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FAUNAL DIVERSITY OF WETLANDS IN THE INDIAN BOTANICAL GARDEN, HAORA, WEST BENGAL

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INTRODUCTION

The Indian Botanical Garden (IBG), Haora, located at the northern flank of river Hugli, is characterised by a unique aquaterrestrial environment having highly heterogenous vegetation. The aquatic environment of this garden complex comprises of a number of small ponds and a mosaic of interconnected lakes of varying dimensions. These lakes are linked with the river Hugli by a sluice mechanism on the south-eastern side. The net area of the garden is 110 ha while the lakes, twenty five in number, encompass one-ninth of the garden area. These lakes and ponds provide suitable living conditions to a wide variety of introduced tropical and subtropical plants of exotic and indigenous origin. These wetlands of IBG, being the source of sustenance for a national living repository of valuable and rare plant species, have been proposed by Shri Raja Mani, the then secretary to the Department of Environment, Ministry of Environment & Forests, Government of India, to bring under collaborative investigation on floral and faunal diversity by the Botanical Survey of India, Haora and the Zoological Survey of India, Calcutta, and hence the present study.

With the above mentioned objective in view, four ponds (located in sectors 8, 9, 11 and 12) and four lakes *viz.*, Dhobi, Prain, Leram and King Lakes were selected for detailed studies on their faunal diversity.

PHYSIOGRAPHY OF THE STUDY AREA

Indian Botanical Garden at Sibpur, Haora district, West Bengal, is located within physiographic subdivision known as 'mature delta' in the lower Ganga Plain. Bio-climatically the area of the garden is lying within the humid tropic region and is endowed with soil of variable sand and clay content (Singh *et al.*, 1990). The coarse sand ranges from 0.1% to 0.34% and the fine sand and silt components make the major part of the soils. The range values of sand, silt and clay contents were recorded respectively as 25.7–36.8%, 33.8–42.7% and 26.9–30.7% in the river side area and 39.3–61.0%, 24.2–35.8% and 13.9–23.9% in the far off stretch of the garden (Singh *et al.*, 1990). The river front

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showed higher clay contents (average 28.7%) as these parts, even in 1970 were subjected to occasional flush floods due to high tides during monsoons (Singh and Ghosh, 1985). Like-wise, p^H values are relatively higher in the river side area (5.8–6.7) than the far off stretch (4.1–5.2) indicating that the soils are feebly acidic to highly acidic in reaction towards the far off sides. In general the river side is rich in clay content, moisture content (17.6%) as well as organic carbon (0.87%) and water holding capacity (62.0%).

Climatic condition is seasonally variable. The mean minimum and mean maximum aerial temperatures vary between 19°C (in winter) and 30°C (in summer). The average rainfall of the area is about 150 cm. Humidity ranges normally between 35–95%. Monsoon months (July–September) are wet and always with higher humidity. Premonsoon period (Summer, March-June) is predominantly dry and warm with occasional rains, while the postmonsoon period (Winter, November-February) is also dry but cold with low temperature and negligible precipitation.

Both the pond and lake water quality parameters showed variations due to heavy rain during monsoon and for the access of river water to the lake system. Some hydrological parameters studied and/or reported from these wetland systems (Singh and Ghosh, 1988) are summarized in Table 1.

Table 1. Range values of some hydrological parameters from ponds and lakes of Indian Botanical Garden, Sibpur.

Hydrological parameters	Range values of water quality in	
	Ponds	Lakes
Water depth (m)	0.8–2.5	1.5–3.5
Water temperature (°C)	27–34	27.5–32.0
p^H	7.0–8.5	6.5–8.5
Electrical conductivity (μ mhos/cm)	–	840–5080
D. O (mg/L)	4.5–11.0	4.0–6.0
Transparency (cm)	60–95	80–130
Residual carbonate (m.c./l)	–	0.02–0.6

Note : Mean annual Ec, p^H and residual carbonates of the lake waters are incorporated from Singh and Ghosh (1988).

In ponds and also in some lakes aquatic vegetation occurs in abundance. The vegetation includes plant communities categorized as free-floating, rooted submerged, semi-emergent and amphibious form and herein reported from both ponds and lakes by Singh and Ghosh (1988) as follows (Table 2).

Table 2. Aquatic vegetation profile of ponds and lakes of Indian Botanical Garden, Sibpur.

