal forest Sighting by villagers,	03	Pond
	Belpahari	Belpahari	Krishnapur(Badyir bil)	Open land, crop field	Sighting by villagers, Abandoned den	02	Pond
	Belpahari	Belpahari	Baishnabpur	Open land	Active den, Abandoned den, Sighting by villagers, Droppings, Pawmarks	04	Pond
	Jamboni	Jamboni	Jhargram Dahi	Crop field	Sighting by villagers, Abandoned den	02	Pond
		Jamboni	Dulong riverside	Mixed forest	Sighted by villagers (seen : winter)	03	River
	Shilda	Binpur	Shalukdoba	Sal forest	Subadult	01	Pond, ED
	Hatibari	Hatibari	Noagaon	Riverside	Active den, Dropping	01	River
	Porihati	No information could be collected					
	Gidhni	No information could be collected					
	Jhargram	No information could be collected					
	Bhulaveda	No information could be collected					

Division	Medinipur						
	Chandra	Chandra	Range Office	Roadside Drainpipe	Sighting by Forest staff	01	Pond, Ed
		Gurguripal	Suknakhali	Sal Plantation	Sighting by villagers	02	ED
	Lalgarh		Kamrangi	Road side	Sighting by villagers	01	Pond, ED
	Medinipur	Gopegarh	Raja NL Khan College	Roadside	Sighting by Night Guards	01	Pond
		Baghasole	Bishra	Crop field	Sighting by forest staff, Active den, Droppings, Pugmarks	02 (01 adult and 01 cub)	Pond
			Jungle Khas 424	Plantation forest	Large active den, sighting by forest staff	03	Pond
	Chandrakona	Chandrakona	Nabakhola Metadahar	Plantation forest	Sighting by villagers (seen: Oct-Feb)	02	Pond
	Pirakata	Pirakata	Abardihi, Pirakata,	Pirakata Mohanpur	Sighting by villagers (seen: winter)	01	Pond, ED
	Godapiasal	Godapiasal	Range office adjacent	Godapiasal	Call	01	Pond
	Arabari	No information could be collected					
	Nayabasat	No information could be collected					

RESULTS AND DISCUSSION

Result indicated that the Indian fox are sparsely distributed in most of the areas of PMD.

In Kharagpur division out of 6 ranges such as Nayagram, Chandabila, Kesarrekha, Hijli, Belda and Kalaikunda only in Belda range no information could be collected. Direct sighting of 11 Indian fox was recorded in 8 sites out of 10 sites by study team, villagers and forest staff during study period in 12 villages surveyed.

In Rupnarayan division all 5 ranges namely Mahalisai, Garbeta, Humgarh, Goaltore and Amlagora were surveyed and showed direct or indirect evidences of Indian fox except Goaltore range where no evidence could be recorded during study period. Total 14 Indian foxes were sighted in 7 sites by study team and others out of 13 villages surveyed. Maximum number was found at Kuilibandh where 4 animals were sighted at a time by villagers.

In Jhargram division study area covered 12 ranges but no direct or indirect evidences or any information from any sources could be collected in 4 ranges like Jhargram, Porihati, Gidhni and Bhulaveda during study period. In other 8 ranges like Lodhasuli, Manikpara, Hatibari, Gopiballavpur, Jamboni, Belpahari, Banspahari and Shilda out of 16 villages, maximum foxes (23) were directly sighted in 11 villages evidenced by dropping, call, pawmarks etc

In Medinipur division, out of 9 ranges Chandra, Lalgarh, Medinipur, Chandrakona Road, Pirakata and Godapiasal ranges were covered for the study. Total 14 Indian foxes were sighted, while no fox could be sighted in Nayabasat and Arabari range.

During study period total 62 direct sighting of Indian fox was done in 34 sites out of 37 sites were studied. Maximum 4 numbers of animals were sighted at a single site. The habitat of Indian fox ranged amongst crop fields, sal forests, plantations forests, road sides, drain sides and open land. Maximum sighting was recorded during late afternoon to evening hours. Various activities including sex of Indian fox could not ascertained properly due to paucity of time (duration of sight). Their presence was prominent near water bodies like pond, river, stream, canal and small earthen dam etc.

Tribal people sometimes hunt it during Shikar utsab (festival) along with other animals as their rituals. Human activities like hunting, habitat loss and extensive agricultural practices are major constraints of low population density of Indian fox over PMD even in South India (Johnsingh, 1978; Johnsingh and Jhala, 2004; Vanak *et al,* 2007). The local people revealed that extensive practices of agriculture including uses of pesticides, conversion of vested and other uncultivated land to agricultural land have adversely affected the Indian fox population in PMD.

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We are thankful to Sri A.K.Raha, IFS Principal Chief Conservator of Forests (Head of Forest Force), West Bengal for his relentless help and guidance. Help rendered by Dr. Tapan Kumar Mishra, Principal, Vidyasagar College, and Calcutta University is highly acknowledged. The authors are also thankful for help and assistance extended by the people of Paschim Medinipur District.

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e-planet 8 (1): 31 - 37

BUTTERFLY DIVERSITY OF NANDANKANAN WILDLIFE SANCTUARY, ORISSA, INDIA

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ABSTRACT

Butterflies undoubtedly play a key role in terrestrial ecosystems as effective pollinators. Lepidopterans, particularly the butterflies, are perhaps the best studied of all pollinator taxa, but their taxa at the Nandankanan zoo premises remain poorly characterized. An attempt has been made to document the butterfly diversity of this renowned wildlife sanctuary of Odisha, India. A total of 92 species has been recorded that includes 68 genera belonging to five families. The maximum species diversity of butterflies shared by Family Nymphalidae (30.43%, n = 92) followed by Lycenidae (21.74%), Pieridae (19.57%), Hesperidae (17.39%) and Papillionidae (10.87%) in the sanctuary area during the survey period.

Key words: Butterflies, random sampling, species diversity, opportunistic survey

INTRODUCTION

India harbors more than 1500 species of butterflies (Kunte, 2000), of which northeast India accounts for nearly two-third (962 species) of the species (Evans, 1932). Although many pioneer workers carried out research on the butterfly species diversity in different parts of India (Mason and Niceville, 1886; Doherty, 1889; Talbot, 1939, 1947; Wynter-Blyth, 1957; Saharia, 1967 and Varshney and Chanda, 1971), the butterfly study in Orissa is less studied (Anonymous, 1995; Sethy, 2004 Sahu *et al.*, 2006 and Nair, 2007). Most of the butterfly studies have been carried out in Similipal Tiger Reserve and Sunabeda Wildlife Sanctuary (Palei, 2006). This study is an attempt to document the butterfly diversity in Nandankanan Wildlife Sanctuary which includes zoological garden, State botanical garden and Kanjia Lake.

Nandankanan Zoological Park (NZP), one of the premier zoos of the country situated amidst natural forest along the banks of Kanjia lake in the state of Orissa. It is located between 20^0 23' North latitude and 85^0 48' East longitude (Survey of India Toposheet No. 73 H/15-NW) with Chandaka-Dampara Wildlife Sanctuary in its vicinity. Zoological park, botanical garden along with the Kanjia lake have been declared as a Wildlife Sanctuary on 3rd August 1979 (vide erstwhile Forest, Fisheries and Animal Husbandry Department, Government of Orissa Notification No. 8F (WL)-160/78-20672/FFAH). The land is characterized by undulating topography, broken by low hills of very gentle slope. The botanical garden is having steeper hills in comparison to zoological park. These remnant hills form part of erstwhile Khurda mals. The forest of Nandankanan zoo includes many semi-evergreen elements which are important biogeographic stepping stones which is the link between the forest species of north-east and south-west India. The forest areas of Nandankanan can be classified as a heterogenous cluster of semi-evergreen patches, dry deciduous forest, scrub forest, swamps and water body of Kanjia lake. The annual average rainfall varies between 1220 mm to 1902 mm. The mean annual maximum humidity varies from 90% to 93% and the mean annual minimum humidity varies from 55% to 61%. The typical climatic condition and varied floral composition attract many species of butterflies to this place.

MATERIALS AND METHODS

The butterflies were surveyed during 2008 - 2009 at Nandankanan Wildlife Sanctuary area. Random sampling and opportunistic survey methods were adapted in the study area to record the diversity. The adult butterflies were photo documented in the field by using the digital still camera (SONY DSC-H50). Some of the confusing specimens were collected with the help of insect net and preserved for further identification. The larval stages of some butterflies were monitored by rearing them in confined situation. The butterflies were identified and verified following

methods adopted by Haribal (1992), Kunte (2000), Wynter-Blyth (1957), Kehimkar (2008) and Antram (2002).

RESULTS AND DISCUSSION

The study area was classified in to 5 sub-sites based on the vegetation composition and level of traffic frequency (Fig. 1).

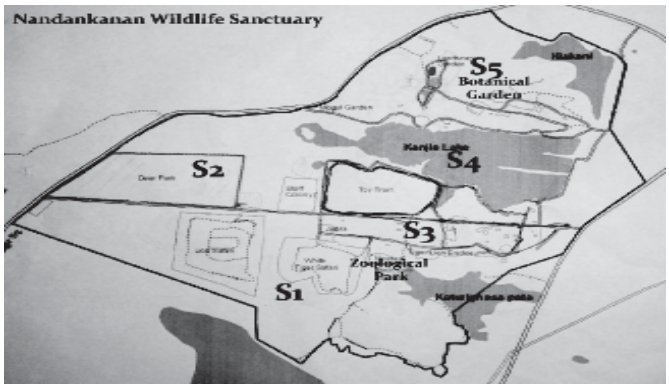

Fig.1 : Map of Nandankanan Wildlife Sanctuary showing different study sites; S1 – Scrub Forest; S2 – Dry Decidous Forest; S3 – Animal exhibit area; S4 – Kanjia wet land and S5 – Mixed forest.

During the study period a total of 92 species of butterflies have been documented belonging to 68 genera and 5 families (Table – 1). Maximum numbers of species were observed in the family Nymphalidae (30.43%, n = 92) followed by Lycenidae (21.74%), Pieridae (19.57%), Hesperidae (17.39%) and Papillionidae (10.87%) (Fig 2).

