

# Assessment and Identification of Aquatic Diversity of Wetlands of Yamuna Nagar District, Haryana, India

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**ABSTRACT-** The aquatic and marshy angiospermic plants are the most important component of aquatic and wetland ecosystem. They increase productivity of the aquatic ecosystem and help to maintain ecosystem balance. The importance of aquatic diversity for sustainable life support system is an acceptable fact throughout the world. India has a rich variety of wetlands habitats. Tropical swamp, forests once formed an important part of vegetation and extended all along the base of the Himalayas from Assam to Jammu Kashmir. Wetlands are one of the most productive ecosystems and thus subjected to human greed which is yet another reason for their extinction is deforestation. Unfortunately, these habitats have not been explored from ecological point of view. From this minor study, 59 species of wetland plants belonging to 37 families were recorded to be used. Out of the total 59 species, dicot (47%) species and monocot (46%) less numbers are belong to Pteridophytes. In this study, we were observed that many common aquatic macro and microflora of wetlands and marshlands of Yamuna nagar like as *Aeschynomena indica*, *Alternanthera philoxeroides*, *A. sessilis*, *Anagallis arvensis*, *Ceratophyllum demersum*, *Chrysopogon zizanioides*, *Commelina benghalensis*, *Cyperus alternifolius*, *Cyanotis axillaris*, *Cyperus rotundus*, *Dryopteris filix-mas*, *Dryopteris sieboldii*, *Echinochloa colona*, *Eichhornia crassipes*, *Hygrophila salicifolia*, *Ipomoea aquatica*, *Lemna minor*, *Ludwigia scandens*, *Polygonum hydropiper*, *Portulaca oleracea*, *Potamogeton natans* etc. The fresh water wetlands of Yamuna Nagar are under threat due to human interference and other anthropogenic activities.

**Key-words-** Wetlands, Semi aquatic, Biodiversity, River Yamuna

## INTRODUCTION

Wetlands are dynamic ecosystems, continually undergoing natural changes due to infilling with sediments and nutrient subsidence and a rise in water levels during heavy floods. They sustain all life forms and perform some useful functions in the maintenance of overall balance of nature. Wetlands are distinctive ecosystems and not simply mixture of aquatic and terrestrial ecosystems<sup>[1]</sup>. The biota of wetland is mostly affected by the duration of flooding, the nutrients discharged from number of sources and season and flood regimes also affects the wetland biota.

According to the plant response to flooding or water logging areas is described in three distinct adaptations i.e. morphological adaptations, physiological adaptations and other adaptations. Hydrophytes can be defined “large plants” (Macrophytes), such as aquatic mosses, liverworts, non-microscopic algae and vascular plants, which grow on a substrate that is at least periodically deficient of oxygen as a result of excessive water content. This term includes both aquatic plants and wetland plants<sup>[2,3]</sup>.

Submerged species serve as a food source for native fauna, habitat for invertebrates, and also possess filtration capabilities. For example: Sea grasses, Floating plants cover a large surface area in the wetland. They have small roots and are only found in slow-moving water. They provide food source for avian species, for example Water lilies etc.<sup>[4]</sup>

Trees and shrubs are forested wetlands generally known as swamps<sup>[5]</sup>. The upper level of these swamps is influenced by high water level, which is negatively affected by dams.

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For example: Taxodium, mangrove etc. The wetland also supports large number of fauna. Fishes are more dependent on wetland ecosystem than any other type of habitat. Tropical fishes need coral reefs for food and mangroves for hatchery and nursery grounds. Amphibians for example: frog is the most critical amphibian species present in the wetland<sup>[6]</sup>.

Wetlands are very useful to us. By producing resources, enabling recreational activities and controlling flood and pollution, they contribute to the national and local economies and environmental consequences. Wetlands provide important and incredible services to society, these services can neither be sold nor do they have the market value and tried to give wetlands an economic value<sup>[7-10]</sup>.

