



# Plant Archives

Journal homepage: <http://www.plantarchives.org>  
 DOI Url : <https://doi.org/10.51470/PLANTARCHIVES.2021.v21.no2.042>

## MACROPHYTIC DIVERSITY OF SOME WETLANDS OF JAMMU REGION, J&K, INDIA

Assadullah Sheikh and Deepika Slathia\*

Department of Environmental Sciences, University of Jammu, Jammu, 180006 (J&K) India

Corresponding Author

\*Dr. Deepika Slathia

Department of Environmental Sciences, University of Jammu, Baba Saheb Ambedkar Road, Jammu 180006

Email-dsenviron2012@gmail.com

(Date of Receiving : 15-01-2021; Date of Acceptance : 19-05-2021)

### ABSTRACT

The present ecological investigation communicates the macrophytic diversity of six wetlands of Jammu region comprising of three lacustrine wetlands viz. Surinsar, Mansar and Sanasar and three riverine wetlands i.e., Gharana, Kukarian and Pargwal. A total of 43 macrophytic species belonging to 34 genera and 24 families with 30 monocot species and 13 dicots were recorded, thereby showing the dominance of monocot flora. Among various ecological groups, emergent with 22 species showed qualitative dominance over submersed (13 species) and rooted floating-leaved types=free-floating types (4 species each). The present study revealed that there is no well-marked variation in the macrophytic groups among the studied wetlands and mostly mixed distribution was observed. Maximum macrophytic diversity was recorded in Mansar wetland (26) followed by Pargwal (22), Surinsar (16), Gharana (14), Kukarian (14) and Sanasar (11). The present study provides a baseline information on the macrophytes of wetlands for subsequent research on the vital aspects of these aquatic ecosystems and would be helpful in planning management strategies.

**Keywords:** Macrophytic diversity, wetlands, emergent, free-floating, submerged.

### INTRODUCTION

Wetlands referred to as 'nature's kidneys' are ecotone areas between aquatic and terrestrial ecosystems (Smith, 1980) with high diversifications sustaining both amphibious as well as purely aquatic taxa and harbors a very complex taxonomic makeup of the macrophytic community (Banerjee and Venu, 1994). They maintain ecological balance by performing hydrological, physicochemical, biological, and socio-economic functions (Williams, 1990). Aquatic macrophytes are the key constituents of aquatic ecosystem (Pandit, 1984 and Sharma *et al.*, 2007) and comprise of a large variety of aquatic vegetation, including macroalgae, mosses, ferns, and angiosperms (Wetzel, 1983 and Gopal, 1995). The main local determinants of the composition of aquatic flora in a waterbody are water level fluctuations, exposure, substrate composition, organic matter content, the amount of light, and water chemistry (Shah *et al.*, 2019; Sheikh and Slathia, 2019). Macrophytic diversity is one of the most important features of the aquatic ecosystem for maintaining its stability and resilience. As primary producers, macrophytes are at the base of herbivorous and detritivorous food chains providing food and shelter to invertebrates, fishes, birds, and other aquatic biota (Timms and Moss, 1984). Aquatic macrophytes represent the most important biotic component of the littoral zone of the lake ecosystem (Pieczynska, 1990) as nutrient pumps (Pandit *et al.*, 2010) dynamically guiding the cycling of minerals and serve as an