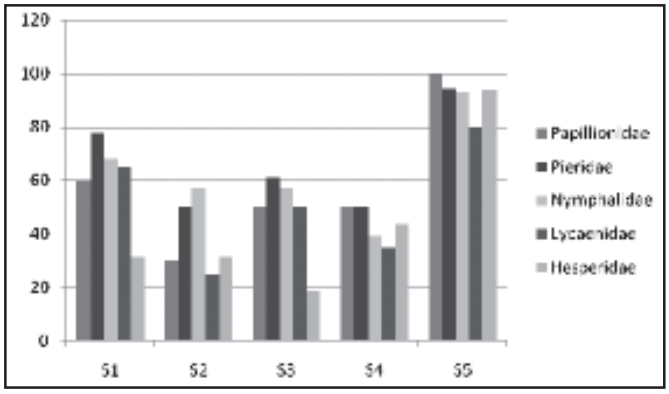

Fig.2 : Graph showing site specific species diversity at Nandankanan Wildlife Sanctuary

However, as far as the habitat is concerned, the mixed vegetation and the drier area i.e. S-5 and S-1 occupy 32% and 22% (n= 263) of total number of butterflies encountered in the sanctuary area, respectively. It is observed that the number of butterflies sighted is minimum i.e. 14% and 15% in moist deciduous (S-2) and near aquatic habitat (S-4), respectively. But the butterflies like *Atrophaneura hector, Graphium nomius, Graphium doson, Graphium Agamemnon, Euthalia nais, Curetis thetis* are the canopy the dwellers those are mostly preferring the mixed vegetation with good canopy cover. As far as the microhabitat is concerned, leaf litter ground is mostly preferred by *Elymnias hypermenstra, Mycalesis perseus, Mycalesis mineus, Orsotrioena medus, Ypthima huebneri, Neopithecus zalmora.* However, bushy and scrub forest habitat is preferred by most of the butterflies like *Papilio polytes, Catopsilia Pomona, Catopsilia pyranthe, Eurema spp., Leptosia nina, Appias libythea, Phalanta phalantha, Acraea violae, Ixias spp., Junonia spp., Hypolimnas bolina, Hypolimnas missipus, Amblypodia anita,* etc. Besides, many species belong to family Hesperiidae which prefer the bushy microhabitat. Although, Nandankanan is situated in the vicinity of the city of Bhubaneswar, the varied microhabitat of the sanctuary is adapting more than 92 species of these host specific colourful insects.

Butterflies are most sensitive to habitat disturbance and environment alteration. As the microhabitat of the butterflies are very species specific, a little change in the environment or the microhabitat affect the distribution pattern of the species. It is noticed that some butterflies like *Papilio polytes, Graphium doson, Catopsilia Pomona, Eurema hecabe, Cepora nerissa* show very good reflex towards the rise in ambient temperature. These butterflies migrate from the open grassland area towards the high canopy habitats as the temperature rises. The endothermic metabolism of butterflies makes them vulnerable towards the trends of global warming. Although lots of studies have been conducted on the habitat utility, distribution and ecology, the impact of global warming on the distribution pattern of butterflies have been less studied.

Butterflies are the predominant prey base for many birds, reptiles, other insects and even spider species. They serve as the primary consumer in the grassland and forest ecosystem. Other than the source of prey base, butterflies are excellent pollinators. Most of the butterflies from family Papilionidae, Pieridae, Nymphalidae significantly contribute towards the

Table : 1 Check list of butterflies of Nandan Kanan Sanctuary

Sl. No.	English name	Scientific name	Micro habitat
PAPILIONIDAE			
1	Blue Mormon	*Papilio polymnestor* Cramer	DD, SC
2	Common Banded Peacock	*Papilo crino* Fabricius	SEG
3	Common Jay	*Graphium doson* C & R Felder	SEG, DD
4	Common Mime	*Papilio clytia* Linnaeus	SC
5	Common Mormon	*Papilio polytes* Linnaeus	DD, SC
6	Common Rose	*Atrophaneura aristolochiae* (Fabricius)	DD,SC
7	Crimson Rose	*Atrophaneura hector* (Linnaeus)	SEG
8	Lime	*Papilio demoleus* Linnaeus	DD,SC
9	Spot Swordtail	*Graphium nomius* Esper	SEG,DD
10	Tailed Jay	*Graphium agamemnon* Linnaeus	SEG,DD,SC
PIERIDAE			
11	Common Albatross	*Appias albina* Boisduval	SEG,SC
12	Common Emigrant	*Catopsilia Pomona* Fabricius	SEG,DD,SC
13	Common Grass Yellow	*Eurema hecabe* Linnaeus	SC,GL
14	Common Gull	*Cepora nerissa* (Fabricius)	SC, GL
15	Common Jezebel	*Delias eucharis* Drury	SEG,GL
16	Common Wanderer	*Pareronia valeria* Cramer	SEG,DD
17	Mottled Emigrant	*Catopsilia pyranthe* Linnaeus	SC,GL
18	One Spot Grass Yellow	*Eurema andersoni* Moore	SC,GL
19	Pioneer	*Belenois aurota* (Fabricius)	SEG,DD
20	Psyche	*Leptosia nina* Fabricius	DD,SC
21	Small Grass Yellow	*Eurema brigitta* (Cramer)	SC,GL
22	Small Orange Tip	*Colotis etrida* (Boisduval)	SC
23	Small Salmon Arab	*Colotis amata* (Fabricius)	SEG
24	Spotless Grass Yellow	*Eurema laeta* (Boisduval)	SC,GL
25	Striped Albastross***	*Appias libythea* (Fabricius)	SC
26	Three Spot Grass Yellow	*Eurema blanda* (Boisduval)	SC,GL
27	White Orange Tip	*Ixias marianne* Cramer	SC
28	Yellow Orange Tip	*Ixias pyrene* (Linnaeus)	SC
NYMPHALIDAE			
29	Common Evening Brown	*Melanitis leda* Linnaeus	SEG,DD
30	Angled Castor	*Ariadne ariadne* Linnaeus	SC
31	Baronate	*Euthalia nais* Forster	SC
32	Blue Pansy	*Junonia orithya* (Linnaeus)	SC
33	Blue Tiger	*Tirumala limniace* Cramer	SEG,DD
34	Chocolate Pansy	*Junonia iphita* (Cramer)	SEG,DD,SC
35	Commander	*Limenitis procris* Cramer	DD,SC
36	Common Baron	*Euthalia aconthea* Cramer	SC
37	Common Bushbrown	*Mycalesis perseus* Fabricius	DD
38	Common Fourring**	*Ypthima huebneri* Kirby	SEG,DD
39	Common Indian Crow	*Euploea core* Cramer	SEG,DD,SC
40	Common Leopard	*Phalanta phalantha* Drury	SC,GL
41	Common Nawab	*Polyura athamas* (Drury)	DD,SC
42	Common Palmfly	*Elymnias hypermenstra* (Linnaeus)	DD,SC
43	Common Sailor	*Neptis hylas* Moore	DD,SC
44	Common Sergeant	*Athyma perius* (Linnaeus)	SEG,DD
45	Danaid Eggfly*	*Hypolimnas misippus* Linnaeus	DD
46	Dark Branded Bushbrown	*Mycalesis mineus* (Linnaeus)	DD
47	Glassy Tiger	*Parantica aglea* (Stoll)	SEG,DD
48	Great Eggfly	*Hypolimnas bolina* (Linnaeus)	DD,SC
49	Grey Pansy	*Junonia atlites* (Linnaeus)	SC
50	Lemon Pansy	*Junonia lemonias* Linnaeus	SC,GL
51	Nigger	*Orsotrioena medus* Fabricius	SEG,DD
52	Peacock Pansy	*Junonia almana* (Linnaeus)	SC,GL
53	Plain Tiger	*Danaus chrysippus* Linnaeus	DD,SC,GL
54	Striped Tiger	*Danaus genutia* Cramer	SC,GL
55	Tawny Coster	*Acraea violae* Fabricius	SC,GL
56	Yellow Pansy	*Junonia hierta* (Fabricius)	SC
LYCAENIDAE			
57	Ape Fly	*Spalgis epius* (Westwood)	DD,SC
58	Club Silverline	*Spindasis syama* (Horsfield)	SC,GL
59	Common Cerulean	*Jamides celeno* Linnaeus	DD
60	Common Pierrot	*Castalius rosimon* Fabricius	SC,GL
61	Common Silverline	*Spindasis vulcanus* Fabricius	SC,GL
62	Gram Blue	*Euchrysops cnejus* Fabricius	GL
63	Leaf Blue	*Amblypodia anita* Hewitson	DD,SC
64	Lesser Grass Blue	*Zizina otis* (Fabricius)	GL
65	Lime Blue	*Chilades laius* Stoll	SC,GL
66	Line Blue sp.	*Nacaduba sp.*	DD,SC, GL
67	Monkey Puzzle	*Rathinda amor* (Fabricius)	SC
68	Pale Grass Blue	*Psuedozizeeria maha* (Kollar)	GL
69	Pea Blue	*Lampides boeticus* Linnaeus	SC
70	Plains Cupid	*Chilades pandava* (Fabricius)	DD,SC
71	Quaker	*Neopithecops zalmora* (Butler)	DD
72	Slate Flash	*Rapala manea* Hewitson	SEG,DD
73	Striped Pierrot	*Tarucus nara* Kollar	SC
74	Sun Beam	*Curetis thetis* (Drury)	DD,SC
75	Tiny Blue	*Zizula hylax* Fabricius	SC,GL
76	Zebra Blue	*Leptotes plinius* Fabricius	DD,GL
HESPERIIDAE			
77	Bush Hopper	*Ampittia dioscorides* (Fabricius)	GL
78	Chestnut Bob	*Iambrix salsala* Moore	SC,GL
79	Common Grass Dart	*Taractrocera maevius* (Fabricius)	DD
80	Common Redeye	*Matapa aria* (Moore)	DD,SC
81	Common Small Flat	*Sarangesa dasahara* Moore	SEG,DD
82	Giant Redeye	*Gangara thyrsis* Fabricius	DD
83	Golden Angle	*Caprona ransonnetti* (C. & R. Felder)	DD
84	Grass Demon	*Udaspes folus* Cramer	DD,SC
85	Indian Palm Bob	*Suastus gremius* Fabricius	GL
86	Indian Skipper	*Spialia galba* Fabricius	SC,GL
87	Indian/Ceylon Ace**	*Halpe homolea* (Hewitson)	SC
88	Restricted Demon	*Notocrypta curvifascia* C & R Felder	SC,GL
89	Rice Swift	*Borbo cinnara* Wallace	SC
90	Straight Swift	*Parnara guttatus* (Bremer & Grey)	DD,SC
91	Tiny Flat	*Sarangesa sati*	DD
92	Tree Flitter	*Hyarostis adrastus* (Stoll)	DD,SC

SEG-Semi-evergreen forest, DD- Dry deciduous forest, SC- Scrub forest and GL- Open grassland.; *****Schedule –I, **Schedule –II and ***Schedule -IV

pollination processes. The butterflies like *Papilio polymnestor, Graphium doson, Atrophaneura aristolochiae, Atrophaneura hector, Graphium nomius, Graphium Agamemnon, Delias eucharis, Euthalia aconthea, Curetis thetis* are the canopy fliers which are contributing more for pollination in trees

whereas *Ixias pyrene, Ixias marianne, Euthalia nais, Euploea core, Phalanta phalantha, Hypolimnas bolina, Junonia atlites, Junonia almanac, Amblypodia anita, Rathinda amor* etc. are taking major role in pollination processes in scrub forests and dry deciduous forest areas.

Butterflies do have very significant role in ecological balance and are also very good pollinator. Among the 92 species of butterflies recorded at Nandankanan, four of them are protected by the Wildlife (Protection) Act, 1972. Danaid egg fly (*Hypolimnas misippus***)** belongs to schedule – I whereas two species i.e. Common four ring (*Ypthima huebneri*) and Indian ace (*Halpe homolea*) belong to schedule – II and Striped albatross (*Appias libythea*) belongs to schedule – IV of WPA, 1972. Butterflies provide ecological benefit as strong pollinators and predominant prey base for many animals. They indicate any little change in environment as instant ecological indicators. Thus, it is necessary to conserve the species diversity as well as to continue study to understand the most attractive and colourful creature of nature.

