Asian Australas. J. Biosci. Biotechnol. 2017, 2 (2), 181-192

Asian-Australasian Journal of Bioscience and Biotechnology
ISSN 2414-1283 (Print) 2414-6293 (Online)
www.ebupress.com/journal/aajbb

Article

Aquatic weeds diversity of Bangladesh Agricultural University Campus, Mymensingh, Bangladesh

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Received: 07 August 2017/Accepted: 27 August 2017/ Published: 31 August 2017

Abstract: A study was conducted to find out the biodiversity of aquatic weeds of Bangladesh Agricultural University Campus Mymensingh from January to May, 2016. A total of 39 weed species were identified from the area. Among four common groups of weeds, five species of floating weeds: *Eichhornia crassipes, Pistia stratiotes, Azolla pinnata, Lemna minor, Spirodela polyrrhiza,* 22 species of emergent weeds: *Alternanthera philoxerodies, Ipomea aquatica, Polygonum glabrum, Sagittaria* spp., *Oxalis corniculata, Marsilea quadrifolia, Commerlina bengalensis, Commelina appendiculata, Ipomea carnea, Nymphaea rubra, Nymphaea nauchali, Leersia hexandra, Scirpus mucronatus, Ludwigia adscendens, Enhydra fluctuans, Trapa natans, Colocasia esculenta, Hygrorayza aristata, Ipomoea* spp., *Nymphoides aquatica, Typha latifolia, Aponogeton* spp., five species of submerged weeds: *Hydrilla verticilata, Cartophyllum demersum, Vallisneria spiralis, Najas minor, Vallisnaria* spp. and seven species of algae: *Microcystis* spp., *Chara* spp., *Anabaena* spp., *Nitella* spp., *Spirogyra* spp., *Chlorella* spp., *Euglena* spp. were identified. Various useful and harmful aspects of these weeds were also discussed.

Keywords: aquatic weeds; biodiversity; Bangladesh Agricultural University campus

1. Introduction

Aquatic weeds are those unabated plants which grow and complete their life cycle in water and cause harm to aquatic environment directly and related to eco-environment relatively. Water is one of the most important natural resources and in fact basis of all life forms on earth (Lancar and Krake, 2002). Aquatic plants vary greatly in type, with some similarity to common land plants while others are quite different. They fall into one of the four common class types: algae, floating plants, submerged plants and emerged plants. Grouping is based on the positioning of their roots and leaves (Lichtenstein, 2010). Floating aquatic weeds vary in size from single cell (algae) and may grow up to large vascular plants (Lancar and Krake, 2002). They can be found in fresh or salt water. The leaves of these plants are firm and remain flat in order to absorb more sunlight (Lichtenstein,

2010).In Bangladesh about 350 species ware recorded as weeds of cultivated field. Among the weeds, about one-third is monocotyledonous plant and the remaining is dicotyledonous plant. Members of the families Poaceae, Cyperaceae, Leguminosae, Asteraceae, Euphorbiaceae, Amaranthaceae, Solanaceae, Scrophulariaceae and Acanthaceae are common. The most successful and common genera are *Cyperus, Lindernia, Eragrostis, Panicum, Cynodon, Hygropylla, Euphorbia, Phyllanthus, Leucas, Scoparia, Croton, Celosia, Alternanthera* and *Solanum*. In aquatic conditions *Eichhornia, Potamogeton, Pistia* and *Monochoria* spp. are the most common weeds in deep water rice fields. Three species of ferns (*Marselia, Ceratopteris* and *Salvinia*) are also recorded as weeds of rain-fed rice fields. About 20% of the present weed flora has been recognized as naturalized exotic weeds. Among these *Argemone maxicana, Alternanthera philoxeroides, Croton bonplandianum, Nicotiana plumbaginifolia, Lathyrus aphaca, Celosia argentea* and *Vicia angustifolia* may be important (Pasha, 1966). In low-lying areas e.g. *haors, baors, beels,* ditches where no crop cultivation is practiced, a large number of aquatic plants grow and form thick natural vegetation and sometimes these are also listed as weeds, although they are not. In such vegetations, plants like *Aeschynomene aspera, A. indica* (Shola), *Trapa* spp. (Paniphal), *Ipomoea aquatica* (Kalmi), *Hygroryza aristata,* species of *Cyperus, Eleocharis, Hydrilla, Utricularia, Sagittaria, Monochoria, Nelumbo, Nymphaea, Aponogeton, Potamogeton, Polygonum, Ottelia, Ceratopteris,* and many species of grasses and other families are found crowded together. Such 'weed' species are the sources of food and shelter of many aquatic birds, fishes and other animals including man. When any such species invade the crop-fields, they are termed as weeds. The worldwide distribution of aquatic weed species is described by ICID. A selection of effected countries follows below: Africa: Egypt, Kenya, Tanzania, Uganda, and Zimbabwe. Asia: Bangladesh, India, Indonesia, Malaysia, Philippines, Thailand and China. Latin America: Argentina, Brazil, Central America and Mexico. Others: Australia, Europe, North America.The aquatic weeds are of great importance today as far as food supply to fish species is concerned. Aquatic weeds are an integral component of an aquatic ecosystem and serve as source of food to the water birds and animals thus forming a base for aquatic wildlife conservation practices. Macrophytes of different water bodies in India are studied by researchers such as Wetzel (1975), Majid (1986), Sugunan (1989), Venkatraman *et al.* (2000), Ambasht (2005), Raut *et al.* (2005), Kiran *et al.*(2006), Sitre (2013) and many more. As there are no previous reported studies on aquatic weed biodiversity of Bangladesh Agricultural University Campus an attempt has been made to study these weeds to fulfill the objectives of identify different groups of aquatic weeds of Bangladesh Agricultural University Campus; and record different useful and harmful aspects of these aquatic weeds.