indicator for monitoring the degree of damage to the ecosystem (Pandit, 1992; Adhishwar and Choudhary, 2013) and help in sieving, trapping, and regulating concentration of dissolved and particulate matter coming from autochthonous and allochthonous sources (Theophile *et al.*, 2004; Sheikh and Slathia, 2019). They also act as an efficient accumulator of heavy metals (Scheffer, 1989) and play important role in the natural process of self-purification of water body (Dembitsky *et al.*, 1992). Macrophytes respond to the changes in water quality and have been used as bio-indicator of pollution (Tripathi and Shukla, 1991). The role of macrophytes in freshwater aquatic systems has received increased attention over the last more than a decade, primarily due to their widespread decline in many wetlands and lakes because of growing cultural eutrophication (Shah *et al.*, 2019). Perusal of literature has shown that voluminous macrophytic studies have been attempted by earlier workers from temperate lakes of Kashmir (Zutshi *et al.*, 1972; Pandit, 1984; Kak, 1987; Ravinder and Pandit, 2005; Wani and Pandit, 2008; Pandit *et al.*, 2010 and Shah *et al.*, 2019) and sub-tropical lakes Mansar and Surinsar from Jammu (Kant and Anand, 1978; Anand and Sharma, 1991; Mohan and Kant, 1993; Sharma, 2008; Sheikh and Slathia, 2019). However, no attempt has been made to document the macrophytic diversity of the important riverine wetlands of Jammu region. Keeping in view the importance of macrophytes in aquatic ecosystems and their management implications, an attempt has been made to investigate the

qualitative composition and distribution aspects to provide an authenticated checklist of macrophytic species of six important wetlands of Jammu Siwalik.

