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Distribution and Seasonal Changes of Aquatic Macro Floral Diversity in Bhuwasa Pond of Banswara Southern Rajasthan

Research Article

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Abstract

The study presents the macro floral diversity of the Bhuwasa pond. It provides sensitive and cost-effective means of assessing the water quality of this pond. Aquatic macro floral diversity and its role in understanding this pond ecosystem have vast significance. 23 species of aquatic macrophytes belonging to 17 families. Free-floating (7 species) showed the largest number in our study, followed by anchored floating (5 species), anchored submerged (3 species), amphibious & rooted (2 species), emergent amphibious (2 species), free submerged (1 species), rooted emergent (1 species), submerged and floating (1 species) and wet fields and marshes (1 species) during the seasons (pre-monsoon, monsoon & post-monsoon). Shannon-Wiener's indices were from 2.91 to 2.94 for all species in different seasons. Simpson's diversity indices were from 0.93 to 0.95 for all species found in different seasons. Evenness were from 0.5 to 0.95 and species richness were 2.0 to 3.5 also recorded in all seasons.

Keywords: Macro floral diversity; Bhuwasa pond; Abundance; Diversity index

Introduction

Plants have evolved in many different ways of surviving in aquatic conditions and some have thick wax or hairy leaves so that the leaves are unwetable that types of aquatic plants are hydrophytic and macrophytes. Aquatic macrophytes are adapted to live in water. These are aquatic photosynthetic organisms large enough to be seen with the naked eye that actively grows permanently or periodically submerged floating or growing on the water's surface. The present study is planned to explore Bhuwasa Pond for the species diversity of aquatic macrophytes. Commonly occurring species were noticed during the period of study. Most of these macrophytes grow naturally here.

Aquatic plants play a vital role in aquatic ecology. Macrophytes may enhance the variability of ecologically relevant physicochemical variables and impede mixing processes [1-3]. These macrophytes can change the quantity, composition and distribution of other aquatic organisms

when they are abundant. Aquatic plants provide food for Water birds and other animals, establishing the foundation for aquatic wildlife conservation efforts. Researchers such as have examined the macrophytes of several water bodies in India [4-10]. Aquatic macrophytes are a group of plants that survive in wet habitats, including angiosperms, ferns, mosses, liverworts, and certain macroalgae [11]. It refers to plants visible to the human eye with at least some vegetative parts growing in permanent or intermittent water environments [12]. Aquatic angiosperms (flowering plants), pteridophytes (ferns) and bryophytes are the prominent plants that dominate marshes, shallow lakes and streams (mosses, liverworts, hornworts), where nitrogen loading is high, and they often develop more aggressively. Aquatic macrophytes are vital components of freshwater ecosystems that reflect the ecosystem's overall health [13].

Aquatic macrophytes are impacted by water quality and they provide food, shelter and breeding places for aquatic fauna. These macrophytes may be floating unattached plants (plants with the majority of the plant at or near the water's surface rooted and floating freely in the water and are not anchored to the bottom), floating attached plants (plants with floating leaves with stems under the surface and roots that anchor the plant to the substrate), submerged plants are found when the entire plant is submerged under the water's surface and emergent plants (plants with roots that grow below water but stems and leaves that grow on the water surface) [14]. Macrophytes thrive in such conditions and sediments, where they may best root and endure the water's erosive power during periodic scour episodes [15].

Macrophytes are those plants that grow in or near water and are emergent, submerged or floating. These modify themselves to survive in the aquatic environment. Their distribution is specific and depends on the water quality and environmental conditions. Macrophytes are unchangeable biological filters and carry out purification of the water bodies by accumulating dissolved metals and toxins in their tissues [16]. The variation in water chemistry can be assessed by surveying the abundance of macrophytic communities. The trophic nature has mainly influenced the variety of communities and indicator species that occur at particular sources. The macrophytes restore the extension of phytoplankton and help in the reuse of organic matter. The submerged species of macrophytes also act as green manure, favorable to the abundance of zooplankton and benthic fauna [17,18]. Aquatic macrophytes in ponds play a vital ecological balance and help stabilize and regulate the trophic state. They serve as bio-indicators also. They significantly affect soil chemistry and light levels as they capture pollutants and trap sediments. Excess sediment will settle into the benthos aided by the reduction of flow rates caused by the presence of plants stems, leaves and roots. Macrophytes often grow more vigorously where nutrient loading is high.