2. Materials and Methods

2.1. Study area and period

Bangladesh Agricultural University campus was selected for the study. The campus contained lots of ponds, drains and a lake. The weeds of these ponds, drains and lake were taken into consideration for the study. The study was conducted for a period of five months from January to May, 2016.

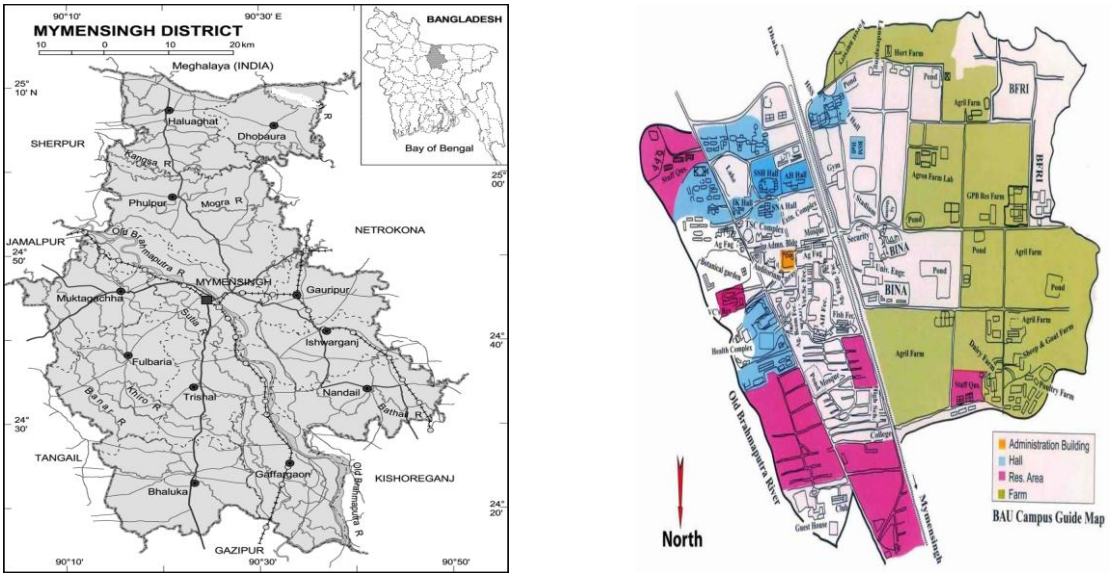

Figure 1. Map showing the Mymensingh district and study area, Bangladesh Agricultural University, Mymensingh.

2.2. Collection of sample

Aquatic weed samples were collected from the Bangladesh Agricultural University Campus, Mymensingh on each sampling days. The samples were collected from various sites of the campus. These weeds were collected with the help of different fishermen and laboratory assistant personnel. The weeds were preserved in 10% formalin after identification.

