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## STUDIES ON SOME INVASIVE ALIEN MACROPHYTES IN ARTHUNA POND OF GARHI TEHSIL IN DISTRICT BANSWARA OF SOUTH RAJASTHAN, INDIA

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### ABSTRACT

This Present study is aimed to determine the diversity and distribution of Alien Macrophytic plants found in the Arthuna pond of Garhi Tehsil in Banswara District of South Rajasthan. In the years 2019 and 2020, the specimens were collected from four sites located from the north to south and east to west of study area. A total of seven species belonging to six genera and six families are reported as Invasive Alien Macrophytes. These are *Ipomea* sps., *Nymphoides*, *Nymphaea*, *Nelumbo*, *Potamogeton*, *Azolla* belonging Convovulaceae, Menyanthaceae, Nelumbonaceae, Salviniaceae, Nymphaeaceae, Potamogetonaceae respectively. Physicochemical parameters like water pH, Temperature, TDS, Dissolve oxygen, Turbidity were analysed in three seasons winter, summer and rain. The Invasive Alien Species possess serious threat to local diversity and human Health therefore systematic study about the invasive plant species is necessary.

**Keywords:** Biodiversity, Invasive Alien Macrophytes, Arthuna pond, Garhi Tehsil, Threat.

### INTRODUCTION

Green plants have occupied diverse ecological habits ranging from hot tropics to polar ice. Plants being stationary in nature, are well adapted to endure prevailing environmental conditions. A number of ecological factors regulate distribution of world vegetation. Water is one of the most important ecological factors in the biosphere. It is the key factor in plant distribution. Most of the physiological processes of plants are water dependent. Water requirement of different plants differs with species. Most of plant species tends to adapt themselves with respect to the quantity of water available in their habitats. Some plants tolerate water stress and some others withstand with water excess. On this basis Warming (1909) primarily recognized three major groups of plants.

- 1) Aquatic plants or Hydrophytes
- 2) Land or terrestrial plants
- 3) Halophytes or Marshy plants

#### Hydrophytes

Hydrophytes are plants which live in water (Hydro=water+ Phyton= plant). In literal sense, the term hydrophytes includes all plants including the vast majority of Algae, many Fungi, a few Bryophytes and Pteridophyta and good number of Angiosperms. However in Strict sense of usage, the term hydrophytes is restricted only to those rooted or free floating vascular plants which live upon the surface of water or submerged at various depths.

So hydrophytes are the plants that are adapted to aquatic environment.

#### Classification of Hydrophytes

##### Free floating hydrophytes

These plants float freely on the water surface and are not rooted e.g. *Eicchornia*, *Pistia*, *Lemna*, *Wolffia*.

##### Floating but rooted

These plants float on the surface of water but remain attached to the bottom of water reservoir by their roots. E.g. *Nymphaea*, *Potamogeton*, *Trapa*.

##### Submerged but not rooted hydrophytes

These are the plants in contact with only water, being completely submerged and not rooted in the mud. Their stems are long and leaves generally small. E.g. *Ceratophyllum*, *Utricularia*, *Najas*.