**MATERIALS AND METHODS**

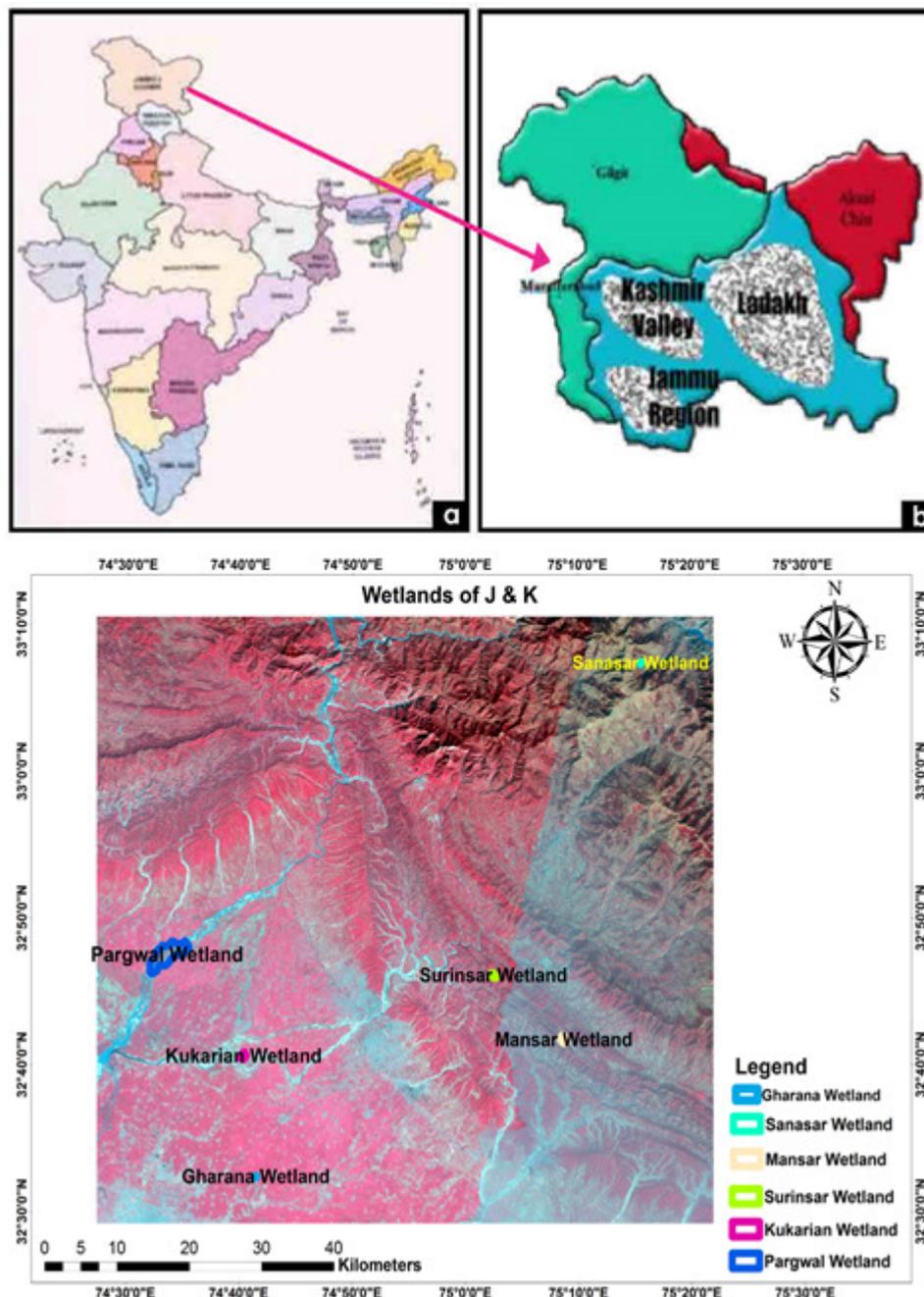
**Study area**

UT of Jammu and Kashmir is bestowed with large number of lotic and lentic water bodies. The present investigation was carried out to document the macrophytic diversity of six important wetlands of Jammu region viz. Surinsar, Mansar, Sanasar, Gharana, Kukarian and Pargwal from October (2018) to September (2019) (Fig.1). The various Morphometric features of six wetlands have been presented in Table1.

**Methodology**

Macrophytic plant survey was carried out in the littoral

zone of lakes and mostly the margins of the wetlands during the study period. In field, macrophytes were washed thoroughly to get rid of adhering material, separated and brought to laboratory for identification. Plants were identified with the help of available literature of Biswas and Calder (1954), Ward and Whipple (1959), Subramanyam (1974), Adoni *et al.* (1985), Kak (1987), Anand and Sharma (1991), Mohan and Kant (1993) and Cook (1996). The identification was also confirmed by comparing the herbarium specimen with voucher specimen kept in herbarium of Department of Botany, University of Jammu and Biodiversity cell, University of Kashmir. The target species were later grouped into different life forms and respective proportion of each life form viz. emergent, submerged, free floating and rooted floating leaf in the aquatic species pool was estimated.



**Fig. 1 :** Showing the location of study area (a) map of India (b) Jammu and Kashmir (c) six studied wetlands.

**Table 1 :** Morphometric features of the six studied wetlands of Jammu

Wetland feature	Mansar	Surinsar	Sanasar	Gharana	Kukarian	Pargwal
Location	75°08'39 E; 32° 41'47 N	75°02'30.05"E; 32°46'12.63" N	75°15'42.4"E; 33°07'25.8" N	74°41'26" E; 32° 32'27" N	74°40'18."E; 32°40'9.5" N	74°35' 55.9"E; 32°47' 58.13" N
Nature	Rural wetland	Rural wetland	Rural wetland	Rural wetland	Rural wetland	Rural wetland
Climate	Subtropical	Subtropical	Temperate	Subtropical	Subtropical	Subtropical
Distance from Jammu City	55km	45km	130Km	35km	40km	46km
Altitude (amsl)	666m	606m	2037.5m	270 m	256.3m	264.2m
Area(sq.Km)	0.59	0.30	0.04	0.75	24.25	49.25
Water source	Rainfed and subterranean springs	Rainfed and subterranean springs	Rainfed and subterranean springs	Rainfed and Defense Canal (River Chenab)	River Tawi (River Chenab)	River Chenab
Max depth	38.0m	24.0m	1-3m	<1m	1-2m	0.5-1m
Wetland type	Lacustrine, non-drainage with temporary outlet	Lacustrine, non-drainage with temporary outlet	Lacustrine and non- drainage	Riverine, non-drainage with inlet and outlet	Riverine (Tawi river) with permanent inlet and outlet	Riverine (Chenab river) with permanent inlet and outlet
Anthropogenic pressures	Deforestation, encroachment, domestic waste discharge, solid waste dumping, agricultural runoff, and tourism.	Deforestation, encroachment, domestic waste discharge, solid waste dumping, agricultural runoff, and tourism.	Tourism, deforestation, and solid waste dumping.	Encroachment domestic waste discharge, agricultural runoff, and tourism.	Encroachment, agricultural runoff, and irrigation.	Encroachment, domestic waste discharge, agricultural runoff, solid waste dumping and developmental activities