2.3. Identification

For the identification, the samples were placed on a table for the easy contrast of vision. Identification was done by only eye observation. Identification was done according to Journey (1993), Pasha (1996), Kevin and Lancar (2002), George (2005) etc.

3. Results and Discussion

3.1. Classification of aquatic weeds in Bangladesh Agricultural University campus

3.1.1. Floating weed

Floating weeds were observed in the surface of the large, deep and shallow depths of water bodies, deep continuous flowing canals, continuously flowing rivers, large ponds, lakes etc. Some of the weeds in this ecosystem freely floated and moved long distances, while some of them floated on the water surface but anchored down to soil under water body (Figure 2).

Table 1. List of floating weeds.

Scientific name	Common name	Local name
Eichhornia crassipes	Water hyacinth	Kochuripana
Pistia stratiotes	Water lettuce	Topapana
Lemna minor	Duckweed	Khudipana
Azolla pinnata	Mosquito fern	Kutipana
Spirodela polyrrhiza	Geant duckweed	Sonapana

3.1.2. Emergent weed

Emergent weeds grew in shallow waters and situated near the water bodies where water receded and rose with the seasons or regular releases from a large water body or reservoir (Figure 2).

Table 2. List of emergent weeds.

Scientific name	Common name	Local name
Alternanthera philoxerodies	Alligator weed	Malancha
Ipomea aquatic	Water spinach	Kolmi
Polygonum glabrum	Polygonum	Bishkatali
Sagittaria spp.	Arrowhead	Panikocu
Oxalis corniculata	Indian sord	Amroolshak
Marsilea quadrifolia	4 leaved water clover	Shusnishak
Commerlina bengalensis	Dayflower	Kanai bashi
Commelina appendiculata	Asiatic dayflower	Kanai doga
Ipomea carnea	Gloria-d la manana	Dholkolmi
Nymphaea rubra	Red water lily	Lalshapla
Nymphaea nauchali	White water lily	Sadashapla
Leersia hexandra	Southern cut grass	Arail
Scirpus mucronatus	Bog bulrush	Soktochechra
Ludwigia adscendens	Water primrose	Keshordham
Enhydra fluctuans	Hingcha	Helencha
Trapa natans	Water caltrop	Paniphal
Colocasia esculenta	Chinese potato	Cochu
Hygrorayza aristata	Asian waterweed	Dol
Ipomoea spp.	Water spinach	Kolmishak
Nymphoides aquatica	Banana lily	Kara
Typha latifolia	Common cattail	Hugla
Aponogeton spp.	Aponogetonvalvaecus	Gechu

3.1.3. Submerged weed

Submerged weed species germinated or sprouted, grew and reproduced beneath the water surface. Their roots and reproductive organs remained in the soil at the bottom of the water body. These weeds caused maximum damage, because they were not visible on the surface and impeded the flow of water varying upon the degree of their intensity and growth. Most of these weeds were found in shallow and medium deep water bodies and continuous flowing canals and drainage ditches (Figure 2).

Table 3. List of submerged weeds.

Scintific name	Common name	Local name
Hydrilla verticilata	Water thyme	Hydrilla
Cartophyllum demersum	Coontail	Kata jhanji
Vallisneria spiralis	Eel weed	Vallisneria
Najas minor	Brittle naiad	Najas
Vallisneria spp.	-	Panimorich

3.1.4. Algae

Algae are very primitive plants. Some algae are microscopic (Planktonic algae), others are thin and stringy or hair-like (Filamentous algae), while still others are large and resemble higher plants but without true roots (Chara) (Figure 2).

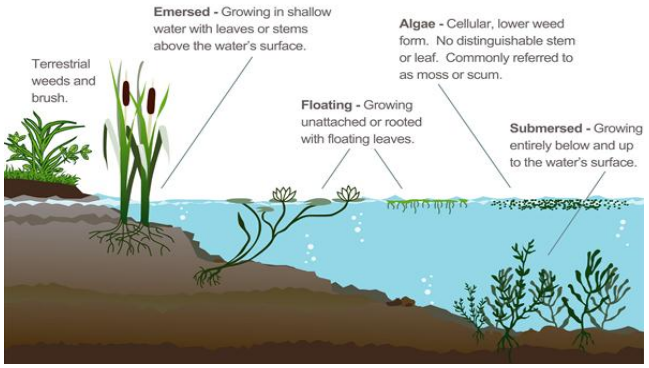

Figure 2. Classification of aquatic weeds (source-http://www.aquaticbiologists.com/algae--weed-id-guide.

