

*Wetland Ecosystem Series 4*

**Fauna  
of  
Kabar Lake Wetland  
(BIHAR)**



**ZOOLOGICAL SURVEY OF INDIA**

*Wetland Ecosystem Series 4*

# **Fauna of Kabar Lake Wetland**

*Edited by the Director, Zoological Survey of India, Kolkata*



सत्यमेव जयते

**Zoological Survey of India  
Kolkata**

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## KABAR LAKE WETLAND—AN OVERVIEW

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### INTRODUCTION

It is only in the last few decades that the role and value of the wetlands are recognised as they support a wide range of functions that are essential for plant, animal and human life and also for maintaining the quality of the environment. Genetic diversity, rich resource of fauna and flora, constitute an important gene pool for potential exploitation and management. In ecological sense, wetland "value" is mainly related to primary production in providing food energy that drives the ecosystem (Mitsch, 1986). The direct and indirect benefit of wetland are high productivity; reservoirs for storing water, controls flood; prevent soil erosion; water purification and nutrient recycling; aquifer recharge; aesthetic, cultural and recreational value and high biological diversity especially waterfowl habitat.

### DEFINITION

According to *Ramsar Convention* 1971, wetlands are defined as "Areas of marshes, pens, peatlands of water whether natural or artificial, permanent or temporary with water which is static or flowing, fresh, brackish or salt including areas of marine water, the depth of which at low tide does not exceed six meters." Cowardin *et al.* (1979) modified the definition and according to him "Wetlands are lands of transition between terrestrial and aquatic system wherein the water table is usually at or near the surface of the land or the land is covered by shallow water."

### GOVERNMENT POLICY

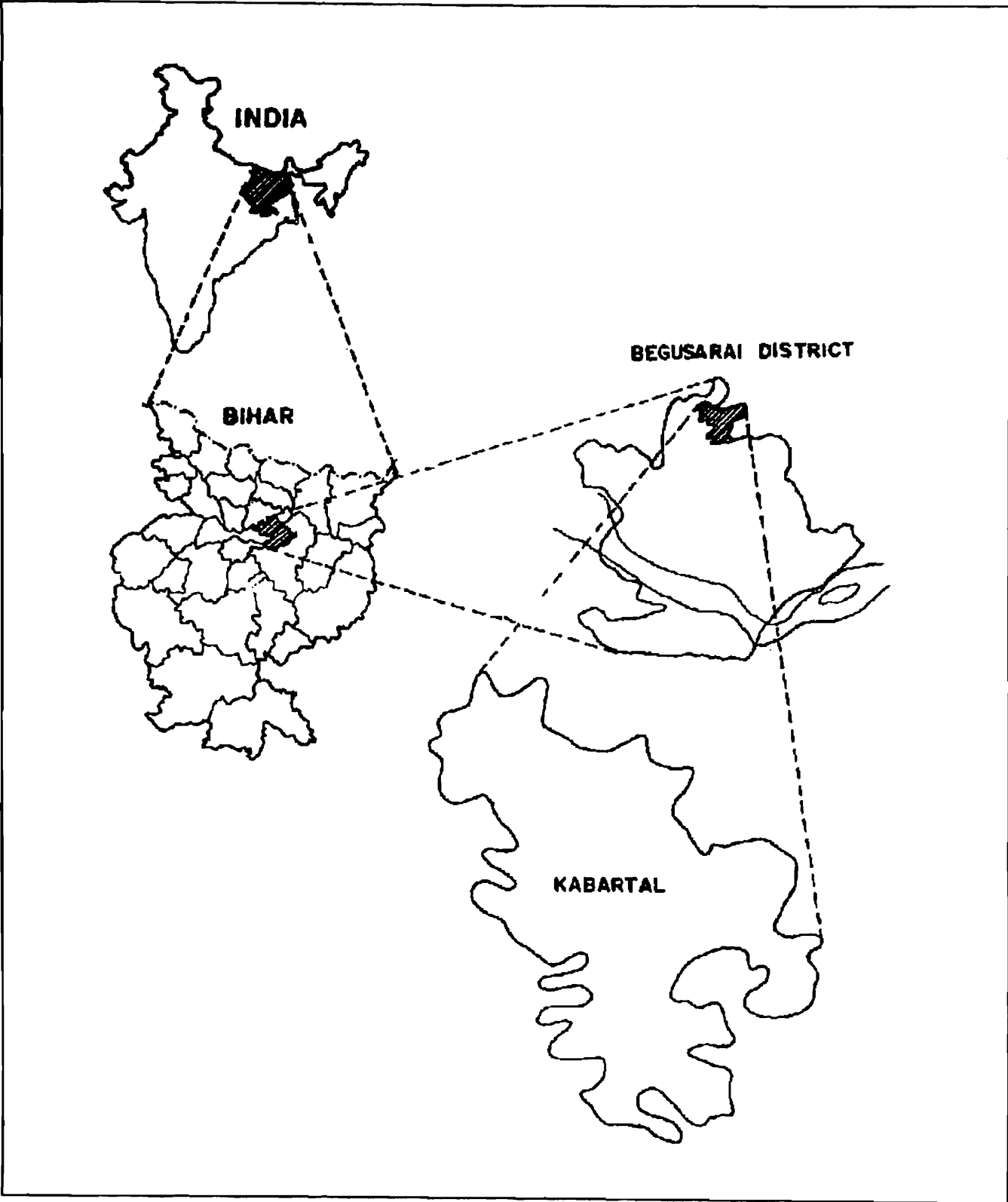
Realising the international importance of wetland and need for conservation, a significant step towards this was India's ratification of Ramsar Convention. Ministry of Environment & Forests, Government of India, initiated the following conservation measures *viz.*, management action plan, research, public awareness, policy formulation and legal implementation. A National Committee was constituted in the seventh Five Year Plan and in the first meeting held on 2nd April 1987, the Expert Committee recognised ten wetlands as areas of conservation and for the preparation of Management Action Plan. Subsequently, on 8th December 1988, six more wetlands were added to the list. Recently, the Ministry of Environment & Forests updated the list of wetlands, making a total of 21. Ministry of Environment & Forests is also operating two other conservation programmes for wetlands *viz.*, National River Conservation Plan (NRCP) and National Lake Conservation (NLCP). In 1995, National River Conservation Directorate (NRCD) was added for Pollution Abatement Programmes.

Indian subcontinent is rich in the number of wetlands and wetland bio-diversity. The directory of wetlands prepared by Ministry of Environment & Forests (1990) lists 2175 natural wetlands covering 15,37,226 hectares and 65,254 artificial wetlands comprising nearly 25,89,266 hectares. These wetlands are located in different geographic regions, starting from high altitude areas of Himalayan terrain formed by the glacial action to the flood plains of Ganges, salt marshes of Rajasthan,

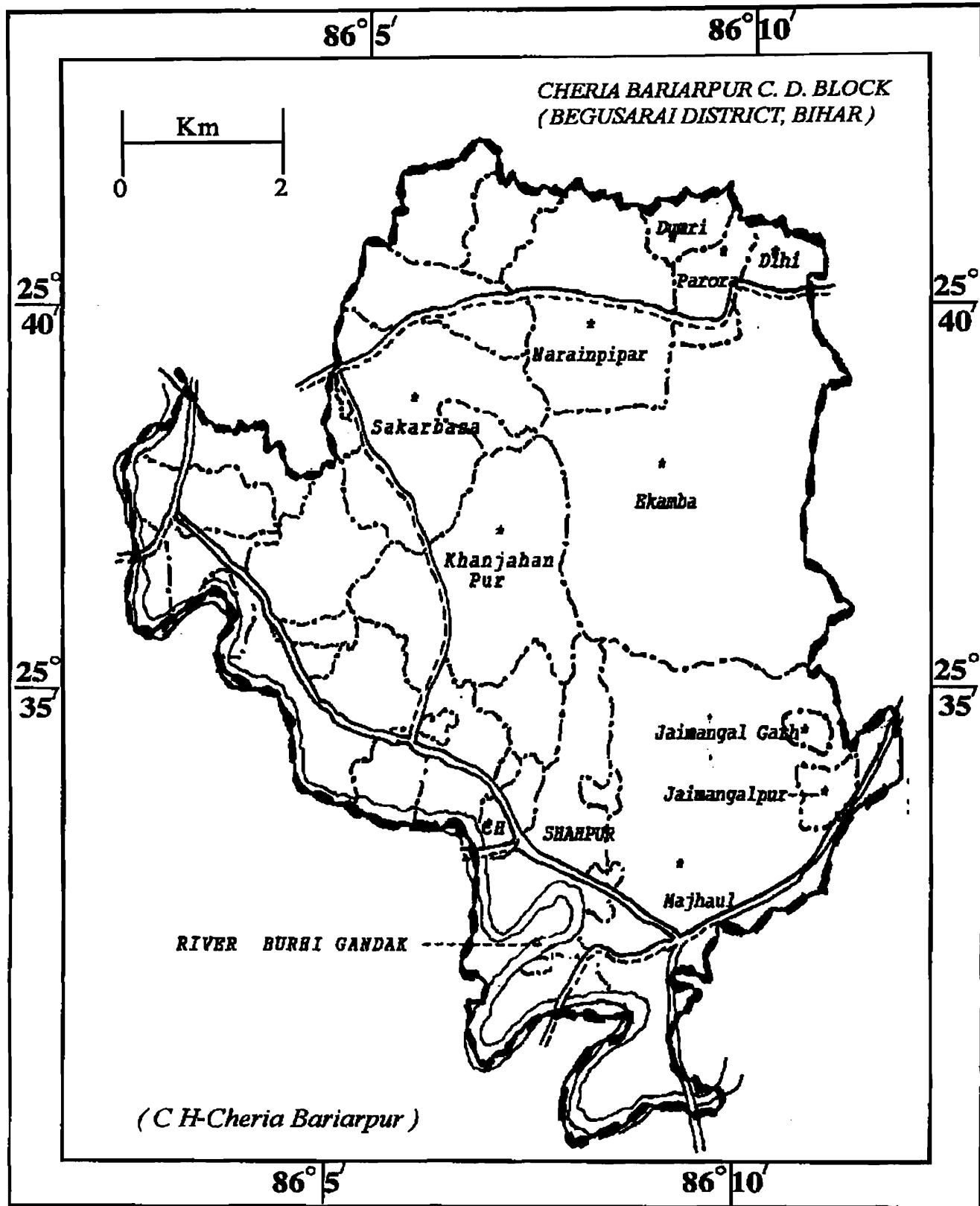
ox-bows of Bihar, and costal wetlands of Orissa to the best man-made wetlands of the country *i.e.*,  
(Chilka), Tamilnadu (Pulicat), Kerala (Astamudi) Keoladeo National Park of Bharatpur, Rajasthan.

**Table-1.** List of nationally important wetlands/lakes identified for conservation and management action plan of the Ministry of Environment & Forests.

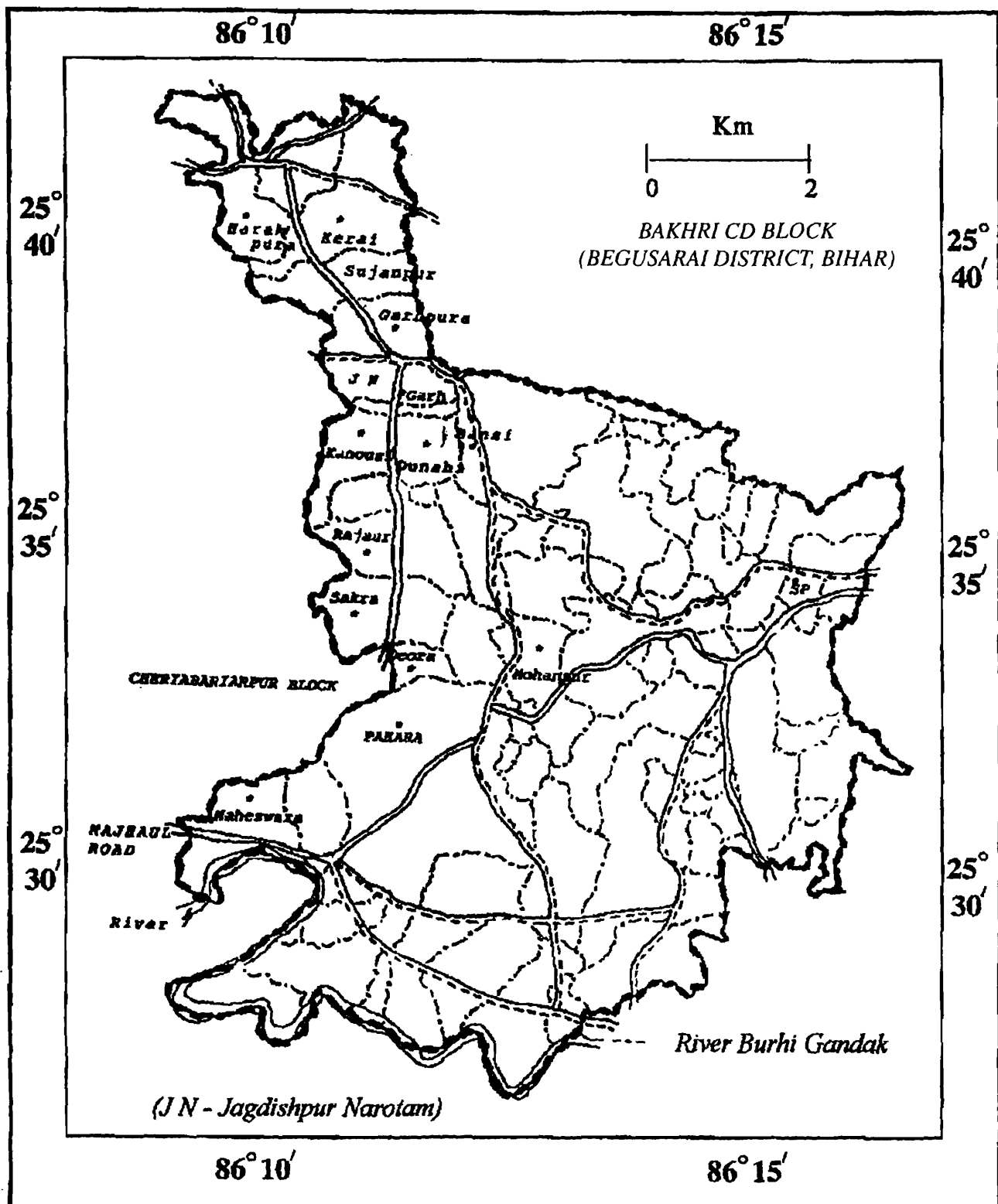
Sl. No.	A. Wetlant	State/Union Territory
1.	Wular	Jammu & Kashmir
2.	Tso Murari	Jammu & Kashmir
3.	Tisgul Tso	Jammu & Kashmir
4.	Renuka	Himachal Pradesh
5.	Pong Dam	Himachal Pradesh
6.	Chandratal	Himachal Pradesh
7.	Harike	Punjab
8.	Ropar	Punjab
9.	Kanjili	Punjab
10.	Chilka	Orissa
11.	Kabar	Bihar
12.	Keoladev National Park	Rajasthan
13.	Sambhar	Rajasthan
14.	Kolleru	Andhra Pradesh
15.	Loktak	Manipur
16.	Astamudi	Kerala
17.	Sastamakota	Kerala
18.	Ujani	Maharashtra
19.	Nalsarovar	Gujarat
20.	Deepar Beel	Assam
21.	Rudrasagar	Tripura
	<b>B. Lakes</b>	
22.	Dal	Jammu & Kashmir
23.	Sukhna	Chandighrah
24.	Nainital	Uttar Pradesh
25.	Sagar	Madhya Pradesh
26.	Kodai Kanal	Tamilnadu
27.	Ootacamund	Tamilnadu
28.	Pulicat lake	Tamilnadu
29.	Rabindra Sarovar	West Bengal
30.	Powai	Maharashtra
31.	Pichola Complex	Rajasthan
32.	Husain Sagar	Hyderabad



**Map No. 1**  
Geographic Location of Kabar Lake, Bihar



Map No. 2  
Villages around Kabar Lake Wetland, Bihar



Map No. 3  
Villages around Kabar Lake Wetland, Bihar

### SPECIES DIVERSITY IN WETLANDS

Wetlands are often subjected to expansion and contraction in area with changes in the water level due to the fluctuation in the receiving water and rainfall, as a result the species richness varies depending upon the period of flooding. Hydrology and transportation of chemical in the wetland stimulates the diversity due to "Spatial Heterogeneity." Biological diversity in Indian wetlands is estimated to be 19,221 species falling under 24 groups of animal kingdom inhabiting fresh, marine and brackish water (Ghosh, 1997).

### KABAR LAKE WETLAND, BIHAR

The river Ganges and its tributaries and the

flat fertile plain through which they flow, is one of the great natural resources of the country. The Ganges as well as its tributaries are constantly vulnerable to the changes in their course in the delta region. Such changes occurred in comparatively recent times in the geologic history, specially since 1750 AD (Chaturvedi, 1985). Such meandering rivers, changed their direction leaving many natural depressions, which are later fed by rain water forming *ox-bow* lakes. One such largest lake situated in the Indo-Gangetic plain is Kabar Lake (Kanwar Jheel/Kabar Tal). Kabar lake is situated at 22 km north-west of Begusarai town in Bihar state and at about 225 km from the state capital, Patna, located at 25° 30' north Latitude and 87° 05' east Longitude.

**Table-2.** Technical Details of the Kabar Lake Wetland

1.	Title	Kabar Lake Wetland (Kabar Tal, Kabar Jheel, Kanwar Jheel Pakshi Vihar)
2.	Location	Longitude: 87° 05' Latitude : 25° 30'
3.	Nearest Village	Munjhol
4.	District	Begusarai
5.	State	Bihar
6.	Nearest Railway Station	Begusarai
7.	Nearest Air Port	Patna
8.	Nearest National Highway	NH 31 at Barauni
9.	Nearest River	Burhi Gandak
10.	Biogeographical Province	Indo-Malayan (Udwardy, 1975)
11.	Biogeographic Zone	Indo-Gangetic Plain
12.	Biological Category	Freshwater
13.	Wetland Type	Ox-bow lake
14.	Altitude	32-45 m above sea level
15.	Area in Hactares	7,400 Hactares during high floods and 300-400 Hactares during lean season 6737 Acres (Legal boundary)
16.	Depth of the lake	1-5 meters

### Water spread area

The water spread area of the lake is subjected to high floods during monsoon months. It is also due to the siltation of the channel leading to the river Burhi Gandak, the water flow from the lake is affected, thereby altering the water spread area. In a normal monsoon situation, Kabar lake, its adjacent Nagri Jheel and Bikrampur Chaur unite and extend to nearly 18,290 Acres (7,400 Hactares). During the post monsoon months, due to heavy letting off the water for irrigation, the water level recedes drastically with the result, the continuity of the water column is completely lost, the lake water is located only in certain pockets of saucer shaped depressions (commonly known as Ghats), in an area of about 5,000-6,000 Acres (300-400 Hactares). Furthermore, as the water level recedes, during the drier months, over 2,800 hactares of the exposed mudflat is converted into paddy fields.

### Legal status of the lake

According to Cadstral map of Kabar, the total area of the lake is 6,737 acres of which 6,647 acres of the land is located in Cheriabariarpur block and 90 acres in Bukhari block. The legal boundaries which are under private ownership is always submerged. During the monsoon months, the lake is flooded to its capacity; the area is used by the landless *Sahanis*, who hold the fishing rights. When the water recedes, the exposed lake bed is again used by the land owners for cultivation. Thus the lake has a special status. The legal boundaries demarcated by the Government of Bihar is as below :

1. South-East to North-East-Manjhol-Garphura Road.
2. North-East to East-Garphura-Parora-Narainpiper Road.
3. West-Narainpiper-Sripur Road.
4. South-Sripur-Munjhol Road.

### Present status of the lake

As per the notification, of the Bihar Gazettee

published on 10th February, 1987 by the order of the Governor of Bihar, in exercise of the power conferred by subsections (1) and (2) of the section 37 of the Wildlife Protection Act-1972 (Act-53 of 1972), the area mentioned in the column-2 of the schedule appended here to be situated in the district of Begusarai as "Closed Area" and shall be called "Kanwar Jheel Pakshi Vihar." The boundaries of the lake are as given above.

The following villages are included in the schedule *viz.*, Munjhol, Jaimangalpur, Jaimangalgarh, Sakara, Rajopur, Khanosi, Garh, Vijayanarayan, Garphura, Ekamba, Dihi, Parora, Narainpiper, Karol, Sripur, Ramauli, Khosurpur, Jagdishpur, Naroatham, Cheriabariarpur, and Manikpur.

### Historical significance

The Jaimangal temple and the Jaimangal fort on the bank of the Kabar lake are known for their historical importance. A number of relics belonging to remote past have been excavated from the area. The excavations include Terracotas, Glazed ware, Iron sickle, and other articles belonging to Post *Suguna* period. Several coins of Tuglak period were also excavated from the area. Apart from the above, several cannon balls are recovered from the fort area. The deity 'Jaimangal' (Durga or Bhavani) resides in an ancient temple surrounded by Jaimangal fort.; Thus the mound 'Jaimangal temple and Jaimangal fort' have historical significance is located on the bank of the lake. Archaeologically, the area deserves serious attention as several findings such as Northern Blackware, Terracota head, fragments of idols made of Cherts and Besalts were found in the area. The earthen seal was also found to indicate that these establishments belonged to *Gupta* dynasty who ruled between 400-600 AD.

### Geomorphology

The lake area lies in the *Indo-Gangetic* plain of alluvial basin. The average height from the

main sea level is about 32-45 meters. Geologically, the entire alluvial basin forms a part of a Ganga basin and has been the result of depositional action by freshwater agencies, mainly during the quaternary period. The land system is essentially the product of three successive meander regimes of Bagmati, Burhi Gandak and Bainti and Balan in Northern Bihar. The morphostratigraphic sequence of land system in the meander belt of older flood plain of Munjhol terrace belongs to the Holocene period.

The land system in the lake area is represented by feebly oxidised dark grey to grey colour clay and silt and fine sand layers. The flood plain morphology is characterised with levees, *ox-bow* lakes, swamp lakes, abandoned channels, meanders and flood plain scouring routes. According to geological findings, the concentration of the *ox-bow* lakes on the left side of the Burhi Gandak indicates that the river has gradually shifted westwards and southwards. A few swamps that have been transformed into lakes to water logged condition prevailing round the year constitute the Kabar lake. *Lithographic* information available from the Central Ground Water Board and Minor Irrigation, Government of Bihar reveals that the entire sediments are composed of unconsolidated clastics namely clay, silt, various grades of sand, gravel, coarse granular material, graveliferous sand with intervening blue clay formed 100-400 meters near Cheriabariapur. A layer of top clay with varying thickness occurs in the area from 15-80 meters.

The soil types of the area is grouped under two broad heads; loam and clay depending upon the degree of admixing with sand and silt. There is also a gradual change in the mechanical composition from levee soil to flood basin soil *i.e.*, from loam or silt to clayey loam and clay. The floor of the Kabar lake is covered with black clay mixed with peat.

### Ground water

The alluvial deposit of Bihar by virtue of their

loose unconsolidated nature are the best reservoirs of ground water as it is mainly consists of sand-gravel and clay and all these lithological types are porous and the porosity varies from 17 to 30 per cent. Ground water occurs both in the water table and in the confined condition.

In Kabar lake area, the ground water is available within two three meters range and geologically, Kabar lake is believed to be a ground water lake with water zone ranging from 4-6 meters. Central Ground Water Investigation also revealed that in several areas of Kabar lake, the water is saline with high chloride content between the depths ranging from 131-135 meters and 145-151 meters respectively. The probable cause of salinity may be due to the stagnancy of the aquifer water or the contamination of hot spring water from an unknown depths or source.

### Geological hazards

According to Geological Survey of India, major environmental hazards of the area are :

1. The central part of the Kabar lake is saucer shaped depression, it receives surface run-off from the north eastern side and after getting filled up its capacity, it spills the surface water through south-eastern portion is liable for inundation, if Kabar lake overflows.
2. Sheetwash erosion of the top soil is common in Kabar lake as the slope along the lake is towards the centre.
3. Ground water salinity has been reported in several parts of the Kabar lake area and therefore, this hazard is to be taken into consideration before ground water exploitation.

### Soil/sediment characteristics

Lake sediment is an important medium eventually influencing the lake *milieu*, the abiotic and biotic structure. Observation based on the available study and the present investigations by

the authors, have been incorporated to help make the ecological profile of Kabar lake complete and meaningful.

Lake sediment analysis reveals loamy nature rich in humus. It has been observed that the sediment below and near water is invariably muddy, and the depth of the mud measured upto 2.6 meters. The apparent colour of the sediment is gray in winter and early summer due to perhaps low organic matter content turning gradually black by late summer and south west monsoon due to high organic content. The range of important physico-chemical values recorded for the sediment for the period (1991-92) is given in table-3.

Based on the percentage of organic matter and abundance of acation, the sediment has been categorised as mineral sediment. Detailed chemical studies on the mineral composition of the sediment do not exist. From the available data of the chemical characteristics, the sediment in Kabar lake can be considered as rich in organic plant nutrients. The soil is marginally acidic, more perhaps due to humus. The conductivity of the soil is high, characteristic of mineral sediment, and gradually declines from winter months to south-west monsoon, perhaps due to gradual death and decay of aquatic vegetation and other animals. The physico-chemical parameters like total alkalinity, chloride, organic matter, available phosphorous, nitrate, total calcium and magnesium too were reported to be increasing from winter to summer. This perhaps can be attributed to increase inputs of nutrients through surface run-off

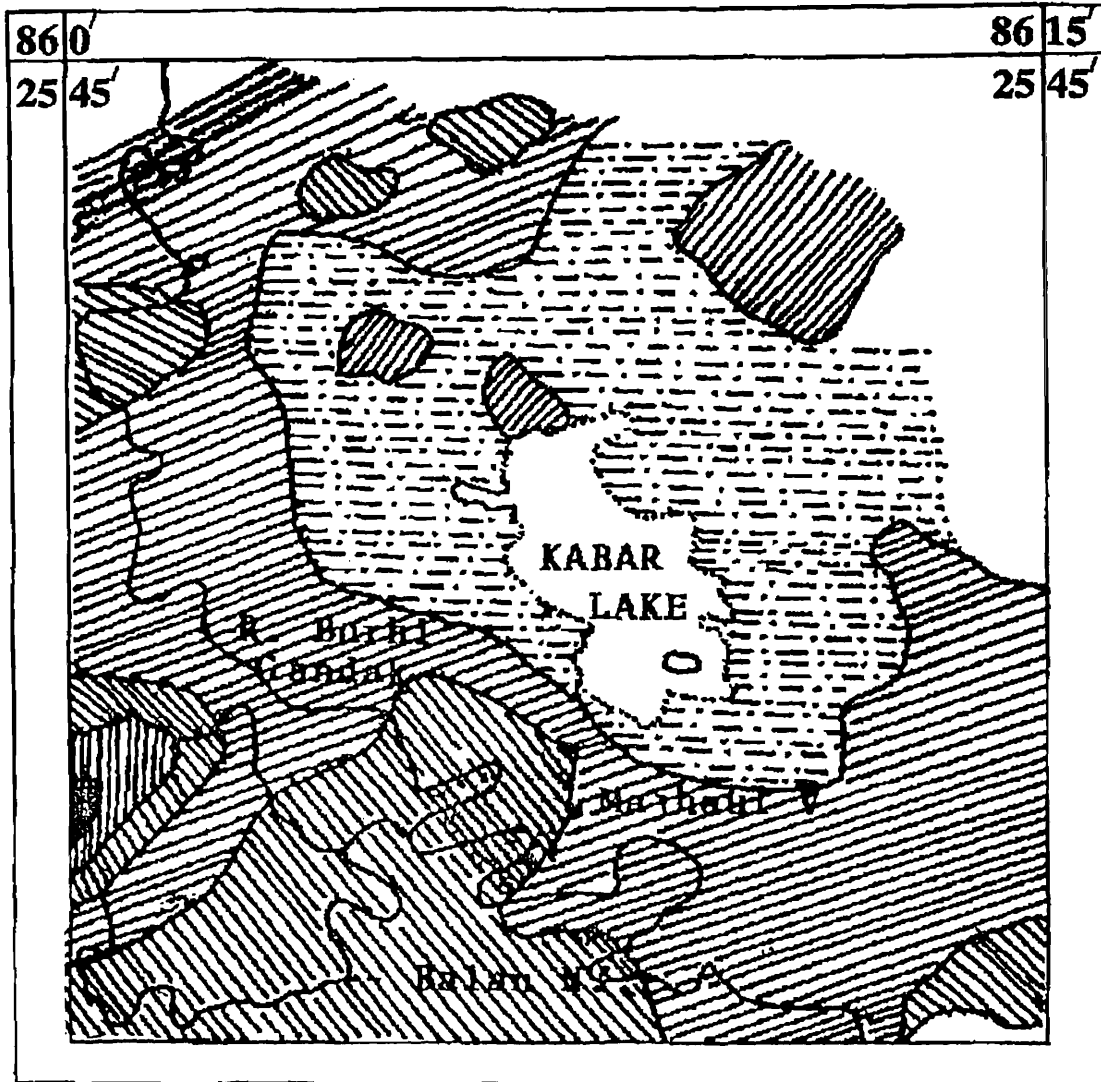
although south-west monsoon and cumulative increase eventually by winter season and beyond.

The organic carbon characteristic data in Kabar lake, according to authors view, compared with a detailed study on the sedimental constituents in Gandhisagar lake, Madhya Pradesh (Rao, Srivastava and Chaube, 1989) and Dal lake (Pandit, 1993), help us to draw inferences on the organic productivity. The organic carbon (%) values in Gandhi Sagar ranged between 1.5-2.43 and regions having higher organic carbon value have been classified as high energy zones. Further, it has been observed that such zones are rich in submerged aquatic vegetation such as *Hydrilla*, *Vallisneria* and *Potamogeton* and rich in dissolved oxygen and phosphorous too. While Sinha *et. al.*, (1993) provided detailed variation on the bottom sediment and not spatial variation, the authors are of the view that Kabar lake does host innumerable high energy zones too, in view of high abundance of aquatic vegetation, including rooted plants although the lake sediment.

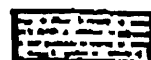




Further comparing the high organic content (9.28-18.56) of Dal lake with Kabar lake, the former obviously appears to have more higher energy zones in its basin than the latter. Again, comparing data on mineral composition of bottom sediments in Kabar lake, Bihar; Dal lake, Kashmir and Gandhi Sagar, Madhya Pradesh, the sedimentary nutrients concentration in Kabar lake are higher than Dal lake and Gandhi Sagar lake thereby indicating higher trophic status of bottom sediments in Kabar lake.

**Table-3.** Lake sediment analysis

1. Specific gravity	0.01-1.22	2. Conductivity	248-820 Umho/cm
3. Total alkalinity	0.76-3.2 mg/l	4. pH	5.0-6.5
5. Chloride	5.2-36.0 mg/l	6. Organic matter	3.7-30.93%
7. Organic carbon	2.5-17.94%	8. Available phosphorous	3.6-7.0 g/100gm
9. Nitrate	1.42-1.51 g/100 gm		



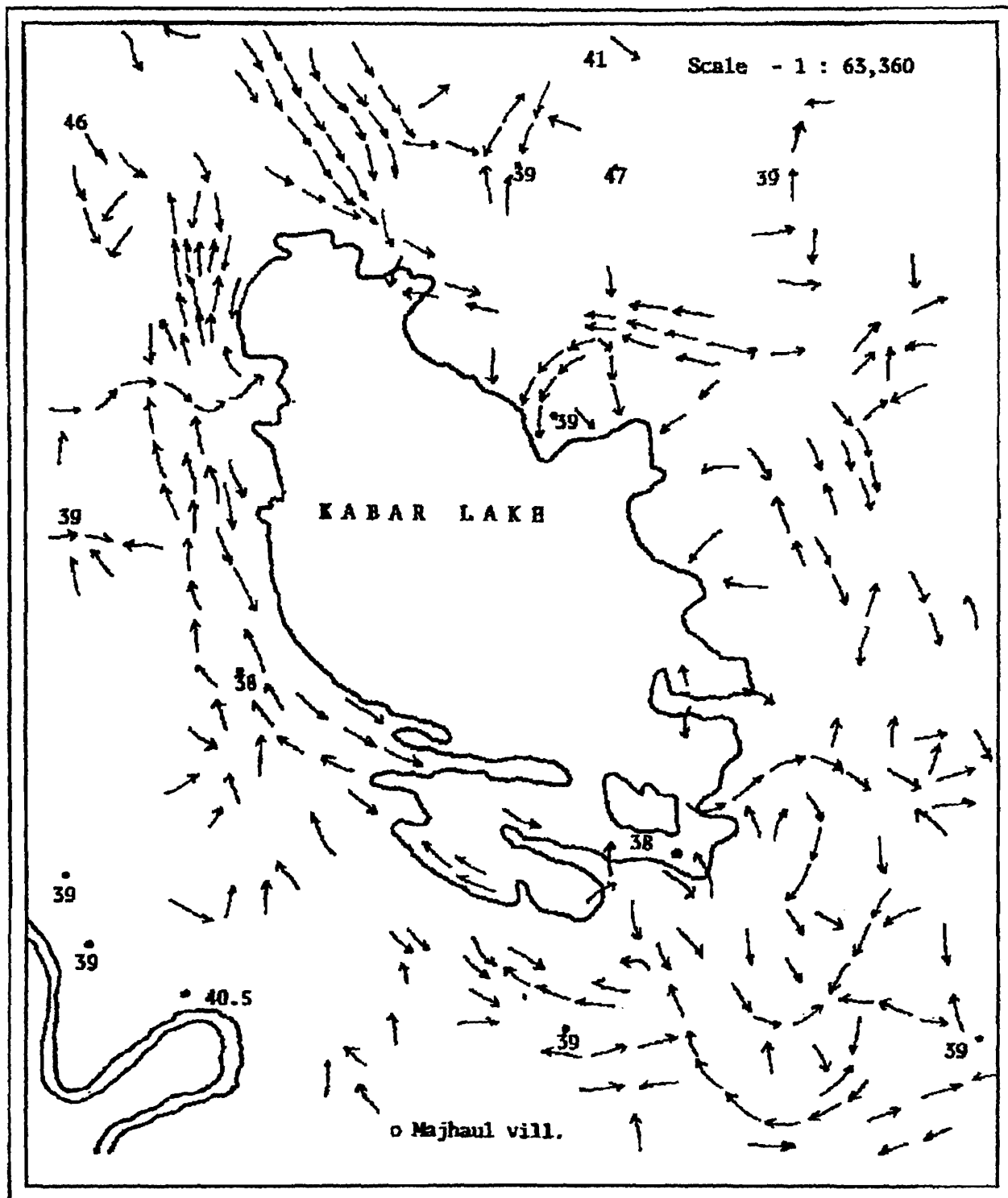
I N D E X

-  - 2 - 4 m below ground level
-  - 4 - 6 m below ground level
-  - 6 - 7 m below ground level
-  - 7 - 8 m below ground level
-  - 8 m & above below ground level

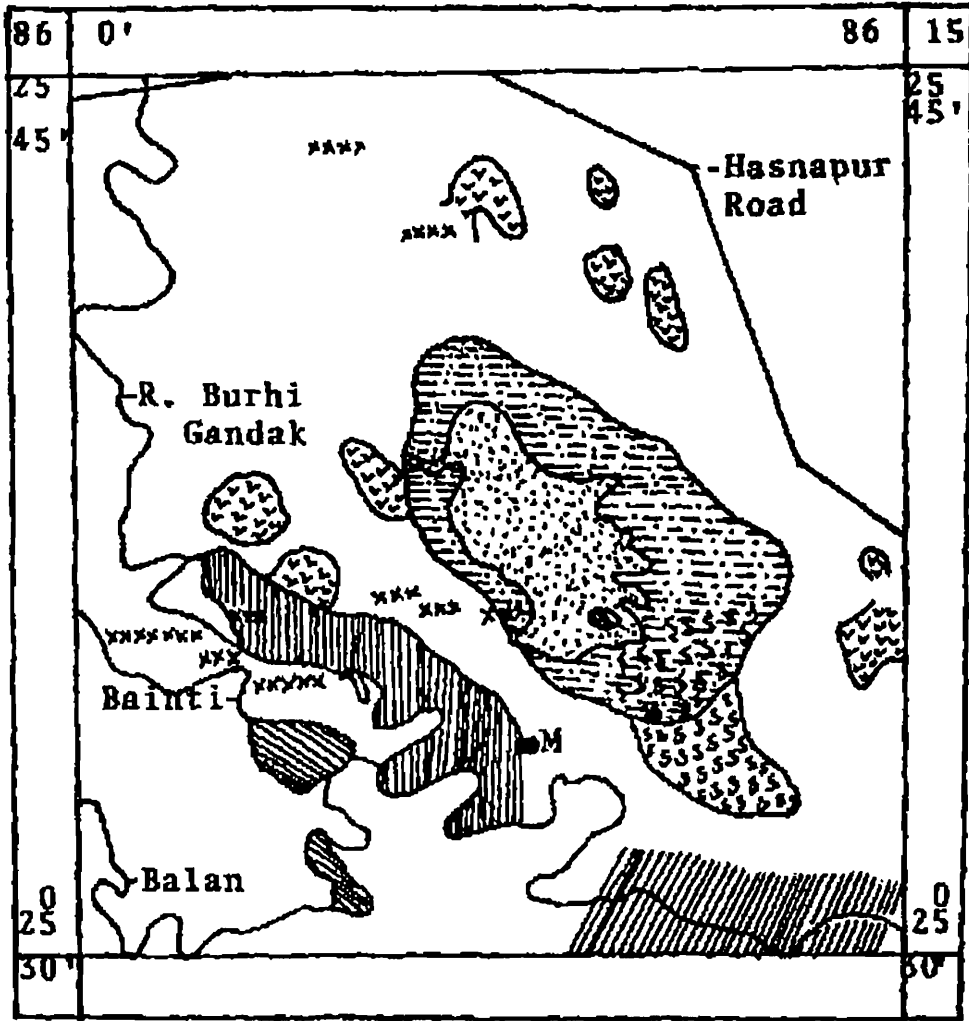
( COURTESY : G S I, From Topo sheet No. 72 k/2 )



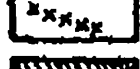




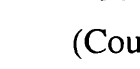
Map No. 4

Map showing depth to water level in the parts surrounding Kabar Lake Wetland, Bihar.



Map No. 5  
Direction of flow of surface Run-off  
(. Indicate the heights in meters above m s l.)



-  Area liable to inundation if Kabar lake overflows
-  Area undergoing extensive soil erosion
-  Area covered with saline soil
-  Area of Archeological interest
-  Area susceptible for river bank erosion
-  Area with constant water logging & soil rich in organic content
-  Area having high salinity in ground water
-  Area with high soil moisture

(Courtesy : G S I, from Topo sheet No. 72 k/2)

**Map No. 6**

Map showing land condition around Kabar Lake Wetland, Bihar.

(Scale—1:253, 440)

## CLIMATE

The climate of the area is humid tropical typical of middle Gangetic plain. Three seasons have been recognised, the winter commencing from November extending up to March, summer from April to middle of June and monsoon lasting from June to September. The average rainfall of the area ranges from 1140-1270 mm/year, of which 80-85% recorded during monsoon only. Summer showers, constitute the remaining 15-20%. The relative humidity ranges from 35% (Summer) to 80% (Monsoon) and the temperature ranges from 5° Celcius (Winter) to 38° Celcius in summer. During summer westerly wind blows over the area causing increase in the diurnal temperature and reduction in the relative humidity.

## AGRICULTURE AROUND KABAR LAKE

Kabar lake bed, is cultivated from time immemorial in an area of about 15,300 acres with only one crop. An area of about 5150 acres of land is cultivated for two agricultural crops viz., Rabi and Khariff. No co-operative farming is recorded from the area and the chief crops are :

Khariff—Paddy, Maize, Arhar, Sakarkand  
Rabi—Wheat, Sugarcane, Maize,  
Mustard, Grams, Chilli.

## SOCIO-ECONOMIC SURVERY AROUND KABAR LAKE

A socio-economic survey of the population living around Kabar lake, who are mainly dependent on the lake ecosystem for their livelyhood was first taken by Sri J. Misra, Chief Wildlife Warden and Sri M.S. Jogi, Divisional Forest Officer, Ranchi, Bihar. The fifteen villages surrounding the lake fall under Cheriabariapur block and Bukhari block covering an area of 127 km<sup>2</sup> (81,74,428 Acres) with around 66,698 inhabitants. Males out number females as in the case of the district with 24,734 males and 24,285

females, and 17,729 children. The details of the population is as below :

Farmers	:	3,990
Marginal labourers	:	7,555
Marginal workers	:	3,863
Household industries	:	755
Non workers	:	45,356

Survey of the population from Kabar lake area reveals a total of 10,774 fishermen, of which 7397 are traditional fishermen and 3377 are non fishing Sahanis and 538 others, with an average of 6-7 persons per family. By profession Sahanis are fishermen or agricultural labourers. Fishing appears to be more paying profession with annual estimated income of Rs. 6,400 (minimum) and 10,038 (maximum) per family.