Aquatic macrophytes play a vital role in making a healthy ecosystem and serve as primary producers of oxygen through photosynthesis. It provides a substratum for algae, protection for benthic fauna and a breeding ground for fish. Biodiversity and ecosystem-oriented studies with particular reference to macrophytes in freshwater bodies have attracted many research workers [19-21].

Materials & Methods

Aquatic macrophytes samples were collected during the early morning on a seasonal basis from each sampling site during the study period from July 2021 to June 2022 (pre-monsoon, monsoon and post-monsoon season). The identification of macrophytes was done with the help of standard books, monographs and identification keys [22-24].

Macrophytes in shallow water were immediately gathered, whereas those in deeper water were caught using a long-handled hook. The specimen was carefully cleaned and surplus water was absorbed with filter paper and stored in polythene bags lined with filter paper until transported to the laboratory. It was preserved in 5% formalin and then examined. Three replicate samples were collected from two stations with a hand net of 50 cm x 50 cm from the littoral zone. The macrophyte leaves and roots were then washed thoroughly several times in the net itself, removing all attached faunas manually from each strand with the help of a magnifying glass. A boat was used to collect data on macrophytes throughout the shoreline. A tub was used to collect submerged plants from the boat. A 1mx1m light wooden quadrat was used for a random sample approach. Hand plucking was used to count the macrophytes.

Importance Value Index (I.V.I.)

Importance value index = Relative frequency + Relative density + Relative dominance,

Where, Relative frequency = number of occurrences of one species, Relative density = number of individuals of one species, Relative dominance = Total area coverage (by visual estimation)

Simpson's Dominance Index (D): - The Simpson's index (D) is calculated using the following equation:

$$D = \frac{\sum_{i=1}^{s} n_i(n_i - 1)}{n(n-1)}$$

Where 'ni' = the proportion of ith species.

It represents the probability that two individual organisms randomly selected from a samplewill belong to different species.

Shannon-Wiener Index (H')

This is a frequently used approach for measuring biotic diversity in aquatic and terrestrialhabitats.

$$H' = \sum_{i=1}^{s} -\frac{n_i}{n} \ln \frac{n_i}{n}$$

Where, H = species diversity index, s = number of species, ni = percentage of the total sample

The Shannon index considers both species richness and abundance. It's just the distribution's information entropy, with species as symbols and relative population sizes as probabilities.

Evenness Index (E)

This is the relative distribution of members within a community among taxonomic categories:

E= H'/logS

Where log S= Natural log of the total number of species

H' = Shannon - Wiener diversity index. It refers to how evenly the abundances of the different groups in a sample or community are distributed.

Abundance and Density

Both of these terms refer to the number of species in a community.

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Individual species abundance is reported as a proportion of the total number of species present in the community, making it a relative metric. Particular species are enumerated instead of merely their presence or absence being studied while sampling the abundance of a species. When defining the community structure, abundance and frequency is quite important.

$$\text{Relative frequency} = \frac{\text{No.of unites in which the species occurred}}{\text{Total no.of unit studied}} = \times 100$$

$$\text{Relative Density} = \frac{\text{Density of a given species}}{\text{Total Densities of all the species}} = \times 100$$

$$\text{Relative Abundance} = \frac{\text{Total no.of species A}}{\text{Total no.of individual of all species recorded}} = \times 100$$

Results & Discussion

23 species belonging to 17 families of aquatic macrophytes were recorded in the present investigation (Table 1). In terms of species number of plants, free-floating (7 species) showed the largest number in our study, followed by anchored floating (5 species), anchored submerged (3 species), amphibious & rooted (2 species), emergent amphibious (2 species), free submerged (1 species), rooted emergent (1 species), submerged and floating (1 species) and wet fields and marshes (1 species) during the seasons (pre-monsoon, monsoon & post-monsoon). In terms of individual numbers, free-floating was the most dominant during the post-monsoon, while anchored floating and anchored submerged were dominant rest of the other seasons. *Wolffia* sp., *Eichhornia* sp. and *Lemna* sp. were found dominant during post-monsoon. *Hydrilla* sp. and *Lemna* sp. were the most during pre-monsoon *Chara* sp., *Utricularia* sp. and *Eichhornia* sp. were dominant during monsoon.

Seasonally, the important value index was highest in the post-monsoon (P.O.M.), which is followed by *Hydrilla* (dominating), *Eichhornia, Utricularia, Wolffia, Ipomoea, Trapa, Lemna, Pistia* and *Nymphaea* during pre-monsoon and monsoon. It was studied that excessive growth of aquatic weeds can be used as a bioindicator of water quality. In this study, anchored submerged, *Hydrilla* sp. was observed to be the most dominant genus in all seasons, such growth of the Hydrilla indicates that it is able to adapt to water conditions (Table 2). Similar findings regarding *Hydrilla* sp. are reported by [25].