Vegetation communities	Plant species observed from	
	Ponds	Lakes
Free floating :		
Algae	+	+
Macrophyte		
1. *Azolla pinnata*	+	+
2. *Eichhornia crassipes*	+	+
3. *Lemna minor*	+	+
4. *Pistia stratiotes*	+	+
5. *Salvinia auriculata*	+	+
Rooted submerged :		
6. *Hydrilla verticillata*	+	+
7. *Otellia alismoides*	–	+
8. *Vallisneria spiralis*	+	+
Semi-emergent :		
9. *Ceratophyllum demersum*	+	+
10. *Ludwigia adscendens*	+	+
11. *Ludwigia perenis*	+	+
12. *Nelumbo nucifera*	+	–
13. *Nymphoides cristata*	+	+
14. *Nymphaea nouchali*	+	+
15. *Nymphaea stellata*	+	+
16. *Victoria amazonica*	+	–
Amphibious :		
17. *Alternanthera philoxeroides*	+	+
18. *Alternanthera sessilis*	+	+
19. *Marsilea quadrifolia*	+	+
20. *Cyperus* spp.	+	+
21. *Polygonum* spp.	+	+
22. *Scirpus* spp.	+	+

Note : Out of 22 species of macrophytes observed 19 species occurred both in lakes and ponds. *Otellia alismoides* was recorded from only lakes and *Nelumbo nucifera* and *Victoria amazonica* occurred only in ponds. The free floating algae was composed of solitary, colonial and filamentous species like *Euglena, Volvox, Microcystis, Spirogyra*, etc. which were common to both lakes and ponds.

Both the ponds and lakes harbour plant communities of variable density. In general, free floating community (*Lemna, Pistia*) was higher in pond system than the lakes which were dominated by rooted submerged plants (*Hydrilla-Vallisneria*). The dominant vegetative features of the four ponds and four lakes surveyed were as follows :

A. **Ponds** :		
1. Pond (P_1 in Sector 12)	:	Mainly free floating forms dominated by *Pistia stratiotes.*
2. Pond (P_2 in Sector 11)	:	Mixed vegetation, mainly emergent forms, dominated by lotus (*Nelumbo nucifera*).
3. Pond (P_3 in Sector 9)	:	Mainly *Lemna* dominated free floating forms with some marginal vegetation.
4. Pond (P_4 in Sector 8)	:	Mixed rooted submerged and semi-emergent vegetation with exotic *Victoria amazonica* introduced.
B. **Lakes** :		
5. Dhobi Lake (L_1 in Sector 24)	:	Scattered free floating forms with moderate mixed vegetation dominated by *Vallisneria spiralis* and low fish culture.
6. Prain Lake (L_2 in Sector 22)	:	Used for semi-intensive fish culture and almost without any vegetation.
7. Leram Lake (L_3 in Sector 2)	:	Scattered free floating (*Pistia*), submerged (*Vallisneria*) and marginal vegetation with moderate fish culture.
8. King Lake (L_4 in Sector 14–18)	:	With a wide arrary of mixed vegetation communities and no fish culture.

MATERIALS AND METHODS

Field observations and survey works were carried out from four ponds and four lakes (Fig. 1) as mentioned above during 1994–95. Three surveys, each of four days duration, were conducted during premonsoon, monsoon and postmonsoon periods. Data on some environmental (Temperature, humidity, vegetation and soil condition) and hydrological parameters (Temperature, p^H, electrical conductivity, D.O., turbidity and residual carbonate) were observed and/or gathered from published papers on the subject. Collections were made using a drag net and a plankton net as well as by hand

