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SURVEY FOR DIFFERENT KINDS OF AQUATIC MICROPHYTES FOUND AT MUZAFFARPUR

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ABSTRACT

The current study was carried out in Manikamaun wetland located in North Bihar, where Macrophyte diversity and biomass estimation was observed from June 2019 to March 2020. A total of 24 species of macrophytes belonging to 15 families were recorded from the wetland. From the identified species, Hydrocharitaceae (3), Potamogetonacea (3), Poaecae and Cyperaceae (2 each) were found dominant. Biomass productivity of observed macrophytic plants was estimated, Aquatic macrophytes were categorized in 4 types, viza, Free-floating plants (40%), Submerged (33%), Rooted with floating leaves (25%) and emergent (2%). Maximum biomass was recorded in month of February 387.91 g/m2 and minimum during the month of July 123.27 g/m2, a total of 2541.88 g/m2 of biomass was recorded from the maun. Among the various macrophyte species reported, highest biomass contributor was Eichhornia crassipes 1293.26 g/m2, followed by Najas graminea (610.17 g/m2), Nelembo nucifera (562.75 g/m2), and Hydrilla verticellata (221.24 g/m2). The aquatic ecosystem is composed of aquatic flora and fauna which interact together in maintaining the aquatic ecosystem. Aquatic macrophytes are macroscopic forms of aquatic vegetation, including macro algae, mosses, ferns and angiosperms found in aquatic habitat. Macrophytes of freshwater ecosystems have diverse roles to play in the structure and functioning of these aquatic ecosystems.

Keywords: Aquatic, Microphytes, Hydrocharitaceae, Potamogetonacea

INTRODUCTION

The word "hydrophytes" is used to refer to aquatic macrophytes, which are a collection of taxonomically different macrophytes whose life cycles occur either fully or partially in aquatic settings. The phrase "aquatic macrophytes" is often used interchangeably with the term "hydrophytes." The term "aquatic macrophytes" can also be used to refer to these plants. Macrophytes are able to optimally respond to the environmental heterogeneity and inhabit a variety of different types of aquatic habitats thanks to the adaptive mechanisms that they have evolved over the course of time. These mechanisms have allowed them to inhabit a variety of different types of aquatic environments. Among these ecosystems are freshwater bodies, watercourses, marshes, swamps, places that become flooded periodically, brackish environments, and marine settings, to name just a few. The many different kinds of plants that may be seen in aquatic situations are together referred to as the "aquatic macrophytic vegetation

ECOLOGICAL GROUPS AND ADAPTATION FEATURES OF AQUATIC MACROPHYTES

There are a variety of habitats on this planet that are suitable for the growth of aquatic macrophyte plants. It is well known that groups of closely related species commonly replace one another in the aquatic ecosystems of diverse parts of the world. The majority of macrophyte species may be found all over the world. The flexibility of aquatic macrophytes' physiological and metabolic processes in response to changes in the conditions of their environment is one of the characteristics that distinguishes them from other types of macrophytes. Macrophytic vegetation includes not only species that live in deep water or shallow water, but also species that actively develop in water and have the ability to either emerge from the water or remain submerged for extended periods of time. Some species are able to grow and reproduce in environments that are only temporarily submerged in water, are able to adjust to changes in the level of the water, or inhabit what are known as ephemeral water bodies.

Growth forms of aquatic macrophytes

There are a variety of habitats on this planet that are suitable for the growth of aquatic macrophyte plants. It is well known that groups of closely related species commonly replace

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Plant growth conditions in the aquatic environment

Aquatic environment is defined by a range of qualities that limit the growth of land plants, but aquatic macrophytes are blessed with unique adaptations to live in the submerged conditions or on the water surface. This allows them to survive in the aquatic environment. Because of this, aquatic macrophytes are able to flourish in their natural environment. The assemblage and distribution of aquatic macrophytes are not only regulated by climatic parameters such as the light regime and temperature, but also by the availability of inorganic carbon and other features associated to the aquatic environment. These factors include: The most important ones are the water level and the flow velocity, the structure and the density of the bottom sediments, the chemical composition of the water, which includes salinity and nutrient concentrations, as well as pH, transparency, gas saturation, conductivity, and other physicochemical parameters of the water.