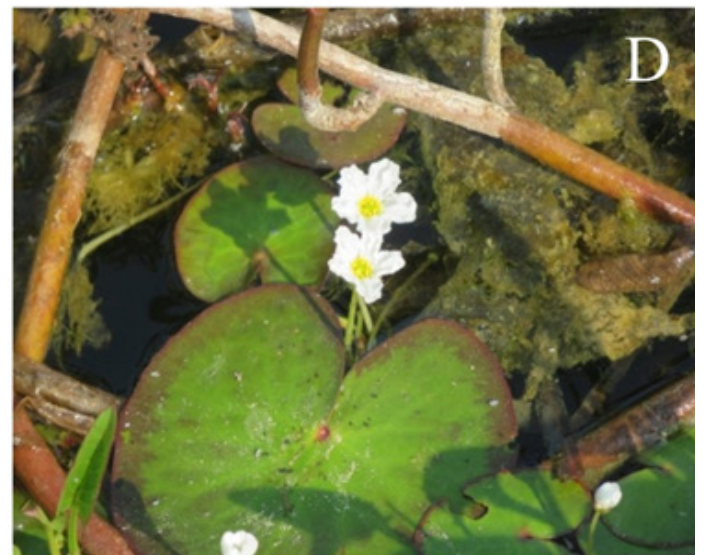
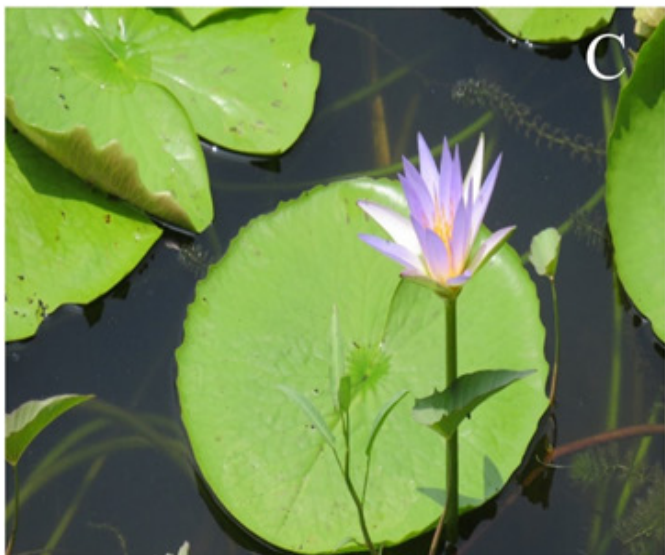
##### Rooted Submerged hydrophytes

These plants remain completely submerged in water and rooted in soil. E.g. *Hydrilla*, *Vallisneria*.

##### Rooted emergent hydrophytes

These plants grow in shallow waters. Their shoots are partly or completely exposed to air. The root system is completely under water and fixed in soil. E.g. *Cyperus*,

PHOTOPLATE



**Figure A** *Ipomea aquatica*  
**Figure B** *Ipomea carnea*  
**Figure C** *Nymphaea nauchali*

**Figure D** *Nymphoides hydrophylla*  
**Figure E** *Nelumbo nucifera*  
**Figure F** *Potamogeton natans*

*Ranunculus, Sagittaria.*

### **Amphibious and rooted hydrophytes**

These plants grow near the water reservoir in shallow and muddy places E.g. *Polygonum, Marsilea*. Fresh water ecosystem provides a wide variety of valuable economic goods and irreplaceable ecosystem services. Exotic species invasion is worldwide threat to the Integrity of aquatic ecosystem.

### **Macrophytic vegetation**

A Macrophyte is an aquatic plant that grows in or near water and either emergent, submerged, or floating, and includes helophytes (a plant that grows in marsh, partly submerged in water, so that it regrows from buds below the water surface).

### **Native or Indigenous Species**

A species is said to be native to given geographic area over a given period when it is represented in that area by population seen as long standing at the beginning of that period. The species grows and lives naturally in area without having been Introduced by human and their activities. The species may also be characterized by a distribution range that apparently does not depend on dispersal by human.

### **Alien, Non-native or Exogenous species**

The convention on Biological Diversity (CBD 1992) in its ' Interim Guiding Principles for the prevention Introduction and Mitigation of Impacts of Alien species,' defines Alien species as "a species occurring outside its normal distribution." When Alien species starts proliferating and spreading beyond its definite limits, it is said to be invasive. The practice of growing non native water plants has led to several species becoming naturalized and invasive.

