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A Floristic Account of Macrophytes in the Selected Wetlands of Valsad District, Gujarat, India

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Abstract

Valsad district is located at the southernmost tip of Gujarat, India at the bank of the Arabian Sea, and the global position is located on 72.93º East longitude and 20.63º North latitude. The present study discussed the baseline status of the macrophytes in the five selected wetlands. During the study period (January 2019 to December 2019) total of 52 species of macrophytes belonging to 42 genera under the 28 families were recorded, where 46 species represented angiosperms, 05 species represented the pteridophytes, and 01 species represented macroalgae and at the selected sites macrophyte diversity present in the trend of Site-4 > Site-1 > Site- 5 > Site- 2 > Site-3. Ecological classification of reported macrophytes shows that 14 % of macrophytes were free-floating, 15 % were floating but rooted, 8 % were submerged but rooted, 13 % were amphibious & rooted, 04 % macrophytes represented the submerged but not rooted category, and 46 % macrophytes represented emergent & rooted category. Raunkiaer's Life form categorized the reported macrophytes into four categories: 19 % were Chamophytes, 37 % were Hemicryptophytes, 13 % were Cryptophytes and 31 % were Therophytes.

Keywords: Floristic account, Macrophytes, Valsad, Wetlands.

INTRODUCTION

Wetlands are the transitional areas of the terrestrial ecosystem and aquatic ecosystem. Wetlands are the most productive and adaptive ecosystems on the Earth, provides private and public services with benefits. Wetlands are known as "Kidney of Landscape" due to their utilization for water quality improvement and also known as "Biological supermarket" due to their high support system of biological diversity **(Ghosh et al., 2018).** Phytosociology is the branch of vegetation science that studies

existing plant communities, with a focus on classification **(Srinivasa Rao et al., 2013).** Vegetation genesis, dominant species, geographical location, water chemistry, and soil or sediment characteristics, etc. are responsible to express rich biodiversity **(Gogoi et al., 2019).** Phytosociology is a qualitative and quantitative examination of vegetation that attempts to define biodiversity and vegetation in terms of the number of species that may become extinct, which determines the spread of particular species in a particular habitat in response to an increase the human disturbance in the ecosystem. Plants that are bound to the water to complete their life cycle known as aquatic plants, from that group, some plants are completely submerged and more or less grow just along the water's edge **(Marwat et al., 2013).** Macrophytes are macroscopic aquatic plants that include angiosperm, pteridophytes, some bryophytes, and few algae. Macrophytes grow continuously or periodically depending upon the availability of the required amount of water. In the wetland, macrophytes act as a link between the sediment, water, and (occasionally) atmosphere **(Deegan et al., 2007).** Aquatic macrophytes are limited economic value in the modern world generally herbaceous nature most of the species serve as good sources of food to mankind and animals. A large number of aquatic plants are very important for medical uses as well as a source of food for people **(Parmar & Singh, 2015).** Due to the ability of macrophytes to absorb large amount of nutrients and heavy metals from contaminated soil or water, macrophytes are considered as the useful in wastewater treatment **(Tang et al., 2017).** Macrophytes are acted as measurable indicators of the ecological conditions of surface waters **(Mackay et al., 2010).** The goal of this present investigation is to determine the macrophyte baseline status in the few selected wetlands of Valsad district, Gujarat.

MATERIAL AND METHODS

Description of the study area:

The investigation work has been carried out at Valsad district, Gujarat, India. Valsad district is located at the southernmost tip of Gujarat, India at the bank of the Arabian Sea, and the global position is located on 72.93^{o} E and 20.63^{o} N. Based on the pollutant, run-off entering into the lakes, and situated area of lakes, five different wetland sites were selected for the investigation.