Shannon-Wiener's index for all species was found in the post-monsoon (2.93), as compared to the pre-monsoon (2.92) and monsoon (2.91). Simpson's diversity indices for all species were found in post-monsoon (0.95), as compared to the pre-monsoon (0.94) and monsoon (0.93). The lowest diversity indices were observed during monsoon as compared to the other two seasons. Evenness (0.5-0.95) and Species richness (2.0-3.5) were also recorded for all seasons. Similar findings regarding indices are reported by [26]. Low diversity values of Shannon- Wiener's index and Simpson's diversity indices indicated that the Bhuwasa pond shows initial polluted conditions due to anthropogenic activities. Aquatic macrophytes provide food, shelter and a place for breeding therefore; it is an ideal component of aquatic wildlife conservation strategies. The growth of aquatic macrophytes indicates the presence of pollution in water. Aquatic macrophytes serve as the foundation for many micro and macro-organisms.

Table 1: Macro floral diversity of Bhuwasa pond.

S. No.	Botanical Name	Common name	Family	Habitats
1	*Azolla pinnata*	Mosquito fern	Salviniaceae	Amphibious and rooted
2	*Limnophila indica*	Indian marsh weed	Scrophulariaceae	Amphibious and rooted
3	*Nymphoides hydrophylla*	Water snowflake	Menyanthaceae	Anchored floating
4	*Nelumbo nucifera*	Indian lotus	Nelumbonaceae	Anchored floating
5	*Potamogeton natans*	Floating Pondweed	Potamogetonaceae	Anchored floating
6	*Ipomoea aquatica*	Swamp morning glory	Convolvulaceae	Anchored floating
7	*Nymphaea nouchali*	Water lily	Nymphaeaceae	Anchored floating
8	*Vallisneria americana*	Water-celery, Tape grass	Hydrocharitaceae	Anchored submerged
9	*Hydrilla verticillata*	water thyme	Hydrocharitaceae	Anchored submerged
10	*Potamogeton crispus*	Curly-Leaf Pondweed,	Potamogetonaceae	Anchored submerged
11	*Polygonum spp.*	Knotweed	Polygonaceae	Emergent amphibious
12	*Typha spp.*	Reed, Cattail,	Typhaceae	Emergent amphibious
13	*Ceratophyllum demersum*	Hornwort, Rigid Hornwort	Ceratophyllaceae	Free submerged
14	*Wolffia spp*	Watermeal	Araceae	Free-floating
15	*Eichhornia crassipes*	Common Water Hyacinth	Pontederiaceae	Free-floating
16	*Lemna minor*	Common duckweed	Araceae	Free-floating
17	*Pistia stratiotes*	Water Cabbage	Araceae	Free-floating
18	Spirodela polyrhiza	Common Duck meat	Araceae	Free-floating
19	*Trapa natans*	Buffalo nut (Singhada)	Trapaceae	Free-floating
20	*Utricularia aurea*	golden bladderwort	Lentibulariaceae	Free-floating
21	*Ipomea carnea*	Pink (Bush) morning glory	Convolvulaceae	Rooted emergent
22	*Sagittaria guayanensis*	Guyanese arrowhead	Alismataceae	Submerged and floating
23	*Eleocharis atropurpurea*	purple spikerush	Cyperaceae	Wet fields and marshes

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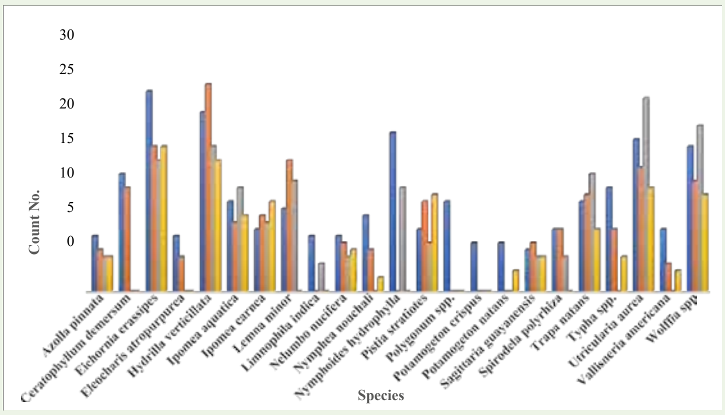
Table 2: Analytic statistics of macro floral diversity of Bhuwasa Pond.