However, it is important to note that these studies tried to assign monetary values to the services and functions that are provided by wetlands<sup>[11-13]</sup>. Moore and Peter<sup>[14]</sup> of this paper agreed with the argument of who confessed that economic values are something which must be inevitably used to legal conservation efforts of particular sites and regions; however, assigning monetary value comes with ethical and philosophical issues.

India is a hub of biodiversity, encompassing a wide spectrum of habitats from tropical rain forests to alpine vegetation and from temperate forests to coastal wetlands. India contributes significantly to this latitudinal biodiversity trend with the mere 2.4% of the world's area. Wetlands are transitional zones between the terrestrial and aquatic environment<sup>[15]</sup>.

The present work is conducted to study the angiospermic diversity of wetlands in Yamuna Nagar. The research work includes finding the hydrophytes, field photography at its location and studying their habits and habitat.

Further survey and intensive studies in different seasons will be helpful in drafting conservational strategies and management sustainable to restore the natural habitats of the Yamuna Nagar wetlands.

## MATERIALS AND METHODS

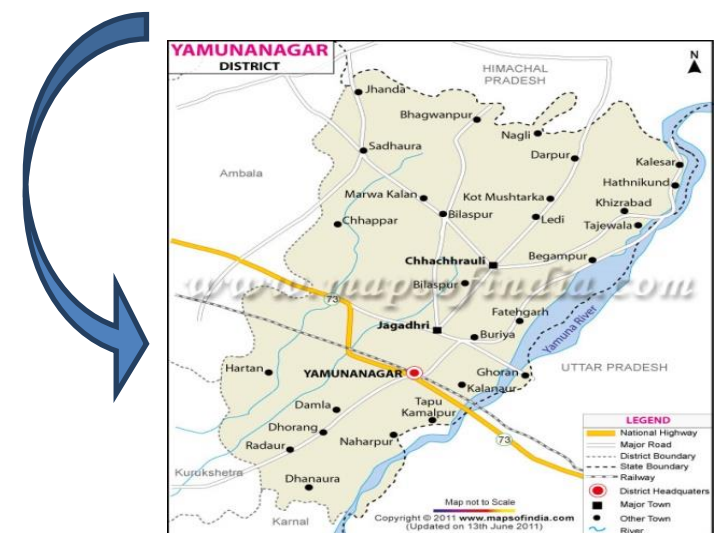
### Description of study area

The present study has been carried out in the duration of the 1<sup>st</sup> week, March and till July month ending in the Year 2015 at the Department of Environmental Science, Guru Nanak Khalsa College, Yamuna Nagar, India. A thorough survey on the aquatic and wetland angiospermic macrophytes of the Yamuna Nagar district, Haryana was carried out for duration of six months, 2015 during, which regular excursions were made at short intervals to collect the plants of the area. During these periods of survey aquatic and wetland plants occurring in different aquatic bodies and water saturated areas of the district have been collected Plant species and its photography. The study area Yamuna Nagar is situated at the south-east of the state capital Chandigarh, India. It lies between the parallels of 31° 70' N latitude and 77° 18' E longitude and 255m above mean sea level of Haryana, India. It is one of the 21<sup>th</sup> district of Haryana, India. It occupies an area of 1,756

square kilometers. The climate of the district is sub-tropical and characterized by hot and dry summer in May and June, when the temperature raises up to 4°C, south-west monsoon season and a bracing cold season  $\geq 5^{\circ}\text{C}$  in December and January. The majority of rainfall is received in the rainy season (July to September) with the occasional rainfall due to western disturbances in January to February.

The survey was done in the wetlands, within one km area on both the sides of four major roads diverging from Yamuna Nagar to many villages of Kalesar, Ladwa, Thana-chhappar and Kalanaur region were searched for the aquatic and wetland vegetation. The major area belongs to the fertile Indo-Gangetic Plains. The climate of the area is monsoonal and the majority of rainfall is received in the rainy season (July to September) with the occasional rainfall due to western disturbances in March to June. The average annual rainfall varies from 1200 to 1300 mm in this region.

The main river/streams of the district are Yamuna, Markanda, Giri, Asan, and Bata Nala. The total wetland area in the district is 4893 ha and river/streams contribute 87%. The present work is conducted in the study of the angiospermic diversity of wetlands in Yamuna Nagar, Haryana, India.