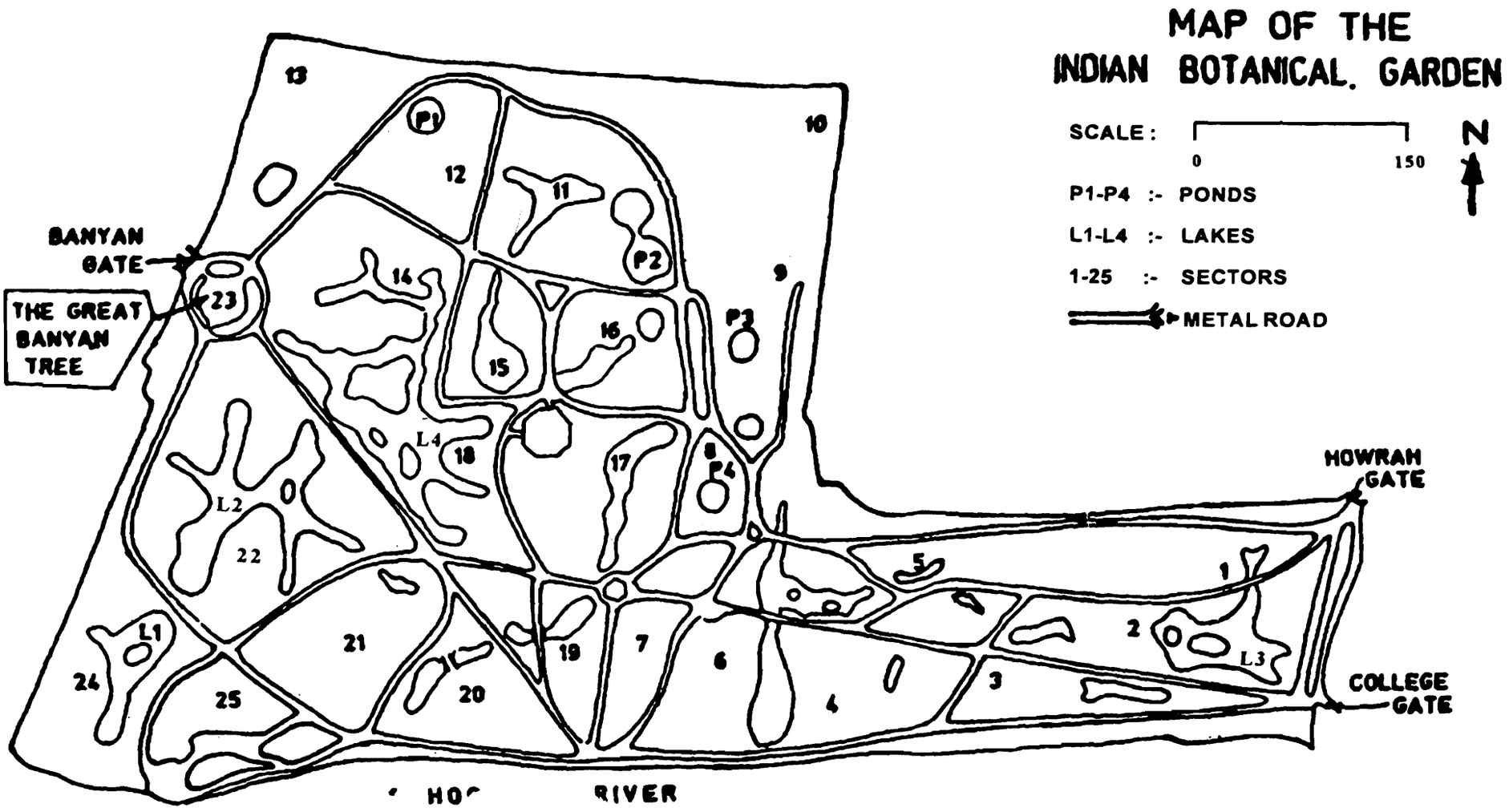

Fig. 1. Plan of the Indian Botanical Garden showing study ponds ($P_1 - P_4$) and lakes ($L_1 - L_4$).

picking. Larger animals, namely, mammals, birds, reptiles and amphibians (and culturable fishes) were observed in the field. Further information on culturable fishes and higher vertebrates were also gathered from local knowledgeable persons as well as fishermen.

FAUNAL DIVERSITY

Of the three categories of wetland fauna viz., (i) aquatic, (ii) wetland dependent (for food e.g. king fishers) and (iii) wetland associates (for shelter e.g. reed dwellers) as defined by Nandi *et al* (1993), only the first two categories of fauna were found during present study. Mention may be made that there was no reed marsh in the garden and hence reed dwelling wetland associates were virtually absent. Besides, some important occasional visitors such as dryland dwelling vertebrates, common and/or characteristic to the biodiversity of the Indian Botanical Garden, are only incorporated but not indicated in the tables. The inventory of the species of vertebrates including fishes, collected observed and/or informed, are herein listed showing their presence (+) or absence (–) from the pond or lake systems as a whole but both macroinvertebrates and zooplankton species are listed/shown separately from each of the ponds and lakes.

A. VERTEBRATE COMPONENTS

Mammals :

Only the Bandicoot Rat, *Bandicota indica* (Bochstein), a wetland dependent species feeding on aquatic molluscs, *Pila globosa*, can be definitely reported as scarcely available (wetland fauna) around ponds and lakes of IBG. The Smooth Indian Otter, *Lutra perspicillata*, an important wetland dependent species, was reported to occur in IBG even in early 1990s; but their presence in and around the garden complex could not be traced. The occurrence of Marsh Mongoose, *Herpestes palustris* Ghosh from Botanical Garden during 1960 (Agarwal *et al.*, 1992) also could not be reascertained. However, some mammals like Small Indian Mongoose, Small Indian Civet, Indian Flying Fox, Indian Pygmy Pipistrelle, Five Stripped Squirrel, Lesser Bandicoot Rat, House Rat and House Shrew could be observed in the area as dryland associates.

Birds :

Eighteen species of water birds, waders and wetland dependent fish feeding kingfishers, belonging to 8 families have been recorded from pond and lakes (Table 3). They are all resident and commonly occur in the Gangetic plains of lower West Bengal. While all the 18 species have been observed from lakes but 6 species *viz.*, *Egretta alba* (Linnaeus), *Dendrocygna javanica* (Horsfield), *Nettapus coromandelianus* (Gmelin), *Rostratula bengalensis* (Linnaeus). *Tringa hypoleucos* Linnaeus could not be sighted in ponds. This may be due to their preference for larger waterbodies available in the garden complex.