## **MATERIAL AND METHODS**

### **Study Area**

Banswara district is located in Southern most part of Rajasthan. It has an area of 5037 Square kilometer and lies between 23.11°N to 23.56°N latitudes and 73.58°E to 74.49°E longitudes at an average altitude of 302 meters above Sea level. This District lies in the humid Southern plain zone of Rajasthan, Its climate is sub humid. The temperature regimes do not reach extremes and so the area has mild winters and mild summers. Banswara falls in the Arabian sea branch of south west Indian Monsoon, Although occasionally the bay of bengal also breaks into add to rainfall in the district. It has highest rainfall , 1200 mm in Rajasthan.

Garhi is a small village and Tehsil in Rajasthan, approximately 38 kilometers from Banswara district. It is situated in Western India. It is located at 23° 36' E 74° 80' E with an Altitude of 148 meters. Garhi Tehsil has the average annual rainfall 800 mm. Arthuna is located in western side of Garhi Tehsil, approximately 15 kilometers away from Garhi Tehsil.

### **Methodologies**

During the study plants occurring in Arthuna pond were collected photographs were taken and Identified. The field survey was conducted thrice in the year 2019-20. Water samples were also collected in every season. To check the physicochemical properties of water different methods and Instruments were used like pH meter, conductivity meter, digital thermometer, Nephelo Turbidity meter and Titrametric method.

## **RESULTS AND DISCUSSION**

### **Obervation**

The present study focuses on an inventory of invasive alien Macrophytes diversity of Garhi Tehsil of District Banswara. Selection of pond for the study of plants has been done due to the richness of pond. After meticulous observation following aquatic alien plants were identified. For each genera botanical name, common name, family name, feature of special Interest, description and photographs were provided.

### **Botanical Name :**

*Ipomea aquatica* (Angiosperm-Dicot)

(Photoplate Figure-A)

### **Common Name:**

Swamp morning glory, water spinach

### **Family Name:**

Convolvulaceae

### **Habitats/Morpho-ecological group:**

Anchored floating.

### **Native/origin:**

Asia

### **Climatic condition for propagation**

Best leaf production comes from plants grown in soils rich organic matter prefers a pH in the range 5-7, tolerating 4.3- 7.5, the seeds do not germinate well at temperature lower than 25°c

### **Feature of special interest, economic importance/ Description:**

A semi aquatic, tropical plant, grown as a vegetable for its tender shoots. The young shoots are mildly laxative and are used by Diabetic patients.

**Botanical Name :**  
*Ipomea carnea* (Angiosperm-Dicot)

(Photoplate Figure-B)

**Common Name:**  
Bush morning glory

**Family Name:**  
Convovulaceae.

**Habitats/Morpho-ecological group:**  
Rooted emergent.

**Native / origin:**  
Native shrub of South America.

**Climatic condition for propagation:**  
Optimum temperature and pH for cultivation is 19°C to 29°C and 7.7- 8.2 respectively.

**Feature of special interest, economic importance/ Description:**

This flowering plant has heart shaped leaves that are a rich green and 6-9 inches long. It had immense potential for pharmacological and insecticidal properties. It has great importance in Ayurveda.

**Botanical Name :**  
*Nymphaea nouchali*(Angiosperm-Dicot)

(Photoplate Figure-C)

**Common Name:**  
Water lily

**Family Name:**  
Nymphaeaceae

**Habitats/Morpho-ecological group:**  
Anchored floating.

**Native/ origin:**  
Europe, North Africa, temperate Asia and tropical Asia

**Climatic condition for Propagation:**

It requires Sandy loamy and clay soil, Suitable pH acid, neutral alkaline(basic).It can not grow in the shade. It can grow in water. pH between 6 and 7. The flowers , Which only open in bright sunshine, have a soft delicate scent.

**Feature of special interest, economic importance/ Description:**

Its petiole is very long and delicate in plants with roots attached and leaves floating, the surfaces of floating leaves possess waxy coating.

