

DOI No.: <http://doi.org/10.53550/EEC.2023.v29i04s.037>

# Distribution of Hydrophytes in Panchana Dam, District Karauli, Rajasthan, India

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(Received 11 February, 2023; Accepted 29 April, 2023)

## ABSTRACT

Aquatic plants are important elements of food web dynamics. These are also known as water loving plants or macrophyte, are unchangeable biological filter of aquatic ecosystem. They oxygenate the water and provide food and shelter to all aquatic fauna. Present study elaborates the macrophytic diversity of the most important water body, Panchana dam of Karauli city in district Karauli towards the eastern part of Rajasthan state. Panchana dam consists of wide variety of aquatic and marshy vegetation at two sites in different seasons. We have recorded a total of 27 aquatic vegetation groups out of them, 24 were of angiosperms, two Pteridophytes and one alga. The highest species diversity was observed in the summer, followed by winter and then monsoon. The indicator macrophytes were *Ceratophyllum demersum*, *Hydrilla*, *Ipomea aquatica*, *I. fistulosa*, *Lemna*, *Potamogeton*, *Spirodela*, *Trapa* and *Typha* were recorded as dominant species in the summer. Macrophytes habitat are like free floating, floating rooted, submerged, muddy, marshy and moist soil. The total plant species with their botanical name, family and description were presented. The structure of aquatic vegetation of Panchana dam was changed in various seasons as a result of nutrient enrichment due to human activities and sewage disposal in the water.

**Key words:** *Aquatic ecosystem, Hydrophytes, Macrophytes, Panchana dam*

## Introduction

The species, which normally stand in water and grow at least a part of their life cycle in either completely submerged or emerged condition or floating, are called aquatic plants. All creatures of water depend on them for food and shelter. Aquatic plants play an important role in aquatic ecosystem. Aquatic plants are also called hydrophytes or macrophytes. Thousands of plant species live in freshwater habitats around the world. They oxygenate the water and provide food and shelter for all kinds of animals, including aquatic insects, fishes and mammals such as muskrats. Aquatic habitats are

also crucial in providing necessary habitat for feeding, nesting and migrating waterfowl (Havera, 1999).

Biodiversity includes assemblage of plants, animals and microorganisms their genetic variability expressed in varieties and population, their habitat, ecosystems and natural areas, the mosaic of which gives richness to the natural environment. Biodiversity or biological resources provide food, clothing, housing, medicine and spiritual nourishment to human beings (Kulshrestha, 2005). The green plants are primary producers in every food chain of an ecosystem.

Freshwater ecosystems are experiencing decline

in biodiversity far greater than those in the most affected terrestrial ecosystems. Some problems of freshwater ecosystem such as unfavorable climate, different kinds of pollution, eutrophication, acidification and alien species lead to reduction in native hydrophytes diversity (Chambers *et al.*, 2008). The macrophytes produce additional amount of nutrients and that pollute the water after their death (Tewari and Mittal, 2020). The baseline statistics on biodiversity is necessary for the preservation and management strategies of wetland and aquatic habitats (Ravi *et al.*, 2020). In Kerala, the systematic reports regarding the freshwater ecology, limnology and conservation biology of pond was insufficient.

The aquatic macro-vegetation plays a noteworthy role in maintaining the ecological balance by nutrient recycling (Paul, 2022).