**Fig. 1:** Study site of Yamuna Nagar district, Haryana, India

The data was collected through secondary sources mainly from the website of Government of Haryana and Ministry Of Environment and Forest, Govt of India and Departmental library, References from research papers; books, articles, and newspaper were taken for interpretation of data.

The present study is based on the extensive surveys on the wetlands representative parts of Yamuna Nagar, Haryana and scrupulous review of the information available on aquatic plants, while conducting the surveys on biodiversity including invasive plants of the above regions, information was also gathered from local inhabitants

The methodology followed during the collection of material was as follows:

**Collection-** The pictures of the macrophytes were taken in their natural environment. It was not possible to collect and preserve them in the herbarium sheets because many hydrophytes have spongy tissues carrying large amount of water and on drying they may even lose their shape. A few plants have been collected moist areas and placed in the folds of a newspaper. All morphological notes observed in the specimen were entered in the field notebook.

**Preservation-** The collected and preserved specimens were then placed on blotting sheets and placed one above the other in plant press. These blotters, when kept under pressure, remove moisture from the plants and the moisture is absorbed by the blotting sheets. The wet blotting sheets were replaced with dry ones from time to time. The process was completed in a week or more, depending upon the particular plant types, the dry specimens were kept in fresh blotting sheets and sealed in the polythene envelopes.

**Identification-** Identification is the process through which a specimen is identified by its characters with the help of standard worldwide or Indian flora *viz.* [16-19] and others taxonomist. The specimen were identified by the genus and species keys and compared with full description and illustrations, thereafter it was carefully compared with earlier identified plants of that species or variety as the case may be Literature was consulted and collected from library of Guru Nanak Khalsa College, Yamuna Nagar was consulted. The plants associated with this work have been enumerated according to Bentham and Hooker's system of classification and Mounting and labeling of some collected and preserved plants were mounted on herbarium sheets and these sheets were labeled with the species names as followed in the description of this work and lastly the presentation of the plant species are presented in tabular form according to their families, botanical names and number of species and percentage wise contribution of different families for aquatic plant.

## RESULTS

The present study is based on the extensive survey and study on aquatic and marshy angiosperms and pteridophytes plants of Yamuna Nagar, Haryana. Aquatic plants, which have been included in the present study are those plants normally found in nature growing in association with running or standing water whose level is at or above the surface of the soil, During the present study Maximum numbers of Aquatic and semi aquatic plant diversity in the present studies were observed during April to July and estimated inventory data that density of aquatic plants was greater during summer supporting the present studies (Table 1 & Table 2).

From this minor study, 59 species of wetland plants belonging to 37 families were recorded to be used. Out of total 59 species, dicot (47%) species and monocot (46%) less numbers are belong to Pteridophytes (Table 1, Fig. 2 to Fig. 15).

According to habit wise contribution are is herbs (86%), large herb (5%), and small shrub (7%), shrub (2%) (Table 2, Fig. 3, Fig. 4). Table 1 represented that Poaceae was dominant in density and diversity among all the observed phytoplanktons. The dominancy of Poaceae in the similar physiographic region has also been reported by various workers. Relative approximate abundance of phytoplankton in different wetlands of Yamuna nagar is also investigated. It showed maximum of Poaceae, followed by Malvaceae, Solanaceae, Fabaceae, Asteraceae Polygonaceae, Cyperaceae, Ameranthaceae, Polygonaceae, Pontederiaceae, Scrophulariaceae, Dryopteridaceae, Convolvulaceae, Apocynaceae, Commelinaceae, Primulaceae, Euphorbiaceae, Hydrochritaceae, Lemnaceae, Equisetaceae and lastly Adiantaceae families.