## RESULTS AND DISCUSSION

The present study registered a total of 43 macrophytic species belonging to 34 genera and 24 families from the six studied wetlands (Table2). Among these, 40 species belonged to 23 families of the angiosperms and 3 species to macro-algal group. Also, 30 species belonging to monocots showed dominance over 13 species of dicots. Among the 24 families observed in these wetlands, the order of dominance was observed as Potamogetonaceae (06 species)> Cyperaceae (05 species) >Hydrocharitaceae = Polygonaceae (3species each)> Characeae = Menyanthaceae = Poaceae = Plantaginaceae = Salviniaceae = Typhaceae (02 species each)> Acoraceae =Alismataceae = Amaranthaceae = Araceae = Brassicaceae = Ceratophyllaceae =Convolvulaceae = Equisetaceae =Lemnaceae =

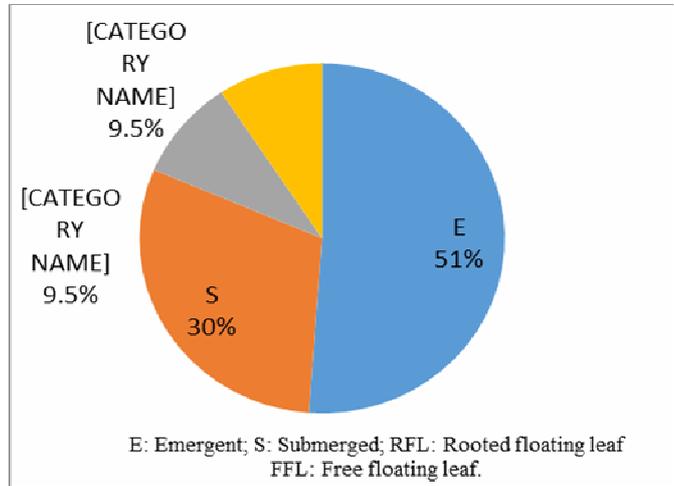
Marsileaceae = Nelumbonaceae = Pontederiaceae = Ranunculaceae = Scrophulariaceae (01 species each). The families (op.cit.) form the important constituents of the flora of these wetlands. Among the six wetlands, maximum macrophytic diversity was recorded Mansar (26 species) followed by Pargwal (22 species), Surinsar (16 species), Gharana = Kukarian (14 species each) and minimum for Sanasar wetland (11 species) (Fig. 2). Macrophytic analysis has shown the dominance of emergent type (22 species) followed by submersed (13 species), rooted floating leaf (4 species) and free-floating type (4 species) (Table1). The percentage composition of different groups of macrophytes has been observed as emergent (51%), submersed (30%), free floating leaf (9.5%) and rooted floating-leaf type (9.5%) (Fig. 3).