## Materials and Methods

### Study area

Rajasthan is the India's largest state by area (132,139 sq. mile), situated at the north western side of India. Panchana dam is one of the important freshwater bodies of district Karauli of Rajasthan state (Fig. 1). It is 4 km. away from district headquarter of Karauli. But the main dam is situated in Tiketpura Pahari

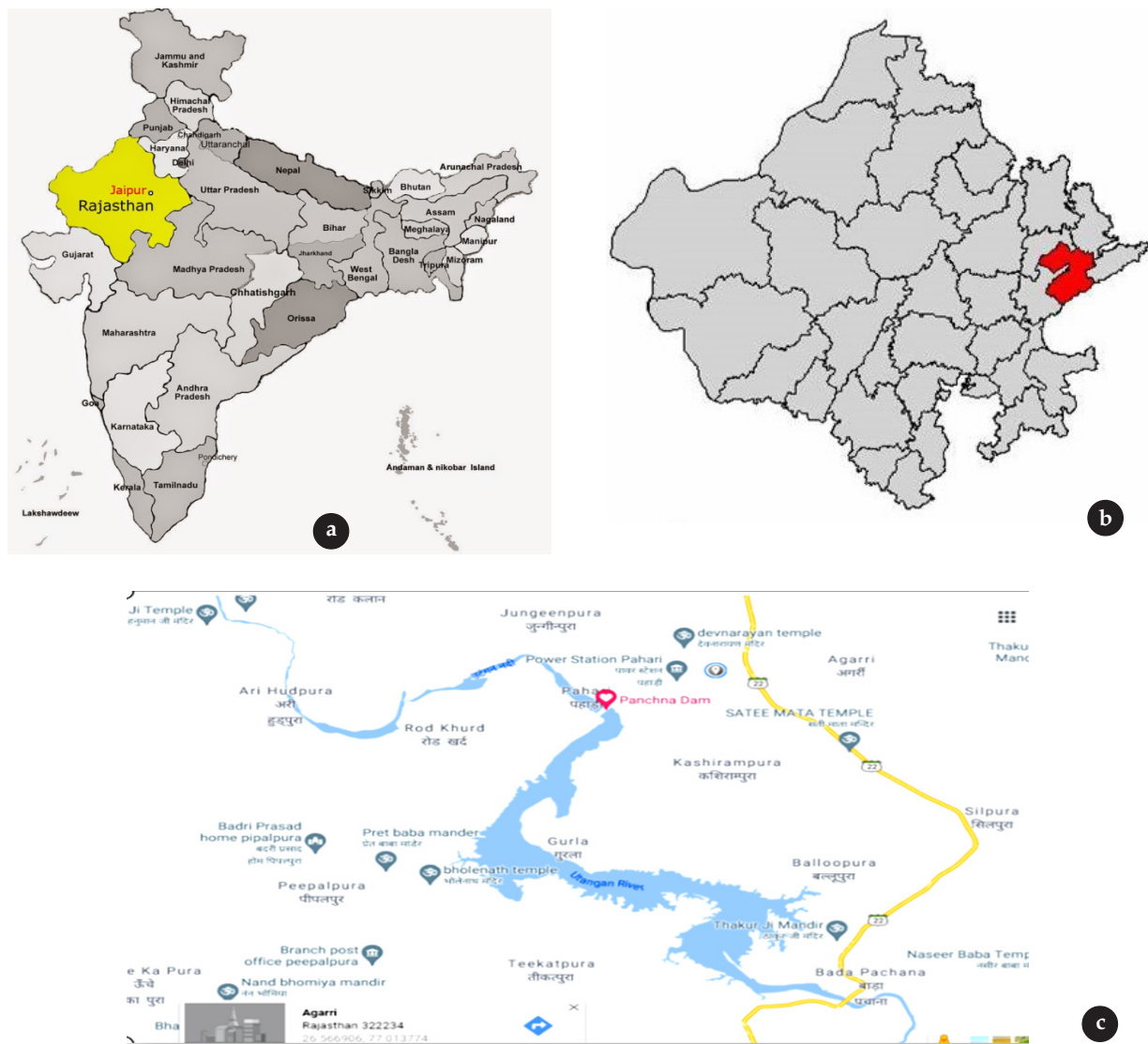


Fig. 1. (a) Map of India, (b) Location of Karauli district in Rajasthan state, and (c) Panchana Dam location in Karauli district.

village near about 12 km north of city Karauli. It is a perennial source of water which is used for irrigation and drinking purposes.