Sahanis engage boats during their fishing operation and each boat costs Rs. 800-1,500 and an average of 1,500 boats appear to be operating in the entire area. Occasionally boats are also engaged for bird trapping. About 58.4% of the Sahanis engage themselves in paddy harvesting, farming and occasional bird trapping. The table given below will give the details of the occupation of Sahanis :

(Courtesy : Forest Department, Govt. of Bihar)

Occupation	No. of family engaged
Fishing	490
Paddy cutting	444
Farming	63
Business	45
Others	32
TOTAL	1.074

The density of population of the district is around 759/km<sup>2</sup>. The population around Kabar lake wetland is 66,898 distributed in fifteen villages surrounding the lake, the details are as in table-4. It is clear from the table that the area is not thickly populated, percapita average land is 4.75 acres as compared to other areas of the district.

### REPORT ON BIRD MASSACRE

S.P. Sahi (1982) reports 200 birds mainly coots, common teals, pintails, shovellers and pochards were sold in Munjhol market on a single day (27.01, 1982). He further states, "Sahanis are traditional fishermen and bird trappers of the village" netted 30,000 birds in November 1981; 30,000 in December; 5,000 in January 1982 and about 2,000 during February of the same year. In all 70,000 birds including ducks, teals, were netted and sold in Munjhol market alone. He estimated that around, 1,50,000 migratory birds visited during that winter. However, according to State

Forest Authorities "Bird trapping" have never been a profession of the Sahanis. There is also no concrete evidence as to how and when Sahanis started bird trapping business in the lake. This they attribute to the population explosion of the Sahanis and compelled them to adopt bird trapping business as a subsidiary occupation. Ramakrishna & Siddiqui and others found that the bird trapping was far less, with the evidence occasional trapping, in the remote and inaccessible area of the lake. Awareness among the fishing Sahanis, law enforcement and education have been the main factors for decline in bird trapping.

**Table-4.** Villages surrounding Kabar lake wetland, Bihar.

Sl. No.	Villages	Area of the Village	Area cultivated	Irrigated land	Non irrigated land	Population	Occupation as agricultural labour
1.	Munjhol	6666.20	4628.12	2058.78	2569.34	20,458	1750
2.	Maheswara	1128.00	665.26	613.09	52.74	3,634	114
3.	Paharsra	4873.73	3973.48	237.51	1599.97	6,988	912
4.	Karor	446.68	372.95	102.37	270.58	3,351	534
5.	Narainpiper	1441.34	1329.34	224.69	1104.97	2,676	369
6.	Parora	4873.73	3973.34	2373.51	1599.97	6,988	912
7.	Sahpur	1519.42	909.67	270.90	638.73	3,647	613
8.	Akamba	7282.00	1692.18	788.81	903.37	23,048	571
9.	Knjahpur	2586.00	2134.57	1252.65	881.92	4,511	438
10.	Sakarvasa	1378.17	1097.94	182.83	915.11	2,628	275
11.	Bariarpur	301.06	108.90	21.67	87.23	3,445	256
12.	Kumbhi	1356.32	1258.12	336.97	921.15	3,424	475
13.	Rajor	1232.00	1198.27	654.46	543.81	3,123	311
14.	Manikpur	477.00	456.85	231.66	225.19	1,506	311
15.	Kanosi	408.00	393.14	159.72	233.41	1,821	290
	<b>Total</b>	<b>31,744.28</b>	<b>20,743.42</b>	<b>9,453.89</b>	<b>11,289.53</b>	<b>66,698</b>	<b>7555</b>

## LIMNOLOGY

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### INTRODUCTION

Geomorphologically, Kabar lake as also the chain of adjoining *chaurs* (smaller depressions temporarily holding water) may be classified as *ox-bow* lakes, origination from meandering Burhi Gandak river. The river meandered further along its downward course, leaving behind a series of *ox-bow* lakes that are now mainly rainfed.

Detailed limnology of the *ox-bow* lake has not been studied to date and what follows is the first ever limnological account of the lake, on the basis of first hand studies in the region during different climatic seasons. In general, the lake water is alkaline, rich in carbonates and relatively infertile *i.e.*, oligotrophic or nutrient poor chemically. A brief factor wise limnological profile of the lake is given below :

### Material & Methods

The lake was surveyed all through its length and breadth. In all, approximately 38-41 sampling sites of the lake and plankton from surface and subsurface, bottom nekton, predominately fishes, crustaceans, malacofauna, macro-invertebrates etc., were collected from the sampling stations covering all parts of the lake. The list of sampling stations (commonly known as Ghats) is appended in a separate Table-3. The limnological measurements for critical parameters were made

either *in-situ*, using electronic probes or in the field camp set at the edge of the lake. The bottom water samples were collected using Kremmer type water samplers with trip mechanism. The water samples, after suitable pretreatment such as Winklerisation, brought to the field laboratory without loss of time for analysis. Standard methodology in practice was followed in laboratory field; APHA, 1985; Lind, 1979; Wetzel and Likens, 1979; UNESCO Technical Monograph 1980 etc. A detailed analytical procedure was followed at Environmental laboratory, Patna University, Patna for selected parameters, not carried out in the field station, immediately after its collection within the shortest possible time brought in suitable containers.

### Colour & Visibility (*Secchi Disc Transparency*)

Colour and variability to a greater extent determine the light transmission within the lake and thus regulates biological processes occurring within. Further, to a varying degree, both give some qualitative indication of productivity or the water when simply viewed from above. True colour or specific colour of the lake water was not estimated. The apparent colour of the lake may be described as blue green, resulting among others, mainly from dissolved substances in the lake as also particulate organic matter (*Seston-abioseston* and *bioseston*), plankton both *phyto* and *zooplankton*.

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**Table-1.** Analytical Procedure followed for Physico-Chemical parameters of Kabar lake.

Sl. No.	Parameters	Methods Employed
1.	Temperature	Direct method by immersing Mercury thermometer and Probes of Analytical kit.
2.	Light	Direct measurement with Lux meter
3.	Humidity	Direct measurement with Hygrometer (Barigo)
4.	Transparency (ZSd, m)	Secchi Disc using 20'' dia
5.	pH	pH meters (ph-ep-Japan, Systronics Portable & Elico Water kit)
6.	Dissolved Oxygen (mg/l)	Titrimetric with Modified Winkler's method
7.	Free Carbon dioxide (mg/l)	Titrimetric with NaOH & Phenolphthalein
8.	Carbonate & Bicarbonate alkalinity (mg/l)	Titrimetric method following Golterman <i>et.al.</i> (1978) using phenolphthalein & Methyl orange
9.	Calcium, Magnesium & Total hardness (mg/l)	Titrimetric method using EDTA, ammonium buffer & Erichrome black-T
10.	Chlorides (mg/l)	Titrimetric method using Systronics Spectrophotometer
11.	Nitrogen series (Nutrients) [mg/l]	Calorimetric method using Systronics Spectrophotometer
12.	Phosphorous (mg/l)	Stannous chloride method using Systronics Spectrophotometer
13.	Sulphate (mg/l)	Gravimetric method with methyl red indicator
14.	Specific conductance (Umho/cm)	Conductivity Bridge (Systronics)
15.	Total dissolved solids (mg/l)	Gravimetric method after evaporation
16.	Biochemical Oxygen Demand (BOD) [Mg/l]	BOD incubator for 5 days at 20°C
17.	Productivity	Light & Dark Bottle Method

The range of Secchi disc values observed in different seasons for the entire period of study has been tabulated below. These values are taken from three different transects of the lake exhibiting deeper zones such as Mahalaya, Kochala, Guhavadi, and Simra ghats, wherein, the water table in the lake remains even during the summer months. It is clear from the table, that the visibility was less during monsoon, followed by summer and winter months. The reason is obvious, that the suspended solids carried by the flood water enter the lake, decreasing the visibility. During the summer months, due to the *senescence* of the macrophytic vegetation in the lake, the lake water becomes turbid. In general, the Secchi disc

visibility or transparency largely depends on the turbidity of the lake ecosystem.

### Depth

The depth of the sampling station was measured using a sounding line having a lead weight at one end marked with divisions at 10 cm intervals from below upwards. Accounting for the free surface oscillations, the water-air interface, the accuracy of the measurement ranges within  $\pm 0.01$  m. In general the lake is quite shallow and the depth varied between 0.5-3.2 m during the investigation, the sampling station Mahalaya ghat exhibited greatest depth of 3.2 m during the

**Table-2.** Seasonal variation in Transparency (Zsd, m) values of Kabar lake, Bihar

Sampling Station	Winter	Summer	Monsson
Mahalaya Ghat	2.60-2.90	1.60-1.80	1.10-1.40
Kochala Ghat	2.45-2.70	1.90-2.10	1.05-1.20
Guhavadi Ghat	2.50-2.80	1.80-1.95	0.95-1.20
Simra Ghat	2.60-2.80	1.55-1.80	1.20-1.45

monsoon and post monsoon months, while the general average depth varied between 0.4-1.6 m during summer months.

### Temperature

Extensive field or *in-situ* measurements of surface water in the lake varied widely with the ambient atmospheric temperature and the prevailing weather conditions at the time of sampling. Surface water temperature in the lake varied between 18° Celcius, seasonal minimum to 28° Celcius, the maximum recorded during the course of the study. The range of differences between the subsurface and bottom waters varied widely from nil (Zero or no difference) to significant 1.5-2.0° Celcius at different sampling stations. No *thermal stratification* was observed in the lake water column at different sampling stations during the course of study.

### Hydrogen ion concentration (pH)

*In-situ* measurements of surface water pH made on board (Boat) at different sampling stations using portable pH meters. Chemically, the lake water generally exhibits a nearly alkaline pH (7 and above). The range of pH values recorded for subsurface waters (horizontal variation) varied widely between 7.0-8.3, while the bottom water showed only marginal variation (7.5-7.9) at different sampling stations all through the lake. The difference between the surface and bottom water pH (*Vertical profile*) at any given sampling station was extremely low (0.2-0.4 units to nil).

### Dissolved oxygen

In general, the dissolved oxygen content of surface water (horizontal profile) showed wide variation and ranged between 1.8-9.4 mg/l during the period of study. A similar trend in difference was also noted in the dissolved oxygen content in bottom regions where the values ranged between 1.6-8.2 mg/l.

The range of dissolved oxygen content between the surface and bottom water layers in the lake were generally nil, more so in shallow well lighted clear patches. At other sampling stations too, difference in the dissolved oxygen content in the verticle profile of the water column was only marginal, ranging between 0.1-1.0 mg/l indicating no significant depletion in the dissolved oxygen content in the lake *hypo-limniol*. The aerobic lake water, therefore, show no significant virtual variations in its dissolved oxygen content at most sampling stations, all through the column.

### Free carbon dioxide

Generally, free carbon dioxide was found to be absent in both surface and also at bottom waters, indicating the presence of carbonates and no carbonic acid or free carbon dioxide that can be analysed. At other times, usually during summer, at several sampling points as well as at bottom samples, free carbon dioxide and carbonic acid was present (pH 8.3 and above) and carbonates virtually absent.

### Total hardness

It was observed that the hardness in general

varied between 75.00-200 mg/l (Calcium carbonate) during the period under study. The lake water did not show any significant differences in range of hardness for surface and bottom layers.

### Chloride

Chloride level in the lake water was estimated to monitor the extent of loading mainly due to sewage pollution and other domestic wastes from surface run-offs into the lake. Chloride ionic content of the lake water ranged between 7.00-28.00 mg/l in both surface as also in bottom waters, with no significant differences between these regions. The chloride content of Kabar lake

indicates no appreciable organic pollution, through domestic and sewage effluents.

### Biochemical Oxygen Demand (BOD)

The Biochemical Oxygen Demand (BOD) values for surface water incidentally for the winter season (January-February), varied within a narrow range of 2.6-4.6 mg/l and for summer 3.8-6.2 mg/l. The region wise break up of BOD values for inlet, midlake, and outlet were 3.8, 2.6 and 4.6 mg/l respectively.

BOD values have been reported to have a marked seasonal pattern in most earlier studies. being high in summer and low during winter. Bagde & Verma (1985), reports similar BOD pattern in a lake. The low BOD values in the lake water indicate lower biological oxygen demand by micro-organisms. Based upon the BOD values, the lake can be classified as fairly clean using the common pollution classification (Great Britain). Comparable values for BOD (mg/l) from other similar extensive or large lakes supporting a luxurious growth of macrophytic vegetation are not known from the region, indeed tropical India as well. Not surprisingly enough, extensive aquatic vegetation with the lake water column influences water quality characteristic within the lake ecosystem. The low BOD values also indicate insignificant levels of organic pollution.

**Table-3.** List of sampling stations in Kabar Lake Wetland.

Kanha Ghat	Badi Kochala
Kumra Ghat	Choti Kochala
Simra Ghat	Naina Ghat
Rathra Ghat	Katai Ghat
Bela Ghat	Mysaha Ghat
Bainsihai Ghat	Kunal Ghat
Kuima Ghat	Bohra Ghat
Chatar Ghat	Amra Ghat
Kanwa Ghat	Mahalaya Ghat
Jaimangal Ghat	Guhawadi Ghat

**Table-4.** Showing range of physico chemical milieu prevailing in sub surface waters in Upper, Middle and Lower regions of Kabar lake, Begusarai District, Bihar during winter season (Nov.-Feb.) based upon three field studies (1989-90) covering 63 random samples.

Parameters	Inlet	Midlake	Outlet	Average of the C
ZSD, (m)	1.28-1.68	100%	0.55-1.26	1.0616
Depth (d, m)	1.29-1.93	1.22-2.25	1.50-2.50	1.812
Ambient Atm. Temperature (° C)	27.5-31.0	23.0-28.0	15.0-32.0	—
Surface Water Temperature (° C)	21.0-24.5	18.5-28.0	18.0-22.5	—
Bottom Water Temperature (° C)	21.0-24.5	18.5-21.5	17.0-22.0	—
Conductivity mhos/cm <sup>2</sup>	110.-125.0	108.0-120.0	70.0-100.0	90.8-117.5
pH	7.3-8.5	7.4-8.4	7.6-9.4	7.3-9.4
Dissolved Oxygen mg/l	7.0-7.1	5.7-8.5	4.7-8.3	5.8-7.96
Free Carbon dioxide mg/l	Traces 180	Absent - 3.0	Nil 40.0	Absent - 18.0
Total Alkalinity mg/l	133-194	126-128	64-152	107-160
Total Alkalinity meq/l	3.235	2.52-3.33	3.04	—
Total Hardness mg/l	122-124	124-184	99-139	129-187.27
Calcium Ca <sup>++</sup> mg/l	72-78	50-74	40-60	7-20
Magnesium Mg <sup>+</sup> mg/l	6-8	6-8	6.0-12.0	6-9.3
Chlorides Cl <sup>-</sup> mg/l	16-18	16-26	14-22	17-20
Orthophosphate P-PO <sub>4</sub> Ug/l	0.602	—	0.642-0.602	0.602-0.826
Nitrate Nitrogen N-NO <sub>3</sub> Ug/l	0.812	—	0.826-0.752	0.725-0.826
Sulphates SO <sub>4</sub> mg/l	1.26	—	1.64	1.45S
BOD	3.84	—	3.8	3.8

**Table-5.** Showing range of physico chemical milieu prevailing in sub surface waters in Upper, Middle and Lower regions of Kabar lake, Bengusarai District, Bihar during summer season (March-June) based upon three field studies (May 1989-April 91) covering 103 random samples.

Parameters	Inlet	Midlake	Outlet	Average of the lake
ZSD, (m)	0.78	0.72-1.02	0.6266	0.626-1.02
Depth (d, m)	1.2-1.3	0.48-3.00	2.2-3.2	0.48-1.5
Ambient Atm. Temperature (° C)	28.0-36.0	31.0-34.0	26.0-28.5	24.0-36.0
Surface Water Temperature (° C)	26.0-33.0	24.0-35.0	23.5-32.0	24.0-36.0
Bottom Water Temperature (° C)	NA	NA	NA	—
Conductivity mhos/cm <sup>2</sup>	220.0-310.0	210.0-290.0	210.0-330.0	210.0-330.0
pH	7.01-8.8	6.16-8.5	8.3-9.0	7.01-8.4
Dissolved Oxygen mg/l	2.20-8.0	2.8-10.4	2.5-11.0	2.2-11.0
Free Carbon dioxide mg/l	Traces 22	16.0	Nil	Nil-6.33
Total Alkalinity mg/l	56.0-195	56.0-152	78.0-189	56.0-189.0
Total Hardness mg/l	74.0-140.0	47.0-76.0	72.0-189.0	56.0-189.0
Calcium Ca <sup>++</sup> mg/l	18.0-32.0	10.0-28.0	10.0-36.0	12.6-33
Magnesium Mg <sup>+</sup> mg/l	9.73-18	7.3-15.8	16.0	—
Chlorides Cl <sup>-</sup> mg/l	3.5-11.0	7.1-14.0	3.5-11.0	3.5-14.00
Orthophosphate P-PO <sub>4</sub> Ug/l	0.85	0.24	Nil	—
Nitrate Nitrogen N-NO <sub>3</sub> Ug/l	0.725	0.24	Nil	—
Sulphates SO <sub>4</sub> mg/l	1.05	—	—	—

**Table-6.** Showing range of physico chemical milieu prevailing in sub surface waters in Upper, Middle and Lower regions of Kabar lake, Begusarai District, Bihar during winter season (June-Sept.) based upon three field studies (1988-1990) covering 47 random samples.

Parameters	Inlet	Midlake	Outlet	Average of the lake
ZSD, (m)	0.60-2.86	1.72-1.96	1.57-1.92	1.02
Depth (d, m)	0.90-2.85	1.80-2.79	0.9-2.56	1.42
Ambient Atm. Temperature (° C)	32.2	32.0-36.3	30.0-35.0	30.85
Surface Water Temperature (° C)	26.8-33.00	27.4-28.9	27.4-32.0	26.84
Bottom Water Temperature (° C)	32.0	30.5-31.5	31.0-32.0	30.02
Conductivity mhos/cm <sup>2</sup>	232.0-554.0	220.0-484.0	233.0-339.40	238.56
pH	7.0-8.3	7.0-8.2	7.1-8.4	7.42
Dissolved Oxygen mg/l	2.2-8.3	3.7-10.0	2.4-8.4	4.65
Free Carbon dioxide mg/l	Traces 22.0	8.0-40.0	Nil-18.0	20.12
Total Alkalinity mg/l	220.0-270.0	206.0-288.0	74.0-192.0	112.60
Total Hardness mg/l	112-164	112-124	79-139	110.20
Calcium Ca <sup>++</sup> mg/l	56.0-60.0	40.0-76.0	25.0-14.0	40.88
Magnesium Mg <sup>+</sup> mg/l	8.0-12.0	18.0-16.0	10.0-14.0	10.52
Chlorides Cl <sup>-</sup> mg/l	10-33	12-32	12-25	12.12
Orthophosphate P-PO <sub>4</sub> Ug/l	0.85	0.726	0.725	0.7253
Nitrate Nitrogen N-NO <sub>3</sub> Ug/l	0.725	0.568	0.686	0.7013
Sulphates SO <sub>4</sub> mg/l	1.05	0.96	1.2	1.07



## NUTRIENTS

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### INTRODUCTION

Ecologically speaking wetlands have also been known to function as "Biotic filters" and "Sediment traps" (Lee *et. al.* 1975), trapping nutrients by serving as natural biological filters for run-off waters from the surrounding system. Nevertheless, our understanding of the nutrient dynamics in wetlands is still limited mainly for lack of appropriate scientific approaches and analysis. The crucial role of many inputs (hydrological, climatic and biotic) and processes of decomposition have not been thoroughly investigated. Further, each wetland ecosystem is unique in its own right, each wetland has to be investigated in its totality as an ecosystem and subsystem. Any meaningful approach to understand the nutrient dynamics has to take into account nutrient loading, cyclic movements and other critical factors.

Reports on nutrients and their dynamics, in freshwater wetlands in tropical country, especially in India is often fragmentary and suffer from serious paucity of comprehensive, exhaustive studies. A humble attempt has been made to study the nutrient profile of Kabar lake.

### METHODS

Different workers have, more by chance rather than design, preferred analysis of different forms of same nutrients. Say, one worker has ensured the analysis of organic nitrogen, the other forms like ammonia-nitrogen or total nitrogen were not

analysed more perhaps for field or technical constraints. Nevertheless, pooling the various forms of phosphorous and nitrogen in the lake water and their possible range of values for at least to all seasons of study. Adequate care was taken to ensure that random sampling revealed an integral pattern (for entire lake) and that the water samples were collected from significant sampling stations inlet-midlake-outlet. The different forms of plant nutrients analysed have been discussed under the following format:

#### Compounds of Nitrogen (N)

Nitrate-Nitrogen ( $\text{NO}_3\text{-N}$ , mg/l)

Nitrite-Nitrogen ( $\text{NO}_2\text{-N}$ , mg/l)

Organic-Nitrogen (Org.-N, mg/l)

Ammonia-Nitrogen ( $\text{NH}_3\text{-N}$ , mg/l)

Kjeldahl-Nitrogen (Kjel.-N, mg/l)

#### Nitrate-Nitrogen ( $\text{NO}_3\text{-N}$ , mg/l)

Nitrate concentrations in unmodified natural waters are usually low and minima and maxima limits for natural concentrations vary widely between 1.0-10.0 mg/l (Lind, 1979). Concentrations of different forms of nitrogen are highly variable (metabolic demands) and therefore nitrate is highly variable, seasonally and spatially (Wetzel, 1975). The nitrate-nitrogen values in subsurface and bottom waters of Kabar lake exhibit a narrow range of variation. While the subsurface water had nitrate-nitrogen values varying narrowly between 2.26-2.93, the bottom showed only marginally higher ranges (2.71-3.16

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mg/l). The spatial variations in nitrate-nitrogen concentrations are not pronounced so also horizontal variations (differences). Nitrate concentrations in subsurface water samples for inlet-midwater and outlet were observed to vary narrowly the range being 0.752 mg/l (outlet), 0.826 mg/l (midlake) and 0.812 mg/l (inlet). However, variation in seasonal concentrations were more obvious and ranged between 3.25-4.0 mg/l. Since, it is loosely bound to soils, nitrate concentrations input in the lake are likely to increase with surface run-off and therefore most studies rightly report higher nitrate concentrations during the rainy seasons. The nutrient concentrations during the monsoon months showed higher values (3.6-4.52 mg/l). Therefore, nitrate-nitrogen concentrations during the winter months were minimal (0.424 mg/l) in subsurface and 0.82 mg/l in bottom waters, a pattern observed elsewhere in other studies (Kharatkar and Trivedi, 1993).

Further, quite a few early studies indicate a wide range of fluctuation in the nitrate-nitrogen (Alikunhi, 1955; Ganapati, 1960). In general, non polluted waters show lower nitrate-nitrogen concentrations. This is true of Kabar lake, where fluctuations in nitrate concentrations may be attributed to one of the following factors: low input through sewage or domestic waste and or from algal blooms of nitrogen fixing algae or possibly other reasons, as the dynamics of inorganic plant nutrients in a wetland ecosystem is a complex phenomenon.

#### **Nitrite-Nitrogen (NO<sub>2</sub>-N, mg/l)**

The nitrite-nitrogen concentrations in subsurface and bottom waters in the Kabar lake were observed to be present below detectable limits (Nil to 0.01 mg/l.). The data on the nitrite-nitrogen is in agreement with most other studies on the lake ecosystems in India. Kharatkar & Trivedi (1993) reported similar low concentrations from macrophytes infested lakes in Maharashtra. The near absence of nitrites indicate no appreciable contamination of lake water column through sewage, dissolved organic

matter from surface run-off from agricultural fields around and within the lake basin.

#### **Organic-Nitrogen**

The range of Organic dissolved nitrogen (Org. N) in the surface waters in Kabar lake wetland were observed to follow in a range of 0.694-1.456 mg/l, while the bottom waters showed marginally higher concentration of 2.296-2.352 (Average 2.324) mg/l. The marginally higher dissolved organic nitrogen concentration in bottom waters results from inputs through dissolved organic detritus.

#### **Ammonia-Nitrogen (NH<sub>3</sub>-N, mg/l)**

The ammonia concentrations for the subsurface waters in the Kabar lake ranged between 0.795-1.456 mg/l the annual average of values for subsurface waters was 1.1194 mg/l. The ammonia-nitrogen values computed for bottom waters was of higher range (2.296-2.352 mg/l, so also the average (2.324 mg/l). Ammonia concentration is generally low (1.00 mg/l) in non polluted, well oxygenated water (Lind, 1979). The subsurface indeed the hypolimnetic zones too, in around the central Kabar lake well oxygenated and free from the influence of organic pollution, and therefore normally confirm to low oligotrophic limits, characteristics of unpolluted waters. Ammonia-nitrogen concentrations, often product of ammonification of organic matter (Ellis *et. al.*, 1946), vary between 5-10 mg/l in organically polluted, anaerobic hypolimnion of the eutrophic lakes. The relatively higher concentrations of ammonia-nitrogen from bottom samples may be attributed to the concentration from sediment pool and submerged vegetation. Finally, the ammonia-nitrogen concentration profile in Kabar lake is indicative of oligotrophic nature and extremely low levels of pollution. Further, personal enquiries and search revealed not a single case of mass "fish kills" or fish mortality reports in Kabar lake, a common feature of the eutrophic lakes of Hyderabad (Ramkrishna, 1992).

### **Kjeldahl-Nitrogen (Kjel.-N, mg/l)**

The classical method (Kjeldahl method) was used to determine the total nitrogen content. In the present study, values varied between 1.567-4.536 (average 1.9937), in subsurface waters to 4.48-4.536 mg/l (average 4.508 mg/l) in bottom samples. Higher concentration of total Kjeldahl-nitrogen have been reported from freshwater lakes in Maharashtra attributing it due to the presence of higher organic matter, in the form of algal biomass or detritus. In Kabar lake, detritus seems to be the possible source or reservoir of Kjeldahl-nitrogen in both subsurface and bottom samples.

### **Phosphorous**

Limnological interest in phosphorous stems from its active complex role in aquatic ecosystems. In nature it cycles through many states and phosphorous concentration in any one state reflects the metabolic activity or decomposition processes in the system. For instance, lower phosphorous concentrations indicate high synthetic activity. Interestingly, it is the only element stimulating autotrophic growth and therefore analysed in relation to excessive production and eutrophication.

Phosphorous in water occur in a number of inorganic (polyphosphates and orthophosphates) and further in different soluble (dissolved) and particulate form. Surprisingly enough, the biological role and significance of different forms of phosphorous are still far from clear and current theories subject to modification (Wetzel and Likens, 1979).

### **Orthophosphate (PO<sub>4</sub>-P) and Total Phosphorous**

The stannous chloride calorimetric method was used for analysis. The following forms of phosphorous-orthophosphate, soluble reactive phosphate and total phosphorous were analysed for two consecutive field visit (winter season and summer season).

The inorganic orthophosphate concentrations for subsurface waters varied normally from traces to 0.642 mg/l during winter season. No major horizontal variation was observed in orthophosphate concentrations at inlet (0.601 mg/l), or outlet (0.602 mg/l) but mid waters around Mahalaya and Kochala ghats 0.642 mg/l, the mid water lake region showed marginally higher concentrations than that of other regions. The other biologically significant form—the total phosphorous concentrations in subsurface water during summer season again showed a narrow range of variation, between 0.10-0.25 mg/l. Here again the horizontal variations in subsurface waters concentrations in different parts of the lake were minimal, being 0.10 mg/l for inlet and 0.25 mg/l of mid waters. The littoral water region recorded similar range, varying normally between 0.16-0.18 mg/l.

Since, no data exists on different forms for the rainy season, no observations have been drawn on the seasonal pattern or variation, if any. Nevertheless, some meaningful picture emerges using chemical data from the only previous study on the important nutrient around the period (1988-89, Singh & Roy, 1990). A close analysis and evaluation of the data (ibid, 1990) revealed that possibly only one form-inorganic orthophosphate-phosphorous was analysed for surface waters. Its concentration too varied between a narrow range (0.62-1.65 mg/l and 0.85 mg/l) while the maximum concentrations were observed in the rainy season (1.50-1.65 mg/l) and the winter recorded an inter-mediate range of values (0.65-0.95 mg/l). Singh and Roy (1990) attribute the high range in phosphorous concentrations as indicative of eutrophication in Kabar lake, however, the present authors are of the opinion that the influx of water from the overflowing rivers has resulted in the general increase of nutrients during monsoon months.

The present study and critical evaluation of previous data on this important form or phosphorous in the lake revealed the following picture. The average concentration of the orthophosphate-phosphorous in surface waters of

Kabar lake varied normally within a narrow range of values, from traces (below detectable limits) to 1.65 mg/l for the period 1989-1991. The phosphate concentrations therefore, are appreciably higher than the reported mean phosphate content of most lakes *viz.*, 0.03 mg/l. Sawyer, Lackey and Lenz (1945) regard 0.03 mg/l phosphorous concentration as sufficient enough to trigger algal bloom. The threshold limits in tropical freshwater wetlands of huge size and dimensions (present extent of 6,937 hectares) are not well-known and therefore not established.

As observed earlier, each freshwater lake or wetland ecosystem has to be viewed in totality, taking all abiotic and biotic components and inputs into consideration. The authors' observations made herein are of a little variance in view of the highly complex biotic diversity of Kabar lake and its ecology.

Despite the appreciably higher range of phosphate concentration in Kabar lake, only the midlake region and deep waters around Mahalaya and Kochala ghat do show some evidence of algal blooms. The water around the outlet (Jaimangal Ghat) as also the inlet (Guabari Ghat) appeared to be devoid of any algal blooms. The lower phosphate-phosphorous concentration values of inlet (0.60 mg/l) and outlet (0.602 mg/l) corroborate this view point of view. The increased competition for and relatively higher uptake of limited (short supply) inorganic plant nutrients from the other major biotic community-aquatic macro-phytes, as also the well established inhibitory influence of aquatic macrophytes on algae and other biotic communities may possibly compete for the limited nutrients and therefore lower concentrations of orthophosphate-phosphorous.

The phosphate concentrations and its seasonal pattern suggest similar relationships. The extremely low orthophosphate concentrations, traces to 0.642 mg/l during the winter season may be attributed to high synthetic activity in Kabar lake. The general climatic conditions during winter—clear sky, more incident sunlight striking

the water column provide conducive to optimal growth. The relatively higher concentrations during the rainy season may attributed among others, primarily to release from decaying aquatic vegetation and surface run-off.

### Sulphate (SO<sub>4</sub> mg/l)

Sulphate estimated by titrimetric method, in Kabar lake, were in low concentration in subsurface waters and were further observed to vary within a narrow range 1.26-1.64 mg/l (average 1.40 mg/l) at different parts of the lake (inlet 1.26 mg/l; midwater 1.64 mg/l; outlet 1.32 mg/l). Since, subsurface water samples for different seasons could not be sampled for sulphate, no observation can be drawn on the seasonal pattern. Nevertheless, the winter data help us to provide a profile of sulphate concentrations in the lake.

The sulphate concentrations in the lake are in agreement with the general range values (5-50 mg/l) for natural waters, while a handful of studies exist on sulphur metabolism in algae, sulphate is reported to be taken up by higher plants and algae too (Lind, 1979). The vast array of aquatic vegetation (biomass) available at Kabar lake, as also the phytoplankton actively take up available sulphate (free SO<sub>4</sub> ions) and therefore account for low sulphate concentrations in the waters. Further, lower sulphate concentrations also indicate the absence of organic matter and less chemically reducing environment (high redox potential).

Hydrogen sulphide (H<sub>2</sub>S mg/l) was absent from majority of sampling stations (midlake and outlet) and the different lake regions did not emit pungent smell. But the stagnant water course along the Guabari ghat (near inlet of the lake) did show the presence of Hydrogen sulphide and by extension low redox potential of the water. Thus, the sulphur cycle was apparently generated due to reduction of sulphur and organic sulphur through anaerobic respiration of micro-organisms.

**Silica**

Silica is important in natural water as structural constituent of diatoms and many species of freshwater sponges. The limnological importance of silica stems from this fact that silica cycle exists in lakes that contain diatoms or sponges. Singh and Roy (1990) recorded the silica concentration in Kabar lake between 30-46 ppm for two years (1988-1989). Silica in natural water rich in diatom blooms, show interesting spatial and seasonal variation, a diatom bloom or maxima substantially accounting for the elimination of silica during peak season. Sedimentation (sinking of diatom

castings) helps to contribute silica concentration in water, completing the cycle. Baruah *et. al.*, (1993) following their plankton variability studies in Kabar lake report bacillariophyceae as the dominant group of phytoplankton, closely followed by Myxophyceae and Chlorophyceae. The silica concentration range (30-46 ppm) in the lake may, therefore be attributed to surface run-offs and sediment. Kachroo (1984) observed interesting correlation between high silica concentrations, diatoms and indeed phytoplankton. Hegde and Bharati (1985) also observed higher silica content, as favourable for diatom growth.



## DIURNAL VARIATION AND PHYTOPLANKTON DIVERSITY

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### INTRODUCTION

Studies on diurnal variation of physico-chemical factors, planktonic abundance and movement are carried out by several workers in tropical impoundments [Ganapati, (1955); George (1961); Michael (1964); Sreenivasan (1969); Khan & Siddiqui (1970); Nasar (1977); Kaul (1977); Vasist & Zutschi (1977); Vijayaraghavan (1977) and others]. The detailed study on the Indian wetlands is still in the infant stage, as wetland studies are of recent origin. It was therefore, felt to study the diurnal rhythm of phytoplankton and physico-chemical factors of Kabar lake, a wetland in the Gangetic belt of North Bihar.

In order to assess the diurnal variation during different periods of the year, six attempts have been made by the authors covering different seasons. During the study, collection of water and plankton samples were made from surface, 1 meter (below the surface water) and bottom (since the depth is not more than 2.0-2.5 m), at four hour intervals for nearly 30 hours from the deepest part of the wetland. Plankton samples are preserved in 3% formaldehyde with 5 drops of Lugol's Iodine, analysing with aid of Sedgewick Rafter Cell, under Sterio binocular microscope. Results are expressed in units/litre.

### RESULTS

Temperature, pH and transparency, dissolved oxygen, free carbon dioxide, chloride, alkalinity

are analysed during the study period. Fluctuations in temperature is similar to that of observations already made by Michael (1962); Munawar (1970); Vijayaraghavan (1971); Patil *et. al.*, (1984). During the monsoon, the entire wetland is flooded and takes more time to react to temperature fluctuation, on the other hand, during the lean summer period, the entire mass of water is divided into small water bodies of discontinuous nature (*ghats*) behaving in the form of a smaller water bodies experiencing wide fluctuation in temperature. The transparency of water was minimum during the monsoon months due to turbid water entering from the flood plains, while during the summer and winter, the lake bed is clearly visible. Variations are also noticed during the morning and afternoon hours, probably due to the movement of phyto-zooplankton.

Dissolved oxygen content was maximum during the afternoon hours and least during the early hours of the day and the results corroborates the work of Hutchinson (1957) that photosynthetic activities of the submerged vegetation and phytoplankton increase dissolved oxygen content in the wetland (maximum recorded was 9.6 mg/l and minimum recorded was 2.6 mg/l). Absence of carbon dioxide in most of the investigations in surface waters, except during the summer months and occurrence during the night and steady increase in pH from noon onwards upto 9 pm were observed.

Phytoplankton exhibited a similar trend of

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increase during the day time and decrease during the night in surface water of summer months, however during the monsoon and winter trends appear to vary. The peak in planktonic population noticed at 3 pm and a gradual decrease thereafter from 6 pm onwards. In monsoon months, distribution was not uniform in the vertical profile of the lake. The maximum recorded during the entire investigation was 1800 units/litre at surface and 860 units/litre at the bottom of the water column.

Planktonic analysis revealed Cyanophycean, Chlorophycean, and Bacillariophycean members. Specific identification of the phytoplankton is given in the table. Chlorophycean members dominated during monsoon and post monsoon months. 24 species Chlorophyceae are encountered in Kabar lake. Volvocales which are normally represented by the species such as *Pandorina*, *Chlamydomonas*, *Geocystis* were not encountered in the wetland study. Most of these members of the Volvocales mentioned above are usually associated with the water bodies undergoing eutrophication. Such results are in confirmity with those of Phillipose (1958). The distribution of *Volvox sphaerica* in the wetland was restricted to summer months in the areas where the water level decreased considerably and senescent vegetation was maximum. Similar results were obtained in the lake studies of tropical region by Rao (1982). *Hydrodictyon* also exhibited restricted distribution (summer months of February and March), in the areas of anthropogenic activity. Therefore, it can be inferred that the distribution of *Hydrodictyon* is associated with the eutrophication process. Distribution of *Spirogyra*, *Oocystis* also showed similarity with the *Hydrodictyon* and *Volvox species*.

Desmids dominated among Chlorophycean members such as *Closterium*, *Cosmarium*, *Ankistrodesmus*, *Scenedesmus* and *Coelastrum*. These species appeared more abundant during the post monsoon months of October to December. Similar results were obtained by

Gonzalves and Joshi (1946), when the water experienced moderate alkalinity.

Cyanophycean members were similar to tropical impoundments in their distribution. *Microcystis*, *Oscillatoria*, *Anabaena*, *Chroococcus* dominated summer months in surface water. Species such as *Rivularia*, *Spirulina*, *Anabaenopsis* dominated in lower depths (1 meter and below), however their record in benthic layer was lowest. The distribution of these species was also interesting as they encounter in less number from the monsoon months and their number increases from the end of monsoon (September), the peak being the summer months of March-June. Two interesting species, *Euglena* and *Phacus*, dominated during summer months, were not recorded during monsoon. During winter, *Phacus* showed occasional appearance in very few places.

Members of the Bacillariophyceae such as *Navicula*, *Gomphonema*, *Melosira* and *Fragilaria* were maximum at noon during summer months at surface and subsurface (1m depth). Bottom samples showed minimum population during the study except *Pinnularia* and *Melosira*. The population study during monsoon months indicated poor representation. The distribution of Bacillariophyceae in surface water indicates their strong affinity towards light.

Analysis of diurnal variation revealed the rich distribution of algal members during post monsoon and winter months. Chlorophycean is only the exception, showing dominance even during monsoon months. A few species such as *Ankistrodesmus*, *Scenedesmus*, *Navicula*, exhibited their occurrence throughout the year. Vertical migration of phytoplankton showed regular pattern in the case of Bacillariophycean members. Chlorophycean and Cyanophycean members are prominent plankters in the surface water at night. This vertical and horizontal migration has profound influence on the feeding behaviour of many of the species especially fishes and therefore such study reveal the

habitat preferences of many of planktivorous fishes.

Table showing the species diversity of Phytoplankton in Kabar lake, Bihar.

#### CYANOPHYCEAE

1. *Microcystis aeruginosa* Kutz.
2. *Spirulina menenghiana* Zanard ex Gomant
3. *Oscillatoria limosa* Ag. Ex Gomant
4. *Oscillatoria principes* Vauch
5. *Lyngbya gracilis* (Menegh.) Raben
6. *Anabaenopsis* sp.
7. *Anabaena sphaerica* Bornet et Flahault
8. *Nostoc linckia* Roth). Born et Flahult
9. *Rivularia aquatica* De Wille
10. *Chroococcus minutus* (Kutz)

#### CHLOROPHYCEAE

1. *Volvox sphaerica* (Ehrenberg)
2. *Hydrodictyon reticulatum* (L.) Lagerh
3. *Pediastrum tetras* var *excisum* (Raben)
4. *Pediastrum duplex* Meyen
5. *Coelastrum intermedium* (Bohlin)
6. *Ankistrodesmus falcatus* (Corda) Ralfs
7. *Scenedesmus quadricauda* var *longispina* Chodat Smith
8. *Scenedesmus dimorphous* (Turpin) Kuetzing
9. *Scenedesmus arquatus* var *Capitatus* G.M. Smith
10. *Selenastrum gracile* Reinsch
11. *Oocystis parva* W et. W
12. *Chlorella vulgaris* Beyernick
13. *Tetradon minimum* (A Braun) Hansgirg

14. *Zygnema globosum* Czurde
15. *Spirogyra hyalina* Cleve
16. *Spirogyra affinis* (Hass.) Pelit
17. *Spirogyra paludosa* Czurde
18. *Cosmarium hammeri* Reinsch
19. *Cosmarium auriculatum* Reinsch
20. *Cosmarium maximum* (Wood) Schmidle
21. *Closterium monoliferum* (Bory) Ehrenberg
22. *Closterium reniformae* (Ralfs) Arch
23. *Chara verticillata* Roxb.
24. *Nitella flexilis* (L.) C.A. Agardh

#### BACILLARIOPHYCEA

1. *Navicula viridis* Kutz.
2. *Nitzschia* sp.
3. *Cymbella cystula* (Hempr.) Grwn
4. *Asteronella* sp.
5. *Gomphonema* sp.
6. *Pinnularia major* Kutz.
7. *Melosira* sp.
8. *Fragilaria* sp.

#### EUGLENINAE

1. *Euglena viridis* Ehrenberg.
2. *Phacus hispida* (Eichn) Lemm.

Studies on the Phytoplankton stems from their crucial role in aquatic ecosystem—as primary producers, in sustaining heterotrophic communities, biological treatment of organic wastes and influencing the abiotic features of water quality such as pH, colour, taste and odour. Above all, they have been successfully used as biological indicators of water quality. While some phytoplankton flourish in highly nutrient rich (eutrophic) waters, others are

sensitive to organic and other wastes (industrial effluents). Yet other types exhibit luxurious growth of one, or rarely few species, resulting in : "Water blooms" (noxious algal blooms), emitting offensive odour and imparting taste to water, eventually creating a noxious or toxic condition causing animal deaths (Mass mortality or fish kills), human illness. The phytoplankton species composition has therefore also been used to indicate the degree or extent of water pollution.

