Rec. zool. Surv. India : **97** (Part-4) : 103-143, 1999

FAUNAL RESOURCES OF WEST BENGAL—2
SOME SELECTED WETLANDS OF HAORA AND HUGLI DISTRICTS

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INTRODUCTION

The present paper deals with the wetland faunal resources of West Bengl based on some selected wetlands of Haora and Hugli districts. It includes a total of 32 freshwater wetlands comprising of 17 waterbodies from Haora and 15 from Hugli districts. The occurrence and diversity of species from these wetlands are dealt under 12 major faunal groups indicating the occurrence of each species recorded during 1991-92 and 1992-93.

The study of faunal diversity in wetlands/waterbodies of West Bengal was initiated by Annandale in the early part of twentieth century (*vide* Annandale and Dover, 1923). But after the Ramsar Convention in 1971, a fresh surge of interests was developed throughout the world including our country as well as in the State of West Bengal. Although the State covers an area of 88,752 sq. km. comprising of 18 districts, most of these studies in West Bengal were confined to Calcuta and its adjoining areas (Ghosh, 1987, 1990 ; Ghosh and Sen 1987, 1998 ; De *et al.*, 1989 ; Ghosh and Chattopadhyay, 1990, 1994). Of these, Ghosh and Chattopadhyay (1994) reported on the biological resources, particularly the aquatic flora (macrophytes) and avifauna of Santragachi jheel, Haora district, West Bengal. But, besides this report (Ghosh and Chattopadhyay, loc. cit.) no other studies were made so far from wetlands of these two districts.

Realising the importance of such studies from this part of the country, the present work on wetland faunal resources of West Bengal was initiated in late 1980s from different parts of the State. The first part of the work dealing with North and South 24-Parganas districts has been published (Nandi *et al.*, 1993) and the present one is the second in the series.

THE STUDY AREA

General

Both Haora and Hugli districts entirely fall under the physiographic subdivision known as 'mature delta' in the lower Ganga Plain. The vast plain of these two districts is endowed with fertile alluvial soils, 70 per cent of which is used for cultivation of paddy and kharif crops. These two districts, Haora and Hugli, have a total area of 1467 sq. km. and 3149 sq. km. with a population of 37.91 lakhs and 43.52 lakhs (as per 1991 census) i.e., having 2967 persons and 2311 persons per sq. km. respectively (Table 1). They are located between the latitudes 22°13' and 23°01' North and longitudes 87°30' and 88°30' East (Figs. 1 and 2). They are hemmed in between

Hooghly (Bhagirathi) river on the east and Rupnarayan river on the south-west and intersected by Damodar river. These rivers provide a network of waterways, notably the Damodar group with two branches *viz.*, the Kana Damodar or Kausiki and the old Damodar ; and the Bhagirathi group with its branch, the Saraswati. Numerous tributaries of the main rivers and creeks, called *khals*, which run dry or very shallow in summer months serve as the natural drainage system of the Damodar-Bhagirathi interriverine floodplain and Darakeswar-Damodar inter riverine floodplain areas of these two districts. The triangular portion west of the Darakeswar comprising of Goghat Police Station having an area of 378 sq. km. is the only upland region located in the Hugli district (Banerjee, 1972).

It may be mentioned that the very name of Haora district is derived from 'haor' (swampy area) which was earlier known to be present in countless number in this district. However, at present, this district is dominated by industrial establishments in the north-eastern sector.

Table 1. Physiographical features of Haora and Hugli districts

Parameters	Haora district	Hugli district
Area (in Sq. Km.)	1467	3149
Latitude	22°13'-22°47' N	22°39'-23°01'N
Longitude	87°51'-88°22' E	87°30'-88°30' E
Population (1991 census)	37.19 lakhs	43.52 lakhs
Population density (per sq. km.)	2967	2311
Climatic condition	Humid tropical	Humid tropical
Temperature (mean max.)		
Summer	35-40°C	34-40°C
Monsoon	28-32°C	27-32°C
Winter	11-18°C	11-17°C
Rainfall (Average)	167.6 cm	151.6 cm
Wet season (June to October)	120-150 cm	115-140 cm
Dry season (November to May)	15-45 cm	10-40 cm
Humidity	30-95%	30-95%
Soil type	Alluvial	Alluvial
Land scape type	'Mature delta' plain	'Mature delta' plain
Forest cover (sq. km.)	Nil	3 sq. km.
Protected area	Nil	Nil
Water resources (hectares)	12885	28267

Climate

The climatic conditions, though vary seasonally in these two districts, exhibit a regional uniformity consisting of two main seasons, *viz.*, the dry season from November to May and the wet season from June to October. The dry season during winter months (November to February) is characterised by cold weather with only a little cloud and rain, the fall varying from 0.32-2.5 cm. January is the coldest month with nearly uniform temperature of 13°C in the plains. Humidity gradually diminishes to about 60 per cent in February. Dew fall is highest in November and in the first half of December. Temperature rises gradually from March and is maximium in May which is marked as the hottest month with temperature reaching between 35°C and 40°C. Hailstorm sometimes diminishes the heat in March-April. Heat is also occasionally diminished by the "Nor' Westers" with sudden showers in summer (April-May). These districts receive an abundant rainfall (over 150 cm) through south-west monsoon which usually bursts in the second or third week of June. July is the wettest month with rainfall as high as 31 cm. Humidity becomes 90-95 per cent in monsoon months.

Soil

In general, soil of Haora and Hugli districts is alluvial type, poor in organic matter and nitrogen. The soil pH of the wetlands is near neutral varying between 6.5 and 7.5. Salinity in soil of some tidal flood areas of these two districts bordering Hugli and Rupnarayan rivers is negligible.

Vegetation

In ponds, *jheels* and marshy areas floating, fixed and amphibious macrophytes occur in abundance. This vegetation type includes emergent plants comprising mostly of the family Cyperaceae (*Mutha* grass) and Gramineae (fodder grass). The root and lower part of the stem of these hydrophytes are usually submerged under water while the leaves are exposed to the air. A number of species belonging to this vegetation type are commercially important such as *Shola* (*Aeschynomene indica*), *Madurkathi* and *Mutha* grass (*Cyperus* spp.), *Kalmi shak* (*Ipomoea aquatica*) and *Hogla* (*Typha elephantina*). Some rooted floating forms *viz.*, *Sushni shak* (*Marsilea quadrifoliata*) and *Paniphal* (*Trapa bispinosa*), naturally grown or cultivated in wetland areas are also known for their commercial value. Besides their commercial value, wetland plants are being increasingly recognized for their ecological values in recent years. They provide feeding, breeding, spawning and nesting sites for a large number of fishes, prawns, birds and other aquatic animals. While several plant species, namely, water hyacinth, wate lettuce and duckweeds, naturally grown in wetlands of Haora and Hugli districts, are being used in the pollution abatement of east Calcutta's sewage-fed wetlands. However, life form diversities of wetland plants occurring in these two districts can be conveniently categorised as follows (Table 2).

Table 2. Categorization of floral diversities with examples

Categories		Examples
A. Free floating forms :		
a) Floating hydrophytes	:	Kochuripana (*Eichhornia crassipes*), Tokapana (*Pistia*), Khudipana (*Lemna*). Guripana (*Wolffia*), Kutipana (*Azolla*), etc.
b) Suspended hydrophytes	:	Jhanji (*Ceratophyllum, Utricularia*).
B. Fixed anchored forms :		
a) Anchored submerged hydrophytes	:	Patashaola (*Vallisneria spiralis*), Panikola (*Ottelia*), Kureli/Jhanji (*Hydrilla*), Shaolaghas (*Najas*) etc.
b) Anchored floating hydrophytes	:	Padma (*Nelumbo nucifera*), Shapla (*Nymphaea* spp.), Panchuli (*Nymphoides* spp.), Paniphal (*Trapa* spp.), etc.
C. Amphibious forms :		
a) Emergent amphibious hydrophytes	:	Sushni shak (*Marsilea quadrifoliata*), Kalmi shak (*Ipomoea aquatica*), Halencha (*Enhydra fluctuans*), Senchi (*Alternanthera sessilis*), Shola (*Aeschynomene* spp.), Kochu (*Colocasia esculenta*), Ghechu (*Aponogeton* spp.), etc.
D. Facultative forms :		
a) Reeds	:	Nol/Khagra (*Phragmites karka*), Hogla (*Typha* spp.).
b) Sedge	:	Muthaghas (*Cyperus* spp.), etc.
c) Weeds	:	Thulkuri/Thankuni (*Centenella asiatica*).
E. Algal forms :		
a) Solitary unicellular algae	:	*Euglena, Microcystis*, Diatoms.
b) Colony forming algae	:	*Volvox*.
c) Filamentons algae	:	*Spirogyra, Oscillatoria*.
d) Branched coenocytic algae	:	*Chara, Nitella*.

Some algal forms *viz.*, *Spirogyra* and *Microcystis* occur abundantly in lentic freshwater systems. In summer months *Microcystis* often turns the water surface green in shallow water ponds. The colony forming algae, *Volvox*, particularly predominate in ponds during spring.

Wetland Profile

The wetlands of both Haora and Hugli districts are mainly small freshwater wetlands. Low salinity can only be encountered in wetlands adjacent to Hugli and Rupnarayan rivers for having tidal influence in some of them. The wetland units of these two districts vary in shape, size, origin and in vegetation type. There are both temporary and permanent wetlands as well as natural and man-made wetlands. The ponds, big or small, are locally known as *pukurs, dobas, dighies* and *jheels*. While *haors, beels, jolas* and *dahas* are natural wetlands. There is no lake or ox-bows as such in these districts. However, for convenience, these local wetland units are defined in addition to the common one (see 'Note' below) as follows (Table-3).

Table 3. Defining the local wetland units.

Local wetland units		Brief definition
A. Man-made wetlands		
i) *Pukur*	:	Small pond formed by hollowing out or impoundment.
ii) *Doba*	:	Very small pond formed usually and artificially to raise the homestead land.
iii) *Dighi*	:	Large, deep pond usually excavated by the Zamindars (feudal landlords) for religious and/or drinking purposes.
B. Natural or Man-made wetlands		
iv) *Jheel*	:	Shallow freshwater pond or marsh.
C. Natural wetlands		
v) *Beel*	:	Large, natural and shallow saucer-like depression often combining freshwater marsh, lake and/or floodplain.
vi) *Daha*	:	Natural pool of fresh standing water formed by sudden rushing outgress of river water due to spating of the river and break down of the embankment.
vii) *Haor*	:	A combination of floodplain and beel.
viii) *Jola*	:	A freshwater marsh.

Note : Mention may be made that *ponds* are small, man-made, fresh, standing waterbodies having less than 10 ha of open water. *Pools* are natural, standing freshwater bodies with less than 100 ha open water. *Lakes* are deeper waterbodies, natural or man-made. *Floodplains* are areas periodically innundated with flood water of a river. While *freshwater marshes* are more or less permanent waterbodies dominated by reeds.

Interriverine regions of these two districts often hold vast sheet of surface run-off or flood water during monsoon. These are locally called *jolas* (marshes). A number of large catchment basins, in fact, turn into marshes. Some of them are permanent, containing water even in the summer months. In Haora district these marshes are located (i) between Saraswati river and Kana Damodar (Rajapur *Jola*), (ii) between Damodar river and Kana Damodar (Amta *Jola*) and (iii) on the west of Haora town (Haora *Jola*). In the Hugli district they are found (i) between Bhagirathi and Saraswati river (Dunkuni *Jola*), (ii) around old silted up channels of Damodar at Pandua (Khanyan marsh), (iii) between the confluence of Chaubis Bigha *khal* and Kata *khal* at Baligori (Khanakul marsh), (iv) at the confluence of Amodar and Tarajuli (Sultanpur *beel*), (v) between Kalachhara and Jangipara Railway Station (Kumirmora *beel*) and (vi) the marshes between Damodar *khal* and Kana Damodar in Khanakul Police Station and between the Ghia and Kana Nadi (Banerjee, 1972).

The hydrological parameters observed in wetlands of these two districts are summarized in Table 4 as follows :

Table 4. Hydrology of the wetlands surveyed from Haora and Hugli districts.

Hydrological parameters	Range values of the parameters	
	Haora district	Hugli district
Water/wetland area (ha)*	0.1-87.0	0.1-70.0
Water depth (m.)**	1.2-10.0	1.5-7.0
Water temperature (°C)	10.0 34.0	14.0-34.5
pH	6.3-8.5	6.5-8.5
Electrical conductivity (µmhos/cm)	980-2900	1200-3300
Dissolved oxygen (mg/1)	5.2-10.7	5.0-9.0
Turbidity (cm)	14-75	7-55

Note : * Approximate area measurement of the wetlands is shown in Table 5.
** Maximum water depth for Haora district refers Siva *daha* and that of Hugli district refers to Dunkuni *jola*.

MATERIAL AND METHODS

A total of 32 freshwater wetlands, 17 from Haora and 15 from Hugli district (Table 5, Figs. 1-2) were surveyed during the year 1991-92 and 1992-93 respectively. The surveys were conducted thrice a year during Premonsoon (February-May), Monsoon (June-September) and Postmonsoon (October-January) periods. Both permanent and temporary wetlands including floodplains were taken into consideration. However, only 7 wetlands from Haora district and 4 wetlands from Hugli district were seasonally surveyed thrice a year with special reference to fringe

fauna. The geographical locations of these wetlands are shown in Figs. 1 and 2 and in Table-5 (asterisks indicate wetlands surveyed thrice a year). During the course of survey field observations on some environmental (Temperature, humidity, vegetation, soil type, etc.) and hydrological parameters (Temperature, pH, conductivity, turbidity, dissolved oxygen, etc.) were noted. Collections were made using nets (drag net, cast net and plankton net), seives as well as hand picking. Larger animals belonging to mammals, birds, reptiles and cultivable fishes were observed in the field. Major wetland faunal groups are represented in Tables 6-14 indicating the occurrence of the species in wetlands under Haora and Hugli districts in parantheses as numbered in Table 5 below.

Table 5 : List of wetlands surveyed fom Haora and Hugli districts, West Bengal.