In this study, we were observed that many common aquatic macro and microflora of wetlands and marshlands of Yamunanagar like as *Aeschyno meneindica*, *Alternanthera philoxeroides*, *Alternanthera sessilis*, *Anagallis arvensis*, *Ceratophyllum demersum*, *Chrysopogon zizanioides*, *Commelina benghalensis*, *Cyperus alternifolius*, *Cyanotis axillaris*, *Cyperus rotundus*, *Dryopteris filix-mas*, *Dryopteris sieboldii*, *Echinochloa colona*, *Eichhornia crassipes*, *Grangeamadera spatana*, *Hygrophila salicifolia*, *Ipomoea aquatica*, *Forsskal*, *Lemna minor* Linn, *Ludwigiaad scendens*, *Marsile aquadrifolia*, *Melochia corchorifolia*, *Nelumbo nucifera*, *Nymphaea pubescence*, *Oxalis corniculata*, *Polygonum hydropiper*, *Portulaca oleracea*, *Potamogeton natans*, *Ranunculus sceleratus*, *Rumex dentatus*, *Trapa natans*, *Typha angustata*, *Valisnaria spiralis*, *Utricularia gibba*, *Veronica anagallis-aquatica*, *Xanthium strumarium*etc (Fig. 4 to Fig. 15).

The recorded plants have been enumerated in Table 1 with families have been arranged according to Bentham & Hooker's (1862–1883) System of classification. However, genera within a family and species within a genus are arranged alphabetically.