Table 4. List of algae.

Scientific name
Microcystis spp.
Chara spp.
Anabaena spp.
Nitella spp.
Spirogyra spp.
Chlorella spp.
Euglena spp.

3.2. Briefing about available aquatic weeds

3.2.1. Floating aquatic weeds

In Bangladesh Agricultural University campus there was found some floating aquatic weeds liketopapana (*Pistia stratiotes*), Khudipana (*Lemna minor*), Kutipana (*Azolla pinnata*), Sonapana (*Spirodela polyrrhiza*). Some discussions of floating aquatic weeds are given below. *Pistia stratiotes* is a free-floating aquatic. The roots were laxative and diuretic, good for wounds, and burns (Yusuf *et al.*, 2009). Large mats blocked light, shaded native submerged plants, and alter immersed plant communities (Ramey, 2001). Khudipana is a free floating aquatic weed. The plant might also be used in homeopathy in India (Mitra *et al.*, 1997). Kutipana is a free-floating aquatic weed. In New Zealand it has had a detrimental impact on the native species *Azolla rubra (*Owen, 1997). It was included in the federal noxious weed list in USA (USDA-NRCS, 2004).Kutipana was

available in some of the ponds of the study area.Sonapana is a free floating aquatic weed. It is grew quickly, especially if the water was warm and nutrient enriched. It used to reduce nutrients in sewage effluent (Mitra *et al.*, 1997) (Figure 3-6).

Figure 3. Topapana.

Figure 4. Khudipana.

Figure 5. Kutipana.

Figure 6. Sonapana.

3.2.2. Emergent aquatic weeds

In Bangladesh Agricultural University campus there was found some emergent aquatic weeds like Malancha (*Alternanthera philoxerodies*), Kolmi (*Ipomoea aquatica*), Bishkatali (*Polygonum hydropiper*), *Panikochu* (*Sagittaria* spp.), Amroolshak (*Oxalis corniculata*), Sushnishak (*Marsilea quadrifolia*), Kanaibashi (*Commelina bengalensis*), Kanaidoga (*Commelina appendiculata*), Dholkolmi (*Ipomoea carnea*), Lalshapla (*Nymphaea rubra*), Sadashapla (*Nymphaea nauchali*), Arail (*Leersia hexandra*), Chechra (*Scirpus mucronatus*), Keshordham (*Ludwigia adscendens*), Helencha (*Enhydra fluctuans*), Paniphal (*Trapa natans*), Kochu (*Colocasia esculenta*), Dol (*Hygroryza aristata*), Kolmishak (*Ipomoea* spp.), Kara (*Nymphoides aquatica*), Hugla (*Typha* spp.) and Ghechu (*Aponogeton* spp.). Some emergent aquatic weed is discussed below. Malancha is a large perennial herb. It was rooted at the edge of the water bodies and spread out as a floating mat over the water surface and over the adjacent moist ground as well. Leaves were in opposite pairs, narrow, slightly fleshy and with a waxy surface. The terrestrial form of the plant can also invade agricultural and pasture lands, and drainage and irrigation may be impacted as well (Coulson, 1977; Julien and Bourne, 1988; Julien and Broadbent, 1980). Kolmi is a green leafy weed. It grew on the embankment of the pond and spread over the water. According to various sources Kolmi had been used extensively as a medicinal plant (Subramanyam, 1962). It also used in the treatment of ringworm (Anonymous, 1959). Plants fed to livestock, pigs, ducks, and chickens (Brown, 1946; Westphal, 1992). Bishkatali is an annual herb. The height of the stem varied from 20 to 70 cm. It also used for the treatment of haemorrhoids and as a diuretic (Holm, 1997). Extracts from *Polygonum hydropiper* had significant biocidal properties against nematodes (Sukul, 1970). *Sagittaria* is a noxious aquatic weed in Bangladesh. The weed was capable of aggressive growth and rapid spread. *Sagittaria* tubers, a good source of carbohydrates and were eaten by many people especially in China, Japan, Southeast Asia, and Russia (Juzepczuk, 1934; Mühlberg, 1982). In some countries, tubers were used to feed to cattle and pigs. The species was used in the aquarium trade and in aquatic gardens (Holm, 1997). Amrool is an emergent weed. The weed grew in cool condition, especially under the tree or other shadowed area where the soil and the ambient was having moisture. Amroolshak was an invasive weed and very hard to eradicate. The leaves of Amrool can be used as raw or cooked, added to salads, cooked as a potherb with other, milder flavored greens or used to give a sour flavor to other foods (PFAF, 2013). *Marsilea quadrifolia* is commonly known as sushnishak in Bangladesh. It is an aquatic fern. The weed got profound antibacterial and antioxidant effect and might have potential use in medicine (Ripa *et al.*, 2009).