Sl. No.	Name of the wetland	Name of the nearest town/ village	Approximate area (hectare)	Ecological category
	HAORA DISTRICT			
1.	Santragachi *jheel**	Haora	87.0	FW,P
2.	Paddapukur *jola*	Haora	(0.8) $^{+}$	FW,P
3.	Kulai *jheel*	Ranihati	0.36	FW,T
4.	Phuleswar *jheel**	Uluberia	0.9	FW,P
5.	Natibpur *jheel**$^{++}$	Uluberia	0.35	FW^{++},P
6.	Birshibpur *jheel**	Birshibpur	12.4	FW,P
7.	Malanchberia *jola*	Birshibpur	6.0	FW,T
8.	Kashipur *jola*	Kashipur	0.17	FW,T
9.	Bagnan *jheel*	Bagnan	0.6	FW,P
10.	Goalpota pond	Garchumuk	0.2	FW,P
11.	Sujan Saheber *dighi*	Bara Garchumuk	2.4	FW,P
12.	Gadiara pond*	Gadiara	0.1	FW,P
13.	Amta pond	Amta	0.3	FW,P
14.	Siva *daha**	Amta	4.2	FW,P
15.	Dadkhali *daha**	Amta	5.4	FW,P
16.	Jhikhira pond	Jhikhira	0.3	FW,P
17.	Udaynarayanpur pond	Udaynarayanpur	3.6	FW,P

Table 5. *Contd. :*

Sl. No.	Name of the wetland	Name of the nearest town/ village	Approximate area (hectare)	Ecological Category
HUGLI DISTRICT				
1.	Madrasipara *jheel*	Bandel	1.2	FW,P
2.	Locopara *jheel*	Bandel	6.0	FW,P
3.	Tribeni *jheel*	Tribeni	3.0	FW,T
4.	Hatgachha *dighi*	Kalitala	10.0	FW,P
5.	Khanyan *jola*	Khanyan	0.2	FW,T
6.	Jugihedo pond*	Pandua	1.2	FW,P
7.	Kalipur *jheel*	Arambagh	0.6	FW,T
8.	Muktarpur *jola*	Bali-Dewanganj	70.0	FW,T
9.	Kaknan *jheel*	Badar	1.8	FW,T
10.	Jagatpur *beel**++	Garerghat	60.0	FW++,T
11.	Krishinanagar pond	Khanakul	3.6	FW,P
12.	Radhanagar pond	Khanakul	0.1	FW,T
13.	Baligori *jheel**	Tarakeswar	20(2.85)+	FW,P
14.	Kamarkundu *jheel*	Kamarkundu	10.0	FW,P
15.	Dunkuni *jola**	Dunkuni	6900(9.2)+	FW,P

Abbreviations : FW = Freshwater ; P = Permanent Wetland, T= Temporary Wetland ; * = Wetlands surveyed seasonally (thrice a year) ; + = One of the wetland complex surveyed shown in paranthesis ; + + = Predominantly freshwater wetland with traces of salinity due to tidal influence.

FAUNAL RESOURCES

Haora and Hugli districts are not so rich in habitat and faunal diversity. Wetlands are inhabited by aquatic species as well as wetland dependent and wetland associated species. Some terrestrial and arboreal species are also found as 'occasional visitors' However, for the purpose of present report, species habitually found to live or spend a major part of their time as wetland components (Nandi *et al.*, 1993) are incorporated as follows :

Vertebrates

Mammals

In fact, aquatic mammals are absent from wetlands in these two districts. Besides Bandicoot Rat, *Bandicota indica* (Bechstein) belonging to the family Muridae, no other mammalian species

could be found to depend on wetlands or associated with wetlands. However, Jackal, Indian Fox, Small Indian Mongoose, Small Indian Civet, Indian Mole Rat, etc., are observed as 'occasional visitors' in and around wetlands. The Bandicoot Rat is well represented in the urban and suburban areas of these two districts. Some tribal people in groups were encountered to hunt these rats with sticks, bows and arrows around wetland marshes at Tribeni-Kalitala areas of Hugli district. Otters (*Lutra* species), an important wetland dependent species, though reported to occur earlier around Garchumuk and Amta areas of Haora district and around Garerghat, Pandua and Baligori (Tarakeswar) areas of Hugli district, could not be recorded. It may be mentioned that both Smooth Indian Otter, *Lutra perspicillata* and the Fishing Cat, *Felis viverrina* were enocountered in the remote wetlands of coastal plain of North and South 24-Parganas districts (Nandi *et al.*, 1993). The lack of suitable habitats coupled with industrial development, agriculture and human settlement have wiped out this important wetland species.

4.1.2. Birds :

A total of 54 species of birds, either as wetland dependants or as wetland associates, including both resident and migratory species, belonging to 14 families have been recorded in these two districts (Table 6). Of these, 27 species are resident and 17 species are migratory birds depending on wetlands, while 10 species, comprising 3 resident and 7 migratory, are referred herein as wetland associates. Only 5 species of resident birds, 3 species of the family Ardeidae, *viz.*, *Ardeola grayii* (Sykes), *Bubulcus ibis* (Linnaeus), *Egretta garzetta* (Linnaeus) and two species of the family Anatidae, *viz.*, *Dendrocygna javanica* (Horsfield) and *Nettapus coromandelianus* (Gmelin) have been found to occur in abundance. Of the 17 wetland dependent and 7 wetland associated migratory species, some birds even though they are occasionally abundant have been recorded here as common for not being available throughout the year/season.

The avian species, either resident or migratory, depending on wetlands are comprised of swimmers, divers, waders and some fish eating aerial predators like kites and kingfishers. These wetland dependent birds belong to 11 families *viz.*, Podicipedidae, Phalacrocoracidae, Ardeidae, Ciconiidae, Anatidae, Accipitridae, Rallidae, Jacanidae, Rostratulidae, Charadriidae and Alcedinidae. However, the resident birds show greater diversity of species (representing 27 species), while the migratory birds depending on wetlands, especially the anatids, occur in small or large flocks and represent sessonal numerical abundance of individual birds of a few species, namely, *Anas crecca* Linnaeus, *A. strepera* Linnaeus, *A. quequedula* and *A. clypeata* Linnaeus. The large flocks of migratory birds in Santragachi *jheel* of Haora district visiting between October to February over the years have helped to declare the area a sanctuary. A study of avian fauna made by the Zoological Survey of India in early 1980's indicates the occurrence of 68 species of birds including 27 migratory species has helped to designate the wetland as "S.E. Rly.Centenary Sanctuary for Birds" (Ghosh and Chattopadhyay, 1994).

Table 6. List of resident and migratory birds recorded in wetlands of Haora and Hugli districts, West Bengal.

Family and species (Common name)	Occurrence in wetlands of Haora district	Hugli district
A. RESIDENT BIRDS (Wetland dependent)		
Family : PODICIPEDIDAE		
1. *Podiceps ruficollis* (Pallas) (Little Grebe)	(1,2)	(14, 15)
Family : PHALACROCORACIDAE		
2. *Phalacrocorax niger* (Vieillot) (Little Cormorant)	(1, 2, 4, 9, 10, 14, 15)	(2, 4, 6, 8, 11, 13, 14, 15)
3. *Anhinga rufa* (Daudin) (Darter)	(1, 2)	(14, 15)
Family : ARDEIDAE		
4. *Ardea purpurea* Linnaeus (Purple Heron)	(2, 15)	(8, 10, 15)
5. *Ardeola grayii* (Sykes) (Pond Heron)	(1-17)	(1-15)
6. *Bubulcus ibis* (Linnaeus) (Cattle Egret)	(1, 2, 7, 8, 11, 14, 15)	(5, 8, 9, 10, 13, 14, 15)
7. *Egretta alba* (Large Egret)	(1, 2, 11, 15)	(8, 10, 15)
8. *Egretta garzetta* (Linnaeus) (Little Egret)	(1, 2, 6-11, 15, 17)	(1, 3-6, 8, 9, 13-15)
9. *Nycticorax nycticorax* (Linnaeus) (Night Heron)	(1, 11)	(4,13-15)
10. *Ixobrychus cinnamomeus* (Gmelin) (Chestnut Bittern)	(1, 9, 11, 15)	(1, 3, 4, 8-11, 13-15)
11. *Ixobrychus flavicollis* (Latham) (Black Bittern)	(1, 15)	(14, 15)
12. *Ixobrychus sinensis* (Gmelin) (Yellow Bittern)	(4, 7, 14)	(2, 8, 14, 15)
Family : CICONIIDAE		
13. *Anastomus oscitans* (Boddaert) (Openbill Stork)	(2, 10)	(10, 15)
Family : ANATIDAE		
14. *Dendrocygna javanica* (Horsfield) (Lesser Whistling Teal)	(1, 14, 15)	(13-15)
15. *Nettapus coromandelianus* (Gmelin) (Cotton Teal)	A (1, 14, 15)	(13-15)

Table 6. *Contd.*

Family and species (Common name)	Occurrence in wetlands of Haora district	Hugli district
Family : ACCIPITRIDAE		
16. *Haliastur indus* (Boddaert) (Brahminy Kite)	(11, 15)	(4)
17. *Haliaeatus leucoryphus* (Pallas) (Pallas's Fishing Eagle)	(11)	–
Family : RALLIDAE		
18. *Amaurornis phoenicurus* (Pennant) (Whitebreasted Waterhen)	(1, 2, 14, 15)	(13-15)
19. *Gallinula chloropus* (Linnaeus) (Indian Moorhen)	(2, 15)	(14, 15)
Family : JACANIDAE		
20. *Metopodius indicus* (Latham) (Bronzewinged Jacana)	(1, 14, 15)	(13-15)
Family : ROSTRATULIDAE		
21. *Rostratula bengalensis* (Linnaeus) (Painted Snipe)	(1, 14, 15)	(13-15)
Family : CHARADRIIDAE		
22. *Vanellus malabaricus* (Boddaert) (Yellow Wattled Lapwing)	(7, 15)	(15)
23. *Vanellus indicus* (Boddaert) (Red Wattled Lapwing)	(1)	(15)
Family : ALCEDINIDAE		
24. *Ceryle rudis* (Linnaeus) (Lesser Pied Kingfisher)	(1, 4, 9, 11, 14-16)	(1, 4, 11, 13-15)
25. *Alecdo atthis* (Linnaeus) (Common Kingfisher)	(1, 11, 14, 15)	(1, 4, 6, 13-15)
26. *Pelargopsis capensis* (Linnaeus) (Storkbilled Kingfisher)	(14, 15)	(13, 15)
27. *Halcyon smyrnensis* (Linnaeus) (Whitebreasted Kingfisher)	(1, 2, 8, 11, 12, 14, 15)	(4, 6, 11, 13-15)

Table 6. *Contd.*

Family and species (Common name)	Occurrence in wetlands of Haora district	Hugli district
B. MIGRATORY BIRDS (Wetland dependent)		
Family : ANATIDAE		
28. *Tadorna ferruginea* (Pallas) (Brahminy Duck)	(1)	(14, 15)
29. *Anas acuta* (Linnaeus) (Pintail)	(1)	(15)
30. *Anas crecca* Linnaeus (Common Teal)	(1)	(15)
31. *Anas strepera* Linnaeus (Gadwal)	(1)	(15)
32. *Anas quequedula* Linnaeus (Garganey)	(1)	(15)
33. *Anas clypeata* Linnaeus (Shoveller)	(1)	(15)
34. *Aythya fuligula* (Linnaeus) (Tufted Pochard)	(1)	(15)
35. *Aythya ferina* (Linnaeus) (Common Pochard)	(1)	(14,15)
36. *Aythya nyroca* (Gulderstadt) (White-eyed Pochard)	(1)	(15)
Family : CHARADRIIDAE		
37. *Tringa totanus* (Linnaeus) (Redshank)	(1,15)	(13,15)
38. *Tringa ochropus* Linnaeus (Green Sandpiper)	(15)	(13,15)
39. *Tringa glareola* Linnaeus (Wood Sandpiper)	(14,15)	(14,15)
40. *Tringa hypoleucos* Linnaeus (Common Sandpiper)	(10)	(8,13)
41. *Pluvialis dominica* (P.L.S. Muller) (Eastern Golden Plover)	(15)	(15)
42. *Gallinago stenura* (Bonaparte) (Pintail Snipe)	(15)	(15)
43. *Gallinago gallinago* (Linnaeus) (Fantail Snipe)	(15)	(15)
Family : RECURVIROSTRIDAE		
44. *Himantopus himantopus* (Linnaeus) (Black-winged Stilt)	(10)	(10)
C. REED INHABITING BIRDS (Wetland associates)		
Family : MUSCICAPIDAE (Resident & Migratory)		
A: *Resident species*		
45. *Orthotomus sutorius* (Penant) (Long-tailed Tailor bird)	(15)	(15)

Table 6. *Contd.*

Family and species (Common name)	Occurrence in wetlands of Haora district	Hugli district
B. *Migratory species*		
46. *Acrocephalus aedon* (Pallas) (Thickbilled Warbler)	(15)	(15)
47. *Acrocephalus stentoreus* (Hemprich and Ehrenberg) (Southern Great Reed Warbler)	(7,15)	(14,15)
48. *Acrocephalus dumetorum* Blyth (Blyth's Reed Warbler)	(7,15)	(14,15)
49. *Phylloscopus collybita* (Vieillot) (Chiffchaff or Brown Leaf Warbler)	(7)	(15)
50. *Phylloscopus fuscatus* (Blyth) (Dusky Leaf Warbler)	(7,15)	(14,15)
51. *Phylloscopus inornatus* (Blyth) (Yellowbrowed Leaf Warbler)	(7,15)	(14,15)
52. *Phylloscopus trochiloides* (Sundevall) (Dull Green Leaf Warbler)	(15)	(15)
Family : PYCNONOTIDAE (Resident)		
53. *Pycnonotus jocosus* (Linnaeus) (Redwhiskered Bulbul)	(7,15)	(14,15)
54. *Pycnonotus cafer* (Linnaeus) (Redvented Bulbul)	(15)	(15)

Mention may be made that there is no remarkable difference in the representation of waterfowls between the wetlands of coastal plains (North and South 24-Parganas districts ; Nandi *et al.*, 1993) and Gangetic plains particularly due to Santragachi jheel in Haora district which serves as the safe refuge for migratory birds. But, in the wetlands of North and South 24-Parganas districts, waders belonging to the families Ardeidae, Rallidae and Charadriidae were found to be represented by 31 species (Nandi *et al.*, 1993) compared to 20 species of Haora and Hugli districts.

Among the birds, 27 (50%) species are waterfowls, 11 (20%) waders, 10 (18.5%) reedland birds and the rest six species are kite, eagle and kingfishers. The waterfowls include 11 species of ducks and geese, 9 species of herons, egrets and bitterns and the rest 7 species are, 1 species each of a grebe, darter, cormorant, stork, rail, moorhen and jacana. Both waterfowls and waders are in great pressure of hunting in rural areas, particularly during winter months with the arrival

of migratory species. However, in some *jheels* at Kamarkundu, Baligori and Dunkuni of Hugli district and Amta, Santragachi of Haora district Lesser Whistling Teals and Cotton Teal are encountered throughout the year.

4.1.3. Reptiles

Six species belonging to four families comprising of turtle, monitor lizards and snakes were found to be associated with wetlands in both Haora and Hugli districts (Table 7). Of these, a trionychid pond turtle and two colubrid freshwater snakes are aquatic and exclusively wetland dependent. The rest three species belonging to the families Varanidae and Elapidae are terrestrial but often associated with wetlands for their food and/or shelter. The varanid monitor lizards are well adapted to swimming even in flowing flood water. In the floodplain areas they usually inhabit in burrows of high embankment with vegetative cover. However, flood plain areas of these two districts are also inhabited by a species of poisonous elapid snake, *Naja naja kaouthia,* locally known as 'Kaoute sap' There are several reports of death due to bite of this monocellate cobra species in and around paddy fields.

Table 7. List of wetland inhabiting/associated reptiles of Haora and Hugli districts.