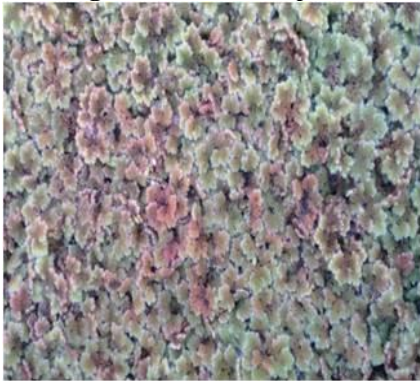
**Fig. 4:** *Adiantum capillus*



**Fig. 5:** *Alternanthera seilis*



**Fig. 6:** *Potamogeton natans*



**Fig. 7:** *Azolla pinnata*



**Fig. 8:** *Caesulia axillaris*



**Fig. 9:** *Ceratophyllum demersum*



**Fig. 10:** *Coix lacryma-jobi*



**Fig. 11:** *Colocasia esculata*



**Fig. 12:** *Pilea microphylla*



**Fig. 13:** *Eichhornia crassipes*



**Fig. 14:** *Nymhoides cristata*



**Fig. 15:** *Alternanthera philoxiriodes*

**Fig. 4–15:** Some selected Aquatic plants of many Wetlands, Yamunanagar, Haryana, India

**Table 1:** Aquatic and wetland vascular plants recorded from Yamuna Nagar, Haryana

S. No.	Family	Botanical name	No. of Species
1.	Acanthaceae	<i>Hygrophilas alicifolia</i> (Vahl) Nees	1
2.	Adiantaceae	<i>Adiantum capillus-veneris</i> Linnaeus	1
3.	Amaranthaceae	<i>Alternanthera aphloxeroides</i> (Martius) Griseb. <i>Alternanthera rasessilis</i> (Linnaeus) R. Brown ex DC	2
4.	Araceae	<i>Colocasia esculenta</i> (Linnaeus) Schott <i>Spirodelap olyrrhiza</i> (Linnaeus) Schleiden	2
5.	Asteraceae	<i>Caesulia axillaris</i> Roxburgh <i>Grangeam aderaspatana</i> (Linnaeus) Poiret <i>Xanthium strumarium</i> Linnaeus	3
6.	Brassicaceae	<i>Rorippa indica</i> (Linnaeus) Hiern	1
7.	Ceratophyllaceae	<i>Ceratophyllum demersum</i> Linnaeus	1
8.	Commelinaceae	<i>Commelinaben ghalensis</i> Linnaeus <i>Cyanotis axillaris</i> (Linnaeus) D. Don ex Sweet	2
9.	Convolvulaceae	<i>Ipomoea aquatic</i> Forsskal <i>Ipomoea fistulosa</i> Martius ex Choisy	2
10.	Cyperaceae	<i>Cyperus alternifolius</i> Steudel <i>Cyperus rotundus</i> Miquel, F.A.W. <i>Eleocharis dulcis</i> (N. L. Burman) Trinius ex Henschel	3
11.	Dryopteridaceae	<i>Dryopteris filix-mas</i> (Linnaeus) Schott <i>Dryopteris sieboldii</i> (T. Moore) Kuntze	2
12.	Fabaceae	<i>Aeschynomene indica</i> Linnaeus	1
13.	Hydrochritaceae	<i>Vallisnarias spiralis</i> Linnaeus	1
14.	Lemnaceae	<i>Lemna minor</i> Linnaeus	1
15.	Lentibulariaceae	<i>Utricularia gibba</i> Subsp. <i>exeleta</i> (R. Brown) Taylor	1
16.	Lythraceae	<i>Ammannia baccifera</i> Linnaeus	1
17.	Marsiliaceae	<i>Marselia quadrifolia</i> Linnaeus	1
18.	Menyanthaceae	<i>Nymphoides cristata</i> (Roxburgh) Kuntze	1
19.	Nelumboaceae	<i>Nelumbo nucifera</i> Gaertner	1
20.	Nympheaceae	<i>Nymphaea pubescence</i>	1
21.	Onagraceae	<i>Ludwigia adscendens</i> (Linnaeus)	1
22.	Oxalidaceae	<i>Oxalis corniculata</i> Linnaeus	1
23.	Poaceae	<i>Arundo donax</i> Linnaeus <i>Chrysopogon zizanioides</i> (Linnaeus) Roberty <i>Coixlacryma jobi</i> Linnaeus <i>Echinochloa acolona</i> (Linnaeus) Link <i>Echinochloa crus-galli</i> (Linnaeus) Palisot de Beauvois <i>Paspalidiumge minatum</i> (Forsskal) Stapf <i>Paspalumpa spaloides</i> (Michx.) Scribn. <i>Phragmites karka</i> (Retzius) Trinius ex Steudel <i>Saccharum spontaneum</i> Linnaeus <i>Sacciolepis interrupta</i> (Willdenow) Stapf	10

24.	Polygonaceae	<i>Polygonum hydropiper</i> Linnaeus <i>Polygonum lebeium</i> R. Brown <i>Rumex dentatus</i> Linnaeus	3
25.	Pontederiaceae	<i>Eichhornia crassipes</i> (Martius) Solms <i>Monochoria vaginalis</i> (N. L. Burman) C. Presl ex Kunth	2
26.	Portulacaceae	<i>Portulaca oleracea</i> Linnaeus	1
27.	Potamogetonaceae	<i>Potamogeton natans</i> Linnaeus	1
28.	Primulaceae	<i>Anagallis arvensis</i> Linnaeus	1
29.	Ranunculaceae	<i>Ranunculus sceleratus</i> Linnaeus	1
30.	Salviniaceae	<i>Azolla pinnata</i> R. Br.	1
31.	Scrophulariaceae	<i>Scoparia dulcis</i> Linnaeus <i>Veronica anagallis-aquatica</i> Linnaeus	2
32.	Sphenocleaceae	<i>Sphenoclea zeylanica</i> Gaertner	1
33.	Sterculiaceae	<i>Melochia corchorifolia</i> Linnaeus	1
34.	Trapaceae	<i>Trapanatans var. bispinosa</i> (Roxburgh) Makino	1
35.	Typhaceae	<i>Typha angustifolia</i> Linnaeus	1
36.	Urticaceae	<i>Pilea microphylla</i> (Linnaeus) Liebm.	1
37.	Verbenaceae	<i>Phyla nudiflora</i> (Linnaeus) Greene	1

**Table 2:** Types wise distribution of species

S. No.	Type of the species	No. of Species	Percentage (%)
1	Herbs	51	86
2	Large herb	3	5
3	Small shrub	4	7
4	Shrub	1	2

**Table 3:** Abbreviations used for Aquatic plants

S. No.	Classification	No. of species	Percentage (%)
1	Eph	4	6.77
2	Eph, Hyp, Ten	1	1.69
3	Hel	31	52.54
4	Hel, Hyp	1	1.69
5	Hel, Ten, Hyp	1	1.69
6	Hyp	6	10.16
7	Hyp	1	1.69
8	Hyp, Ten	1	1.69
9	Pla	1	1.69
10	Pla, Vit	1	1.69