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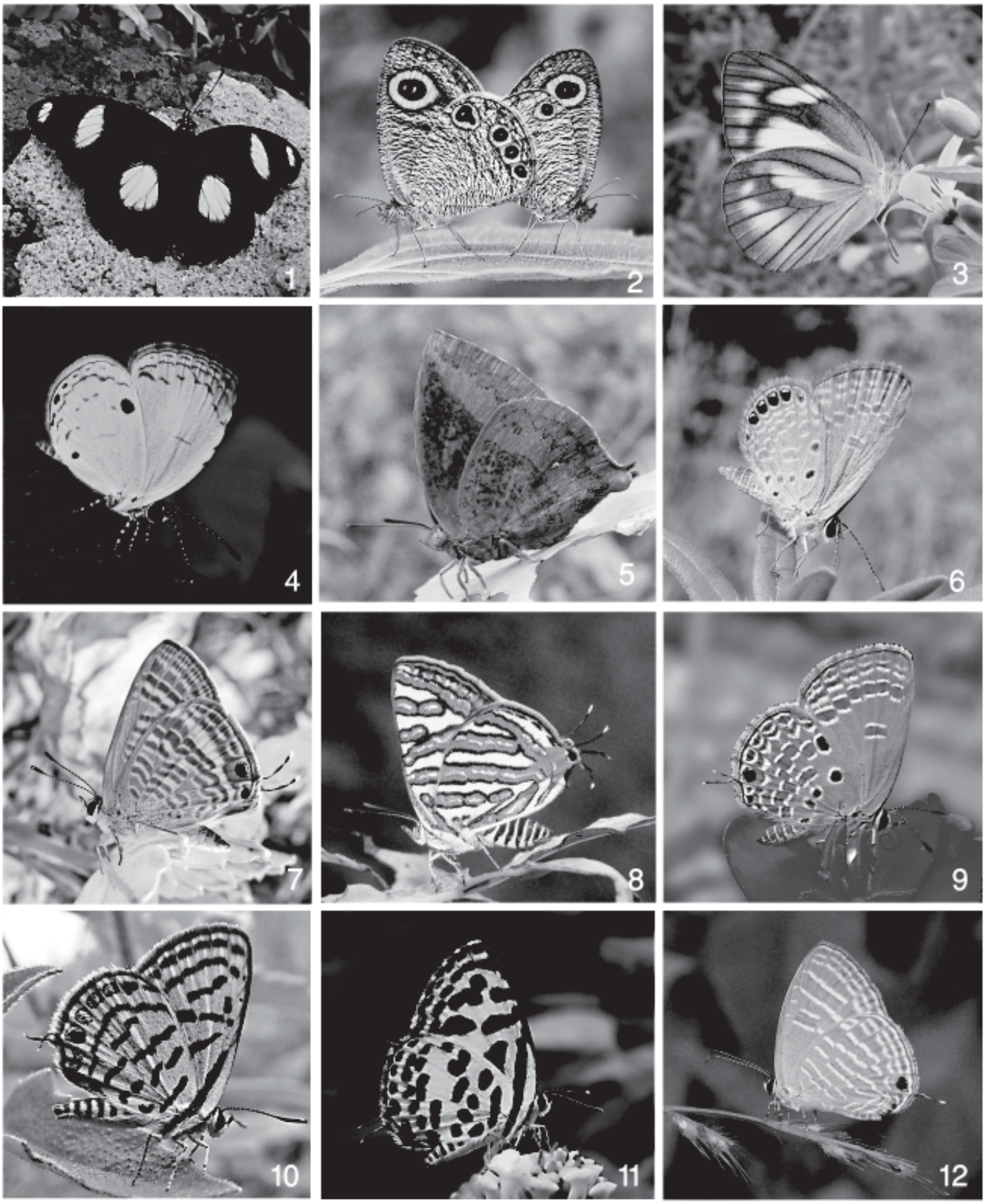

Fig. 1 - 12 : Butterflies of Nandankanan**;** 1- Danaid eggfly (Schedule – I, WPA, 1972), 2 -Common fourring (Schedule-II), 3-Striped albatross (Schedule-IV), 4 to 12 - Lycenidae (4. Quaker, 5. Leafblue, 6.Grass jewel, 7. Pea blue,8. Common silverline, 9. Plains cupid, 10. Striped pierrot, 11. Common pierrot and 12. Common cerulean).

Fig.13 - 24 : Butterflies of Nandnankanan; 13 - 18 – Papillionidae (13. Common rose, 14. Common jay, 15. Blue mormon, 16. Tailed jay, 17. Common mormon, 18. Common mime) 19-24 -- Pieridae (19. Spotless grass yellow, 20. Common grass yellow, 21. Three-spot grass yellow, 22. White orange tip, 23. Psyche and 24. Common wanderer).

Fig.25-36 : Butterflies of Nandankanan; 25-33-- Nymphalidae (25. Blue pansy, 26. Peacock pansy, 27. Chocolate pansy, 28. Yellow pansy, 29. Common indian crow, 30. Common baron, 31. Common palm fly, 32. Evening brown, 33. Common bush brown), 34 - 36 -- Hesperiidae (34. Red eye, 35. Common palm bob, 36. Leaf flitter).

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BIOCHEMICAL COMPOSITION OF SOME EDIBLE PORTUNIDAE CRABS FROM PARANGIPETTAI COAST

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ABSTRACT

In the present study, biochemical composition viz., protein, carbohydrate and lipid were studied for 10 commercially important crabs (*Scylla serrata, S.tranquebarica, Portunus pelagicus, P.sanguinolentus P.gladiotor, Charybdis feriata, C.lucifera, C.natator, C.granulata and Podophthalmus vigil*). The protein contents were found to be following in the order (*S.tranquebarica >S.serrata >P.sanguinolentus >P.pelagicus >C.natator>C.lucifera >C.feriata >P.gladiotor >P.vigil >C.granulata).*Maximum (42.30%) protein content was found in *S.tranquebarica* and minimum recorded in *C.granulata* (17.90%). Carbohydrate contents were found to be higher in *S. serrata* (2.17%) and lower value was found *P.gladiotor* (1.46%) respectively. The lipid content of the present study was maximum (1.48%) in *S.tranquebarica* and minimum (0.97%) *in P.gladiotor*. So mud crabs are declared superior over blue swimming crabs in term s of nutritive value.

Keywords : Commercial crabs, protein, lipid, carbohydrate

INTRODUCTION

Marine invertabrates are widely used as food and feed supplements throught the world . Crabs, among many other invertabrates, are considered to be important shell fishery products (Gokoglu and Yerlikaya,2003) .A crab is characterized by a flattened, broad body covered by a shell or carapace. Crabs belong to the order *Decapoda*, class Crustacea and phylum Arthropoda. The order Decapoda consists of two sub-orders that are (a) Natantia-the swimmers and (b) Reptantia-the crawlers. Reptantia includes the crabs, lobsters and hermit crabs. They have heavy legs that can support the body for crawling. True crabs are the most successful decapods with about 4500 species *(*Yoloye, 1988*)*. Crabs are found throughout the world, chiefly in marine waters, Most of marine crabs occurring along Indian coast are belonging to the family Portunidae (Radhakrishnan, 2000). The commercially important portunid crabs found along Parangipettai coast are *Scylla serrata, S.tranquebarica, Portunus pelagicus, P. sanguinolentus* and *charybdis freiata, lucifera,C. natator, C.granulata C..tracata and Podopthalamus vigil* (John samual *et al.,* 2004). Shellfish is one of the most important sources of the proteins provided from sea, and blue crab is one of the most important of them. (Enzenross *et al.,*1997). Crab is highly nutritious and healthy owing to its contents such as essential amino acids, protein, unsaturated fatty acids and minerals (Adeyeye, 2002; Skonberg and perkins, 2002;Gokoglu and Yerlikaya, 2003; Vilosoa-Martinez *et al.,* 2007;Chen *et al.*,2007; Kuley *et al., 2007;* Kucukgulmez and celik, 2008; Adeyeye, 2008) .The crab meat contains many nutrients like vitamins carbohydrates, minerals and free amino acids. It is not only tasty and nourishing but carries therapeutic Value. Many therapeutic properties are attributed to the crab meat and it is used for asthma and chronic fever *(*Raja 1981*)*.The crab not only has a delicious taste and unique pleasant aroma, but also has good nutritive value *(*Naiguang, 2004*)*. But swimming crab, both *Portunus pelagicus and P.sanguinolentus* are being exported mostly frozen and in canned forms and this crabs availability are abundant throughout the year. In recent days crab food items have become more popular and gained global reception; they are extensively fished and marketed in all the Maritimes states of India and aboard *(*Rao *et al.,* 1973*).*

In India, the consumers mostly prefer large sized mud crabs, *viz*., *S. tranquebarica* and *S. serrata*. The natural availability of mud crabs is restricted in some seasons only. Because of their delicacy and larger size, the live mud crabs are always in greater demand and fetch a higher price both in national and international markets. But the blue swimming crabs' *P. sanguinolentus, P. pelagicus,* and other crabs are abundant throughout the year. In the present study, some commercially important crab species (*Scylla*

serrata, S. tranquebarica, Portunus pelagicus, p.sanguinolentus and P. gladiotor, Charybdis feriata C. lucifera, C. natator, C. granulata and Podophthalmus vigil) were investigated to determine their proximate composition. The study would demonstrate the proximate composition; which would encourage an increase in the consumption and utilization of these species in India.

MATERIALS AND METHODS

Some commercially important healthy crabs (*Scylla serrata, S. tranquebarica, Portunus pelagicus, P. sanguinolentus* and *P. gladiator, Charybdis freiata, C. lucifera, C. natator, C. granulata and podopthalamus vigil)* were collected from Parangipettai coast (Lat. 11º 29'N and Long. 79º 46'E). They were brought to the laboratory and acclimatized to the laboratory conditions (Salinity 30-34ppt; dissolved oxygen 5.0-6.0 ppm; temperature 28-30°C and pH 7.5-8.5). After acclimatization, all the crabs were dried at 60 °C in an oven and used for biochemical analysis.

Protein Estimation: The total protein was estimated using Biuret method of Raymont *et al.*, 1964.

Lipid Estimation: The extraction of lipid was done by the chloroform-methanol mixture Folch *et al.*, 1956.

Carbohydrate Estimation: The total carbohydrate was estimated by following the Phenol-sulphuric acid method of Dubois *et al.*, 1956.