Family and species	Haora district	Hugli district
Family : TRIONYCHIDAE		
1. *Lissemys punctata* (Bonaterre) (Indian Flap-shelled Turtle)	(10,11,14,15)	(4,6,13,15)
Family : VARANIDAE		
2. *Varanus bengalensis* (Daudin) (Large Bergal Monitor)	(8,11,15)	(1,15)
3. *Varanus flavescens* (Gray) (Yellow Monitor Lizard)	(15)	(15)
Family : COLUBRIDAE		
4. *Enhydris enhydris* (Schneider) (Smooth Water Snake)	(1-4,9-11,14-17)	(1-6,10,11, 13-15)
5. *Xenochrophis piscator* (Schneider) (Checkered Keelback)	(1,2,5,7,11, 14-17)	(1-4,6,8,10,11, 13-15)
Family : ELAPIDAE		
6. *Naja naja kaouthia* (Lacepede) (Indian Cobra)	(10,12)	(8,13,15)

4.1.4. Amphibians (Figs. 3-4) :

Five species of frogs and one species of toads belonging to three families *viz.*, Ranidae, Microhylidae and Bufonidae have been recorded (Table 8). All these species are wetland dependent for their larval development. The adult ones prefer cool shady bushes where they hide under stones, logs and among vegetation. The microhylid and the bufonid species are found active after showers. The Skipper Frog, *Rana cyanophlyctis* Schneider, is a truly wetland inhabiting species. They are invariably found floating on the water surface in ponds. pools and ditches as well as larger freshwater wetlands adjacent to the water edge. Sarkar (1984), while working on the amphibian fauna of Calcutta and its envirns covering both Haora and Hugli districts, recorded 13 species of amphibians belonging to four families from the area and mentioned that *R. cyanophlyctis* is one of the commonest frog of the area.

Table 8. List of amphibian fauna associated with wetlands of Haora and Hugli districts.

Family and species	Occurrence in wetlands of	
	Haora district	Hugli district
Family : RANIDAE		
1. *Rana cyanophlyctis* Schneider (Skipper Frog)	(1-17)	(1-15)
2. *Rana tigerina* Daudin (Indian Bull Frog)	(1,2,7,9,10, 11,14,15)	(4,6,8,9, 10,13-15)
3. *Rana limnocharis* Wiegmann (Paddy-field Frog)	(1,7,8,12-15)	(4-10, 13-15)
4. *Rana hexadactyla* Lesson (Green Frog)	(2,14)	(15)
Family : MICROHYLIDAE		
5. *Microhyla ornata* (Dumeril and Bibron) (Ornate Frog)	(6,14)	(10,13,15)
Family : BUFONIDAE		
6. *Bufo melanostictus* Schneider (Common Indian Toad)	(1,2,4,5,9, 13,14,16)	(1,2,4,13-15)

4.1.5. Fishes (Figs. 5-13) :

A total of 48 species of fishes belonging to 15 families have been recorded (Table 9). Of these, only two species of estuarine gobiid fishes *viz.*, *Apocryptes bato* and *Ophiocara porocephala* have been encountered in floodplain wetlands of Khanakul under Hugli district. While different varieties of gobiid fishes (Black, white and red varieties of *Gule* fish) and estuarine flat fishes (locally known as *Banspata*) are also reported to occur in the Garerght-Khanakul areas (Jagatpur *beel*). The tidal waters from Rupnarayan river nearby sometimes inundate this area and the irrigation waters of this region also bring estuarine element in the fish fauna of this floodplain wetland.

The cyprinid fishes as well as *Oreochromis, Anabas, Clarias* and *Heteropneustes* are extensively cultured in the freshwater wetlands of Haora and Hugli districts. The cyprinid fishes include major carps like *Catla catla* (Ham.), *Labeo rohita* (Ham.), *Labeo calbasu* (Ham.) and *Cirrhinus mrigala* (Ham.), minor carps like *Labeo bata* (Ham.) and exotic craps like *Cyprinus carpio* Linn, *Ctenopharyngodon idella* (Val.) and *Hypophthalamichthys molitrix* (Val.). Some weed fishes belonging to the genera *Puntius, Esomus, Rasbora* and *Lepidocephalus* under the family Cyprinidae abound in these wetlands. During March-April the local fisherwomen are found to catch *Lepidocephalus* species in plenty along with the freshwater gobiid fish (*Glossogobius giuris*) and shrimps in their scoop nets. The juveniles of the weed fish species occur in large numbers during rainy season which indicates that they are high fecund species and breeds naturally during summer months. However, a number of other weed fishes like *Chanda nama* (Ham.) and *C. ranga* (Ham.) (Family Chandidae), *Colisa fasciatus* (Schneider) (Family Belontidae) and *Badis badis* (Ham.) (Family Nandidae) also breed in summer and abound in monsoon months.

The channid, bagrid, silurid, clariid, anabantid and mastacembelid fishes (Table 9) are available in good numbers in these wetlands. These predatory species mostly abound in flood plain wetlands and are harvested from October to April prior to drying up of the temporary wetlands.

Table 9. List of fish fauna associated with wetlands of Haora and Hugli districts.

Family and species	Occurrence in wetlands of	
	Haora district	Hugli district
Family : NOTOPTERIDAE		
1. *Notopterus notopterus* (Pallas)	(1,4,5,9,11 14-16)	(2,4,6,11 13-15)
Family : CYPRINIDAE		
2. *Catla catla* (Hamilton)	(1,2,4-6, 9-17)	(1-4, 6, 11-15)
3. *Labeo rohita* (Hamilton)	(")	(")
4. *Labeo calbasu* (Hamilton)	(1,5,6,9,11, 14-17)	(2,4,6,11, 13,15)
5. *Labeo bata* (Hamilton)	(1,5,11,16)	(2,4,6,13,15)
6. *Cirrhinus mrigala* (Hamilton)	(1,2,4-6,9-17)	(1-6,11-15)
7. *Ctenopharyngodon idella* (Valenciennes)	(4,9,16)	(4,6,11,13)
8. *Cyprinus carpio* Linnaeus	(1,2,5,16,17)	(2,6)
9. *Hypophthalmichthys molitrix* (Valenciennes)	(1,2,5,11, 16,17)	(2,6,11,13)
10. *Puntius javanicus* (Blan.)	(16,17)	(2,4,6)

Table 9. *Contd.*

Family and species	Occurrence in wetlands of	
	Haora district	Hugli district
11. *Puntius sarana* (Hamilton)	(3,9,11)	(2,4,6,13,15)
12. *Puntius sophore* (Hamilton)	(1,2,5,6,11, 14-17)	(1,2,4,6,11-15)
13. *Puntius ticto* (Hamilton)	(1-17)	(1-15)
14. *Puntius gelius* (Hamilton)	(1,3,7-9,12 14-16)	(5-10,13-15)
15. *Amblypharyngodon mola* (Hamilton)	(1-17)	(1-15)
16. *Esomus danricus* (Hamilton)	(1-17)	(1-15)
17. *Salmostoma bacaila* (Hamilton)	(1,9,14,15)	(2,6,8,13,15)
18. *Rasbora daniconius* (Hamilton)	(1,6,9,14,15)	(2,4,6,13-15)
19. *Lepidocephalus guntea* (Hamilton)	(1,6,9,11, 14-17)	(1,2,4,6,8,11, 13-15)
Family : BAGRIDAE		
20. *Mystus cavasius* (Hamilton)	(1,11,14,15)	(4,6,10,15)
21. *Mystus vittatus* (Bloch)	(9,11,14-17)	(4,6,8,12,13,15)
22. *Mystus tengra* (Hamilton)	(1,2,5,9,11, 14-17)	(1,2,4-6,8, 12-15)
Family : SILURIDAE		
23. *Ompak pabda* (Hamilton)	(14,15)	(10,15)
24. *Wallago attu* (Schneider)	(11,14,15)	(8,10,13,15)
Family : CLARIIDAE		
25. *Clarias batrachus* (Linnaeus)	(1-17)	(1-15)
Family : HETEROPNEUSTIDAE		
26. *Heteropneustes fossilis* (Bloch)	(1-17)	(1-15)
Family : BELONIDAE		
27. *Xenentodon cancila* (Hamilton)	(5,11)	(8,10)

Table 9. *Contd.*

Family and species	Occurrence in wetlands of	
	Haora district	Hugli district
Family : CYPRINODONTIDAE		
28. *Aplocheilus panchax* (Hamilton)	(1-17)	(1-15)
Family : CHANNIDAE		
29. *Channa orientalis* (Schneider)	(1-4, 6-17)	(1-15)
30. *Channa punctatus* (Bloch)	(1-17)	(1-15)
31. *Channa striatus* (Bloch)	(1-17)	(1-15)
32. *Channa marulius* Hamilton	(14-15)	(8-15)
Family : SYMBRANCHIDAE		
33. *Monopterus cuchia* (Hamilton)	(10-12)	(14, 15)
Family : CHANDIDAE		
34. *Chanda nama* (Hamilton)	(5,15)	(8,10)
35. *Chanda ranga* (Hamilton)	(1-17)	(1-15)
Family : GOBIIDAE		
36. *Glossogobius giuris* (Hamilton)	(1,2,4-6,9,11 14-17)	(1,2,4,6,8, 10-15)
37. *Oligolepis acutipinnis* (C.V.)	(5,11)	(10)
38. *Apocryptes bato* (Hamilton)	–	(10)
39. *Ophiocara porocephala* (Val.)	–	(10)
Family : ANABANTIDAE		
40. *Anabas testudineus* (Bloch)	(1-17)	(1-15)
Family : CICHLIDAE		
41. *Oreochromis mossambica Peters*	(1,2,6,9,11, 14,15)	(2,4,6,11, 14,15)
42. *Oreochromis nilotica* Valenciennes	(1,9)	(2,4,6,15)
Family : NANDIDAE		
43. *Nandus nandus* (Hamilton)	(6,11,14,15)	(14,15)
44. *Badis badis* (Hamilton)	(1-10, 14-17)	(4,6,8,10,13-15)

Table 9. *Contd.*

Family and species	Occurrence in wetlands of	
	Haora district	Hugli district
Family : BELONTIDAE		
45. *Colisa fasciatus* (Schneider)	(1-17)	(1-15)
Family : MASTACEMBELIDAE		
46. *Mastacembelus armatus* (Lacepede)	(11,15)	(8,15)
47. *Mastacembelus pancalus* (Hamilton)	(1-17)	(1-15)
48. *Macrognathus aculeatus* (Bloch)	C(1-17)	(1-15)

The higher representation of fishes (76 species) in the earlier study (Nandi *et al.*, 1993) is mainly attributed to brackishwater fishes available in 'bhasabadha' fisheries in North nd South 24-Pargnas districts.

4.2. Invertebrates

4.2.1. Decapod crustaceans (Figs. 14-18) :

Macrocrustaceans mainly belong to the order Decapoda and comprise of prawns and crabs. Four species of prawns and three species of crabs were identified from freshwater wetlands of these two districts (Table 10). Two species of *Macrobarachium viz., Macrobrachium lamarrei* (H.M. Edwards) and *M. dayanum* (H.M. Edwards) and a species of atyid shrimp abound in these wetlands. All the three species of crabs *viz.*, *Varuna litterata* (Fabricius), *Paratelphusa hydrodromus* Herbst and *Sartoriana spinigera* Wood Mason are common in occurrence. However, during summer months, the grapsid crab, *Varuna litterata,* locally known as *Chiti Kankra*, occurs in plenty (3-4 quintals) in Jagatpur *beel* of Hugli district, which is sold at Rs. 3/- per kilogram in the local market.

Table 10. List of decapod crustaceans recorded from wetlands in Haora and Hugli districts.

Family and species	Occurrence in wetlands of	
	Haora district	Hugli district
DECAPODA : MACRURA		
Family : PALAEMONIDAE		
1. *Macrobrachium rosenbergii* (de Man)	(5,9,11)	(4,6,10)
2. *Macrobrachium lamarrei* (H.M. Edwards)	(1-17)	(1-15)
3. *Macrobrachium dayanum* (H.M. Edwards)	(1,2,4-6, 9-17)	(1,2,4,6,8, 10-15)

Table 10. *Contd.*

Family and species	Occurrence in wetlands of	
	Haora district	Hugli district
Family : ATYIDAE		
4. *Caridina* sp.	(1-17)	(1-15)
DECAPODA : BRACHYURA		
Family : GRAPSIDAE		
5. *Varuna litterata* (Fabricius)	(5,11,12)	(10,13)
Family : POTAMONIDAE		
6. *Paratelphusa hydrodromus* Herbst	(7,8,15)	(5-10)
7. *Sartoriana spinigera* Wood Mason	(1-4,6,9-17)	(1,2,4,6,11-15)

4.2.2. Insects :

Aquatic insects dominate the fringe fauna over all other major groups. There are altogether 13 insect orders inhabiting the fringe areas of the wetlands. They depend on wetlands for their adult and/or larval life. Majority of them serve as the food for fishes and water birds. Only dominant orders are dealt herein as follows :

4.2.2.1 Order Hemiptera (Figs. 19-24) :

Twenty seven taxa belonging to seven families have been identified from various freshwater wetlands of these two districts (Table 11). Of these, so far 15 species are determined at the species level, namely, *Diplonychus annulatus* (Fabr.), *Diplonychus molestum* (Dufour), *Lethocercus indicus* (Lep. & Serv.) (Family : Belostomidae) ; *Corixa pronotoria* Distant, *Micronecta scutellaris* (Stal) (Family Corixidae) ; *Limnogonus nitidus* (Mayr), *Naboandelus signatus* Distant, *Rhagadotarsus kreepalini* Breddin (Family Gerridae) ; *Hydrometra greeni* Kirkaldy (Family Hydrometridae) ; *Laccotrephes griseus* (Guerin), *Ranatra elongata* Fabr., *Ranatra filiformis* Fabr., *Ranatra sordidula* Dahrn (Family Nepidae) ; *Anisops batilliformis* Landblad and *Anisops sardea* Herrich-Shaffer (Family Notonectidae). Among these species, water bugs (*Diplonychus* spp.) are mostly available in abundance in all the wetlands. The males of these water bugs have been found to carry eggs on their back even in pre and postmonsoon periods. *Ranatra* species also occur in abundance. Of the three species recorded, *Ranatra filiformis* is the most frequently occurring species found in both culturable fish-ponds as well as uncultivated ponds amongst fringe vegetation. But *Ranatra elongata* occurs as bottom fauna of temporary wetlands usually without any hydrophytes. However, *Anisops* species usually predominate in piscicultural ponds. While the other common species belonging to *Lethocercus, Micronecta, Gerris, Limnogonus, Rhagadotarsus* and *Plea* are more or less common inoccurrence. The rest of the hemipteran species are scarcely recorded in these two districts.

Table 11. List of hemipteran fauna occurring in wetlands of Haora and Hugli districts.

Family and species	Occurrence in wetlands of	
	Haora district	Hugli district
Family : BELOSTOMIDAE		
1. *Diplonychus* spp. (3 species)	(1-17)	(1-15)
2. *Lethocercus* sp.	(1,12,13)	(9,12,15)
Family : CORIXIDAE		
3. *Corixa* spp. (2 species)	(3,15)	(5,6,10,13,17)
4. *Micronecta* spp. (2 species)	(1,7,9,14,15)	(1,6,10,13, 15,17)
Family : GERRIDAE		
5. *Gerris* spp. (2 species)	(1,4-6,9,11,14 15,17)	(2-4,6,11,13,15)
6. *Limnogonus* spp. (2 species)	(1,4,6,11,12,14,15)	(4,6,13,15)
7. *Naboandelus* sp.	—	(4)
8. *Rhagadotarsus* spp. (2 species)	(6,11,14,15)	(4,6,13)
Family : HYDROMETRIDAE		
9. *Hydrometra* spp. (2 species)	(6,14,15)	(6,13,14)
Family : NEPIDAE		
10. *Laccotrephes* spp. (2 species)	(1,2,9,12-15)	(2,6,13-15)
11. *Ranatra* spp. (3 species)	(1-17)	(1-15)
Family : NOTONECTIDAE		
12. *Anisops* spp. (3 species)	(1,4-6,9,11,12)	(4,6,10,13, 15,17)
Family : PLEIDAE		
13. *Plea* spp. (2 species)	(1,3,4,7,9,12,	(2,4,6,9,13,15)
(Total - 27 Species)	14,15)	

4.2.2.2. Order Coleoptera (Fig. 25) :

So far 35 species belonging 21 genera under 4 families *viz.*, Dytiscidae, Hydrophilidae, Chrysomelidae and Curculionidae have been identified from wetlands of these two districts. (Table 12). It includes 17 species of dytiscids comprising of 9 genera and 13 species of hydrophilid belonging to 8 genera as wetland dependent aquatic beetles. The rest 5 species belonging to Chrysomelidae (3 species) and Curculionidae (2 species) are aquatic weed associated species.