It is the largest earthen dam of Rajasthan state. Bhainsawat, Manchi, Attaki, Bhadrawati and Berkhedra, these five rivers create the dam. Because it is made up from five rivers so it is called in combined form of five rivers as Panchana. All these five rivers are coming from different directions and carrying water which flows through various sediment pockets of different topography.

It is an earthen dam with maximum height up to 33.19 m and ogee shaped crest with solid roller bucket type of dam. It is the largest earthen dam of Rajasthan state which is built on the Panchana River near the Gudla village. Panchana dam site falls under eastern gravelly/rocky plateau with outliers of Aravallis with the total catchment area of 621.60 sq. km and the compound area of about 10606 ha. The climate of the Panchana dam is almost semi-arid and comparatively milder with distinct winter, summer and rainy seasons (Table 1).

**Table 1.** Geographical and climatic features of Panchana dam

Geographical features	
Range	Panchana dam
District	Karauli
Division	Bharatpur
State	Rajasthan
Location	77°00'00" E Longitude; 16°33'30" N Latitude
Highest point	262 m
Length	1040 m with top width 10.98 m, height 33.19 m
Gross catchment Area	621.60 sq. km.
Surrounding Hills	Hilly area of Vindhyan and Aravali
Climatic features	
Summer temperature	Maximum 45°C, Minimum 24°C
Winter temperature	Maximum 31°C, Minimum 9°C
Average annual rainfall	724 mm annually
Monsoon period	July to September

This dam was constructed in 1977 under the Panchana Irrigation Project, Irrigation Division, Karauli (PIP, 2005). It includes seven tunnel gates with the Russian dam technology. The door of every gate are opened and pulled by the powerful and solid iron wires by the motor engines. The dam has a canal system known as Panchana main (feeder) canal, 11.57 km long which bifurcates into two branches (Shri Mahaveer Ji, 14.8 km; and Piloda,

18.8 km) at its tail end. Some important features of Panchana dam are following:

### Sample collection

The present study is the outcome of two years monthly survey with critical observations and collection. Identification was done with the help of flora and subject experts. The field study was organized for a period of two years (February 2018 to January 2020) and each month survey was carried out with the collection of the aquatic plants of Panchana dam. The criteria for the selection of a plant as a specimen were submerged or floating in lentic and lotic conditions. The aquatic flora is concerned with three sites of the Panchana dam.

For the present investigation, we have selected two different sites of the dam these are: (1) Dam site area where dam made up in Tiketpura and Pahari villages (hereafter known as Site-I), and (2) Main Ghat of Panchana reservoir near Karauli-Hindaun city state highway (hereafter known Site-II).

Site-I situated in north western direction of the state highway where anthropogenic activity level lower than the Site-II. The location of Site-II was near the Tiketpura Pahari village where main dam is situated. At the Site-I near Panchana Ghat and state highway where opposite side direction on the top of hill Anjani Mata temple is situated. There are houses, cattle and crop fields are appeared on the bank of Panchana dam. There is cleaning of animals, vehicles, fishing, irrigation, bathing, washing activities done by the peoples. At the time of fair and festivals the label of garbage increases.

Site-II is located within 0.25 km distance from the Anjani Mata temple. During the Keladevi fair, (March-April, every year) people take bath, washing of their vehicles and washes their clothes at a large scale on the Panchana Ghat. One annual fair organized on Anjani Mata temple after Diwali (Devuthni Ekadashi) eleventh day. There are cattle fair also organized on Shivratri festival at every year in Karauli city from long time ago. At this time, people released many things in water at the time of Navratra and Shraddh Paksh.

### Identification of plants

Water temperature was recorded regularly by digital thermometer at the site. The preserved plant samples were immediately brought to the laboratory for the identification of aquatic vegetation. The identification of species is based on the monographs

and flora like Biswas and Calder (1936), Subhramanyam (1962), Shetty and Singh (1988, 1991, 1993). The plant list was categorized according to their systematic positions following Bentham and Hookers classification system.