S.N.	Scientific Name	Count No.			Relative frequency			Relative density			Relative abundance			I.V.I.		
		PRM	MON	POM	PRM	MON	POM	PRM	MON	POM	PRM	MON	POM	PRM	MON	POM
1.	*Sagittaria guayanensis*	23	20	25	1.29	6.67	5.97	9.26	2.96	2.82	9.31	1.98	2.14	19.86	11.61	10.93
2.	*Lemna minor*	47	31	41	2.65	3.33	3.00	14.35	4.58	4.63	15.27	6.16	7.02	32.27	14.08	14.65
3.	*Pistia stratiotes*	43	33	49	2.42	3.33	5.97	15.27	4.88	5.53	18.25	6.56	4.19	35.95	14.78	15.69
4.	*Spirodela polyrhiza*	23	15	26	1.29	1.66	2.98	6.94	2.21	2.93	9.68	5.96	4.45	17.92	9.85	10.37
5.	*Wolffia spp*	75	55	80	4.22	5.0	5.97	25.46	8.13	9.02	29.80	7.29	6.85	59.49	20.43	21.85
6.	*Ceratophyllum demersum*	32	18	30	1.80	3.33	4.47	8.33	2.66	3.38	11.17	3.58	3.42	21.31	9.57	11.28
7.	*Ipomoea aquatica*	49	40	53	2.76	5.0	4.47	18.51	5.91	5.98	19.74	5.30	6.05	41.02	16.22	16.51
8.	*Ipomoea carnea*	43	31	40	2.42	5.0	2.98	14.35	4.58	4.51	14.90	4.11	6.85	31.67	13.69	14.35
9.	*Eleocharis atropurpurea*	13	13	16	0.73	5.0	2.98	6.01	1.92	1.80	5.96	1.72	2.74	12.71	8.64	7.53
10.	*Vallisneria americana*	16	15	19	0.90	5.0	4.47	6.94	2.21	2.14	7.07	1.98	2.16	14.92	9.20	8.79
11.	*Hydrilla verticillata*	96	85	99	5.40	6.66	5.97	39.35	12.57	11.17	36.88	8.45	8.47	81.64	27.69	25.62
12.	*Utricularia aurea*	83	63	77	4.67	5.0	5.97	29.16	9.31	8.69	28.68	8.35	6.59	62.52	22.67	21.25
13.	*Nymphoides hydrophylla*	38	26	48	2.14	3.33	4.47	12.03	3.84	5.41	17.88	5.17	5.48	32.06	12.35	15.37
14.	*Nelumbo nucifera*	26	20	29	1.46	5.0	4.47	9.25	2.95	3.27	10.80	2.65	3.31	21.52	10.61	11.06
15.	*Nymphea nouchali*	19	19	14	1.07	5.0	2.98	8.79	2.81	1.58	5.21	2.51	2.39	15.08	10.33	6.96
16.	*Polygonum spp.*	13	9	14	0.73	1.66	1.49	4.16	1.33	1.58	5.21	3.58	4.79	10.11	6.57	7.86
17.	*Eichhornia crassipes*	90	79	94	5.07	6.66	5.97	36.57	11.68	10.60	9.31	7.85	8.05	76.66	26.21	24.62
18.	*Potamogeton natans*	10	8	9	0.56	3.33	2.98	3.70	1.18	1.01	15.27	1.59	1.54	7.62	6.10	5.54
19.	*Potamogeton crispus*	7	7	8	0.39	3.33	4.47	3.24	1.03	0.90	18.25	1.39	0.91	6.61	5.76	6.29
20.	*Azolla pinnata*	24	18	26	1.35	3.33	4.47	8.33	2.66	2.93	9.68	3.58	2.96	19.37	9.57	10.38
21.	*Limnophila indica*	12	11	13	0.67	3.33	2.98	5.09	1.62	1.46	29.80	2.18	2.22	10.61	7.14	6.67
22.	*Trapa natans*	53	39	49	2.98	5.0	5.97	18.05	5.76	5.53	11.17	5.17	4.19	39.29	15.94	15.69
23.	*Typha spp.*	29	21	32	1.63	5.0	4.47	9.72	3.10	3.61	19.74	2.78	3.65	23.27	10.89	11.74



Graph 1: Macro floral diversity.