Table 12. List of Coleopteran species occurring in wetlands of Haora and Hugli districts.

Family and species (No. of species)	Occurrence in wetlands of	
	Haora district	Hugli district
Family : DYTISCIDAE		
1. *Canthydrus* spp. (3 species)	(1,3, 4, 6-17)	(1-15)
2. *Clypeodytes* spp. (2 species)	(6, 7, 13)	(6,14)
3. *Cybister* spp. (2 species)	(1, 12, 13)	(1, 6, 7, 12-15)
4. *Eretes* sp.	(12)	(12)
5. *Hydaticus* sp.	(7)	(9)
6. *Hydrocoptus* sp.	(6)	(13-15)
7. *Hydrovatus* spp. (3 species)	(1,9,12,14,15)	(2.11.13-15)
8. *Laccophilus* spp. (3 species)	(1,4,6,7,12,14,15)	(1-6,9,10,12-15)
9. *Uvarus* sp.	(7)	(9)
Family : HYDROPHILIDAE		
10. *Amphiops* spp. (2 species)	(4,6,9-12, 14,15)	(10,14)
11. *Berosus* sp.	(5-7,9)	(4,5,9,11)
12. *Enocrus* sp.	—	(14)
13. *Helochares* spp. (3 species)	(1,6,7,9-12,14,15)	(1,5,6,9,10,14,15)
14. *Hydrophilus* sp.	—	(10)
15. *Laccobius* sp.	(15)	—
16. *Regimbertia* spp. (3 species)	(6,12,15)	(1,5,6,9,13-15)
17. *Sternolophus* spp. (2 species)	(6,7,12,14,15)	(1,6,9,10,13)
Family : CHRYSOMELIDAE		
18. *Altica* sp.	(6)	—
19. *Cassida* sp.	(1)	—
20. *Lema* sp.	(5)	—
Family : CURCULIONIDAE		
21. Curculionids (2 species) (Total-35 species)	(1,6)	(6,7,10)

Of the above 35 species of Coleopterans 11 species could be identified as follows : Family : Dytiscidae-*Canthydrus morsbachi* (Wehneke), *Canthydrus ritsemai* (Regimbart), *Canthydrus laetibilis* (Walker), *Hydaticus fabricii* Mac Leay, *Eretes sticticus* (L.) and *Hydrocoptus subvittulus* Mots ; and Family : Hydrophilidae *Berosus indicus* Mots., *Helochares anchoralis* Sharp, *Helochares crenatus* Sharp, *Regimbartia attenuata* F. and *Sternolophus rufipes* (F.).

4.2.2.3. Miscellaneous insects :

The nymphs or naiads and/or larval forms of the orders Odonata and Diptera were often encourtered in wetlands of these two districts. Dragon fly nymphs belonging to the family Libellulidae were most frequently found on the bottom of shallow water around fringe vegetation. They are short and stout forms with narrower head and broader strongly spined abdomen devoid of caudal gills. Damsel fly nymphs belonging to the family Coenagrionidae have elongated cylindrical body, broader head, slender abdomen with caudal gills. These nymphs are quite common in these wetlands. The larvae and pupae of mosquitoes belonging to the family Culicidae and chironomid larvae are encountered in abundance especially in temporary wetlands used for jute retting in the Hugli district. No attempt of identifying these larval forms at the species level has been made.

However, adult odonate belonging to the genera *Crocothemis, Orthetrum, Lathrecista, Diplacodes, Neurothemis, Brachythemis, Ischnura, Ceriagrion, Pseudagrion* and *Agriocnemis* are common in occurrence in and around wetlands of these two districts (Dr. T. R. Mitra, Pers. comm.). An orthopteran insects, *Grylotalpa* sp. is also common in wet sandy soils at the water edge.

4.2.3. Arachnids :

The wetlands of Haora and Hugli districts are associated with six species of spiders belonging to three families *viz.*, Lycosidae, Tetragnathidae and Salticidae. They are usually observed amongst floating and emergent vegetation of these wetlands These spiders are belonged to the genera *Pardosa* (2 species), *Hippasa* (1 species) and *Lycosa* (1 species) (Family Lycosidae), and *Tetragnatha* (1 species) (Family Tetragnathidae), in addition to an undetermined species of jumping spider (Family Salticidae). Mention may be made that most of these spider specimens represent immature forms.

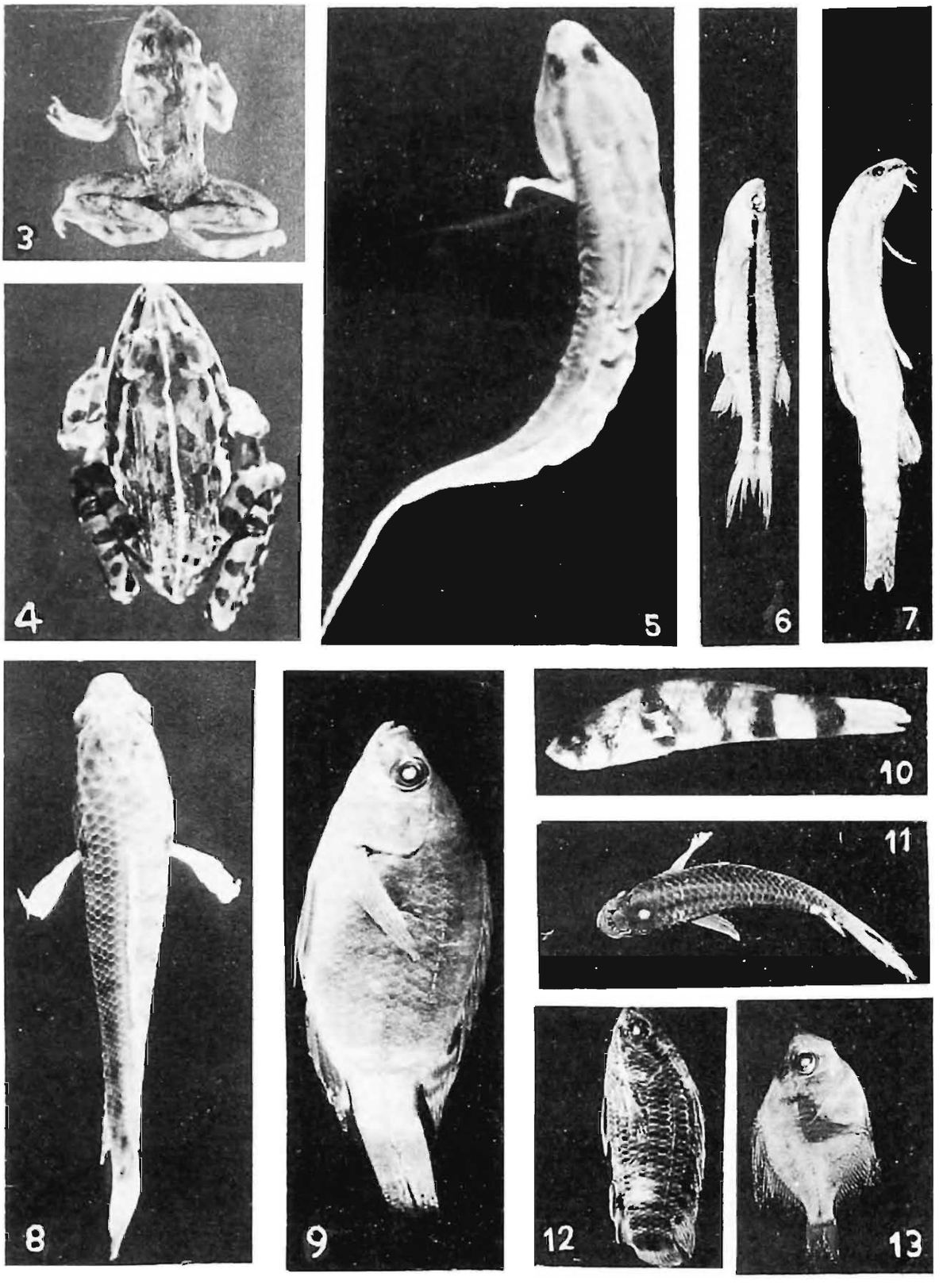
4.2.4. Annelids :

Three species of earth-worms *viz.*, *Metaphire posthuma* (Vaillant), *Lampito mauriti* Kinber and *Perionyx excavatus* (Perrier) in the wet soils and three species of leeches *viz.*, *Glossiphonia weberi* Blanchard, *Helobdella nociva* Harding and *Hemiclepsis marginata* Muller in waters have been recorded from some wetlands of these two districts.

4.2.5. Molluscs (Figs. 26-30)

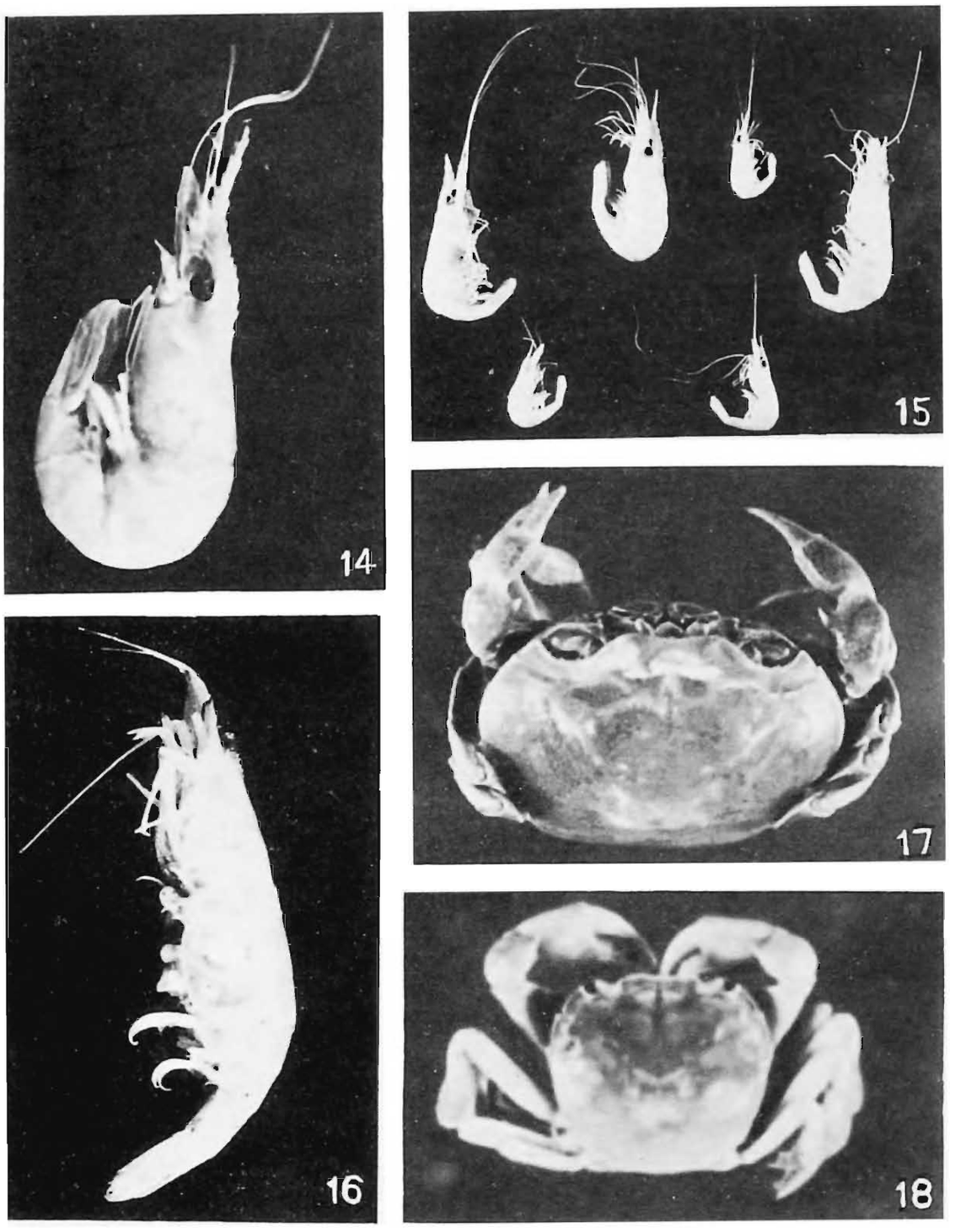
Sixteen species of molluscs belonging to 8 families have been recorded from wetlands of Haora and Hugli districts. Of these 16 species, 7 out of 15 species of gastropods occur abundantly in these two districts. The viviparid species, *Bellamya bengalensis* (Lamarck) occur in large numbers in almost all the wetlands surveyed from both the districts. This species. *B. bengalensis*,

PLATE 1



Figs. 3-13. Some common wetland fauna (frogs and fishes) of Haora and Hugli districts.
Fig. 3. *Rana cyanophlyctis* Fig. 4. *Rana tigerina* Fig. 5. *Ophiocara porocephala* Fig. 6. *Esomus danricus* Fig. 7. *Lepidocephalus guntea* Fig. 8. *Channa punctatus* Fig. 9. *Oreochromis mossambica* Fig. 10. *Oligolepis acutipennis* Fig. 11. *Aplocheilus punchax* Fig. 12. *Badis badis* Fig. 13. *Chanda ranga.*

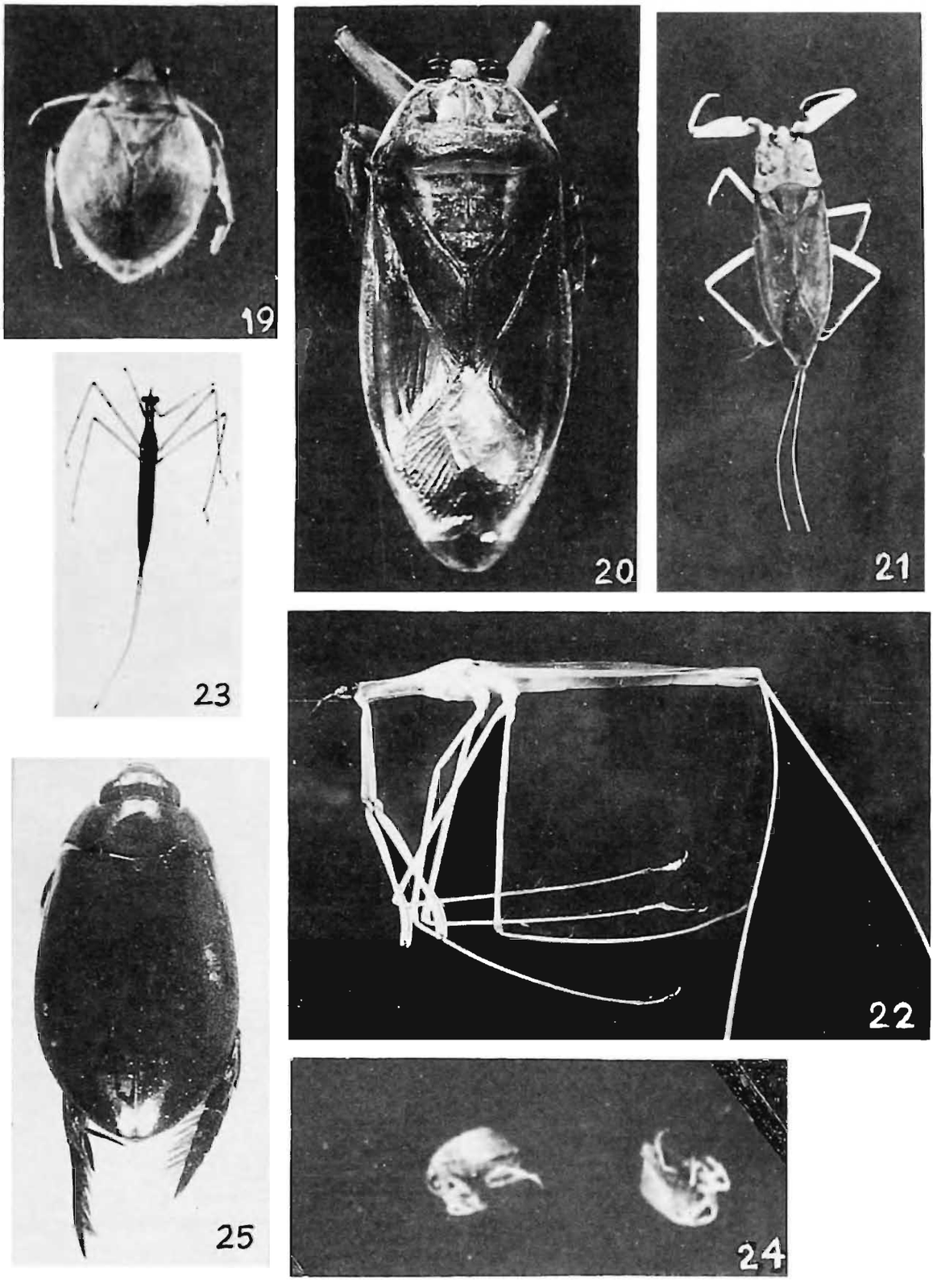
PLATE 2



Figs. 14-18. Some commercially important prawns and crabs of freshwater wetlands in Haora and Hugli districts.