## Results and Discussion

There are many different types of emergent macrophytes commonly found in the shallow stagnant waters of tropical and subtropical countries of the world (Goswami *et al.*, 2010). In this study, we have observed 27 species of macrophytes out of them 14 species are dicot and 10 species are monocot while 2 species of two genera representing two families of Pteridophytes and one from algae.

From the above surveillance, we can summarize that this study area is mainly occupied by emergent plant species emergent plant species (37%) followed by moist soil plants and submerged (21%), free floating (17%), suspended submerged (4%) recorded (Fig. 2).

Rajasthan is area wise biggest state of India but Rajasthan is measured as a desert state whereas it also has loaded aquatic flora with range. Aquatic angiosperm plant species of Panchana dam includes native and naturalized plants. The study area shows a plant diversity comprise of 24 species belongs to 20 angiosperm families and only two families are related to Pteridophyta plant kingdom and single one related to algae. So total no. of species found in the study area are 27 which is good sign of biodiversity (Table 2).

Graphical representation of families and total no. of species shows that the diversity of plant species are high in dam water area. It also reports about the testimony of variety of the plant groups which are

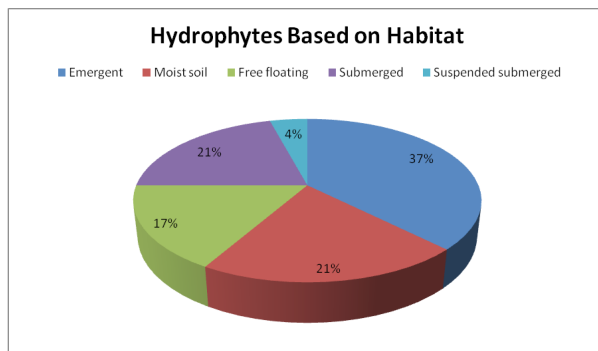


Fig. 2. Analysis of data based on habitats showed by the macrophytes of Panchana dam

belonging to Algae (*Chara sp.*), Pteridophytes (*Azolla sp.* and *Marsilea sp.*) beside these, 10 species belonging to monocotyledons and 14 species belonging to dicotyledons group (Figs. 3, 5).

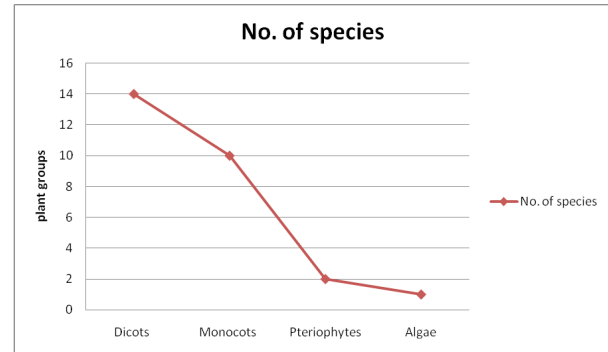


Fig. 3. Graph between no. of species and plant groups of Panchana dam

The highest species diversity was observed in the summer, followed by winter and then monsoon. The indicator macrophytes like, *Ceratophyllum demersum*, *Hydrilla*, *Ipomea sp.*, *Potamogetone* and *Typha* were recorded throughout the year in both sites of Panchana dam. *Azolla*, *Digeria muricata*, *Eclipta alba*, *Schoenoplectus articulatus*, *Hydrilla verticillata*, *Ceratophyllum demersum* and *Typha* as dominant species in winter. *Lemna minor*, *Hydrilla verticillata*, *Ceratophyllum demersum*, *Trapa natans*, *Spirodela polyrhiza*, *Elatine triandra*, *Ipomea sp.* and *Marsilea* were reported dominant in summer (Fig. 4).