The distribution of phytoplankton in Kabar lake is mostly patchy, with most water zones apparently devoid of phytoplankton. The littoral regions all around in several ghats of Kabar lake wetland with a luxuriant growth of macrophytic vegetation show poor phytoplankton community. The possible reasons for the absence of phytoplankton perhaps results from allelopathic or inhibitory influence of macrophytes on other species. Alternately, the floating leaves cause shading effect in littoral region creating conditions not conducive for plankton growth. The macrophytes are also known to compete for available inorganic plant nutrients, so essential for stimulating phytoplankton growth.

The following discussion of phytoplankton composition and seasonal variation therein is based on the field studies conducted for three years. Of the phytoplankton vegetation,

bacillariophyceae were the most dominant group followed by myxophyceae and chlorophyceae in terms of average density. In all 44 species of phytoplankton were reported and this accounted for 80.90% of the plankton. The seasonwise phytoplankton population density is as under :

Season	Phytoplankton density (Units/litre)
South-west monsoon	62-184 (u/l)
Winter	96-194 (u/l)
Summer	526-1800 (u/l)

The summer season recorded the highest peak in phytoplankton population, a trend in line with the general seasonal periodicity of phytoplankton in aquatic ecosystems in India. The myxophycean members were abundant in summer, declining in density gradually in monsoon and winter. Euglenophyceae, represented by two species abounds in summer months. Members of bacillariophyceae too found in large numbers throughout the study period, exhibiting peak growth during summer declining with the onset of monsoon. In all eight species of diatoms are reported from the lake, with *Pinnularia*, *Navicula* and *Cymbella* occurring in abundance. In conclusion, based on the phytoplankton quotient and the dominance of diatoms and desmids, the lake water may be classified as falling in Oligotrophic range.

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## MACROPHYTIC VEGETATION

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### INTRODUCTION

The Kabar lake wetland has diverse and extensive growth of macrophytic vegetation with a record of 112 species of vascular plants and a species of Pteridophyte as in the table. The aquatic macrophytic vegetation in the lake falls nearly in the widely established category viz. shallow water submerged species, floating leaf forms, amphibious marsh forms, moist meadow forms and dry meadow forms. The present work is based on the extensive field studies for three years by Ramakrishna, Muley and Siddiqui. Observations on the habit and habitat, association and abundance of macrophytes are recorded and the identification for the same was followed from fresh material with the help of standard literature from Botanical Survey of India and consultation with Prof. Vivekananda Banerjee of Botany Department, Patna University, Patna.

#### 1.1. Shallow water submerged forms

Distribution and abundance of the macrophytes are as under :

1. *Hydrilla verticillata* (Linn.) Royle; Family: Hydrocharitaceae. Dominant and Distributed throughout the lake.
2. *Vallisneria spiralis* (Linn.) Royle; Family: Hydrocharitaceae, present in patches of the deeper parts in the lake such as Guhabari, Kochala and Mahalaya ghat.

3. *Nechamandra alternifolia* (Roxb). Theo.; Family: Hydrocharitaceae, distributed in deeper parts of the water column of more than 1.0-1.5m.
4. *Ottelia alismoides* (Linn.) Pers.; Family: Hydrocharitaceae, present in patches in the lake margin.
5. *Limnophila gratioloides* R. Br.; Family: Scrophulariaceae, dominant and distributed throughout the lake.
6. *Limnophila racemosa* Benth.; Family : Scrophulariaceae, dominant and distributed throughout the lake.
7. *Utricularia stellaris* Limit.; Family : Lentibulariaceae, dominant and distributed throughout the lake with *Limnophila* sp.
8. *Smilax zeylonica* Linn.; Family : Liliaceae, Present in patches in the margin of Kochala and Mahalaya ghat especially during the drier part of the year.
9. *Meriophyllum tuberculatum* Linn. Family: Haloragidaceae. Moderately distributed throughout the lake.

#### 1.2 Floating leaf forms

1. *Nelumbo nucifera* Gaertn.; Family: Nymphaeaceae. Present in patches throughout the lake margin.
2. *Nymphaea stellata* Wild.; Family:

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- Nymphaeaceae, more dominant than *N. nucifera*, however, not widely distributed.
3. *Nymphoides cristatus* (Roxb.) O. Tuts.; Family: Menyanthaceae, dominant among the floating leaf forms.
  4. *Nymphoides indicum* (Linn.) O. Kuntz.; Family : Menyanthaceae, distributed in small patches.
  5. *Eichhornia crassipes* (Martz.) Solms.; Family : Pontederiaceae. Dominant in the lake margin of inlet (Guhabari), outlet (Jaimangal garh) as well as in the canal leading to the Burhi Gandak river from the lake.
  6. *Monochoria histata* (Linn.) Solms.; Family : Pontederiaceae, present in small patches of the lake.
  7. *Potamogeton crispus* Linn., Family : Commelianaceae, present in patches throughout the lake.
  8. *Potamogeton nodosus* Pair.; Family : Commelianaceae, present in patches of the lake.
  9. *Hygrophiza aristata* (Retz.) Nees.; Family : Poaceae. Present in small patches as free floating vegetaion in open water, usually a drifting community.
3. *Merrymia emarginata* (Burn f.) Hallifer. Family : Convolvulaceae, present in small patches.
  4. *Caldesia parnassifolia* (Mart.) Solms.; Family : Alistamataceae, present in large patches in pockets especially during winter months.
  5. *Commelina communis* Clarke.; Family: Commelinaceae.
  6. *Commelina diffusa* Linn.; Family : Commelinaceae.
  7. *Jussiaea repens* Linn.; Family : Onagraceae.
  8. *Marselia quadrifolia* Linn.; Marseliaceae : Pteridophyta distributed throughout the lake margin.

#### 1.4 Moist meadow forms

1. *Phragmites karka* (Retz.) Trin.; Family: Poaceae.
2. *Saccharum spontaneum* Linn.; Family : Poaceae.
3. *Oryza sativa* Linn.; Family: Poaceae.
4. *Cyper pumilus* Linn.; Family : Cyperaceae.
5. *Cyper rotundus* Linn.; Family : Cyperaceae.
6. *Scirpus supinus* Linn.; Family: Cyperaceae.
7. *Scripus articularis* Linn.; Family: Cyperaceae.
8. *Fimbristylis woodwardi* C.B. Clarke; Family : Cyperaceae.
9. *Juncellus aloperculoides* Clarke; Family : Cyperaceae.
10. *Najas minor* All.; Family : Najadaceae.
11. *Eragrostis nutans* (Raetz) Nees.; Family : Poaceae.
12. *Hygrophila polysperma* T. Aedens.; Family : Acanthaceae.

Species belonging to *Monochoria*, *Potamogeton*, and *Hygrophiza* are springly distributed in the lake and their distribution is irregular.

#### 1.3 Amphibious marsh forms

1. *Ipomea aquatica* Forsk.; Family : Convolvulaceae, present in patches throughout the lake margin especially abundant in channel leading to the river and near Jaimangal garh.
2. *Ipomea chrysoides* Key Gawl.; Family: Convolvulaceae, similar to *I. aquatica*.

**1.5 Dry meadow forms**

1. *Polygonum hydropapier* Linn.; Family : Polygonaceae.
2. *Paspalum punctatum* (Burn.); Family : Poaceae.
3. *Bambusa* sp.; Family : Poaceae.
4. *Paniculum paludosum* Roxb.; Family : Poaceae.
5. *Paniculum repens* Linn.; Family : Poaceae.
6. *Heliotropium indicum* Linn.; Family : Boraginaceae.
7. *Zizyphus mauritiana* Ham.; Family : Rhamnaceae.
8. *Crotolaria verrucosa* Linn.; Family : Leguminosae.
9. *Tephrosia hamiltoni* J.R. Drum.; Family : Leguminosae.

**MAJOR TREES**

Large fruit yielding trees encountered around the fringes of the wetland are *Mangifera indica* (Mango) and *Tamarindus indicus* (Tamarind), especially near the adjoining villages of the lake. *Barringtonia acutangula* (Oak murtle) abounds in the marshy area. Other tree species of the wetland are *Ficus religiosa* (Pipal), *Ficus bengalensis* (Banyan), *Ficus glomerata* (Gular), *Ficus infectoria*, *Acacia nitotica* (Babul), *Acacia arabica* (Kikar), *Strobilus scrapher* (Shorea), *Azardichta indica* (Neem), *Albezzia labeek* (Siris) and few others.

Forest Department of Bengusarai district (Government of Bihar) has initiated afforestation programme with the plantation of trees on the elevated pockets with in the lake basin to prevent total submergence during monsoon and to enhance the wetland value for avifauna. Species of plants taken for afforestation programme are

*Dalbergia sissoo* (Sissoo), *Salix tetrasperma* (Willows), *Phoenix dactylifera* (Palmyra), *Phoenix sylvestris* (Date palm), *Eugenia jambolana* (Jamun), *Feronia* sp. etc.

**FLORA OF KABAR LAKE WETLAND  
(Plants in and around Kabar Lake)****MENISPERMACEAE**

*Stephania hermandifolia* Welp, 14211

**NYMPHACEAE**

*Nelumbo nucifera* Gaertn 14279.

*Nymphaea stellata* Willd 14265, 14275.

*Nymphaea* sp. 14276.

**CAPPARACEAE**

*Cleome gynandra* Linn. 14320, 14263.

**MALVACEAE**

*Abelmoschus moschatus* Medic 14309.

*Abutilon indicum* (Linn.) Swee 14224.

*Malachra capitata* Linn. 14298.

*Sida acuta* Burn f. 14202.

*Sida humilis* Wild 14214.

*Urena lobata* Linn. 14203.

**STERCULIACEAE**

*Melochia corchorifolia* Linn. 14240.

**TILIACEAE**

*Corchorus aestuans* Linn. 14242

**RHAMNACEAE**

*Zizyphus mauritiana* Ham. 14231

**LEGUMINOSAE**

*Aeschyomene indica* Linn. 14243

*Biophytum sensitivum* (Linn.) DC, 14222.

*Cassia occidentalis* Linn. 14208

*Crotolaria verrucosa* Linn. 14302

*Desmodium gangeticum* DC, 14312

*Indigofera liniofolia* Retz 14304

*Neptunia prostrata* (Lamk.) Baill 14339

*Sesbania paludosa* Prain 14280, 14256

*Thephrosia hamiltoni* J. R. Drumm 14323

*Teramnus labialis* Spreng 14316

*Vicia sativa* Linn. 14216

## HALORAGIDACEAE

*Corchorus aestuans* Linn. 14252

## LECYTHIDACEAE

*Barringtonia acutangula* Gaertner 14324

## ONAGRACEAE

*Ludwigia abscondens* (Linn.) Hara 14268

*Ludwigia perennis* Linn. 14216

*Jussiaea repens* Linn.

## CUCURBITACEAE

*Braninca hispidula* Congn 14332

*Bryonopsis* Linn. Naud 14245

*Caccinia indica* (Naud) W & A 14226

*Luffa acutangula* Roxb. 14313

*Momordica* sp.

## RUBIACEAE

*Oldenlandia corymbosa* Linn. 14232

*Oldenlandia diffusa* Roxb. 14246

## COMPOSITAE

*Ageratum conyzoides* Linn. 14206

*Eclipta alba* Linn. 14342

*Veronia axillaris* Less 14225, 14315

## APOCYNACEAE

*Tabernaemontana citrifolia* Linn. 14300

## MENYANTHACEAE

*Nymphoides cristatum* (Roxb.) O Kuntze

*Nymphoides indicum* Linn. O Kuntze

## BORAGINACEAE

*Trichodesma indicum* (Linn.) Lehm 14300

*Heliotropium indicum* Linn. 14219

## CONVOLVULACEAE

*Ipomea aquatica* Forsk 14210

*Ipomea chrysoidea* Ker-Gawl 14277, 14333

*Merremia emarginata* (Burn f.) Hallier f.

## SCROPHULARIACEAE

*Bacopa monnieri* (Linn.) Pennel 14278

*Limnophila gratioloides* R. Br. 14239

*Limnophila racemosa* Benth 14257

*Scoparia dulcis* Linn. 14310

## LENTIBULARIACEAE

*Utricularia stellaris* Linn. f. 14231

## PEDALIACEAE

*Martynia annua* Linn. 14222

## ACANTHACEAE

*Asystasia gangetica* T. Anders 14314

*Hygrophila auriculata* (Schum) Haine 1433

*Hygrophila polysperma* T. Anders 14342

*Peristrophe bicalyculata* (Retz) Nees 142

*Rungia parviflora* Nees 14307

## VERBENACEAE

*Phylla nodiflora* (Linn.) Greene 14311

## LABIATAE

*Anesmeles indica* (Linn.) O Ktze 14289

*Leucas aspera* Spreng 14274

*Leucas lavandulaefolia* Rees 14207

*Ocimum basilicum* Linn. 14330

*Ocimum sanctum* Linn. 14218

## AMARANTHACEAE

*Achyranthes aspera* Linn. 14220

*Aerva lanata* (Linn.) Juss. 14204

*Alternanthera sessilis* (Linn.) DC 14233

*Amaranthus tenuifolia* Willd 14340

*Digera muricata* (Linn.) Mart 14228

## CHENOPODIACEAE

*Basella rubra* Linn. 14331

*Chaenopodium album* Linn. 14261

*Chaenopodium murale* Linn. 14269

## POLYGONACEAE

*Polygonum hydropapier* Linn. 14241

## EUPHORBIACEAE

*Croton bonplandianum* Baill 14241

*Euphorbia hirta* Linn. 14326

*Phyllanthus urinaria* Linn. f 14319

## MORACEAE

*Ficus heterophylla* Linn. f 14319

## HYDROCHARITACEAE

*Ottelia alismoides* (Linn.) Pars 14235,  
14237, 14238, 14259, 14336

*Hydrilla verticillata* (Linn.f) Royle

*Vallisneria spiralis* Linn. 14293

*Nechamandra alternifolia* (Roxb.) Thw 14287

**LILIACEAE***Smilax zeylonica* Linn. 14308**PONTEDERIACEAE***Monochoria histata* (Linn.) Solms 14342**COMMELINACEAE***Commelina diffusa* Burm f 14299*Commelina communis* Clarke 14318**ALISMATACEAE***Caldesia parnassifolia* (Linn.) Parl 14267**POTAMOGETONACEAE***Potamogeton crispus* Linn. 14294*Potamogeton nodosus* Poir 14255**NAJADACEAE***Najas minor* All 14288**POACEAE***Eragrostis nutans* (Retz.) Nees*Hygrorhiza aristata* (Retz.) Nees*Phragmites karka* (Retz.) Nees*Saccharum spontaneum* Linn.*Oryza sativa* Linn.*Paspalum punctatum* (Born)*Bambusa* sp.*Paniculum paludosum* (Roxb.)*Paniculum repens* (Linn.)**CYPERACEAE***Cyper pumilus* (Linn.)*Cyper rotundus* Linn.*Fimbristylis woodwardi* C.B. Clarke*Juncellus aloperculoides* C.B. Clarke*Scirpus supinus* Linn.

of macrophytic vegetation especially weeds is known to hinder fishery resource, choking water, making water unpalatable, increase water loss and create certain disease problems. Contrary to these undesirable effects, macrophytes are known to provide cheap, simple and efficient way of treating waste water (Williams, 1983; Venkateswarulu, 1984) and provides breeding ground for several phytophagous fishes, molluscs and insects. Further, certain emergent species are known to occupy different habitats, tolerating fluctuating water level and undesirable condition, yet offering habitat for water fowls.

The whole gamut of aquatic vegetation in the Kabar lake wetland falls into widely established categories, viz., floating, submerged and emergent and representing distinct vegetational zones in the lake ecosystem. The general distribution, abundance, growth and development of aquatic macrophytes in Kabar lake wetland seems to be in general agreement with most observed facts affecting the ecology of the macrophytes in other freshwater ecosystems viz., ponds, lakes, reservoirs etc. The entire Kabar lake basin as also the water column, at most places was observed to play host to wide variety of aquatic weeds. The growth of submerged as also floating or surface vegetation and indeed emergent weeds (marginal zones or transition zones, land-water interface) was simply, alarming, the clear (devoid of vegetation) water patches were most exception rather than the rule. The canal serving as the main outlet too had beds of submerged vegetation, despite substantial depth, human interference and other factors.

In short, the species diversity of aquatic vegetation in the lake both in quantity and content is simply impressive and interesting, making the system very productive besides serving as suitable major habitat for innumerable resident and migratory water fowl and other avifauna, ichthyofauna and as specialised microhabitat for the whole gamut of entomofauna (crustacea, insecta and insect larvae), malacofauna and periphyton.

**SUMMARY**

Aquatic vegetation has a profound influence on the nutrient budget of the aquatic ecosystem and their hydrological balance. A general opinion also exists that the excessive growth of aquatic vegetation particularly in tropical and subtropical areas causes loss of water resources, which adversely effect the economy of the country (Varshney and Rozská, 1976). Excessive growth

Ecologically speaking, the rich species diversity of aquatic vegetation and weeds inhabiting the Kabar lake ecosystem offers immense scope for studies on phytophysiology and ecology of macrophytes. The zonation and distribution of aquatic macrophytes are in response to light regimes, depth, substratum, water quality and availability of inorganic plant nutrients and such critical factors need detail studies. Some efforts have been made, though lot remains to be done. Gopal, Sharma and Trivedi (1978) have reviewed Indian studies on the ecology and productivity of macrophytes in selected freshwater ecosystems, based on their analysis of different studies, they observed that aquatic vegetation exhibits great phenotypic plasticity as also adaptability to their ever changing situation in the environment eventually resulting in great modification of the phenophases under different ecophases or ecological conditions. A near similar paradox exists in so far as the distribution of aquatic macrophytes in Kabar lake. While apparently, there does exist association, often pure, mixed and other combinations with specific vegetation preferring a specific zone or region, variation to the general pattern are often encountered and appear natural.

The ecological reason for preponderance, predominance or otherwise in the distribution pattern exists but here again variance is often the rule and therefore any generalisation is difficult. The negative or inhibitory influence (*Allelopathy*) if any, of one species in the system also needs to be investigated as the macrophytes in turn influence aquatic productivity. The maximum growth of one species has been observed to reduce the biomass of other species (Sing, Mehrotra and Chandra, 1985; Rai *et.al.*, 1985). Interestingly, enough, in the mid lake ecosystem, mixed associations between aquatic weeds are not uncommon. The possible reason for growth or retardation of the other may be by mat formation (total coverage) by one species and resultant decrease or blocking of the incident light and attenuated light dependent processes

(Photoperiodism-Photorespiration), exchange of biogenic gases between air-water interface and other nutrient in the substratum or water column.

Yet another striking though seasonally variable feature regarding the ecology of macrophytes in Kabar lake is the abundance of dying and decaying vegetation, often forming thick mat or bed at the substratum and indeed accumulating considerably in the water column. The natural death and decay add, increasing organic matter (loading) into the system. This complied to other integral, natural forms of loading (detritus) in eventually influencing the growth, distribution and abundance of aquatic weeds in Kabar lake. The role of detritus in the extensive wetland needs thorough investigation and evaluation to help to assess the potential aquatic productivity of Kabar lake, impressive by all accounts, in view of generally abundant and high diversity of standing crop of different aquatic weeds.

In general, the lake exhibits an impressive array of all types of aquatic vegetation in all its major habitats, substratum/bottom, midwater column, surface and littoral region playing host to rooted, submerged, free floating and emergent types although the aquatic ecosystem. The intense hot summer season results in appreciable fall and reduction in biomass more following the withdrawal of water for irrigation, coupled with changing water levels (depths) in the lake receding boundaries. Summer season, therefore, witnesses not only reduction in the diversity of the macrophytes but also indeed death and decay (unfavourable condition).

The distribution and abundance of different types of aquatic macrophytes in the extensive wetland ecosystem also appear to be regulated by the physico-chemical characteristics of the substratum as also the water column. The alkalinity and the pH of the medium also influence growth and distribution of aquatic weeds in lakes and ponds (Moyle, 1949; Singh, Mehrotra and Chandra 1985). The surface and subsurface and bottom water therefore, may be

regarded as distinctively alkaline and highly productive. The alkalinity values too corroborate the high productive potential of the lake. The range of electrical conductivity values for water in the lake is also pointer of high productivity values in the lake.

Apart from offering a rich and variety of food, shelter, nesting and roosting site for birds, several species are found to be excellent fodder for cattle and thatching material for huts (*Phragmites karka*). Several species of macrophytes are known to be utilised in the preparation of drugs, the litter

formed by the senescent vegetation is known to be an excellent fodder for pigs.

Compared to deeper zones, shallow water habitats usually are structurally more complex and are characterised by greater heterogeneity (Wetzel, 1975), this fact is well represented by distribution in the lake. Finally, the distribution and abundance of amphibious marsh forms, moist and dry forms are mainly related to the exposed area of the lake margin and also related to the water level of the wetland and anthropogenic activity in the form of utilisation for paddy cultivation.



## ZOOPLANKTON

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### INTRODUCTION

The zooplankton community, technically a heterogeneous assemblage of often phenotypically close but varied plankton groups such as protozoa, freshwater sponges, rotifera, cladocera, copepoda, ostracoda, etc. to quote a few dominant groups, call for specific systematic field collection methodology from different major and minor *micro* habitats, besides requisite taxonomic expertise, so conspicuous by its absence on freshwater wetland fauna from India.

Information on the composition and relative abundance of the zooplankton in any aquatic ecosystem is prelude to an understanding of the nature of secondary production and energy flow pattern (Balakrishna Nair *et. al.*, 1985). Its role in wetland ecosystem is directly related to fish catch potential, eutrophication and biological structure. Taxonomic treatment of the faunal communities is much more fragmentary because of the vastness of the country, variation in the collective methodology. The Indian scenario on selected zooplankton communities is summarised in the work of Michael (1980), Michael and Sharma (1992), Fernando and Kanduru (1984) and few others.

### FIELD METHODOLOGY

Adequate care was taken althrough the course of field studies to ensure random sampling and

appropriate collection/preservation/sorting was adopted. Net plankton, other faunal collections were made from diverse habitats-littoral/limnetic regions, *neustonic* zones (air-water interphase) and amidst macrophytes (Periphytic entomofauna, malacofauna, annelids etc.), from limnologically significant sampling stations. The No. 25 conical shaped plankton towner was gently 'towed' in subsurface waters (from slow moving Reinforced Fibreglass boat, without outboard motor) for obtaining a possible *qualitative* (species composition) profile of primary plankters and littoral groups in the ox-bow lake for general community studies. For quantitative studies, requisite amount of lake water (100 litres, using 201 capacity PVC bucket X 5 times) was sieved through a 64 µm mesh net plankton and strained sample treated as quantitative sample for enumeration (No. of units/l). Plankton samples from deep water regions (depth 2-3 – Mahalaya, Kochala, and around, deepest zones in the wetland) were collected using the Indianised version of Kremer Water Sampler with trip mechanism. Replicate samples (5 times X 11) from desired depth, often bottom or sediment-water interphase, were sieved through 64 µm nylon mesh net, seperately for both qualitative and quantitative studies. *In-situ* measurements of bottom water temperature pH, conductivity, etc. and other physico-chemical *milieu* prevailing at different sampling stations. The station data were duly supplemented with adequate notes on prevailing field ecological conditions for drawing

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observations on ecology of different zooplankter groups.

Of the possible whole gamut of wetland fauna collected by the Freshwater Biological Station, Zoological Survey of India team, quite a few animal groups—entomofauna, malacofauna, annelids etc., have been studied by respective group specialist (taxonomists) for technical and operational convenience and feature elsewhere in this monograph. What follows hereunder, therefore, is a general treatment of major zooplankter groups and littoral fauna, their species richness, abundance, distribution and ecology based on field ecological observations and field station data. Thus, while some groups have been adequately analysed taxonomically, observations on annelids, freshwater mites, arachnids, besides the ubiquitous aquatic insects—both adult and larvae have been incorporated as they are a significant biological component of the lake plankton, nekton and *neuston*, successfully exploiting the vast and varied ecological *niches* and play a definite role in the overall structure and dynamics of wetland fauna, indeed its ecology.

As submitted earlier, the approach adopted reflects authors technical limitations and therefore suffer from understandable bias, tilting more in favour of taxonomic treatment of some groups—especially rotifers than others—the ubiquitous rich and diverse freshwater copepods and the less worked out ostracods. Detailed analysis of general species composition and structure of all these heterogeneous groups should help to throw more light on their overall role and relevance in the aquatic food chain.

### ZOOPLANKTON GROUPS

In general, the copepods quantitatively outnumber all other zooplankter groups all through the year, in all seasons. On the basis of the general abundance, diversity and distribution of different major zooplankter groups, the copepods, predominantly the immature stages, are

numerically abundant, occurring freely in all samples examined, closely followed by cladocerans, rotifers (however, rotifers exhibit far greater species richness) and ostracods, finishing the fourth position in terms of species number and abundance. The pattern of qualitative abundance and distribution of these different groups may be summed up as Copepods>Cladocerans>Rotifers>Ostracods>Conchostraca>Annelids>Insect larvae>Nematodes>Protozoa.

The different zooplankton species also reveal clear seasonality or seasonal pattern in their distribution/abundance. The winter season samples, although the three year field study period (1988-1991), showed preponderance of copepod populations, especially the immature ones in various naupliar and copepod stages. Not surprisingly, majority of the net zooplankton samples revealed extremely high population density of diaptomid and cyclopid stages, indicating numerical abundance of copepod over other plankter groups. Predominance by copepods is well corroborated through earlier studies on plankton variability by Baruah *et. al*, (1993). In yet another study Khatri (1986) reports similar dominance by copepod in all seasons in Lakhota lake, Jodhpur, Rajasthan; while Gupta and Soni (1987) too recorded abundance of crustacean nauplii in the lakes of Central India. However, occasionally, cladocerans and rotifers alike show numerical abundance over copepods in terms of species richness and numbers. George (1966), Singh and Sahai (1979), Jha (1979), Gupta and Soni (1987) reported similar dominance by rotifer/cladocerans over copepods in various lakes.

Further, of the mature adult copepod observer, few calanoid diaptomid genera predominate the cyclopid, the harpacticoids finding poor to no representation (here again size selective, site specific collection methodology helps account for their absence rather than other reasons). The calanoid fractions are primarily planktonic occurring abundantly in open water samples with a sprinkling of few cyclopid genera (2-3 species),

which otherwise are primarily littoral and benthic. Again the copepod component of zooplankton in the ox-bow lake under report, is dominated by few (2-3) species of calanoid and a species or two of cyclopoid genera in the limnetic region while the macrophytic rich, shallow littoral region are richer in cyclopoid and calanoid fraction. This *ecological co-existence* stems primarily from greater variety of availability of ecological and food *niches* and temporal and habitat partitioning the extensive lake habitat offers. Of the calanoid genera, *Heliodyptomus viduus*, *Phyllodyptomus blanci* predominate limnetic waters in association with *Mesocyclops leuckarti* Claus, 1857. Both aquatic macrophytes (Gehrs, 1974) and fish (Carter and Goudier, 1986) are known to influence horizontal distribution of copepod populations in lake and these together with lake size, depth, transparency, temperature, and related factors too appear to exercise sure influence on abundance/distribution of copepod in Kabar lake. Apparently, neither ambient subsurface water temperature, nor pH appear to exercise major influence on horizontal distribution of copepods in this primarily ox-bow lake, where pH differences are wide varying between 7.1-8.6, during the study period.

### Cladocera

The cladocerans closely follow the major copepod component, occupying a good second position in numerical abundance. However, qualitatively, they enjoy an unparalleled first position, in terms of species richness and distribution, finding wide representation through as many as 28 species and subspecies. The cladoceran component therefore, is highly rich in diversity and distribution. Further, the different cladoceran plankter groups exhibit the following pattern of abundance and natural distribution *viz.*, Chydorids>Macrothricidae>Daphniidae>Bosminidae>Sididae and Polynemidae. The winter season witnessed remarkable species richness and abundance in cladoceran population. Population

peaks during the winter are not uncommon, Raghunathan (1990) reports of major peak first in September/October and another in February in large tank (Chinglepet), near Madras city.

The limnetic chydorids (Chydoridae) predominate the scene, though genus *Chydorus* Leach, 1816, fairly well represented by 6 species. Besides, two other genera *viz.*, *Pleuroxus* Baird, 1843 and *Alonella* Sars, 1862, under subfamily Chydorinae, also find adequate representation. Two of the species of genus *Pleuroxus* *viz.*, *Pleuroxus aduncus* (Jurine, 1820) and *Pleuroxus trigonellus* (O.F. Muller, 1976) occur more frequently and widely than on the two species of genera *Alonella* *viz.*, *Alonella excisa* (Fischer, 1854). Interestingly enough, *Alonella excisa* occurred in only late winter collection in weedy littoral region around Khaira ghat in the present investigation. The subfamily Aloninae comes close to second, in order of abundance and distribution, represented by three species under genus *Alona* Baird, 1843 *viz.*, *Alona rectangula* Sars, 1862a and one of its subspecies *Alona rectangula richardi* (Stingelin, 1895).

The macrothricids (Macrothricidae, Norman & Brady, 1867) are close next in order of numerical abundance to chydorids in Kabar lake. Thus, genus *Macrothrix* Baird, 1843 with two of its four Indian species, as also *Echinisca* Lieven, 1848, with one of its two Indian species *viz.*, *Echinisca odiosa* (Gurney, 1907) and the monotype *Ilyocryptus spinifer* Herrick, 1882 are common in summer and winter season plankton. However, both *Macrothrix spinosa* and *Macrothrix geoldei* find fair representation although the year and exhibit no seasonality in their distribution and or food/habitat preference. The third major fraction of the cladoceran fauna includes plankter species under Bosminidae of which the monotypic genus *Bosminopsis* Richard, 1895, represented by *Bosminopsis* Richard, 1895, observed in monsoon and early winter collections, extending its range of its geographic distribution to Bihar. The remaining cladoceran fauna includes species from

families Sididae, Daphnidae and Moinidae. Apparently, these are poorly represented and therefore restricted in their distribution and abundance in this ox-bow lake. Further, they show no marked seasonal preference and or abundance.

Occurrence of *Latanopsis australis* Sars, 1888, under monotypic genus *Latanopsis* Sars, 1888 is interesting from the view point of geographic distribution and apparently was observed in samples from winter season only. However, the only species observed under the genus *Daphnia* O.F. Muller, 1785, viz., *Daphnia lumholtzi* Sars, 1885, despite its intermittent nature and restricted distribution, exhibits pronounced seasonal abundance. The mild population of *Daphnia lumholtzi* Sars, 1885, was observed to occur more commonly during late winter samples but strangely enough never in swarm proportions, otherwise a common feature with some *Daphnia* species. Again, a little too surprisingly enough, only helmeted forms, in various shapes and intergrades were observed with no epihippal females or population with epihippa or summer eggs were encountered. The various winter collection examined showed only *cyclomorphic* or seasonal forms. Observations on the possible causative factors—vertical movements, size selective predation and or behavioural ecology, responsible for surprising absence of “swarms” or swarm population, and further interestingly presence of only relatively larger helmeted forms in limnetic water in Kabar lake during winter season are discussed elsewhere (under communication).

In the final analysis, a cursory comparison of the cladoceran fauna reported from this lake to date (Baruah *et. al.*, 1993) and Sharma and Dutta Munshi, (1995) is revealing, instructive and only further corroborates authors contention for serious taxonomic studies for detailed picture of the overall general composition of crustacean microfauna/rotifers and other major plankter groups. The present finding, listing 28 species and subspecies under 17 genera and 7 families is

only illustrative, helping us to gauge the immense species richness in the cladoceran genera in the ox-bow lake.

### Rotifers

Interestingly, the rotifer component too reveal remarkable species richness as the cladocera are not numerically predominant. While the Monogononts (Class : Monogonata) find fair representation with approximately 29 species under 10 genera and 7 families, the Digonont rotifers (Class : Digononta, Bdelloidea) are conspicuous by their absence.

The 29 species of freshwater rotifers reported, predominantly include littoral or meroplanktonic forms as also limnetic species of the Monogononts, the largest group, represented by 7 families; Lecanid rotifers are diverse, enjoy wide distribution and are dominant followed by Brachionid rotifers. The lecanid rotifers (Lecanidae) apparently prefer littoral habitat and exhibit clear seasonality, occurring more frequently in winter samples, besides summer season. The two subgenera—*Lecane* (*Lecane*) and *Lecane* (*Monostyla*) under genus *Lecane* Nitzsch, 1821, are well represented by 7 and 4 species/subspecies respectively. *Lecane* (*Monostyla*) *bulli* (Gosse) 1851, a cosmopolitan species, is fairly common in all lecanids, indeed rotifers. The brachionid rotifer, the other major fraction of the rotifer plankton, in ox-bow lake, are represented by the genus *Brachionus* Pallas 1766 (6 species/subspecies), and to a lesser extent by *Keratella* Bory de st. Vincent, 1822 (2 species/subspecies) and *Platyias* Haring, 1913 (one species) all eurytypic in distribution. Further, all these cyclomorphic genera also exhibit characteristic seasonal forms or morphotypes and thus cyclomorphoses. Apparently, the rotifer component exhibit far greater degree of periodic *polymorphism* or cyclomorphosis than their cladoceran counterpart. Thus ubiquitous highly cyclomorphic genus *Brachionus* is well

represented by *Brachionus calyciflorus*, *Brachionus falcatus*, *Brachionus diversicornis*, *Brachionus caudatus*, *Brachionus angularis* and their varieties; the genus *Keratella* by two polymorphic species *Keratella tropica* & *Keratella cochlearis* while genus *Platytias* though single species (*Platytias quadricornis*) and its morphs. Besides, a species or two of genus *Lecane* also exhibit seasonal morphotypes.

Cyclomorphosis in lake populations of rotifer plankton results possibly from a combination of environment (temperature, pH, food etc.) and biotic factors (predation induced). Pennak, (1989) opines cyclomorphosis as complicated interaction between organism and environment. The rotiferan plankton in Kabar lake revealed no pronounced seasonal periodicity but nonetheless are numerically abundant during winter and rainy season. However, *Brachionus diversicornis* a 'summer form' and largest species of the genus *Brachionus* was collected from clear, deep water midlake region (Maahalaya ghat, depth varying with 2-3 meters) from late summer samples. Other significant rotiferan species recorded from the *ox-bow* lake are *Trichocerca (Diurella) Similis* (Wierzenski, 1893) the *humped* form, hitherto reported only from Baroda (Wulfret, 1966) and West Bengal (Sharma, 1979). Interestingly enough, the limnetic forms apparently are less abundant than the littoral ones—various species of genus, *Lecane* were observed to be more abundant and widely distributed. In general, the abundance and diversity in rotifers populations in lakes appear to be governed by the amount of available food.

The density and species richness of rotifers populations in a water body are a clear indicator of its trophic status. Different workers cite different species of genus *Brachionus* as indicators of eutrophication (Arora, 1966; Chowrasia and Adoni, 1987). Thus, a consistent presence of various species of genus *Brachionus-Brachionus caudatus*, *Brachionus calyciflorus*, *Brachionus falcatus*, *Brachionus quadridentata*

and *Brachionus angularis* in Kabar lake are a clear indicator of its fast changing trophic status.

Based upon Myers categorisation of rotifers to pH tolerance, the rotifer species may be broadly described as *alkaline* water species (pH range of above 7) ex. different species of genus *Brachionus*, and the *transcursion* species or broad range amply exemplified by over 7 species of predominant cosmopolitan genus *Lecane*. The general range of pH for subsurface water in Kabar lake, North Bihar is 7.1-8.6 and has no remarkable influence on distribution and or abundance of rotifer population in the lake. In general, broad range or *transcursion* species characterise the rotifer plankton in Kabar lake. Possibly the rotifer plankton species in Kabar lake have their pH optima from 7.1 to 8.6 a little over the neutrality like other *euryokaus* rotifer species.

### Protozoans & Ostracods

The apparent poor representation of free living protozoans plankton species in Kabar lake has more to do with size selective community sampling than perhaps other natural reason—food availability, competition, predation etc. *Centropyxis aculeata* was observed only in summer and rainy season and strangely enough not in winter samples. Chaurasia & Adoni (1985), reported similar peak in summer in eutrophic lake from Central India. Baruah *et. al.*, (1993) recorded *Arcella discoidea* as the common protozoan plankton. Ciliates dominate in the area infested by the macrophytic vegetation, *Eicchornia crassipes* and the species encountered are *Loxophyllum* species, *Chilodonella* species, *Frontonia* species, *Vorticella* species, *Oxytricha* species and *Euplotes* species.

The ostracods, primarily littoral or *meiobenthic* plankters, including few planktonic species, finish a poor fourth in terms of density and species richness. Despite their crucial role in the overall aquatic system, they have received very little attention. Ostracod taxonomy and ecology in India

have not received their due attention (Victor & Fernando, 1979) and this has primarily led to their neglect. In all 8 species under 5 genera were observed. Baruah *et. al.*, (1993), recorded a single *Cypris* species, while Sharma & Dutta Munshi (1995) reported 5 species from Kabar lake. Genus *Stenocypris* Sars, 1889 is well represented by three species *Stenocypris major*, (= *Stenocypris malcomsoni*), *Stenocypris derupta* and *Stenocypris hislopi*—all interesting distributional records from not just *ox-bow* lake, indeed North Bihar or Bihar state, for that matter. The other cypridid seed shrimp include the common widely distributed *Cypris subglobosa* and a species of each under the genera *Strandesia* Stulhmann, 1888, and *Heterocypris* Clause 1892. More habitat specific sampling and detailed taxonomic investigations are bound to reveal a full picture of ostracod community and their ecological role in the extensive *ox-bow* lake ecosystem.

#### **Other animal communities : Water Mites/ Micro-crustaceans**

Information on the water mite fauna is restricted to field/laboratory observation on the two commonly occurring widely distributed species *viz.*, *Arrenurus rouxi* Green water mites and *Hydrachna kloomi* (Red water mites) in samples from both littoral waters and open waters. The two limnophilic genera are euryoecic indicating their ability to thrive in wide range of physico-chemical milieu. They were observed to occur in macrophytic infested (water hyacinth), turbid, foul smelling, organic rich water around the inlet of the lake as also in the samples from clear waters around the mid lake regions with equal abundance.

Of the non cladoceran fauna under freshwater Branchiopods (Branchiopoda), observations on the Conchostracans (Clam shrimps) based on the reported identification by fellow expert (Dr. L. P. Gupta, per Comm.). Genus *Caenestheriella* (Family : Caenestheriidae) is represented by *Caenestheriella indica* (Gurney, 1906), while

genus *Cyclestheria* by *Cyclestheria hislopi* Baird. Branchiopods are known to occur typically in the absence of fish but there are few reports of their occurrence in lake with fishes too (Thrope and Covich, 1991). Littoral, pond like macrophytes infested environs around edges in Kabar lake provide ample food and habitat *niches* for Conchostracans to skim sediment-water interphase. Further, the extensive area (approximately 25 km<sup>2</sup> annually witnesses extensive reduction of its water spread area, following *abstraction* (withdrawal) for irrigation and natural vagaries (hot, dry, summer months with high ambient atmospheric temperature upto 42°C and above). Temporary ponds/pools, therefore, are a common site with the initial onset of monsoon. The clam shrimp possible hatch from resting eggs soon developing into juveniles resembling adults. Of the decapod crustacean inhabiting the *ox-bow* lake, the 'river shrimp' *Macrobrachium* predominates, represented by *Macrobrachium lammarrei* Lamarei (N. Milne Edwards), which enjoys clear numerical abundance over the others almost around the year. The atyid shrimp is represented by a single species — *Cardenia nilotica* (Roux.), whereas in the food crabs *Paratelphusa* (*Paratelphusa*) *spinigera* Woodmason is numerically abundant than *Paratelphusa* (*Paratelphusa*) *jacquemontii* Rathbun.

#### **Oligochaete Worms and Leaches**

The aquatic oligochaete representation in Kabar lake, again bears a close relation to sampling/ collection priority and methodology and therefore, only the commonly occurring forms find representation. The common genera *Branchiodrilus*, *Dero* (= *Alodera*) and *Nias* are represented by about as many species, indeed double their number (six), while the leaches (Hirudinea or Hirudinoidea) by the two common genera *viz.*, *Hirudunaria* and *Glossiphonia* and the terrestrial genus *Metaphire* by *Metaphire posthuma* (Vallient) and yet another species. The

oldest and yet biologically and commercially important family of aquatic oligochaetes—the Tubificidae—*Tubifex (Tubifex) tubifex* (Muller) and *Limnodrilus holfmeisteri*, besides *Branchiura sowerbyi*. The highly variable abiotic environment—temperature, pH, dissolved oxygen, ionic content and other dissolved matter together with biotic factors—abundance of macro-invertebrates, fishes, amphibians, turtles as also various species of waterfowl influence, in particular, abundance and distribution of leeches in Kabar lake.

Summing up, distribution and abundance of different invertebrate communities, in any freshwater lake/wetland ecosystem primarily is a function of the prevailing abiotic and biotic attributes—exploitation, competition, and predator-prey interaction operating within the system. Further lakes or wetlands are not uniform habitats and play host to ever changing niches—ecological, food, habitat, etc. on a continually varying scale.

Kabar lake in North Bihar is one such dynamic, highly diverse, variable, lentic water system, providing a fascinating biological pattern along a continuous and interesting blend of permanently submerged and temporary pools on seasonal/annual basis. As a result, the whole gamut of animal communities—zooplankton, benthos, vertebrate nekton including bird nekton, *neuston*, and periphyton or *aufwuchs*, as also phytoplankton, aquatic macrophytes and associated microbial flora/fauna enjoy remarkable species richness and diversity. In short, the biotic diversity of the wetland fauna is simply marvellous, highly rich and diverse, indeed it has to be seen to believe. Despite gradual changes in its trophic status, from *oligotrophic*-nutrient and algae poor to *mesotrophic* or *eutrophic*-nutrient and algae rich, its negative impact on the biological structure and composition of wetland fauna, their abundance and diversity, is apparently far from perceptible, more so in the absence of faunal data base on freshwater wetland.