Table 3. List of birds recorded in wetlands of Indian Botanical Garden.

Family and species	Recorded from	
	Ponds	Lakes
Family PODICIPETIDAE		
Podiceps ruficollis (Pallas)	+	+
Family PHALACROCORACIDAE		
Phalacrocorax niger (Viellot)	+	+
Family ARDEIDAE		
Ardeola grayii (Sykes)	+	+
Bubulcus ibis (Linnaeus)	+	+
Egretta alba (Linnaeus)	–	+
Egretta garzetta (Linnaeus)	+	+
Nycticorax nycticorax (Linnaeus)	+	+
Family ANATIDAE		
Dendrocygna javanica (Horsfield)	–	+
Nettapus coromandelianus (Gmelin)	–	+
Family RALLIDAE		
Amaurornis phoenicurus (Pennant)	+	+
Gallinula chloropus (Linnaeus)	+	+
Family JACANIDAE		
Metopodius indicus (Latham)	+	+
Family ROSTRATULIDAE		
Rostratula bengalensis (Linnaeus)	–	+
Family CHARADRIIDAE		
Tringa totanus (Linnaeus)	–	+
Family CHARADRIIDAE		
Tringa hypoleucos (Linnaeus)	–	+
Family ALCEDINIDAE		
Ceryle rudis (Linnaeus)	+	+
Alcedo atthis (Linnaeus)	+	+
Halcyon smyrnensis (Linnaeus)	+	+

Reptiles :

Five species of reptiles *viz.*, a pond turtle, *Lissemys punctata* (Bonaterre), two varanid lizards, *Varanus bengalensis* (Daudin) and *Varanus flavescens* (Gray) and two colubrid snakes, *Enhydris enhydris* (Schneider) and *Xenochrophis piscator* (Schneider) were found to be associated with ponds and lakes of IBG. They are scarcely found except *Xenochrophis piscator* which is more or less common in lakes. While three species of wetland fauna comprising of a turtle, *Kachuga tecta* (Gray) Water Monitor, *Varanus salvator* Laurenti and a colubrid water snake, *Cerberus rhynchops* (Schneider) occurring earlier about 130 years ago from IBG, reported by Ahmed and Dasgupta (1992) based on the registered specimens present in the National Zoological Collection (NZC), could not be observed during the present survey work. However, a number of dryland lizards *viz.*, *Hemidactylus* spp., *Calotes versicolor* (Daudin) and *Mabuya* sp. and snakes *viz.*, *Ptyas mucosus* (Linnaeus), *Amphiesma stolata* (Linnaeus) and *Lycodon aulicus* (Linnaeus) were observed from the garden area. But an important elapid snake *viz.*, King cobra, *Ophiophagus hannah* (Cantor) inhabiting IBG during 1880s (*vide* Ahmed and Dasgupta, 1992) appears to be exterminated from this garden complex.

Amphibians :

Six species (two common and four scarce) of amphibians belonging to three families *viz.*, Bufonidae (*Bufo melanostictus* Schneider), Microhylidae (*Microhyla ornata* Dumeril and Bibron) and Ranidae (*Rana cyanophlyctis* Schneider, *Rana hexadactyla* Lesson, *Rana limnocharis* Wiegmann and *Rana tigerina* Daudin) have been recorded either in the ponds and lakes or in the moist shady places on the banks of these wetlands. Both *Microhyla ornata* and *Rana cyanophlyctis* were common in occurrence in the garden complex. *Rana hexadactyla* was encountered in King lake. However, it may be mentioned that Anderson (1871), Bhaduri (1945, 1947) and Sarkar (1948) have reported three rare species *viz.*, *Uperodon globulosum* (Gunther), *Rana erythrea* (Schlegel) and *Rana crassa* in addition to some common ones. A thorough search of the various moist microhabitat may reveal the present status of these rare species in IBG.

Fishes :

A total of 44 species of fishes belonging to 19 families were recorded from the wetlands of IBG (Table 4). All the 44 species have been recorded from lake system, while only 31 species have been listed from pond system (Table 4). Both weed fishes and air-breathing species predominate in the ponds while the lakes, being brought under pisciculture, are dominated by culturable varieties of cyprinid fishes. The lakes are also widely inhabited by a freshwater gar fish, *Xenentodon cancila* (Hamilton).

Both Prain Lake and Leram Lake are more or less intensively used for fishery purpose. The culturable varities include mostly cyprinid fishes along with cichlid species (Tilapias). Both major carps *viz.*, *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* and exotic carps like *Cyprinus carpio*, *Ctenopharyngodon idella* and *Hypophthalamichthys molitrix* are liberated in lakes for culture while the Tilapias *viz.*, *Oreochromis mossambica* and *Oreochromis nilotica* are grown naturally in the lake system. In the unculturable ponds weed fishes belonging to the genera *Puntius*, *Chanda*, *Esomus*, *Colisa* and *Badis* predominate over air-breathing fishes like murrels (*Channa* spp.), climbing perches (*Anabas testudineus*) and cat fishes (*Clarias batrachus* and *Heteropneustes fossilis*).