Adaptations of macrophytes to life in the aquatic environment

Because the environmental constraints that affect aquatic plants are frequently very different from those that affect terrestrial plants, aquatic macrophytes have developed a set of adaptations that are specific to life in the aquatic milieu. This is because the environmental constraints that affect aquatic plants are often much more severe than those that affect terrestrial plants. This is due to the fact that aquatic macrophytes have evolved a set of

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specific adaptations to living in the aquatic environment in order to thrive there. Because gas diffusion in water occurs approximately 10,000 times more slowly than it does on land, and because the light intensity in the aquatic environment is considerably lower than it is in the terrestrial environment, aquatic plants require particular systems to guarantee that they are able to successfully photosynthesise and respire in the aquatic environment. One of the biochemical mechanisms that guarantees aquatic plants can adapt to low oxygen supply is the capability to convert to anaerobic metabolism in order to manufacture ATP in the absence of oxygen.

CURRENT STATE OF AQUATIC MACROPHYTE VEGETATION

Human activities have an effect on the biological diversity of a region, including the quantity of macrophytes, by modifying the habitats of these organisms and the structure of the landscape that surrounds them. This in turn has an effect on the number of macrophytes that may be found in an area. This is particularly true with regard to freshwater bodies and wetlands, which are recognised for being some of the ecosystems all over the globe that have been influenced by people the most. The physical destruction and transformation of the physicochemical features of water in small rivers, shallow lakes and ponds, as well as eutrophication, chemical pollution, and the invasion of alien species, are some of the anthropogenic and climatic factors that are currently posing a threat to aquatic macrophyte plants in freshwater ecosystems. Other factors that are contributing to this threat include the introduction of exotic species. The intensification of agriculture (ploughing of coastal areas, unreasonable land reclamation, and overgrazing), the development of transportation and engineering infrastructure, urbanisation, human recreational activities, and chemical pollution are all human-caused factors that have a negative impact on the biodiversity of freshwater ecosystems.

DIVERSE ROLE OF MACROPHYTES IN FRESHWATER ECOSYSTEMS

As primary producers, by providing structure in the habitat of many animal species, and by giving refuge and food to invertebrates (Castella et al., 1984), macrophytes play a significant role in the functioning of the freshwater ecosystems of many shallow water bodies (Rossier, 1995). It has been shown that macrophytes, which make up the majority of primary producers in freshwater systems with a shallow water depth, make a significant contribution to the biodiversity of ecosystems (Zeng et al., 2012). Macrophytes play an important role in a variety of ecosystem processes, including biomineralization, transpiration, sedimentation, elemental cycling, the transformation of materials, and the emission of biogenic trace gases into the atmosphere (Carpenter & Lodge, 1986). Recent research has shown that aquatic macrophytes have an important role in controlling the amount of nutrients that are available in the water and in improving the structural integrity of lakeshores (Carpenter & Lodge, 1986; Blindow et al., 2014). The geology, land usage, water and sediment chemistry, and land use may all have an effect on the macrophyte assemblage (Barko et al., 1991; Lougheed et al., 2001; del Pozo et al., 2011).

OBJECTIVES OF THE STUDY

The primary objective of this research is to analyse and evaluate the composition of macrophytes as well as the variety of these organisms at a number of different locations along the Lumbocan river in Butuan City, Agusan del Norte, Philippines. More specifically, the goals of this investigation were also to:

1. Analyze and determine the identity of the many types of aquatic macrophytes found in certain areas of the Lumbocan River;

2. Determine and evaluate the relative frequency of aquatic macrophytes in the region, as well as the diversity indices of these organisms;

REVIEW OF LITERATURE

Mister K. J. Murphy (2017) The term "aquatic macrophytes" refers to photosynthetic organisms that live in water and are either always or seasonally buried below, floating on, or growing up through the water's surface. Another definition of "aquatic macrophytes" is "water plants." These beasts are large enough to be seen to the naked sight of a human being. There are seven distinct plant divisions that are separated under the category of aquatic macrophytes. Cyanobacteria, chlorophyta, rhodophyta, xanthophyta, bryophyta, pteridophyta, and spermatophyta are the divisions that make up plants. The species composition of aquatic macrophytes in the more primitive divisions is not as extensively documented as the species composition of vascular macrophytes (Pteridophyta and Spermatophyta), which are represented by 33 orders and 88 families and comprise around 2,614 species in c. 412 genera.