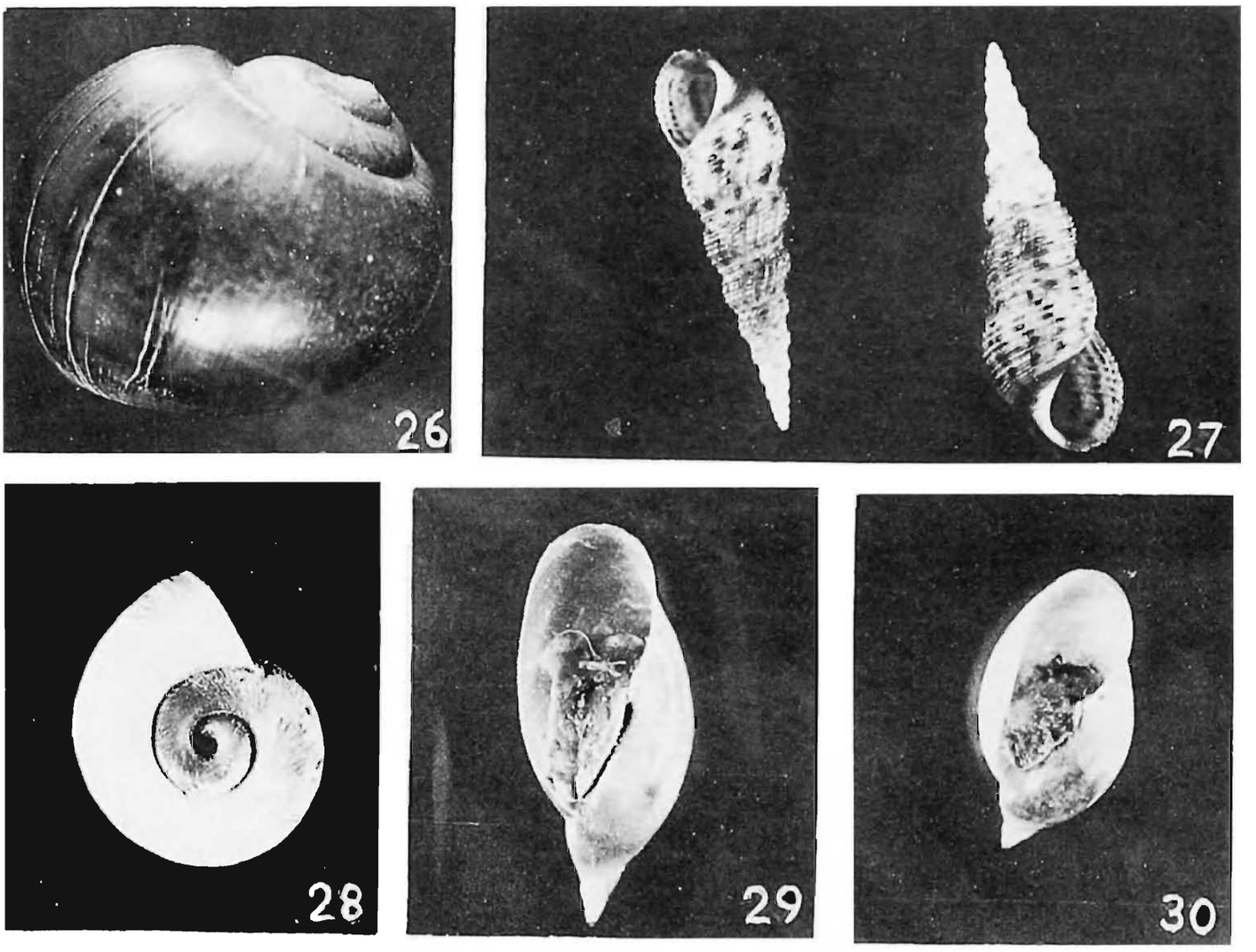
Fig. 14. *Mcrobrachium resenbergi* Fig. 15. *Macrobrachium lamarrei* Fig. 16. *Macrobrachium dayanum* Fig. 17. *Sartoriana spinigera* Fig. 18. *Varuna litterata.*

PLATE 3



Figs. 19-25. Some common insect fauna of freshwater wetlands in Haora and Hugli districts. Fig. 19. *Diplonychus annulatus* Fig. 20. *Lethocercus indicus* Fig. 21. *Laccotrephes griseus* Fig. 22. *Ranatra elongatum* Fig. 23. *Ranatra filiformis* Fig. 24. *Plea* sp. Fig. 25. *Cybister* sp.

PLATE 4



Figs. 26-30. Some common molluscs of freshwater wetlands in Haora and Hugli districts.
Fig. 26. *Pila globosa* Fig. 27. *Thiara tuberculata* Fig. 28. *Indoplanorbis exustus* Fig. 29. *Lymnaea acuminata* Fig. 30. *Lymnaea luteola.*

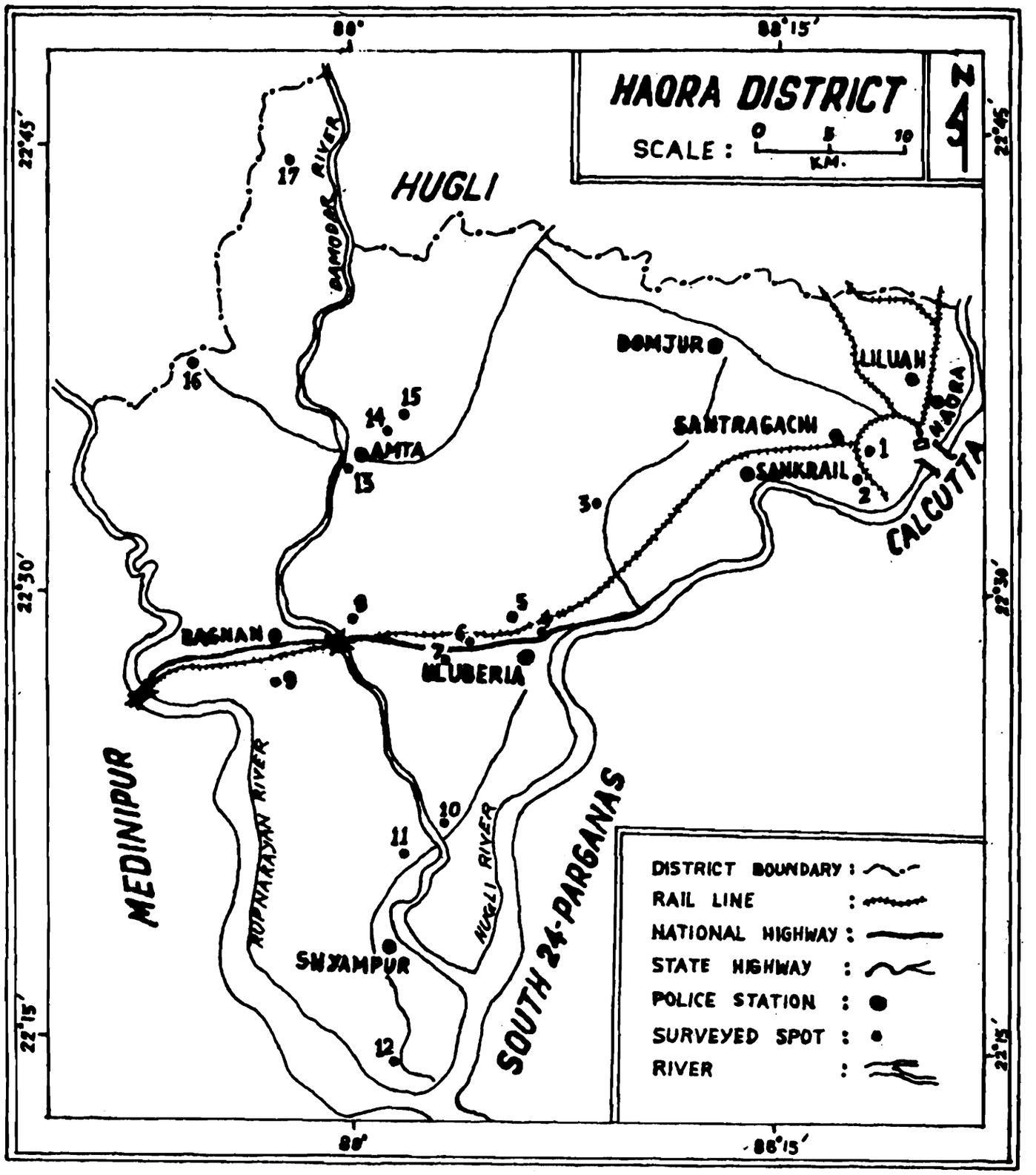


Fig. 1. Map of Haora districts showing the location of wetlands surveyed.
(Name of wetlands : 1. Santragachi *jheel*, 2. Paddapukur *jola*, 3. Kulai *jheel*, 4. Phuleswar *jheel*, 5. Natibpur *jheel*, 6. Birshibpur *jheel*, 7. Malanchberia *jola*, 8. Kashipur *jola*, 9. Bagnan *jheel*, 10. Goalapota pond, 11. Sujan Saheber *dighi*, 12. Gadiara pond, 13. Amta pond, 14. Siva *daha*, 15. Dadahali *daha*, 16. Jhikhira pond, 17. Udayanarayanpur pond).

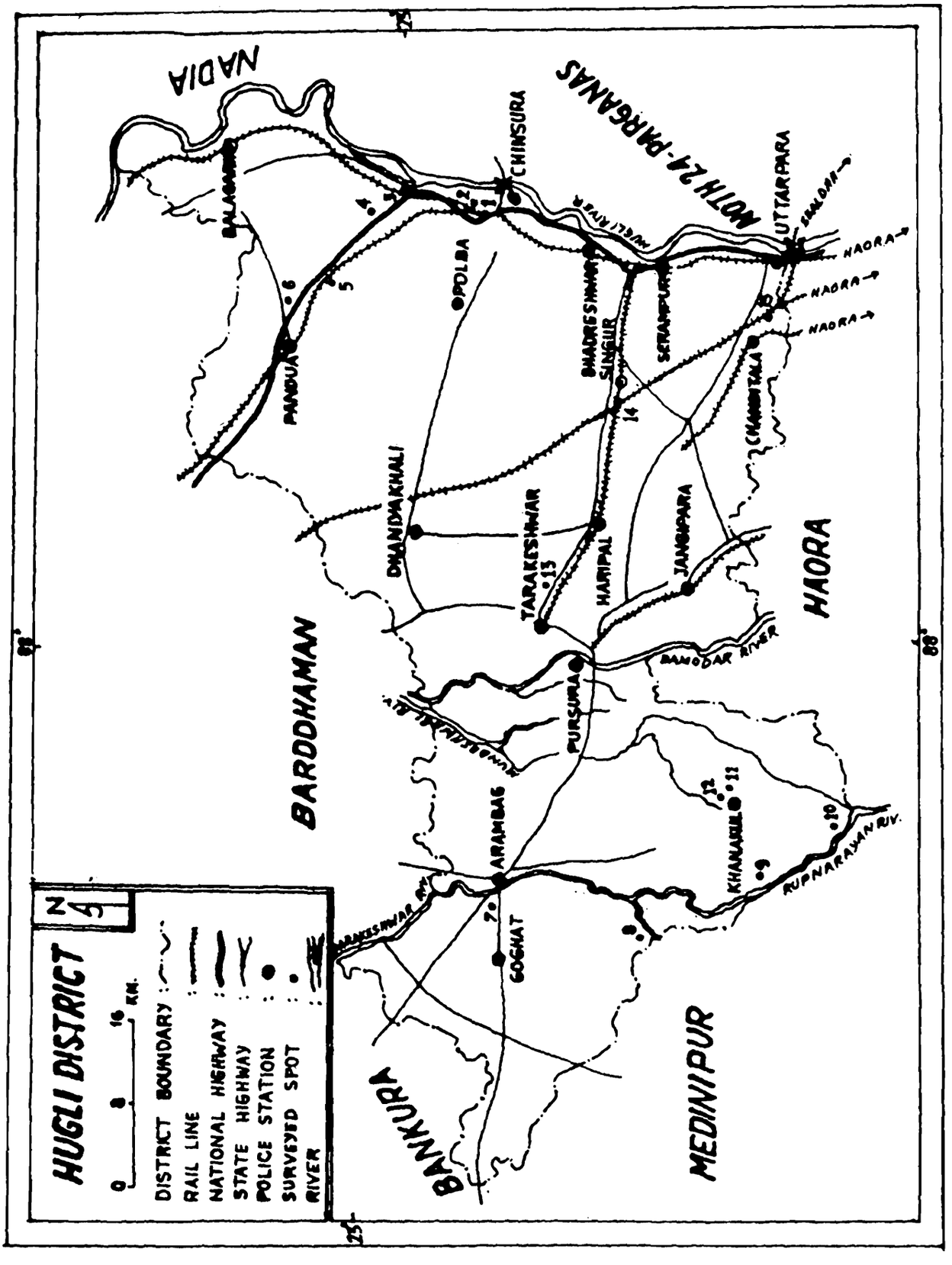


Fig. 2. Map of Hugli district showing the location of wetlands surveyed.
(Name of wetlands : 1. Madrasipara *jheel*, 2. Locopara *jheel*, 3. Tribeni *jheel*, 4. Hatgachha *dighi*, 5. Khanyan *jola*, 6. Jugihedo pond, 7. Kalipur *jheel*, 8. Muktarpur *jola*, 9. Kaknan *jheel*, 10. Jagatpur *beel*, 11. Krishnanagar pond, 12. Radhanagar pond, 13. Baligori *jheel*, 14. Kamarkundu *jheel*, 15. Dunkuni *jola*).