**Table 2 :** Macrophytic species along with the families recorded in the six wetlands

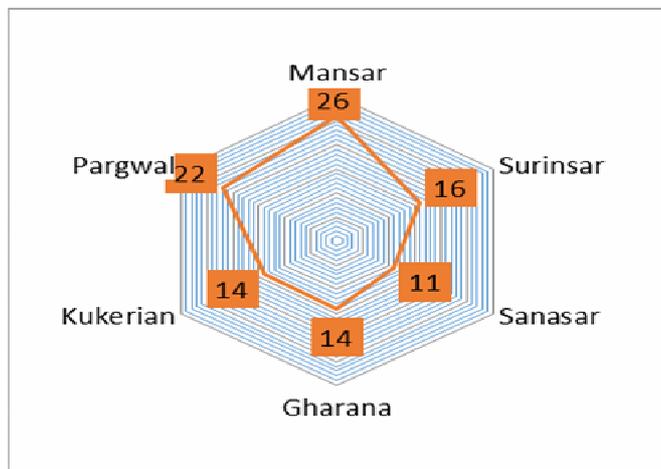
Ecological groups/family	Species Name (43)
<b>EMERGENT</b>	<b>22</b>
<b>Family Cyperaceae</b>	<i>Carex fedia</i> Nees.
	<i>Cyperus difformis</i> Linn.
	<i>Cyperus glomeratus</i> Linn.
	<i>Fimbristylis bisumballeta</i> (F) Bubani
<b>Family Polygonaceae</b>	<i>Scirpus lacustris</i> L.
	<i>Polygonum barbatum</i> Linn.
	<i>Polygonum glabrum</i> Wild.
<b>Family Poaceae</b>	<i>Polygonum hydropiper</i> L.
	<i>Phragmites australis</i> (Cav.) Trin. ex Steud.
<b>Family Typhaceae</b>	<i>Echinochola crus galli</i> (L.)
	<i>Typha domingensis</i> Pers.
<b>Family Acoraceae</b>	<i>Typha angustata</i> Bory & Chaub.
<b>Family Alismataceae</b>	<i>Acorus calamus</i> L.
<b>Family Amaranthaceae</b>	<i>Alisma plantago</i> L.
<b>Family Araceae</b>	<i>Alternanthera sessilis</i> (L.) R.Br. ex DC
<b>Family Brassicaceae</b>	<i>Colocasia esculenta</i> (Linn) Schott
<b>Family Convolvulaceae</b>	<i>Nasturtium officinale</i> W.T. Aiton
	<i>Ipomea carnea</i> Jacq.

<b>Family Equisetaceae</b>	<i>Equisetum diffusum</i> D. Don
<b>Family Lemnaceae</b>	<i>Lycopus</i> sp L.
<b>Family Plantaginaceae</b>	<i>Linnophila indica</i> (L.) Druce
	<i>Veronica anagallis-aquatica</i>
	<i>Ranunculus sceleratus</i> L.
<b>SUBMERSED</b>	<b>13</b>
<b>Family Potamogetonaceae</b>	<i>Potamogeton crispus</i> Linn.
	<i>Potamogeton</i> sp.
	<i>Potamogeton lucens</i> Linn.
	<i>Potamogeton natans</i> Linn.
	<i>Potamogeton pectinatus</i> Linn.
	<i>Potamogeton perfoliatus</i> Linn.
<b>Family Hydrocharitaceae</b>	<i>Vallisneria spiralis</i> Linn.
	<i>Najas indica</i> (Wild) Cham.
	<i>Hydrilla verticillata</i> (L.F.) Royle
<b>Family Characeae</b>	<i>Chara vulgaris</i> L.
	<i>Nitella hyalina</i> (DC) C. Agardh
<b>Family Ceratophyllaceae</b>	<i>Ceratophyllum demersum</i> L.
<b>Family Plantaginaceae</b>	<i>Veronica anagallis-aquatica</i>
<b>ROOTED FLOATING LEAVED</b>	<b>4</b>
<b>Family Menyanthaceae</b>	<i>Nymphoides cristata</i> (Roxb) Kuntze
	<i>Nymphoides indica</i> (L.) Kuntze
<b>Family Marsileaceae</b>	<i>Marsilea quadrifolia</i> L.
<b>Family Nelumbonaceae</b>	<i>Nelumbo nucifera</i> Gaertn.
<b>FREE FLOATING TYPE</b>	<b>4</b>
<b>Family Salviniaceae</b>	<i>Azolla pinnata</i> R.Br.
	<i>Salvinia natans</i> (L.) All.
<b>Family Araceae</b>	<i>Lemna minor</i> L.
<b>Family Pontederiaceae</b>	<i>Eichhornia crassipes</i> (Mart.) Solms