RESULTS AND DISCUSSION

Ten species of crabs *(Scylla serrata, S. tranquebarica, portunus pelagicus, P. sanguinolentus and P. gladiotor, charybdis feriata C.lucifera, C. natator, C. granulata and podophthalmus vigil*) from family Portunidae collected from Parangipettai coastal waters, southeast coast of India for proximate composition analysis. The protein content ranged from 42.3% to17.9%. Higher protein was found in *S.tranquebarica* 42.3% followed by *S. serrata* (40.05%), *P.sanguinolentus* (23.6%) *and P. pelagicus* (22.5%). The lower value of protein content was ranged from *C.granulata* (17.9%) followed by *P.vigil* (19.5%) and *P.gladiotor* (19.8%) Fig.1

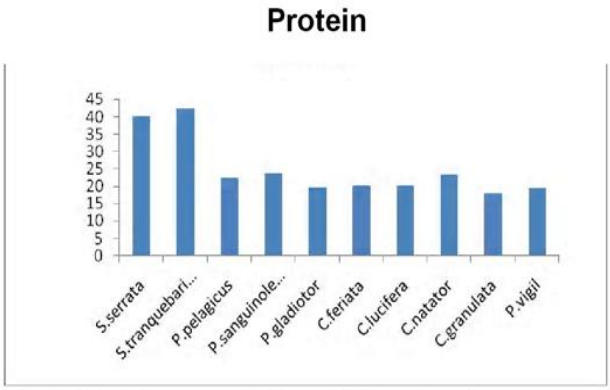

Fig.1 : Protein concentration of different crabs

The carbohydrate concentration of different crabs ranged from 2.17% to 1.41%. The highest carbohydrate concentration was recorded from *S.tranquebarica, i.e* 2.17% followed by *S.serrata* (2.06%), *P.sanguinolentus* (1.90%) *and p. pelagicus* (1.87%). The lowest value of carbohydrate content was observed from *P.gladiotor* (1.46%) followed by *C.granulata* (1.48%) and *P. vigil* (1.57%) (Fig.2)

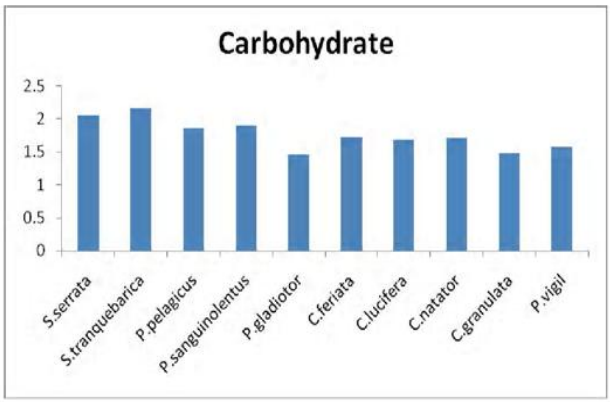

Fig.2 : Carbohydrate concentration of different crabs

The lipid content of crabs ranged from (1.48% to 0.97%); in that the maximum lipid content was recorded from *S.tranquebarica i.e 1.48%* followed by *S. serrata* (1.41%). *P. vigil* (1.38%), *P. sanguinolentus and C. feriata*(1.37%).The minimum lipid concentration was recorded from *C.granulata* (0.97%) followed by *C.lucifera (1.17%) and P. gladiotor* (1.17%) (Fig 3).

Biochemical studies are very important from the nutritional point of view. The biochemical constituents in animals are known to vary with season, size of the animal, stage of maturity, temperature and availability of food etc. Protein is essential for the sustenance of life and accordingly exists in the largest quantity of all nutrients as a component of the human

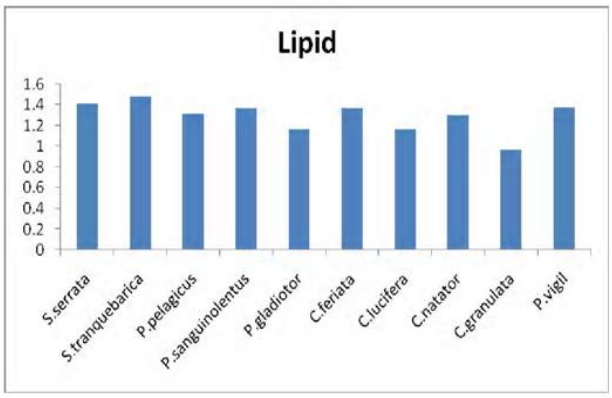

Fig.3 : Lipid concentration of different crabsin %.

body (Okuzumi and Fujii, 2000). An increasing demand for good quality animal protein for the exploding population has led to effective and increasing exploitation of the aquatic resources. The acceptability and easy digestibility of fish proteins make it very valuable in combating protein malnutrition, especially in children. The protein of fish has a high biological value with its growth promoting capacity. Fish occupy an important part in the world protein supply, accounting for about 10 % of the total protein supply. About 60% of the population in the developing countries derives 40% or more of their total animal protein supplied from fish. The average protein content of fish approximately ranges from 8 to 23g/100g wet edible protein. In the present study protein contents of different species of crabs ranged from 42.3% to17.9%. Values of protein in the present study matches with other studies (Sheen and D'Abramo, 1991; Mahammad Zafar, 2004; Murugesan et al., 2008). The protein content of soft shell crab was found to be 8.33% and hard shell crab was 14.93% in *S.ocenica* (Anil and Suseelan, 2001). Balasubramanian and Suseelan (2001) assessed the protein values in *C. smithii* was 59.8 to 71% in dry matter basis. The protein values in *P. vigil* was 15.75 to 20.16 %. (Radhakrishnan and Natarajan, 1979) and in *C. affinins* was 17.8% (Vasconcelos and Braz, 2001). In *S. serrata*, the protein content of the body meat and claw meat was 20.11% and 18.54% respectively (Prasad and Neelakantan, 1989). Anon (1999) reported that the protein value in blue crab was 17.17%. George and Gopakumar (1987) observed the protein content in S. serrata with egg (19.16%), without egg (20.92%), body meat (16.8%) and claw meat (16.28%). George *et al.* (1990) noticed the protein values in cooked crab of S. serrata ranged from 14.43 to 18.96%. The protein content of *P. pelagicus* and *P. sanguinolentus* was 0.47 to 15.91% and 12.81 to 13.6% respectively (Radhakrishnan, 1979). Skonberg and Perkins (2002) investigated the protein value in green crab (*Carcinus maenus*) was 16.8 to 17.1% in raw and steamed meat. Gokoolu and Yerlikaya (2003) assessed the protein value in blue crab (*C.sapidus*) claw and body meat to be 15.0%, 14.71% swim crab (*P. pelagicus*) claw and body to be meat 21.54% and 22.64% respectively. Zafer M (2004) reported that the protein values in *S. serrata* male were 17.69% and 19.39% for females. Khan (1992) investigated 11.60% protein in body meat of male and 19.92% protein in females body meat of *S.serrata*. Thirunavukkarasu (2004) recorded the protein values in *S. tranquebarica* from different parts viz., body meat (65.48 to 72.24%), claw meat (69.5 to 80.29%) and leg meat (69.47 to 74.7%). In *Callinectes sapidus* the protein values of claw meat, breast meat and hepatopancreas was 19.56%, 18.81% and 18.81% respectively (Kulcukgulmez and celik 2008).Yalcin kaya *et al.*,(2009) reported that the protein value in warty crab (*Eriphia verrucosa*) were 19.66%.

Carbohydrates constitute only a minor percentage of total biochemical composition. Carbohydrates in fishery products contain no dietary fiber but only glucides, the majority of which consist of glycogen. They also contain traces of glucose, fructose, sucrose and other mono and disaccharides (Okuzumi and Fujii, 2000). In the present study, carbohydrate content was higher in *S.tranquebarica* (2.17%) and lower in *P.gladiotor* (1.46%) crabs (0.68%). The previous studies were suggested that the carbohydrate in the muscle varied from 0.3 to 0.63% in *P. vigil* (Radhakrishnan and Natarajan, 1979), 2.4 to 3.4% in *C. smithii* (Balasubramanian and Suseelan, 2001), 0.17% in body meat, 0.24% in claw meat of *S. serrata* (Prasad and Neelakantan, 1989), 0.16 to 0.55% in *P. pelagicus* and 0.44 to 0.73% in *P. sanguinolentus* (Radhakrishnan, 1979). In *S. tranquebarica*, the carbohydrate values of body meat, claw meat and the leg meat was 0.59 to 2.23%, 0.68 to 2.87% and 0.76 to 2.76% respectively (Thirunavukkarasu, 2004). Recently Murugesan *et al.*, (2008) reported that carbohydrate content of hard shell crabs (1.42%) of *C. lucifera* was little bit lower than eyestalk ablated crabs (1.45%).

Lipids play an important role in fish nutrition for the provision of body energy and essential fatty acids. Lipids are highly efficient as sources of energy and they contain more than twice the energy of carbohydrates and proteins (Okuzumi and Fujii, 2000). The marine lipids also have applications in food, healthcare, pharmaceutical products and as an ingredients in feed, in agriculture and the aquaculture industry. Marine lipids contain high level of polyunsaturated fatty acids, especially EPA (Eicosapentaenoic Acid, C20:5n3) and DHA (Docosahexaenoic Acid, C22:6n3).

In the present study, lipid content of the *S.tranquebarica*1.48% was higher than *C.granulata* (0.97%) crabs. In *P. vigil* the lipid values assessed from 5.13 to 9.73% by Radhakrishnan and Natarajan (1979). Balasubramanian and Suseelan (2001) recorded that the lipid values from 6.2 to 7.6% in *C. smithii*. In *Chaceon affinis*, the lipid values were 0.7% and in blue crab it was 1.5% (Anon, 1999). Prasad and Neelakantan (1989) noticed that the lipid content in *S. serrata* from body meat was 1.65% and claw meat was 2.01%. George and Gopakumar (1987) assessed the lipid values in *S. serrata* with egg (0.43%), without egg (0.7%), body meat (1.07%) and claw meat (1.0%). In *P. pelagicus* the lipid value was 3.3 to 5.6% and *P. sanguinolentus* it was 3.8 to 5.5% (Radhakrishnan, 1979). The lipid content of the body meat (0.9 to1.6) claw meat (1.83 to 2.06%) and leg meat (1.58 to 2.08%) was estimated by Thirunavukkarasu (2004). Recently Murugesan *et al*., (2008) reported that lipid content of hard shell crabs (1.65%) of *C. lucifera* was little bit lower than eyestalk ablated crabs (1.85%). In crustaceans, lipids are not only the principal organic reserve and source of metabolic energy, but also indispensable in maintaining cellular integrity. Lipids as a general rule act as major food reserve along with protein and are subject to periodic fluctuations influenced by environmental variables like temperature (Nagabhushanam and Farooqui, 1982). According to the results obtained in this present investigation, the protein, lipid and carbohydrate level was optimum. Although the results of chemical composition of crabs analysis had demonstrated that can be potentially good and same time more study is necessary to evaluate the nutritional value of this crabs as food ingredients.