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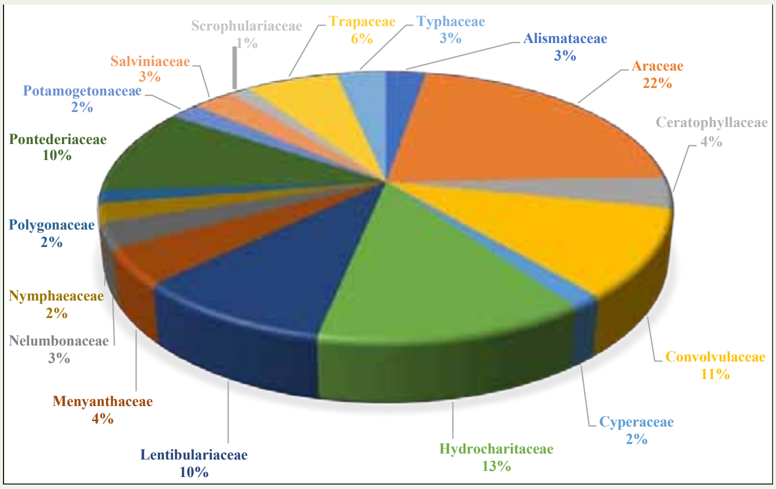
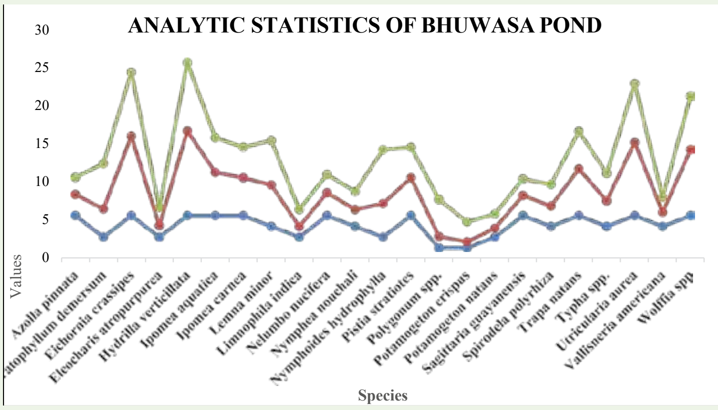
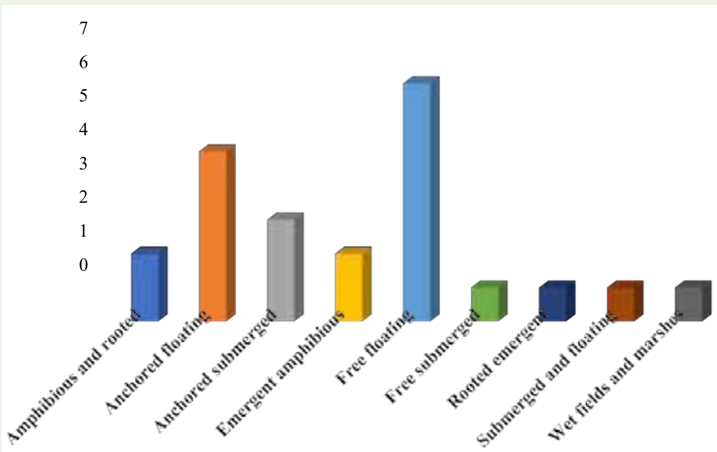


Graph 2: Macro floral dicersity based on families.



Graph 3:



Graph 4: Habitat based on macro faunal diversity

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Ipomoea *Nymphoides* *Typha* *Nelumbo* *Hydrilla* *Spirodela*

Plate 1

Tables 1 & 2 summarize the all information and graphs from 1 to 4 show different types of macro floral diversity of the Bhuwasa pond.

Conclusion

Because of their growing relevance in an aquatic ecosystem, the study of aquatic macrophytes has risen dramatically during the last century. It contributes significantly to the structure and operation of the aquatic ecosystem. It impacts the hydrological and physico-chemical environments, as well as supplying food and habitat to a variety of organisms.