Sara Puijalon (2015) Aquatic plants contribute to the maintenance of critical functions and the biodiversity that is associated with freshwater ecosystems, while also assisting in the fulfilment of the needs of human civilizations. In this analysis, the methods by which abiotic and biotic filters play a role in defining the ecological niches that are inhabited by

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macrophytes are taken into consideration. It has been suggested that a model of the distribution of growth forms that is simple and adaptable, and that takes into account the effects of abiotic filters, would be of some help. There is a discussion on the effects that this will have on the dynamics of plant communities, as well as the key threats that this will provide to the prevalence and diversity of macrophytes.

Mitu De (2019) The flora and fauna of the aquatic environment are the two fundamental components that come together to form the aquatic ecosystem. These two aspects cooperate with one another to contribute to the protection of the aquatic environment. The phrase "aquatic macrophytes" refers to the bigger types of aquatic vegetation such as macro algae, mosses, ferns, and angiosperms, all of which have the potential to be discovered in aquatic habitats. Macrophytes in freshwater ecosystems provide a wide variety of tasks, many of which are important to the functioning of the ecosystem as a whole and contribute to the structure of these aquatic environments. The depth, density, diversity, and types of macrophytes that are found in a region all serve as indicators of the health of the system that they are a part of, which is an aquatic environment. In addition to that, aquatic vegetation has the capability of influencing the quality of the water. Macrophytes are widely acknowledged to be an important component of the aquatic environment owing to the fact that they serve as a habitat as well as a source of food for the many species that live in the water.

Andre Andrian Padial (2018) Angiosperms, ferns, mosses, liverworts, and some kinds of macroalgae are all included in the diverse group of creatures that are collectively referred to as aquatic macrophytes. These aquatic macrophytes are found in settings that are either seasonally or constantly wet. They thrive in muddy or sandy soil. One of the numerous implications of aquatic macrophytes is the fact that they are exceedingly abundant and play a large part in the way that aquatic habitats are organised spatially. This is only one of their many effects. The number of ecological studies that include water plants has greatly increased over the course of the last several years. However, in order to get at a reasonable assessment of the scientific productivity, it is necessary to take a close look at the research that has been done on aquatic macrophytes in the Neotropics. Only then will it be possible to arrive at an accurate conclusion. In the study that is being presented here, we used scientometrics to carry out an analysis of the scientific output that was devoted to Neotropical macrophytes. Identifying the most notable research trends and gaps relevant to this group of species was the primary objective of this study.

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RESEARCH METHODOLOGY

STUDY SITE

A freshwater wetland known as Manikamaun can be found in the Mushari block of the Muzaffarpur district in the Indian state of North Bihar. Its coordinates are as follows: 25 degrees 54 minutes 00 seconds north latitude, 26 degrees 23 minutes 00 seconds east longitude. The water distribution area covers around 40 hectares, and the majority of its water comes from ground water and precipitation. The water level experiences seasonal changes throughout the year, and locals mostly use it for irrigation, washing clothes, and fishing. Seasonal shifts in the water level may be observed throughout the year.

SAMPLING METHODS

The collection of macrophytes was carried out using a quadrat made of PVC tubing of one square metre in size on a monthly basis beginning in June 2019 and continuing through March 2020. At the site of the sample, which had previously been sectioned off into an upper, a middle, and a lower zone, a quadrat was now being positioned at a point that had been chosen at random. The quadrat frame allowed for the collection of samples of macrophytes that were found above ground. The collection of samples was done manually; freefloating and submerged plants were chosen, and in the case of rooted macrophytes, local fisherman were assisted in diving and clipping the macrophytes that were visible inside the frame.

DATA ANALYSIS AND RESULT

During the course of this research, a total of 24 species of marcophytes were found in Manikamaun. These species belonged to 18 different families. The plants that were discovered in Manikamaun were separated into a variety of categories, with 3 species belonging to the freefloating category, 4 species belonging to the rooted floating leaf category, 8 species belonging to the submerged category, and 9 species belonging to the emergent category. There were a greater number of members of the Hydrocharitaceae

- Poaceae
- Potamogetonceae
- Cyperaceae
- families than any other family.