Site-1: Segvi Lake [SL] – This lake is situated in Segvi village, Valsad, with coordinates of 20^{o} 35' 20.4" N 72^{o} 54' 46.0" E with a 650.04 m perimeter area. Due to the little or non-existent amount of effluents discharged into the lake, this lake was considered a clean lake for this investigation. Site-2: Rakhodiya lake [RL] – This lake, named Rakhodiya lake, is situated in the Valsad city area and has coordinates of 20^{o} 36' 53.4" N 72^{o} 55' 21.4" E. It has a 555.19 m perimeter area. A large volume of household sewage and a lot of agricultural run-offs were discharged in this lake from the surrounding area. Site-3: Atak Pardi Lake [AL] – This lake is located near the Regional Transport Office in Atak Pardi village [AL], with coordinates of 20^{o} 35' 20.9" N 72^{o} 57' 24.4" E and a perimeter area of 714.19 m perimeter area. This lake carried a large amount of ceramic effluents from nearby areas. Site-4: Pardi lake [PL] – Pardi lake is located in Pardi village near the Pardi GIDC and carried a considerable volume of

household sewage and industrial run-off in it. This lake is located at 20º 30' 35.7" N 72º 57' 11.9" E coordinates and has a perimeter of 2298.25 m. Site- 5: Gundlav Lake [GL] – This lake is situated in Gundlav village near the industrial area, with coordinates of 20º 37' 16.8" N 72º 57' 45.3" E, with a 636.35 m perimeter area and a large volume of industrial effluents discharged into the lake.

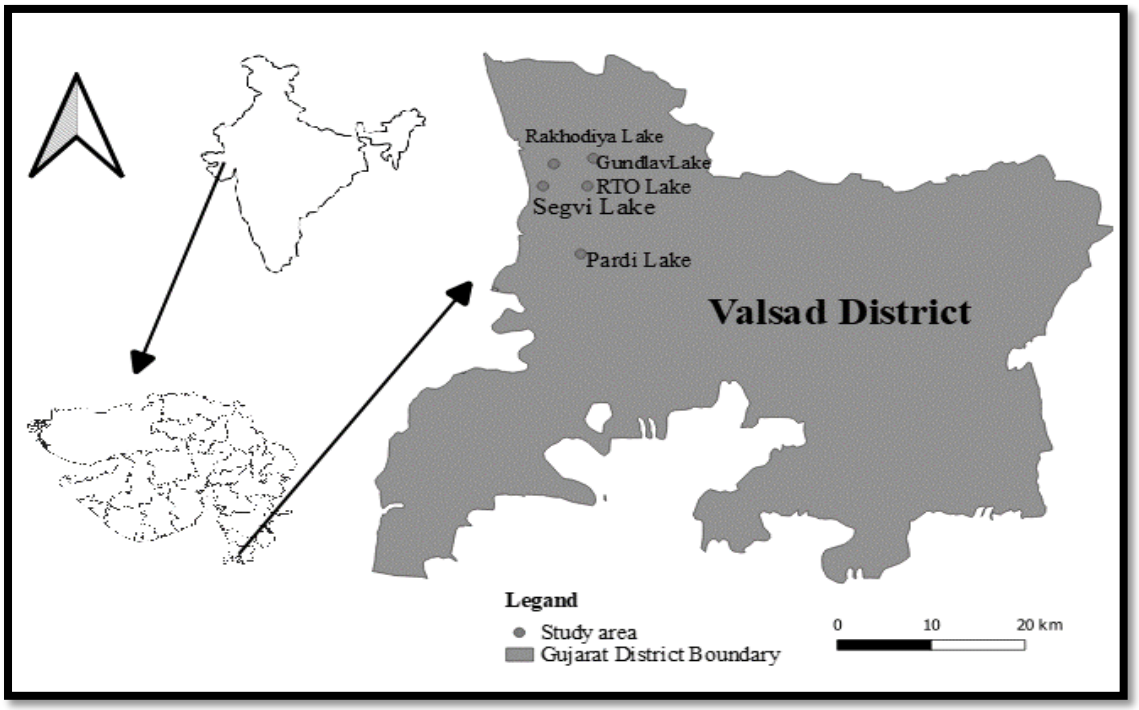


Figure 1: Selected Wetland Sites from Valsad District, Gujarat, India

Macrophyte analysis:

Field trips were attempted throughout the study time (January 2019 to December 2019) to collect & record precisely aquatic macrophyte species & got it identified by the herbarium, Botany department, VNSGU, and floras **(Shah, 1978; Cooke, 1967).** The macrophyte species were categorized according to the system of Raunkiaer's life form classification system **(1934).**

Statistical analysis:

Statistical analysis like Sorenson percentage similarity of selected wetlands was done using **PAST 4.03** software.

RESULT AND DISCUSSION

During the investigation (January, 2019 to December, 2020), a total of 52 species of macrophytes belonging to 42 genera under the 28 families were recorded at the selected wetlands of Valsad district, Gujarat (Table: 1). Among the total 28 family, Araceae was

the largest one which comprises 6 macrophyte species (*Colocasia esculenta* L. Schott, *Lemna minor* L., *Lemna trisulca* L., *Pistia stratiotes* L., *Spirodela polyrhiza* L. Schleid. and *Wolffia arrhiza* L. Wimmer) followed by the Cyperaceae family (5 species), Poaceae and Boraginaceae (4 species), Lythraceae family (3 species). Meanwhile, the following families represented only two species for each, Alismataceae, Asteraceae, Commelinaceae, Convolvulaceae, Hydrocharitaceae, Nymphaeceae, Salviniaceae and another 16 families were considered as monospecific ones (Table:1).

Table 1: Recorded species, families, life form classification (LC) & ecological classification (EC) of the recorded species in the selected wetlands.

No.	NAME	FAMILY	EC	LF	Site 1	Site 2	Site 3	Site 4	Site 5
1	*Alternanthera sessilis* (L.) Dc.	Amaranthaceae	ER	TP	*	*	*	*	*
2	*Ammania baccifera* L.	Lythraceae	ER	TP		*	*	*	
3	*Ammania multiflora* Roxb.	Lythraceae	ER	TP	*	*	*	*	*
4	*Azolla pinnata* R. Br.	Salviniaceae	FF	TP	*	*		*	
5	*Bacopa monnieri* (L.) Pennell	Scrophulariaceae	AR	HCP	*			*	
6	*Bergia ammanniodes* Roxb.	Elatinaceae	ER	CP	*	*	*	*	*
7	*Ceratophyllum demersum* L.	Ceretophyllaceae	SNR	TP	*	*	*	*	*
8	*Chara sp.*	Chlororophyceae	SNR	TP				*	*
9	*Coldenia procumbens* L.	Boraginaceae	ER	TP				*	*
10	*Colocasia esculenta* (L.) Schott	Araceae	AR	CP		*		*	
11	*Commelina benghalensis* L.	Commelinaceae	AR	HCP	*	*	*	*	*
12	*Commelina diffusa* Burm. f.	Commelinaceae	AR	HCP	*	*	*	*	*
13	*Cyperus alopecuroides* Rottb.	Cyperaceae	ER	HCP		*		*	*
14	*Cyperus articulatus* L.	Cyperaceae	ER	HCP	*	*	*	*	*
15	*Cyperus compressus* L.	Cyperaceae	ER	HCP	*	*	*	*	*
16	*Cyperus difformis* L.	Cyperaceae	ER	HCP	*		*	*	
17	*Cyperus iria* L. var. *iria*	Cyperaceae	ER	HCP	*	*	*	*	*
18	*Eclipta prostrata* (L.) L.	Asteraceae	ER	CP		*	*		
19	*Eichhornia crassipes* (Mart.) Solms.	Pontedariaceae	FF	CP		*		*	*
20	*Eragrostis ciliata (Roxb.) Nees*	Poaceae	ER	HCP	*	*	*	*	*
21	*Grangea maderaspatana* (L.) Poir.	Asteraceae	ER	TP	*		*	*	*
22	*Heliotropium indicum* L.	Boraginaceae	ER	CP	*	*			*
23	*Heliotropium ovalifolium* Forsk.	Boraginaceae	ER	CP	*	*			*

