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DEVELOPMENT OF A WATER BODY FOR CONSERVATION OF AQUATIC BIODIVERSITY IN BOTANIC GARDEN OF INDIAN REPUBLIC, NOIDA

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Abstract: As per Article 9 of Convention on Biological Diversity (CBD), Botanic Garden of Indian Republic (BGIR), NOIDA was established to conserve endemic and threatened plants of different habitats of the country under *ex-situ* conservation. Hence, an attempt is made to develop a prototype water body in sandy soil without using civil construction materials for biogenesis of aquatic flora and fauna and to conserve aquatic plants. To prevent water percolation, a thick layer of leftover bentonite wastes and a semi-permeable membrane was laid. Further, to overcome the adverse effects and to boost biogenesis, water was reclaimed by addition of fresh raw dung and organic compost in requisite proportion. As a result, microbial growth/film on the bottom of the water body, planktons and other biota were generated by its own. Furthermore, 5 species of *Nymphaea,* and 1 each species of *Nelumbo* and *Victoria* were introduced. Under micro and macroscopic observations, different planktonic forms of flora and fauna were recorded and attracted avian fauna and other terrestrial creatures for feeding and drinking purposes. Besides, *Ceratophyllum demersum, Hydrilla verticillata, Potamogeton crispus* and *Potamogeton nodosus* also occurred naturally. Thus, the aim of developing a water body for conservation of aquatic biodiversity in BGIR is achieved.

Keywords: Bentonite waste, Biodiversity, *Ex-situ* conservation, Fauna, Flora, Reclamation.

INTRODUCTION

India is one of the 17 mega-diverse countries of the world having rich biodiversity (UNEP-WCMC, 2014; Kumar and Verma, 2017). India is rich in having more than 50,000 plant species starting from *microscopic* (*i.e.*24,120 species of Virus/Bacteria to primitive Algae/Fungi) to *macroscopic* (*i.e.*25,892 species of Lichens/ Bryophytes to most evolved/modern group of plants like Angiosperms). These are distributed in 12 Phyto-geographical Regions of the country that have already been identified since 1793 (BSI, 2019). Among the reported species, most are under threat as per IUCN (2021) and are required to be conserved for future generations. Similar situation is prevailing all along the globe and in dire need for their conservation. Hence, as per requirement of Stockholm UNO Conference, 1972 and 42 Articles of 1st 'Convention on Biological Diversity (CBD)' during 'Earth Summit' held in 1992 at Rio de Janeiro, Brazil, Botanic Garden of Indian Republic (BGIR) previously known as National Botanic Garden (NBG) was established in 1997 in NOIDA (New Okhla Industrial Development Authority) over 200 acre land area for the conservation of endemic and

threatened plant species of the country under *ex-situ* conservation and fulfillment of other requirements. Biodiversity conservation is must as it is required for the maintenance of ecological balance and survival of entire biotic community including humans (Ashok, 2017; Verma, 2018; Kumar, 2021).

The process involves introduction of live plants from different Phyto-geographical Regions, adaptation, plantation, development, multiplication and propagation using seeds, twigs, etc. and restoration in its natural habitats. Thus, now this garden is functioning as a living repository of more than 10,500 (total 10,666) individuals belonging to 876 plant species. These were brought from 23 states of the country and are being conserved scientifically in different sections/areas *viz.* (a). Woodland/Arboreta (green belt all along boundary wall), (b). Economic plant, (c). Fruits, (d). Medicinal plant, (e). Cactus and succulent, (f). Horticulture and (g). Nurseries (6 including 1 with Fogging and Sprinkler system) specifically as per Article 9 of CBD i.e. *ex-situ* conservation.

Amongst, most species belong to terrestrial habitat, so for conservation of aquatic plant species specially the National Flower *i.e. Nelumbo nucifera* Gaertn. and other aquatic macrophytic plant species including an amazing largest leaf bearing aquatic plant of the world *i.e. Victoria amazonica* (Poepp.) J.C. Sowerby, a water body similar to the natural habitat was required to be developed. Along with the conservation aspect, it was also needed to showcase such plants in totality to the visitors of varying age groups and nature. BGIR performs scientific researches in conservation, extend services for environmental education/ training and awareness for mass conservation of floral resource of the country and their restoration in respective territorial areas as well as prepares National Database of conserved plants.