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When comparing the various types of macrophytes based on the zone in which they were present in water, emergent plants had the highest number of macrophytes recorded at 38%, followed by submerged plants at 33%, rooted-floating leave at 17%, and free-floating plants at 3%. It has been reported that the values of biomass for emergent plants in temperate zones vary from 1.5 to 3.5 kg m 2 for the aerial shoots. These values may be found in emergent plants (Boyd, 1969; Kvet, 1971; Szajnowski, 1973, Westlake, 1975). More or less the same quantity of airborne biomass, frequently surpassing 2.0 kg/m2, has been found for emergent macrophytes in tropical zones. This value ranges from (Pearsall, 1959; Ogawa et al., 1961; Sinha, 1970; Ambasht, 1971; Kaul, 1977; Westlake, 1975). In Waithou Lake, Manipur, Devi (1993) also found larger ranges of biomass levels (1305.76 g /m2 for the first year and 1173.01 g /m2 for the second year). Billore et al., (1998) also observed a larger range of biomass value for the floating macrophytes in the Solasagar pond in Ujjain, which was between 1.7 and 2.7 kg/m^2.

Table 1 List of identified macrophytes in Manikamaun wetland

SI. No	**Scientific Name**	**Family**	**Habitat**
1.	Nymphaea nouchali Burm.f.	**Nymphaeaceae** Salisb.	Rooted Floating
2.	Nelumbo nucifera Gaertn.	**Nelumbonaceae** Dunn.	Rooted Floating
3.	Nymphoides cristatum H. Hara	**Menyanthaceae** Sequier.	Rooted Floating
4.	Ipomoea aquatic Forssk	**Convolvulaceae** Juss.	Emergent
5.	Bacopa monnieri (L.) Pennell	**Scrophulariaceae** Juss.	Emergent
6.	Alternanthera philoxeroides (Mart.)Griseb	**Amaranthaceae** Juss.	Emergent

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7.	Ceratophyllum demersum L.	**Ceratophyllaceae** S. F.Gray	Submerged
8.	Azolla pinnata R.Br.	**Salviniaceae** Martinov	Free Floating
9.	Hydrilla verticillata (L. f.) Royle	**Hydrocharitaceae** Juss	Submerged
10.	Nechamandra alternifolia (Roxb. Exwight) Thwaites	**Hydrocharitaceae** Juss	Submerged
11.	Vallisneria spiralis L.	**Hydrocharitaceae** Juss	Submerged
12.	Eichhornia crassipes (Mart.) Solms	**Pontederiaceae** Kunth	Free Floating
13.	Colocasia esculenta (L.) Schott.	**Araceae** Juss.	Emergent
14.	Spirodela intermedi a W.Koch	**Lemnaceae** S. F. Gray	Free Floating
15.	Potamogeton crispus L.	**Potamogetonacea** Dum	Submerged
16.	Potamogeton nodosus Poiret	**Potamogetonacea** Dum	Submerged
17.	Najas graminea Del.	**Najadaceae** Juss.	Submerged
18.	Cyperus imbricatus L.	**Cyperaceae** Juss.	Emergent

19.	Cyperus compressus L	**Cyperaceae** Juss.	Emergent
20.	Cynodon dactylon (L.) Pers.	**Poaceae** Barmhart.	Emergent
21.	Cortaderia selloana Schult. & Schult.f.) Asch. & Graebn.	**Poaceae** Barmhart.	Emergent
22.	Glyceria maxima (Hartm.) Holmb.	**Poaceae** Barmhart.	Emergent
23.	Marsilea minuta L	**Marsileaceae** Mirab. .	Rooted Floating
24.	Chara fibrosa Ag. ex Buz.	**Characeae** R. D. Wood	Submerged

Table. 2 Range and Total biomass (g/m^2) of different macrophytes species of Manikamaunwetland