24	*Heliotropium supinum* L.	Boraginaceae	ER	CP	*	*			*
25	*Hydrilla verticillata* (L. f.) Royle	Hydrocharitaceae	SR	CRP	*	*	*	*	*
26	*Hydrolea zeylanica* (L.) Vahl	Hydroleaceae	ER	HCP				*	
27	*Ipomoea aquatica* Forsk.	Convolvulaceae	FR	HCP	*	*	*	*	*
28	*Ipomoea fistulosa* Mart. ex Choisy	Convolvulaceae	ER	CP		*	*	*	*
29	*Leersia hexandra* Sw.	Poaceae	AR	HCP	*	*	*	*	*
30	*Lemna minor* L.	Araceae	FF	TP	*	*		*	*
31	*Lemna trisulca* L.	Araceae	FF	TP	*	*	*	*	*
32	*Limnophyton obtusifolium* (L.) Miq	Alismataceae	FR	HCP				*	
33	*Ludwigia hyssopifolia* L.	Onagraceae	FR	HCP		*		*	*
34	*Marselia quadrifolia* L.	Marsileaceae	AR	TP	*			*	
35	*Nelumbo nucifera* Gaertn.	Nymphaeceae	FR	CRP	*		*	*	
36	*Nephrolepis cordifolia L.*	Nephrolepidaceae	ER	TP			*		*
37	*Nymphaea nouchali* Willd	Nymphaeceae	FR	CRP	*		*	*	
38	*Nymphoides indicum* (L.) O. Ktze.	Gentianaceae	FR	CRP				*	
39	*Oldenlandia corymbosa* L.	Rubiaceae	ER	TP	*	*	*	*	*
40	*Panicum paludosum* Roxb.	Poaceae	ER	HCP	*		*	*	*
41	*Pistia stratiotes* L.	Araceae	FF	TP	*			*	
42	*Pteris vittata* L.	Pteridaceae	ER	HCP			*		*
43	*Polygonum glabrum Willd.*	Polygonaceae	AR	HCP	*	*	*	*	*
44	*Saccharum spontaneum* L.	Poaceae	ER	HCP	*				
45	*Sagittaria sagittifolia* L.	Alismataceae	FR	HCP				*	
46	*Salvinia natans* L.	Salviniaceae	FF	TP	*				
47	*Spirodela polyrhiza* (L.) Schleid.	Araceae	FF	TP	*	*	*	*	*
48	*Trapa natans* L.	Lythraceae	FR	CRP	*				
49	*Typha angustata* Bory & Chaub.	Typhaceae	ER	CP	*	*	*	*	*
50	*Utricularia aurea Lour.*	Lentibulariaceae	SR	CRP	*			*	
51	*Vallisneria spiralis* L.	Hydrocharitaceae	SR	CP	*	*	*	*	*
52	*Wolffia arrhiza* (L.) Wimmer	Araceae	SR	CRP	*	*	*	*	*
	Total species				**37**	**32**	**30**	**43**	**34**

EC (Ecological classification) abbreviations: FF= Free-floating, FR= Floating but rooted, SR= Submerged but rooted, SNR= Submerged but not rooted, AR= Amphibious and rooted, ER= Emergent but rooted. LC (Life form classification) abbreviations: CP= Chamophytes, HCP= Hemicryptophytes, CRP= Cryptophytes, TP= Therophytes.