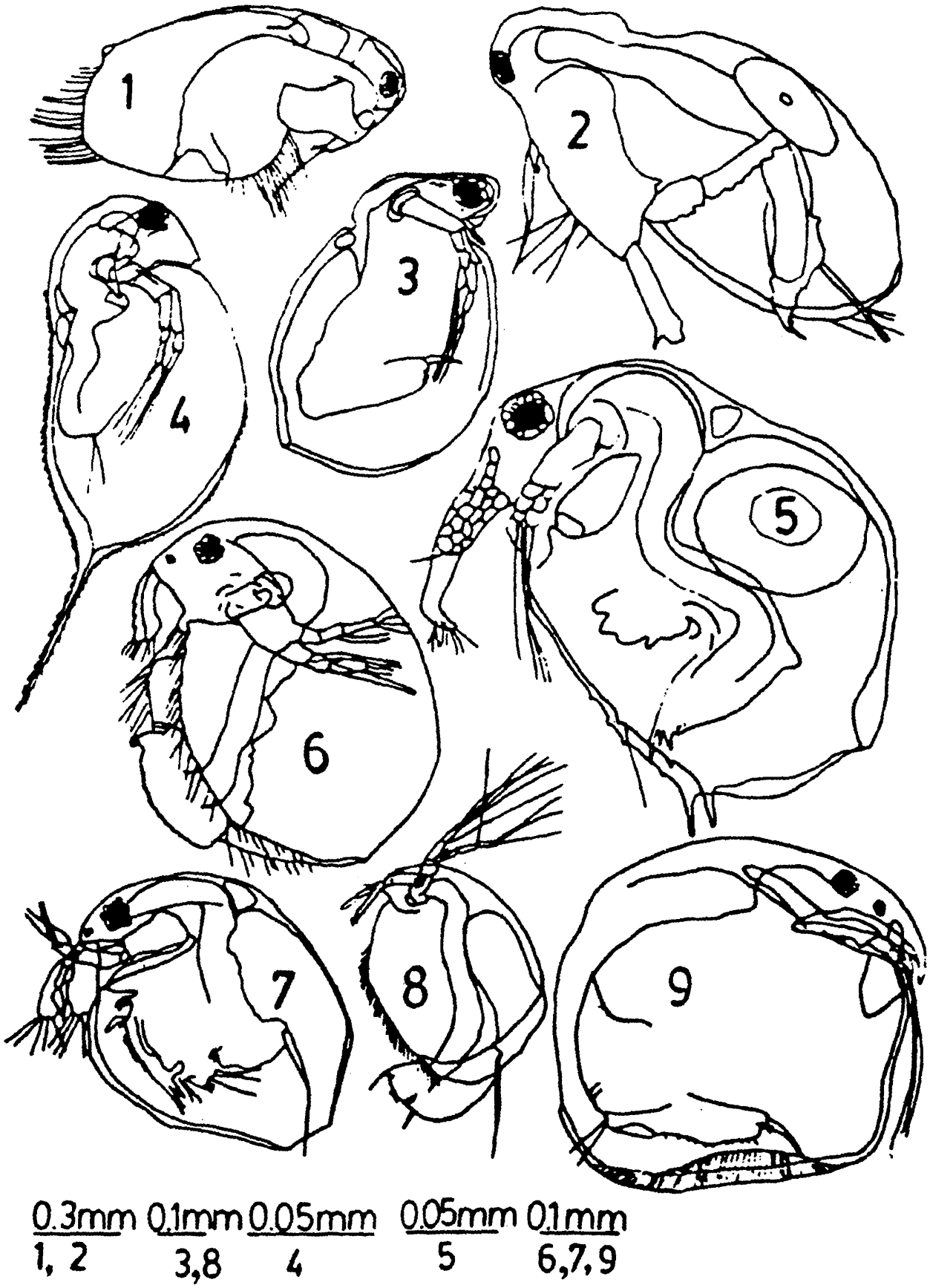


Fig. 31. Some interesting and uncommon species of Cladocera occurring in freshwater wetlands of Haora and Hugli districts.

(1. *Latonopsis australis*, 2. *Pseudosida bidentata*, 3. *Ceriodaphnia reticulata*, 4. *Daphnia similis*, 5. *Bosminopsis deitersi*, 6. *Macrothrix spinosa*, 7. *Guernella raphalis*, 8. *Grimaldina brazzai*, 9. *Chydorus ventricosus*).

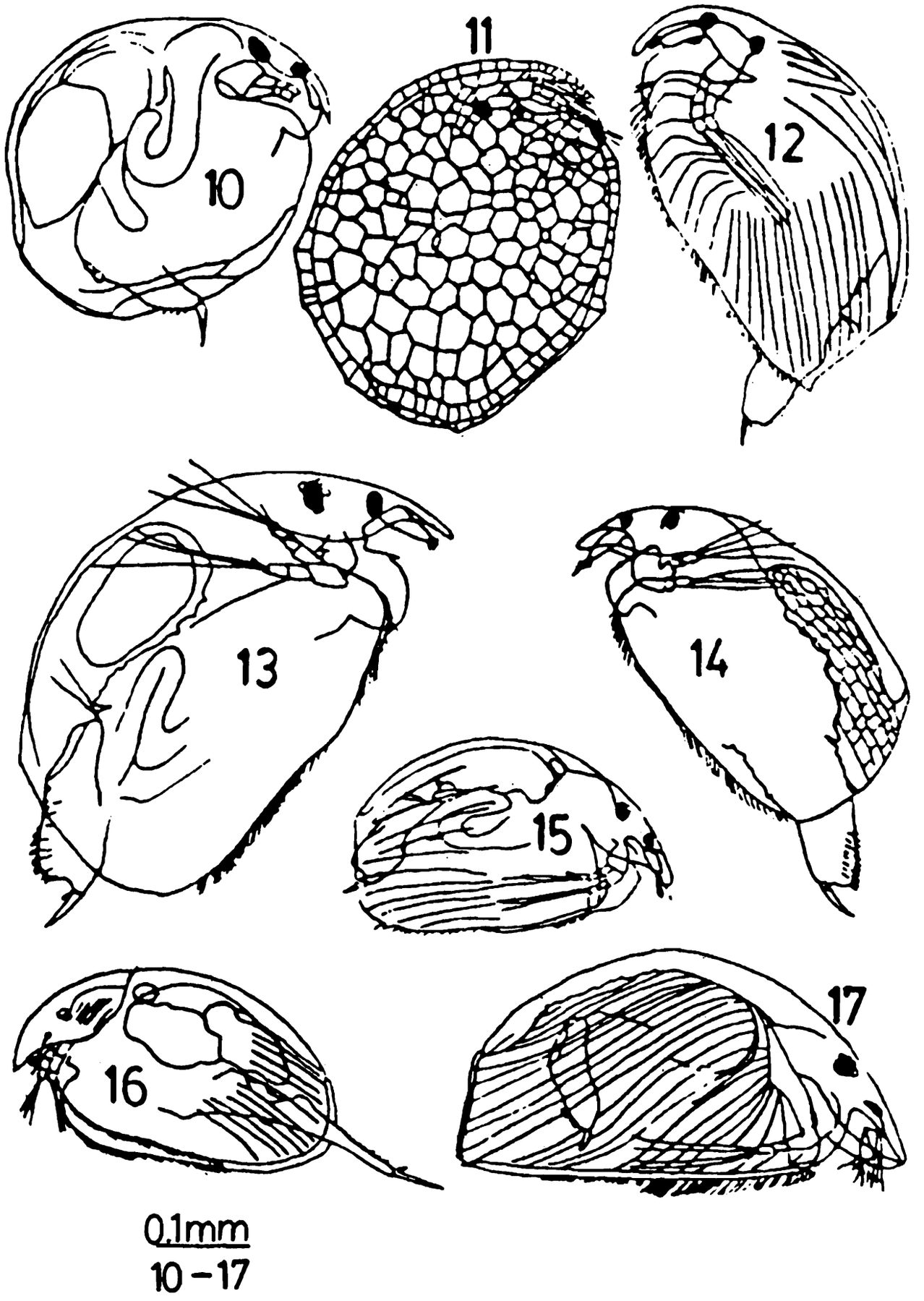


Fig. 31. Some interesting and uncommon species of Cladocera occurring in freshwater wetlands of Haora and Hugli districts.

(10. *Chydorus eurynotus*, 11. *Chydorus faviformis*, 12. *Alonella excisa*, 13. *Alona monacantha*, 14. *Alona costata*, 15. *Alona verrucosa*, 16. *Camptocercus australis*, 17. *Graptoleberis testudinaria*).

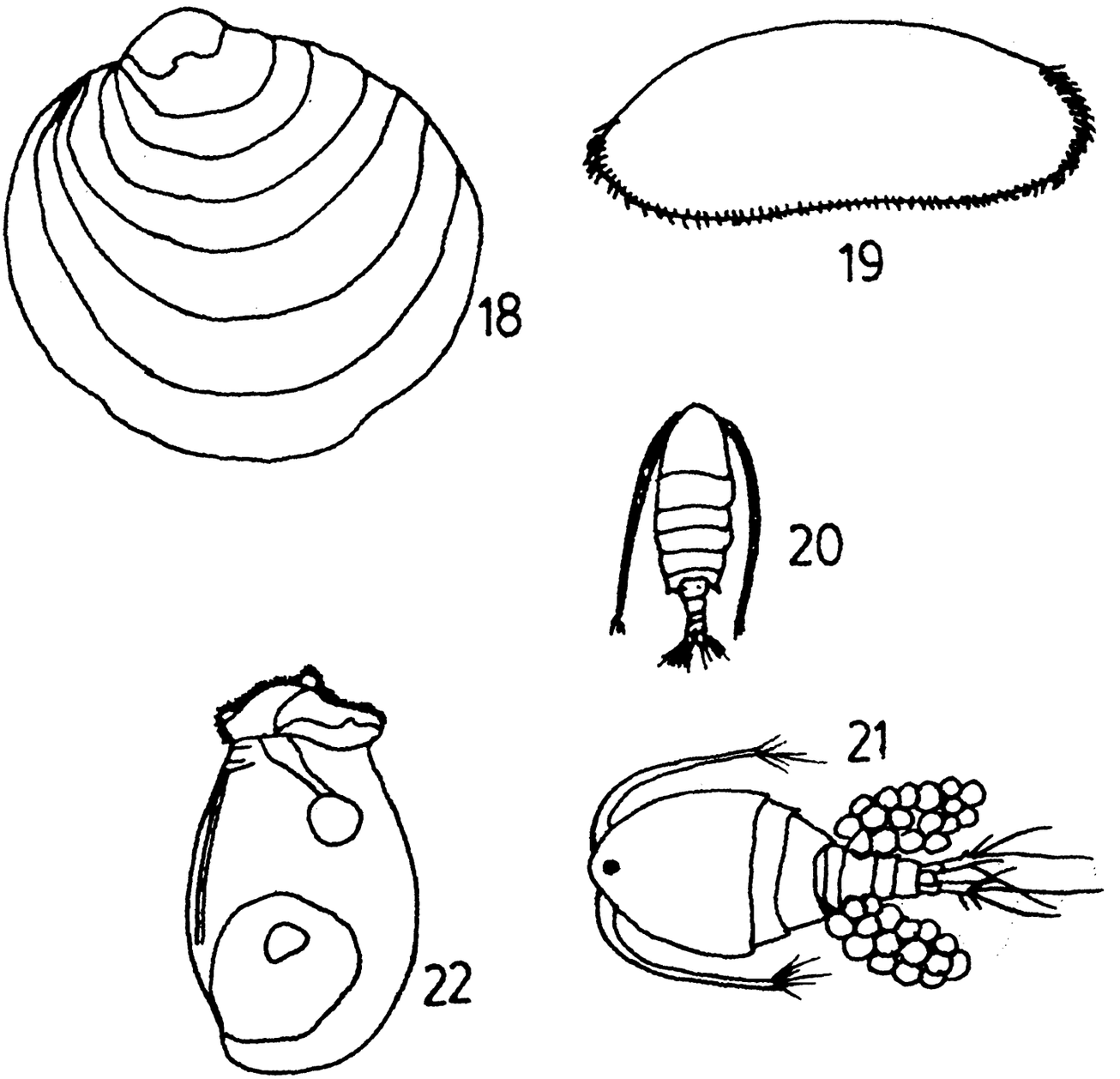


Fig. 31. Some representative species of other groups of zooplankton.

(18. *Cyclestheria hislopi* — Conchostraca
19. *Stenocypris* sp. — Ostracoda
20. *Diaptomus* sp. — Copepoda
21. *Mesocyclops hyalinus* — "
22. *Asplacha* sp. — Rotifera)

as well as a pilid gestropod, *Pila globosa* (Swainson) and a bivalve species, *Lamellidens marginalis* (Lamarck) are consumed by the poor people of these two districts. These molluscs and their flesh are found to be sold in *bhagas* (lots/groups) in the rural markets held twice a week. Raut and Biswas (1991) while studying the population density of *L. marginalis* in relation to soil from ten ponds of West bengal including a pond from Haora district observe that this species occurs in higher number in sandy clay substratum at a water depth of 57 to 73 cm. It is worthmentioning that 2.37% of this freshwater mussel (19 of 800 *L. marginalis*) are known to bear pearl from Hugli district (Raut and Biswas, 1989).

The occurrence of *Neritina violacea* (Gmelin), a brackishwater species (Subba Rao, 1989), at Gadiara of Howrah district indicates the influence of tidal flood water in this wetland.

4.2.6. Zooplankton (Figs. 31.1-31.22)

So far 74 species of zooplankton belonging to five different groups *viz.*, Copepoda, Ostracoda, Cladocera, Conchostraca and Rotifera have been recorded from fresh water wetlands of Haora and Hugli districts (Table 14). Of the 74 species of zooplankton, 52 species (70.2%) are represented by cladocerans, 8 species (10.8%) by copepods, 6 species (8.1%) by ostracods, 1 species (1.3%) by conchostracans and 7 species (9.4%) by rotifers. In all, 53 named species are recorded from Haora district and 39 species from Hugli district. While of the 52 named species of Cladocera recorded from these two districts 22 species are new records to West Bengal (Venkataraman and Das, 1993).

Table 13. List of molluscan species recorded from wetlands in Haora and Hugli districts.