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e-planet 8 (1): 43 - 47

FLUVIAL AND MARINE PROCESSES ALONG PURI SHORELINE

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ABSTRACT

The entire 70 kilometer coastline from Satpara to Konarak was being nourished by the rivers debouching to its west in the Chilka lake. The material flow in these rivers have dwindled down to an insignificant level now. The rivers have neither considerable mount of sediments nor the drainage is sufficient to revive Chilka's past status. A close study of the drainage systems in the Konarak-Astaranga area indicates the avulsion of rivers to the east or north-east. The drainage flow was constrained due to level uplift. Shoreline between Kushabhadra and Prachi has accreted a minimum of 63m of land in about 52 years. Chilka mouth have been shifting from west to east and then finally it closed due to sluggish flow from the rivers debouching into the lake. Longshore current along this coast is starved of sediment to carry eastward and deposit along the beach. The Bouguer gravity anomaly map of Oil India Ltd. indicate a relatively high gravity anomaly in the shelf immediate south of Puri. The other gravity highs in the continental shelf are aligned along NE-SW trend.. The magnetic survey in the Bay of Bengal has revealed that the magnetic signals of 85º East Ridge swerve easterly in the segment north of 14º N Lat. and meets the continental crust, to the east of 85º E longitude close to Puri.

Key word : Magnetic basement, shoreline, coastal erosion, accretion, drainage system, mangroves

INTRODUCTION

Remote sensing studies have revealed three sets of lineaments traversing the Mahanadi delta viz. 1. notheast—southwest, 2. north west – south east and 3.east – west. South of Puri the continental shelf narrows down to 25 km developing a canyon like valley hewn on the shelf edge. The narrowing of the shelf from 60 km to 25 km is abrupt and the shelf break is steep giving rise to vertical drop of more than 400 m.

The Puri-Konarak shoreline nearly stops growing a little after the 2nd stage strandline which passes along the northern shores of Sar and Samang lakes. However, there is growth in the northern segment even after the 4th stage strandline near the mouth of Brahmani and Baitarani rivers. Hence the depletion of sediment in this part of the shelf began in the Late Holocene, even thousands of years before any engineering structure came in the upstream.

This paper tries to bring out the relationship in the coastal hydrodynamics with the shelf morphology, tectonics across and along the shore, the volume of sediment discharge from the rivers and the coastal accretion and erosion processes.

The subsurface geology and geomorphology of the Puri-Konark coastal zone reflect a complex history of regional plate tectonic event followed by marine, fluvial and deltaic sedimentary processes interrupted or aided by high magnitude of eustatic changes of sea level due to Last Glacial Cycle. The east coast of India (ECI) represents a passive continental margin originated after the break-up of Gondwanaland. The Mahanadi delta is one of the major deltas formed at one of the three fossil triple junctions along the ECI. The delta is result of sediment input from four sets of rivers and their ramifying distributaries – Baitarani, Brahmani in the north, Mahanadi in the middle trending East-West and finally Devi, Daya and Bhargavi building the southern part of the delta. Kumar and Bhattacharya (2003) observed that the delta has ceased to grow in the southern shoreline to the west of Devi, where as it is still active in the north with influx from Brahmani and Baitarani. The coastal processes along the southern segment of Mahanadi delta reflects the fluvio-marine dynamics and the geological and structural setup in the area

GEOLOGY

Beach ridges in Mahanadi delta are few because of a dominant and dynamic fluvial action which wiped out most of the beach deposits. The oldest beach ridge near Gordia is recognised by a small patch of relict sandy ridges at 35 km from the present coast. Marine metallic sediments deposited in the subsurface, 30 to 35 km landward off the present

coast indicate Late Pleistocene marine transgression (Mahalik et. al., 1998). Four stages of palaeo-deltaic lobes suggest major stages of delta building activity controlled by palaeo strand lines. During the first and second stages of the growth of Mahanadi delta the growth occurs uniformly all over the delta front from north to south reference of which is mentioned below. But subsequently the Puri-Konarak shoreline nearly stops growing a little after the 2nd stage strandline which passes along the northern shores of Sar and Samang lakes. Where there is growth in the northern segment even after the 4th stage strandline near the mouth of Brahmani and Baitarani rivers.

Rocks belonging to Eastern Ghat Super Group (EGSG) –Khondalite, Charnockite and Anorthosite — occur as discontinuous hills and mounds mainly to the north and west of the delta complex. Bornhardts and inselbergs of these rocks are seen in the upper deltaic plains around Khurda and along courses of Daya river. To the east of this zone there is a drastic drop in the frequency of EGSG.

STRUCTURE

The geographical studies followed by ground truth data have revealed three sets of lineaments traversing the Mahanadi delta viz. 1) northeast—southwest, 2) northwest – southeast and 3) east – west. The NE-SW lineament appears to be the oldest generation and there are beach ridges parallel to NE-SW trend defined by the Precambrian trends. These are predominant in the upper deltaic plains in the north central part of the delta and along the coastal tract in the area north of Mahanadi. The southern part of the delta south west of Devi river shows prominent development of NW-SE lineament which runs parallel to the course of Devi river and corresponds to Mahanadi graben trend. The disposition of Dhamra river mouth is defined by E-W trending lineament. (Kumar and Bhattacharya 2003).

SHORELINE CHANGES

Chilka shoreline: Puri-Konarak stretch of coastline forms the southern most segment of the Mahanadi Delta. Two major rivers, distributaries of Mahandi river, Daya and Bhargavi which is debouch into the Chilka Lake to the west of the coastline under review, about 30 km west of Puri. In the north-eastern part of a palaeo-shoreline of Chilka Lake about 30 km east of the present shore in the east. This suggests that in the past, Daya and Bhargavi debouched into the Chilka Lake, some 30 km northeast of the present location. The south-eastern part of Chilka lake is bordered by a linear barrier spit which is about 42 km long and 150 m wide. Except at two points in the north eastern part where the sea water used to flush into the lake, two-three decades ago. The sandy barrier spit is a continuous feature. The elevated level of Mugger Muhano used to remain just 30 cm deep in summer in the decades after 1972.

Kushabhadra-Prachi beach: This needs no evidence if one analyses the position of Sun temple at Konarak with respect to the shoreline. It was erected in the 12th century AD on the beach and today it stands about 2 km away from the shoreline. We do not have records of the geological changes in other areas during the last 9 centuries, but accretion along the shoreline during this period is certain.

Puri beach: The marine drive to the west of Puri town runs parallel to the shoreline for about 2.5 km. Some changes in the hydrodynamics have resulted in the erosion of half the width of marine drive for a length of 1.4 km. This development has appeared during the monsoon of 2007, rousing a lot of concern among the inhabitants and the administration.

COASTAL PROCESSES

Coastal areas have varied topography and are generally dynamic environments. Continental and oceanic processes converge along coasts to produce landscape capable of rapid changes. Strong waves that batter the coast are generated by offshore storms. The waves expend their energy on the shore. A beach is a landform constituting loose material like sand and gravel are accumulated by waves on the shoreline.

A major morphological feature of many sandy wave dominated coasts is the concave upward bottom slope lying between outer reaches of the surf zone and inner continental shelf — known as shore face. Marine bed load transport and morphodynamics of the shore face are primarily influenced by the local wave energy and current pattern. The shore face is generally found in the water depths of 4m and 25m. The shape and morphology of the shore face is an equilibrium response of an unconsolidated coast to the typical wave and current conditions. Much remains to be done in the quantitative relationship of process and response in this zone. The upper shore face forms a reservoir for sand removed from the beach and surf zone during coastal storms. Fair weather wave processes will tend to return this

material to the surf zone and beach. Storm down welling currents must move sand seaward faster than wave orbital currents can return it.

The sand on the beaches is supplied to the coastal areas by rivers that transport it from the catchment area of the drainage system. Any interference with the material flow of sand from inland areas to the beach by say construction of dam will lead to trapping of the sand (Prothero et. al., 1996). Consequently the beaches will be depleted of sand and erosion occurs. Beach erosion can be as a result of cyclones and storms (Hall,1988), a rise in sea level, interference by human activities with natural shore processes like formation of Industries and large buildings by the side of the coast.

The coastline along Puri-Konark sector is nourished by sand through longshore current which transports sediments from west to east during greater part of the year. The rivers to the west of Puri district Daya and Bhargavi do not bring in bedload sediment like it used to do in the past and so there is no replenishment of sand in the continental shelf off Chilka and Puri. The entire 120 km length of continental shelf from Puri to Rushikulya river mouth is starved of sediment.

GEOMORPHOLOGY

The coastline stretches for nearly 72 km starting from Satpara to Prachi with well developed shoreface, wide beaches, berm, fore dunes, rear dunes and aeolian flat. The gradient of the beach is rather steep with very huge fore dunes on the western segment from Satpara to Chhamu nadi. The aeolian flat is present in the sector Puri to Prachi since the area north of Satpura to Puri beach is occupied by the palaeo lake bed of Chilka. In the offshore domain the continental shelf is about 50 km wide to the west of Gopalpur. It is 60 km off Chilka lake (Faruque et al 2005, Faruque & Panda 2008). The shelf is wider off Mahandi. However just south of Puri the continental shelf narrows down developing a canyon like valley hewn on the shelf edge. The narrowing is abrupt giving rise to near vertical drop. The high energy waves while grazing through the wide shelf will result in dissipation of energy and reduced impact on the coast. A narrow continental shelf will allow the strong wave energy to move into the beach without much resistance resulting in greater impact on the coast.

The accretion along Kushabhadra-Prachi coast and erosion at Kushabhadra mouth or east of Prachi could mean a routine coastal process. The accretion occurred at least from some time in the historic past till 20th century and erosion which is taking place today may have something to do with mega engineering projects taking shape across the drainage systems in the upstream of the drainage systems.

Coastal erosion is necessarily a disastrous phenomenon, however, problems crop up when erosion and cultural activity come into confrontation.sea level rise or ingression of sea can devastate everything we have. This may add to the increase in climate change refugees in Orissa. There is a huge amount at stake and if we fail to invest in fighting climate change today. From whichever angle you look at it cost of climate threat is colossal. Whether it's economic investment, cultural heritage or simply the community crisis, we have to lose everything without gaining anything. Thus beaches are essentially energy sinks. They act as buffer between waves and coast, a buffer which must dissipate energy without suffering any net change itself. Continental and oceanic processes converge along coasts to produce landscapes that are characteristically capable of rapid change. Our activities perhaps come in the way of natural processes. This is compounded by the global warming and its consequential rise in sea level which will accelerate the coastal erosion. The options of checking the erosion are by one is Hard engineering structures and second Green bio-shield.

The problem of erosion needs to be handled in a way that does not interfere with the natural systems. The second option is less expensive, eco-friendly, sustainable, can be a source of support to the farmers and fishermen colonising along the coast and above all add to the natural forest products of the area. Developing mangrove forest along the coast will help to a large extent save the coastal tract. There are other plants which work as sand binder and help resist erosion. The species that grow along Bhitarkanika area are not distantly located from Puri and the deltaic sediments of the two areas are almost identical. Hence plantation of Mangrove forest along the Puri coastal tract is a possible remedy to save the coastal tract from erosion(newell, 1995).

One need to analyse the existing mangrove forest of Bhitarkanika to apply the advantages along other coastal tracts. In Mahanadi-Brahmani-Baitarani compound delta mangroves are seen at the mouth of Brahmani & Baitarani Delta, the Bhitarkanika. The Bhitarkanika creeks with the lush green mangroves

Fig. 1 : Geographical position of Sonapurpeta- Palur, Chilika lake, Brahmagiri-Dhamara and Dhamara Subarnarekha.