Keeping these into consideration, developmental plan of a water body was made, area allocated and resources arranged for execution. But major hurdle was the characteristics of soil as this botanic garden is mainly established over the sand bed of river Yamuna in which retention of water is very poor. Efforts were made to develop water bodies without using civil construction materials by involving various techniques and know-how. However, all expenses and efforts made earlier were gone in vain possibly due to errors in planning and shortfall in execution.

Communication-wise BGIR is well connected with nearby cities through metal roads and elevated metro station as 'Botanic Garden'. From the same metro station, another elevated metro route is originating for Delhi and constructed approx. 2 dozen piers within the garden premises. While doing so, sodium and potassium bentonite were used for proper sealing/geo-technical strengthening to drilled/excavated land (Odom, 1984; Hosterman and Patterson, 1992; FPS, 2006). Thus, by experiencing soil binding/sealing properties of bentonite, once again initiative for development of a prototype water body was initiated, planned for execution and developed the same efficiently in 12 days time period involving garden staff and machineries at limited expenses. However, the used bentonite was unknowingly contaminated with spillage of other construction materials such as oil, greases, cement and leftover bentonite fluid spread over open land, prevented normal occurrence of living entities (Chhabra, 1996; FPS, 2006). Even then, keeping in view of its sealing properties, such soil was spread/used all over for lining the floor/bed of newly developed water body, watered and being maintained for more than 7 years. Retention of water was achieved and genesis of micro to macroscopic biological entities took place by various ways and as assumed, different species of aquatic plant species were conserved.

MATERIALS AND METHODS

For conservation of aquatic plants, one among 5 previously developed and defunct water body No. 5 (size 75 ft. long, 48 ft. wide and 8.5 ft. deep) of unusual shape, located next to functional existing natural small water body and behind the Charak Udyan in Botanic Garden of Indian Republic was selected (fig.1). The developmental work was started on 09.09.2015 by the effort of garden staff using available machineries and hired a JCB for 8 days to get final size of water body to 68 ft. long, 44 ft. wide and 3 ft. deep.

Fig. 1: New developed water body in almost half part of the non-functional water body No. 5 at BGIR.

Initially, cleaning/de-weeding and uprooting of weedy herbs/shrubs, etc. from proposed area was undertaken. The soil spread/heaped in and around piers of new Metro Line under Phase-II was filled up to 5 ft., leveled and firm smooth surface of bottom was made by tractor and metallic roller. Then, a laminated two-ply semi-impermeable sheet at a depth of approx. 4-5 ft. was laid over ground and slant of the bank. Further, to get all along desired depth of 3 ft. in water body, 2 ft. thick layer of bentonite mixed soil was again spread all over, leveled and surface was made firm and smooth.

On 12th day from date of start of developmental work of water body, water was filled in for 4 hours and level remains maintained until 28.09.2015. Depleted water depth was replenished in 30 minutes. The occurrence of any living being in water body and over its floor was constantly monitored for 7 days from date of filling water. When there was no sign of anything, fresh cow dung (5 tashla) and organic compost (10 tashla) was added on 23.09.2015 for enriching the water and soil surface (Chhabra, 1996) for biogenesis of microbial film (layering of slime forming bacteria and microscopic benthic algae) / growth and activities over underwater soil surface and water. The colour of water got changed from muddy (on 22.09.2015) to green (on 28.09.2015) by mass production of phytoplanktonic forms including microscopic fauna. After that, 29 individual plants of 5 species of *Nymphaea namely Nymphaea caerulea* Sav. (blue)-1, *Nymphaea mexicana* Zucc. (yellow)-6, *Nymphaea pubescens* Willd. (white)-8 and *Nymphaea rubra* Roxb. ex Andrews (red)-7 introduced earlier in the garden were planted. Further, *Nymphaea colorata* Peter (voilet)-7 was planted on 29.09.2015 by bringing them from Yamuna Biodiversity Park. After 7 months when these plants sustained, 4 saplings of *Nelumbo nucifera* Gaertn., was also introduced on 08.04.2016 by bringing the saplings from Acharya Jagadish Chandra Bose Indian Botanic Garden, Howrah and seeds of Victoria amazonica (Poepp.) J.C. Sowerby sown and 2 each individuals of *Labeo catla* F. Hamilton and *Labeo rohita* F. Hamilton were also introduced.