**Botanical Name :**  
*Nymphoides hydrophylla* (Angiosperm- Dicot)

(Photoplate Figure-D)

**Common Name:**  
Banana plant, water snow flake, Kumudini

**Family Name:**  
Menyanthaceae (floating Heart family)

**Habitats/Morpho-ecological group:**  
Anchored floating

**Native/origin:**  
Asia and Europe

**Climatic condition for cultivation:**

It requires pH between 6 and 7. The flowers , Which only open in bright sunshine, have a soft delicate scent.

**Feature of special interest, economic importance/ Description:**

It is used as ornamental water garden plants. It is edible and used as vegetable in Taiwan.

**Botanical Name :**  
*Nelumbo nucifera* (Our National flower-Angiosperm-Dicot)

(Photoplate Figure-E)

**Common Name:**  
Indian lotus and bean of India, Kamal

**Family Name:**  
Nelumbonaceae

**Habitats/Morpho-ecological group:**  
Anchored floating

**Native /origin:**  
Asia and Europe

**Climatic condition for propagation :**

In colder Climates such a low water level , Which heats up more quickly, is helpful for better growth and flowering . Lotus germinates at temperature above 13°C. In the growing season from April to September (Northen

hemisphere), the average day time temperature needed 23 to 27°C. in Regions with low light levels in winter , the sacred lotus has a period of Dormancy.

**Feature of special interest, economic importance/ Description:**

One of two extant species of aquatic plant in the family Nelumbonaceae. It is often Colloquilly called a water lily. Leaves are used for wrapping food and as plate. Flower is used as source of lotus perfume, Dried flowers are used in preparation of fragrant herbal tea. Young leaves, petioles, and flowers are eaten as vegetables. Fresh seeds can be eaten for taste and called kamal gatta, dry seeds are used in worship by hindus and called kamal kakadi. *Nelumbo* has a unique property, it can generate heat. This property of *Nelumbo* is known as Thermogenesis. Thermogenesis in flowers attracts pollinators. *Nelumbo* also shows Ultrahydrophobicity, the leaves of *Nelumbo* are Highly water repellent.

**Botanical Name :**  
*Azolla pinnata* (Pteridophyta)

**Common Name:**  
Mosquito fern/ water fern

**Family Name:**  
Salviniaceae

**Habitats/Morpho-ecological group:**  
Amphibious and Rooted

**Native/ origin:**  
Africa and Asia.

**Climatic condition for propagation :**

The growth of *Azolla* is typically reduced above 35°C and no species can survive if temperature remain above 45°C for prolonged period of time. The optimum temperature for most species is between 18° to 28°C. this can be high as 30°C for species Such as Under high sunlight intensities *Azolla* fronds turn brick red. It can survive within pH range 3.5 to 10.It cannot grow in Acidic Soils.

**Feature of special interest, economic importance/ Description:**

Sheath like root pockets develop instead of root cap. In addition to its traditional cultivation as a bio fertilizer for wetland paddy due to its ability to fix nitrogen, *Azolla* is finding increasing use for sustainable production of livestock feed. *Azolla* is rich in protein, essential amino acids, vitamin and minerals.

**Botanical Name :**  
*Potamogeton natans* (Monocot)

(Photoplate Figure-F)