Name of Species	**Range (entire range)**		**Total Biomass (g/m^2)**
Eichhornia crassipes	220.5	26.25	1293.26
Najas graminea	95.55	25.2	610.17
Nelumbo nucifera	82.83	13.5	562.75
Hydrilla verticellata	43.2	1.92	221.24
Nymphaea nouchali	49.31	22.4	179.32
Potamageton nodosus	40.8	6.13	126.02

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Nymphoides cristata	13.86	2.64	71.31
Ceretophyllum demersum	14.97	3.74	62.7
Alternanthera philoxeroides	5.19	1.8	41.41
Colocasia esculenta	5.82	1.51	21.86
Potamageton cripus	4.95	0.88	14.29
Ipomoea aquatic	2.4	0.24	7.44
Vallisneria spiralis	1.36	0.54	5.8
Nechamandra alternifolia	1.4	0.16	5.2
Chara fibrosa	0.64	0.36	4.02
Marsilea quadrifolia	0.75	0.15	3.2
Other species	0.48	0.02	4.371
All species combined	387.91	123.27	2796.07

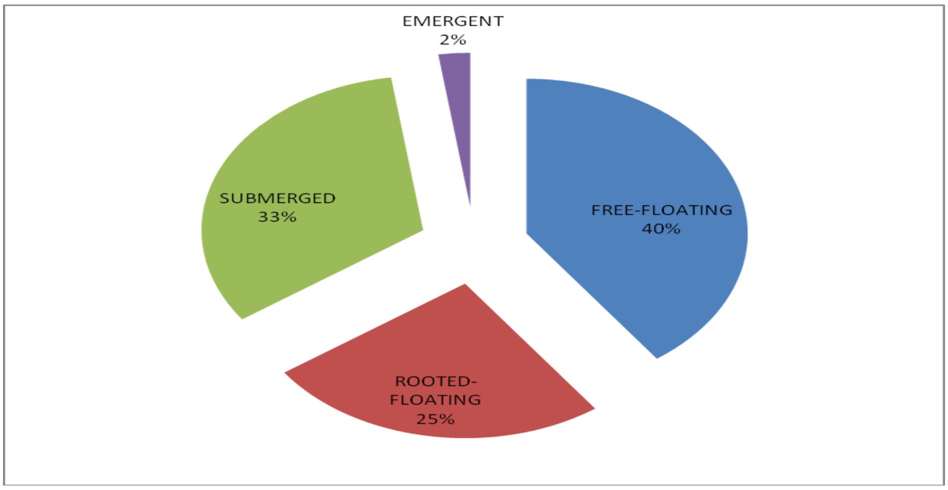

Figure 4. 1 Percentage contribution from different types of macrophytes

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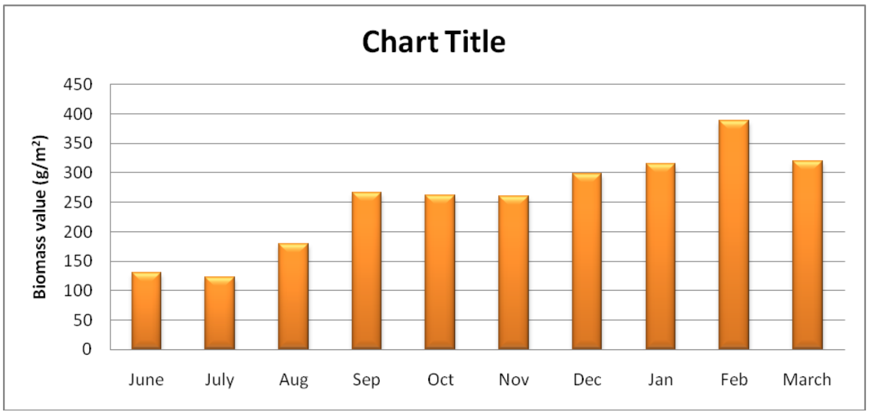

Figure 4. 2 Monthly biomass variation of Aquatic macrophytes in manikmaun

The highest biomass of Nelumbo nucifera was measured to be between 13.50 to 82.83 g/m2, according to the records. The current estimated values have been found to be greater than the values that were reported by Billore and Vyas (1982) in Lake Pichhola, Udaipur (5.0 to 25.0 g/m2), Ambasht and Ram (1976) in Varanasi (63.20 g/m2), and Devi, K.L (1998) in Lake Utrapat, Manipur (20.82 - 66.96 g/m2). The findings presented here were found to be significantly lower than the values recorded in Pantnagar (700.0 g/m2) and Kaul et al., (1978) in Anchar lake, Kashmir (549.0 - 813.0 g/m2) by Singh (1976), Devi, O.I (1993) in Lake Waithou, Manipur (95.28 g/m2 and 104.30 g/m2 for the first and second years respectively). In the current study, the total biomass for Nymphoides cristatum was 13.86 g/m2 on Site, with a density of 2.64 g/m2.