Most of these macrophytes grow naturally but some macrophytes used for human consumption and cultivated by human, for example *Trapa*. *Trapa* grown for its edible fruits (Singh and Tomar, 1982). There were huge growth of aquatic macrophytes like *Lemna*, *Ipomea*, *Hydrilla*, *Potamogetone*, *Trapa* and *Marsilea* (Sharma *et al.*, 2012). These plants are good biological indicators of the environmental conditions of Panchana Rivers. These plants grow dominantly with bad odor in the polluted water during summer. The luxuriant growth of aquatic macrophytes evinced the highly productive nature of the river. The dominance of emergent species among the growth forms indicates the encroachment of littoral vegetation, indicating a succession trend towards marsh meadow (Maheshwari, 1960; Vyas, 1964).

**Table 2.** Characteristic features of various species of aquatic macrophytes of Panchna dam

Species	Family	Description
<i>Azolla pinnata</i>	Salviniaceae	Free floating on the surface of water, formed red colored blooms. Plant body is small sized. Leaf is bilobed.
<i>Bacopa monneri</i> L.	Scrophulariaceae	Submerged, suberect or glandular punctuate herbs, rooting at the nodes.
<i>Ceratophyllum demersum</i> L.	Ceratophyllaceae	Submerged, rootless, monoecious, much branched aquatic herbs.
<i>Centella asiatica</i>	Apiaceae	Small trailing herbs of moist soil, glabrous stem, and pink striated, rooting at nodes, fleshy, orbicular or reniform leaves, long petiole smooth on upper surface and hairy below.
<i>Cynodon dactylon</i> L.	Poaceae	Emergent, creeping, stoloniferous, often rhizomatous perennials. Forming matted tufts, 10-40 cm high.
<i>Chara</i>	Characeae	Branched, monoecious, multicellular alga node and internodes present, plant body divided into rhizoids and main axis.
<i>Cyperus articulatus</i> L.	Cyperaceae	Emergent, subphyllous, perennial sedge rhizomes, long creeping culms trigorous, smooth, glabrous, distinctly transversely septate when dry, clothed at base with 3-4 sheaths. Occurrence in the stagnated water.
<i>Digeria muricata</i> L.	Amaranthaceae	Emergent, common weed, erect, annual herbs, branches, spreading, glabrous.
<i>Eclipta alba</i> L.	Asteraceae	Emergent, common weed, erect or prostrate, hirsute herbs, often rooting at the lower nodes.
<i>Elatine triandra</i> L.	Elatinaceae	Emergent, small, tender, creeping herbs, rooting at nodes.
<i>Hydrilla verticillata</i> L.	Hydrocharitaceae	Suspended submerged freshwater herbs, slender, root fibrous. Found in association with <i>Potamogetone</i> , <i>Nymphaea</i> and <i>Chara</i> etc.
<i>Ipomea aquatica</i> Forsk. FI	Convolvulaceae	Free floating or creeping on water surface, marshy herbs, rooting on the nodes, stem fistular, glabrous.
<i>I. fistulosa</i> Mart. Ex.	Convolvulaceae	Emergent, erect, stout shrubs, near water resources in forms dense community, easy and fast growth by stem cutting propagation.
<i>Lemna minor</i> L.	Lemnaceae	Free floating, annual herbs, near water, root sheath not appendaged at the base: root-cap obtuse, fronds upto, 0.25 cm long. Sessile, symmetrical, abovoid or oblong, more or less flat on both surfaces.
<i>Marsilea minuta</i>	Marsileaceae	Submerged, the rhizomatous, herb with slender stolon like stems, on or just below the surface with their roots, just near soil. The leaf blades divided into four equal obovate pinnate.
<i>Najas minor</i>	Hydrocharitaceae	Submerged, grows in dense cluster, propagation by stem fragments or small seeds, leaves are unbranched and strap shaped, 4.5 cm in size with serration.
<i>Oxalis corniculata</i>	Oxalidaceae	Moist soil, low growing herbs, narrow creeping roots at the nodes, trifoliolate leaves.
<i>Polygonum barbatum</i> L.	Polygonaceae	Emergent, erect to creeping ascending, annual or perennial herbs.
<i>Portulaca oleracia</i>	Portulacaceae	Moist soil herbs, annual, succulent, fleshy, glabrous leaves rounded at the tip. Stems are reddish in color, tap root with fibrous secondary root.
<i>Potamogetone crispus</i> L.	Potamogetonaceae	Submerged slender, branched, glabrous herbs.
<i>P. pectinatus</i> L.	Potamogetonaceae	Submerged, profusely branched, aquatic herbs, stolon filiform.
<i>Schoenoplectus articulatus</i> L.	Cyperaceae	Emergent, short lived perennial tufted sedge without, conspicuous rhizome, culms terete, hollow, smooth, dark green.