Submerged community was almost uniformly distributed in all wetlands with 8 species each in Mansar and Pargwal, 4 species in Kukarian, 2 species each in Surinsar and Sansar and 1 species in Gharana wetland. Maximum submerged species in Mansar and Pargwal wetlands were attributed to high water transparency. High water transparency (Slathia *et al.*, 2018) and low coverage of free floating macrophytes (Pandit *et al.*, 2005) are considered important factors for the distribution of submerged group. Rooted floating leaf forms were observed in Mansar and Surinsar lakes (3 species each), Sanasar (2 species), Pargwal (1 species) and were found absent in Gharana and Kukarian wetlands. Among free floating forms Gharana wetland showed the highest representation with 4 species, lowest in Pargwal, Kukarian, Sanasar (1 species each) and were absent in Mansar and Surinsar.



**Fig. 3 :** Showing the percentage contribution of the various growth forms of macrophytic species.



**Fig. 2 :** Showing macrophytic diversity in six wetlands.

Among various wetlands, the dominant macrophytic species included *Potamogeton*, *Ipomoea*, *Polygonum* and *Nymphoides* in Mansar; *Ipomoea*, *Typha*, *Polygonum* and *Nymphoides* in Surinsar; *Eichhornia* and *Typha* in Gharana; *Nasturtium* and *Nymphoides* in Sanasar; *Typha*, *Potamogeton* and *Nasturtium* in Kukarian) and *Typha*, *Polygonum*, *Cyperus* and *Potamogeton* in Pargwal. The dominant families in these wetlands were observed as Potamogetonaceae (Mansar and Pargwal), Polygonaceae and Cyperaceae (Surinsar), Cyperaceae and Menyanthaceae (Sanasar), Cyperaceae (Gharana), Potamogetonaceae and Cyperaceae (Kukarian).

## DISCUSSION

The qualitative composition and distribution of macrophytes are the important parameters for assessing the health of the ecosystem. Macrophytes are generally adapted to live in different types of wetlands with some adapting to more than one wetland types. Emergents are considered as the most productive communities of macrophytes (Kaul *et al.*, 1978). Dominance of emergent group in these wetlands during the present investigation, may be attributed to intensive growth of macrophytes in the littoral zones and their high adaptability to varied environmental conditions, water level fluctuations and, other environmental stresses (Dar *et al.*, 2014; Slathia *et al.* 2018; Sheikh and Slathia, 2019). Dominance of emergent vegetation in these wetlands indicate their eutrophic nature (Pereira *et al.*, 2012). Similar trend of dominance of emergent in wetlands has been recorded by various workers (Van der Valk and Davis, 1976; Handoo and Kaul, 1982; Theophile *et al.*, 2005; Sharma and Singh, 2017 and Sheikh and Slathia, 2019). The factors like biotic interferences and influx of nutrient rich runoff not only affect the macrophytic composition growing in these wetlands, but also the entire biodiversity of the riverine and lacustrine ecosystem (Sharma, 2008 and Sharma *et al.*, 2017). The silt load and mixing of allochthonous material in these wetlands was due to continuous anthropogenic pressure, waste discharge and runoff from the agricultural fields carrying a considerable organic and inorganic matter and litter from the catchment area (Sharma and Deka, 2014). Species diversity is a useful parameter for the comparison of communities under the influence of biotic disturbance or to know the state of succession and stability in the community (Sharma and Deka, 2014).

## CONCLUSION

The present communication documented 43 species represented by 34 genera and 24 families of macrophytes that included 30 species of monocots and 13 of dicots. Dominance of emergent group in these wetlands indicated nutrients enrichment and productive nature of the wetlands. Mansar lake recorded maximum and Sanasar lake represented the least macrophytic diversity. There was no well marked differentiation in varied macrophytic groups and almost all the communities were found intermixed. Present study suggested regular monitoring of the impacts of anthropogenic pressures, land use changes and climate change on the diversity and distribution of macrophytes in these wetlands for devising conservation and management strategies.

## Acknowledgements

Authors gratefully acknowledge the necessary laboratory facilities provided by Head, Department of Environmental Sciences, University of Jammu, Jammu for carrying out the present work. The authors further declare that they have no conflict of interest.

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