Out of the 52 species, 46 species represented angiosperms, five species such as *Azolla pinnata* R. Br., *Marselia quadrifolia* L. *Nephrolepis cordifolia* L., *Pteris vittata* L., and *Salvinia natans* L. represented the pteridophytes, and one species *Chara* represented macroalgae. Macrophyte diversity present in the trend of Site-4 > Site-1 > Site- 5 > Site- 2 > Site-3 in the selected wetlands of Valsad District, Gujarat, where site-4 shows the richest diversity with 43 macrophyte species followed by site-1 (37 macrophytes) and site- 5 (34 macrophytes); site- 3 represents the lowest diversity with 30 macrophytes during January 2019 to December 2020. Figure 2 describes the Sorenson percentage similarity, which indicates that site-1 Segvi Lake [SL] was highly similar with the other selected wetlands, and site- 2 Rakhodiya lake [RL] & site- 4 Site-4: Pardi lake [PL] were highly dissimilar with each other.

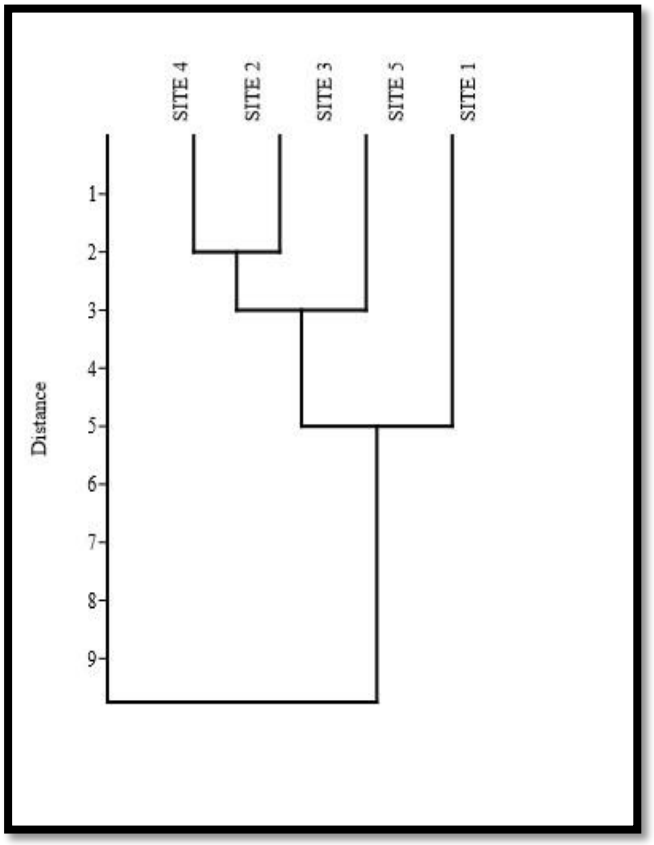
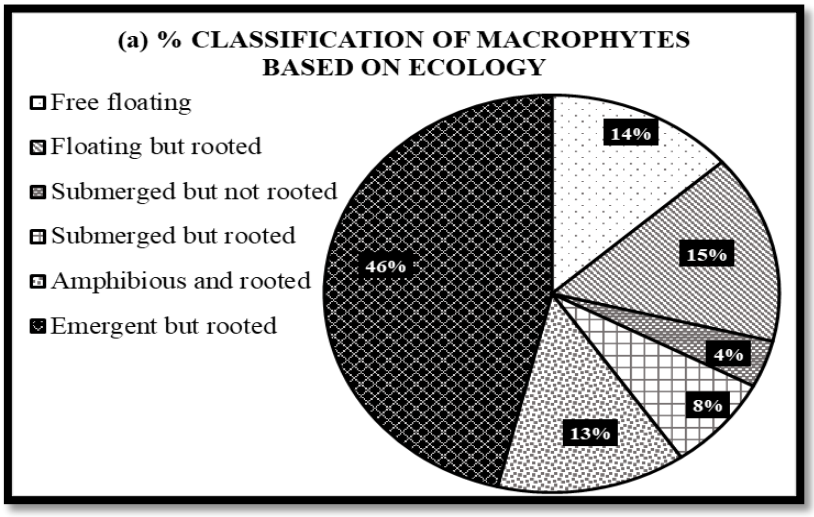