**Table showing the details of various groups of Zooplankton of Kabar lake, Bihar.**

Subclass	COPEPODA	1. <i>Pseudosida bidentata</i> Herrick, 1884
Order	EUCOPEPODA	Genus <i>Diaphanosoma</i> Fiescher, 1850
Suborder	CALANOIDEA	2. <i>Diaphanosoma sarsi</i> Richard, 1894a
Family	DIAPTOMIDAE	Family DAPHNIDAE Straus, 1820
Subfamily	DIAPTOMINAE	Genus <i>Daphnia</i> O. F. Muller, 1785
	Genus <i>Heliodiaptomus</i> Kiefer, 1932	3. <i>Daphnia lumholtzi</i> Sars, 1895
	1. <i>Heliodiaptomus viduus</i> Kiefer, 1932	Genus <i>Scapholebris</i> Schedler, 1858
	2. <i>Heliodiaptomus</i> sp. + Copepod stages	4. <i>Scapholebris kingi</i> Sars, 1903b
	Genus <i>Phyllodiaptomus</i> Kiefer, 1936	Genus <i>Simocephalus</i> Schedler, 1858
	3. <i>Phyllodiaptomus blanci</i> (Guerne & Richard, 1896)	5. <i>Simocephalus vetulus</i> (O.F. Muller, 1776)
Division	OLIGOBRANCHIOPODA	<i>sensus lato</i> incl. <i>Simocephaloides vetuloides</i> Sars
Order	CLADOCERA	Family MOINIDAE
Family	SJIDIDAE	Genus <i>Moina</i> Baird, 1850
	Genus <i>Pseudosida</i> Herrick, 1884	

6. *Moina brachiata* (Jurine 1820)

Family BOSMINIDAE

Genus *Bosmina* Baird, 19457. *Bosmina longirostris* (O.F. Muller, 1776)Genus *Bosminopsis* Richar, 18958. *Bosminopsis deitersi* Richard, 1895

Family MACROTHRICIDAE

9. *Macrothrix spinosa* King, 185310. *Macrothrix geoldi* Richard, 1897Genus *Ilyocryptus* Sars, 1826a11. *Ilyocryptus spinifer* Herrick, 1882

Family CHYDORIDAE

Subfamily CHYDORINAE

Genus *Echinisca* Lieven, 184812. *Echinisca odiosa* (Gurney, 1907)Genus *Pleuroxus* Baird, 184313. *Pleuroxus aduncus* (Jurine, 1820)14. *Pleuroxus triogonellus* (O.F. Muller, 1776)Genus *Alonella* Sars, 1826a15. *Alonella excisa* (Fischer, 1854)Genus *Chydorus* Leach, 181616. *Chydorus barroisi* Richard, 184917. *Chydorus sphaericus* (O.F. Muller, 1776)18. *Chydorus parvus* (Daday, 1898)19. *Chydorus reticulatus* Daday, 189820. *Chydorus ventricosus* Daday, 189821. *Chydorus flaviformis* Birge, 1898

Subfamily ALONINAE

Genus *Alona* Baird 1843 emend Smirnov, 197122. *Alona dravidi* Richard, 1895a23. *Alona rectangula* Sars 1826a24. *Alona rectangula richardi* (Stingelin, 1895)Genus *Bipertura* Smirnov, 197125. *Bipertura karua* (King, 1853)26. *Bipertura affinis* (Leydig, 1860)Genus *Oxyurella* Dybowsky & Grochowski, 189427. *Oxyurella singalensis* (Daday, 1860)

Family POLYPHEMIDAE

Genus *Polyphemus* O.F. Muller, 178528. *Polyphemus pediculus* (Linne, 1761)

Phylum ROTIFERA

Class MONOGONATA

Order PLIOMA

Family NOTAMMATIDAE

Genus *Cephalodella* Bory de St. Vincent1. *Cephalodella furficula* Ehrenberg

Family SYNCHAETIDAE

Genus *Synchaeta*2. *Synchaeta* sp.

Family TRICHOCERCIDAE

Genus *Trichocerca* Lamarck 18013. *Trichocerca simulus* (Wierzenski, 1893)4. *Trichocerca cylindrica*

Family ASPLANCHNIDAE

Genus *Asplanchna* Gossae, 18865. *Asplanchna* sp.

Family BRACHIONIDAE

Genus *Brachionus* Pallas 17666. *Brachionus calcyflorus* Pallas 17767. *Brachionus quadridentatus* Hermann 17838. *Brachionus diversicornis* (Daday, 1895)9. *Brachionus patulus* (Muller, 1776)10. *Brachionus faclatus* Zacharias 189811. *Brachionus angularis* Grosse, 1851Genus *Trichotria* Bory de St. Vincent, 182212. *Trichotria tetractis* (Ehrenberg, 1830)

Genus *Keratella* Bory de St. Vincent, 1822

13. *Keratella cochlearis* (Gosse, 1857)

14. *Keratella tropica* Apstein

15. *Keratella valga*

Genus *Platylas* Harring, 1913

16. *Platylas quadricornis* (Ehrenberg, 1832)

Genus *Euchlanis*

17. *Euchlanis dilatata* Ehrenberg, 1832

Genus *Dipleuchanis*

18. *Dipleuchanis propatula* Gosse, 1886

Family LAECANIDAE

Genus *Lecane* Nitzsch, 1827

19. *Lecane (Lecane) ungulata* (Gosse, 1886)

20. *Lecane (Lecane) papuana* (Murray)

21. *Lecane (Lecane) luna* O.F. Muller, 1776

22. *Lecane (Lecane) luna* f. *dorsicalis* Sharma

23. *Lecane (Lecane) eontia* (Turner, 1892)

24. *Lecane (Lecane) ploensis* (Voigt, 1902)

25. *Lecane (Lecane) ludwigi* (Eckstein, 1892)

26. *Lecane (Monostyla) lunaris* Ehrenberg, 1892)

27. *Lecane (Monostyla) hamata* (Stokes, 1859)

28. *Lecane (Monostyla) bulla* Gosse, 1851

29. *Lecane (Monostyla) styrax* Harrings, & Myers. 1859

Subclass OSTRACODA Latrialle, 1806

Order PODOCOPIDA Muller, 1894

Suborder PODOCOPA Sars, 1866

Super family CYPRIDACEA Baird, 1845

Family CYPRIDIDAE Baird, 1845

Subfamily CYPRIDINAE Baird, 1845

Tribe CYPRIDINI Baird, 1845

Genus *Cypris* O.F. Muller, 1776

1. *Cypris subglobosa* Sowervy, 1840

Tribe CYPRICERCINI Mckenzie, 1871c

Genus *Cypricercus* Sars, 1894

2. *Cypricercus* sp.

Tribe EUCYPRIDINI Bronstein, 1947

Genus *Strandesia* Stuhlman, 1888/  
Vavra, 1885

3. *Strandesia purpurescens* (Brady, 1886)  
(*Cypris purpurescens* Brady, 1886)

Subfamily CYPERTTINAE Hartmann,  
1864

Genus *Cyprretta* Vavra, 1895

4. *Cyprretta* sp.

Subfamily STENOCYPERININAE  
Ferguson, 1964

Genus *Stenocypris* Sars, 1889

5. *Stenocypris major* (Baird, 1859)

(*Stenocypris malcolmsoni* Brady, 1886)

6. *Stenocypris derupta* Vavra, 1906

7. *Stenocypris hislopi* Ferguson, 1969

Family NOTODROMADIDAE  
Kaufmann, 1906

Genus *Centrocypris* Vavra, 1895

8. *Centrocypris* sp.

Family EUCANDONIDAE Swain,  
1961

Genus *Candonopsis* Vavrà, 1891

9. *Candonopsis* sp.

Subclass BRANCHIOPODA

Division EUBRANCHIOPODA

Order CONCHOSTRACA

Family CAENESTHERIIDAE

Genus *Caenestheriella*

1. *Caenestheriella indica* Gurney, 1906

Family CYCLESTHERIDDA

Genus *Cyclestheria*

2. *Cyclestheria hislopi*

Phylum ANNELIDA  
 Super Class CLITELLATA  
 Class OLIGOCHAETA  
 Order PLESIOPORA  
 Family NAIADIDAE

1. *Branchiodrilus* sp.
2. *Dero (Alloclero)* sp.
3. *Nais* sp.

Family TUBIFICIDAE

4. *Tubifex (Tubifex) tubifex* (Muller)
5. *Limnodrilus* sp.

Order OPISTHOPHORA  
 Family MEGASCOLOIDEA

6. *Metaphire posthuma* (Vaillant)
7. *Metaphire* sp.

Class HIRUDINEA  
 Family HIRUDUNIDAE

8. *Hirudinaria* sp.

Order RHYNCHNOBDELA

Family GLOSSIPHONIDAE

9. *Glossiphonia weberi* Blanchard

Class ARACHNIDA  
 Order ARANEAE  
 Suborder TROMBIDIFORMES  
 Family ARGYRONECTIDAE

1. *Argyronecta aquatica*

Class HYDRACHNOIDEA  
 Family HYDRACHNIDAE

2. *Arrenurus rouxi*
3. *Hydrachna kloomi* Imamura

Class CRUSTACEA  
 Subclass BRANCHIURA  
 Order ARGULOIDA  
 Family ARGULIDAE

Genus *Argulus*

4. *Argulus indicus* (Linnaeus)

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## MOLLUSCA

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### INTRODUCTION

In order to have an up-to-date knowledge on the faunal resources of Indian wetland ecosystems, an attempt has been made to explore and study the fauna from the freshwater lakes of India. The Kabar lake in Begusarai district of Bihar state is one of the lakes included under present study. The present report is based on the collections made during recent surveys undertaken and also some material received for identification from other sources.

Studies on freshwater molluscs of India were made earlier by several workers who contributed several papers. The most important one among these contributions are 'The Fauna of British India, Mollusca' (Freshwater Gastropoda and Pelecypoda) by Preston (1915) and the more recent, 'Handbook : Freshwater Molluscs of India' by Subba Rao (1989). As such there is no comprehensive data on the faunal resources of Indian wetland ecosystem especially on freshwater lakes. Therefore the present contribution on the Kabar lake, one of the selected lakes from the Indian sub-continent is significant.

Kabar lake is situated at (25° 35'N; 86° 10'E) 22 kms. N. of Begusarai town. The main source of water of the lake is the river Buri Gandak. At present the lake has been declared as 'closed area' and called as "Kanwar Jheel Pakshi Vihar"

Classification followed here is after Subba Rao (1989).

### SYSTEMATIC LIST OF MOLLUSCS COLLECTED FROM KABAR LAKE

Class GASTROPODA  
Order MESOGASTROPODA  
Family VIVIPARIDAE

1. *Bellamya bengalensis* f. *typica* (Lamarck)
2. *Bellamya bengalensis* f. *anandalei* (Kobelt)
3. *Bellamya bengalensis* f. *doliaris* (Gould)
4. *Bellamya dissimilis* (Mueller)

Family PILIDAE

5. *Pila globosa* (Swainson)

Family BITHYNIIDAE

6. *Digoniostoma pulchella* (Benson)
7. *Gabbia orcula* (Frauenfeld)

Family THIARIDAE

8. *Thiara (Melanoides) tuberculata* (Mueller)
9. *Thiara (Tarebia) lineata* (Gray)

Order BASOMMATOPHORA  
Family LYMNÆIDAE

10. *Lymnaea (Pseudosuccinea) acuminata* f. *typica*  
Lamarck
11. *Lymnaea (Pseudosuccinea) f. acuminata*  
*rufescens* Gray
12. *Lymnaea (Pseudosuccinea) f. gracilior*  
Martens

Family PLANORBIDAE

13. *Indoplanorbis exustus* (Deshayes)

14. *Gyraulus convexiusculus* (Hutton)  
 15. *Gyraulus euphraticus* (Mousson)

Class BIVALVIA  
 Order UNIONOIDA  
 Family UNIONIDAE

16. *Lamellidens corrianus* (Lea)  
 17. *Lamellidens marginalis* (Lamarck)

### Key to the families

1. Shell with a single valve .....2.
- Shell with two valves.....UNIONIDAE
2. Shell with an operculum .....3.
- Shell without an operculum.....6.
3. Shell small, below 10 mm in length ..... BITHYNIIDAE.
- Shell larger, above 10 mm in length .....4.
4. Shell globosely inflated, pyramidal, operculum with concentric growth lines.....5.
- Shell turreted, operculum with spiral growth lines.....THIARIDAE.
5. Shell globose, aperture ovate, operculum calcareous.....PILIDAE.
- Shell pyramidal, aperture circular, operculum horny.....VIVIPARIDAE.
6. Shell elongate with a raised spire, columellar axis typical twisted .....LYMNAEIDAE.
- Shell discoidal, spire depressed, columellar axis not twisted.....PLANORBIDAE.

Family VIVIPARIDAE

Genus *Bellamya* Jousseume, 1886

### Key to the species

Shell with dark spiral bands, body whorl rounded at periphery.....*B. bengalensis*.

- Shell without spiral bands, body whorl subangulate at periphery.....*B. dissimilis*.

### *Bellamya bengalensis* f. *typica* (Lamarck)

1822. *Paludina bengalensis* Lamarck, *Hist. nat. Anim.Sans, Vert.*, 6(2) : 174.  
 1989. *Bellamya bengalensis* f. *typica* : Subba Rao, *Handbook : Freshwater Molluscs of India* : 45, fig. 55.

*Material examined* : 14 exs., Coll. S.Z. Siddiqi (22.11.90); Ramakrishna (12.2.90) and A.K. Pandey (4.4.90 & 12.4.91).

*Distribution* : India : Common throughout.

*Remarks* : Shell elongate, conical, spire equal to body whorl in length, apex pointed, whorls rounded, aperture subcircular with a black margin.

### *Bellamya bengalensis* f. *annandalei* (Kobelt)

1889. *Vivipara annandalei* Kobelt, *Nachr. Malak.Ges.* 60 : 101.  
 1989. *Bellamya bengalensis* f. *annandalei* : Subba Rao, *Handbook : Freshwater Molluscs of India* : 46, fig. 57.

*Material examined* : 3 exs., Coll. E.V. Muley (2.6.89); S.Z. Siddiqi (28.1.90).

*Distribution* : India : Bihar (new record), Andhra Pradesh, Tamil Nadu, West Bengal.

*Remarks* : Shell thin, translucent, smaller, whorls gradually increasing in diameter, with rather straight sides, suture shallow.

This form is known to occur in 'pools of foul water used for domestic purposes' (Annandale, 1921).

### *Bellamya bengalensis* f. *doliaris* (Gould)

1843. *Paludina doliaris* Gould, *Proc. Boston Soc. nat. Hist* : 144.  
 1989. *Bellamya bengalensis* f. *doliaris* : Subba Rao, *Handbook : Freshwater Molluscs of India* : 47.

*Material examined* : 1 ex., Coll. E.V. Muley (1.4.88).

*Distribution* : India : Bihar (new record), Maharashtra, West Bengal.

*Elsewhere* : Myanmar.

*Remarks* : Shell smaller and more conical with a biangulate body whorl.

***Bellamya dissimilis* (Mueller)**

1774. *Nerita dissimilis* Mueller, *Hist. Verm. Test.* pt. 2 : 184.

1989. *Bellamya dissimilis* : Subba Rao, *Handbook : Freshwater Molluscs of India* : 48, figs. 64-67.

*Material examined* : 2 exs., Coll. E.V. Muley (1.4.88); S.Z. Siddiqi (28.1.90).

*Distribution* : India : Common throughout.

*Elsewhere* : Bangladesh, Malaysia, Myanmar, Pakistan, Sri Lanka.

*Remarks* : Shell greenish, broadly ovate, body whorl indistinctly angulate at the periphery, with fine microscopic spiral striae, sometimes with a pale band.

Family PILIDAE

Genus *Pila* (Bolten) Roeding, 1798

***Pila globosa* (Swainson)**

1822. *Ampullaria globosa* Swainson, *Zool. Illustrations*, 2, pl. CXIX.

1989. *Pila globosa* : Subba Rao, *Handbook : Freshwater Molluscs of India* : 58, figs. 80-82.

*Material examined* : 10 exs., Coll. E.V. Muley (1.4.88) : S.Z. Siddiqi (22.11.90) : A.K. Pandey (4.4.90) & Ramkrishna (25.8.89).

*Distribution* : India : Bihar, Madhya Pradesh, Maharashtra, Orissa, Uttar Pradesh, West Bengal.

Family BITHYNIIDAE

**Key to the genera**

Shell more elongate, outer lip a little thickened,

umbilicus usually with an oblique channel .....*Digoniostoma*

Shell subglobose, outer lip thin, umbilicus without a channel.....*Gabbia*

Genus *Digoniostoma* Annandale, 1920

***Digoniostoma pulchella* (Benson)**

1836. *Paludina pulchella* Benson, *J. Asiat. Soc. Beng.*, 5 : 746.

1989. *Digoniostoma pulchella* : Subba Rao, *Handbook : Freshwater Molluscs of India* : 80, figs. 113, 114, 119, 120.

*Material examined* : 1 ex., Coll. U.P. Sharma (1991-92).

*Distribution* : India : Common throughout.

*Elsewhere* : Malay Archipelago, Myanmar.

*Remarks* : Shell elongate, subumbilicate, spire conical, whorls rounded, sutures impressed, aperture oval.

Genus *Gabbia* Tryon, 1865

***Gabbia orcula* (Frauenfeld)**

1862. *Bithynia orcula* Frauenfeld, *Verhandl. Zool. Bot. Geschaft* : 1154.

1989. *Gabbia orcula* : Subba Rao, *Handbook : Freshwater Molluscs of India* : 76.

*Material examined* : 3 exs., Coll. U.P. Sharma (1991-92).

*Distribution* : India : Assam, Bihar, Maharashtra, Punjab, Rajasthan, Uttar Pradesh.

*Remarks* : Shell small, subglobose, imperforate, smooth, whorls rounded, body whorl inflated, sutures deep, columellar margin slightly reflected.

Family THIARIDAE

Genus *Thiara* Roeding, 1786

**Key to the subgenera**

Height of body whorl exceeding height of spire,

number of whorls upto 9.....*Tarebia*

Height of body whorl less than height of spire,  
number of whorls above 9 .....*Melanoides*

Subgenus *Melanoides* Olivier, 1807

*Thiara (Melanoides) tuberculata* (Mueller)

1744. *Nerita tuberculata* Mueller, *Hist. Verm. Terr. Fluv.*, 2 : 191.

1989. *Thiara (Melanoides) tuberculata* : Subba Rao, *Handbook : Freshwater Molluscs of India* : 103, figs. 183, 184.

*Material examined* : 2 exs., Coll. E.V. Muley (2.6.89).

*Distribution* : India : Common throughout except Kashmir.

*Elsewhere* : North and South Africa, Eastern Mediterranean countries, S.E. Asia, S. China, Malaysia, Malay Archipelago, North Australia, various Pacific Islands, Ryukyu Islands in Japan, New Hebrides.

*Remarks* : Shell variable, narrowly elongate with 10-12 rounded whorls, vertically ribbed and spirally striate, reddish brown dots and flames present on shell surface.

A highly adaptable species, occupies as varied habitat as low saline waters at sea level and freshwater at 1600 m. altitude (Bentham-Jutting, 1956).

Subgenus *Tarebia* H. & A. Adams, 1854.

*Thiara (Tarebia) lineata* (Gray)

1828. *Helix lineata* Gray, in *Wood's Index Text. suppl.*: 24, fig. 68.

1989. *Thiara (Tarebia) Lineata* : Subba Rao, *Handbook : Freshwater Molluscs of India* : 101, fig. 191.

*Material examined* : 2 exs., Coll. E. V. Muley (2.6.89).

*Distribution* : India : Bihar, Assam, Madhya Pradesh, Maharashtra, Orissa, Uttar Pradesh, West Bengal.

*Elsewhere* : Bhutan, Myanmar, Sri Lanka.

*Remarks* : Shell distinctly broad and shorter than in the preceding species, sculptured with weak granules and dark spiral lines.

Order BASOMMATOPHORA

Family LYMNAEIDAE

Genus *Lymnaea* Lamarck, 1799

Subgenus *Pseudosuccinea* Baker

*Lymnaea (Pseudosuccinea) acuminata f. typica*  
Lamarck

1822. *Limnaea acuminata* Lamarck, *Hist. nat. Anim. Vert.*, 6(2) : 160.

1989. *Lymnaea (Pseudosuccinea) acuminata f. typica*: Subba Rao, *Handbook : Freshwater Molluscs of India* : 126, figs. 258, 259.

*Material examined* : 10 exs., Coll. E.V. Muley (2.6.89); A. K. Pandey (10.4.91).

*Distribution* : India : Common throughout.

*Elsewhere* : Bangladesh, Pakistan, Myanmar.

*Remarks* : Shell ovate, spire short and broad with an acuminate apex, bodywhorly large, a little angular above.

*Lymnaea (Pseudosuccinea) acuminata f. gracilior*  
Martens

1822. *Limnaea acuminata* var. *gracilior* Martens, *Conch. Mittheil.*, 1 : 77.

1989. *Lymnaea (Pseudosuccinea) acuminata f. gracilior* : Subba Rao, *Handbook : Freshwater Molluscs of India* : 127, figs. 267, 163.

*Material examined* : 2 exs., Coll. Ramakrishna (25.5.89).

*Distribution* : India : Common throughout.

*Elsewhere* : Myanmar.

*Remarks* : Distinguished from other forms by its long, narrow shell, colour varies between greyish to light pink.

***Lymnaea (Pseudosuccinea) acuminata f. rufescens* Gray**

1881. *Limnaea rufescens* Gray, in *Sowerby's Genera of shells*, 1, pl. 178, fig. 2.

1989. *Lymnaea (Pseudosuccinea) acuminata f. rufescens* : Subba Rao, *Handbook : Freshwater Molluscs of India* : 127, figs. 254, 255.

*Material examined* : 14 exs., Coll. E.V. Muley (1.4.88); S.Z. Siddiqui (28.1.90); A. K. Pandey (4.4.90).

*Distribution* : India : Common throughout.

*Elsewhere* : Bangladesh, Pakistan, Myanmar.

*Remarks* : Shell narrower than in *f. typica* with a longer spire, aperture uniformly less expanded.

Family PLANORBIDAE

Key to the genera

Shell larger (above 10 mm. in diameter), rounded at periphery.....*Indoplanorbis*

Shell smaller (less than 10 mm. in diameter), angulate or carinate at periphery.....*Gyraulus*

*Genus Gyraulus* Charpentier, 1837

Key to the species

Shell strongly carinate at the periphery, body whorl slightly descending in front .....  
.....*G. euphraticus*

Shell subangulate at the periphery, body whorl not descending in front .....*G. convexiusculus*

***Gyraulus convexiusculus* (Hutton)**

1849. *Planorbis convexiusculus* Hutton, *J. Asiat Soc. Beng.*, 18(2) : 657.

1989. *Gyraulus convexiusculus* : Subba Rao, *Handbook : Freshwater Molluscs of India* : 154, figs. 362, 364.

*Material examined* : 1 ex., Coll. U.P. Sharma (1991-92).

*Distribution* : India : Common throughout.

*Elsewhere* : Iran to Philippines, Japan.

*Remarks* : Shell depressed, whorls 4-5, rapidly increasing in width, body whorl subangulate at the periphery, aperture ovate-lunate.

***Gyraulus euphraticus* (Mousson)**

1874. *Planorbis euphraticus* Mousson, *Conch., Paris.*, 22 : 44.

1989. *Gyraulus euphraticus* : Subba Rao, *Handbook : Freshwater Molluscs of India* : 154, figs. 365, 367.

*Material examined* : 4 exs., Coll. A.K. Pandey (12.4.91).

*Distribution* : India : Bihar, Punjab, West Bengal.

*Elsewhere* : Afghanistan.

*Remarks* : Shell similar to that in preceding species, differs in being strongly carinate at the periphery and the body whorl deviating from the spiral of the upper whorls.

Genus *Indoplanorbis* Annandale & Prashad, 1921

***Indoplanorbis exustus* (Deshayes)**

1834. *Planorbis exustus* Deshayes, in *Belanger, Voy. Indes Orientales* : 417, pl. 1, figs. 11-13.

1989. *Indoplanorbis exustus* : Subba Rao, *Handbook : Freshwater Molluscs of India* : 142, figs. 326, 327.

*Material examined* : 15 exs., Coll. E.V. Muley (2.6.89); S.Z. Siddiqui (28.1.90); Ramakrishna (25.8.89). (12.4.91).

*Distribution* : India : Common throughout.

*Elsewhere* : Bangladesh, China, Indonesia,

Malaysia, Myanmar, Pakistan, Persia, Thailand, Vietnam.

*Remarks* : Shell depressedly coiled, large, thick, whorls convex, apex of spire below the plane, aperture ear-shaped.

Class BIVALVIA  
Order UNIONOIDA  
Family UNIONIDAE

Genus *Lamellidens* Simpson, 1900

#### Key to the species

Shell broad, dorsal margin a little curved, blackish brown with a lighter border along the ventral margin.....*L. marginalis*

Shell narrow, dorsal margin rather uniformly straight, coloured with dark brown.....  
.....*L. corrianus*

#### *Lamellidens corrianus* (Lea)

1834. *Unio corrianus* Lea, *Trans. Amer. Philos. Soc.*, 6(2) : 65, pl. 9, fig. 25.

1989. *Lamellidens corrianus* : Subba Rao, *Handbook: Freshwater Molluscs of India* : 165, figs. 386, 387.

*Material examined* : 3 exs., Coll. Ramakrishna (12.2.91)

*Distribution* : India : Common throughout.

*Elsewhere* : Bangladesh, Myanmar.

*Remarks* : Shell narrow, elliptical, inflated at the umbonal region, dark brown throughout, narrowly rounded at the posterior end, two cardinals in each valve.

#### *Lamellidens marginalis* (Lamarck)

1822. *Unio marginalis* Lamarck, *Hist. nat. Anim, Sans. Vert.*, 4 : 79.

1989. *Lamellidens marginalis* : Subba Rao, *Handbook: Freshwater Molluscs of India* : 168, figs. 404, 405.

*Material examined* : 3 exs., Coll. A.K. Pandey (12.4.91).

*Distribution* : India : Common throughout.

*Elsewhere* : Bangladesh, Myanmar, Sri Lanka.

*Remarks* : Shell broad, oblong-ovate, blackish-brown with a light brown border along the ventral margin; posterior end broadly rounded, cardinal teeth two in right valve, one in left.

### SUMMARY

Molluscs of Kabar lake comprise a total of 13 species under 9 general and 7 families. As the lake is rich in aquatic vegetation all the families of common freshwater gastropods which usually occur among weeds in the stagnant waters are represented.

Bivalves are represented by mere two species of a single genus *Lamellidens*. This however, may not be a true reflection of occurrence of bivalves in the lake.

All the species reported here have all India range in their distribution and no endemism is seen. Two infra-specific forms of *Bellamya bengalensis* viz. f. *annandalei* and *doliaris* are recorded for the first time from Bihar.

Four species viz., *Pila globosa*, *Bellamya bengalensis*, *Lamellidens marginalis* and *L. corrianus* have considerable economic importance since these shell fishes are widely consumed as favoured food by the common people in Bihar (Subba Rao and Dey, 1989). Snails of these species are regularly sold in the market in the districts of Singhbhum, Ranchi, Palamau and Hazaribag. In addition, *Lamellidens marginalis* is the only freshwater bivalve known to produce pearls.

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## INSECTA : ODONATA

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### INTRODUCTION

Seasonal changes in the water level that are characteristic feature of wetlands are influenced by rainfall and run-off from the catchment area. Such seasonal changes fluctuate the physico-chemical conditions of the lake, affecting the distribution, abundance and duration of the emergence of several taxonomic members.

Members of Odonata constitute an integral part of the aquatic ecosystem in their larval stages and their distribution is largely governed by the larval adaptation to the physico-chemical characters of the water body and ability to withstand adverse breeding condition is a measure of their distributional potentiality of the species (Werger, 1978). Faunistic study of dragon flies based on the larval conditions pose several taxonomic problems (Arthington and Watson, 1982). According to them, occurrence of sexually mature odonata found at the freshwater site is a strong evidence that they breed in the lake. Accordingly, adult odonate members were collected from the area and the taxonomic description of the six species of odonata collected from the Kabar lake wetland ecosystem is given below :

### SYSTEMATIC ACCOUNT

Order	ODONATA
Suborder	ZYGOPTERA
Super family	COENAGROIDEA
Family	PLATYCNEMIDIDAE

Subfamily ISCHNURINAE

Genus *Ischnura* Charpentier

#### 1. *Ischnura senegalensis* (Rambur)

1842. *Agrion senegalensis* Rambur, *Ins. Neuropt.*, : 276.  
1933. *Ischnura senegalensis*, Fraser, *Fauna Brit. India*, 1 : 348-351.  
1988. *Ischnura senegalensis*, Prasad & Varshney, *Rec. zool. Surv. India : Occ. Paper No. 110* : 8.

*Distribution* : Throughout India, France, Africa, Myanmar, Sri Lanka, Phillipines, Indonesia, Japan.

*Remarks* : Most common Indian damselfly of the genus, distributed throughout the permanent waterbodies.

Suborder ANISOPTERA

Super family AESHNOIDEA

Family GOMPHIDAE

Subfamily LIDENIINAE

Genus *Ictinogomphus* Rambur

#### 2. *Ictinogomphus rapax* (Rambur)

1842. *Diastatomma rapax* Rambur, *Ins. Neuropt.*, : 169.  
1934. *Ictunus rapax* Fraser, *Fauna Brit. India*, 2 : 373-376.  
1934. *Ictinogomphus rapax*, Kumar & Jumeja, *Newsl. Zool. Surv. India*, 2(2) : 95.  
1988. *Ictinogomphus rapax*, Prasad & Varshney, *Rec. zool. Surv. India., Occ. Paper No. 110* : 14.

*Distribution* : Throughout India, Nepal, Sri Lanka, Malaysia.

*Remarks* : Common throughout the wetland area especially among the macrophytic vegetation.

Subfamily SYMPETRINAE

Genus *Diplacodes* Kirby

3. *Diplacodes trivialis* (Rambur)

1842. *Libellula trivialis* Rambur, *Ins. Neuropt.*, : 115.

1933. *Diplacodes trivialis*, Fraser, *Fauna Brit. India*, 3 : 336–338.

1988. *Diplacodes trivialis*, Prasad & Varshney, *Rec. zool. Surv. India : Occ. Paper No. 110* : 21.

*Distribution* : Throughout India in wet and semi wet areas, Nepal, Myanmar, Sri Lanka, Thailand, Malaysia and Indonesia.

*Remarks* : One of the commonest species found throughout the year near water bodies. Occasionally seen on grassy vegetation. Specimens in Bihar are very common during monsoon and post monsoon.

Genus *Crocothemis* Brauer

4. *Crocothemis servilia servilia* (Drury)

1770. *Libellula servilia* Drury, *III Ex. Ins.*, 1 : 6.

1936. *Crocothemis servilia servilia*, Fraser, *Fauna Brit. India*, 3 : 345–347.

1988. *Crocothemis servilia servilia*, Prasad & Varshney, *Rec. zool. Surv. India : Occ. Paper No. 110* : 22.

*Distribution* : Throughout India, Iraq, Nepal, Myanmar, Sri Lanka, Phillipines, Indonesia, Australia, Japan.

*Remarks* : Common species occurring in vegetation around larval habitats. Adults are seen throughout the year.

Subfamily TRAMEINAE

Genus *Rhyothemis* Hagen

5. *Rhyothemis variegata variegata* (Linnaeus)

1768. *Libellula variegata* Linnaeus, *Amoenitates Acad.*, 6 : 412.

1936. *Rhyothemis variegata*, Fraser, *Fauna Brit. India*, 3 : 423–424.

1988. *Rhyothemis variegata variegata*, Prasad & Varshney, *Rec. zool. Surv. India : Occ. Paper No. 110* : 28.

*Distribution* : Throughout India, Nepal, Myanmar, Sri Lanka, Malaysia.

*Remarks* : Common among water bodies with marginal vegetation.

Genus *Pantala* Hagen

6. *Pantala flavescens* (Fabricius)

1898. *Libellula flavescens* Fabricius, *Ent. Syst. Suppl.*, : 285.

1936. *Pantala flavescens*, Fraser, *Fauna Brit. India*, 3 : 414–416.

1988. *Pantala flavescens*, Prasad & Varshney, *Rec. zool. Surv. India : Occ. Paper No. 110* : 28.

*Distribution* : Circumtropical and subtropical in distribution : Throughout India, Morocco, Nepal, Myanmar, Sri Lanka, Thailand, Indonesia, and China.

*Remarks* : Common species throughout India near temporary and permanent bodies.

SUMMARY

Diversity of adult odonata and abundance of odonate larvae indicate the status of the water body. In the present wetland, distribution of nearly 6 species indicate the health of the water body, as larvae are sensitive to the fluctuations of physico-chemical parameters and thus also act as biological indicators of pollution. Studies on natural population often implicate food quantity and or quality as an important factor affecting the life history dynamics. Larval abundance in Kabar lake

wetland was mainly due to the extensive growth of macrophytic vegetation (112 species of vascular plants in the lake ecosystem). Macrophytic association with macrobenthic forms, microcrustaceans, molluscs, insects and insect larvae (belonging to hemiptera, coleoptera) offers a good niche for many fishes and their youngones which form the food of this group.

Based on the Hilsenhoff's tolerance score (Lehmukhl, 1979) the biotic index of odonata fall between 0 and 3. Members with zero tolerance score (Agrionidae - 0; Gomphidae - 0.5) are highly sensitive and taxa with score 3 are moderate (Lestidae - 3; Coenogronidae - 3). Hence, natural

and undisturbed aquatic ecosystem will have greater diversity of the species and such water bodies include many sensitive species with very little tolerance for disturbance.

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## INSECTA : COLEOPTERA

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### INTRODUCTION

In connection with the study of freshwater animals of India, aquatic coleoptera were collected from Kabar Lake, Bihar. The material consists of 137 examples containing 17 species under 10 genera belonging to 3 families, namely Gyrinidae, Dytiscidae and Hydrophilidae. The distinctive characteristics of each family with habit and habitat, number of species occurring in the world fauna and those found in India and their role in aquatic system have been given very briefly below :

#### GYRINIDAE

The members of the family Gyrinidae are commonly known as 'Whirligig beetles' because of their habit of swimming in groups on the surface of ponds and quiet streams. These beetle can easily be distinguished by their eyes being divided horizontally into two parts, flattened legs and specialised antennal shape. They are usually found in freshwater ponds, lake margins, open flowing streams, quiet stream margins bog, pools, swamps and road side ditches. They are predominantly scavengers, feeding upon live or dead insects trapped or floating on the water surface. The larvae are predacious, feeding on other aquatic insect, larvae and nymph.

700 species under 11 genera are known from all over the world (Lawrence 1982). Vazirani (1984) recorded 63 species under 5 genera from India. As regards fauna of Kabar Lake no mention of any species is available in literature. In the present collection only one species is available.

### DYTISCIDAE

The members of the family are commonly known as 'Predeceous diving beetles' and most perfectly adapted to the aquatic life. They together with members of Gyrinidae and part of the family Hydrophilidae form one of the main constituents of insect fauna of aquatic biota. They are very active swimmers, preying on other small water life. The larvae, popularly known as 'water tigers' of larger species may at times destroy the fry or fingerlings of commercial fishes. The group have a characteristics appearance with convex form, stream lined body and paddle like hind legs.

3,000 species under 120 genera are known from the world. Vazirani (1977) recorded 371 species under 41 genera from India and her neighbouring countries. A few more Taxa have been added to the Indian fauna in recent years. Most interesting of these is the discovery of new terrestrial genus, *Geodessus* from Meghalaya (Brancucci 1979). This is the first genus of the family found to be terrestrial inhabitat.

#### HYDROPHILIDAE

Members of the family Hydrophilidae are commonly known as 'Water scavenger beetles' Majority of this group of insects are truely aquatic in habitat and form an important constituent of freshwater ecosystem. Some however, are terrestrial or found in moist places such as dung, decaying vegetable heaps, under crevices in oozing tree trunk, rotten banana stem and such other places. These insects can be easily distinguished

by their shape of antenna and size of maxillary palpi which are conspicuously large and longer than antennae. Systematic position of the subfamilies of the family Hydrophilidae is interesting and controversial. Authorities vary greatly in their opinion in limit and number of subfamilies and families. No comprehensive work on any family belonging to the superfamily Hydrophilidae has been done in India. Information on Hydrophilidae are all scattered in different journals.

2400 species under 140 genera are known from the world. (Family Hydraenidae treated here as subfamily). From the survey of literature and the study of species present in national collection 292 species under 47 genera have been recorded from India.

Distributional data of the species have been given from the published records and actual study of the material. Only reference to the up-to-date valid names of the species and genera has been given. Keys to the families, genera and species wherever, necessary have been added. Information on number of species of each family in India against the world faunal number has been provided. In each family food, feeding habits and general behaviour have been indicated.

Materials of this study are deposited in Freshwater Biological Station, Hyderabad, Andhra Pradesh.

#### CLASSIFIED LIST OF AQUATIC COLEOPTERA OF KABAR LAKE, BIHAR

##### Family 1 DYTISCIDAE

##### Subfamily 1. NOTERINAE

##### Genus 1. *Canthydrus* Sharp

1. *Canthydrus laetabilis* (Walker)

##### Subfamily 2. LACCOPHILINAE

##### Genus. 2. *Laccophilus* Leach

2. *Laccophilus anticatus* Sharp
3. *Laccophilus rufulus* Regimbert
4. *Laccophilus sharpi* Regimbert

##### Subfamily 3. HYDROPORINAE

##### Genus 3. *Hyphoporus* Sharp

5. *Hyphoporus* sp.

##### Subfamily 4. DYTISCINAE

##### Genus 4. *Hydaticus* Leach

6. *Hydaticus* sp.

##### Genus 5. *Cybister* Curtis

7. *Cybister limbatus* Fabricius
8. *Cybister posticus* Aube
9. *Cybister sugillatus* Erichson
10. *Cybister tripunctatus esiaticus* Sharp.

##### Family II. GYRINIDAE

##### Subfamily 5. ENHYDRINAE

##### Genus 6. *Dineutus* Macleay

11. *Dineutus unidentatus* (Aube)

##### Family III. HYDROPHILINAE

##### Genus 7. *Sternolophus* Solier

12. *Sternolophus rufipes* (Fabricius)

##### Genus 8. *Hydrophilus* Muller

13. *Hydrophilus rufocinctus* Bedel
14. *Hydrophilus* sp.

##### Genus 9. *Berosus* Leach

15. *Berosus pulchelus* Mcleay
16. *Berosus indicus* Motschulsky

##### Genus 10. *Regimbertia* Zaitsev

17. *Regimbertia attenuata* (F.)

#### SYSTEMATIC ACCOUNT

##### Key to the families of aquatic Coleoptera recorded from Kabar Lake

- 1(4) Hind coxae immovably fixed to the

- metasternum, 1st visible abdominal sternite is completely divided and more or less fused with 2nd and 3rd. Maxillary palpi not longer than antennae.
- 2(3) Eyes not completely divided; antennae filiform. Mid and hind legs not very short and broad.....  
.....DYTISCIDAE.
- 3(2) Eyes completely divided into dorsal and ventral parts; antennae short and thick; mid and hind legs forming short broad paddles.....GYRINIDAE.
- 4(1) Hind coxae not immovably fixed to the metasternum and not completely dividing the 1st visible abdominal sternite antennae different in form, maxillary palpi conspicuously large and longer than antennae.....HYDROPHILIDAE.

**Key to the genera of family DYTISCIDAE**

- 1(6) Scutellum not visible.
- 2(5) Fourth segment of pro and mesotarsi not reduced, sub equal to the 3rd segment; prosternal process straight, sometimes little depressed.
- 3(4) Posterior legs with two tarsal claws of equal length; sides of the pronotum rebordered .....*Cenhydrua*.
- 4(3) Posterior legs with a single tarsal claw; sides of the pronotum not rebordered .....*Laccophilus*.
- 5(2) Fourth segment of the pro and mesotarsi much reduced; hardly visible; prosternal process arehed and oblique .....*Hyphoporus*.
- 6(1) Scutellum visible.
- 7(8) Hind margins of the four basal matatargal segments on both the anterior and posterior faces fringed with golden yellow cilia,

overlapping the next base of the next segment.....*Hydaticus*.

- 8(7) Hind margins of the four basal matatarsal segments not fringed with any cilia.....*Cybister*.

**Genus 1. *Canthydrus* Sharp, 1882**

1977. *Canthydrus*, Vazirani, *Cat. Orient. Dyticidae* : 5

Only a single *Canthydrus laetabilis* was collected from Kabar Lake.

**1. *Canthydrus laetabilis* (Walker) 1858**

1977. *Canthydrus laetabilis*, Vazirani, *Cat. Orient. Dytiscidae*, p. 6.

*Material examined* : 26 exs., Kabar Lake, Bihar.

*Distribution* : The species is widely distributed in India and is known from West Bengal; Assam; Bihar; Orissa; Andhra Pradesh; Maharashtra; Gujarat; Kerala; Rajasthan and Uttar Pradesh. Also known from Burma, Bangladesh, Sri Lanka, Pakistan and Nepal.