**Common Name:**  
Floating Pond weed

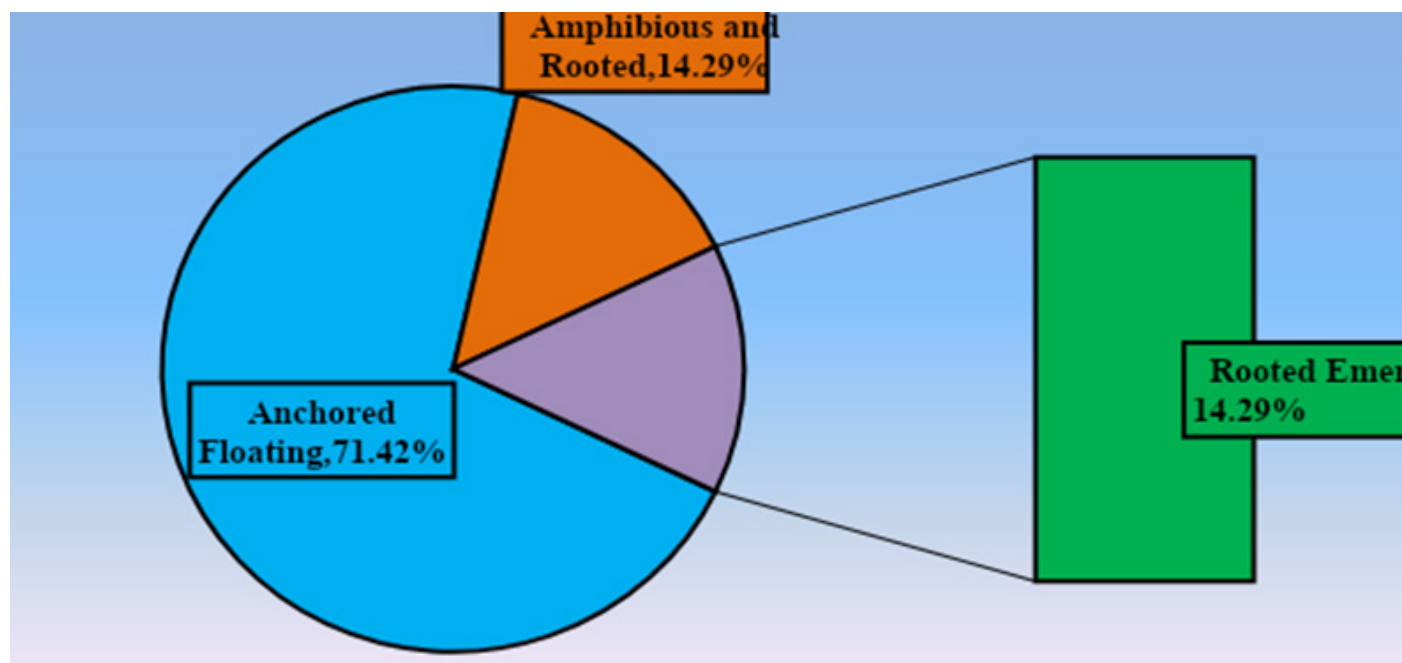
**Family Name:**  
Potamogetonaceae

**Habitats/Morpho-ecological group:**  
Anchored floating

**Native/origin:**  
Europe

**Climatic condition for cultivation:**

It grows in Shallow slow moving acidic to Basic Water.



**Figure:1** Analysis of data based on habitats showed by the Aquatic Alien Plants

### Feature of special interest, economic importance/Description:

All *Potamogetons* have a delicate membranous sheathing scale, the stipule, at the leaf axil. The morphology of Stipule is an important character for species identification. *Potamogeton natans*, like many other species of pond weed, is Capable of tremendous morphological variation. In still water its leaf blades are broad and sub Cordate at the base. In flowing or Tidal water, the leaf blades become narrower and the bases tapered.

The present study recorded 6 genera of aquatic alien plants belonging to 6 families in the study area. Family with maximum no. of species includes Convolvulaceae with 2 sps. Menyanthaceae, Nelumbonaceae, Salviniaceae, Nymphaeaceae, Potamogetonaceae were represented by only one sp. Out of 6 genera 5 genera belongs to Angiosperms and one genera represented Pteridophyta. Out of 5 Angiosperms four are dicots and one is monocot. Dicots are dominated in the study area. Among 6 morpho-ecological groups anchored floating plants dominated in study area by sharing 71.42 % followed by amphibious

rooted with 14.29 % and rooted emergent plants with 14.29 %.

### Discussion

Many aquatic plants are characteristically, invasive due to their immense potential for rapidly increasing their spatial spread and on establishment; these invasive species impair ecological processes such as water table level, soils quality and nutrient cycling there by influencing both the flow and chemistry of water, blocking drainage pipes etc. Thus invasive alien species affects aesthetics, wildlife avifaunal habitability and overall ecology.