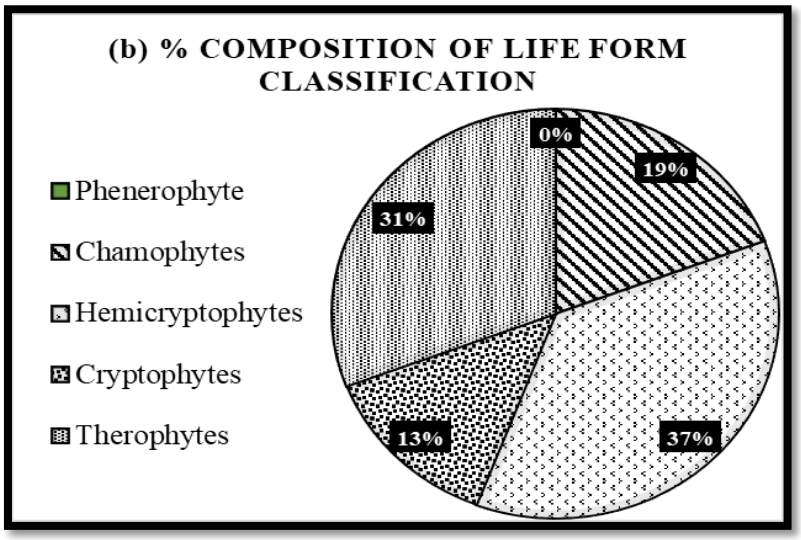
Figure 2: Sorenson percentage similarity of selected wetlands.

Ecological classification of the aquatic macrophytes based on adaptation in water **(Saikia, 2013)** presented in the figure 3 (a), where the macrophytes were categorized in to six different categories as follows: 14 % of macrophytes were free-floating, 15 % were floating but rooted, 8 % were submerged but rooted, 13 % were amphibious & rooted, only 4 % macrophytes represented the submerged but not rooted category, and 46 % macrophytes represented emergent & rooted category which was the dominant

category of the selected wetlands (Fig: 3, a). Raunkiaer's Life form **(1934)** categorized the reported macrophytes into four categories and results showed that the location of the macrophyte buds were mostly half hidden (hemicryptophytes, 37 %) or near to the ground (chamophytes, 19 %) at selected wetlands. 31 % of macrophytes were therophytes and only 13 % of macrophytes show the location of the bud below the surface level, they were Cryptophytes. Phenerophytes were absent at the selected wetland sites (Fig: 3, b).



(a)



(b)

Figure 3 (a): Percentage classification of macrophytes based on ecology, Figure 3 **(b):** Percentage composition of life form classification

CONCLUSION

A total of 52 macrophyte species were recorded from the selected study area of Valsad district, Gujarat during the study period (January, 2019 to December, 2020). The present investigation provided remarkable information about the macrophyte diversity and distribution in the selected wetlands. Out of the 52 species, 46 species represented angiosperms, five species represented pteridophytes, and one species represented macroalgae. From the recorded families Araceae was the dominant family with six macrophyte species. Valsad District is a developing area of Gujarat state, India. Reduction of macrophyte diversity and species richness observed at studied wetlands was supposedly linked to the pollution status of the selected wetlands. During the study period, it was observed that out of the selected wetlands, Site-3 Atak Pardi Lake [AL] was a highly disturbed area of the Valsad District due to the high pressure of anthropogenic activity. This investigation proved that the various recorded macrophytes were sensitive to pollutant levels. It is essential to take proactive steps to maintain and manage these wetlands, as well as to preserve their diverse native flora, not only for the human being but also for the environmental balance.

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