RESULTS AND DISCUSSION

The methodology adopted for development of water body in Botanic Garden of Indian Republic (BGIR) is economically viable and subsequent outcome generated in the form of developed diversity in composition of aquatic flora and fauna including dependent organisms is depicted in table 1 and photo plates I to V. The newly created water body may provide a congenial environmental condition, intended for the conservation of existing conserved aquatic plants and or likely to be conserved in future. Such act may keep people aware about its different identity than any other lilies and at the same time, it may also be utilized to showcasing the curious and amazing largest leaf bearing aquatic plant species of the world *i.e. Victoria amazonica* (Poepp.) J.C. Sowerby. Thus, it became imperative to establish a water body (on land of alkaline sandy soil and in alkaline water) for the

conservation of aquatic plants under *ex-situ* condition, as, conservation of aquatic biodiversity in natural way is really a big challenge (Arya, 2021).

Table 1: Diversity of flora and fauna in developed water body including dependent organisms at BGIR.

S.No.	Name of the organisms	Vernacular name	Status
A. INTRODUCED FLORA AND FAUNA			
1.	**Aquatic Plants**		
	i. *Nelumbo nucifera* Gaertn.	Kamal	National Flower, Endemic, Medicinal, Economic
	ii. *Nymphaea caerulea* Sav.	Blue Kumud	Ornamental, Medicinal, Economic
	iii. *Nymphaea colorata* Peter	Violet Kumud	Ornamental
	iv. *Nymphaea Mexicana* Zucc.	Yellow Kumud	Ornamental
	v. *Nymphaea pubescens* Wild.	White Kumud	Ornamental
	vi. *Nymphaea rubra* Roxb. ex Andrews	Red Kumud	Ornamental
	vii. *Victoria amazonica* (Poepp.) J.C. Sowerby	*Victoria*	Largest leaf bearing aquatic plant, Ornamental
2.	**Fauna**		
	Labeo catla F. Hamilton	Catla	Endemic, Least Concern, Economic
	Labeo rohita F. Hamilton	Rohu	Least Concern, Economic
B. NATURALLY OCCURRED FLORA AND FAUNA			
1.i.	**Flora : Phytoplankton**		
	i. *Chlamydomonas reinhardtii* P.A. Dang	*Chlamydomonas*	Economic
	ii. *Chlorella vulgaris* Beijerinck	*Chlorella*	Economic
	iii. *Closterium ehrenbergii* Meneghini ex Ralfs	*Closterium*	Economic
	iv. *Eudorina elegans* Ehrenberg	*Eudorina*	Economic
	v. *Fragilaria* sp.	*Fragilaria*	Economic
	vi. *Navicula cryptocephala* Kutz	*Navicula*	Economic
	vii. *Pediastrum simplex* Meyen	*Pediastrum*	Economic
	viii. *Phacus longicauda* (Ehrenberg) Dujardin	*Phacus*	Economic
	ix. *Scenedesmus quadricauda* (Turpin) Brébisson	*Scenedesmus*	Economic
	x. *Spirogyra* sp.	*Spirogyra*	Economic, Weed
	xi. *Zygnema* sp.	*Zygnema*	Economic, Weed
1.ii.	**Macro-algae**		
	Chara sp.	*Chara*	Economic, Weed
1.iii.	**Macrophytes**		
	i. *Ceratophyllum demersum* L.	Hornwort	Economic
	ii. *Hydrilla verticillata* (L.f.) Royle	Water thyme	Medicinal, Economic
	iii. *Potamogeton crispus* L.	Curled pondweed	Weed
	iv. *Potamogeton nodosus* Poir.	Long leaf pond weed	Weed
	v. *Vallisneria spiralis* L.	*Vallisneria*	Weed