**Genus 2. *Laccophilus* Leach, 1817**

1977. *Laccophilus*, Vazirani, *Cat. Orient. Dyticidae*, p. 9.

**Key to the species of the genus *Laccophilus* recorded from Kabar Lake**

- 1(4) Elytra unicolonous, without any distinct markings.....*L. rufulus*.
- 2(1) Elytra with distinct black or brown patterns.
- 3(4) Elytra brownish black with markings consisting of yellow fascia.....  
.....*L. antecatus*.
- 4(3) Elytra testaceous ruddish with zig zag undulating linco.

## 2. *Laccophilus antecatus* Sharp, 1890

1977. *Laccophilus antecatus*, Vazirani, *Cat. Orient. Dytiscidae*, p. 9.

*Material examined* : 2 exs.

*Distribution* : The species seems to be endemic to India and has been recorded from West Bengal; Assam; Bihar; Orissa and Manipur.

## 3. *Laccophilus rufulus* Regimbert, 1888

1977. *Laccophilus rufulus*, Vazirani, *Cat. Orient. Dytiscidae*, pp. 14-15.

*Material examined* : 14 exs.

*Distribution* : The species is known only from India and has been recorded from Assam; Manipur; Orissa and Madhya Pradesh.

## 4. *Laccophilus sharpi* Regimbert, 1889

1977. *Laccophilus sharpi*, Vazirani, *Cat. Orient. Dytiscidae*.

*Material examined* : 17 exs.

*Distribution* : The species is widely distributed and has been recorded from West Bengal; Bihar; Orissa; Madhya Pradesh; Maharashtra; Tamil Nadu; Gujarat; Rajasthan and Andaman Island. Also known from Myanmar, Sri Lanka, Nepal, Pakistan, Iraq, Japan and Formosa.

## Genus 3. *Hyphoporus* Sharp, 1882

1977. *Hyphoporus*, Vazirani, *Cat. Orient. Dytiscidae*, p. 44.

## 5. *Hyphoporus* sp.

*Material examined* : 1 ex.

*Remarks* : The species could not be identified upto specific level due to paucity of material.

## Genus 4. *Hydaticus* Leach, 1817.

1977. *Hyphoporus*, Vazirani, *Cat. Orient. Dytiscidae*, p. 75.

## 6. *Hydaticus* sp.

The Genus was represented in the collection by single damaged specimen the specific identity of species could not be confirmed.

## Genus 5. *Cybister* Curtis

1977. *Cybister*, Vazirani, *Cat. Orient. Dytiscidae*, 85.

## Key to the species of the genus *Cybister* recorded from Kabar Lake

- 1(4) Female with a rudimentary second claw on hind tarsi.
- 2(3) Pronotum without lateral reddish margin.....*C. sugillatus*.
- 3(2) Pronotum with lateral reddish margin .....*C. posticus*.
- 4(1) Female without a rudimentary second claw on hind tarsi.
- 5(6) Elytra with yellow lateral strips extending to and including the epipleurae, species without any sexual sculpture in the female in the form of longitudinal or zig zag striations.....*C. tripunctatus asiaticus*.
- 6(5) Elytra with yellow lateral strips submarginal, not extending to the epipleurae at the base. Female with the sexual sculpture of deep irregular short striations, covering nearly five-sixth of elytral length .....*C. limbatus*.

## 7. *Cybister limbatus* (Fabricius) 1775

1977. *Cybister (Meganectes) limbatus*, Vazirani, *Cat. Orient. Dytiscidae*, p. 91.

*Material examined* : 2 exs.

*Distribution* : The species is widely distributed and has been recorded from West Bengal; Arunachal Pradesh; Bihar; Orissa; Madhya Pradesh; Maharashtra; Goa and Kerala. Also

known from Japan, China, Vietnam, Formosa and Phillipines.

8. *Cybister posticus* Aube, 1838

1977. *Cybister (Meganectes) posticus*, Vazirani, *Cat. Orient. Dytiscidae*, p. 88.

*Material examined* : 1 ex.

*Distribution* : The species is restricted in distribution within India and Bangladesh and has been recorded from West Bengal; Assam; Maharashtra; and in the present work from Bihar. Also known from Bangladesh.

9. *Cybister sugillatus* Erichson, 1834

1977. *Cybister (Meganectes) sugillatus*, Vazirani, *Cat. Orient. Dytiscidae*, p. 89.

*Material examined* : 2 exs.

*Distribution* : The species is widely distributed and has been recorded in India from West Bengal; Manipur; Assam; Orissa; Tamilnadu; Madhya Pradesh; Maharashtra; and in the present work from Bihar. Also known from Japan, China, Phillipine and Indonesia.

10. *Cybister tripunctatus asiaticus* Sharp, 1882

1977. *Cybister tripunctatus asiaticus*, Vazirani, *Cat. Orient. Dytiscidae*, p. 92.

*Material examined* : 3 exs.

*Distribution* : The species is widely distributed and the subspecies *asiaticus* is found in India. The species is common but was recorded only from West Bengal and in this work from Bihar. Also known from Pakistan, Afganistan, Nepal, Sri Lanka and Bangladesh.

Family II. GYRINIDAE

The family is represented in the collection by a single species.

Genus 6. *Dineutus* Macleay, 1825

1825. *Dineutus* Macleay, *Annulosa Javanica*, ed 1 : 30.

11. *Dineutus unidentus* (Aube)

1984. *Dineutus (Spinodineutus) unidentus*, Vazirani, *Fauna of India*, pp. 20-22.

*Material examined* : 27 exs.

*Distribution* : The species is widely distributed and has been recorded from West Bengal; Bihar; Kerala; Madhya Pradesh; Meghalaya; Orissa; Rajasthan; and Tamilnadu. Also known from Myanmar, Sri Lanka, Indonesia, Malayasia and Thailand.

Family III. HYDROPHILIDAE

Key to the genera HYDROPHILIDAE recorded from Kabar Lake

- 1(4) Scutellum not longer or not much longer than its width at base.
- 2(3) All femora clothed at base with a silky procumbent and dense pubescence. Prostital carina with an anterior brush of long setate.....*Sternolophus*.
- 3(2) The anterior femora only are clothed with pubescence at base, wanting or very much reduced on middle and posterior femora. Prostital carina without anterior brush of long setate .....*Hydrophilus*.
- 4(1) Scutellum a long triangle.
- 5(6) Upper surface never of a uniform, deep and shining black. Body elongate but not laterally compressed .....*Berosus*.
- 6(5) Upper surface always of a uniform deep and shining or metallic black. Body convex, elongate and laterally compressed.....*Regimbertia*.

Genus 7. *Sternolophus* Solier, 1834

1834. *Sternolophus* Solier, *Ann. Soc. ent. Fr.*, 3 : 302.

12. *Sternolophus rufipes* (Fabricius) 1792

1840. *Sternolophus rufipes*, Laporte, Castelanau, *Hist. Nat. Ins.* 2 : 54.

*Material examined* : 3 exs.

*Distribution* : The species is widely distributed and one of the commonest species of Hydrophilidae around Calcutta but it has been recorded from West Bengal; Kashmir; Andaman and Nicobar Island. Also known from tropical Asia, East Asia and Sunda Island.

Genus 8. *Hydrophilus* Muller, 1764

1980. *Hydrophilus*, Smetna. *Mem. ent. Soc. Canada.* 111 : 10-11.

13. *Hydrophilus rufocinetus* (Bedel), 1892

1893. *Hydrophilus rufocinetus*, Kuwert, *Deut. Ent. Zeitx.*, p. 90.

*Material examined* : 1 ex.

*Distribution* : The species is endemic to India and has been definitely recorded from West Bengal and from North India without any specific locality. The species is now recorded from Bihar.

14. *Hydrophilus* sp.

*Material examined* : 3 exs.

*Remarks* : Specific identity of the species could not be established as all the three specimens, being female.

Genus 9. *Berosus* Leach, 1817

1817. *Berosus* Leach, *Zool. Misc.*, 3 : 92.

Key to the species of *Berosus* recorded from Kabar Lake

- 1(2) Elytral apex with spine pronotum without black patch.....*indicus* Mots.  
2(1) Elytral without apical spine. Pronotum with black patch.....*pulchellus*.

15. *Berosus indicus* Motschulsky, 1861

1861. *Berosus indicus* Motschulsky, *Bull. Soc. Imp. Nat. Moscou*, 34 : 110.

*Material examined* : 8 exs.

*Distribution* : The species has been recorded from West Bengal and now reported from Bihar. Also known from Sri Lanka, South Asia, Sunda Island.

16. *Berosus pulchelus* M'Leay, 1825

1825. *Berosus pulchelus* M'Leay, *Annul. Jav.*, : 35.

*Material examined* : 5 exs.

*Distribution* : The species was recorded from West Bengal and now recorded from Bihar. Also known from Myanmar, Sri Lanka, Tonkin, Indo-China, Annam, Australia, Formosa, Phillipines and Indonesia.

Genus 10. *Regimbertia* Zaitsev, 1908

1908. *Regimbertia* Zaitsev, *Hor. Soc. ent. Ross.*, 38 : 362.

17. *Regimbertia attenuata* (Fabricius)

1828. *Regimbertia attenuata*, d'Orchymont. *Cat. India Ins. Part.* 14 : 138.

*Material examined* : 17 exs.

*Distribution* : The species was known from West Bengal and now recorded from Bihar. Also known from Sri Lanka, Indo-China, Annam, Cambodia, Sumatra, Phillipines, Formosa, Japan and Australia.

## SUMMARY

Seventeen species belonging to ten genera and three families of aquatic coleoptera have been dealt with in this paper. Keys to the families, genera and species have been given. Distributional data of the species within India and outside of the country have also been provided. References only to up-to-date valid names under each genus and species have been added.

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## INSECTA : HEMIPTERA : WATER-BUGS

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### INTRODUCTION

The Kabar Lake, in the District of Begusarai, Bihar, remained so long unexplored. The Freshwater Biological Station of Zoological Survey of India at Hyderabad, has carried out explorative surveys for consecutive three years from 1989 to 1991 with an object to evaluate and assess the constituent fauna of the lake. In bringing out a consolidated report on this research, the collected samples from the lake were subjected to meticulous examinations by the departmental specialists on different taxonomic disciplines.

The present article concerns with the result of our study on the water-bugs collected from the lake, which comprise 14 species under 12 genera belonging to nine families. From the point of rarity and limited distribution, the occurrence of one species, namely *Merragata pallescens* Distant (1909) of the family Hebridae, is very significant. The background history of the species reveals that so far only three specimens were collected and that too pretty long back : two specimens, in the repository of the National Zoological Collection, Calcutta, were collected from Rajsahi and Pubna (now in Bangladesh) in the year 1907 and 1916 respectively and the other specimen, according to Lundblad (1934) in the repository of British Museum, were collected by Distant himself on 8.iv.1910. from a tank in the compound of Indian Museum, Calcutta. Thus, after a long dismaying silence for more than 90 years, we rediscover the species from the Kabar Lake by obtaining three specimens and hence register

the locality as a new habitat of this interesting rare species.

The diagnostic characters and recorded distribution of the species studied have been given in the text. The keys of different taxa of the concerned groups have suitably been included in the present paper. The identified studied specimens have been sent back to the Freshwater Biological Station, Hyderabad, leaving a few specimens for the National Zoological Collection, Calcutta.

### MATERIALS AND METHODS

The water-bugs are mainly of two major categories according to the nature of habitat, aquatic and semiaquatic. The aquatic bugs live beneath the water and the Kabar Lake samples comprise four families, namely Corixidae, Nepidae, Pleidae and Belostomatidae. The semiaquatic bugs dwell on the surface of water and the studied samples are of five families, namely Gerridae, Veliidae, Hydrometridae, Mesoveliidae and Hebridae. The water-nets, made up of close meshed Nylon threads, have been used to collect the water-bugs from the Kabar lake. The collected materials, in the field, were preserved in 70% Ethyl alcohol. In the Laboratory, the specimens have been studied under Stereoscopic Binocular Microscope. The studied materials have been kept as wet-collections by preserving them in the freshly changed 70% Ethyl alcohol. Each species is labelled properly by depicting its systematic positions and collection data.

## SYSTEMATIC ACCOUNT

List of water-bugs found in the Kabar Lake,  
Bihar.

Series—HYDROCORISAE

## Family I. CORIXIDAE

1. *Micronecta* sp.

## Family II. NEPIDAE

2. *Ranatra filiformis* Fabricius

3. *Ranatra varipes* Stal

4. *Laccotrephes elongatus* Montandon

5. *Laccotrephes griseus* (Guerin)

## Family III. PLEIDAE

6. *Plea* sp.

## Family IV. BELOSTOMATIDAE

7. *Diplonychus annulatum* (Fabricius)

8. *Lethocerus indicus* (Lepeletier & Serville)

Series—AMPHIBICORISAE

## Family V. GERRIDAE

9. *Gerris spinolae* Lethierry & Severin

10. *Gerris adelaidis* Dohrn

11. *Limnogonus parvulus* (Stal)

12. *Limnogonus nitidus* (Mayr)

## Family VI. VELIIDAE

13. *Microvelia douglasi* Scott

## Family VII. HYDROMETRIDAE

14. *Hydrometra greeni* Kirkaldy

## Family VIII. MESOVELIDAE

15. *Mesovelia vittigera* Horvath

## Family IX. HEBRIDAE

16. *Merragata pallescens* Distant

Key to the families of water-bugs found in  
the Kabar Lake

1. Antennae shorter than head, usually hidden in cavities beneath eyes and not visible from above.....Series HYDROCORISAE .....2.
- Antennae longer than head, inserted in front of eyes and clearly visible from above.....Series AMPHIBICORISAE.....5.
2. Rostrum very short and broad with no distinct segmentation, front tarsi spatulate and developed into comb-like palae; base of head overlapping the anterior margin of pronotum.....CORIXIDAE.
- Rostrum cylindrical or cone shaped with distinctly 3-4 segmented; front tarsi normal and not modified into pale; base of the head inserted into the pronotum.....3.
3. Abdomen with a pair of long slender posterior appendages; hind coxae short, free and rotatory.....NEPIDAE.
- Abdominal appendages may or may not present, if present otherwise, hind coxae broadly jointed to the thoracic pleura.....4.
4. Front legs not chelate; body strongly convex above; adults small, less than 3 mm in length; abdomen without any appendages .....PLEIDAE.
- Front legs chelate; body greatly flattened above; adults large, 13-82 mm, in length (Indian forms); abdomen with a pair of short, flat retractile posterior appendages .....BELOSTOMATIDAE.
5. Claws of at least front tarsi inserted before apex.....6.
- Claws all inserted at tips of tarsi .....7.
6. Rostrum 4-segmented; middle and hind legs

elongated; hind femora very long greatly exceeding the apex of abdomen; adult with median metasternal scent gland opening.....GERRIDAE.

— Rostrum 3-segmented; middle and hind legs not elongated; hind femora scarcely, if at all, surpassing the tip of abdomen; adult with lateral metathoracic scent gland openings.....VELIIDAE.

7. Head as long as entire thorax; body long and cylindrical.....HYDROMETRIDAE.

— Head shorter, not exceeding the combined length of pronotum and scutellum; body not cylindrical.....8.

8. Antennae 4-segmented; rostrum 3-segmented; under surface of head without any rostral groove; tarsi 3-segmented; winged forms with scutellum exposed and double, ocelli present; but wingless forms without scutellum and ocelli.....MESOVELIDAE.

— Antennae 4 or 5-segmented; rostrum 4-segmented; under surface of head deeply grooved to form a rostral groove (rostral sulcus); tarsi 2-segmented; scutellum exposed and double; ocelli well developed.....HEBRIDAE.

#### Series—HYDROCORISAE

##### Family I. CORIXIDAE

##### Genus *Micronecta* kirkaldy

##### 1. *Micronecta* sp.

*Material examined* : 3 exs., 6.iv.1990, A. K. Pandey and party, coll.; 4 exs., 5.iv.1991, A. K. Pandey and party, coll.

The family Corixidae is represented in the collection under study by seven examples which are referred to the genus *Micronecta*. When a large series of good condition material becomes

available it will be possible to ascertain the species of the genus.

#### Family II. NEPIDAE

##### Key to the genera of the family NEPIDAE of Kabar Lake

1. Body slender, subcylindrical; pronotum slender and much longer than broad; hind coxae very close; anterior femora a little incrassate but not grooved beneath; anterior femora provided with one or two pairs of sharp teeth; anterior coxae very long.....*Ranatra*.

—Body elongately suboval and flattened; pronotum about as long as or little shorter than broad; hind coxae widely separated; anterior femora incrassate and beneath longitudinally grooved to hold the tibiae; anterior femora provided with a round tubercle at the base on each; anterior coxae very short.....*Laccotrephes*.

##### Genus *Ranatra* Fabricius

##### Key to the species of the genus *Ranatra*

1. Adults with a body length of about 27-28 mm and abdominal appendages 3-4 mm. longer than body; metasternal process posteriorly triangular with a distinct mid-longitudinal ridge.....*filiformis*.
- Adults with a body length of about 19-20 mm and abdominal appendages 7-8 mm shorter than the body; metasternal process posteriorly blunt and a bit rounded with mid-longitudinal carination less distinct .....*varipes* Stal.

##### 2. *Ranatra filiformis* Fabricius

1790. *Ranatra filiformis*, Fabricius, *Skr. nat. Selsk. I*, 1 : 228.

1974. *Ranatra filiformis*, Fernando & Cheng, *Edn. Mus. J.*, 19 : 33.

1992. *Ranatra filiformis*, Bal & Basu, *Proc. zool. Soc. Calcutta*, **45** (Suppl. A) : 325.

*Material examined* : 3 exs., 6.vi.1989, E. V. Muley and party, coll.; 4 exs. 29. viii.1989, Ramakrishna and Party, coll.; 4 exs., 10.iv.1991, A. K. Pandey and party, coll.; 5 exs., 11.iv.1991, A. K. Pandey and party, coll.

*Diagnosis* : As in key.

*Distribution* : India : Assam; Bihar; Maharashtra; Orissa; U.P.; West Bengal.

*Elsewhere* : Malay Peninsula, Philippines, Sri Lanka, Thailand.

### 3. *Ranatra varipes* Stal

1861. *Ranatra varipes*, Stal, *Ofvers. K. vet.-Akad. Forh.* **18** : 203.

1974. *Ranatra varipes* : Fernando & Cheng, *Edn. Mus. J.*, **19** : 32.

*Material examined* : 1 ex., 6.vi. 1989, E.V. Muley and party, coll.; 1 ex., 29. viii.1989, Ramakrishna and party, coll.; 2 exs., 5.iv.1990, A.K. Pandey and party, coll.

*Diagnosis* : As in key.

*Distribution* : India : Bihar; Meghalaya; Orissa; Tamilnadu; U.P.; West Bengal.

*Elsewhere* : Myanmar, Malaya Peninsula, Nepal, Sri Lanka, Thailand.

### Genus *Laccotrephes* Stal

#### Key to the species of the genus *Laccotrephes*

1. Adults never attain a body length above 20 mm; abdomen above with a light bluish tinge; anterior area of prosternum provided with as strong acute spine like structure.....  
.....*griseus*.

—Adults above 20-26 mm in body length; abdomen above not light bluish in colour anterior area of prosternum provided

with a small less conical tubercle  
.....*elongatus*.

### 4. *Laccotrephes griseus* (Guerin)

1829. *Nepa griseus*, Guerinl, *Iconogr Regne Anim. Ins.*, : 352.

1947. *Laccotrephes griseus*, Hafiz & Pradhan, *Rec. Indian Mus.*, **45** : 364.

1992. *Laccotrephes griseus*, Bal & Basu, *Proc. zool. Soc. Calcutta*, **45** (Suppl. A) : 325.

*Material examined* : 7 exs., 2.vi.1989, E.V. Muley and party, coll.

*Diagnosis* : As in key.

*Distribution* : India : Bihar; Meghalaya; Pondicherry; Tamilnadu; West Bengal.

*Elsewhere* : Myanmar, Malacca, Seychelles, Sri Lanka, Thailand.

### 5. *Laccotrephes elongatus* Montandon

1907. *Laccotrephes elongatus*, Montandon, *Bull. Soc. Sci. Buc.*, **15** : 330.

1910. *Laccotrephes elongatus*, Distant, *Fauna Brit. India, Rhynchota*, **5** : 313.

*Material examined* : 1 ex., 28.viii.1989, Ramakrishna and party, coll.; 1 ex., 15.ii.1991, Ramakrishna and party, coll.

*Diagnosis* : As in key.

*Distribution* : India : Bihar; Maharashtra; West Bengal.

### Family III. PLEIDAE

#### Genus *Plea* Leach

### 6. *Plea* sp.

*Material examined* : 1 ex., 10.iv.1990, A. K. Pandey and party, coll.; 1 ex., 11.iv.1991, A. K. Pandey and party, coll.; 2 exs., 14.iv.1991, A. K. Pandey and party, coll.

The family Pleidae is represented in the collection under study by four examples which have been identified as the genus *Plea*. If a large series of good specimens are available, it will be possible to ascertain the species of the genus.

#### Family IV. BELOSTOMATIDAE

##### Key to the species of the family BELOSTOMATIDAE of Kabar Lake

1. Body moderate in size, generally attain a length from 12-27 mm, and more or less ovate or subovate; head in front of eyes subtriangularly produced; hemelytra with distinct membrane, often very small, contains areas moderately convexly ampliate; anterior tarsal claws two of equal length on each .....*Diplonychus*.
- Body large in size, length may vary from 40-110 mm and narrowly elliptical; head in front of eyes not conically produced; hemelytra with distinct membrane provided with prominent longitudinal veins and not outwardly ampliate; anterior tarsal claw one on each .....*Lethocerus*.

##### Genus *Diplonychus* Laporte

##### 7. *Diplonychus annulatum* (Fabricius)

1803. *Nepa annulate* Fabricius, *Syst. Rhyngo.* : 106.
1839. *Sphaerodema annulatum* : Hafiz & Ribeiro, *Rec. Indian Mus.*, **41** : 431.
1992. *Sphaerodema annulatum*, Bal & Basu, *Proc. zool. Soc. Calcutta*, **45** (Suppl. A) : 325.
1994. *Diplonychus annulatum* : Thirumalai, *Rec. zool. Surv. India, Occ. Paper*, **165** : 25.

*Material examined* : 1 ex., 6.vi.1989, E.V. Muley and party, coll.; 8 exs., 26.viii.1989, Ramakrishna and party, coll.; 2 exs., 10.iv.1990, A.K. Pandey and party, coll.; 3 exs. 9.iv.1990, A.K. Pandey and party, coll.; 1 ex.; 10.ii.1991,

Ramakrishna and party, coll.; 1 ex., 11.ii.1991, Ramakrishna and party, coll.; 1 ex., 19.ii.1991, Ramakrishna and party coll.; 1 ex., 8.iv.1991, A.K. Pandey and party, coll.

*Diagnosis* : Adults may attain a length of about 21-22 mm and breadth about 16-17 mm; body much broad and oval in shape; head as long as interocular space; hemelytra with small membrane and not provided with any shining spot beyond the middle of the inner margin; embolium convexly ampliate with its outer margin a little reflexed.

*Distribution* : India : Assam; Bihar; Orissa; Meghalaya; West Bengal.

*Elsewhere* : Bangladesh, Formosa, Pakistan.

##### Genus *Lethocerus* Mayr

##### 8. *Lethocerus indicus* (Lepeletier & Serville)

1825. *Belostoma Indica* Lepeletier & Serville, *Encycl. Meth.* : 272.
1974. *Lethocerus indicus* : Fernando & Cheng, *Edn. Mus. J.*; **19** : 41.
1993. *Lethocerus indicus* : Bal & Basu, *Proc. zool. Soc. Calcutta*, **45** (Suppl. A) : 326.

*Material examined* : 3 exs.; 30.i. 1990, S.Z. Siddiqi and party, col.

*Diagnosis* : This giant Indian water-bug may be 62-85 mm in body length; head between eyes with parallel sides; pronotum with a transverse faciae at the basal end, a fine mid-longitudinal carination; hemelytra with distinct membrane provided with prominent longitudinal veins; posterior legs provided with thick sets of swimming hairs on the ventral sides.

*Distribution* : India : Assam; Bihar; Kerala; Maharashtra; Mozoram; Orissa; U.P.; West Bengal.

*Elsewhere* : China, Java, Myanmar, Malaya Peninsula, Pakistan, Philippines, Sri Lanka, Sumatra.

## Family V. GERRIDAE

Key to the genera of the family GERRIDAE  
of Kabar Lake

1. Antennae small, subequal to or shorter than half of the body length, second and third antennal segments together subequal to or shorter than the first segment.....*Gerris*.
- Antennate only moderately prolonged, usually shorter than the body length; second and third antennal segments together longer than the first segment .....*Limnogonus*.

Genus *Gerris* FabriciusKey to the species of the genus *Gerris*

1. First antennal segment nearly as long as the remaining three segments together; a black distinct carina on the posterior lobe of pronotum; posterior femur distinctly longer than the body length .....*spinolae*.
- First antennal segment shorter than the remaining three segments together; a distinct brownish carina on the posterior lobe of pronotum; posterior femur nearly 1/6th length shorter than the body length.....*adelaidis*.

9. *Gerris spinolae* Lethierry & Severin

1896. *Gerris spinolae*, Lethierry and Severin, 'Cat. Gen. Hem., 3 : 62.
1918. *Gerris spinolae*, Paiva, *Rec. Indian Mus.*, 14 : 24.
1992. *Gerris spinolae*, Bal & Basu, *Proc. zool. Soc. Calcutta*, 45 (Suppl. A) : 326.

*Material examined* : 1 ex.; 5.iv.1990, A.K. Pandey and party, coll.; 7 exs. 11.ii.1991, Ramakrishna and party, coll.

*Diagnosis* : Adults may attain a body length of

about 11-12.5 mm; antennal third segment much shorter than the second segment and a little shorter than the fourth segment. Other diagnostic characters as in key.

*Distribution* : India : Bihar, U.P.; West Bengal.

*Elsewhere* : Myanmar.

10. *Gerris adelaidis* Dohrn

1896. *Gerris adelaidis*, Dohrn, *Stetin, ent. Ztg.*, 21 : 408.
1918. *Gerris adelaidis*, Cheng and Fernando, *Oriental Ins.*, 3(2) : 4.
1992. *Gerris adelaidis*, Bal & Basu, *Proc. zool. Soc. Calcutta*, 45 (Suppl. A) : 326.

*Material examined* : 1 ex.; 24.viii.1989, Ramakrishna and party, coll.; 1 ex., 6.iv.1990, A.K. Pandey and party, coll.; 3 exs.; 7.iv.1990, A.K. Pandey and party, coll.; 1 ex.; 9.iv.1990, A.K. Pandey and party, coll.; 2 exs., 15.ii.1991, Ramakrishna and party, coll.

*Diagnosis* : Adults may attain a body length of about 11.5 mm; head with a basal semilunar pale yellow spot. Other diagnostic characters as in key.

*Distribution* : India : Bihar; West Bengal.

*Elsewhere* : Borneo, Cambodia, China, Malay, Myanmar, Sri Lanka, Thailand.

Genus *Limnogonus* StalKey to the species of the Genus *Limnogonus*

1. Anterior lobe of pronotum provided with a single roundish yellow patch; posterior tip of pronotum more or less convexly rounded; fourth antennal segment nearly half in length than the first segment .....*parvulus*.
- Anterior lobe of pronotum provided with a pair of linear small yellowish patches; posterior tip of pronotum remarkably angular; fourth antennal segment slightly smaller than the first segment .....*nitidus*.

11. *Limnogonus parvulus* (Stal)

1896. *Gerris parvula*, Stal, *K. Svenska Eug. Zool.*, **4** : 265.
1918. *Limnogonus parvulus*, Cheng and Fernando, *Oriental Ins.*, **3(2)** : 102.
1992. *Limnogonus parvulus*, Bal & Basu, *Proc. zool. Soc. Calcutta*, **45** (Suppl. A) : 326.

*Material examined* : 4 exs.; 6.iv.1990, A.K. Pandey and party, coll.; 1 ex.; 7.iv.1990, A.K. Pandey and party, coll.; 1 ex.; 10.iv.1990, A.K. Pandey and party, coll.

*Diagnosis* : Body length of adult insects may be 6-6.5 mm; antennae with first segment longest and as long as or little longer than the second and third segments together. Other diagnostic characters as in key.

*Distribution* : India : Assam; Bihar; Meghalaya; Kerala; Orissa; U.P.; West Bengal.

*Elsewhere* : Bangladesh, China, Java, Malaya Peninsula, Myanmar, Pakistan, Singapore, Sri Lanka.

12. *Limnogonus nitidus* (Mayr)

1865. *Hydrometra nitida*, Mayr, *Verh.. zool., bot. Ges. Wien*, **15** : 443.
1979. *Limnogonus nitidus*, Polhemus, *Bull. Fish Res. Stn. Sri Lanka*, **29** : 90.
1992. *Limnogonus nitidus*, Bal & Basu, *Proc. zool. Soc. Calcutta*, **45** (Suppl. A) : 326.

*Material examined* : 1 ex.; 15.ii.1991, Ramkrishna and party, coll.

*Diagnosis* : Adult insects may be 6-8 mm; antennae with second and third segment shortest and subequal in length. Other diagnostic characters as in key.

*Distribution* : India : Assam; Bihar; Meghalaya; Kerala; Orissa; U.P.; West Bengal.

*Elsewhere* : Bangladesh, Java, Malaya, Sri Lanka, Sumatra.

## Family VI. VELIIDAE

Genus *Microvelia* Westwood13. *Microvelia douglasi* Scott

1874. *Microvelia douglasi*, Scott, *Ann. Mag. nat. Hist.*, **14(4)** : 448.
1910. *Microvelia kumaonensis*, Distant, *Fauna Brit. India, Rhynchota*, **5** : 138.
1979. *Microvelia douglasi*, Polhemus, *Bull. Fish Res. Stn. Sri Lanka*, **29** : 94.
1992. *Microvelia douglasi*, Bal & Basu, *Proc. zool. Soc. Calcutta*, **45** (Suppl. A) : 326.

*Material examined* : 2 exs.; 14.iv.1991, A. K. Pandey and party, coll.

*Diagnosis* : Adult insects about 2 mm in body length; black pronotum with anterior margin pale yellowish, centrally interrupted and not reaching anterior angles; antennae with basal two segments thickened; antennal second segment slightly shorter than first but distinctly shorter than third while fourth longest, pronotum with the lateral angles broadly subacutely prominent in macropterous forms.

*Distribution* : India : Bihar; U.P.

*Elsewhere* : Japan, Samoa, Sri Lanka, Singapore.

## Family VII. HYDROMETRIIDAE

Genus *Hydrometra* Latreille14. *Hydrometra greeni* Kirkaldy

1898. *Hydrometra greeni*, Kirkaldy, *Entomologis*, **31** : 2.
1902. *Hydrometra vittata*, Distant, *Fauna Brit. India, Rhynchota*, **2** : 170.
1979. *Hydrometra greeni*, Polhemus, *Bull. Fish Res. Stn. Sri Lanka*, **29** : 94.

1982. *Hydrometra greeni*, Andersen, *Semi aquatic bugs, Entomonograph*, 3 : 107.

*Material examined* : 2 exs.; 11.iv.1991, A. K. Pandey and party, coll.

*Diagnosis* : Adult insects may be 11-12 mm in length; white longitudinal line of the hemelytra four to six times, often broadly interrupted by transverse veinlets; males with 6th abdominal segment transversely depressed ventrally which, in turn, sinuate ventrally as seen in profile; females with last dorsal abdominal segment broader behind than in front.

*Distribution* : India : Bihar; Orissa; South India; U.P.; West Bengal.

*Elsewhere* : Sri Lanka.

*Remarks* : *H. vittata* Stal is no longer a valid species, which has been synonymised with *H. lineata* Eschscholtz from Philippines. Therefore, Distant's record of *H. greeni* Kirkaldy from Ceylon is the species found widely in India. Another species *H. butleri* Hungerford and Evans (1934) also designated and recorded from India.

#### Family VIII. MESOVELIIDAE

##### Genus *Mesivelia* Mulsant and Rey

##### 15. *Mesovelia vittigera* Horvath

1898. *Mesovelia vittigera*, Horvath, *Ent.*, 14 : 160.

1939. *Mesovelia vittigera*, Hafiz and Ribeiro, *Rec. India, Mus.*, 241 : 423.

1982. *Mesovelia vittigera*, Andersen, *Semi aquatic bugs, Entomonograph*, 3 : 62.

1992. *Mesovelia vittigera*, Bal & Basu, *Proc. zool. Soc. Calcutta*, 45 (Suppl. A) : 326.

*Material examined* : 2 exs.; 6.iv.1990, A.K. Pandey and party, coll.; 5 exs.; 17.iv.1990, A.K. Pandey and party, coll.; 10 ex.; 10.iv.1990, A.K. Pandey and party, coll.

*Diagnosis* : Adult attain a length between 2.5-3.0 mm; body elongate with prominent head; eyes

large almost touching the anterior margin of pronotum; two ocelli about equally distant from eyes as far from each other; antennal second segment shortest, other three segments subequal in length; pronotum with lateral angles tuberculously sub-prominent; hemelytra may be absent (apterous forms) when present may be fully developed (macropterous forms) or half developed (brachypterous forms); corium encloses 3 closed-cells on the outer half; scutellum large; tibiae longly hirsute.

*Distribution* : India : Andaman Islands; Bihar; Orissa; Tamil Nadu, U.P.; West Bengal.

*Elsewhere* : Bangladesh, Myanmar, Sri Lanka, Sumatra.

#### Family IX. HEBRIDAE

##### Genus *Merragata pallescens* Buch. White

##### 16. *Merragata pallescens* Distant

1909. *Merragata pallescens*, Distant, *An. Mag. nat. Hist.*, 3(8) : 498.

1934. *Merragata pallescens*, Lundblad, *Arch. Hydrobiol. Suppl.*, 12 : 277.

*Material examined* : 3 exs.; 15.iv.1991, A. K. Pandey and party, coll.

*Diagnosis* : Adult insects grow upto 2 mm length; head, pronotum and scutellum pale cinnamon-brown in colour; antennae short and stout; antennal third segment shortest while other three segments subequal in length; pronotum with lateral margins strongly depressed and lateral angles broadly prominent, posterior margin concave; scutellum subtriangular with apex broadly subtruncate; hemelytra mostly membranous without veins, only basal area with a single prominent closed cell.

*Distribution* : India : Bihar; West Bengal.

*Elsewhere* : Bangladesh.

*Remarks* : This is a rare species and hence reported from India after more than 90 years. In

this connection it may be mentioned that Lundblad (1934) stated that the British Museum is holding a specimen of *pallescens*, labelled "Tank, Museum compound, Calcutta 8.iv.1910, Distant coll. 1911-383" A present only two examples are available in the N.Z.C., Calcutta which were collected from Rasahi and Pubna, now Bangladesh, in 1907 and 1916 respectively.

### ROLE OF WATER-BUGS IN AQUATIC ECOSYSTEM

Water-bugs, in general, are effective predators of varied aquatic organisms. Their role in nature may be both beneficial as well as harmful. They are beneficial in predating upon the larvae of noxious insects like mosquitoes, gnats, midges, etc., which are responsible for various kinds of human-diseases. On the other hand, water-bugs cause considerable damage in pisciculture and frog culture by killing the fishfry, tadpoles and even small frogs for their food which directly cause the economic loss to the trade.

Giant water-bugs *Lethocerus indicus* (8.5 cms. in length) can attack a fish three or four times its own size. They cause havoc in the pisciculture by destroying considerable number of fishes. Water-scorpions attack carp spawn and fry, and cause tremendous damages (Jhingran, 1975). In addition to causing direct mortality these water-bugs also actively compete with the carp-fry for food to the detriment of the fish.

Assessment of wetland fauna and the biological potentialities of the concerned groups therein, are highlighted at present in different parts of the world. It also involves various aspects of water-bugs since they play a vital role as predators in the food chain in the aquatic ecosystem. Therefore, studies on the life history and biology of these

bugs are required for better understanding of the actual role played by these insects in nature (Bal and Basu, 1992).

### SUMMARY

The present work consists of water-bugs collected from the Kabar lake, Bihar, comprise 16 species under 12 genera belonging to nine families. The concerned families are Corixidae, Nepidae, Pleidae, Belostomatidae, Gerridae, Veliidae, Hydrometridae, Mesoveliidae and Hebridae. One species, namely *Merragata pallescens* Distant (1909) of the family Hebridae, is very rare and recorded here in its new habitat in the lake while it was last recorded more than 90 years ago in India. The diagnostic characters and distribution of each species, and the taxonomic keys of different taxa have been included in the present work.

### ACKNOWLEDGEMENT

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## PISCES

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### INTRODUCTION

During the year 1988 to 1991, the Freshwater Biological Station, Zoological Survey of India, Hyderabad in collaboration with the Gangetic Plain Regional Station, Zoological Survey of India, Patna carried out ten intensive surveys of Kabar lake Wetland Begusarai District, Bihar, with a view to understand the wetland ecosystem and the faunal analysis as a whole for the management action plan of the Ministry of Environment & Forests. This paper deals with the fishes collected from the wetland during the survey by the authors and the other party members.

It appears that there was no published work on the fish fauna of Kabar lake wetland, except the work of Srivastava (1980) on the Fishes of Uttar Pradesh and Bihar, Shaw and Shebbeare (1937) on the fishes of Northern Bengal and Sharma (1992) on Kabar lake Ecosystem. In addition, the general nature and distribution of fishes in Peninsular India are given by Day (1889), Jayaram (1981), Jerdon (1849), Misra (1959, 1969, 1976), Talwar and Jhingran (1992).

A systematic account of the species is dealt in the paper. The data includes, systematics of the species, diagnostic characters, geographical distribution and remarks on the species. The classification is followed after, Srivastava (1980), Jayaran (1981) and Talwar and Jhingran (1992).

Altogether 37 species have been dealt. The material is deposited in Freshwater Biological Station, Hyderabad, and Gangetic Plain Regional Station, Zoological Survey of India, Patna, in the National Zoological Collection.

### List of freshwater fishes of Kabar Lake, Wetland, Bihar

Order OSTEOGLOSSIFORMES

Family NOTOPTERIDAE

1. *Notopterus notopterus* (Pallas) 1767

Order CYPRINIFORMES

Family CYPRINIDAE

2. *Chela laubuca* (Hamilton) 1822
3. *Esomus danricus* (Hamilton) 1822
4. *Rasbora daniconius* (Hamilton) 1822
5. *Amblypharyngodon mola* (Hamilton) 1822
6. *Cirrhinus mrigala* (Hamilton) 1822
7. *Catla catla* (Hamilton) 1822
8. *Labeo calabasu* (Hamilton) 1822
9. *Labio bata* (Hamilton) 1822
10. *Labio rohita* (Hamilton) 1822
11. *Osteobrama cotio cotio* (Hamilton) 1822
12. *Puntius sophore* (Hamilton) 1822
13. *Puntius chrysopterus* (McClelland)

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- Family COBITINAE
14. *Lepidocephalus (Lepidocephalichthys) guntea* (Hamilton)
- Order SILURIFORMES  
Family BAGRIDAE
15. *Mystus bleekeri* (Day) 1878  
16. *Mystus cavasius* (Hamilton) 1822  
17. *Mystus tengara* (Hamilton) 1822
- Family SILURIDAE
18. *Ompok bimaculatus* (Block) 1797  
19. *Wallago attu* (Schneider) 1801
- Family CLARIDAE
20. *Clarius batrachus* (Linnaeus) 1758
- Family HETAROPNEUSTIDAE
21. *Heteropneustes fossilis* (Bloch) 1774
- Order BELONIFORMES  
Family BELONIDAE
22. *Xenentodon cancila* (Hamilton) 1822
- Order CHANNIFORMES  
Family CHANNIDAE
23. *Channa striatus* (Bloch) 1785  
24. *Channa marulius* (Hamilton) 1822  
25. *Channa punctatus* (Bloch) 1785
- Order SYMBRANCHIFORMES  
Family SYMBRANCHIDAE
26. *Monopterus cuchia* (Hamilton) 1822
- Order PERCIFORMES  
Family CHANNIDAE
27. *Chanda nama* (Hamilton) 1822  
28. *Chanda ranga* (hamilton) 1822
- Family NANDIDAE
29. *Badis badis* (Hamilton) 1822

30. *Nandus nandus* (Hamilton) 1822
- Family ANABANTIDAE
31. *Anabus testudineus* (Bloch) 1785
- Family GOBIDAE
32. *Glossogobius giuris* (Hamilton) 1822
- Family BELONTIDAE
33. *Colisa fasciatus* (Schneider) 1801
- Order MASTACEMBELIFORMES  
Family MASTACEMBELIDAE
34. *Macrornathus aculeatus* (Bloch) 1795  
35. *Mastacembulus armatus* (Lacepede) 1800  
36. *Mastacembulus punctatus* (Hamilton) 1822
- Order TETRAODONTIFORMES  
Family TETRAODONTIDAE
37. *Tetraodon cutcutia* (Hamilton) 1822

### SYSTEMATICS

- Order OSTEOGLOSSIFORMES  
Suborder NOTOPTEROIDEI  
Family NOTOPTERIDAE

Genus *Notopterus* Lacepede 1800

#### 1. *Notopterus notopterus* (Pallas) 1767

1767. *Gymnotus notopterus* Pallas, *Spec. Zool.* I, (7), p. 40, t. VI, fig. 2.
1889. *Notopterus kapirat* Day, *Fauna Brit. India Fish.*, I, p. 406.
1981. *Notopterus notopterus* Jayaram, *Handbk. Freshwat. Fishes* : 53 fig. 33.