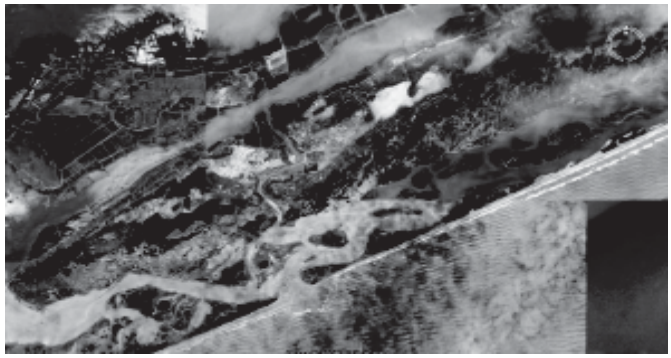

Fig. 5 : Google photographdepicting change of direction of the streams

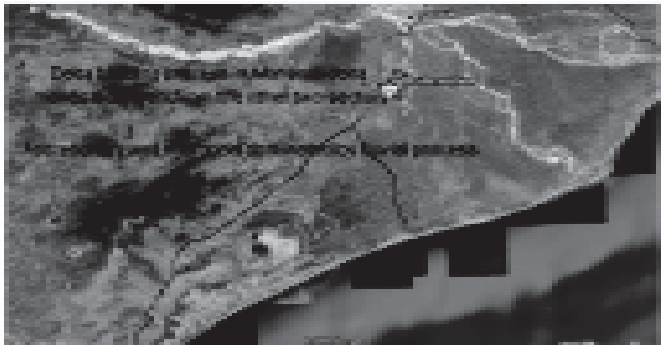

Fig. 2 : Delta building process in Mohanadi delta makes it different from other 2 sectors accretionary and microfidal dominated fluvial process

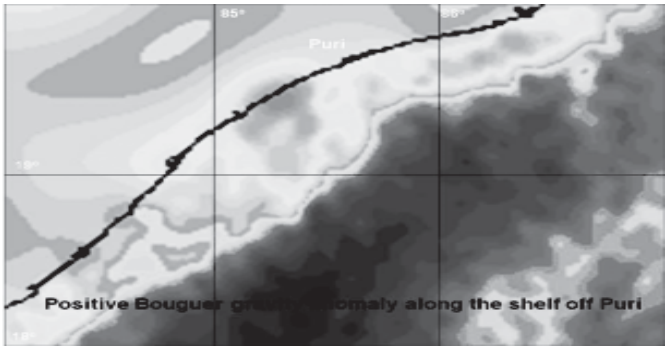

Fig. 6 : Positive Bouguer gravity anomaly along the shelf of Puri

Fig. 3 : Ingrassion of sea in Kushabhadra

Fig. 7 : Mangrove species (Avicinnia species) can act as bio-shield

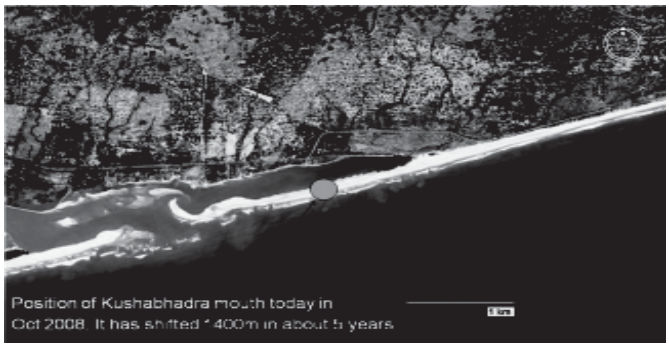

Fig. 4 : Position of kushabhadra mouth by Oct-2008 (it has shifted 1400 mts about 5 years)

Fig. 8 : Mangrove in the mud flat with strong roof system

make an ideal breeding place for crocodiles several other species like sea turtle, king crab etc. The varieties of mangroves genera seen in Bhitarkanika area are: Rhizophora, Bruguiera, Ceriops, Avicennia, Sonneratia, Heritiera, Kandelia, Xylocarpus, Lumnitzera, Delichandrone, Exoecaria, Phoenix, Tamarix, Brownlowia, Cleodendrum, Scrirpus, Tylophora and intsia etc (Smita Nayak, 2006).

The mangroves are the coastal tropical forests. Mangroves are trees that live at or near the water's edge in protected marine habitats. There are several features that all species of mangrove trees have in common. Tolerance to conditions of high soil salinity. Tolerance to submergence in water or waterlogged soil, and to low oxygen conditions. This is one reason why mangrove trees can thrive in areas too harsh for other vegetation. Black mangroves survive in water- logged soil by using special "root snorkels" called pneumatophores. These structures are covered with small holes called lenticils that allow the roots to breathe the same way a snorkel lets you breathe while underwater. The osmotic pressure of these plants is high due to higher salt concentration in soil and water. It has thick, succulent, evergreen, leathery, texture with wax coating foliages. Mangroves can survive in strong wind velocity, tidal extremes, high temperature and muddy soil. It has often been seen that coastal areas shielded by mangrove forests face relatively less impact of the frequent storms and tidal thrusts lashing the shores of east coast of India. Mangrove vegetation is also a good agent to check the sand erosion from the coastal deltaic beaches.

But unfortunately before we realize the importance of mangrove we might have caused irreparable damage to the mangrove. It is imperative to mention here that huge areas of mangrove have been lost from Southeast Asia due to population expansion and human activities such as wood extraction, conversion of aquaculture, salt production, mining and pollution from coastal industrialization and urbanization (Ali *et al*, 2009). Considering the impact of anthropogenic disturbances on mangrove areas, enforcement of rules and regulations pertaining to mangrove forest protection, preparation of community based mangrove resource management plan, rehabilitational reforestation of degraded mangrove areas, identification of alternative livelihood projects and non-conversion of existing mangrove forest into other areas can be implemented for management of these areas (Ghoshal *et al.*, 2005). With so many plus qualities of mangrove it is worthy to try these as a bio-shield for protection of beaches.

There are several grasses like Vetiver and Marram which act as sand-binders. These grow deep roots into the sand and can tolerate saline environment but grow on the dunes and help stabilize the dunes. These are some of the bio-shields which make a better eco-friendly and productive measures to check erosion and add aesthetics to the natural surrounding of the coastal tracts.

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e-planet 8 (1): 48 - 54

STUDIES ON GROWTH PERFORMANCE RATE OF INDIAN COMMON CARP (*Cyprinus carpio carpio*) IN CERTAIN SEWAGE FED PONDS OF BANKI (ORISSA)

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ABSTRACT

The present study is aimed to estimate the growth performance rate of Indian major carp in sewage fed ponds of Banki town in relation to major water quality and some biochemical parameter were considered as indicators of fish growth. Growth rate of fish showed a marked difference among all three ponds .This study supports that environmental stresses of the sewage. Effluent greatly influence growth rate of *Cyprinus carpio carpio* .All analysis tend to indicate that maximum growth of fish in a particular sewage fed pond was the result of better water quality expressed in terms of high concentration of dissolved oxygen, low concentrations of nutrients and diversity of plankton that were favorable for fish growth.

Key words: Common carp, growth, sewage, eutrophication,organic waste,pollution,environmental stress

INTRODUCTION

Of three forms of wastes such as solid, liquid and gases, liquid waste is much detrimental to aquatic habitats. Liquid wastes mainly consist of waste water from residential, commercial and industrial areas in towns and cities. In cities and towns, wastewater is transported through sewerage system having a network of channels and pipes. For example, domestic sewage consists of water containing food wastes, various washing and laundry wastes, water form lavatories and baths, etc. (Voznaya, 1981; Jhingran, 1995; Rao, 1994; Bieeton, 1969, Banerjee *et al.* 1979). The sewage water mainly has 99.9% of water and rest 0.1% of organic and inorganic substances.

Swage is universally considered as valuable organic fertilizer as it contains abundant nutrient elements. However the raw sewage is not supplied to the fish pond because of the presence of high biochemical demand, low dissolved oxygen contents, total suspended solids, bacteria load, high CO_2 contents and high values of ammonia and hydrogen sulphide[1] . Sewage treatment has been targeted to remove these constituents (Edwards, 2000).

Success of sewage fed fish culture depends mainly on the water quality management. Hence it is necessary to have the intimate knowledge of the chemical environment of such system. The term '3 Rs', or 'Reduce-Reuse-Recycle' has also been used for these proposes. Use of sewage in fish culture is a profitable proposition and has manifold advantage which is a major source of nutrients for sustainable production and helps to combat environmental pollution.

MATERIALS AND METHODS

Three ponds were selected for the present investigation. These ponds are: Pond – A, Pond – B and Pond – C located in different places in Banki town in the district of Cuttack. Pollution of these three ponds result from organic as well as inorganic substances. These are contributed principally by sewage. These ponds carry their load of pollutants either in the form of dissolved colloids or in the particulate form. Besides these, the ponds also receive untreated animal excreta and wastes from animal farm, oil extraction and small industries.

These water bodies were in degraded condition due to discharge of wastewater into it. Organic wastes give rise to scum and sludge that make water unfit for use and leads a depletion of oxygen; again affecting biotic lives. Phosphates present in detergents further stimulate algal growth that adds to the organic loading of the water. Therefore analysis of physicochemical and biological parameters of water of these sewage fed ponds are essential, which help us to know the pollution level and prepare us to

take necessary steps to develop them into models for natural and sustainable management of urban waste water, aquaculture and to improve the aesthetics of the site.

The first important consideration in the selection of the site is to know the growth rate of fish in sewage-fed ponds of different strength. The present investigation was aimed at finding out the possibilities of rearing fish in sewage-fed ponds to meet the increase demand of fish. This provides an opportunity to examine the degree of morphological, physiological imbalances and quality differences of fishes cultured in different sewage-fed ponds.

Cyprinus carpio carpio (exotic carp) has been one of the most important species among the cultivable carps. It was selected for the present experiment. The rationale of its selection was that it has excellent growth rate, easy availability, wide distribution, commercial importance etc. It is a hardy fish for better survival in sewage-fed ponds. Its seed has been in high demand by the aqua-farmers for variety of purposes such as monoculture and polyculture. In view of consistent demand for finger-lings, studies were therefore undertaken in the different sewage fed ponds.

In this work three rectangular nets were installed in three sewage-fed ponds about three meters away from the pond embankment. The volume of each net was 1.295 m^3. Fry of *Cyprinus carpio carpio* (1.2-1.6g.) were acclimatized for about a week and introduced into the net @8 fishes/net. The used stocking density was 60,000/ha. The fishes were reared for 36 days and no supplementary feed were provided during the culture period.

Procedure of Sample Collection

During the 36 days of culture period in three different ponds, water and surface sediment samples were collected from each pond near the installed net. During the period of investigation, physicochemical analysis was done at a set time of the day (10am) at twice a week intervals. The samples of water were collected in neutral glass containers and Ruttner's water sampler from each treatment. Water was collected from several places of each pond and then pooled into one before analysis.