Table 4. List of fishes occurring in wetlands of Indian Botanical Garden.

Family and species	Occurrence in	
	Ponds	Lakes
Family ANGUILLIDAE		
Anguilla bengalensis (Gray & Hardwicke)	–	+
Family CYPRINIDAE		
Labeo rohita (Hamilton)	+	+
Labeo bata (Hamilton)	–	+
Catla catla (Hamilton)	+	+
Cirrhinus mrigala (Hamilton)	+	+
Ctenopharyngodon idella (Valenciennes)	–	+
Cyprinus carpio Linnaeus	–	+
Hypophthalamichthys molitrix Valenciennes	–	+
Puntius sophore (Hamilton)	+	+
Puntius ticto (Hamilton)	+	+
Puntius sarana (Hamilton)	–	+
Puntius phutunio (Hamilton)	+	+
Amblypharyagodon mola (Hamilton)	+	+
Esomus danricus (Hamilton)	+	+
Salmostoma bacaila (Hamilton)	–	+
Lepidocephalus guntea (Hamilton)	+	+
Family NOTOPTERIDAE		
Notopterus notopterus (Pallas)	+	+
Family BAGRIDAE		
Mystus cavasius (Hamilton)	+	+
Mystus vittatus (Bloch)	+	+
Mystus tengra (Hamilton)	+	+
Family SILURIDAE		
Wallago attu (Schneider)	–	+
Family CLARIIDAE		
Clarias batrachus (Linnaeus)	+	+

Table 4. *Contd.*

Family and species	Occurrence in	
	Ponds	Lakes
Family HETEROPNEUSTIDAE		
Heteropneustes fossilis (Bloch)	+	+
Family BELONIDAE		
Xenentodon cancila (Hamilton)	+	+
Family CYPRINODONTIDAE		
Aplocheilus panchax (Hamilton)	+	+
Family SYMBRANCHIDAE		
Monopterus cuchia (Hamilton)	+	+
Family CHANNIDAE		
Channa orientalis (Schneider)	+	+
Channa punctatus (Bloch)	+	+
Channa striatus (Bloch)	+	+
Channa marulius (Hamilton)	–	+
Family CHANDIDAE		
Chanda nama (Hamilton)	+	+
Chanda ranga (Hamilton)	+	+
Family MUGILIDAE		
Mugil tade (Forsskal)	–	+
Family GOBIIDAE		
Glossogobius giuris (Hamilton)	+	+
Oligolepis acutipinnis (C.V.)	–	+
Family ANABANTIDAE		
Anabas testudineus (Bloch)	+	+
Family CICHLIDAE		
Oreochromis mossambica Peters	+	+
Oreochromis nilotica Valenciennes	–	+
Family NANDIDAE		
Nandus nandus (Hamilton)	–	+
Badis badis (Hamilton)	+	+

Table 4. *Contd.*

Family and species	Occurrence in	
	Ponds	Lakes
Family BELONTIDAE		
Colisa fasciatus (Schneider)	+	+
Family MASTACEMBELIDAE		
Macrognathus aculeatus (Bloch)	+	+
Mastacembelus pancalus (Hamilton)	+	+
Mastacembelus armatus (Lacepede)	–	+

B. INVERTEBRATE COMPONENTS

The collected aquatic invertebrates comprising of macro-invertebrates and zooplankton are reported hereunder from all the four ponds and four lakes (Tables 5 and 6) using abbreviation P_1 to P_4 for ponds and L_1 to L_4 for lakes as referred above.

Macro-invertebrates :

A total of over 64 species of macro-invertebrates, both aquatic and wetland associated, comprising of decapod crustaceans (6 species), hemipterans (15 species), coleopterans (18 species), arachnids (10 species) and molluscs (9 species) as well as some miscellaneous larval insects (6 species) were recorded from ponds and lakes of the Botanical Garden (Table 5). Among the aquatic macroinvertebrates, only microhemipterans like *Plea* spp. could not be observed from three lakes presumably due to their use in pisciculture. On the other hand some species belonging to the genera *Macrobrachium* (decapod crustaceans), *Diplonychus* and *Ranatra* (hemipterans) are quite common in both ponds and lakes. Most of the species of spiders (arachnids) are found associated with aquatic weeds. Their occurrences are herein reported based on the collected specimens. However, molluscan species are found to occur in low to high densities in ponds and lakes of which Leram lake represents high density of two gastropod *viz.*, *Assiminnea francessiae* and *Indoplanorbis exustus* and one bivalve species such as *Lamellidens marginalis*.