2.i.	**Fauna : Zooplankton including 1 Fish**		
	i. *Channa punctata* Bloch	Garai (Fish)	Endemic, Least Concern, Economic
	ii. *Chironomids* larvae	Chironomids	Economic
	iii. *Cybister* sp. larvae	*Cybister*	Economic
	iv. *Cyclops bicuspidatus* Claus	*Cyclops* with egg	Economic
	v. *Cyclops* sp.	*Cyclops* without egg	Economic
	vi. *Cyclops* sp.	Nauplius larva	Economic
	vii. *Daphnia magna* Straus	*Daphnia*	Economic
	viii. *Gerris* sp.	Pond Skater	Economic
	ix. *Moina macrocopa* Strau	*Moina*	Economic
	x. *Ranatra* sp.	Water Stick Insect	Economic
	xi. *Tubifex tubifex* O. F. Müller	Sludge worm	Economic
2.ii.	**Other Fauna visiting the water body including based on their foot mark**		
	i. *Ardea alba* L.	Great white Heron	Least Concern
	ii. *Ardeola grayii* Sykes	Pond Heron	Least Concern
	iii. *Boselaphus tragocamelus* Pallas	Nilgai	Endemic, Least Concern
	iv. Dragonfly	Dragonfly	Economic
	v. Flies	Flies	Economic
	vi. *Halcyon smyrnensis* L.	White-throated Kingfisher	Endemic, Least Concern
	vii. *Vanellus indicus* Boddaert	Titeeri	Endemic, Least Concern
	viii. *Varanus bengalensis* Daudin	Water monitor	Endemic, Least Concern

Note : 9 (7 flora and 2 fauna) species introduced; 17 (11 Phytoplankton + 1 Macro Alga + 5 Macrophytes) floral and 11 faunal species naturally occurred; 8 Fauna become dependent upon water body for their feeding and drinking purposes.

In this direction, initially an attempt was made on 01.03.2014 in available small ponds with 5 saplings of *N. nucifera* by bringing them from AJCB Indian Botanic Garden, Howrah which couldn't survive. Further, 2 attempts also made on 25.10.2014 and 05.09.2015 but the result was the same as it happened before. So, to have this plant along with other aquatic plants, further an attempt was made to develop an artificial but natural habitat/water body economically. This water body of approx. 68 ft. long, 44 ft. wide and 3 ft. deep was located behind Charak Udyan *i.e.* in between Medicinal Section and Fruit Section. Besides, other benefits of having the water body is to create surrounding areas congenial for proper growth of terrestrial plants, scientific research, providing water and food for other creatures of garden including migratory birds, reptiles, etc.

The making of water body was properly conceived, planned and executed on 09.09.2015 (without involving any Engineer/ Planner/ Expert and civil construction materials) with the assistance of routine garden staff and available machineries except a JCB which was hired for 8 days and altogether spent ₹ 40,000/- only. The water was extracted from underground sources having permissible alkaline characteristic, poured on 22.09.2015 and filled the water body within 4 hours (photo plate I). Further, pH level of water body was measured to 12 which may has happened possibly due to leaching out of cations from slurry of sodium and potassium bentonites contaminated with cement is in conformity as described in Hosterman and Patterson (1992), Chhabra (1996) and FPS (2006). The same was used in construction of piers of Metro route and was further utilized in the development of the water body.

At such a high pH level, expectation of survival of any organism other than the alkalinity tolerant

Photo plate I: 1. Full of weed in non-functional water body, 2. Cleaned by de-weeding, 3. Uprooting stumps, 4. Picking of bentonite mixed soil from excavated site of New Metro Route, 5. Dumping of bentonite mixed soil at proposed site of water body, 6. Piling of brought soil, 7. Leveling by JCB, 8. Leveling by Tractor, 9. Manually making firm surface by roller, 10. Laying of a semi-permeable single sheet all along excavated land, magnified view of sheet is in inset, 11. & 12. Laying of soil up to 2 ft over laid semi-permeable sheet, 13-16. Embankment work under progress, 17. Leveling by Tractor over bank and bottom of water body and 18. Pouring water.