Growth Performance of Common carp in sewage fed ponds

As regards the methodological norms adopted for conducting the experiments, in the rearing ponds No. A, No. B and No. C, all the details of some parameters is recorded in Table-1. At the end of 36 days' of culture period, harvesting was done and all the relevant details are recorded in Table-2.

Table 1 : General features with various methodlogical norms for conducting the experiment.

S.L. No.	General Features:	Standard sizes weight
1	Initial weight range (g)	1.2-1.6 gm
2	Average weight / fry (g)	1.3
3	Initial length range (cm)	1.7-2.9
4	Average length (cm)	2.6
5	Culture period (days)	36

Physicochemical Analysis

Temperature

Water temperature of the sewage fed pond was recorded on the spot with the help of a standard mercury thermometer.

Dissolved Oxygen (DO)

Dissolved oxygen of water was analyzed by modified iodometric method of Winkler (Wetzel and Likens, 1991). For estimation, water samples were collected in narrow mouth glass topped bottles taking necessary precautions to exclude air bubbles. The water sample was immediately fixed on the spot by adding MnS_4 and alkaline iodide. After addition of concentrated H_2SO_4 the sample was titrated against N/80 sodium thiosulphate using starch as an indicator.

Ammonium-Nitrogen (NH_4-N)

A modified phenate method (wetzel, 1991) was used to measure ammonium nitrogen. Sample water was treated with tri sodium phosphate buffer solution and the reagent A and B was mixed in the solution. Final mixture was measured spectrophotometrically (Shimadzu UV spectrophotometr, model UV 1601) to be 665 nm.

Nitrate Nitrogen (NO_3-N)

The amount of nitrate present in the water sample was estimated by ultra violate spectrophotometric method (APHA, 1995) using aluminum hydroxide suspension and I N HCL at 220 nm and at 275 nm in a spectrophotometer (Shimadzu UV spectrophotometer, mode UV 1601). Measurement of the ultra violates absorption at 220 nm enable rapid determination of nitrate. The nitrate calibration curve follows Beer's law up to 11 mg/1N. Because dissolved organic matter may also absorb at 220 nm and nitrate does not absorb at 275 nm, a second measurement was made at 275 nm to correct the nitrate value.

Orthophosphate (OP)

The orthophosphate level of water was determined calorimetrically (Spectronic –20 D Colorimeter) at 690 nm following the stannous chloride method (APHA, 1995).

pH

pH was measured by electrically operated pH meter. pH meter was standardized with known buffer solutions. After that the electrodes of the pH meter was dipped into the water sample and the correct pH was indicated in the pH meter.

Total Alkalinity

The amount of acid required to neutralize bases in water is a measure of the alkalinity of water. Carbonate and bicarbonate are considered to be the predominant bases in natural waters. Water samples, which turn yellow upon addition of methyl orange indicator, are considered to be alkaline and usually alkalinity is expressed as mg/litter of calcium carbonate.

Fish Growth

Average Body Weight

Changes in absolute weight of test fish were determined by recording their length and weight over the time. All the collected fishes were measured individually from each culture system. The length and weight of fish were recoded to the nearest millimeter and to the nearest milligrams, respectively.

Net Gain in Body Weight

The net weight was obtained by calculating weight differences between initial and final body weight of fish. All the individual measurements were then pooled to get an average value.

RESULTS AND DISCUSSION

Temperature

The temperature of water ranged from 28^0 c to36^0, during the period of study. There was a gradual rising trend over time with some fluctuation. (Fig-1)

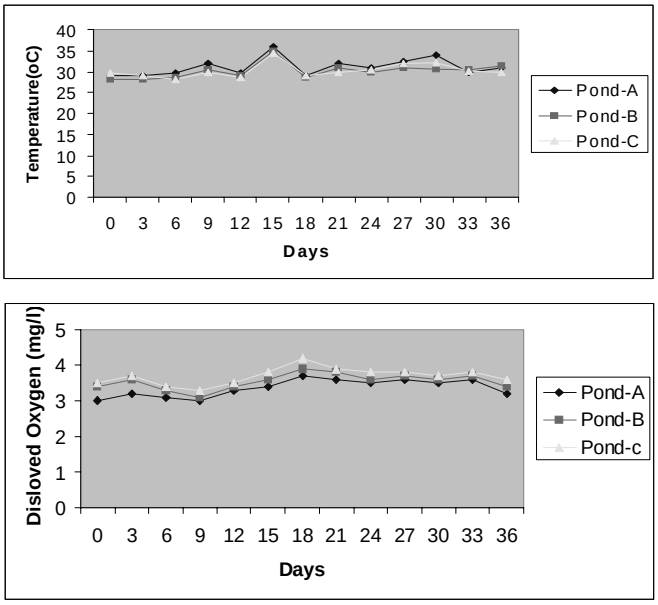


Fig.1 : Time course variation of temperature (A) and dissolved oxygen (B) of water in different sewage fed ponds.

Growth Performance of Common Carp in sewage fed ponds

Dissolved Oxygen

Dissolved oxygen concentration of ponds varied between 3.0 and 4.2 mg/L. There was a gradual increasing trend in mean values from pond-A (3.3mg/L) to pond-C (3.8 mg/L) (fig-1). As time progress, the concentration exhibiting a fluctuating trend in all ponds throughout the period of experimentation.

Ammonium-N

The concentration of NH_4-N ranged from 2.06 to 7.25 mg L^{-1} during the culture period. There was a clear-cut difference in the concentration of NH^4-N among three ponds showing the following order of variation: Pond-A > Pond-B > Pond-C (Fig.2). The values of

NH_4-N tended to rise over time. The percent of declination was 23%, and 39.7% in pond-B, and pond-C respectively than the pond-A. As time progressed the concentration increased till day 12 and then slightly afterwards.

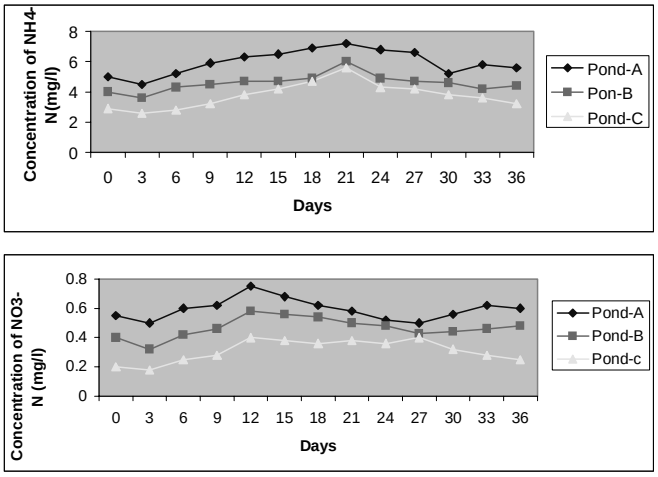


Fig.2 : Time course variation of ammonium-N(A) and Nitrate-N(B) of water in different sewage fed ponds.

Nitrate –N

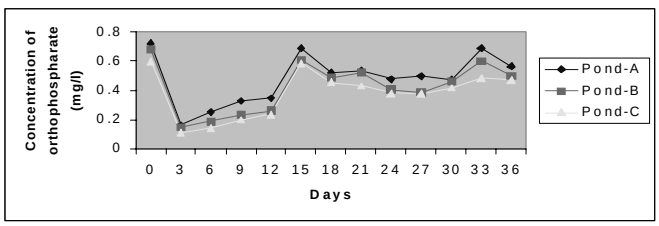
Nitrate-N concentration varied between 0.19 and 0.75 mg L^{-1}. There was a marked difference in the mean concentration of Nitrate-N in all ponds. The pond-A showed 23.9% and 38.1% higher value than pond-B and pond-C. (Fig.-2).

Orthophosphate

The mean concentrations of orthophosphate varied between 0.112 and 0.722 mg L^{-1}.The concentration sharply decreased on day 3 and gradually increased till day 15 and then showed a fluctuating trend afterwards (fig. 3).

pH

The pH was ranged between 7.8 to 8.4. There was a marked difference in the mean concentration of pH in all ponds and remained between 7.8 to 8.4. The concentration sharply decreased from pond-A, pond-B and pond-C. (Fig.3)



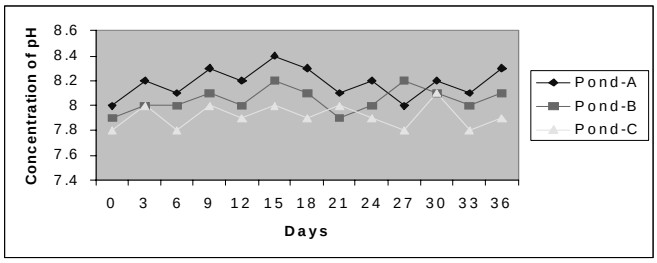


Fig.3 : Time course variation of orthophosphate (A) and pH (B) of water in different sewage fed ponds.

Total Alkalinity

The alkalinity varied between 91.0-102.0 mg/L. The pond-A showed higher value than pond-B and pond-C.

Fish Growth

The fish growth was maximum (6g) in pond-C and minimum (4.5g) in pond-A. This shows that conditions for fish growth were better in pond-C compared to pond-A. (Fig. 4)

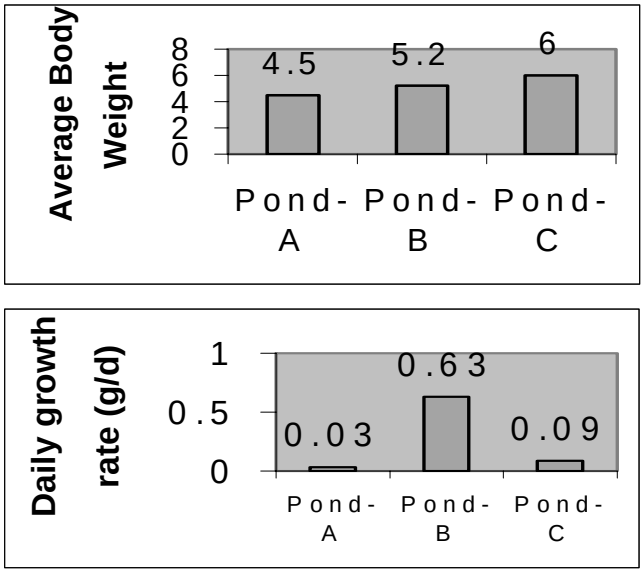


Fig. 4. Responses of average body weight (A) daily growth rate- (B) of fish in different sewage fed ponds.