Zooplankton :

A total of over 55 species of zooplankton belonging to six different groups *viz.*, Hydrozoa (1 sp.), Copepoda (4 spp.), Ostracoda (5 spp.) Cladocera (38 spp.), Conchostraca (1 sp.) and Rotifera (>3 spp.) have been observed from ponds and lakes of IBG (Table 6). Of the six zooplankton groups, Cladocera has the highest diversity of 38 species belonging to six different families and of the ponds and lakes, King lake represents highest diversity of cladocerans as well as other zooplankton. In general, lakes support greater diversity of species of zooplankton than the ponds. Eleven cladoceran species marked with asterisks (*) in Table 6 were not recorded from various other wetlands of Haora district, West Bengal (Nandi *et al.*, 1999). Larger cladocerans *viz.*, *Daphnia* species could not be recorded from wetlands of IBG. This may be due to high predation pressure by fish and/or insects. However, among ostracods, the occurrence of *Strandesia weberi* is worth mentioning.

Table 5. List of macroinvertebrates recorded from wetlands of Indian Botanical Garden.

Group/Family and species	Recorded from							
	Ponds				Lakes			
	P_1	P_2	P_3	P_4	L_1	L_2	L_3	L_4
A. Decapod crustaceans :								
Family PALAEMONIDAE								
Macrobrachium rosenbergii (de Man)	–	–	–	+	+	+	+	–
Macrobrachium lamarrei (H. M. Edwards)	+	+	+	+	+	+	+	+
Macrobrachium dayanum (H. M. Edwards)	–	–	–	+	+	+	+	+
Family ATYIDAE								
Caridina sp.	–	–	–	+	+	–	–	+
Family GRAPSIDAE								
Varuna litterata (Fabricius)	–	–	–	+	+	+	+	–
Family POTAMONIDAE								
Sartoriana spinigera (Wood Mason)	+	–	–	+	+	–	–	+
B. Hemipteran insects :								
Family BELOSTOMIDAE								
Diplonychus annulatus Fabr.	+	+	+	+	+	+	+	+
Diplonychus spp. (2 species)	+	+	+	+	+	+	+	+
Family GERRIDAE								
Gerres spp. (2 species)	+	+	+	+	+	–	–	+
Family HYDROMETRIDAE								
Hydrometra sp.	–	+	+	+	+	–	+	+
Family NEPIDAE								
Laccotrephes griseus (Gnerin)	+	–	+	+	+	–	–	+
Ranatra filiformes Fabr.	+	+	+	+	+	+	+	+
Ranatra sordidula Dahrn	–	+	–	+	–	–	–	+
Family NOTONECTIDAE								
Anisops spp. (2 species)	–	–	+	+	+	+	+	+
Family PLEIDAE								
Plea spp. (2 species)	–	+	+	+	–	–	–	+

Table 5. *Contd.*

Group/Family and species	Recorded from							
	Ponds				Lakes			
	P_1	P_2	P_3	P_4	L_1	L_2	L_3	L_4
C. Coleopteran insects :								
Family DYTSCIDAE								
Canthydrus laetabilis (Walker)	–	+	+	–	–	–	–	+
Canthydrus spp. (2 species)	+	+	+	+	+	–	–	+
Cybister spp. (2 species)	–	+	+	+	–	–	–	+
Laccophilus spp. (2 species)	–	+	+	+	+	+	–	+
Family HYDROPHILIDAE								
Amphiops spp. (2 species)	–	+	+	+	+	+	+	+
Helochares spp (2 species)	–	+	–	–	–	+	–	–
Regimbertia spp. (2 species)	+	+	+	–	+	–	–	+
Sternolophus spp. (2 species)	–	+	+	–	–	–	–	+
Family CHRYSOMELIDAE								
Leaf beetles (2 species)	–	–	+	+	+	–	+	–
Family CURCULIONIDAE								
Weevils (1 species)	–	–	+	–	+	–	+	–
D. Larval insects :								
Order ODONATA								
Ischnura sp.	+	+	+	+	+	+	+	+
Brachythemis spp. (2 species)	–	+	+	+	+	–	+	+
Order DIPTERA								
Mosquito larvae	+	+	+	+	+	–	+	+
Chironomid larvae	+	+	+	+	+	–	–	+
Order EPHEMEROPTERA								
Mayfly larvae	–	+	+	–	–	–	–	–
E. Arachnids :								
Family LYCOSIDAE								
Evippa shivajii Tikader & Malhotra	–	–	–	–	–	–	–	+
Pardosa annandalei (Gravely)	–	+	–	–	–	–	–	–