11	Pla	1	1.69
12	Pla, Vit	1	1.69
13	Ple	4	6.77
14	Ple , Hyp	1	1.69
15	Ros	1	1.69
16	Ten	1	1.69
17	Ten, Eph	1	1.69

[Eph= Epiphyte; Hel = Helophyte; Hyp = Hyperhydrate; Pla = Plankton; Ple= Pleustophyte; Ros= Rosulate; Ten= Tenagophyte; Vit = Vittate]

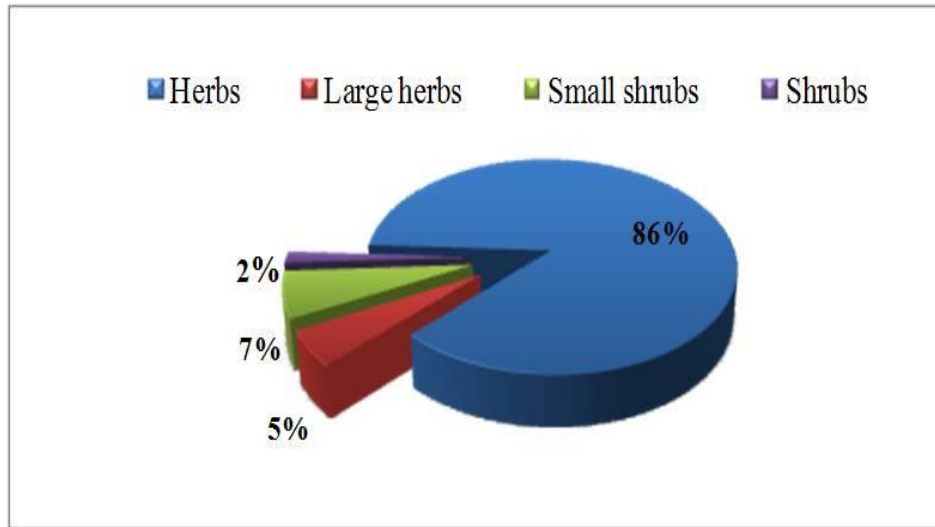


Fig. 2: Habit wise contribution species

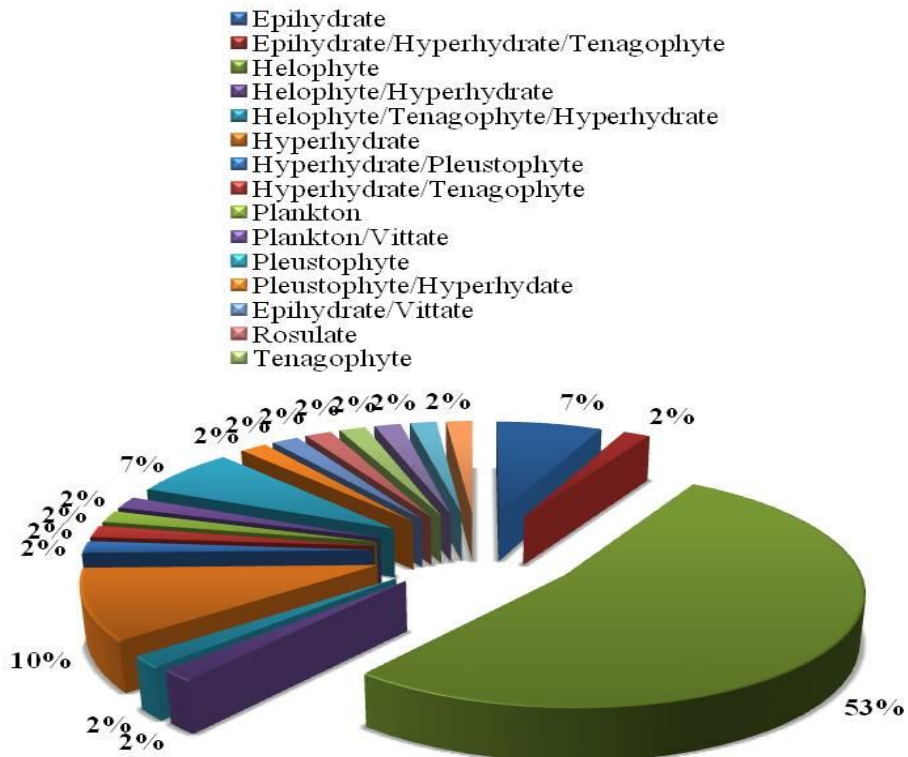


Fig. 3: Classification wise distribution of species

## DISCUSSION

In this work the methods of documentation of the species of angiosperms are similar to the observations. <sup>[10-13]</sup>. The biota of wetland is mostly affected by the duration of flooding, the nutrients discharged from number of sources and season and flood regimes also affects the wetland biota and define adaptations Wetlands are distinctive ecosystems and not simply mixture of aquatic and terrestrial ecosystems according to the Tiner *et al.* <sup>[1,2]</sup>. We tried to give wetlands an economic value loss of wetlands and their ecosystem services can have both economic and environmental consequences Wetlands provide important and incredible services to society, these services can neither be sold, nor do they have the market value according by Keddy <sup>[5]</sup>, Butlar *et al.* <sup>[6]</sup>, Keddy and Paul <sup>[7]</sup>, Mitsch *et al.* <sup>[8]</sup>, BenDor *et al.* <sup>[9]</sup>.

The present communication deals with the qualitative and quantitative analysis of phytoplankton in Western Yamuna Canal (WYC) and Yamuna River, which receives industrial effluents and domestic sewage from point and non-point sources accordingly to Malhotra *et al.* <sup>[21]</sup>.

The author of this paper agrees with the argument of the economic values are something which must be inevitably used to legal conservation efforts of particular sites was similar to Moore and Peter <sup>[14]</sup>.

This survey report documented the species of angiosperm diversity similarly finding hydrophytes families. They registered plants of many species of different families that is Poaceae with, Polygalaceae and Nymphaeaceae, Cyperaceae, Hydrocharitaceae and Scrophulariaceae similar to Kumar and Narain <sup>[20]</sup>, Malhotra *et al.* <sup>[21]</sup>, Udaya *et al.* <sup>[22]</sup>, Saini *et al.* <sup>[23]</sup>, Mishra and Narain <sup>[24]</sup>.