**Diagnosis :** Body oblong, laterally compressed, length of the head 4.9 and height of the body is 3.75 in the total length. Eyes diameter 4.25-5.0 in length of the head. Abdomen with about 28 prepelvic double serrations. Head compressed, cavernous. Snout obtuse and convex. Mouth wide, cleft of mouth extending upto or beyond posterior border of eye. Eyes moderate, superior, in part of head, not visible from ventral surface. Lips thin, jaws equal. Teeth on jaws, palate and also on tongue. Muciferous channels on head well developed. Preopercle serrated. Gill membrane partly united. Dorsal fin small, tuft like, inserted near middle of the body with seven or eight rays. Anal fin very low, ribbon like with 100-110 rays, confluent with caudal fin. Pelvic fin rudimentary. Caudal fin small. Scales small. Lateral line more or less arched with about 180 scales.

**Distribution :** Fresh and brackish waters of India, Pakistan, Burma, malaya Archipelago and Philippines.

**Remarks :** Food fish of commercial value.

Order CYPRINIFORMES  
Family CYPRINIDAE  
Subfamily CULTIRINAE

Genus *Chela* Hamilton 1822

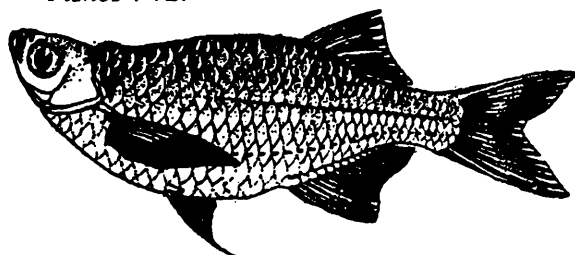
## 2. *Chela laubuca* (Hamilton) 1822

1822. *Cyprinus laubuca* Ham. *Fish. Ganges*, pp. 260, 384.

1889. *Perilampus laubuca* Day, *Fauna Brit. India Fish.*, I, p. 360, fig. 11.

1962. *Chela laubuca* Misra, *Rec. Indian Mus.*, 57 : 139-40, fig. 65.

1981. *Chela laubuca* Jayaram, *Handbk. Freshwat. Fishes* : 72.



**Diagnosis :** Body long, compressed. Abdomen keeled from below pelvic origin to anus. Head short, compressed. Snout blunt. Mouth oblique, cleft reaching to below front margin of eye. Eyes large, lateral in middle of head, may be visible from below ventral surface. Suborbital bones broad. Lips thin. Lower jaw without a knob at its symphysis. Dorsal fin inserted slightly behind anal origin with 9-11 rays (2-3 simples). Pelvic fins inserted nearer to pectoral than to anal. Outer pelvic ray elongated. Anal fin with 13-25 rays. Caudal lobes equal. Predorsal scales do not extend to space between eyes. Lateral line curved downwards with 34-68 scales.

**Distribution :** Uttar Pradesh, Bihar, West Bengal, Bangladesh and Myanmar.

**Remarks :** Barbels absent, colour silvery with fine black dots on the body. Species feeds on zooplankton such as *Daphnia*, *Cyclops*, *Diaptomus*, Phytoplankton such as *Mycrocystis*, *Cosmarium*, *Navicula* (Diatom).

Subfamily RASBORINAE

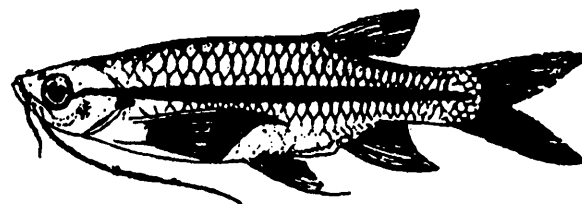
Genus *Esomus* Swainson 1839

## 3. *Esomus danricus* (Hamilton)

1822. *Cyprinus denrica* Hamilton. *Fish. Ganges*, 325, 390, pl. 16, fig. 88.

1962. *Chela denricus* Misra, *Rec. Indian Mus.*, 57 : 145, fig. 69.

1981. *Esmous denricus* Jayaram, *Handbk. Freshwat. Fishes India* : 78.



**Diagnosis :** Body elongate, strongly compressed. Abdomen rounded. Head small blunt, obliquely directed upwards. Eyes placed inferiorly,

visible from below ventral surface. Lips thin lower jaw prominent. Two pairs of barbels, maxillary pair very long extending upto anal fin. Pharyngeal teeth in a single row. Dorsal fin inserted in the interspace between anal and pelvic fins, nearer anal than pelvic with six branched rays and no spine. Anal fin with five branched rays. Caudal fin forked. Scales moderate size.

*Distribution* : Throughout India, Pakistan, Nepal, Bangladesh, Sri Lanka, Malaya, Thailand, South Vietnam.

*Remarks* : Usually inhabits ponds and pools with macrophytic vegetation, recorded also in the Gangetic river system. Small size and edible.

Order CYPRINIFORMES  
Family CYPRINIDAE  
Subfamily RASBORINAE

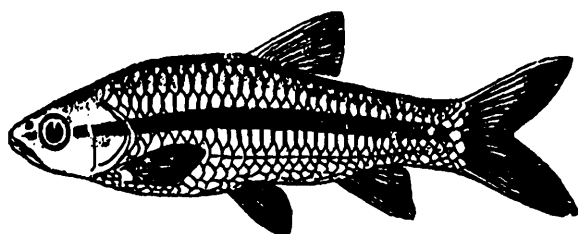
Genus *Rasbora* Bleeker 1859

#### 4. *Rasbora daniconius daniconius* (Hamilton)

1822. *Cyprinus daniconius* Hamilton. *Fish. Ganges*, 327, 391, pl. 15, fig. 39.

1962. *Rasbora daniconius* Misra, *Rec. Indian Mus.*, 57: 145-46.

1981. *Rasbora daniconius daniconius* Jayaram, *Handbk. Freshwat. Fishes India* : 84.



*Diagnosis* : Body elongate, compressed. Abdomen rounded. Head large, pointed. Snout slightly pointed. Mouth large, cleft oblique. Eyes placed laterally, not visible from below. Lips thin. Lower jaw prominent, with one central and two internal prominences, one on each side fitting into corresponding emargination on upper jaw. Pharyngeal teeth with one or two rows. Dorsal fin

inserted behind the origin of pelvic fin with nine (seven branched) rays and no spine. Anal fin with seven or eight rays (five or six branched). Caudal fin emarginate or forked. Scales large or moderate. Lateral line with 32 or 34 scale. A black lateral stripe along the centre of the body present.

*Distribution* : Throughout India. Also Bangladesh, Pakistan, Sri Lanka, Thailand, Malaysia, Myanmar.

*Remarks* : Common throughout as food fish.

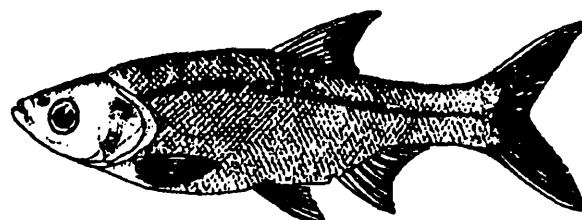
Genus *Amblypharyngodon* Bleeker 1860

#### 5. *Amblypharyngodon mola* (Hamilton)

1822. *Cyprinus mola* Ham. *Fish. Ganges*, 334, 392, pl. 38, fig. 92.

1889. *Amblypharyngodon mola* Day, *Fauna British India Fish.*, I, p. 291. fig. 101.

1981. *Amblypharyngodon mola* Jayaram, *Handbk. Freshwat. Fishes India* : 86.



*Diagnosis* : Body moderately elongate, subcylindrical. Abdomen rounded. Head conical, compressed. Snout with thin integuments, obtusely rounded. Mouth wide, antero-lateral and not protractile. Eyes large, centrally placed, not visible from below ventral surface. Upper lip absent. Lower lip with short labial fold. Lower jaw prominent. Pharyngeal teeth with molariform. No barbels. Dorsal fin inserted slightly behind the insertion of pelvic fin with nine rays and no spine. Anal fin short with seven rays. Caudal fin forked. Scales small. Lateral line incomplete with 55-75 scales.

*Distribution* : Throughout India except Malabar coast.

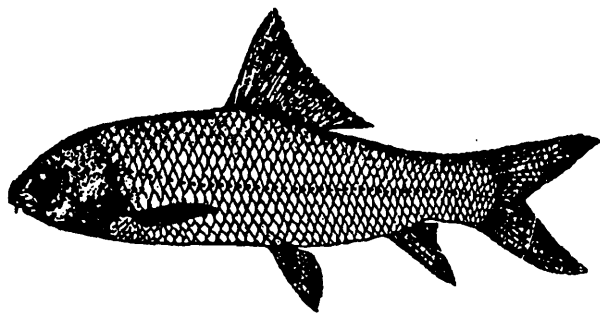
*Remarks* : A silvery lateral band on either side

of the body which turns black on preservation with formalin. Commonly occurring mainly from lower altitudes. Inhabits streams, ponds, reservoirs and river. Good commercial value for its taste.

Genus *Cirrhinus oken* 1817

6. *Cirrhinus mrigala* (Hamilton)

1822. *Cyprinus mrigala* Hamilton. *Fish. Ganges*, 279, 386, pl. 6.
1982. *Cirrhinus mrigala* Jayaram, *Handbk. Freshwat. Fish India*.
1991. *Cirrhinus mrigala* Talwar & Jhingram, *Inland fishes*, Vol. I : 172.



**Diagnosis** : Body moderately elongate, subcylindrical. Abdomen rounded. Head conical, compressed. Snout with thin integuments, obtusely rounded. Mouth wide, antero-lateral and not protractile. Eyes large, centrally placed, not visible from below ventral surface. Upper lip absent. Lower lip with short labial fold. Lower jaw prominent. Pharyngeal teeth with molariform. No barbels. Dorsal fin inserted slightly behind the insertion of pelvic fin with nine rays and no spine. Anal fin short with seven rays. Caudal fin forked. Scales. small. Lateral line incomplete with 55-75 scales.

**Distribution** : Throughout India except Malabar coast.

**Remarks** : A silvery lateral band on either side of the body. Commonly occurring mainly from lower altitudes. Inhabits streams, ponds, reservoirs and river. Good commercial value for its taste.

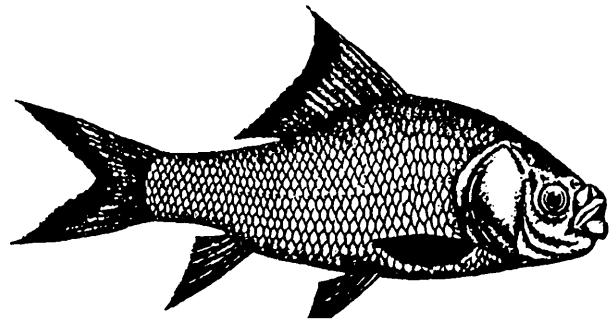
Family CYPRINIFORMES

Subfamily CYPRININAE

Genus *Catla* Cuvier & Valenciennes 1844

7. *Catla catla* (Hamilton) 1822

1822. *Cyprinus calabasu* Hamilton. *Fish. Ganges*, 237, 318, pl. 113, fig. 81.
1962. *Catla catla* Misra, *Rec. Indian Mus.*, 57 : 156-57, fig. 79.
1991. *Catla catla* Jayaram, *Handbk. Freshwater fish, India* : 131.



**Diagnosis** : Body short, deep. Abdomen rounded. Head broad, large. Snout bluntly rounded, may be with pores. Eyes situated in the anterior half of the length of the head visible from below ventral surface. Upper lip absent. Lower lip moderately thick, continuous with the free posterior margin. Barbels absent. Lower jaw with a movable articulation at the symphysis but without prominent knob. Dorsal fin long, inserted above tip of pectoral fin with 17-19 rays (three or four simple) and without any spine. Anal fin short, with eight rays. Caudal fin forked. Scales moderate. Lateral line complete with 40-43 scales.

**Distribution** : Throughout Northern India up to Krishna river. Also in Pakistan, Bangladesh, Nepal.

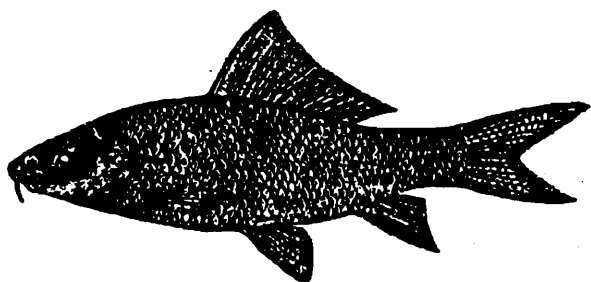
**Remarks** : Only one species known to occur in rivers, tanks and ponds. Important major carp. Game fish of commercial value. Also employed for stocking tanks. Attains 1,800 mm.

Family CYPRINIDAE  
Subfamily CYPRININAE

Genus *Labeo* Cuvier 1817

8. *Labeo calabasu* (Hamilton) 1822

1822. *Cyprinus calabasu* Hamilton. *Fish. Ganges*, 297, 387, pl. 2, fig. 83.  
1889. *Labeo calabasu* Day, *Fauna of British India, Fish I*, pp. 259, fig. 93.  
1962. *Labeo calabasu* Misra, *Rec. Indian Mus.*, 57 : 161, fig. 82.  
1991. *Labeo calabasu* Jayaram, *Handbk. Freshwater Fish, India* : 117.



**Diagnosis** : Body moderately elongated. Abdomen rounded. Head fairly large, snout truncated or rounded, generally projecting beyond the mouth, mostly covered with tubercles or grooves across and overhanging the mouth. Mouth narrow and somewhat inferior. Eyes moderately large generally situated in the commencement of the posterior half of the head, not visible from below the ventral surface. Lips thick, fleshy fringed, covering both jaws, continuous at angle of mouth forming a labial fold. Jaws with sharp margin and with soft movable horny covering which may be generally five or four. Dorsal fin inserted ahead of pelvic fins with 11-26 rays and without spine. Anal fin inserted ahead of pelvic fins with 11-26 rays and without spine. Anal fin short with seven or eight rays. Caudal fin deeply forked, scales large, moderate with numerous parallel striae. Lateral line complete with 36-85 scales.

**Distribution** : Throughout India, Pakistan, Bangladesh and Nepal.

**Remarks** : Inhabits river and ponds, fish of commercial importance. Grows to 900 mm total length.

9. *Labeo bata* (Hamilton) 1822

1822. *Cyprinus bata* Hamilton. *Fish. Ganges*, pp. 283, and 386.  
1962. *Labeo bata* Misra, *Rec. India Mus.*, 57 : 159-160.  
1981. *Labeo bata* Jayaram, *Handbk. Freshwater Fish, India* : 117.

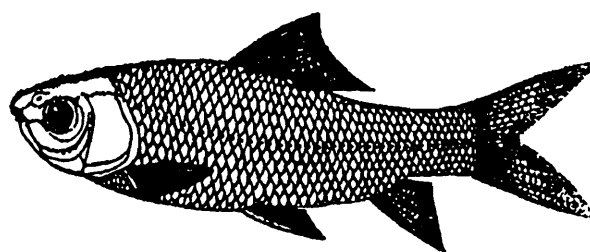
**Diagnosis** : Similar to *Labeo calabasu* the dorsal profile of the body is more convex than that of the abdomen, the greatest width of the head equals its length excluding snout. A tubercle inside lower jaw above the symphysis. Barbels one pair of short maxillary ones. Fine black dots on all the fins.

**Distribution** : Found throughout India, including Krishna and Godavari river, lower Bengal and Assam.

**Remarks** : The fish is highly edible. And commercial value, as it attains good length.

10. *Labeo rohita* (Hamilton) 1822

1822. *Cyprinus rohita* (Ham.). *Fish. Ganges*, pp. 301, 388, pl. 36, fig. 85.  
1962. *Labeo rohita* Misra, *Rec. India Mus.*, 57 : 162-163, fig. 83.  
1981. *Labeo rohita* Jayaram, *Handbk. Freshwater fish, India* : 118.



**Diagnosis** : Similar to *L. calabasu* but the dorsal profile more convex than that of the

abdomen. Snout obtuse projects beyond the jaws. Lips very thick and fringed with a distinct inner fold. Fins black. Barbels thin short maxillary pair. Caudal fin deeply forked.

**Distribution** : Freshwaters of Northern India, Pakistan and Myanmar .

**Remarks** : A major carp for fishery practice, extensively used for stocking tanks throughout the country. It frequents the sluggish water pools of rivers and occasionally seen in shoals. Attain nearly 900 mm.

#### Subfamily CYPRININAE

#### Genus *Osteobrama* Heckel 1842

#### 11. *Osteobrama cotio cotio* (Hamilton) 1822

1822. *Cyprinus cotio* Hamilton. *Fish. Ganges*, 339, 393, pl. 39, fig. 93.

1889. *Rohtee cotio* Day, *Fauna of Brit. India Fish I*, pp. 340, 341, fig. 109.

1962. *Osteobrama cotio* Misra, *Rec. Indian Mus.*, 57: 164.

1991. *Osteobrama cotio cotio* Jayaram, *Handbk. Freshwater Fish, India* : 11.

**Diagnosis** : Body short deeply compressed. Abdomen rounded. Head short, snout bluntly rounded. Mouth small somewhat directed upwards and forward. Eyes large lateral may be visible from below ventral surface. Lips thin, plain. Upper jaw slightly longer, barbels two or none. Dorsal fin inserted behind pelvic fins with 11 or 12 rays and a strong serrated spine. Anal fin long with 14-36 rays. Caudal fin deeply forked. Scales moderate. Lateral line complete with spines.

**Distribution** : Freshwaters of India, except South of river Krishna and Malabar coast.

**Remarks** : Common in Gangetic plains, inhabits freshwater ponds, lakes and rivers.

#### Subfamily CYPRININAE

#### Genus *Puntius sophore* Hamilton 1822

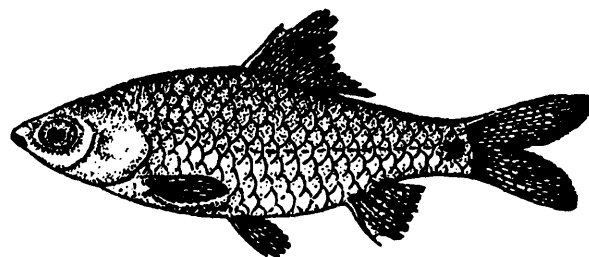
#### 12. *Puntius sophore* (Hamilton) 1822

1822. *Cyprinus sophore* Ham. *Fish. Ganges*, pp. 310, pl. 39, fig. 86.

1889. *Barbus stigma* Day, *Fauna of Brit. India Fish I*, pp. 329.

1962. *Puntius sophore* Misra, *Rec. Indian Mus.*, 57: 115.

1991. *Puntius sophore* Jayaram, *Handbk. Freshwater Fish, India* : 100.



**Diagnosis** : Body short compressed. Abdomen rounded. Head short, snout obtuse, conical or pointed. Mouth arched, anterior, not protrusible. Eyes moderate to large, dorso-lateral, not visible from below ventral surface. Lips thin covering jaws, may have leathery lobes, but without any horny covering. Jaws simple, covered by lips pharyngeal teeth without any knob or tubercle at the symphysis. Barbels none. Dorsal fins short, inserted nearly opposite pelvic fins, with 9-13 rays. Anal fin short with seven to nine rays. Caudal fin forked. Scales moderate with and strongly divergent striae. Lateral line complete. A round black blotch more or less distinct at root or caudal fin present.

**Distribution** : Freshwaters of India and Pakistan.

**Remarks** : Mainly omnivorous, depends on desmids, diatoms, copepods, cladocerans and even detritus of the lake.

#### 13. *Puntius chrysopterus* (McClelland) 1839

1839. *Systemus chrysopterus* McClelland, *Indian Cyprinidae, Asiatic Researches*, 19(2), pp. 285 and 383.

1878. *Barbus chrysopterus* Day, *Fish India*, pp. 559, 579 & 580, fig. 6.

1981. *Puntius chrysopterus* Jayaram, *Handbk. Freshwater Fish, India* : 100.

**Diagnosis** : Height of the body 3 in the total length, compressed laterally. The dorsal profile much more convex than that of the abdomen, mouth narrow, horse shoe-shaped with upper jaw very slightly longer than the lower one, when the mouth is closed. Dorsal fin arises slightly in advance of the ventral fin. Lower caudal fin slightly longer. Dorsal, ventral and anal fins generally stained with black spots.

**Distribution** : Throughout Gangetic belt of Uttar Pradesh, Bihar, Punjab and Sindh.

**Remarks** : Edible.

Family COBITIDAE  
Subfamily COBITINAE

Genus *Lepidocephalus* Bleeker

Subgenus *Lepidocephalichthyes* Bleeker 1863

14. *Lepidocephalus (Lepidocephalichthyes) Guntea* (Hamilton)

1822. *Cobitus guntea* Hamilton, *Fish Ganges*, pp. 353, 394.

1889. *Lepidocephalichthyes guntea* Day, *Fauna of Brit. India Fish*, I, pp. 220.

1981. *L. (Lepidocephalichthyes) guntea* Jayaram, *Handbk. Freshwater Fish, India* : 181.



**Diagnosis** : Body elongate and moderately compressed, abdomen rounded. Head short, conical, snout blunt. Mouth inferior narrow and slightly arched. Eyes small, superior, not visible

from below ventral surface. Lips thick, fleshy, continuous at angle of mouth, lower lip interrupted in the middle. Jaws and palate without teeth. Barbels six, two pairs rostral and one pair maxillary. A large erectile bifid suborbital spine below or in front of eyes. Dorsal fin is located opposite of the ventrals and caudal fin is entire, scales minute. Inner ray of pectoral fin in males ossified as a flat osseous vertical plate-like structure. Anal fin short. A longitudinal broad black band extends over the whole of the dorsal side beginning from the occipital region and reaching over the base of the caudal fin. Caudal and dorsal fins with numerous row of dark spots.

**Distribution** : Throughout North India, Pakistan, Bangladesh, Nepal.

**Remarks** : Absent in Karnataka, Kerala and south of Krishna river. Recorded in higher and lower altitudes. Inhabits flowing and clear standing water.

Order SILURIFORMES

Family BAGRIDAE

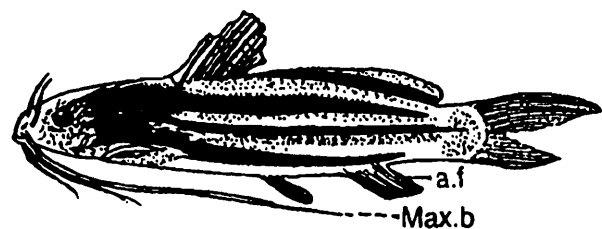
Genus *Mystus* Scopoli 1777

15. *Mystus bleekeri* (Day) 1878

1878. *Macrones bleekeri* Day, *Fish India* : 451, pl. 101,

1981. *Mystus bleekeri* Misra, *Rec. Indian Mus.*, 57 : 177-88, fig. 106.

1981. *Mystus bleekeri* Jayaram, *Handbk. Freshwater Fish, India* : 196.



**Diagnosis** : Body moderately elongate compressed. Abdomen rounded. Head of moderate size, compressed. Mouth terminal, transverse moderately wide. Eyes moderately large, supra

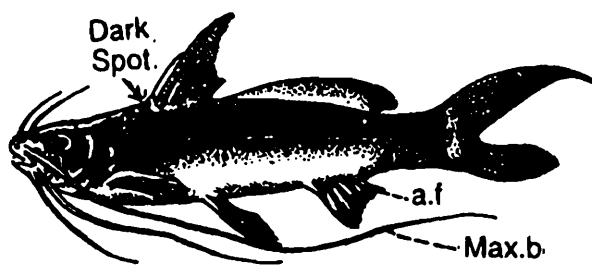
lateral, in anterior part of the head and not visible from below ventral surface. Lips thin, jaws sub equal. Teeth uniformly villiform in bands on jaws and palate, that on latter always interrupted. Maxillary barbels reach the anal fin, sometimes beyond. Interorbital width more than 3 times in head length. No dark spot at the base of the dorsal fin. Branchiostegal rays 10. Body with two light longitudinal bands one above and other below lateral line.

**Distribution :** States of Punjab, West, Bengal, Assam, Orissa, Gujarat, U.P., Bihar and upper catchment of Ganga river. Also in Pakistan, Myanmar, Malaysia.

**Remarks :** Occurs in shallow rivers, canals beels. Reported to constitute uneconomic fishery.

#### 16. *Mystus cavasius* (Hamilton) 1822

1822. *Pimelodus cavasius* Hamilton, *Fishes Ganges* : 203, 379, pl. 11.
1962. *Mystus cavasius* Misra, *Rec. Indian Mus.*, 57 : 188-189, fig. 107.
1981. *Mystus cavasius* Jayaram, *Handbk. Freshwat. Fishes, India* : 196.



**Diagnosis :** Similar to *M. bleekeri*. Maxillary barbels reach caudal fin base or beyond. Interorbital width more than three times the head length. A dark spot at the base of dorsal fin. Median dorsal groove on head extends to the base of the occipital process. A dark spot on the base of the caudal fin often present. Branchiostegal rays six.

**Distribution :** Throughout India. Also in Pakistan, Bangladesh, Thailand, Malaysia and China.

**Remarks :** Inhabits freshwater and tidal rivers and lakes, ponds, and inundated fields. Not of much economic importance.

#### 17. *Mystus tengara* (Hamilton) 1822

1822. *Pimelodus tengara* Hamilton, *Fish Ganges*, p. 183, 377, pl. 23, fig. 60.
1889. *Macrones tengara* Day, *Fauna Brit. India Fish.*, I, p. 156.
1981. *Mystus tengara* Jayaram, *Handbk. Freshwater Fishes* : 197.

**Diagnosis :** Nasal barbel nearly as long as head. Maxillary barbel reaches the base of the ventral fin. External mandibular barbel reaches the middle of the pectoral fin, internal barbel comparatively shorter reaching upto the base of the pectoral. Dorsal spine slightly serrated anteriorly at the tip rather more or less smooth. As long as head excluding the snout. Colour brilliant yellow with black shoulder spot.

**Distribution :** Northern part of India. Pakistan and Bangladesh.

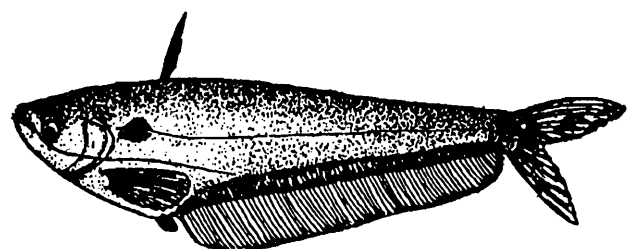
**Remarks :** Not much of commercial value.

#### Family SILURIDAE

#### Genus *Ompok* Lacepede 1803

#### 18. *Ompok bimaculatus* (Bloch) 1797

1797. *Silurus bimaculatus* Block : *Syst. Ichth.* 11: 17. pl. 569.
1962. *Ompok Bimaculatus* Misra, *Rec. Indian Mus.*, 57 : 178-79.
1981. *Ompok bimaculatus* Jayaram, *Handbk. Freshwat. Fishes India* : 207.



**Diagnosis** : Body elongate compressed. Abdomen rounded. Head small, broad, depressed. Mouth superior, moderately wide, its cleft oblique, not extending to the front border of the eyes. Eyes small, their ventral border on level with corner of mouth, visible from underside the head. Jaws subequal. Lower jaw prominent. Teeth uniformly villiform. Maxillary barbels longer, extends upto or beyond anal fin. Anal fin very long very close to caudal fin. Caudal fin forked. Lateral line simple.

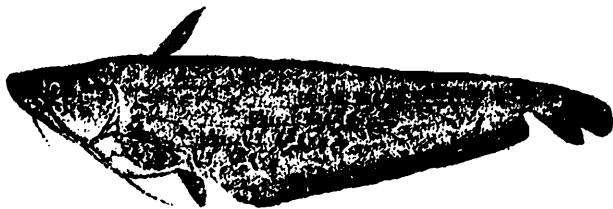
**Distribution** : Throughout India. Also in Pakistan, Bangladesh, Sri Lanka, Myanmar, Malaysia, Thailand.

**Remarks** : Commonly known as 'Butter Catfish' Have good fishery value and esteemed for its taste. Differs from other two species (*O. pabda* and *O. pabo*) by having maxillary barbels longer than head extending upto or beyond anal fin.

#### Genus *Wallago* Bleeker

##### 19. *Wallago attu* (Schneider) 1801

1801. *Silurus attu* Schneider, *Syst. Ichth.* p. 378. pl. 75.  
 1889. *Wallago attu* Day, *Fauna Brit. India Fish*, 1 : 126-27, fig.54.  
 1981. *Wallago attu* Jayaram, *Handbk. Freshwater Fish, India* : 208.



**Diagnosis** : Body elongated compressed. Abdomen rounded. Snout spatulate, somewhat protruded. Mouth subterminal, oblique, gape wide, reaching to or beyond the anterior border of the eyes. Eyes small, above level corner of mouth, not visible from below ventral surface. Lips thin. Jaws subequal, lower jaw longer and prominent. Teeth villiform in bands on jaws and patches on plate.

Two pairs of barbels, one pair each of maxillary and mandibular.

Rayes dorsal fin inserted above half of the pectoral fin, with five rays and without spine. Adipose dorsal fin absent. Anal fin long, caudal fin forked with rounded lobes. Lateral line complete well marked and simple.

**Distribution** : Distributed throughout the freshwaters of India, Pakistan, Ceylon, Myanmar, Sumatra, Jawa, Indo-China.

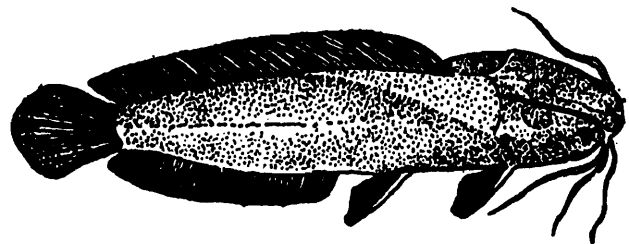
**Remarks** : Varacious, predator catfish commonly known as "Freshwater Shark" Grows to two meters in length.

#### Family CLARIIDAE

##### Genus *Clarias* Scopoli 1777

##### 20. *Clarias batrachus* (Linnaeus) 1758

1758. *Silurus batrachus* Linnaeus : *Syst. Nat.* 1, ed. 10 : 305.  
 1889. *Clarias magur* Day, *Fauna Brit. India Fish*. 1, pp. 115. fig. 48 & 49.  
 1951. *Clarias batrachus* Menon : *Proc. Nat. Ind. Scie. India*, 17, pp. 480.  
 1981. *Clarias batrachus* Jayaram, *Handbk. Freshwater Fishs, India*, pp. 271.



**Diagnosis** : Body elongate compressed. Abdomen rounded. Head moderate-sized, greatly depressed, covered with osseous plates dorsally and laterally forming a cask covering a diverticulum of the gill cavity. Snout broadly rounded and pointed. Mouth terminal, fairly wide and transverse. Eyes small, dorso lateral with free orbital margins, not visible from ventral surface. Lips fleshy, papillated. Jaws subequal, upper jaw

longer. Teeth villiform in patches on jaws and palate. Four pairs of barbels, one pair each of maxillary, nasal and two pairs of mandibular. Gill membrane deeply notched, partly united with each other, free from isthmus. An accessory dendritic branchial organ attached to second and fourth branchial arches. Rayed dorsal fin long without any spine. Adipose dorsal absent. Pectoral fins with serrated spines. Pelvic fins with six rays.

*Distribution* : Inhabits freshwaters of India, Pakistan, Nepal, Sri Lanka, Bangladesh, Myanmar, Malaya, Philippines, Singapore.

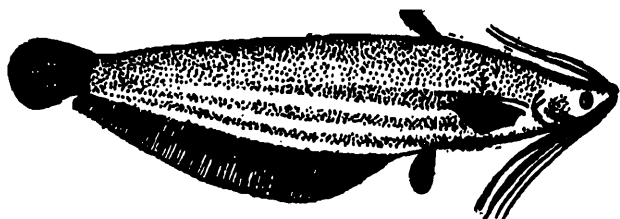
*Remarks* : Commercially important species of high market value. Air breathing with reduced air bladder, consisting of two thin walled sacs united by a transverse tube, lateral chambers covered by an incomplete horny capsule.

Family HETEROPNEUSTIDAE

Genus *Heteropneustes* Muller, 1840

21. *Heteropneustes fossilis* (Bloch) 1774

1774. *Silurus fossilis* Bloch : *Naturg. Ausland Fische*, 8 : 46, pl. 370.
1889. *Saccobranthus fossilis* Day, *Fauna British India Fish*. 1, pl. 114.
1962. *Heteropneustes fossilis* Misra : *Rec. Indian Mus.*, 57 : 185-186.
1981. *Heteropneustes fossilis* Jayaram : *Handbk. Freshwater Fishs, India*, pp. 273.



*Diagnosis* : Body elongate abdomen rounded. Head moderate-sized, greatly depressed, covered with thin skin. Snout flat. Mouth terminal, transverse, narrow. Eyes small, lateral, in anterior part of head, not visible from below ventral surface. Lips fleshy papillated. Jaws subequal.

Teeth villiform in broad bands on jaws and in two oval patches on palate. Barbels : four pairs maxillary extend beyond the pectoral fin. The dorsal fin commences from anterior 1/3 of the body. Pectoral spine serrated, anal and caudal fins are separated, by a distinct notch.

*Distribution* : Freshwaters of India. Also in Pakistan, Bangladesh, Myanmar, Sri Lanka, Thailand.

*Remarks* : Commercially important species. Air breathing with reduced air bladder, consisting of two thin walled pyriform sacs. Sacs united by transverse tube which is connected with oesophagus through a slender tube. Pectoral spine is capable of inflicting painful wound.

Order BELONIFORMES

Family BELONIDAE

Genus *Xenentodon* Regan 1911

22. *Xenentodon cancila* (Hamilton) 1822

1822. *Esox cancila* Hamilton, *Fish Ganges* : 213, 380, pl. 27, fig. 70.
1889. *Belone cancila* Day, *Fauna Brit. India Fish*. 1, 420-21, fig. 136.
1962. *Xenentodon cancila* Misra : *Rec. Indian Mus.*, 57 : 198-199, fig. 116.
1981. *Xenentodon cancila* Jayaram : *Handbk. Freshwater Fishes, India*, 291.



*Diagnosis* : Body elongated, subcylindrical. Abdomen rounded. Head pointed. Snout sharply pointed. Mouth superior, wide, cleft extending to the orbit. Eyes moderate, superior, in anterior part of head, not visible from below ventral surface. Both jaws prolonged into a break, with fine

rugosities. Teeth villiform on jaws; palate edentate. A deep longitudinal groove along the upper surface of the head present. Dorsal fin usually inserted above the anal fin and no spine. Caudal fin truncate. Scales small. Lateral line on posterior half of the body without keel.

**Distribution** : Throughout India, mostly in all states, North East India not common. Also Bangladesh, Pakistan, Nepal, Myanmar, Sri Lanka, Malaysia, Thailand.

**Remarks** : The genera usually present in warm and temperate seas, reaches rivers. Not of much commercial value.

Order CHANNIFORMES

Family CHANNIDAE

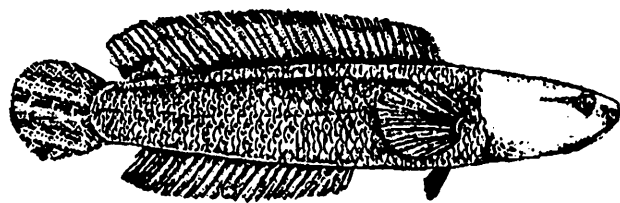
Genus *Channa* Scopoli 1777

### 23. *Channa striatus* (Bloch) 1785

1785. *Channa striatus* Bloch, *Naturl. Ausland. Fische*, 2 : 141, pl. 359.

1889. *Ophicephalus striatus* Day, *Fauna Brit. India Fishes*, 2 : 359.

1981. *Channa striatus* Jayaram : *Handbk. Freshwater Fishes, India*, 307.



**Diagnosis** : Body elongate, subcylindrical. anteriorly, head depressed, dorsally covered with palate-like scales. Abdomen rounded. Gill openings wide. The eyes are laterally placed. Jaws, vomer and plate provided with teeth. All fins are spineless. Dorsal fin long and the anal is shorter than dorsal. Both dorsal and ventral are free from caudal. An accessory respiratory organ in the form of thin bony laminae present in a cavity of the gill chamber. Generally dark greyish or blackish dorsally, yellowish white beneath, cheeks and

lower surface of the mouth spotted with grey.

**Distribution** : Throughout India, Sri Lanka, Bangladesh, Pakistan, Philippines, Malaya, Myanmar, Thailand.

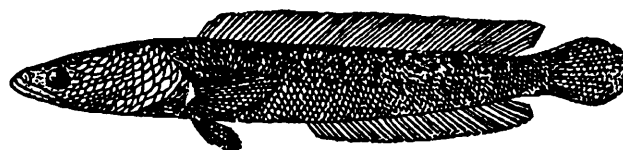
**Remarks** : An important food fish. Smaller than *C. marulius* in length. This species frequents swamps, muddy rivers and tanks. It grows to a length of 900 mm.

### 24. *Channa marulius* (Hamilton) 1822

1822. *Ophicephalus marulius* Hamilton, *Fish Ganges*, pp. 65, 367, pl. 17, fig. 1.

1889. *Ophicephalus marulius* Day, *Fauna Brit. India Fish.*, II, pp. 360.

1981. *Channa marulius* Jayaram, *Handbk. Freshwater Fishes, India*, pp. 306.



**Diagnosis** : Similar to *C. striatus*. Pectoral fins more than half the length of the head, but not reaching the origin of anal fin. Ventral fin 2/3 as long as pectoral. Scales of moderate size on the summit of head. Dorsum of the body is dark green Abodomen whitish. There is a large black prominent ocellus with orange boundary at the upper part of the base of the caudal fin.

**Distribution** : Freshwaters of India, Pakistan, Ceylon and China.

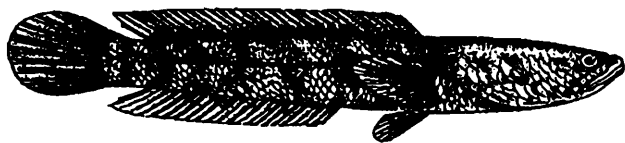
**Remarks** : Inhabits large lakes and rivers, prefers deep clear stretches of water with sandy or rocky bottom. These belong to a group of large sized snake headed fishes popularly known as 'Murrels' Can reach a length of 1200 mm. By virtue of its accessory respiratory organs, can live in any environment.

### 25. *Channa punctatus* (Bloch) 1785

1785. *Ophicephalus punctatus* Bloch, *Naturl. Ausland. Fische*, (7) : 139.

1889. *Ophicephalus punctatus* Day, *Fauna Brit. India Fish*, II : 364-365.

1981. *Channa punctatus* Jayaram : *Handbk. Freshwater Fishes, India* : 306.



**Diagnosis** : General description of the species resemble that of *C. striatus*. However, pelvic fins more than half the length of pectoral fin. Pectoral fins plain. No vertical band. Dorsal fin rays 32-37.

**Distribution** : Usually freshwaters of India. Pakistan, Ceylon, Bangladesh, China, Taiwan.

**Remarks** : Dark grey on the dorsum and white ventral surface. Good commercial fish. Lives in freshwater ponds and reservoirs.

Order SYNBRANCHIFORMES

Family SYNBRANCHIDAE

Genus *Monopterus* Lacepede

26. *Monopterus cuchia* (Hamilton) 1822

1822. *Unibranchapertura cuchia* Hamilton, *Fish Ganges* : 16, 363, pl. 16.

1889. *Amphipnous cuchia* Day, *Fauna Brit. India Fish*, I, 69, fig. 27.

1962. *Amphipnous cuchia* Misra : *Rec. Indian Mus.*, 57 : 221, fig. 135.

1981. *Monopterus cuchia* Jayaram : *Handbk. Freshwater Fishes, India* : 311.



**Diagnosis** : Body much elongated, eel like compressed. Abdomen rounded. Head short, compressed. Snout bluntly rounded. Head short, compressed. Snout bluntly rounded. Mouth wide, terminal, cleft extending to some distance behind the orbit. Eyes small, anterolateral, not visible from below ventral surface. Lips thick. Villiform teeth on jaw and palate. Gill membrane a simple crescentic transverse fold, free from isthmus. Dorsal and anal fin in the form of folds or ridges. Caudal fin bluntly rounded. Scales small, not uniformly distributed. Lateral line well developed and conspicuous.

**Distribution** : Throughout India, Pakistan, Bangladesh, Nepal.

**Remarks** : Inhabits fresh and brackish water. Colour dark brown with small black spots. Lower portion without any spots.

Order PERCIFORMES

Family CHANDIDAE

Genus *Chanda* Hamilton

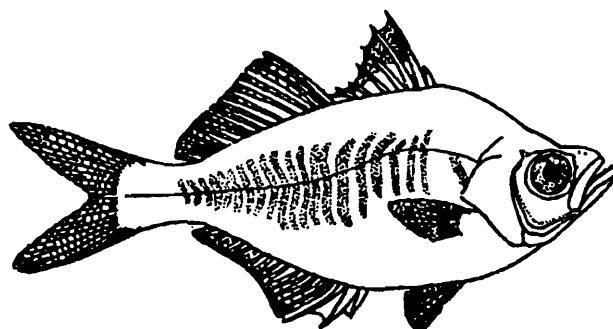
27. *Chanda nama* (Hamilton) 1822

1822. *Chanda nama* Hamilton, *Fish Ganges*, pp. 109, 371, pl. 39, fig. 149.