Table 5. *Contd.*

Group/Family and species	Recorded from							
	Ponds				Lakes			
	P_1	P_2	P_3	P_4	L_1	L_2	L_3	L_4
Pardosa pusiota (Thorell)	–	–	–	–	–	+	–	–
Pardosa birmanica Simon	–	–	–	–	–	–	+	–
Pardosa sp.	–	–	+	–	–	–	–	+
Family SALTICIDAE								
Salticus sp.	–	–	–	–	+	–	–	–
Family TETRAGNATHIDAE								
Tetragnatha spp. (2 species)	–	–	–	–	–	+	–	–
Family ARANEIDAE								
Larinia sp.	–	–	–	–	+	+	–	–
F. Molluscs :								
Family ASSIMINEIDAE								
Assiminea francessiae (Gray)	–	–	–	+	+	+	+	+
Family THIARIDAE								
Thiara tuberculata (Muller)	–	+	–	+	–	+	+	+
Family VIVIPARIDAE								
Bellamya bengalensis (Lamarck)	+	+	+	+	+	+	+	+
Family PILIDAE								
Pila globosa (Swainson)	+	+	+	+	+	+	+	+
Family BITHYNIIDAE								
Gabbia orcula Frauenfeld	–	+	–	+	+	–	+	+
Family PLANORBIDAE								
Indoplanorbis exustus (Deshayes)	+	+	+	+	+	+	+	+
Gyraulus convexiusculus (Hutton)	+	+	+	+	+	+	+	+
Family LYMNAEIDAE								
Lymnaea luteola Lamarck	–	–	+	+	+	+	–	+
Family UNIONIDAE								
Lamellidens marginalis (Lamarck)	–	–	–	+	+	–	+	+

Table 6. List of zooplankton species recorded from wetlands of Indian Botanical Garden.

Group/Family and species	Zooplankton species recorded from							
	Ponds				Lakes			
	P_1	P_2	P_3	P_4	L_1	L_2	L_3	L_4
CNIDARIA : HYDROZOA								
Family HYDRIDAE								
Hydra sp.	–	+	+	–	–	–	–	–
CRUSTACEA : COPEPODA								
Family DIAPTOMIDAE								
Diaptomids (2 spp.)	+	–	–	+	+	+	+	+
Family CYCLOPIDAE								
Cyclopids (2 spp.)	+	+	+	+	+	+	+	+
Family HARPACTICOIDAE								
Harpacticoids (1 sp.)	–	+	+	–	+	–	–	–
Nauplius larvae	–	–	–	+	+	+	+	+
CRUSTACEA : OSTRACODA								
Family CYPRIDIDAE								
Cypretta sp.	–	–	–	–	–	+	+	–
Cypris subglobosa Sowerby	–	–	–	–	–	–	–	+
Stenocypris major (Baird)	–	–	–	–	–	–	+	–
Stenocypris deruputa Vavra	–	–	–	–	–	–	–	+
Strandesia weberi	+	+	–	–	–	–	–	–
Other ostracods (2 spp.)	–	+	+	–	+	+	–	+
CLADOCERA								
Family SIDIDAE								
Pseudosida bidentata Herrick	–	–	–	–	–	–	–	+
Latonopsis australis Sars	–	–	–	–	–	–	–	+
Diaphanosoma excisum Sars	+	–	–	+	–	+	+	+
Diaphanosoma sarsi Richard	+	–	–	–	–	+	+	–

Table 6. *Contd.*

Group/Family and species	Zooplankton species recorded from							
	Ponds				Lakes			
	P_1	P_2	P_3	P_4	L_1	L_2	L_3	L_4
Diaphanosoma brachyurum (Lieven)*	–	–	–	+	–	–	–	+
*Diaphanosoma aspinosum**	–	+	–	–	–	–	–	–
Diaphanosoma leuchtenbergianum Fischer*	–	–	–	–	+	–	–	–
Family DAPHNIIDAE								
Simocephalus vetulus (O. F. Muller)	–	–	–	–	+	+	+	+
Simocephalus exspinosus (Koch)	–	+	–	–	–	–	+	–
Simocephalus serrulatus (Koch)*	–	–	–	–	–	+	–	+
Cereodaphnia cornuta Sars	+	–	+	+	+	+	+	+
Scapholeberis kingi Sars	–	–	–	+	–	–	–	+
Family MOINIDAE								
Moina micrura Kurz	–	–	–	+	+	+	+	–
Moina brachiata (Jurine)*	–	+	–	–	–	–	–	–
Family MACROTHRICIDAE								
Macrothrix spinosa King	–	+	+	–	+	–	+	+
Macrothrix triserialis (Brady)	–	+	+	–	–	+	–	–
Ilyocryptus spinifer Herrick	–	–	–	–	–	–	+	–
Family BOSMINIDAE								
Bosmina longirostris (O. F. Muller)	–	–	–	–	+	–	–	–
Family CHYDORIDAE								
Pleuroxus similis Vavra	–	–	–	–	–	–	–	+
Alonella excisum Fischer	–	–	–	–	–	–	–	+
Chydorus sphaericus (O. F. Muller)*	–	+	–	–	+	+	+	+
Chydorus barroisi (Richard)	–	–	–	–	+	+	–	+
Chydorus reticulatus Daday*	–	–	+	–	+	+	+	+
Chydorus ventricosus Daday	–	–	–	–	–	–	–	+
Dunhevedia crassa King	–	–	–	–	+	+	+	–
Pseudochydorus globosus (Baid)*	–	–	–	–	+	–	–	+
Camptocercus australis Sars	–	–	–	–	+	+	–	–