Table 2. Continued ...

Species	Family	Description
<i>Spergula arvensis</i>	Caryophyllaceae	Moist soil small, annual, branched herbs, glabrous more or less with glandular hairs, prostrate or erect.
<i>Spirodella polyrhiza</i> L.	Lemnaceae	Minute, Free floating, aquatic herbs, fronds upto 8×7mm flat, orbicular or broadly ovate oblong, opaque, dark green, above, and purplish beneath.
<i>Trapa natans</i> L.	Trapaceae	Free floating or submerged, annual herbs, floating leaves in rosette, 1.5-6.00 × 1.5-7.0 rhomboid; crenate, toothed on upper margins, grown for its edible fruits.
<i>Tribulus terrestris</i>	Zygophyllaceae	Annual plant of moist soil, tap rooted, herbaceous, known as noxious weed, small woody fruit with long sharp and strong spines easily penetrate the surface.
<i>Typha elephantina</i> Roxb.	Typhaceae	Emergent, rhizomatous; erect, perennial herbs, up to 3.5m tall; rhizomes deep, seated, robust.

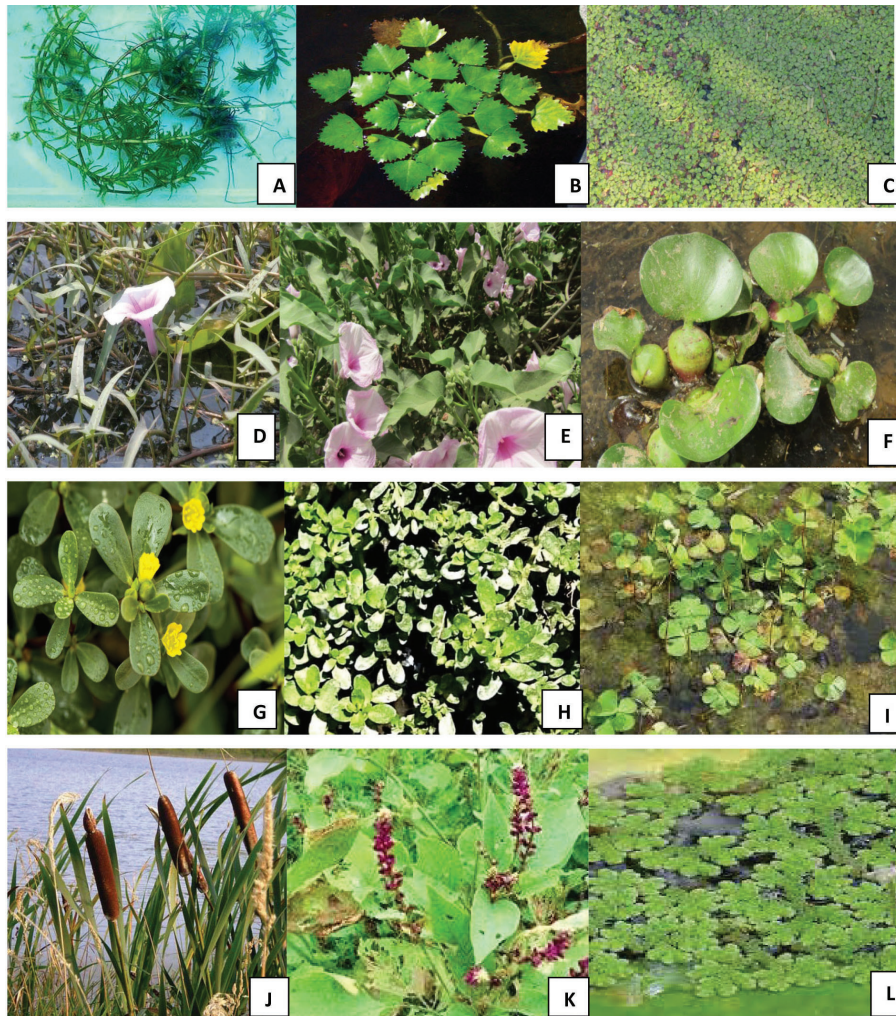


Fig. 4. Some macrophytes of Panchana dam, district Karauli, Rajasthan  
 (A) *Hydrilla*, (B) *Trapa natans*, (C) *Spirodella polyrhiza*, (D) *Ipomea aquatic*, (E) *Ipomea fistulosa*, (F) *Eichhornia crassipes*, (G) *Portulaca oleracea*, (H) *Baccopa monnieri*, (I) *Marsilea minuta*, (J) *Typha elephantina*, (K) *Digeria muricata*, and (L) *Azolla pinnata*

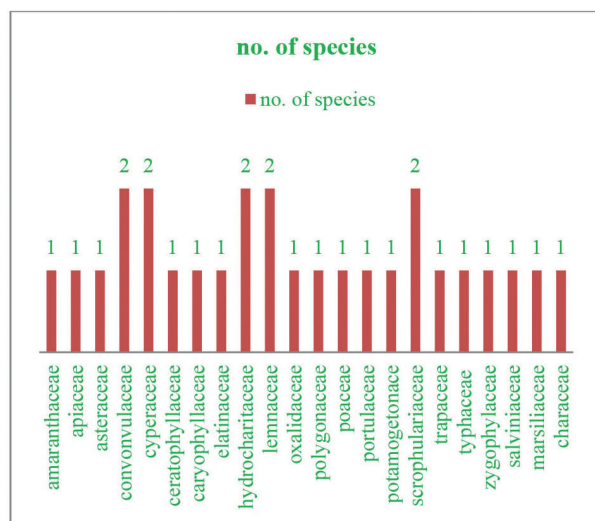


Fig. 5. List of plant families and number of species in Panchana dam

## Conclusion

This study reports an assessment on the macrophyte plants in perennial water source of Karauli district, Rajasthan which is a comprehensive floristic analysis of the aquatic flora. This study provides crucial information on the present status and composition of hydrophytes in Panchana dam, Karauli district of Rajasthan. During the investigation, 27 macrophyte species were reported belonging to different plant groups. There is need to be protected and conserved these species for the future perspective. With this investigation we can conclude that if precautions are not taken, the dam water will be polluted at Site-II more and more. Shallowness will be increased and this site will be converted to a swamp. Further research will be needed to predict about quantitatively effect of aquatic macrophytes on the environmental and ecological characteristics in Panchna Rivers.

## Conflict of Interest

Conflict of interest declared none by the authors.

## Acknowledgements

The first author is express sincere thank to Prof. GP

Singh, Department of Botany, University of Rajasthan, Jaipur (Rajasthan) and Dr. Shyam S. Sharma, Department of Botany, Shri Agrasen PG Girls' College, Hindaun City, District-Karauli (Rajasthan) for their valuable suggestions on various aspects of the present research.

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