1889. *Ambasis nama* Day, *Fauna Brit. India Fish*, I : 484-485, fig. 29.

1962. *Chanda nama* Misra : *Rec. Indian Mus.*, 57 : 223-224.

1981. *Chanda nama* Jayaram : *Handbk. Freshwater Fishes, India* : 318.



**Diagnosis** : Body short, deep, compressed, more or less diaphanous. Abdomen rounded. Head short compressed. Snout sharp. Mouth wide, protractile, one extending to front border of orbit or slightly beyond. Eyes large, superior, visible from below ventral surface. Lips thin. Lower jaw longer than upper. Lower jaw with two pairs of large, crooked canini form teeth. Lateral line indistinct. A dark blotch on the dorsal fin's upper edge generally present.

**Distribution** : Throughout India, Pakistan, Nepal, Bangladesh, Myanmar.

**Remarks** : Inhabits fresh and brackish water. Commonly known as 'Glass fishes' Used in Aquariums.

#### 28. *Chanda ranga* (Hamilton) 1822

1822. *Chanda ranga* Hamilton, *Fish Ganges*, pp. 113, 371, pl. 16, fig. 18.

1889. *Ambasis ranga* Day, *Fauna Brit. India Fish. I* : 485.

1962. *Ambasis ranga* Misra : *Rec. Indian Mus.*, 57 : 224.

1981. *Chanda ranga* Jayaram, *Handbk. Freshwater Fishes, India* : 318.

**Diagnosis** : Closely resembles *C. nama*. Colour white, spotted with black dots. A dark composed of closely set dots present on the shoulder. Teeth small, but non on tongue. Third dorsal spine of the fin is the longest and second anal spine is shorter than third.

**Distribution** : Throughout India, Bangladesh, Myanmar, Thailand, Nepal, Pakistan.

**Remarks** : Usually known as 'Glass fish' an aquarium fish.

Order PERCIIFORMES

Family NANDIDAE

Genus *Badis* Bleeker 1853

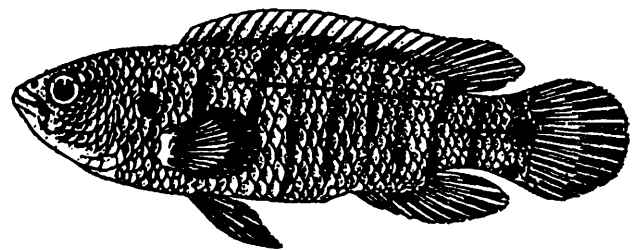
#### 29. *Badis badis* (Hamilton) 1822

1822. *Labrus badis* Hamilton-Buchnan, *Fish Ganges*, pp. 70, 371, pl. 25, fig. 223.

1853. *Badis badis* Bleeker, *Verh. Batav. Genootsch.*, 25, p. 106.

1889. *Badis badis* Day : *Fauna Indian*, pp. 128, pl. 31, fig. 6.

1981. *Badis badis* Jayaram, *Handbk. Freshwat. Fishes, India*, pp. 334.



**Diagnosis** : Body moderately elongate, relatively low and slightly compressed. head large, snout bluntly rounded. Abdomen rounded. Mouth slightly upturned, small, teeth villiform on jaws, tongue edentate. Lower jaw longer. Opercle with one sharp spine, other bones on head armed. A single dorsal fin inserted above the base of the pectoral fin. Caudal fin rounded. Lateral line interrupted, often absent. Anal fin with three spines and 6-8 rays. Air bladder large and simple.

**Distribution** : Throughout India, Bangladesh, Myanmar, Nepal, Pakistan.

**Remarks** : Inhabits freshwater ponds and rivers. Colour of the fish, highly variable, variegated with alternate bands of black and green, bluish black spots behind the gill opening. Prefers live moving animals as its prey. Not much interest to fisheries, but of interest as aquarium fish.

Family NANDIDAE

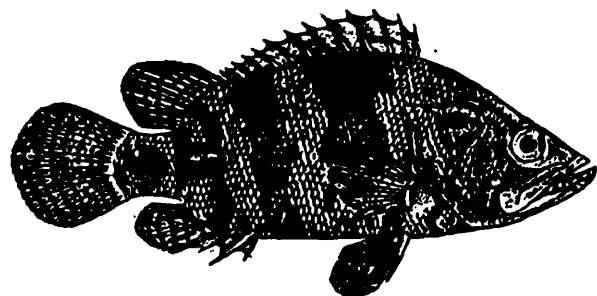
Genus *Nandus* Valenciennes 1831

#### 30. *Nandus nandus* (Hamilton) 1822

1822. *Coius nandus* Hamilton-Buchnan, *Fish Ganges*, pp. 96, pl. 30, fig. 32.

1878. *Nandus marmoratus* Day, *Fauna Brit. Indian*, II, pp. 82, fig. 39.

1981. *Nandus nandus* Jayaram, *Handbk. Freshwat. Fish India*, pp. 335.



**Diagnosis :** Body oblong, compressed. Head large and compressed, snout pointed and conical. Mouth terminal, very protractile, its cleft very wide, extending below posterior border of the eyes or slightly beyond. Eyes large, located in the anterior part of the head, not visible from below. Jaws subequal, lips thin, lower jaw longer. Villiform teeth on jaws, palate and on tongue. Dorsal fin inserted above the pectoral base. Anal fin with three spines and seven rays. Caudal fin slightly rounded. Scales smaller on the nape than on the body. Lateral line interrupted.

**Distribution :** Throughout India, Bangladesh, Myanmar, Malaya, Nepal, Pakistan, Thailand.

**Remarks :** Inhabits fresh and brackish water also found in undated fields. Popular in West Bengal and Bihar. Usually common in summer months. This is a piscivorous species preying upon small crops. It has a very tenacious life. Air breathing fish, with a large and simple air bladder.

Order PERCIFORMES  
Family ANABANTIDAE

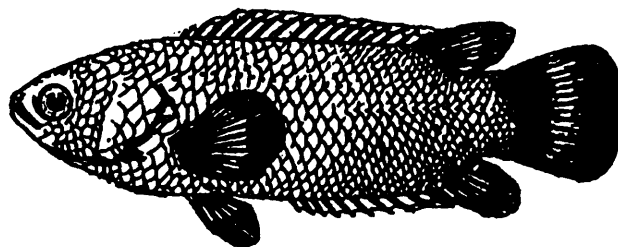
Genus *Anabas* Cuvier & Cloquet 1816

31. *Anabas testudineus* (Bloch) 1785

1785. *Anthias testudineus* Bloch, *Naturges Ausland Fische*, (6) : 121.

1789. *Anabas scandens* Day, *Fauna Brit. Indian, Fish*, II, p. 367, fig. 120.

1981. *Anthias testudineus* Jayaram, *Handbk. Freshwat. Fishes, India*, pp. 379.



**Diagnosis :** Body oblong, compressed. Head moderate, compressed. Snout slightly conical or bluntly rounded. Mouth small, terminal, oblique, cleft not wide. Eyes large. Lips thin. Jaws equal. Villiform teeth on jaws and on vomer, not on palatines. A large elaborate accessory breathing apparatus. Single dorsal fin, inserted above the pectoral base. Caudal fin rounded. Lateral line interrupted.

**Distribution :** Throughout India, Pakistan, Bangladesh, Indo-China, Malaya, Myanmar, Nepal, Pakistan, Sri Lanka, Thailand, Singapore, Philippines.

**Remarks :** Inhabits fresh and brackish water. Common in canals, lakes, ponds and swamps. A very hardy fish and of considerable interest in fishery. Move over dry land for great distances by 'walking' on its 'walking fins'. A highly esteemed fish for its fine flavour. Usually employed in polyculture ponds with *Clarias*, *Heteropneustes*, and carps.

Family GOBIIDAE

Genus *Glossogobius* Gill 1859

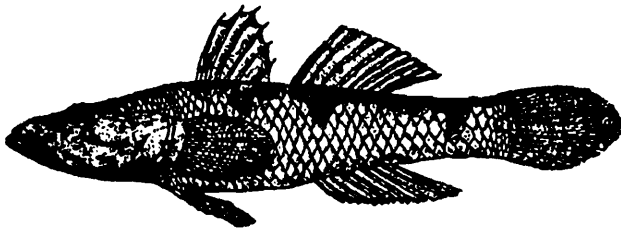
32. *Glossogobius giuris* Hamilton 1816

1822. *Glossogobius giuris* Hamilto, *Fish Ganges*, 51, pl. 33, fig. 15.

1889. *Glossogobius giuris* Day, *Fauna Brit. Indian, Fish*, II, p. 265.

1941. *Glossogobius giuris* Kaumans, *Mem. Indian Mus.*, 13(2) : 256.

1981. *Glossogobius giuris* Jayaram, *Handbk. Freshwat. Fishes, India*, p. 387.



**Diagnosis :** Body elongated, anteriorly cylindrical, compressed. Abdomen rounded. Head depressed, pointed, scales above behind eyes. Mouth little oblique. Eyes large, superior. Lips thick, jaws with villiform teeth on several rows. Tongue bilobate. Two dorsal fins, separated by a short interspace. Pelvic fins united, oblong. Anal fin with eight or nine rays. Caudal fin founded. Iris without process in pupil.

**Distribution :** Throughout India, Pakistan, Bangladesh, Sri Lanka, East and South coast of Africa, Malaya, Thailand, China, Japan, Philippines, Australia.

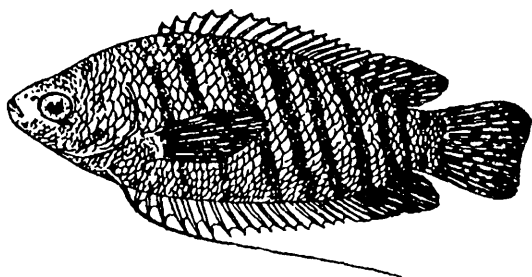
**Remarks :** Inhabits primarily freshwater and estuaries. Also in seas. Forms a minor fishery in West Bengal and Bihar. A very voracious and takes live bites easily.

Family BELONTIDAE

Genus *Colisa* Cuvier & Valenciennes 1831

33. *Colisa fasciatus* Schneider 1801

1801. *Trichogaster fasciatus* Schineider, *Syst. Ichth.*, 164, pl. 36.
1889. *Trichogaster fasciatus* Day, *Fauna Brit. Indian, Fish*, II, p. 372.
1981. *Colisa fasciata* Jayaram, *Handbk. Freshwat. Fishes, India*, pp. 383.
1991. *Colisa fasciatus* Talwar & Jhingram, *Inland Fisheries*, Vol. II : 1006.



**Diagnosis :** Body oblong, compressed. Head moderate, snout blunt. Mouth upturned. Eyes large, lateral in middle of head. Lips thin. Jaws subequal. Small villiform teeth on jaws, palate edentate. A single dorsal fin commencing above from near pectoral base. Pelvic fin is in the form a single elongate, filiform ray. Caudal fin slightly emarginate. Air bladder divided into two in the posterior portion.

**Distribution :** Throughout India. Pakistan, Bangladesh, Nepal, and Myanmar.

**Remarks :** Inhabits rivers and estuaries, also in tanks and ponds. A good aquarium fish.

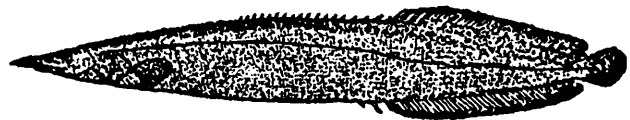
Order SYNBRACHIFORMES

Family MASTACEMBELIDAE

Genus *Macrogathus* Lacepede 1800

34. *Macrogathus aculeatus* (Bloch) 1787

1787. *Ophidium aculeatum* Bloch, *Ichthyology*, V, pp. 60, pl. 159.
1889. *Rhynchobdella aculeata* Day, *Fauna Brit. India, Fish*, II, p. 331.
1981. *Macrogathus aculeatus* Jayaram, *Handbk. Freshwat. Fishes, India*, p. 387.



**Diagnosis :** Body eel like, elongated, compressed. Head long, pointed. Snout long, fleshy, accommodating the concave prolongation of the upper jaw consisting of the paired series of toothed bony plates. Mouth inferior, cleft narrow. Eyes small, not visible from ventral surface. Lips thin. Jaws subequal. No gill rakers. Dorsal fin inserted far behind end of pectoral fin. Anal fin with three spines. Caudal fin rounded, distinctly separated from the dorsal and anal fin. Lateral line present. Air bladder elongate.

**Distribution** : Throughout India, Pakistan, Bangladesh, Myanmar, Sri Lanka, Thailand, Vietnam, China.

**Remarks** : Good looking fish inhabits slow and shallow water. Very little commercial importance.

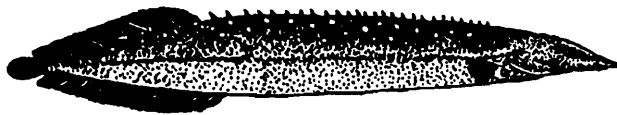
Genus *Mastacembelus* Scopoli 1777

35. *Mastacembelus armatus* Lacepede 1800

1800. *Macrogathus armatus* Lacepede, *Hist. Nat. Poissons*, II, p. 286.

1889. *Mastacembelus armatus* Day, *Fauna Brit. Indian, Fish*, II, p. 334.

1981. *Mastacembelus armatus armatus* Jayaram, *Handbk. Freshwat. Fishes, India*, p. 388.



**Diagnosis** : Body slender, eel like, pointed, snout long, conical without any transversely striated bony plates on the under surface. Mouth inferior, cleft narrow. Eyes small, superior. Lips thin, jaws subequal. Sharp teeth in bands on both jaws. Pre orbital spines strong and usually piercing the skin. Spinous dorsal fin inserted above middle or posterior third of pectoral fins. Dorsal and anal fins broadly joined the caudal fin.

**Distribution** : Throughout India, Bangladesh, Pakistan, Sri Lanka, Nepal, Myanmar, Thailand, and Malaya, China.

**Remarks** : Inhabits fresh and brackish water in plains and in hills. Good and popular food fish of Bihar and West Bengal.

36. *Mastacembelus punctatus* Hamilton 1822

182. *Macrogathus punctatus* Hamilton, *Fish Ganges*, pp. 364, pl. 22, fig.7.

1889. *Mastacembelus punctatus* Day, *Fauna Brit. India, Fish*, II, p. 334.

1981. *Mastacembelus punctatus* Jayaram, *Handbk. Freshwat. Fishes, India* : 389.

**Diagnosis** : Similar to the *Mastacembelus armatus*. Eyes small and are situated before the middle of the length of the head. Snout is trilobed at its extremity. Dorsal fin short gradually increases in length posteriorly, its last spine is short and is equal to the third and fourth spine. Soft dorsal and anal are separated by a notch from the caudal. Caudal fin short and rounded. Ventral fin absent.

**Distribution** : Throughout India, Pakistan, Bangladesh.

**Remarks** : Freshwater species, present in ponds and swamps. Fishes of minor importance. Easily identified with a distinct streak of elongated spots running along the lateral line from eye to the base of the tail.

Order TETRAODONTIFORMES

Family TETRAODONTIDAE

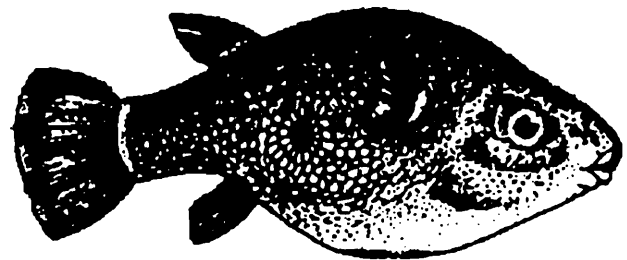
Genus *Tetraodon* Linnaeus 1785

37. *Tetraodon cutcutia* Hamilton 1822

1822. *Tetraodon cutcutia* Hamilton, *Fish Ganges*, 8, pp. 362, pl. 18, fig. 3.

1889. *Tetraodon cutcutia* Day, *Fauna Brit. India, Fish*, II, p. 493.

1981. *Tetraodon cutcutia* Jayaram, *Handbk. Freshwat. Fishes, India*, : 393.



**Diagnosis** : Body more or less short. Abdomen rounded. Head oval shape. Snout blunt. Inter orbital space flat. Mouth terminal, directed forward, transverse and cleft narrow. Eyes large. Lips thick, fleshy. Jaws equal both with a median

suture. Upper jaw slightly longer, both have a cutting edge and are covered with a layer of ivory like substance, palate edentate. Dorsal fin inserted above. Pelvic fins absent. Fins rounded. Skin leathery, without formal spinules.

*Distribution* : Freshwaters of Bihar, Orissa, West Bengal and North East India. Also in Bangladesh, Sri Lanka, Myanmar, Malaya.

*Remarks* : Inhabits fresh and brackish water. No interest to fisheries.

### SUMMARY

The present exploration from Kabar lake

wetland reveals the presence of 37 species of fishes, collected during different seasons for a period of three years. The actual record of fish fauna is more than sixty species, if nearby chauras and other wetlands from the area are taken into account.

### ACKNOWLEDGEMENTS

The authors wish to express their deep felt gratitude to Dr. J.R.B. Alfred, Director, Zoological Survey of India for facilities and help. Thanks are also due to the Officer-in-Charge of Gangetic Plains Research Station, ZSI, Patna.

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## AMPHIBIA

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### INTRODUCTION

Not much is known about the amphibian fauna of Bihar as a whole. Boulenger (1890 & 1920), Annandale and Rao (1918) and Parker (1934) have recorded amphibians from different parts of India and adjoining countries but they also mention very little about the amphibians from the state of Bihar. Without mentioning any place of collection in particular. Venkateswarlu and Murthy (1972) have published a list of amphibians occurring in Bihar. Sarkar (in press) has reported amphibians of Chota Nagpur (South Bihar) in detail. From the above account it is concluded that altogether 13 species of anurans have so far been recorded from Bihar.

The following account is based on a small amphibian collections made from Kabar Lake, Begusarai district of Bihar. Though the collections are too small to give any idea regarding the exact number of species of amphibians occurring in Bihar, we hope, will and some additional information to the amphibian knowledge of the State. The lot contains fourteen examples of anurans belonging to seven species, four genera and four families, of which *Rana erythraea* is recorded for the first time from Bihar, and which extends the total number of amphibian species so far recorded from the state to fourteen. The collections are deposited with the Freshwater Biological Station, Zoological Survey of India, Hyderabad (Andhra Pradesh).

### SYSTEMATIC ACCOUNT

Class AMPHIBIA

Order ANURA

#### Key to the families

1. Jaws toothless .....2  
— Upper jaw toothed.....3
2. Skin rough with well developed warts, parotoids present.....BUFONIDAE  
— Skin more or less smooth, parotoids absent.....MICROHYLIDAE
3. No intercalary ossification (extra cartilaginous bone) between the distal and penultimate phalanges.....RANIDAE  
— An intercalary ossification between the distal and penultimate phalanges. .... RHACOPHORIDAE

Family 1. BUFONIDAE

Genus 1. *Bufo* Laurenti, 1768

1. *Bufo melanostictus* Schneider  
(Common India Toad)

1799. *Bufo melanostictus* Schneider, *Hist. Amph.* 1: 216.

1972. *Bufo melanostictus* : Venkateswarlu and Murthy, *Indian J. Zool.*, 13(3) : 129-130.

*Material examined* : Begusarai dist. : 1 ex., Kabar Lake, 1.ix.1988, E. V. Muley. 2 ex., Kabar Lake, 4.iv.1990; 1 ex., Kabar lake, 5.iv.1990. All coll. A. K. Pandey.

**Diagnostic character** : Head broader than long, with cornified bony ridges; snout rounded, nearly equal to the diameter of the eye; nostril a little nearer to the tip of snout than to the eye; interorbital width broader than that of upper eyelid; tympanum very distinct, two-third the diameter of the eye. Fingers free, first finger a little longer than second, tips of fingers and toes swollen. Toes nearly half-webbed, more than three phalanges of fourth toe free; two oval (inner and outer) metatarsal tubercles present. Tarso metatarsal articulation reaches in between tympanum and eye. Dorsum dark brownish, rough with several spiny warts, parotoid large, kidney-shaped. Venter dull whitish with numerous small spiny warts.

**Distribution** : Kabar Lake : As mentioned in the material examined. Annandale and Rao (1918) recorded it from Saran district, Bihar, and Venkateswarlu and Murthy (1972) from Bihar. The species is recorded for the first time from the area.

**Elsewhere** : Common throughout the plains of India, and Andaman and Nicobar. Also Pakistan, Bangladesh, Sri Lanka, Nepal, Myanmar, South China, Malaya Peninsula and Archipelago.

**Remarks** : Big-sized toad. It is nocturnal in habit, and found in the gardens, under street lamp for preying on arthropods and other invertebrates. Terrestrial, and found in near water during breeding season. The toads are used for dissection in College laboratories, and the males are used in pregnancy diagnosis test of humans.

#### Family II MICROHYLIDAE

Genus 2. *Microhyla* Tschudi, 1838

#### 2. *Microhyla ornata* (Dumeril and Bibron) (Ornate Microhylid)

1841. *Enqystoma ornatum* Dumeril and Bibron.  
*Erpet. gen.*, 8 : 745.

1972. *Microhyla ornata* : Venkateswarlu and Murthy,  
*Indian J. Zool.* 13(3) : 129-130.

**Material examined** : Begusarai dist. : I ex., Kabar Lake, 3.vi.1989, E. V. Muley.

**Diagnostic character** : Head broader than long; snout obtusely pointed, a little longer than the diameter of the eye; nostril nearer to the tip of snout than the eye; interorbital width a little broader than that of upper eyelid; tympanum not so distinct. Fingers free, first shorter than second, tips flattened. Toes with a rudiment of web, tips blunt, two small but distinct oval (inner and outer) metatarsal tubercles present. Tibiotarsal articulation reaches near eye. Dorsum smooth, brownish with broad darker markings. Venter smooth, dual whitish, little darker on throat.

**Distribution** : Kabar Lake : As mentioned in the material examined. Venkateswarlu and Murthy (1972) recorded it from Bihar. First record from Kabar Lake.

**Elsewhere** : It is widely distributed species in India and found all over the plains of the country upto an altitude of 1524 meters, and Andaman. Also Pakistan, Nepal, Bangladesh, Sri Lanka, Myanmar, South China, South East Asia and Taiwan.

**Remarks** : Small sized frog. The frogs are normally found inside the bush, and under dry leaves spread over moist soil. They are nocturnal in habit, sometimes found inside human dwellings during monsoon days.

**Status** : Common.

#### Family III RANIDAE

This family is represented in Kabar Lake, Begusarai dist., Bihar by four species of the genus *Rana*.

Genus 3. *Rana* Linnaeus, 1758.

#### Key to the species of the genus *Rana*

1. Tips of the toes with distinct discs  
.....*erythraea* Schlegal.

2. Tips of toes without discs.....2
3. Toes webbed upto the tips.....  
.....*cyanophlyctis* Schneider.
4. Toes webbed not upto the tips.....3
5. Both inner and outer metatarsal tubercles present.....*limnocharis* Boie.
6. Inner metatarsal tubercles present, outer metatarsal tubercle absent...*tigerina* Daudin.

### 3. *Rana erythraea* (Schlegal) (Leaping Frog)

1837. *Hyla erythraea* Schlegal, *Abbild.* : 27.
1920. *Rana erythraea* : Boulenger, *Rec. Indian Mus.*, 20 : 152-155.
1992. *Rana erythraea* : Sarkar *et al.*, *Fauna of West Bengal, State Fauna Series 3*, (Zool. Surv. India) Part 2.

*Material examined* : Begusarai dist. : 1 ex., Kabar Lake, 6.vi.1989, E.V. Muley.

*Diagnostic character* : Head longer than broad; snout more or less pointed, projecting beyond the mouth, longer than the diameter of the eye; nostril nearer the tip of the snout than the eye; interorbital width equal/little broader than that of upper eyelid; tympanum very distinct, nearly once the diameter of eye. Fingers slender with rudimentary web, first a little longer than second, tips with distinct discs; subarticular tubercles of fingers and toes well-developed. Toes three-fourth webbed two phalanges of fourth toe free, tips with distinct discs; an oval inner metatarsal tubercle present, outer metatarsal tubercle mostly absent. Tibiotarsal articulation reaching between posterior end of eye to tip of snout. Dorsum smooth with distinct dorso-lateral glandular folds running from above the tympanum to the hip on both the sides of the back. Venter smooth.

*Distribution* : Kabar Lake : As mentioned in

the material examined. It is recorded for the first time from Bihar, India.

*Elsewhere* : Assam, West Bengal and Orissa in India, and South-East Asia.

*Remarks* : This is an elongated, medium-sized frog which is not common in Bihar. In general, these frogs are found inside the floating aquatic vegetation and in the bushes grown at the edge of water.

*Status* : Uncommon.

### 4. *Rana cyanophlyctis* Schneider (Skipper Frog)

1799. *Rana cyanophlyctis* Schneider, *Hist. Amph.*, 1: 137.
1972. *Rana cyanophlyctis* : Venkateswarlu and Murthy, *Indian J. Zool.* 13(3) : 130.

*Material examined* : Begusarai dist. : 3 ex., Kabar Lake, 3.vi.1989, E. V. Muley.

*Diagnostic character* : Head broader than long; snout generally rounded, equal to or a little longer than the diameter of the eye; nostril equidistant from the tip of the snout and the eye; interorbital width much smaller than that of the upper eyelid; tympanum distinct, nearly diameter of the eye. Fingers free, first equals second, tips pointed; subarticular tubercles of fingers and toes swollen; a pointed, digit-like inner metatarsal tubercle present, outer metatarsal tubercle absent. Tibiotarsal articulation reaches in between posterior end of tympanum and nostril. Dorsum darker with small warts. Venter whitish and smooth.

*Distribution* : Kabar Lake : As mentioned in the material examined. Annandale and Rao (1918) recorded it from Saran dist., Bihar and Venkateswarlu and Murthy (1972) recorded it from Bihar. The species is recorded for the first time from Kabar Lake.

*Elsewhere* : throughout the plains of India, and upto 1846 m in the Himalayas. Also Pakistan,

Afghanistan, Baluchistan, Iran, Southy Arabia, Nepal, Bangladesh, Thailand and Sri Lanka.

*Remarks* : Medium-size frog. The frogs are normally found floating on the surface of water. Adults are used in College laboratories for dissection.

*Status* : Common.

#### 5. *Rana limnocharis* Bioe (Cricket Frog)

1835. *Rana limnocharis* (Boie), Wiegmann, *N. Acta. Ad. Leop. Carol.* 17(1) : 255.

1972. *Rana limnocharis* : Venkateswarlu and Murthy *Indian J. Zool.* 13 : 129-130.

*Material examined* : Begusarai dist. : 3 ex., Kabar Lake, 5.vi.1990, A. K. Pandey.

*Diagnostic character* : Head generally as long as broad; snout generally pointed, projecting beyond the mouth, as long as or a little longer than the diameter of the eye, nostril nearer to the tip of snout than the eye, interorbital width much smaller than that of the upper eyelid; tympanum distinct, nearly two-third, the diameter of the eye. Fingers free, first longer than second, tips swollen; subarticular tubercles of fingers and toes distinct. Toes half webbed, normally three phalanges of fourth toe free; a distinct oval inner metatarsal tubercle, and a feebly distinct outer metatarsal tubercle present. Tibiotarsal articulation reaches in between tympanum and nostril. Dorsum greyish and warty. Venter whitish and smooth.

*Distribution* : Kabar Lake : As mentioned in the material examined. Venkateswarlu and Murthy (1972) recorded it from Bihar. First record from Kabar lake.

*Elsewhere* : It is a widely distributed species in India and found almost all the biotopes of the Country, and Andaman and Nicobar Island. Also Eastern Asia from Pakistan, Nepal, Bangladesh, Sri Lanka and China to Japan.

*Remarks* : Medium-sized frog. The frogs are

found inside bush grown on moist soil, and on moist forest bed covered with thick canopy of trees.

*Status* : Common.

#### 6. *Rana tigerina* Daudin (Indian Bull Frog)

1803. *Rana tigerina* Daudin, *Hist., Rina Gren. Crap.*, p. 64.

1972. *Rana tigerina tigerina* : Venkateswarlu and Murthy, *Indian J. Zool.* 13(3) : 129-130.

*Material examined* : Begusarai dist. : 1 ex., Kabar Lake, 3.vi.1989, E. V. Muley.

*Diagnostic character* : Head as long as broad or a little broader than long; snout rounded or pointed, projecting beyond the mouth, longer than the diameter of the eye; nostril generally equidistant from the tip of the snout and eye; interorbital width much smaller than that of the upper eye lid; tympanum distinct, nearly equal to the diameter of the eye. Fingers free, first longer than the second, tips not sharp pointed; subarticular tubercles of finger and tips not very distinct. Toes entirely webbed, tips not pointed; Tibiotarsal articulation reaches between posterior end of the eye and nostril. The heels overlapping when the limbs are folded at right angles to the body. Dorsum olive green with darker spots, distinct warts and long glandular folds. Venter whitish and smooth.

*Distribution* : Kabar Lake : Venkateswarlu and Murthy (1972) recorded it from Bihar. First record from Kabar Lake.

*Elsewhere* : The species is common throughout India from the base of the Himalayas to Southern part of the country and Andaman. Also Pakistan, Nepal, Bangladesh, Sri Lanka, Myanmar, Thailand, South China and Taiwan.

*Remarks* : Large frog. Commonest species of edible frog found throughout the plains of India. It frequents inside bush grown on banks of ditches, ponds canals, rivers and lakes.

Bhattacharya (1936) reported its tadpole feeding on mosquito Larvae. Abdul Ali (1985) has stated its utility in the control of agricultural pests.

*Status* : Common.

#### Family RHACOPHORIDAE

Genus *Polypedates* Tschudi, 1838.

#### 7. *Polypedates maculatus* (Gray) (Tree frog)

1832. *Hyla maculata* Gray. *J. Indian Zool.*, pl. 82.

1972. *Rhacophorus maculatus* : Venkateswarlu and Murthy. *Indian J. Zool.* 13(3) : 129-130.

1986. *Polyedates maculatus* : Inger and Dutta, *J. Bombay nat. Hist. soc.* 83 : 139.

*Material examined* : Begusarai Dist. : 2 ex. Kabar Lake, 5,iv.1990, A. K. Pandey.

*Diagnostic character* : Vomerine teeth present. Head broader than long, skin on head free; snout pointed, projecting a little beyond the mouth, generally longer than the diameter of the eye; nostril nearer the tip of the snout than the eye; interorbital width broader than that of the upper eyelid; tympanum distinct, about three fourth diameter of the eye. Fingers with rudimentary web, first equals the second, tips of fingers and toes bear horse-shoe shaped distinct discs; subarticular tubercles of fingers and toes distinct. Toes nearly three-fourth webbed, two phalanges of fourth toe free; a distinct oval inner metatarsal tubercle present. Outer metatarsal tubercle absent. Tibiotarsal articulation reaches in between posterior end of

eye and tip of snout. Dorsum brownish with light darker spots, and smooth. Venter dull whitish and granular.

*Distribution* : Kabar Lake : As mentioned in the material examined. Venkateswarlu and Murthy (1972) recorded it from Bihar (India). First record from Kabar Lake.

*Elsewhere* : Plains of India in general. Also Sri Lanka.

*Remarks* : Medium-sized frog. Nocturnal in habit, generally found inside thick bush, dark and moist corners of village huts and forest rest house.

*Status* : Not very common.

#### SUMMARY

The paper describes 14 example of amphibia belonging to 7 species, 4 genera and 4 families. All the species are recorded for the first time from the area, of which *Rana erythraea* is a first record from Bihar. Keys and short diagnostic characters of the species have been added in the paper for correct identification.

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## REPTILIA

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### INTRODUCTION

Our knowledge of the reptilian fauna of Bihar as a whole is very limited to stray records. Smith (1931, 1935 & 1943) and Wall (1905-1919) although have extensively contributed to the reptile fauna of India and recorded innumerable species of reptiles from different parts of India and adjacent countries, have focused very little on the reptiles of Bihar. Lydekker (1889) and Annandale (1913) have dealt with the Tortoises of Chota Nagpur (South Bihar). Annandale (1912) further contributed to the reptile fauna of Pareshnath Hills (Bihar). Venkateswarlu (1972) published a list of reptiles from Bihar without mentioning the place of collection, while Sanyal and Nandi (1976) contributed to a collection of reptiles from Patna, and Venkateswarlu, Bholanath and Sanyal (1972) recorded the occurrence of Gharial, *Gavialis gangeticus* (Gmelin) from Patna.

We have the opportunity to study a small lot of reptile collections made by the survey of the Freshwater Biological Station, Zoological Survey of India, Hyderabad (Andhra Pradesh) from Kabar Lake of Begusarai district of north Bihar during 1989-1990. Though collections at our disposal are far too small to give an idea of the exact number of species of reptiles occurring in the Lake yet it is hoped that the present account will add to the little known herpetological knowledge of the area. The lot contains eight examples of reptiles belonging to five species, four genera and three families. The collections are deposited in the Freshwater

Biological Station, Zoological Survey of India, Hyderabad.

### SYSTEMATICS ACCOUNT

Class REPTILIA

Order TESTUDINES

Suborder CRYPTODIRA

Family 1. TRIONYCHIDAE

Genus 1. *Lissemys* Smith, 1931

1. *Lissemys punctata andersoni* Webb  
(Indo-gangetic flap-shell Turtle)

1789. *Testudo punctata* Bonnaterre, *Daubenten's Tab. Encycl. Meth. Erept.* : 30, pl. 6.

1980. *Testudo punctata* Webb. *Bull. Mus. Hist. Nat. Paris* 2(2) : 547-557.

1982. *Lissemys punctata* (Lacepede) Webb. *Amphibia Reptilia*, 3 : 179-184.

*Material examined* : 1 ex. Kabar Lake, Begusarai district, Bihar; Coll. Ramakrishna, Hyderabad.

*Diagnostic character* : Shell is low, domed and oval. The head is moderately large, the snout is short and broad. Shell finely granular, eight pairs of costal plates, the last pair meeting medially. Small pre-nuchal lying anterior to the nuchal. Plastron with seven callosities, peripheral present, limb are fully webbed, with only three claws on each foot. Tail is very short. Carapace is olive green with dark yellow blotches, pale

yellow below. The head is olive with yellow blotches.

*Distribution* : Kabar Lake, as mentioned in the material examined. With its two subspecies, the Indian Flap-shell Turtle is widely distributed in the Indian subcontinent. The subspecies *andersoni* is found in northern India, Pakistan, Bangladesh and Nepal in the rivers of Indus, Ganga and Brahmaputra and their tributaries.

*Remarks* : The turtle is a voracious feeder and feeds mainly on frogs, fishes, shrimps, snails etc. It lays 12 eggs in a single clutch.

*Status* : Still common in relatively undisturbed environment throughout the subcontinent. The species is, for some inexplicable reason protected under Schedule I of the Indian Wildlife (Protection) Act, 1972.

Order SQUAMATA  
Suborder SAURIA  
Family AGAMIDAE

Genus *Calotes* Rafinesque, 1815.

2. *Calotes versicolor* (Daudin)

1802. *Agama versicolor* (Daudin) *Hist. Nat. Rept.* 3: 395.

1853. *Calotes versicolor* Jerdon. *J. Asiat. Soc. Bengal*, 22 : 470.

*Material examined* : 3 exs. Kabar Lake, Begusarai, Bihar. Coll. : Ramakrishna.

*Diagnostic Character* : Head oval and laterally compressed body. Two distinct spines on each side of the head behind the tympanum. Limbs well developed, with long slender digits ending in powerful claws. Body scales keeled and directed backwards and upwards. Tail long and rounded. Juveniles with long and light dorso-lateral strips which enclose transverse bars. Belly whitish, with dark streaks. Dorsal scales large and arranged in 35-52 rows at mid body. Dorsinuchal crest composed of 41-49 lanceolate

spines extending to tail. Head and tail of males turn scarlet red to orange. It exhibits considerable colour variation.

*Distribution* : Widely distributed in Indian subcontinent, most of the south east Asian countries.

*Remarks* : It is essentially an arboreal lizard in its habit but also found in the open fields, hedges, gardens, scrublands, and forests. Feeds on spiders and various kinds of insects. During breeding season males assume brilliant scarlet colour, which has given rise to the enormous belief that this lizard sucks blood and gets the misnomer "Bloodsucker".

*Status* : Commonest agamid lizard in India.

Suborder SERPENTES  
Family COLUBRIDAE

Genus *Enhydris* Sonini & Litreille, 1802

3. *Enhydris enhydris* (Schneider)  
(Smooth water snake)

1799. *Hydrus enhydris* Schneider. *Hist. Amph.*, 1 : 245.

1935. *Enhydris enhydris* Pope. *Rept. China* : 314

*Material examined* : 2 exs. Kabar lake, Bihar, Coll. Ramakrishna.

*Diagnostic characters* : Snout broadly rounded, internasal single, twice as long, in contact with loreal, frontal broader than supra occular, 8 supra labials, 4th touching the eye. 21 (rarely 23) scales touching the midbody, scales smooth. Eyes small, placed high on the face. Pupil vertically elliptic. Body colour is dark olive or olive brown above and lemon yellow below. Ventrals demarcated laterally by dark line.

*Distribution* : Kabar Lake, Bihar.

*Elsewhere* : North eastern India, Coastal Andhra Pradesh, Uttar Pradesh, Indo-China, Myanmar, Thailand, Malaya.

**Remarks** : It is an aquatic species frequenting both fresh and brackish water. Feeds principally on fish. In disposition, it is quiet and never attempts to bite when handled. 6-18 youngones are produced at a time. The snake is a prolific breeder.

**Status** : Fairly common in ponds, irrigated fields and sluggish rivers.

#### Family COLUBRIDAE

#### 4. *Xenochrophis piscator* (Schneider) (Checkered Keelback)

1799. *Hydrus piscator* Schneider *Hist. Amph.*, 1 : 247.

1935. *Natrix piscator* Pope. *Rept. China.* : 120

1965. *Xenochrophis piscator* Malnate & Minton. *Proc. Acad. Nat. Sci. Philadelphia*, 117(2) : 19.

**Material examined** : 1 ex. Kabar Lake, Besugarai, Bihar, Coll : Ramakrishna.

**Diagnostic characters** : Head slightly flattened, distinct from neck, snout bluntly pointed, rostral wider than high, internasal distinctly narrowed anteriorly: nostrils between nasal. Eyes moderate size with round pupil, one large loreal. 9 upper labials, 4th and 5th touching the eye, the 6th excluded by the lowest post occular. Body stout, scales in 19 rows in midbody, distinctly keeled, except the outer one or two rows which are smooth. Colouration variable. Dorsal ground colour olive brown with five rows of small spots, varying in size, arranged quinquentially, uniform whitish or yellowish below, head olive brown above with two oblique black streaks, one below, the other behind the eye.

**Distribution** : Kabar Lake, Bihar.

**Elsewhere** : Throughout the Indian subcontinent from Baluchistan to Assam and Myanmar.

**Remarks** : The checkered Keelback is diurnal, vicious, agile and most common freshwater

snake inhabiting marshy areas, pools of water, ditches, canals, shallow edges of rivers with plenty of aquatic vegetation. Food mainly comprising of fishes and frogs. Breeding season starts from late September to October. Clutch size varies from 8-91 eggs and the incubation period varies from 35-55 days. The snake is a prolific breeder.

**Status** : Available in abundance throughout its range.

Genus *Xenochrophis* Gunther, 1864.

#### 5. *Xenochrophis ceratogaster* (Cantor) (Dark bellied marsh snake)

1839. *Psammophis ceratogaster* Cantor. *Proc. Zool. Soc.* : 52.

1864. *Xenochrophis ceratogaster* Gunther. *Rept. Brit. India* : 274.

**Material examined** : 1 ex. Kabar Lake, Besugarai, Bihar. Coll. S. Z Siddiqui.

**Diagnostic characters** : Head long, narrow, distinct from neck, flattened with a blunt pointed snout. Rostral square shaped. Pre occular one, post occular three or four, anterior temporals elongated, two in number, posterior temporals three. Upper labials are 8 or 9, 4th touching the eye; lower labials 9-11. Anterior chin shields are shorter than the posterior ones, costals in 20 or 21: 19 : 17. All dorsal scales are keeled except 2-3 lateral rows, ventrals are 140-160. Sub caudals are 63-78, annals divided. Dorsal colour is dark brown, greenish or olivaceous with light yellow stripe on 5th and 6th scale rows. Many individuals have dark or olive brown spot on the body, ventrum is with reddish tinge with brown or light black-white spots, which are more prominent on the anterior part of the body. A yellow long line along the outer aspects of the ventrals, margin with chocolate on the upper side and with the red on the lower side. Lips are yellow and chocolate, chin and throat are white with red dots, underside of the tail is black.

*Distribution* : Kabar Lake.

*Elsewhere* : Lower Sindh (Pakistan) to West Bengal and Assam in India. Also recorded in central Nepal.

*Remarks* : Most handsome, docile, good tempered, shy, most agile, diurnal snake. Species is completely aquatic. Feeds on small fishes, shrimps and frogs. Egg laying takes place from April to June. Each clutch contains 15-20 eggs.

*Status* : Available in abundance throughout the range of the species.

### SUMMARY

The paper deals with eight examples of

reptiles belonging to five species, four genera and three families. All these species are recorded for the first time from the Kabar Lake.