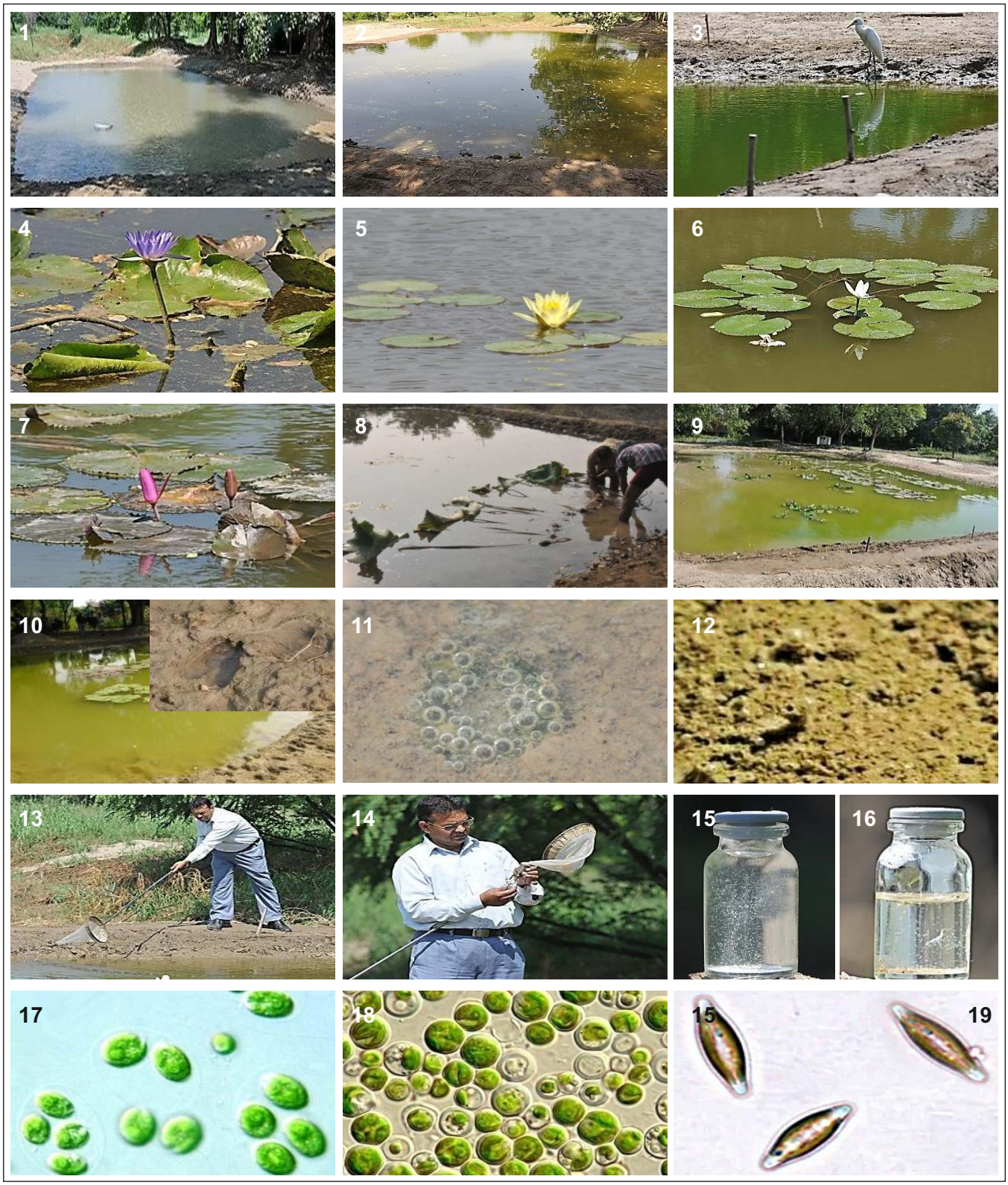

Photo plate II: 1. Poured water was muddy, 2. Fresh cow dung and organic compost was added, 3. By 28.09.2015, water turned green due to over growth of phytoplankton and attracted avian, 4. to 7. Initially, introduced 4 species of *Nymphaea viz. N. caerulea* Sav., *N. Mexicana* Zucc., *N. pubescens* Wild. and *N. rubra* Roxb. ex Andrews in row of different colours, 8. Further introduced 7 individuals of *Nymphaea colorata* Peter (Voilet), 9. Colour of water changed green to yellowish-greenish, 10. Foot marks of Nilgai and birds, 11. Air bubble formed at bottom, 12. Air bubble and hose of Chironomids/ *Tubifex*, 13. & 14. Sampling of plankton, 15. & 16. Preserved Plankton samples, 17. *Chlamydomonas reinhardtii* P.A. Dang, 18. *Chlorella vulgaris* Beijerinck and 19. *Navicula cryptocephala* Kutz.