Kanaibashi was a fleshy weed. It can be used medicinally to cure inflammations of the skin as well as leprosy (Qaiser, 1975). Its use as a famine food in India has been recorded. In Southeast Asia and Africa it is used as fodder and medicinally as a poultice (Holm, 1977). *Commelina appendiculata* is known as kanaidoga in Bangladesh. Dense growth of the weed impeded the fishing activities and destroyed the pond environment (Holm, 1977). Dholkolmi is an emergent weed. A glycosidicsaponin had been purified from *Ipomoea carnea* with anticarcinogenic and oxytoxic properties (Chand *et al*., 2005). The *Nymphaea rubra* is a freshwater perennial herbaceous plant with erect rhizome, rooted into the sediment of the bottom, which produced thin stolons. Previous studies have reported that extracts of various organs from *Nymphaea* can be used as medicinal plant material (Raja *et al.,* 2010). *Nymphaea nouchali* can be used as an ornamental plant because of its spectacular flowers. Like all water lilies its tubers, leaves and rhizomes can be used as food (Irvine *et al.,* 1953). The dried plant collected from ponds, tanks and marshes during the dry season and used in India as animal forage (Banerjee and Matai, 1990). *L. hexandra* grew in the pond embankment and spread over the water surface. This species is a hyper accumulator of heavy metals, with the ability to take up large amounts of chromium, copper, and nickel from water and soil (You *et al.,* 2013). It has ability to absorb chromium in particular has been described as extraordinary (Liu *et al*., 2009). Targets could include industrial wastewater, such as that discharged from electroplating factories, and the contaminated soils around such facilities (Zhang *et al*., 2007). *Scirpus* is commonly known as bulrush in Bangladesh.They can be used in some herbal remedies. The rhizomes of plant were collected in the autumn and winter and dried in the sun before use (Banerjee and Matai, 1990). Keshordham is an emergent aquatic perennial herb. Leaf extract of keshordham can be taken for curing dysentery. Whole plant can be used as a poultice in ulcers and other skin diseases (Yusuf *et al.,* 2009). Helencha founded in large amount in the study area.It grew plenty in ponds and lakes. Leaf paste applied over head as a cooling agent and around the inflamed Brest to reduce inflammation (Yusuf *et al.,* 2009). Paniphal is an aquatic herb. *Trapa natans* produces a nut-like fruit that can be cooked, eaten out of hand, or used in other foods (Magness *et al.,* 1971). It was present in large amount in the study area. *Colocasia esculenta* was thought to be not native to Bangladesh and Southeast Asia, although was widely naturalized. It has become naturalized outside its native distribution range and grows forming dense thickets along rivers, lake shores, and in wetlands displacing native shoreline vegetation and replacing native aquatic plants (Langeland *et al.,* 2008; Queensland Department of Primary Industries and Fisheries, 2011; PIER, 2012). *Hygroryza aristata*, the sole species in the genus, was one of the few grasses that were regularly cultivated for aquaria or ponds. Cattle are fond of this grass and the grain is said to be eaten by the poor people (Magness *et al.,* 1971). Kara is a cluster of thick banana-shaped roots, located close to the leaves near the surface of the water. In favorable climates these plants will soon take over the water surface and will help keeping the water clear and provide shade for aquatic life (Yusuf *et al.,* 2009). Hugla is an obligate wetland species meaning it is always found in or near water. It also used in the chair. Cattails are considered serious weeds in some countries (Holm, 1977; Morton *et al.,* 1975), but not in North America.Hugla often stabilize shorelines and channels from wave action erosion, or ice heaving, and have been used to reduce salinity in rice fields (Marsh, 1962). Gechu is one kind of emergent weed. Leaves came out from the roots. Its color was green and found in small amount. This was probably the *Aponogeton* specks most suited to aquarium use.

Figure 7. Kolmi.

Figure 8. Malancha.

Figure 9. *Polygonumhydropiper*.