Family and species	Occurrence in wetlands of	
	Haora district	Hugli district
MOLLUSCA : GASTROPODA		
Family : NERITIDAE		
1. *Neritina violacea* (Gmelin)	(12)	—
Family : ASSIMINEIDAE		
2. *Assiminea francessiae* (Gray)	—	(10)
Family : THIARIDAE		
3. *Thiara granifera* (Lamarck)	(1,2,12)	(1, 4,)
4. *Thiara scabra* (Muller)	(12)	(15)
5. *Thiara tuberculata* (Gray)	(1,2,4-6,14,15)	(1,10,12,13,15)
Family : VIVIPARIDAE		
6. *Bellamya bengalensis* (Lamarck)	(1-17)	(1-15)
7. *Bellamya dissimilis* (Muller)	(2, 4)	(8, 10)

Table 13. *Contd.*

Family and species	Occurrence in wetlands of	
	Haora district	Hugli district
Family : PILIDAE		
8. *Pila globosa* (Swainson)	(1-17)	(1-15)
Family : BITHYNIIDAE		
9. *Gabbia orcula* Frauenfild	(1,2,6,14,15)	(4,10,15)
10. *Digoniostoma ceremeopoma* (Benson)	(6,7,12)	(10-13,15)
Family : PLANORBIDAE		
11. *Indoplanorbis exustus* (Deshayes)	(1-17)	(1-15)
12. *Gyraulus convexiusculus* (Hutton)	(1,4,6,7,9,11,14,15)	(3-15)
13. *Gyraulus labiatus* (Benson)	(6,7,12,14)	(13)
Family : LYMNAEIDAE		
14. *Lymnaea luteola* Lamarck	(1-5,7,9-12,14,15)	(1,2,5,6,8-11,13-15)
15. *Lymnaea acuminata* lamarck	(1,14,15)	(8,14,15)
MOLLUSCA : BIVALVIA		
Family : UNIONIDAE		
16. *Lamellidens marginalis* (Lamarck)	(1,2,6,9,11,14,15)	(1,2,6,11,15)

Of the five different groups of zooplankton, copepods are commonly found in limnetic as well as littoral regions of freshwater wetlands. Both conchostracans and cladocerans are found in greatest abundance near the fringe vegetation. The species of ostracods and rotifers were encountered in a wide variety of aquatic habitats. But, all these, organisms provide very good food for the fishes.

Among copepod, species of *Diaptomus* and *Mesocyclops* commonly occur in wide variety of wetlands, The ostracods species are scarcely recorded. The cladocerans exhibit greatest diversity in species as well as in abundance by a number of species *viz., Diaphanosoma excisum* Sars, *Scapholeberis kingi* Sars, *Moina micrura* Kurz, *Chydorus barroisi* (Richard), *Dunhevedia crassa* King and *Alona karua* (King). However, some temperate species of Cladocera *viz., Diaphanosoma brachyurum, Daphnia similis, Grimaldina brazzai, Chydorus pubescens, Chydorus faviformis, Leydigia acanthocercoides, Graptoleberis testudinaria, Alona intermedia, Alona costata, Alona rectangula* and *Camptocereus australis* are extremely rare representative of one or a few wetlands in West Bengal (Venkataraman and Das, 1993). These species were not recorded earlier from West bengal. They are introduced into West Bengal presumably by means of passive spread by

migratory birds (Proctor *et al.*, 1967). A palaearctic species of cladoceran *viz., Diaphanosoma brachyurum* (Lieven) has also been reported from floodplain wetlands in West Bengal (Venkataraman and Das, 1994). The conchostracans and rotifers are not so common in occurrence (Table 14).

Table 14. List of zooplankton species recorded from wetlands in Haora and Hugli districts.

Family and species	Occurrence in wetlands of	
	Haora district	Hugli district
CRUSTACEA : COPEPODA		
Family : DIAPTOMIDAE		
1. *Diaptomus* spp. (3 species)	(1,4,5,7,10, 12,13,15,17)	(3-7,13,15)
2. *Paradiaptomus* sp.	(5,7,9,12)	(5,15)
3. *Spicodiaptomus* sp.	(5,8,17)	(3,6)
Family : CYCLOPIDAE		
4. *Mesocyclops hyalinus* Rehberg	(1,4-10,12-14)	(1,3,4,6,10,13-15)
5. *Mesocyclops leucarti* (Claus)	(1,3,8,12,15,17)	(1,14)
6. *Thermocyclops* sp.	(1,7,12)	(13)
CRUSTACEA : OSTRACODA		
Family : CYPRIDAE		
7. *Cypris* spp. (3 species)	(3,6,7,15)	(13,15)
8. *Stenocypris* spp. (2 species)	(14,15)	(3,9,14,15)
Family : NOTODROMADIDAE		
9. *Centrocypris* sp.	—	(6,13,14,15)
CRUSTACEA : CLADOCERA		
Family : SIDIDAE		
10. *Diaphanosoma brachyurum* (Lieven)*	—	(10,11)
11. *Diaphanosoma excism* Sars	(1,4,5,6,9,10,12,17)	(4-8, 10,13)
12. *Diaphanosoma sarsi* Richard	(1,5,9)	—
13. *Latonopsis australis* (Sars)*	(1,8,14)	(13-15)
14. *Pseudosida bidentata* Herrick*	(7,8)	—

Table 14. *Contd.*

Family and species	Occurrence in wetlands of	
	Haora district	Hugli district
Family : DAPHNIIDAE		
15. *Ceriodaphnia cornuta* Sars	(1,11)	(3,7,10,11,13,15)
16. *Ceriodaphnia reticulata* (Jurine)*	(1,14,15)	—
17. *Daphnia lumholtzi* Sars	(5,6,9,17)	(4,15)
18. *Daphnia similis* Claus*	(17)	—
19. *Scapholeberis kingi* Sars	(1,5,8,11,17)	(3,11,13,15)
20. *Simocephalus exspinosus* (Koch)	(1,13-15)	(3,4,15)
21. *Simocephalus latirostris* Stingelin*	(1,13,14)	(15)
22. *Simocephalus vetulus* (O.F. Muller)	(1,5,8,9,17)	(3,10,13)
Family : MOINIDAE		
23. *Moinodaphnia macleayi* (King)	(1)	—
24. *Moina micrura* Kurz	(5,8,14,17)	(1,4,6,10,13,15)
25. *Moina weismanni* Ishikawa*	—	(11)
26. *Bosminopsis deitersi* Richard*	(1,8,15)	—
Family : MACROTHRICIDAE		
27. *Bosmina longirostris* (O.F. Muller)	(15)	(6,13)
28. *Grimaldina brazzai* Richard**	(1,7)	—
29. *Guernella raphalis* Richard*	(1,7)	—
30. *Ilyocryptus spinifer* Herrick	(4,14)	(11)
31. *Macrothrix spinosa* King*	(1,4-6,8,14)	(3,6,8,10,12,13,15)
32. *Macrothrix triserialis* (Brady)	(1,3,6-8,12)	(10,12,15)
Family : CHYDORIDAE		
33. *Alona affinis* Leyding	(1,12)	(11,15)
34. *Alona costata* Sars	(1,6-8,14)	—
35. *Alona davidi* Richard	(1,8,9,14)	(15)
36. *Alona intermedia* Sars*	(1)	(13,15)

Table 14. *Contd.*

Family and species	Occurrence in wetlands of	
	Haora district	Hugli district
37. *Alona karua* (King)	(1,3,6-8,9,14)	(4,8,13-15)
38. *Alona kwangsiensis* Chiang*	(1)	(11)
39. *Alona monacantha* (Stingelin)*	(7)	—
40. *Alona pulchella* Sars	(1,4,6,7,12,14)	—
41. *Alona quadrangularis* (O.F. Muller)	(6-8)	—
42. *Alona rectangula* Sars	—	(14)
43. *Alona verrucosa* Sars*	(1,6-8,14)	(15)
44. *Alonella excisa* (Fischer)*	(7,13,14)	(5,15)
45. *Camptocercus australis* Sars*	(3)	(13)
46. *Chydorus barroisi* (Richard)	(1,6,7,14)	(8,9,12,13,15)
47. *Chydorus eurynotus* Sars*	(1,6-8,14)	(8,10,13,15)
48. *Chydorus faviformis* Birge*	(8)	—
49. *Chydorus pubescens* Sars*	(7,8,10,11)	—
50. *Chydorus ventricosus* Daday*	(6-8, 14)	(11,13)
51. *Dunhevedia crassa* King	(1,6,7,9,14)	(13,15)
52. *Dunhevedia serrata* Daday*	(8)	(5)
53. *Euryalona orientalis* (Daday)	(1,3)	(9-11)
54. *Graptoleberis testudinaria* (Fischer)	(8)	—
55. *Indialona globulosa* (Daday)	(6-8,14)	(9-11)
56. *Kurzia latissima* (Kurz)	(1,3,7)	—
57. *Kurzia longirostris* (Daday)	(1,3,7,14)	(12)
58. *Leydigia acanthocercoides* (Fischer)	(4)	—
59. *Oxyurella singalensis* (Daday)	(1,8,14)	(13,15)
60. *Pleuroxus denticulatus* Birge	(1,7,14)	—
61. *Pleuroxus similis* Vavra	(1,4,8)	—

Table 14. *Contd.*

Family and species	Occurrence in wetlands of	
	Haora district	Hugli district
CRUSTACEA : CONCHOSTRACA		
Family : CYCLESTHERIDAE		
62. *Cyclestheria hislopi* Baird	(4)	(3,5,6,9,15)
ROTIFERA		
Family : ASPLANCHIDAE		
63. *Asplancha* sp.	(4,5,9,12)	(1,6,7,13,15)
Family : BRANCHIONIDAE		
64. *Branchionus calcyflorus* Pallas	(4,5)	(1)
65. *Branchionus falcatus* Zacharias	(9)	(1)
66. *Branchionus* sp.	(4,8,12)	(1,9)
67. *Keratella tropica* (Apstein)	(5)	(5)
68. *Keratella* sp.	(5)	(2,5,15)
Family : FILINIIDAE		
69. *Filinia* sp.	(12)	(1,9)
(Total :-74 species)		

Note : New records for West Bengal (*) and India (**).

PISCICULTURAL PRACTICES

Water resources of Hugli district are greater than Haora district (Table 15). This is also true for cultivable water resource which includes mostly ponds. Fish culture in ponds plays an important role in the inland fishery resources of these two districts. In Haora district, of the total 5,554.66 ha impounded water area, 76.34% are in cultivable condition, 7.48% and 16.17% are in semiderelict and derelict conditions respectively. While in the Hugli district, though it has nearly three times greater impounded water area (16,268.01 ha) than Haora district the cultivable water area is 56.70%, the semi-drelict and derelict areas are 27.94% and 15.35% respectively (Anonymous, 1986). It indicates that a greater proportion of inland impounded water resource is in semi-derelict condition in Hugli district. It can be made suitable for pisciculture with little improvement. In fact, now-a-days, a large number of rural ponds are being desilted/reexcavated through Government schemes/assistance in Hugli district. However, most of the large *beels* and *dighies* which once constituted a major source of internal fish supply, have progressively gone into dereliction requiring heavy capital investment for reclamation.

The culturable fishes in these two districts can be categorised as follows :

i) Major carps : *Catla catla, Labeo rohita, Cirrhinus mrigala, Labeo calbasu.*

ii) Minor carps : *Labeo bata, Puntius sarana*

iii) Siluroid species : *Clarias batrachus, Heteropneustes fossilis*

iv) Exotic species : *Cyprinus carpio, Ctenopharyngodon idella, Hypophthalamichthys molitrix, Puntius javanicus, Oreochromis mossambica, Oreochromis nilotica.*

Almost all the major carps and a number of exotic species are grown in ponds in various combinations. This process of composite fish farming usually yields relatively higher production even though very little attention is paid to supplementary feeding and management of most of these ponds. As the yield of water is much more than that of the same acreage of land, the enterprising youngsters and local bodies are taking much interest in piscicultural practices in these two districts. However, virtually, no attempt is made of mono and/or synergestic culture of giant freshwater prawn, *Macrobrachium rosenbergii,* a highly priced species, in freshwater wetlands. Similarly, attempts to culture freshwater pearl in mussel, *Lamellidens marginalis,* have not so far been made in the private sector though there is a report on the occurrence of pearl in freshwater mussel (2.37%) in Hugli district (Raut and Biswas, 1989). It is worthmentioning that the Fishery Department, Government of West Bengal is trying to develop standard methods for culturing freshwater pearl in West Bengal (Sengupta, 1992).

Table 15. Wetlands/water resources of Haora and Hugli districts.

Types of resources	Haora district (in ha)	Hugli district (in ha)
1. River	1,007.36	4,358.74
2. Canal/*Khal*	2,019.82	3,714.94
3. *Beel / Baor*	118.28	3,884.76
4. Tank*	8,170.70	19,763.50
5. Impounded water area	5,554.66	16,268.01
a) Culturable	4,240.45	9,224.22
b) Semi-derelict	415.70	4,545,76
c) Derelict	898.51	2,498.03

Source : Anonymous, 1986 ; Saha, 1970*

SOCIO-ECONOMIC ASPECTS

Both Haora and Hugli districts are dominated by small and medium sized wetlands. These wetlands, Besides day to day domestic use, support fisheries and offer a number of economic activities, namely, irrigation, jute-retting, brick-making, grazing as well as growing or cultivation of edible and economic species of aquatic plants. A few wetlands are also important in respect of waterfowl habitat. Each and every village and even its small units (*paras*) have a number of freshwater fish ponds. These fish ponds and floodplain wetlands are important source of sustenance for thousands of rural fisherfolks. They represent socially, economically and educationally backward communities of West Bengal. Majority of these active fisherfolks are women who earn their daily bread using a scoop-net (*Chhakni jal*) or hand net in these wetlands.

The entire Hugli district is a gift of waterways, notably the Damodar group, and the Bhagirathi group (Banerjee, 1972). This district is prone to frequent floods at Arambagh subdivision. In the

floodplain areas of Khanakul, Arambagh and Goghat Blocks, human settlements are seen on high and raised land which remains above water during the monsoon floods. During this period, each settlement (*para*) exposes itself as an isolated island amidst vast expanse of flood water.

However, both Hugli and Haora districts are important in respect to economic activities in and around the wetlands. In the Hugli district, a commercially important species of wetland plant locally known as *paniphal* (*Trapa bispinosa*) is widely grown these days in the hundred of railway *jheels* along Haora-Tarakeswar rail-link. Fruits of *Trapa bispinosa* and *Trapa maximowiczii* (*paniphal*) are eaten as food. It is sold at Rs. 4/- to Rs. 10/- per kg. in the Calcutta market. While in and around Kulgachi-Birshibpur, Haora district *Typha* (Hogla) species are widely grown in the derelict and semi-derelict wetlands. *Typha elephantina* is commercially exploited for making mats and screens. More than 300 bundles of *hogla* leaves are produced per hectare of wetlands and one bundle of dried leaves of this species costs Rs. 50-60/- in the local *hogla* shop. A large number of roadside shops are engaged in this trade.

Several wetland plants are used for a variety of purposes such as food, vegetables, fodder, medicine, mat-making, thatching, fuelwood, fertilizer and pollution abatement. The lotus plant (*Nelumbium* sp.) is cultivated at Kantapukur (near Kulgachia, Haora) and sold for ritualistic purposes. The seeds of *shapla* and *saluk* (*Nymphaea* sp.) are made into puffed grain by frying them like popcorn. The puffed seeds are eaten as such by the poor people or made into home-made confectionery. The stems and leaves of *shapla, saluk, susni sak* (*Marsilea quadrifolia*) ; *kalmi sak* (*Ipomoea aquatica*), *kachu sak* (*Colocasia esculenta*), etc., are used as vegetables. These vegetable plants are collected by the poor womenfolk for domestic consumption or for selling in the local market. These species are quite common in the derelict and semi-derelict wetlands of these two districts. The spongy petioles of *shapla, saluk* and *kachu* are made into delicious dishes even by the affluents as holiday-dish.