References

1. Wilcock RJ, Champion PD, Nagels JW, Croker GF (1999) The influence of aquatic macrophytes on the hydraulic and physico-chemical properties of a New Zealand low- land stream. Hydrobiologia 416: 203-214.
2. Raut NS, Pejaver MK (2013) Comparative study on variation of plankton of macrophyte infested and non infested lakes from Thane city, Maharashtra. In National Conference on Biodiversity: Study and Challenges in Conservation– FAVEO (pp. 177-180).
3. Harney NV (2014) Macrophytes biodiversity of Dudhala lake of Bhadrawati, district- Chandrapur (MS), India. Asian J Multidisciplinary Studies 2: 69-72.
4. Sugunan VV (2000) Status of culture-based fisheries in small reservoirs in India. In ACIAR PROCEEDINGS (pp. 274-280).
5. Yadav SR, Sardesai MM (2002) Flora of Kolhapur district. Shivaji University, Kolhapur.
6. Ambasht RS (2005) Macrophytes limnology in the Indian subcontinent. Ukaaz Publication Hyderabad 58: 174.
7. Raut NS, Pejaver MK (2005) Survey of diversity of plankton attached to macrophytes from weed infested lakes. J Aqua Biol 20: 1-7.
8. Patil VG, Khabade SA, Khade SK (2012) Study of hydrophytes and amphibious plants occurred in Panchganga river in vicinity of Ichalkaranji city district Kolhapur, Maharashtra. Ecol Fisheries 5: 63-66.
9. Sitre SR (2013) Assessment of macrophyte biodiversity of a freshwater reservoir of Bhadrawati tehsil in Chandrapur district. Online Int Interdisciplinary Res J 3: 78-81.
10. Sitre SR, Lushaj A, Susaj E, Lushaj BM, Gokhan I (2014) Aquatic weed diversity of a freshwater pond in Chandrapur district of Maharashtra state. Online Int Interdisciplinary Res J 4: 43-46.
11. Chambers PA, Lacoul P, Murphy KJ, Thomaz SM (2007) Global diversity of aquatic macrophytes in freshwater. In Freshwater animal diversity assessment (pp. 9-26). Springer, Dordrecht.
12. Adesina GO, Akinyemiju OA, Muoghalu JI (2011) Checklist of the aquatic macrophytes of Jebba Lake, Nigeria. Ife J Sci 13: 93-102.
13. Céréghino R, Ruggiero A, Marty P, Angélibert S (2007) Biodiversity and distribution patterns of freshwater invertebrates in farm ponds of a south-western French agricultural landscape. In Pond Conservation in Europe (pp. 43-51). Springer, Dordrecht.
14. Vyas V, Yousuf S, Bharose S, Kumar A (2012) Distribution of macrophytes in River Narmada near water intake point. J Nat Sci Res 2: 54-59.
15. Chambers PA, Prepas EE, Hamilton HR, Bothwell ML (1991) Current velocity

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and its effect on aquatic macrophytes in flowing waters. Ecol Appl 1: 249-257.

16. Shah MA, Vyas V, Yadav S (2018) Fish Biodiversity and Its Periodic Reduction: A Case Study of River Narmada in Central India. In Environmental Pollution (pp. 193-206). Springer, Singapore.

17. Bhute KB, Harney NV (2017) Macrophytes biodiversity of Nagrala lake Bhadrawati, district-Chandrapur (MS). Int Res J Sci Eng 6: 17-19.

18. Prasad N, Das T (2018) Diversity and distribution of Aquatic macrophytes with special reference to invasive species in Barak Valley, Assam, Northeast India. NeBio An Int J Environment Biodiversity 9: 102-108.

19. Jhingran AG (1989) Limnology and production biology of two manmade laes in Rajasthan (India) with management strategies for their fish yield optimization. Final Report IDA Fisheries Management in Rajasthan. Central Inland Fisheries Research Institute, Barrackpore, India: 1-63.

20. Sugunan VV (1995) Reservoir fisheries of India. FAO Technical paper No. 343.

21. Kaushal DK, Sharma VK (2001) Ecology based fisheries management in some reservoir of eastern Rajasthan. Bull. Central Inland Fisheries Research Institute, Barrackpore 108: 1-61.

22. Adoni AD (1985) Workbook on limnology India map. Committee Department of Environment, Government of India.

23. Cook CDK (1996) Aquatic and wetland plants of India. Oxford University Press, Oxford, New York, Delhi.

24. Fassett NC (2000) A manual of aquatic plants, Agrobios (India), Jodhpur. pp. 382.

25. Burlakoti C, Karmacharya SB (2004) Quantitative analysis of macrophytes of Beeshazar tal, Chitwan, Nepal. Himalayan J Sci 2: 37-41.

26. Clayton J, Edwards T (2006) Aquatic plants as environmental indicators of ecological condition in New Zealand lakes. In Macrophytes in Aquatic Ecosystems: From Biology to Management (pp. 147-151). Springer, Dordrecht.

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