Table 6. *Contd.*

Group/Family and species	Zooplankton species recorded from							
	Ponds				Lakes			
	P_1	P_2	P_3	P_4	L_1	L_2	L_3	L_4
Dadaya macrops (Daday)*	–	–	–	–	–	+	–	–
Alona karua (King)	–	+	–	+	+	+	+	+
Alona pulchella Sars	–	–	–	+	+	–	–	+
Alona verrucosa Sars	–	–	–	–	+	+	–	+
Alona costata Sars	–	–	–	–	+	–	+	–
Alona kwangsiensis Chiang	–	–	–	–	+	–	–	–
Alona davidi Richard	–	–	–	–	+	+	–	+
Alona rectangula Sars*	–	–	–	–	+	+	–	+
Kurzia longirostris (Daday)	–	–	–	–	+	–	–	+
Oxyurella singalensis (Daday)	–	+	–	–	–	–	+	+
Notalona globulosa (Daday)*	–	–	–	–	–	–	–	+
CRUSTACEA : CONCHOSTRACA								
Family CYCLESTHERIDAE								
Cyclestheria hislopi Baird	–	–	–	–	–	–	–	+
ROTIFERA								
Family ASPLANCHIDAE								
Asplancha sp.	+	+	–	–	–	–	+	+
Other rotifers (2 spp.)	–	+	–	–	+	+	+	+

Note : (*) = These species were not observed from various other wetlands of Haora district (Nandi *et al.*, 1999).

DISCUSSION

The wetland environment of the Indian Botanical Garden was known for its significant diversity in the incidence and abundance of various plant communities in the lakes (Singh and Ghosh, 1988). But, some of these lakes, *viz.*, Prain lake and Leram lake, are increasingly utilized for pisciculture in recent years. As a result, the apparent heterogeneity as noted by Singh and Ghosh (1988) in the bioaquatic environments of these lakes has rapidly been altered with regular anthropogenic interferences. The natural indigenous vegetation grown widely in ponds could not be seen in lakes as they are manually and mechanically cleared for fish cultivation. It influences on the faunal diversity

of these lakes. A comparative account of faunal diversity with reference to macroinvertebrate and zooplankton in relation to plant diversity and usage is summarised in Table 7. It shows that the lakes are in general, more productive than ponds. Among lakes it is revealed that the King lake which is characterised by high plant diversity with no fish culture supports greatest faunal diversity. However, the comparative account of floral and faunal diversity shown in Table 7 clearly indicates the dependency of faunal diversity with that of plants as well as size of the wetland concerned and inversely with anthropogenic/pisciculture activities.

Table 7. Comparative floral and faunal diversities of ponds and lakes in IBG.

	Ponds and lakes	Plant diversity and usage	Faunal diversity (No. of species)		
			Macroinvertebrate	Zooplankton	Total
	A. *Ponds* (Small size and no fish culture)				
1.	Pond (P_1)	Low diversity, *Pistia* dominated	16	7	23
2.	Pond (P_2)	High diversity, Lotus dominated	28	15	43
3.	Pond (P_3)	Medium diversity, *Lemna* dominated	23	8	31
4.	Pond (P_4)	High diversity, *Victoria* introduced	35	10	45
	B. *Lakes*				
5.	Dhobi lake (L_1)	Medium diversity with low fish culture	33	25	58
6.	Prain lake (L_2)	Very low diversity with very high fish culture	24	22	46
7.	Leram lake (L_3)	Low diversity with moderate fish culture	24	21	45
8.	King lake (L_4)	High diversity with no fish culture	35	33	68

SUMMARY

1. Faunal diversity of 4 ponds and 4 lakes in the Indian Botanical Garden dealing with 74 species of vertebrates and over 119 species of invertebrates is reported.
2. It includes 10 major groups representing mammals (1 sp.), birds (18 spp.), reptiles (5 spp.), amphibians (6 spp.), fishes (44 spp.), decapod crustaceans (6 spp.), insects (39 spp.), arachnids (10 spp.), molluscs (9 spp.) and zooplankton (55 spp.).
3. The dependency of faunal diversity with that of plants is dicussed.

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