Phytoplankton distribution of fresh water, wetlands physical and chemical similarities to follow as Sharma *et al.* <sup>[25]</sup> and noticed some Ulothrix being an alga, showed a luxuriant growth near the banks of the river, mainly due to the accumulation of organic wastes (eutrophication) <sup>[26]</sup>.

That is why certain aquatic plant diversity and their density are regulated by seasonal fluctuations of water temperature and apparently disappear in severe condition due to the fact that certain species either become too scarce or occur as spore, resting eggs etc., which are not easily detectable of whole diversity of this wetland area.

## CONCLUSIONS

This study summarizes the monthly and seasonal variations of occurrence of aquatic plants and their influences on aquatic community of rainy water wetlands of Yamuna Nagar, Haryana with an exploration statistical data output. From this minor research work out of 59 species and 37 families maximum species evenness was recorded for Poaceae and minimum for Adiantaceae. Aquatic community study is very important, because they act as primary producers, food for variety of aquatic organisms and an efficient bio-indicator for water quality. The largest population of phytoplankton is thriving in this wetland which enhances its productivity.

It is under heavy anthropogenic pressure due to agriculture practice around the wetland catchment area which led to habitat loss and degradation some parts of wetlands have been drained and transform into the rice field. Hence, there is need to conserve biotic and biotic components of water body and to make people aware of the importance and threats to wetlands and their conservation, various government institutions, University, colleges, NGOs and media should take the lead and make it a mass movement. Local communities should be involved to ensure sustainability of conservation effort undertaken by the government agencies. For this, they can be involved in decision-making processes required for management and conservation of wetlands.

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