The current values have been discovered to be much lower than the value that was recorded by Devi, O.I. (1993) in the waithou lake (47.04 g/m2 and 51.98 g/m2 in the first and second year respectively) and Devi, K.I. (1998) in the utrapat lake (7.66 to 50.13 g/m2) The total biomass that was measured in this investigation was found to be 2541.88 g/m2. Several other employees have reported values of biomass that are greater than what was found in this study. Those other values may be seen here. After doing extensive research on the lakes in Kashmir, Kaul (1977), Vass (1980), Zutshi and Vass (1982), and Kaul and Handoo (1989) revealed that the biomass of the macrophytes ranged from 9 to 150 tons/ha-1. In a fish pond in Varanasi, Ambasht (1971) found that the emergent species had a larger aboveground biomass (1,250 g/m2) than the other species.

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The maximum values recorded in the current research have also been found to be higher than the values that were reported by Crowder et al., (1977) in Opinicon lake (1154.00 g/m2) and Howard-Williams et al., 1986, in lake. Waikaremoana. Ballia (1106.00 g/m2). In the lakes of New Zealand and the reed swamps of Minnesota, in the United States, the values of the biomass ranged from 50 to 100 g/m2 and 630 to 4640 g/m2, respectively (Sculthorpe, 1967). In a study of five lakes in Udaipur, Vyas et al., (1989) reported biomass values for macrophytes ranging from 537.6 to 1884.09 g/m2; these values have been found to be much higher than the values that were reported in the present research. According to the findings of this inquiry, it is abundantly clear that the species that were either free floating or immersed supplied the greatest amount of biomass.

The number of species that were supplied by emergent species was the lowest. The findings are consistent with the research carried out by Shah and Abbas (1979), Forsberg (1959), and Sahai and Sinha. [1979]; [1959]; [Sahai and Sinha] (1970). According to what they found, the biomass of the macrophytes that were free-floating was larger than that of the ones that were immersed. When compared to stands of mixed species, pure stands of any macrophytic species have a higher total biomass, according to Singhal and Singh (1978), who found this to be the case. Pearsall (1930) also emphasised the prolific character of emergents because they have the best of both the submerged and terrestrial habitats, in terms of gaseous exchange of CO_2 and direct sunshine. This is because emergents have the best of both the submerged and terrestrial habitats. While Westlake (1963) was evaluating the ecological data that was available at the time relative to the productivity of the various plant communities, he made the observation that the submerged freshwater plant communities are noticeably less productive than the emergent plant communities.

CONCLUSION

The latitude and longitude that are 85 degrees to the east are the primary focus of the work being done on the project right now. It is possible to find it in the northern part of the state of Bihar, not too far from the east bank of the Gandak River, to the north of the Ganges River, and to the south of Patna, which is the capital of the state of Bihar. It is bordered to the north by the district of Muzaffarpur, to the south by the district of Patna, to the east by the district of Samastipur, and to the west by the district of Chapra. The mean elevation of the terrain is greater than the mean elevation of the sea. The findings of the survey that was conducted in the region indicate that the coverage encompasses an area that is approximately 1981.25

square kilometres in size. The vast majority of the and the years covered by this study "Over the course of four years, studies on the morphology, ecology, and ethnobotany of a variety of water plants native to the Muzaffarpur region of Bihar were carried out by researchers (2001–2004). The district can be located in the upper section of the state of Bihar, and it extends from a latitude of 25o 29" to 26° 1" north, as well as a longitude of 85o 4"." The goal of the routine visits that have been carried out up until the present work period has been to obtain an understanding of the various features of the vegetation.

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