Human have long depended on aquatic resources for food, medicines and materials well as for recreational and commercial purpose such as fishing, tourism. It is necessary to adopt certain conservation strategies to protect and conserve the aquatic life and to maintain the balance of nature and support the availability of resources for future generations.

Although Rajasthan is considered as a desert state but it

**Table No. 1** Some Optimum Physicochemical properties of Water of Arthuna pond for growth of Alien plants:

S. No.	Parameters	March-2019	August-2019	January-2020	Conclusion
1	Dissolved oxygen	4.0 mg/L	4.5 mg/L	5 mg/L	The concentration of dissolve oxygen is inversely proportional to the temperature. cold water have more Dissolve oxygen than hot water. I found more D.O. in winter season. I found less growth of <i>Nelumbo</i> in Winter, So we can say High D.O., low turbidity, low temperature, Low pH and low TDS inhibit the Growth of <i>Nelumbo</i> .
2	pH	8.4	8.3	8.0	This range of pH is optimum for growth of <i>Ipomea</i> , <i>Nymphaea</i> , <i>Nymphoids</i> , <i>Nelumbo</i> , <i>Azolla</i> and <i>Potamogeton</i> . optimum pH. for each plant is already mentioned above.
3	Temperature	24.3°C	29.2°C	19.9°C	<i>Nelumbo</i> seeds cannot germinate below 13°C. This range is optimum for seed germination and Growth of <i>Nelumbo</i> . Each species of <i>Azolla</i> needs 18°C to 28°C temperature for better growth, this range is also optimum for each species of <i>Azolla</i> . This range is also appropriate for <i>Nymphaea</i> , <i>Nymphoides</i> , <i>Ipomea</i> and <i>Potamogeton</i>
4	Total dissolved Salt/ conductivity	413 ppm	169 ppm	189 ppm	Max. TDS found in summer, In my observations I found max. growth of <i>Nelumbo</i> appear in Summer, So we can say <i>Nelumbo</i> needs High TDS for better growth, <i>Nelumbo</i> increases TDS of water, growth of <i>Nelumbo</i> indicates high TDS of water. I found less growth of <i>Nelumbo</i> in winter, winter shows less TDS in compare to summer, less TDS leads to less growth of <i>Nelumbo</i> . Other than <i>Nelumbo</i> all genera can grow on high to low TDS.
5	Turbidity / Transparency	0.7	1.0	0.6	I found high turbidity in rainy Season and less in winter and Summer. High Turbidity promotes flowering in <i>Nelumbo</i> .

also has rich aquatic flora and biodiversity. During the present study total 7spp. were recorded and summarised them according to botanical name, family common name and also by their description. Physicochemical analyses of water samples were also done.

Several studies have been carried out in Rajasthan on Distribution and production of Macrophytes in Picchola lake Udaipur, India (Billore & Vyas, 1982). The classification of Aquatic plants in Rajasthan reviewed in past by ( Pareek, 1996; Pareek & Sharma, 1988). Record of alien plant species in Jaisamand wild sanctuary reported by ( Dubey & Choudhary,2011). Effects of hydrological changes on the biodiversity at Keoladeo national park and their impact on Ecotourism studied by (Sharma, Mathur & Jethoo, 2015). A study on Biodiversity of hydrophytes in Panna sagar Talab, Khetri Jhunjhunu district of Rajasthan conducted by (Verma & Khan,2016). A study on Exotic plant species in Irrigated parts of Bikaner divisin conducted by (Jhakhar, Choyal and Arora, 2018). Physicochemical analysis of water from various sources and their comparative studies conducted by (Shukla,D., Bhadresha, K., Jain, N.K., & Modi, H.A.2013). There is no work done on Invasive alien species in south Rajasthan and specially in Banswara district.

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