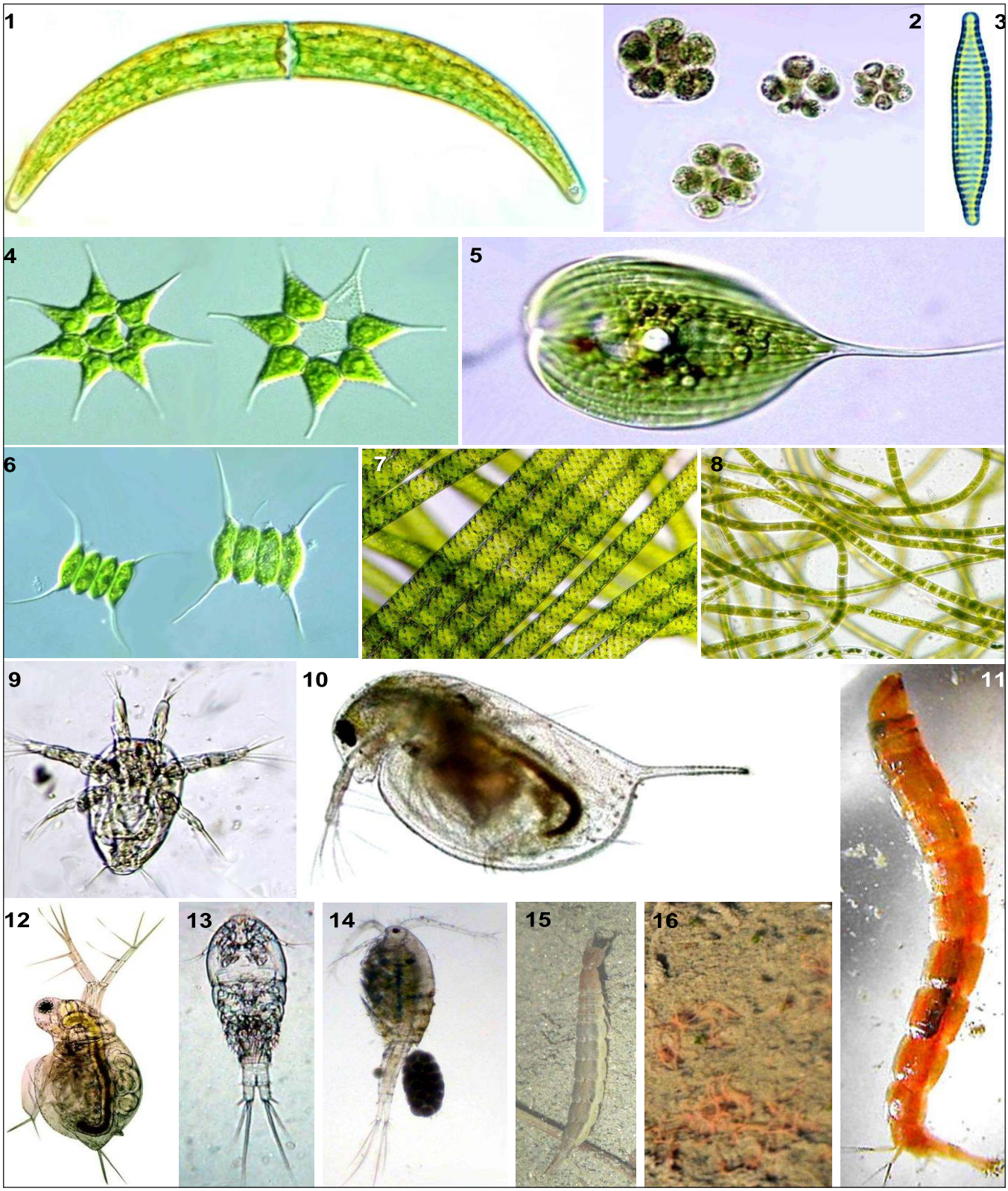

Photo plate III: **Phytoplankton** : 1. *Closterium ehrenbergii* Meneghini ex Ralfs, 2. *Eudorina elegans* Ehrenberg, 3. *Fragilaria* sp., 4. *Pediastrum simplex* Meyen, 5. *Phacus longicauda* (Ehrenberg) Dujardin, 6. *Scenedesmus quadricauda* (Turpin) Brébisson, 7. *Spirogyra* sp., 8. *Zygnema* sp.; **Zooplankton**: 9. Nauplius larva of *Cyclops*, 10. *Daphnia magna* Straus, 11. *Chironomids* larvae, 12. *Moina macrocopa* Straus, 13. *Cyclops* sp., 14. *Cyclops bicuspidatus* Claus, 15. *Cybister* larvae, 16. *Tubifex tubifex* O. F. Müller.