Daily growth rate of fish (0.032 – 0.088 g/d) showed a marked difference among all ponds (fig. 4). The values of growth rate increased gradually from pond-A to pond-C

Survival Rate

The survival rate of fish was highest in pond-C (60%) where as the pond-B and pond-A showed the survival rate of 50% and 37%. (Fig. 5)

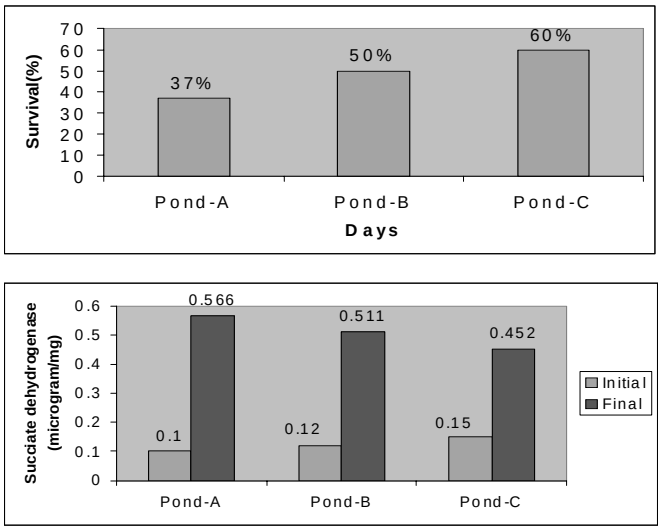


Fig.5 : Response of survival (A) and succinate dehydrogenase (B) of fish in different sewage fed ponds.

In the table –2 and table –3, all the details of harvesting comprising averages of weights and length of harvested fingerlings, survival percentage and hydro biological parameters are shown. The matter contained in the Table-2 and Table-3 is self-explanatory.

Growth difference of fish grown in different ponds was attributable to the differences in the water quality parameters of these three ponds. Comparing the results, the fingerlings output of pond-C has been consistently higher than pond-B and pond-A, indicating that the parameters of this pond for the growth of fish were superior to others. Maximum growth of fish in the pond-C was the result of better water quality expressed in terms of high concentration of DO. Low concentrations of nutrients and diversity of planktons were favourable for fish growth. In case of the fingerlings, from pond-C, their size has been better than pond-B and pond -A in respect of range and average values for the lengths and weights. This revealed about better growth trends in pond-C than pond-B and pond-A.

Table 2 : Results of harvesting of Cyprinus fingerlings at the end of 36 days culture period in three ponds.

Sl. No.	Particulars	Pond –A	Pond –B	Pond-C
1	Survival Percentage	37%	50%	60%
2	Wight range of harvested fingerlings (g)	4.2 – 4.7	4.8 – 5.6	5.7 –6.2
3	Average weight (g)	4.5	5.2	6
4	Length range of harvested fingerlings (cm)	6.2 – 6.3	6.5 –7	6.9 – 7.3
5	Average length (cm)	6.4	9.7	7.2

Table 3 : Hydro biological Parameters

Sl. No.	Particulars	Pond –A	Pond –B	Pond-C
1	Temperature range (^{0}c)	29.0 – 36.0	28.0 –35.0	29.0 –35.0
2	Dissolved oxygen (DO)	3.0 –3.7	3.4 – 3.9	3.5 – 4.2
3	NH_4(N) range (mg/L)	4.5 –7.25	3.6 – 6.0	2.06 5.6
4	NO_3 (N) range (mg/L)	0.5 –0.75	0.32 –0.58	0.19 –0.40
5	Orthophosphate (mg/L)	0.164 –0.722	0.130-0.681	0.112 –0.602
6	PH range	8.0-8.4	7.9-8.2	7.8-8.1
7	Total alkalinity range (mg/L)	98.0-102.0	95.0-100.0	91.0-98.2

In the present study, it was evident from the fact that the concentrations of major nutrients such as ammonium-N, nitrate-N and orthophosphate show significant variation from pond-A to pond-B and pond-C. The reduced level ammonium-N recorded in the pond-C was conducive to fish growth as high concentrations were inhibitory to their growth because of poor fish growth was associated with high concentration of ammonium-N in pond-A and depletion oxygen level associated with nitrification. Nitrate Nitrogen and dissolved oxygen have gone more or less hand-in-hand and inversely proportionate to the ammonia content of the ponds. Nutrient increase in water will not always result in an

increase standing crops James and Evison (1979). This study supports those environmental stresses of the sewage effluent greatly influenced growth rate of *Cyprinus carpio carpio*. The study further supports that the fish growing in the pond-A was under considerable stress as evident from the inverse correlation between the activity of succinate dehydrogenase and fish growth.

All these analyses tend to indicate that better water quality has been superior and appropriate for achieving better growth and higher harvestable number of the fingerlings.

The ponds in the city receive nearly two third of the total sewage of Banki town. The city sewage and animal excreta including unhygienic habits of making relieve nature on the open drains, release enormous quantity of waste water and materials that acts as prime cause of rapid deterioration of water quality of the lake.

The major findings include the following:

(i) The ponds have their own characteristic limnology, amount and type of water input.

(ii) Most of the parameters except DO increase in quantity in heavy sewage fed pond (pond-A).

(iii) The water is alkaline due to the presence of a large number of pollutants.

(iv) The concentration of DO is reduced which may be due to increased organic substances present in the ponds.

(v) Nitrate nitrogen and DO have gone more or less hand in hand and inversely proportionate to the ammonia content.

(vi) Saha (1984) was of the opinion that high pH, high alkalinity and low acidity of a water body indicate its nutrient rich water, which seems to be partially true in case of ponds.

(vii) There is a remarkable influence of local condition on the quality of a pond and it is not possible to generalize the degree of water pollution in all the water bodies of locality.

It is evident that the sewage fish culture is profitable, because it does not require fertilizers and supplemented food thus reducing the cost of production. The growth of fishes is relatively higher in better water quality. For an effective aquaculture and better growth of fishes in sewage fed pond, it is imperative to take steps like controlling discharge of pollutants, at the source, diluting the polluted water mass, to such an extent that the harmful effect of the pollutant is made in effective. The present investigation is an eye opener for fish farmers to use sewage fed pond in fish culture.

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OBITUARY

Dr. Mopuri Brahmam was born in a small village in Andhra Pradesh on 2nd June 1948. He had his initial schooling at his native place. He obtained B.Sc. from Andhra University, M.Sc. from Sagar, M. P. and Ph.D. from Utkal University, Orissa.

He Joined Regional Research Laboratory, one of the sister institute of C.S.I.R. in 1973 and pursued Research in Aromatic and Medicinal Plant Division. For over 25 years, he surveyed the forests of Orissa and brought out "Flora of Orissa" jointly with his senior colleague, Dr. H. O. Saxena in 4 volumes during 1994-96. His other book 'Flora of Similipahar (Similipal)' Orissa in 1981 is a small but humble contribution widely consulted for Biodiversity Assessments of semi-ever green forests.

He introduced several exotic fast-growing trees for fuel and fodder purposes and developed agro-packages for commercial cultivation. He is instrumental in introducing Rubber cultivation in Orissa and developed a few high yielding strains for Orissa Agro-climatic zones and nearly a hundred farmers are growing Rubber in about 1000 acres.

His other major activities include development of Agro-technology for *Jatropha curcas* and popularizing Bio-diesel production.

He has published more than 100 research papers in National and International journals, guided 5 Ph.D.s and visited Sri Lanka, New Zealand, Singapore, Thailand and Mauritius in connection with his research pursuits. He has successfully completed many a number projects and headed the Renewable Energy Cell (REC) at IMMT, Bhubaneswar. He was recognized as 'Scientist G' even after retirement by C.S.I.R. considering his contribution to science and more particularly to taxonomy. He breathed his last at the age of 62 on 30th Nov. 2009.

He has promoted this particular environment journal ***e-planet*** right from the begining and served as Managing Editor till 2009. Starting from contributing personal papers, raising funds and management of edit, he has immensely contributed towards the improvement of the journal.

His premature demise is an irrepairable loss not only to the ***e-planet*** family but also to the scientific community and more so to the taxonomic society as a whole. Members of OPES deeply condole the sad demise of Dr. Brahmam and pray the Almighty to grant him peace in his heavenly abode.

BRIEF INSTRUCTIONS TO AUTHORS

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1. **Submission of manuscript.** Two copies of the manuscript developed in MS-WORD, along with tables and figures in MS-EXCEL and photographs etc. should be sent to the Editor-in-Chief, *e-planet* (OPES). Besides the hard copies, a soft copy in CD should be provided.

2. **Preparation of manuscript.** Papers should be written in simple and clear language, strictly following the latest *e-planet* journal style not exceeding six printed pages. Avoid footnotes in the text. The complete scientific name (genus, species and authority for the binomial) of all the experimental organisms should be given at the first mention both in the Abstract and Materials and Methods. International System of Units in abbreviated form should be used for all the measurements. Spell out the acronyms in the first instance.

Manuscript should be typed in double-spacing on one side of Bond Paper (A-4). Tables must not exceed 12 vertical columns. Leave liberal margins on both the sides. Arrange the manuscript in the order of title, author(s), address of each author, abstract (approx.200 words), key words introduction, materials and methods, results and discussion, acknowledgement (if any) and references.

2.1. **Title.** A short title of the paper should appear on the top of the article, followed by the long title in bold letters. The short title appears on alternate printed pages of each article.

2.2. **Author(s).** Author(s) name(s) should be typed in bold letters, first initials and then surname. Corresponding author's name should be specified by an asterisk mark and e_mail address should be indicated.

2.3. **Address.** The address of corresponding author should be typed in italics indicating the place where the work was carried out. If the present address is different, it should be given as footnote in the first page.

2.4. **Abstract**. Maximum 200 words convening the objectives, methodology and the most important results.

2.5. **Key words.** Maximum of 5-6 key words should be provided for subject indexing.

2.6. **Introduction**. It should be concise and include the scope of the work in relation to the state of art in the same field along with specific objectives.

2.7. **Materials and Methods.** A full technical description of the methods followed for the experiment(s) should be given, providing enough information. Detailed methodology should be given when the methods are new while for standard methods, only references may be cited.

2.8. **Results and Discussion.** In this section, only significant results of the experiment(s) should be reported. Along with the tables and figures, the discussion should deal with interpretation of results and relate the author's findings with the past work on the same subject. The conclusions drawn should be explicitly listed at the end of this section.

3. **References.** Refer this copy as sample for references. For ex*.:* Thankppan A, Das BK, Barman HK and Samal SK (2008) Genetic fingerprinting of *Aeromonas hydrophila* isolated from diseased fresh water fishes of eastern India; e-planet, 6(2): 01-06.Distinction for the same author and same year be done as e.g. 1969a, 1969b. Unpublished data, and personal communication are not acceptable as references but may be referred to parenthetically in the text.

4. **Tables.** Number the tables consecutively in Arabic numerals. Tables should have comprehensible legends. Conditions specific to a particular experiment should be stated. Zero results must be represented by 0 and not determined by n.d. The dash sign is ambiguous. For values <1, insert a zero before the decimal point.

5. **Illustrations.** All graphs, diagrams and half-tones should be referred to as Figure and should be numbered consecutively in Arabic numerals. The figures should either match with the column width (8.5 cm) or the printing area (17.8 x 22 cm). The legends should be brief and self-explanatory. All graphs, figures should be drawn by MS-EXCEL and submitted in editable format. Define in the footnote or legend any non-standard abbreviations or symbols used in a table or figure. Photographs, which must be kept to a minimum, should be good quality glossy prints.

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