The grasses belonging to the family Cyperaceae and Graminae, etc. are often used as fodder for the cattle in addition to mat-making. Two species of Cyperaceae *viz.*, *Cyperus tegetum* (Madur-kathi) and *Juncellus inundatus* (Pati) grown in Balarampur (near Bishibpur) and Garhbhabanipur (near Amta) respectively are used for mat-making.

The plants, flowers and seeds of some Nymphaeaceae are used as tonic for fever, piles, skin disease and dysentry. The Brahmi sak (*Herpestes monicria*, Family Scrophulariaceae) and Kulekhara (*Hygrophila spinosa*, Family Acanthaecae) naturally grown along the water edge of these wetlands are well known for their medicinal value. Some plants like *Bera-kalmi* (*Ipomoea* sp.), also grown along the water margin, are sun-dried and used as fuel by the poors. *Dhanchi* plant *Coronitha* (= *Sesbania*) *cannabina* is cultivated in floodplain wetlands of Hugli district for fire wood and often for natural manuring by making compost fertilizer. Water hyacinth, *Azolla* and other free floating species are also used as compost fertilizer or utilized for the bio-gas plant. These free floating species especially water hyacinth act as water purifiers as they are known to treat sewage and polluted water. It is worth-mentioning that Calcutta's sewage has under gone natural purification in east Calcutta wetlands through this aquatic plant.

The temporary wetlands and roadside ditches are extensively used as paddy seed bed (*Bijtala*) for *boro* (winter rice) cultivation and mostly for jute retting in late monsoon months. During this time the water of these temporary wetlands turn black with a foul smell due to jute steeping and, with the progress of steeping process, these place prove to be notorius breeding grounds for mosquitoes.

The floodplain wetlands of Khanakul (Hugli district), virtually, left fallow during monsoon since no cultivation could be possible due to flood water run-off. While in dry winter season *robi* (dry season, October to March) crops (potato, gourd, mustard, cucumber, etc.) are extensively grown with the supply of water from Damodar Valley Corporation (DVC). The cultivation of *boro* paddy follows the *robi* crops in these floodplain wetlands.

DISCUSSION

The wetlands of Haora and Hugli districts are primarily freshwater wetlands. They are, in general, smaller in size and offer less ecological diversity in wetlands in comparison to those of North and South 24-Parganas districts having both fresh and brackishwater wetlands in addition to mangrove swamps. The faunal diversity in the selected freshwater wetlands of Haora and Hugli districts (combined) represents a total of 286 species of 12 major groups (Table 16), while both freshwater and brackishwater wetlands of North and South 24-Parganas (combined) and Sundarban mangrove ecosystem are represented by 295 and 945 species respectively (Nandi *et al.*, 1993; Mandal and Nandi, 1989). The freshwater wetlands of North and South 24-Parganas districts representing the coastal plains are inhabited by 235 species only compared to 286 species of Haora and Hugli districts representing the Gangetic plains (Table 16). The thereatened wetland fauna of these two districts representing 8 species are listed in Table 17.

Table 16. Comparative faunal diversity (major groups) of freshwater wetlands of North and South 24-Parganas districts (combined) and Haora and Hugli districts (combined)

Major groups	North and South 24-Parganas district (Combined)	Haora distict	Hugli district	Haora and Hugli district (Combined)
Mammals	3	1	1	1
Birds	67	54	53	54
Rreptiles	6	6	6	6
Amphibians	6	6	6	6
Fishes	56	46	48	48
Decapod crustaceans	7	7	7	7
Hemipterans	20	26	27	27
Coleopterans	24	33	31	35
Spiders	8	6	6	6
Annelids	9	6	6	6
Molluscs	12	15	15	16
Zooplankton	17	70	55	74
Total =	235	276	261	286

Table 17. List of threatened' animals occurring in the wetlands of Haora and Hugli districts.

Groups and species	Status of the species as indicated			Present
	IWA, 1972 (1986)	CITES, 1978	IUCN, 1990	Observation
Birds :				
1. *Haliaeetus leucoryphus* (Pallas's Fishing Eagle)	—	—	Rare	Rare
Reptiles :				
2. *Lissemys punctata* (Indian Flap-shelled Turtle)	Schedule I	Appendix I	—	Intermediate
3. *Varanus bengalensis* (Large Bengal Monitor Lizard)	"	"	—	Rare
4. *Varanus flavescens* (Yellow Monitor Lizard)	"	"	Intermediate	Rare
5. *Xenochrophis piscator* (Checkered Keelback)	Schedule II	—	—	Common
6. *Naja naja* (Indian Cobra)	"	—	—	Rare
Amphibians :				
7. *Rana hexadactyla* (Green Frog)	—	Appendix II	—	Rare
8. *Rana tigerina* (Indian Bull Frog)	—	Appendix II	—	Intermediate

Abbreviations : IWA = Indian Wildlife Act ; CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora ; IUCN = International Union for Conservation of Nature and Natural Resources.

Note : 1. The term "threatened" is used in the conservation context to donote species which are "Endangered", "Vulnerable" "Rare," etc., as defined in the IUCN Red List of Threatened Animals (1990).

2. Birds belonging to Alcedinidae, Anatidae, Ardeidae, Ciconiidae, Jacanidae, Phalacrocoracidae, Podicipedidae, Scolopacidae, etc., as well as colubird snakes and freshwater frogs (*Rana* sp.), though listed as 'Small Game' under Schedule IV of the Indian Wildlife (Protection) Act, 1972, are not referred here as threatened animals.

3. Even though the frogs *viz. Rana hexadactyla* and *R. tigerina* are not marine species of commercial importance, they may be considered currently "commercially threatened" as a sustainable commercial resource.

It is evident that Haora and Hugli districts possess relatively poor faunal diversity with respect to vertebrate fauna. But there is higher representation of invertebrate fauna in these two districts over North and South 24-Parganas districts (Table 16). The higher representation of vertebarate fauna (138 vs 115 species) in the freshwater wetland of coastal plains was mainly due to greater diversity of mammals (3 vs 1 species), birds (67 vs 54 species) and fishes (56 vs 48 species). The

additional mammalian species viz. *Felis viverrina* and *Lutra perspicillata* were encountered in the remote wetlands of North and South 24-Parganas for their suitable habitat in wilder environment. The same was true for higher representation of birds like gulls and terns as well as charadriid and muscicapid species. The occurrences of some species like *Notopterus chitala, Tetraodon cutcutia* and some mullets attributed to the higher representation of fishes.

On the other hand, the higher representation on invertebarate diversity (171 vs 97 species) in the wetlands of Gangetic plains of Haora and Hugli districts was found mainly due to greater diversity of hemipterans (27 vs 20 species), coleopterans (35 vs 24 species) and zooplankton (74 vs 17 species). The habitat diversity of wetlands viz. *beel, jheel, jola, daha,* etc., coupled with macrophyte diversity might have offered ample niches for macrophyte associated insect diversity in the wetlands of these two districts. The higher zooplankton diversity in these wetlands might be due to intensive collection from open water as well as weeds in addition to lower predating pressure and lesser diversity of fishes.

The biological resources of freshwater wetlands in other parts of the country also exhibit species richness. The species diversity of avifauna of Keoladeo Ghana National Park of Bharatpur in Rajastan, a man-made freshwater lake, is the richest in the country supporting 364 species of birdlife and is one of the best waterfowl habitat in the world (Ewans, 1989). Ichthyofauna of fresh water wetlands in India *viz.*, Bharatpur wetland in Rajasthan (40 species recorded out of 50 listed species ; Kumar and Vijayan, 1988 ; 46 species ; Kumar *et al.*, 1995) ; Kolleru Lake in Andhra Pradesh (63 species ; Anon, 1988) ; Kabar Lake in Bihar (48 species ; Ramakrishna, 1990) and even in the lakes of temperate region of the country (Lakes of Kashmir : 36 species ; Das, 1964) indicate the species richness of fishes. Both macro-invertebrate and zooplankton fauna of Haigam Lake, a shallow freshwater lake on the floodplain of Jhelum River in Jammu & Kashmir State is also very rich in molluscs, annelids, arthropods, protozoons and rotifers (Scott, 1989). Zooplankton community of Bharatpur wetland are constituted of rotifers (26%) and microcrustaceans *viz.*, cladocerans, ostracods and copepods (63%) in addition to others (Ali and Vijayan, 1983). Venkataramaman (1992) recorded 39 species of cladocerans from the above mentioned wetland. It appears that the cladoceran diversity is considerable in wetlands of Bharatpur as well as in West Bengal.

SUMMARY

1. A funal resource survey of 17 freshwater wetlands of Haora district and 15 from Hugli district reveals the presence of a total of 286 species of wetland fauna belonging to 12 major groups including zooplankton.

2. It includes, among vertebrates, one species of mammal, 54 species of birds, 6 species from both reptiles and amphibians and 48 species of fishes while invertebrate elements comprising of decapod crustaceans (7 species), hemipterans (27 species), coleopterans (35 species), spiders (6 species), annelids (6 species), molluscs (16 species) and zooplankton (74 species).

3. Of the 286 species of wetland fauna, 276 species have been recorded from Haora district and 261 species from Hugli district, differing in fishes, insects, molluscs and zooplankton (Table 16).

4. The present survey reveals 22 new records of Cladocera from West Bengal in additon to the records of the occurrences of 10 temperate species of cladocerans form these wetlands (Venkataraman and Das, 1993).

5. The diversity of fauna from these wetlands (Gangetic plain region) is discussed with special reference to those from freshwter wetlands of North and South 24-Parganas districts representing coastal plain region.

ACKNOWLEDGEMENTS

We would like to thank Dr. A.K. Ghosh, Director, Zoological Survey of India for facilities provided for this work, for suggesting us to undertake wetland faunal resource survey of West Bengal as well as for his wise guidance. We are thankful to Dr. R.K. Varshney and Dr. J.R.B. Alfred, then Additional Directors of this department for their interest and advice in this work. Thanks are also due to Mr. Tapan Sen, Dr. Tusharendu Roy, Mr. Sunil Ghosh, Dr. K.V. Surya Rao, Dr. A. Dey, Mrs. S. Maitra, Mr. S.C. Mitra, Dr. Animesh Ball, Dr. Shyamrup Biswas, Mr. Sujit Ghosh, Mr. C.R. Basu, Dr. T.R. Mitra, Mrs. Manika Mukherjee, Mr. S. Chattopadhyay, Mr. J.M. Dasgupta and other staff of a number of Sections of ZSI for identification of some specimens.

REFERENCES

Ali S. and Vijayan, V.S. 1983. *Hydrobiological Research at Keoladeo National Park, Bharatpur, First Interim Report.* Bombay Natural History Society, Bombay,

Annandale, N. and Dover, C. 1923. Advances in our knowledge of the fauna of the fresh and brackishwaters of India, with bibliography for the years 1912-1922. *J. Asiat. Soc, Bengal,* N.S., **18** : 527-554.

Anonymous, 1986. Endeavour and Achievement. The Directorate of Fisheries, Government of West Bengal.

Anonymous, 1988. *Directory of wetlands in India*, Govt. of India, Ministry of Environment and Forests, New Delhi.

Banerjee, A.K. 1972. *West Bengal District Gazetters* : *Hooghly*, Govt. of West Bengal.

Das, S. M. 1964. The Ictothyofauna of Kashmir, Part-I. The speciation of Kashmir fishes with two new records. *Ichthyologica,* **3** (1-2) : 57-62.

De, M., Bhuinya, S. and Sengupta, T. 1989. A preliminary account of major wetland fauna of Calcutta and its surroundings. *Encology*, **3** (9) : 5-11.

Ewans, M. 1989. *Bharatpur Bird Paradise.* Lustre Press Pvt. Ltd. pp. 1-144.

Ghosh, A. K. 1987. Wetland in Calcutta Metropolitan District. *Urban Management,* ILGUS, **3** : 1-15.

Ghosh, A. K. 1990. Biological resources of wetlands of East Calcutta. *Indian J. Landscape System and Ecol. Studies,* **13**(1) : 10-23.

Ghosh, A.K. and Chattopadhyay, S. 1990. Biological resources of Brace Bridge wetlands. *Indian J. Landscape System and Ecol. Studies,* **13** (2) : 189-207.

Ghosh, D. and Sen, S. 1987. Ecological history of Calcutta's wetland conservation. *Environmental Conservation,* **14**(3) : 219-226.

Ghosh, D. and Sen, S. 1988. Management of urban and periurban wetlands-a rapid appraisal programme for fragile area. Report Calcutta Metropolitan Area Wetland Resource Development Project, pp. 1-20. Institute of Wetland Management and Ecological Design, Calcutta.

Kumar, C.R.A., Ramachandran, N. K. and Asthana, A. 1995. Composition, abundance and distribution of fish in Banganga-Gambhir river system and source of fish to the Keoladeo National Park, Bharatpur *J. Bombay nat. Hist. Soc.,* **92**(1) : 30-39.

Kumar, C.R.A. and Vijayan, V.S. 1988. On the fish fauna of Keoladeo National Park, Bharatpur (Rajasthan). *J. Bombay nat, Hist. Soc.,* **85** (1) : 44-49.

Nandi, N. C., Das, S.R., Bhuinya, S. and Dasgupta, J. M. 1993. Wetland faunal resources of West Bengal. 1. North and South 24-Parganas districts, *Rec. zool. Surv. India Occ. Paper* No. **150** : 1-50.

Proctor, V W., Malone, C.R. and Devlaming, 1967. Dispersal of aquatic organisms. *Ecology,* **48** : 672-676.

Ramakrishna, 1990. Species diversity and management in wetland ecosystems. In : *Taxonomy in environment & Biology,* published by the Director, Zoological Survey of India. Calcutta, pp. 243-255.

Raut, S.K. and Biswas A. 1989. Pearls in freshwater mussels *Lamellidens marginalis* in India (Bivalvia : Unionidae). *Basteria,* **53** : 105-109.

Raut, S.K. and Biswas, A. 1991. Soils limiting the distribution of the freshwater mussel, *Lamellidens marginalis* In ; (Eds. G. K. Veeresh, D. Rajagopal and C. A. Viraktamath) : *Adv, in Magmt, and Cons, of Soil Fauna,* Oxford & IBH pub. Co. Pvt. Ltd., New Delhi, pp. 859-864.

Saha, K.C. 1970 *Fisheries of West Bengal,* State Fisheries Directorate, Govt. of West Bengal.

Sarkar, A. 1984. Taxonomic and ecological studies on the amphibians of Calcutta and its environs. *Rec. zool. Surv. India,* **81** (3&4) : 215-236.

Scott, D.A. (Ed.), 1989. *A directory of Asian wetlands.* IUCN, Gland, Switzerland.

Sengupta, R. 1992. A note on the freshwater pearl culture in West Bengal. *Meenbarta,* January, 1992 ; pp. 25-26.

Subba Rao, N.V. 1989. *Handbook of Freshwater Molluscs of India,* ZSI, Calcutta, pp. 1-289.

Venkataraman, K. 1992. Cladocera of Keoladeo National Park, Bharatpur and its environs. *J. Bombay nat. Hist.* Soc., **89**(1) : 17-26.

Venkataraman, K. and Das, S.R. 1993. The freshwater Cladocera (Crustacea : Branchiopoda) of southern West Bengal. *J. Andaman Sci, Assoc.,* **9** (1 & 2) : 19-24.

Venkataraman, K. and Das, S.R. 1994. Occurrence of Palaearctic Cladocera *Diaphanosoma brachyurum* (Lieven) in West Bengal. *J. Bombay nat, Hist, Soc.,* **91**(3) : 466-467.