Photo plate IV: Macrophytes: 1. *Ceratophyllum demersum* L., 2. *Hydrilla verticillata* (L.f.) Royle, 3. *Potamogeton crispus* L., 4. *Potamogeton nodosus* Poir., 5. *Vallisneria spiralis* L., 6. Cleaning/de-weeding of developed water body after 1 year as it was eutrophicated by over growth of above macrophytes and phytoplanktonic algae, 7. Re-watered and planted all previous species in row of colours, 8. Students were detailed about aquatic flora and fauna, 9. Saplings of *Nelumbo nucifera* Gaertn. introduced, 10. Seeds of *Victoria amazonica* (Poepp.) J.C. Sowerby kept in water for germination, 11. Developed seedlings of *V. amazonica* and **Fish:** 12. Two; each adult of *Labeo catla* F. Hamilton and *Labeo rohita* F. Hamilton also introduced in water body.

Photo plate V: 1. Thinning of over growth of species of *Nymphae* undertaken for developing saplings of *Nelumbo nucifera* as well as *V. amazonica*, 2. Developing leaf of *V. amazonica*, 3. Spawn and Fry of introduced fishes. 4. Fingerlings of fishes near water surface, 5. Aeration started for oxygenation of water for breathing in different stages of fishes, 6. All plants growing very well, 7. Flies, 8. Pond Skater, 9. Dragonfly, 10. Water Stick Insect, 11. Larvae of *Cybister* sp., 12. Water monitor and 13. Group of Great white Heron.

species is almost not possible. So, to bring pH level to normal compatible level and manuring for development of aquatic organism, 5 tashla fresh cow dung and 10 tashla organic/vermi-compost was added in water (Chhabra, 1996) on 23.09.2015. From 2nd day onwards formation of microbial film (layering of slime forming bacteria and microscopic benthic algae) was evident on ground surface by the presence of minute bubbles which may have formed possibly due to accumulation of dissolved gases and/or formed by the development of microbial forms as colour of water also started turning from muddy to yellowish-greenish (photo plate II).

The level of water (poured on 22.09.2015) was found maintained until 28.09.2015 and depleted water level was replenished by addition of water once for 30 minutes. The colour of water changed from yellowish-greenish to green on 28.09.2015 by mass production of phytoplanktonic algal forms including flagellates. It was a good sign of oxygenation in water which may influenced the production of primary and secondary consumers and reflected that water is sufficiently enriched by nitrogen (N) and phosphorous (P) for plantation of aquatic plants.

As the productivity level of water was very high, aquatic plants planted to bring high nutrient level to the required level and to have control over eutrophication by formation of noxious algal blooms. Accordingly, altogether 29 individuals of 5 species of *Nymphaea namely Nymphaea caerulea* Sav. (Blue)-1, *Nymphaea mexicana* Zucc. (Yellow)-6, *Nymphaea pubescens* Willd. (White)-8 and *Nymphaea rubra* Roxb. ex Andrews (Red) -7 of our own collection planted on 28.09.2015 followed by plantation of 7 individuals of *Nymphaea colorata* Peter (Violet) on 29.09.2015 by bringing them from Yamuna Biodiversity Park. To know the occurrence of species of planktonic forms and diversity (flora and fauna), samples were collected by plankton net on 30.09.2015 and 01.10.2015 and on microscopic examinations altogether 11 species of phytoplankton namely *Chlamydomonas reinhardtii* P.A.D ang, *Chlorella vulgaris* Beijerinck, *Closterium ehrenbergii* Meneghini ex Ralfs, *Eudorina elegans* Ehrenberg, *Fragilaria* sp., *Navicula cryptocephala* Kutz., *Pediastrum simplex* Meyen, *Phacus longicauda* (Ehrenberg) Dujardin, *Scenedesmus quadricauda* (Turpin) Brébisson, *Spirogyra* sp. and *Zygnema* sp., 1 macro alga *i.e. Chara* sp. and 4 species of zooplankton *namely Cyclops bicuspidatus* Claus, *Cyclops* sp. (*Cyclops* without egg), *Cyclops* sp. (*Cyclops* with egg) and *Daphnia magna* Straus were recorded. These are depicted in table 1; photo plates II and III.