### ACKNOWLEDGEMENT

The authors are highly indebted to Dr. J.R.B. Alfred, Director, Zoological Survey of India, Calcutta for providing the necessary working facilities and to carry out these studies. They are also thankful to Dr. K.V. Ramarao (Retd.) and Dr. Ramakrishna, Freshwater Biological Station, Zoological Survey of India, Hyderabad for handing over the collection at our disposal for study.

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## AVES

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### INTRODUCTION

The avifauna of this huge freshwater wetland of North Bihar is based primarily on the first hand field observation by the scientists of the Zoological Survey of India, Freshwater Biological Station.

The rainy season observation were made by Dr. E.V. Muley and summer season covered exhaustively for two consecutive years by Dr. M. Vasanth. Two of us (Ramakrishna & Siddiqui) extensively covered the winter seasons during the study period. The observations on the bird nekton were enriched in no less measure by Sri. Ramavilas Sahni, Boatman, Kabar lake wetland, Begusarai. His excellent knowledge of the birds, their habitats has to be seen to believe. He humbly attributes all these to no less a legend than Dr. Salim Ali, the doyen of Ornithology in the Indian subcontinent, as he had the privilege of accompanying the master Ornithologist during his field visits to the wetland.

The list has also been updated using the other relevant published information on the lake (Singh & Roy, 1990 & WWF India and AWB, 1993). The rich vast and varied diversity of the bird fauna both in species content and number may be attributed to the unique ecological habitat the lake offers. The composition of the bird community, especially the aquatic species as also the winter visitors is closely linked to the trophic (food) and other niche the lake ecosystem provides *vis-a-vis* the physico-chemical milieu. The abundance of any

particular group/groups of birds too appear closely correlated to the exclusive ecology of the freshwater wetland.

The endeavour hopefully, serves as the single window, exhaustive *Checklist* or more appropriately an inventory of avifauna that will serve as the *baseline data* for the future *Impact Assessment Studies* furnishing necessary inputs for the eventual management action plan and conservation. The field identification based on standard Indian works, guides and manuals on the field ornithology and using field binoculars. The early morning and evening observations were made invariably during the transit boat journey to 30-40 'Ghats' (sampling sites) for the plankton and lake water samples.

Kabar lake wetland located north west of Begusarai town in North Bihar is the largest winter habitat for waterfowl and other birds in the North-eastern region, indeed the entire North India (WWF-India & AWB, 1993). Interestingly enough, the intrinsic natural potential of the Kabar lake as a major waterfowl habitat has been highlighted only during the last decade or so. The upsurge in the limnological attributes of the lake and their positive role in the overall ecology *vis-à-vis* aquatic productivity and further its holistic value as a major waterfowl habitat calls for systematic long term comprehensive multidisciplinary investigation.

The expressive array of waterfowl inhabiting the freshwater habitat can be gauged by distressing reports already given elsewhere in the book. The unbridled wanton destruction and

exploitation of wintering and residential waterfowl population has led a visible detrimental effect on the once magnificent bird fauna. The threat and significant impact on the waterfowl population were perceptible enough although the course of field studies with barely one tenth of the original waterfowl population wintering in the wetland during the period under review. The decline on the wintering Anatidae population was too obvious to be missed especially during the winters for two consecutive years. In fact, the destruction to the wetland habitat through landuse, increased agricultural activities and increased drawl of water for irrigation appeared more pronounced during the winter months of 1990-1991, with the wetland wearing a deserted look with its ever shrinking water spread area, dried up swamp beds, dead and decaying aquatic macrophytes and increase in the reedy grass land. Only the members of Ciconiade (Storks) and Ardeidae (Herons & Egrets) appeared to be thriving *albeit* in reduced numbers. Moderately thick flocks of Openbilled storks (*Anastomoses oscitans*) in some interior pockets of the wetlands were only consolation.

The much proclaimed conservation measures initiated in force since, 1986-declaration as a prohibited zone and later as a bird sanctuary by Govt. of India in 1989 under Wildlife Protection Act (1972) did not apparently appear to have lured back the winged visitors. Nevertheless, it did succeed in applying brakes to the unbridled menace of bird trapping, though the authors find evidence of the practice *albeit* in its dying stages hopefully. Similarly, again the fishing is legally banned in certain parts of the lake, the authors experience has been otherwise. Also perhaps the intrinsic history of the lake and its special legal status are the major impediment in strict enforcement of conservation measures.

No comprehensive waterfowl census was initiated in the past, despite the importance of Kabar lake together with adjoining chaur

(water bodies) as wintering ground for migratory Anatidae. The following general composition of the waterfowl and other bird population in Kabar lake is after WWF & AWB, 1993. According to these sources, an analysis of approximately 33,954 birds trapped in 1983-84 winter season revealed the "Kill" composed of the following : *Fulica atra* (22.3%), *Anas acuta* (16.5%), *Anas crecca* (13.8%) *Porphyrio porphyrio* (9.0%), *Netta rufina* (4.6%), *Aythia ferina* (4.6%). *Anas strapera* (4.2%), *Anas clypeata* (3.9%), *Podiceps cristatus* (0.5%). The remaining 19.8% (6,700 birds) listed as other species presumably included species of *Anas quadriquadula* and *Aythia nyroca*, both reportedly common in the lake.

A partial census of the waterfowl undertaken in January 1987 recorded the following bird species—*Anastomoses oscitans* (100 exs.), *Dendrocygna, bicolor* (50-60 exs.), *Anas crecca* (500 exs.), *Anas acuta* (1,500 exs.), *Anas quadrecauda* (2,000 exs.), *Netta Ruffina* (150 exs.), *Aythia nyroca* (500 exs.), and *Porphyrio porphyrio* (250 exs.) [WWF India – AWB, 1993]. Yet another official estimate (Forest Department, Govt. of Bihar), revealed the number of birds frequenting the wetland is 109 species of residential and 59 species of migratory birds, as given in the list.

From the study by the authors, Anatidae and Rallidae predominate in the migratory species, while Ciconidae, Phalacrocoracidae, Jacanidae, and Charadriidae among the residential species. In summer months the number is reduced considerably (only 72 species recorded), as the migrant bird return back to their northern breeding ground. The Openbilled stork (*Anastomoses oscitans*) out number the other aquatic birds in the lake during the summer. In fact, they may be regarded as predominant bird group in the lake as they are common right all round the lake interior although the study period, indeed even in winters.

The predominance of Ciconidae in Kabar

lake is also confirmed earlier by Singh & Roy (1990). They reported nine orders of birds of which pelicaniformes and passeriformes species were substantial. Until perhaps the early eighties, the anatidae and charadriiformes, to lesser extent dominated the wintering avifaunal population, comprising together more than 25% of the entire waterfowl. According to our own analyses of the published records, it is natural to conclude that the overall bird nekton population in the lake is grossly influenced by both *extrinsic* and *intrinsic* factors, the extrinsic factors (anthropogenic activity) attended threat and changes in the once pristine habitat, exercising far greater direct impact than other parameters put together. Singh & Roy (1990) also rightly attributed the seasonal changes in the bird population in the Kabar lake to a complex mix or interplay of extrinsic and intrinsic factors. The similarity in observation is not surprising for both the present study and also the one by Singh & Roy (1990) covers almost the same period save for the exhaustive nature of the present study, and the causative factors operating (bird trapping and other changes in the habitat) were the same. The two studies, therefore, lend credence to each other and indeed supplement the findings.

The visiting migratory birds utilise the lake as a foraging and wintering ground during the annual winter season. The local resident and other birds, thrive in the wetland habitat making the optional use of the lake and its environs as feeding/breeding, nesting and perching ground.

The limnological influence of the bird nekton and the contributions have not been highlighted especially with reference to freshwater wetlands in India. Significance limnological inputs, import of nutrients from outside into the lake, impact of bird droppings (faecal material), and further through predation, complex food webs and thus the general ecology deserves detailed investigation not in isolation but more as an important component

of the wetland ecosystem. Eventually, these initial information input will help to evaluate the complete aquatic ecology of the wetland and suggest measures for judicious conservation and meaningful management.

In conclusive, Kabar lake, is a major freshwater wetland ecosystem and is an important waterfowl habitat. Its ecology appears to be basically governed by the whole complex gamut of abiotic, biotic and indeed materiological inputs into the system. Together, the resultant physico-chemical milieu through a complex interchange, exercises a regulatory influence on the whole gamut of biotic diversity or biological attributes of the lake i.e., the entire wetland diversity the flora and fauna. Eventually the wetland habitat helps to provide innumerable complex food, ecological and trophic niche for the diverse habitats.

## SUMMARY

The present paper deals with the results of observations made for three consecutive years covering all seasons of the wetland. During the expedition to the lake ecosystem, standard avifaunal survey techniques were followed and the specimens could not be collected due to the Indian Wildlife (Protection) Act in force. Studies on the avifauna of Kabarlake reveals the distribution of 59 migratory species belonging to 34 genera, 16 families, 9 orders and 107 residential forms under 81 genera, 35 families and orders. The paper also deals with the habitat preference, status and distribution of the avifauna of the wetland, located in the Indo-Gangetic plain.

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**Table-1.** Distribution of wetland birds, in Kabar lake Bihar in comparison to Indian wetland.

Family	Genus		Species		X
	India	Kabar	India	Kabar	
Podicipedidae	1	1	3	2	10
Phalacrocracidae	2	2	4	4	10
Aradeiade	8	7	20	16	10
Ciconidae	5	4	8	4	9.2
Threskiornithidae	4	4	4	4	9.5
Anatidae	18	8	41	20	10
Accipetridae	7	11	15	12	6
Falconidae	1	1	2	1	6
Phasianidae	2	1	2	1	6
Gruidae	2	1	2	1	6.7
Rallidae	8	7	16	7	10
Jacanidae	2	2	2	2	10
Haemantopidae	1	1	1	1	10
Rostratulidae	3	1	3	1	10
Recurvirostridae	3	2	3	2	10
Glareolidae	1	1	2	2	10
Charadriidae	15	7	55	18	9.9
Laridae	6	5	19	7	10
Cuculidae	11	4	11	4	10
Strigide	3	4	5	4	7
Alcedinidae	4	4	10	4	8.3
Meropidae	1	1	4	2	3.5
Hirundinidae	2	1	6	2	5.5
Dicruridae	1	1	2	2	2
Sturnidae	1	2	2	6	5
Muscicappidae	24	13	46	16	2.8
Motacillidae	2	2	2	8	4.5
Nectrinidae	1	1	1	1	3
Ploceidae	4	4	6	8	2.3
<b>Total</b>	<b>143</b>	<b>103</b>	<b>304</b>	<b>162</b>	
% of wetland birds		72.02		53.29	

Source : X Index of dependence of wetlands Vijayan, 1986.

**Table-2.** Status of Kabar lake wetland birds.

Family	Resident	Local migrant	Migrant	Resident migrant
Podicipedidae	1	—	1	—
Phalacrocracidae	4	4*	—	—
Aradeiade	4	10	2	—
Ciconidae	2	2	2**	—
Threskiornithidae	1	—	2	1
Anatidae	4	—	16	—
Accipetridae	6	4	2	—
Falconidae	1	—	—	—
Phasianidae	1	—	—	—
Gruidae	1	—	—	—
Rallidae	4	—	3	—
Jacaniidae	1	1	—	—
Haemantopidae	1	—	—	—
Rostratulidae	1	—	—	—
Recurvirostridae	—	2	—	—
Glareolidae	—	—	2	—
Charadriidae	4	12	—	2
Laridae	1	2	4	—
Cuculidae	4	—	—	—
Strigide	2	2	—	—
Alcedinidae	4	—	—	—
Meropidae	—	2	—	—
Hirundinidae	—	1	1	—
Dicruridae	2	—	—	—
Sturnidae	3	2	1	—
Muscicappidae	6	6	4	—
Motacillidae	2	2	4	—
Nectrinidae	1	—	—	—
Ploceidae	6	2	—	—
<b>Total</b>	<b>67</b>	<b>54</b>	<b>44</b>	<b>3</b>
% of species	40	32	26	2

(\*Local migrant and resident \*\* Migrant and Local migrant)

**Table-3.** Habitat preferences of the families of birds in Kabar lake.

Family	Open water	Floating macrophytic vegetation	<i>Phragmites</i> & Marginal emergent plants	Marginal grassland habitat	Marginal terrestrial vegetation
Podicipedidae	+	—	—	—	—
Phalacrocoracidae	+	+	—	—	—
Ardeidae	—	—	+	+	+
Ciconidae	—	—	+	+	—
Threskiornithidae	+	+	+	—	—
Anatidae	+	—	+	—	—
Accipetridae	—	—	—	+	+
Phasniidae	—	—	—	—	+
Rallidae	+	+	—	—	—
Jacanidae	+	+	+	—	—
Haemantopidae	—	—	+	—	—
Rostratulidae	—	—	+	+	—
Recurvirostridae	—	—	+	—	—
Glareolidae	—	—	+	+	—
Laridae	—	+	+	—	—
Cuculidae	—	—	—	—	—
Strigidae	+	—	—	—	+
Apodidae	—	—	—	+	+
Alcedinidae	+	+	—	—	—
Dicruridae	—	—	—	+	+
Upupidae	—	—	—	+	+
Sturnidae	—	+	—	+	+

(+ denotes the habitat preferences)

Families with value of index of dependence on wetland more than 5 only listed.

Table - 4. List of migratory birds of Kabar lake wetland Bihar.

Order	Family	No.	Common name	Species
PODICIPEDIFORMES	PODICIPIDIDAE	1	Great Crested Grebe	<i>Podiceps cristatus cristatus</i> (Linnaeus 1758)
CICINIFORMES	ARDEIDAE	1	Bittern	<i>Botaurus stellaris</i> (Linnaeus 1758)
	CIOCONIDAE	3	Openbilled Stork	<i>Anastomoses oscitans</i> (Boddaert 1783)
	THRESKIORNITHIDAE	4	Glossy ibis	<i>Plagadis falcinellus</i> (Linnaeus 1766)
		5	Spoon bill	<i>Platelea leucoroidea major</i> Linnaeus 1758
ANSERIFORMES	ANATIDAE	6	Greylag Goose	<i>Anser anser rubrirostris</i> (Swainhoe 1804)
		7	Barheaded Gosse	<i>Anser indicus</i> (Latham 1790)
		8	Brahminy duck	<i>Tadorna ferruginea</i> (Plalas 1764)
		9	Pintail	<i>Anas acuta</i> (Linnaeus 1758)
		10	Common Teal	<i>Anas crecca crecca</i> (Linnaeus 1758)
		11	Shoveller	<i>Anas clypeata</i> (Linnaeus 1758)
		12	Gadwall	<i>Anas strapera strapera</i> (Linnaeus 1758)
		13	Wigeon	<i>Anas penelope</i> (Linnaeus 1758)
		14	Mallard	<i>Anas platyrhynchos</i> (Linnaeus 1758)
		15	Spotbilled duck	<i>Anas poecilorhynchha</i> (Forester 1781)
		16	Garganey	<i>Anas querquedula</i> (Linnaeus 1758)
		17	Redcrested Pochard	<i>Netta ruffina</i> (Linnaeus 1758)
		18	Common Pochard	<i>Aythya ferina</i> (Linnaeus 1758)
		19	White eyed Pochard	<i>Aythya nyroca</i> (Goldenstadt 1770)
		20	Tufted duck	<i>Aythya fuligula</i> (Linnaeus 1758)
		21	Scoup dick	<i>Aythya marila</i> (Linnaeus 1761)
FALCONIFORMES	ACCIPETRIDAE	22	Pale harrier	<i>Circus marcourus</i> (Gmelin 1770)
		23	Marsh harrier	<i>Circus aeruginous Aeruginosus</i> (Linnaeus 1758)
	FALCONIDAE	24	Eastern Perigrine Falcon	<i>Falco peregrinus</i> (Tunstall 1771)
GRUIFORMES	RALLIDAE	25	Indian Water Rail	<i>Rallus aquaticus</i> (Linnaeus 1758)
		26	Spotted crane	<i>Porzana porzana</i> (Linnaeus 1766)
		27	Coot	<i>Fulica atra atra</i> (Linnaeus 1758)
CHARADRIFORMES	CHARADRIDAE	28	Curlew	<i>Numenius arquata</i> (Linnaeus 1758)
		29	Golden plover	<i>Pluvialis apricaria</i> (Linnaeus 1758)

Order	Family	No.	Common name	Species
		30.	Common Red Shank	<i>Tringa totanus</i> (Linnaeus 1758)
		31.	Marsh sandpiper	<i>Tringa stagnatilis</i> (Bechstein 1803)
		32.	Green shank	<i>Tringa nebularia</i> (Gunner 1767)
		33.	Green sandpiper	<i>Tringa ochropus</i> (Linnaeus 1758)
		34.	Woodspotted sandpiper	<i>Tringa glareola</i> (Linnaeus 1758)
		35.	Common sandpiper	<i>Tringa hypoleucos</i> (Linnaeus 1758)
		36.	Fantail snipe	<i>Gallinago gallinago gallinago</i> (Linnaeus 1758)
		37.	Pintail snipe	<i>Gallinago sternura</i> (Benaparte 1830)
		38.	Jack	<i>Gallinago minima</i> (Brunnich 1764)
		39.	Little stint	<i>Calidris minuta</i> (Leisler 1812)
		40.	Temminck's stint	<i>Calidris temminckii</i> (Leisler 1812)
	RECURVIROSTRIDAE	41.	Indian Pratincole	<i>Glariola platincola</i> (Linnaeus 1766)
	LARIDAE	42.	Brownheaded Gull	<i>Laris brunnicephalus</i> (Jerdon 1840)
		43.	Indian Wiskered Tern	<i>Chilodinius hybridus</i> Pallas 1881
		44.	Greenbilled Tern	<i>Gelochilonidas nilotica</i> (Gmelin 1879)
		45.	Common Tern	<i>Sterna hirundo</i> (Linnaeus 1758)
STRICIFORMES	STRIGIDAE	46.	Short eared Owl	<i>Asio flamellus</i> (Pontoppidan 1763)
PASSERIFORMES	HIRUNDINIDAE	47.	Swallo	<i>Hirundo rustica</i> (Linnaeus 1758)
	LANIDAE	48.	Pale-brown Shrike	<i>Lanius collurio</i> (Linnaeus 1758)
	MUSCICAPPIDAE	49.	Red breasted Flycatcher	<i>Muscicappa parva</i> (Bechstein 1794)
		50.	Verditer Flycatcher	<i>Muscicappa thalassina</i> (Swainson 1838)
		51.	Greyheaded Flycatcher	<i>Muscicappa ceylonensis</i> (Swainson 1820)
		52.	Thickbilled Warbler	<i>Phragmanticola aedon</i> (Pallas, 1776)
		53.	Chiff-chaff	<i>Phylloscopus collybita</i> (Vieillot 1817)
	STURNIDAE	54.	Black red Strat	<i>Phoenicurus ochropus</i> (Gmelin 1879)
	MOTACILLIDAE	55.	Indian Tree Pipit	<i>Anthus hodgsoni hodgsoni</i> (Richmand 1907)
		56.	Paddy Field Pipit	<i>Anthus novaeseelandiae richardi</i> (Vieillot 1818)
		57.	Grey Wagtail	<i>Motacilla cinera cinera</i> (Tunstall 1778)
		58.	Yellow Wagtail	<i>Motacilla flava</i> (Linnaeus 1758)
		59.	Pied Wagtail	<i>Motacilla alba</i> (Linnaeus 1758)

**Table-5.** List of Residential birds of Kabar lake wetland Bihar.

Order	Family	No.	Common name	Species		
PODICIPEDIFORMES	PODICIPIDIDAE	1.	Little Greb	<i>Podiceps ruficollis</i> (Pallas 1764)		
PELICANIFORMES	PHALACROCORACIDAE	2.	Large Cormorant	<i>Phalacrocorax carbo sinensis</i> (Linnaeus 1758)		
		3.	Indian Shag	<i>Phalacrocorax fuscicollis</i> (Stephens 1826)		
		4.	Little Cormorant	<i>Phalacrocorax niger</i> (Vieillot 1817)		
		5.	Darter	<i>Anhinga rufa melanogaster</i> (Pennant 1769)		
		CICONIFORMES	ARDEIDAE	6.	Grey Heron	<i>Ardea cinera rectirostris</i> (Gould 1843)
7.	Purple Heron			<i>Ardea purpurea manilensis</i> (Mayen 1834)		
8.	Little Egret			<i>Ardea alba modesta</i> (J.E. Gray 1831)		
9.	White bellied Heron			<i>Ardea insignis</i> (Hume 1878)		
10.	Pond Heron			<i>Ardeola grayii grayii</i> (Sykes 1832)		
11.	Cattle Egret			<i>Bubulcus ibis coramandus</i> (Boddaert 1873)		
12.	Medium Egret			<i>Egretta intermedia intermedia</i> (Wagler 1829)		
13.	Little Egret			<i>Egretta garzetta garzetta</i> (Linnaeus 1766)		
14.	Indian Reef Heron			<i>Egretta gularis</i> (Bose. 1792)		
15.	Night Heron			<i>Nycticorax nycticorax nycticorax</i> (Linnaeus 1758)		
16.	Little Green Heron			<i>Butoroides striatus</i> (Lonnaeus 1758)		
17.	Chestnet Bittern			<i>Ixobrychus cinnamomeus</i> (Gmelin 1789)		
18.	Little Bittern			<i>Ixobrychus minutus</i> (Linnaeus 1766)		
19.	Yellow Bittern			<i>Ixobrychus sinensis</i> (Gmelin 1789)		
20.	Black Bittern			<i>Ixobrychus flavicollis</i> (Latham 1790)		
CICONIDAE	CICONIDAE			21.	Whitenecked Stork	<i>Ciconia episcopus episcopus</i> (Boddaert 1783)
				22.	Adjutant Stork	<i>Leptopilos dunius</i> (Gmelin 1879)
				23.	Blacknecked Stork	<i>Epiphyorhynchus asiaticus</i> (Linnaeus, 1758)
THRESKIRONITHIDAE	THRESKIRONITHIDAE	24.	Spoonbil	<i>Platelia leucoroides major</i> (Temminck & Schlegel)		
		25.	Black ibis	<i>Pseudibis papillosa</i> (Hodgson 1844)		
		ANSERIFORMES	ANATIDAE	26.	Combduck	<i>Sarkidiornis melanotus</i> (Linnaeus 1758)
27.	Wistling teal			<i>Dendrocygna javonica</i> (Horsfield 1821)		
28.	Fulcrous wistling teal			<i>Dendrocygna bicolor</i> (Vieillot 1816)		

Order	Family	No.	Common name	Species
FALCONIFORMES	ACCIPETRIDAE	29.	Cotton teal	<i>Nettapus coramandelianus coramandelianus</i> (Gmelin 1879)
		30.	Blackwinged kite	<i>Elanus caeruleus vociferus</i> (Latham 1790)
		31.	Pariah kite	<i>Milvus migrans migrans</i> (Boddaert 1783)
		32.	Brahminty kite	<i>heliastur indus indus</i> (Boddaert 1783)
		33.	Indian shikara	<i>Accipiter badius dussumieri</i> (Temninck 1824)
		34.	Spotted eagle	<i>Aquila clanga</i> (Pallas 1811)
		35.	Pallas fishing eagle	<i>Heliaetus leucorhynchus</i> (Pallas 1771)
		36.	Whitebellied vulture	<i>Gyps bengalensis</i> (Gmelin 1788)
		37.	Scavenger vulture	<i>Nephron perenopterus</i> (Linnaeus 1758)
		38.	Buzzard eagle	<i>Butaster teesa</i> (Franklin 1832)
		39.	Serpent eagle	<i>Spilornis cheela melanotus</i> (Latham 1790)
		40.	Red Merlin	<i>Falco chicquera</i> (Daudin 1800)
		GALIFORMES	PHASIANIDAE	41.
GRUIFORMES	RALLIDAE	42.	White breasted waterhen	<i>Amaurornis phoenicurus</i> (Pennant 1769)
		43.	Moorhen	<i>Gallinula chloropsis indica</i> (Linnaeus 1758)
		44.	Purple Moorhen	<i>Porphyrio porphyrio</i> (Linnaeus 1758)
		45.	Water cock	<i>Gallicrex cinera</i> (Gmelin 1789)
CHARADRIFORMES	JACANIDAE	46.	Pheasant tailed Jacana	<i>Hydrophasianus chirugris</i> (Scopoli 1786)
	GLAREOLIDAE	47.	Small Indian Pratincole	<i>Glareola lactea</i> (Temninck 1820)
	ROSTRATULIDAE	48.	Painted snipe	<i>Rostratula bengalensis bengalensis</i> (Linnaeus 1758)
	CHARADRIDAE	49.	Yellow wattled lapwing	<i>Vanellus malabaricus</i> (Boddaert 1783)
		50.	Red wattled lapwing	<i>Vanellus indicus indicus</i> (Boddaert 1783)
		51.	Little ringed plover	<i>Charadrius dubius jerdoni</i> (Scopoli)
		52.	Stpme curried plover	<i>Esacus recurvirostris</i> (Cuvier)
			53.	Curlew
		54.	Sandpiper	<i>Tringa glareola</i> (Linnaeus 1758)
	LARIDAE	55.	Indian River Tern	<i>Sterna aurantia</i> (J.E. Gray 1831)

Order	Family	No.	Common name	Species
COLUMBIFORMES	COLUMBIDAE	56.	Little Tern	<i>Sterna albifrons</i> (Pallas 1764)
		57.	Blue rock pigeon	<i>Columba livia intermedia</i> (Gmelin 1789)
		58.	Indian ring doe	<i>Streptopelia decaocto decaocto</i> (Frisvaldszky 1838)
		59.	Indian spotted dove	<i>Streptopelia chinensis tigrina</i> (Temnick 1820)
PSITTACIFORMES	PSITTACIDAE	60.	Large Indian Parakeet	<i>Psittacula eupatria eupatria</i> (Linnaeus 1766)
		61.	Roseringed Parakeet	<i>Psittacula kremeri borealis</i> (Scopoli 1769)
CUCULIFORMES	CUCULIDAE	62.	Koel	<i>Eudynamys scolopacea scolopacea</i> (Linnaeus 1758)
		63.	Coucal	<i>Centropus sinensis intermedius</i> (Stephens 1815)
		64.	Brainfever bird	<i>Hirococcyx varius varius</i> (Vahl 1797)
		65.	Indian Plaintive	<i>Coccomantis merulianus passerinus</i> (Vahl 1797)
		66.	Indian barn owl	<i>Tyto alba</i> (Scopoli, 1769)
STRIGIFORMES	STRIGIDAE	67.	Brown fish owl	<i>Ketupa zeylonicus leschelault</i> (Gmelin 1788)
		68.	Spotted owl	<i>Alteus brama indica</i> (Temminck 1821)
		69.	House swift	<i>Apus affinis affinis</i> (J.E.Gray 1830)
APODIFORMES	APODIDAE	70.	Plamswift	<i>Cypsiurus parvus infumatus</i> (Scatter)
		71.	Blackwinged swift	<i>Himantopus minantopus himantopus</i> (Linnaeus 1758)
CORACIFORMES	ALCEDINIDAE	72.	Pied Kingfisher	<i>Ceryle rudis</i> (Linnaeus 1758)
		73.	Small blue Kingfisher	<i>Alcedo atthis benghalensis</i> (Linnaeus 1758)
		74.	Whitebreasted Kingfisher	<i>Halcyon smirnensis</i> (Linnaeus 1758)
		75.	Blue tailed Bee-eater	<i>Merops orientalis orientalis</i> (Linnaeus 1758)
UPUPIDAE	MEROPIDAE	76.	Small Green Bee-eater	<i>Merops philippinus philippinus</i> (Linnaeus 1758)
		77.	Hoopoe	<i>Upupa epops longirostris</i> (Linnaeus 1758)
PICIFORMES	CORACIIDAE	78.	Indian Roller	<i>Coracias benghalensis affinis</i> (Horsfield 1840)
		79.	maharatta Woodpecker	<i>Dendrocopos Maharatensis</i> (Latham, 1790)
PASSERIFORMES	PICIDAE	80.	Golden backed Woodpecker	<i>Dimopium benghalensis benghalensis</i> (Linnaeus 1758)
		81.	Rufous winged Bushlark	<i>Mirafra assamica</i> (Horsfield 1840)
		82.	Redwinged Bushlark	<i>Mirafra erythroptera</i> (Blyth 1845)
		83.	Rufous tailed Finehark	<i>Ammomanes phoenicurus</i> (Franklin 1831)
	ALAUDIDAE	84.	Small Skylark	<i>Alauda gulgula</i> (Franklin 1831)

Order	Family	No.	Common name	Species
	HIRUNDINIDAE	85.	Common swallow	<i>Hirundo rustica</i> (Linnaeus 1758)
	MOTACILLIDAE	86.	White Wagtail	<i>Motacilla alba dhakunensis</i> (Sykes 1911)
		87.	Indian Pipit	<i>Anthus novaseelandiae richardii</i> (Vieillot 1817)
	IRENIDAE	88.	Redvented Bulbul	<i>Pycnonotus cafer benghalensis</i> (Deignam 1864)
	MUSCICAPPIDAE	89.	Fantail Flycatcher	<i>Rhipidura aureola aureola</i> (Lesson 1830)
		90.	Common Babler	<i>Turdoides caudatus</i> (Dumont 1823)
		91.	Jungle Babler	<i>Turdoides striatus striatus</i> (Dumont 1823)
	NECTARINIDAE	92.	Sunbird	<i>Nectarinia asiatica asiatica</i> (Latham 1801)
	EMBERZIDAE	93.	Blackwinged Bunting	<i>Emberiza melanocephala</i> (Scopoli 1769)
	PLOCEIDAE	94.	Spotted Munia	<i>Lonchura punctatula punctatula</i> (Linnaeus 1766)
		95.	Blackwinged Munia	<i>Lonchura malaca Malaca</i> (Linnaeus 1758)
		96.	Common sparrow	<i>Passer domesticus indicus</i> (Jerdine & Selby 1886)
		97.	Tree sparrow	<i>Passer montanus malaccensis</i> (Dubois 1912)
	STURNIDAE	98.	Greyheaded Myna	<i>Sternus malbaricus malbaricus</i> (Gmelin 1789)
		99.	Brahminy Myna	<i>Sternus pagodorum</i> (Gmelin 1789)
		100.	Peid Myna	<i>Sternus contra contra</i> (Linnaeus 1758)
		101.	Common Myna	<i>Acridotherus tristis tristis</i> (Linnaeus 1758)
		102.	Bank Myna	<i>Acridotherus gingianus gingianus</i> (Latham 1790)
	CORVIDAE	103.	Indian Treepie	<i>Dendrocitta vagabunda vagabunda</i> (Linnaeus 1758)
		104.	House Crow	<i>Corvus splendens splendens</i> (Vieillot 1817)
		105.	Jungle Crow	<i>Corvus macrorhynchos culminatus</i> (Sykes)
	DICRURIDAE	106.	Whitebellied Drongo	<i>Dicrurus adsimilis albrictus</i> (Hodgson)
		107.	Black Drongo	<i>Dicrurus caerulescens caerulescens</i> (Linnaeus 1758)



## ENVIRONMENTAL ASSESSMENT OF KABAR LAKE

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### INTRODUCTION

Increased public awareness for halting environmental degradation have now necessitated environmental appraisal of all projects and natural ecosystems such as wetlands on cost benefit ratio, in terms not just of ecology and environment but also on the socio-economic scale. Therefore, there is an imperative need to collect information on the overall impact on the regional ecology, forest, vegetation, wildlife, associated flora and fauna, besides any local heritage such as archeological and aesthetic values. In essence, the overall extent of benefit/damage for such systems are scrutinised.

Impact assessments are prepared not to underestimate the proposals of the projects by highlighting the inadequacies or deficiencies, but to arrive at a conclusion, so that better appraisal is obtained with least disturbance to the nature we inherit. Thus Environmental Impact Assessment is defined as "An activity designed to identify and predict the impact on biogeographical environment and on the man's health and well being, of the legislative proposal, policies, programmes and operational procedures to interpret and communicate information about the impacts" (Munn, 1979). In other words, it is the environmental planning based on past records, present observation and for future utilisation in a best possible manner.

**Study Area :** The river Ganges and its tributaries are constantly vulnerable to their change in their course in the delta region, leaving behind many natural depressions, which are later

rained forming Ox-bow lakes. One such largest lake situated in the Indo-Gangetic plain is Kabar Lake (Kabar tal, Kanwar Jheel) situated at about 22km North-west of Begusarai town in Bihar state. The water spread area of the lake is subjected to high flood during monsoon months. The water spread area extends to nearly 7,400 hectares during monsoon months and to about 300-400 ha during summer due to heavy letting off the water for irrigation. During summer, therefore, over for 2800 ha of the exposed mudflat is converted into paddy fields.

**Legal Status of the Lake :** During monsoon months, the lake is flooded to its full capacity, the landless Sahanis holds the fishing rights and when water recedes, the exposed lake bed is used by the land owner for cultivation. As per the Bihar Gazette Notification, under Wildlife Protection Act of 1972 (Act 53 of 1972), Kabar Lake, situated in the Begusarai district of Bihar is declared as "Closed Area" and shall be called "Kanwar Jheel Pakshi Vihar"

**Data Collection Method :** Following methods are employed for collection of the data for compilation of Environmental Assessment :

1. Use of Existing data: Data available from the previous surveys, records and Gazetteers.
2. Utilisation of available data: Data available from irrigation and Command area development authorities, fisheries, geologists, forests officers, districts administration etc.

3. Enquiries from Public : Informal and random enquiries from the villagers, and other officials on various aspects of health, domesticated animals, vegetation, wildlife, food habits etc.
  4. Experimentation: Detailed analysis on the limnological, floral, faunistic and ecological aspects carried out in the area during different seasons.
- Schistosomiasis and filariasis are reported from the area, however their incidence is limited.
  - Gastro-enterities, common in villages surrounding the wetland, where the villagers utilise raw and stagnant water for drinking, especially during monsoon months. It is more to the personal hygiene than wetland contribution.

### RESULTS OF ASSESSMENT OF WATER QUALITY

The surface water quality, at present was in the permissible range (pH 6.9–8.5, clear and transparent, suspended solids minimum, dissolved oxygen always > 5mg/l, nutrients minimum values).

- Groundwater needs a closer monitoring of its quality due to salinity intrusion.
- The wetland is free from any source and cause of water quality deterioration, such as major industries releasing effluents from vegetable processing, chemical industry, iron and steel manufacturing, coal mining, metal finishing, brewing, dairy products, quarrying and power generation etc.
- The total salt content, hardness, pH, biochemical oxygen demand and sodium absorption ratio are in the favourable range for irrigation.
- Environmental and public health problems are likely to arise from such wetland due to vector borne diseases such as malaria spread through mosquitoes, sometimes becoming endemic. However, analysis revealed that the dipteran larvae are far less in number. Probably the extensive growth of macrophytic vegetation especially *Chara* species has inhibitory effect on the mosquito larvae. Further, the presence of large number of adult and larval stages of insects are predatory for these mosquito larvae.

### MAJOR WETLAND PROBLEMS

Kabar Lake wetland, an ox-bow lake formed by the meandering river, located in the Indo-Gangetic plain of north Bihar is known for its winter visiting bird fauna, fishery resource, that sustains a large population of fishing Sahanis, macrophytic vegetation especially reeds of *Phragmites karka* extensively exploited as fodder and thatching material. The lake bed is used for agriculture during lean period. The following problems, often causing concern to the managers of this closed area are :

1. The water spread area is subjected to high floods during monsoon months (7400ha) loses its continuity during post monsoon months due to the letting off the water for irrigation. The legal boundaries are still not clearly demarcated.
2. The fishing rights with the landless Sahanis and the tilling rights with the private ownership often cause tension among the beneficiaries.
3. The declaration of Kabar Lake wetland as "Closed Area" (Kanwar Jheel Pakshi Vihar) by the State Government fuelled additional worry to the traditional users such as Sahanis and land owners.
4. Sheet wash erosion of top soil, ground water salinity and inundation in the south eastern portion are the major geological hazards.
5. The channel from the wetland leading to the

- river is often choked and not properly functioning, causing concern to the wetland.
6. The flooding, maintenance of water level and release to agricultural use needs a closer monitoring for wetland management.
  7. Indiscriminate poaching in the past has taken its toll on the winter visitors. The result of such act is already felt by the wetland, by the way of reduction in the number of birds. Though such cases are far less in recent years, the desired results are yet to be felt by the wetland.
  8. The wetland offers an excellent example of macrophytic diversity (112 species recorded), offering a rich variety of food, shelter, nesting and roosting site for birds, fishes and insects, is often exploited as fodder and thatching material needs a closer look before being exploited by the local population.
  9. The senescence of the macrophytic vegetation in the wetland needs further investigation, as this decomposed organic matter is often exploited by the local population for piggery, might lead to eutrophication due to the anthropogenic activity.
  10. The application of fertilizers, pesticides and herbicides in the agricultural fields adjacent to the wetland causes rapid deterioration in the water quality, leading to the change in the biota. This might lead to the disturbance in the wetland ecology.
  11. Wetland in the Gangetic plain are the major source of fish breeding ground, maintenance of such sites are important for fishery resources in the rivers.
  12. The fish production in Bihar is below average (Singh 1992), owing to poor management priorities. A closer and proper management will bring the desired result on increased production. This will also help the economic status of the fishing Sahanis as well as avifauna, the wetland is known for.
  13. Introduction of fishes such as *Tilapia* species often leads to the reduction of sensitive species, as these are highly voracious in their feeding habit.
  14. Weed infestation often results in undesirable effect not only on the ecology of the lake but also on the feeding behaviour of birds. According to Vijayan (1996), a number of waterfowl require habitat with good proportion of open water and less grass habitat (Pochards, Coots, Cormorants, Cotton teal). However, ducks feed on submerged vegetation. Invasion of *Phragmites* and other grasses in the open water has reduced the preferred habitat for waterfowl.
 

Furthermore, the decrease in the open water has also affected the breeding heronaries, darter, cormorants, painted storks and ibis. According to author (ibid), the sight of open water is one of the required stimulus for the birds to lay eggs.
  15. Introduction of pigs in the lake bed during the drier months need a closer monitoring, as the rhizomes of *Scirpus*, *Cyperus*, *Nymphaea*, *Elocharis* are often fed and uprooted by these pigs depriving the food for cranes.

#### FUNCTIONS OF THE KABAR LAKE WETLAND

1. **Flood mitigation** : Kabar lake wetland, is a saucer shaped depression, in Indo-Gangetic belt is fed by the river Burhi Gandak, a tributary of river Ganges, thus receives extra water during floods in the area.
2. **Sediment removal** : A large amount of sediment received from the incoming water during high floods are trapped by the saucer shaped depression of the wetland.

3. **Nutrient removal** : The wetland exhibits nearly oligotrophic condition, due to the extraction of the nutrients by the large mass of submerged, free floating and amphibious macrophytic vegetation.
4. **Toxicant removal** : The macrophytic vegetation are known to remove large quantity of toxic material entering into the system.
5. **Groundwater recharge** : The alluvial deposit of Bihar by virtue of loose unconsolidated nature are the best reservoirs of ground water, as the soil is mainly consists of sand, gravel and clay. The porosity ranges from 17-30 percent. In Kabar lake wetland area, ground water is available within 2-3 meters range and it is believed that the wetland is a ground water lake zone ranging from 4-6 meters.
6. **Ground water discharge** : It is reported that several areas of Kabar lake wetland, the water is saline with high chloride percentage between the depths ranging from 131-135 meters and 145-151.5 meters respectively. The cause of salinity may be due to the stagnancy of the aquifer or the contamination of the hot spring water from unknown sources and depth.
7. **Nutrient export** : A large quantity of nutrients are stored in the biomass of the aquatic vegetation of the wetland and these are often extracted in the form of fodder or cottage industry as thatching material.
8. **Wildlife habitat** : Reserve forests and sanctuaries are absent in the vicinity of the wetland. Mammals are represented by the temple monkeys (*Macaca mulatta*). Other mammalian species recorded are *Vulpes bengalensis* (Fox), *Canis aureus* (jackals), *Boselaphus tragocemalus* (Nilgai), *Lepus nigricollis* (Hare) etc.

Kabar lake is a major wetland and an important waterfowl habitat. Nearly 59 species of migratory and 107 species of resident birds are recorded from the area.

Five species of reptiles belonging to four genera and three families *Lissemys punctata* (Indo-Gangetic Flapshell turtle), *Calotes versicolor* (Indian garden lizard), *Enhydrina enhydris* (Indian water snake), *Xenochrophis piscator* (Checkered keelback) and *Xenochrophis ceratogaster* (Dark bellied marsh snake) all are recorded for the first time from the wetland area of Bihar.

Seven species of amphibians under four genera and four families are recorded for the first time from the wetland, of which the species *Rana erythraea* is first record from the Bihar state.

Kabar lake is known for its fish fauna; as many as 37 species are recorded by the departmental studies, with the inclusion of the fishes from the nearby river connected with the lake, the fish fauna includes nearly 52 species. Recruitment is usually from the flood water of Burhi Gandak.

## SUMMARY

Bird trapping was common feature and as a result of the report of bird massacre of nearly 70,000 numbers during November-December 1981, the wetland became prominent to the public. Awareness, law enforcement by the state government and education has yielded the desired results of dwindling number of such cases. A close monitoring is still needed in this regard. Food and feeding habits, habitat preferences, migratory behaviour, socio-economic condition of the fishing sahanis and agricultural labourers, impact of anthropogenic activity, weed infestation, command area development are some of the environmental priorities for wetland management.









**PLATE-5**



Marsh snake from Kabar Lake Wetland



*Rana* sp. on the macrophytic vegetation