Besides, among the macroscopic organisms recorded, 5 aquatic flora *namely Ceratophyllum demersum* L., *Hydrilla verticillata* (L.f.) Royle, *Potamogeton crispus* L., *Potamogeton nodosus* Poir. and *Vallisneria spiralis* L. (table 1 and photo plate IV) and 6 fauna namely Chironomids (larvae), *Cybister* sp. (larvae; under water insects), *Tubifex tubifex* O. F. Müller, flies, *Gerris* sp. (Pond skaters), *Ranatra* sp. (Water stick insect) were also noticed, as depicted in table 1 and photo plates III to V. One species of fish *Channa punctata* Bloch commonly known as Garai might developed in water body and/or migrated by the introduced aquatic plants and attracted to birds and other creatures of the garden and/or nearby areas for feeding and drinking purposes which is evident by their foot marks all along the banks.

Further, once again 15 full grown *N. nucifera* Gaertn. from Yamuna Biodiversity Park, Delhi was brought and planted on 18.11.2015, but none of them survived possibly due to their oversize than the depth of developed water body. After 5 months, once again 4 saplings were brought from AJCBIBG, Howrah and initially planted in pots and kept in new pond on 08.04.2016. Out of 4, 2 survived saplings were shifted in another pond for a fortnight due to de-weeding as well as dilution of water and reintroduced in previous pond directly in soil. The saplings of *N. nucifera* Gaertn. grew luxuriantly and spread in many directions till December, 2016 but never produced buds and flowers (photo plate IV).

General visitors and students were detailed about process of development of water body and developed aquatic plants. However, due to severe cold condition, leaves disappeared and stem as well as rhizomes/roots remain dormant in water

body. The seedling of *Victoria amazonica* (Poepp.) J.C. Sowerby was also developed from seeds almost at the same time, which was introduced in the water body. This was followed by the introduction of *Labeo catla* F. Hamilton and *Labeo rohita* F. Hamilton. The leaves of *V. amazonica* (Poepp.) J.C. Sower by also started developing and formed altogether 5 leaves and perished during winter season possibly due to abrupt increase in low atmospheric temperature. During the period, water was enriched and eutrophicated with planktonic forms, introduced fishes also produced huge number of eggs and spermatic fluids over the water surface and formed a thick layer of covering and started causing suffocation in spawn/fry and fingerlings. To rescue them, the water body was aerated by electric water pumps mechanically for whole day (3-5 in photo plate V) and also by beating stick over water surface.

During March, 2017, leaves of *N. nucifera* Gaertn. appeared once again above the surface of water followed by development of buds. These buds were appearing almost 4-6 in numbers from 02.04.2017 onwards from each branch and started blooming since 16.04.2017 onwards and still continuing. During the period, at times, it has been observed that *Ardea alba* L. (Great white Heron), *Ardeola grayii* Sykes (Pond Heron), *Boselaphus tragocamelus* Pallas (Nilgai), Dragonfly, Flies, *Halcyon smyrnensis* L. (White-throated Kingfisher), *Vanellus indicus* Boddaert (Titeeri) and *Varanus bengalensis* Daudin (Water monitor) kept visiting to the water body for drinking and to feed on developed aquatic flora and fauna (3 in photo plate II and 7 to13 in photo plate V).

CONCLUSIONS

Based on above facts and findings, it has been inferred that by developing the said water body and introducing altogether 7 flora and 2 fauna (fishes) and through operational activities, 28 species (comprising 11 phytoplankton, 1 macro alga, 5 macrophytes, 4 zooplankton and 7 macroscopic fauna) were developed naturally. It is serving as source of food, drinking water and breeding places which indirectly complying the requirement of CBD. Besides, it has also become a place of visit of the visitors in the garden to know more about aquatic plants and diversity under awareness programme and created congenial environmental condition for the development of terrestrial plants.

The method applied in development of the water body without using civil construction materials and developed flora and fauna may be helpful to those who are looking for aquaculture. Thus, mission of developing water body at a short span of time, enable us to establish the aquatic sacred plants having national importance along with other aquatic flora and fauna (aquatic biodiversity) over sand bed of river Yamuna in BGIR. The newly developed water body is providing subsequent benefits to the dependent organisms as well as meeting out the requirement of not only of Article 9 but also of Article 10, 12 and 13 of CBD is the greatest achievements achieved.

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