Figure 10. Arrowhead.

Figure 11. Amroolshak.

Figure 12. Kanaibashi

Figure 13. Kanaidoga.

Figure 14. Lalshapla.

Figure 15. Sadashapla.

Figure 16. Arail.

Figure 17. Chechra.

Figure 18. Keshordham.

Figure 19. Helancha.

Figure 20. Panifall.

Figure 21. Kochu.

Figure 22. Dol.

Figure 23. Kara.

Figure 24. Ghechu.

3.2.3. Submerged aquatic weeds

In Bangladesh Agricultural University campus there was found some submerged aquatic weeds like Kata jhanji (*Cartophyllum demersum*), *Vallisneria spiralis*, *Najas minor*, Panimorich (*Vallisneria* spp.). Kata janjhi is a submergible aquatic weed. Periphyton can grow on the body of the plant. Small fishes can use it as their shelter. Katjhanjhi has become locally troublesome on several occasions (Cook, 1990). It affected fish production in Thailand (Chomchalow and Pongpangan, 1973). Its fluffy, filamentous, bright-green leaves provided excellent cover for newly hatched fish (Hiscock, 2003). Experiments have also demonstrated the potential utility of vallisneria for photoremediation of pulp and paper mill and distillery effluents. Plants were effective in reducing COD, color and sodium content of effluents (Singhal *et al.*, 2003). The leaves of the *Najas minor* were opposite, unbranched, strap-shaped, and were around 4.5 centimeters in length. The leaves had serrations which are visible to the naked eye (Figure 33). Panimorich is a submerged weed. The leaves of the weed were greenish or yellowish. The leaves varied in size from 3-8 inches. They had long roots about 3-5 inches. The roots were reddish in color. The leaves arose from the roots. No stem was available (Figure 34).

Figure 25. Kata jhanji.

Figure 26.Vallisneria.

Figure 27. Najas.

Figure 28. Panimorich.

3.2.4. Algae

In Bangladesh Agricultural University campus there was found some algae species like *Microcystis*, *Chara, Anabaena, Nitella, Spirogyra, Chlorella* and *Euglena. Microcystis* is probably the most common toxic algae occurring in farm dams, usually form greenish-yellow bubbly masses in still or nearly still water. It has also been implicated in human illnesses including necrosis of the liver (after drinking) and severe dermatitis (after contact) etc. It produces oxygen in sufficient amount (Padmavathi and Veeraiah, 2009). *Chara* is often called muskgrass or skunkweed because of its foul, musty almost garlic-like odor. *Chara* is also found in BAU campus. *Anabaena* is a genus of filamentous cyanobacteria that exists as plankton. It is a blue green species which grew in spirally coiled filaments. *Nitella* were branched multicellular algae that are often confused with submerged flowering plants. It provides cover for fish, food for fish and waterfowl and stabilizes the sediment. *Nitella*s have no roots; they remove nutrients directly from the water (Padmavathi and Veeraiah, 2009). *Spirogyra* is commonly known as water silk or blanket weed. This algae can be one of the most important crops with efficient energy conversion and a significant niche of food web structure in ponds, lakes and reservoir (Ramaraj *et al.*, 2015). They have been used as ingredients in both medicinal and food preparations, traditionally in different regions across the world (Chandini *et al.,* 2008). *Chlorella* is a genus of single-cellgreen algae belonging to the phylum Chlorophyta. When dried, it contain about 45% protein, 20% fat, 20% carbohydrate, 5% fiber, and 10% minerals and vitamins. It is also rich in calories and vitamins (Belasco *et al*., 1997). *Euglena* is a genus of single-celled flagellate Eukaryotes. Most species of *Euglena* have photosynthesizing chloroplasts within the body of the cell, which enable them to feed by autotrophy, like plants. However, they can also take nourishment heterotrophically, like animals (Chandini *et al.,* 2008).

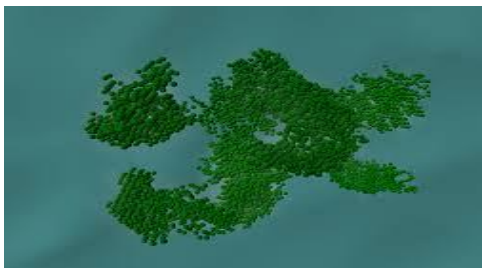

Figure 29. *Microcystis.*

Figure 30. *Chara.*

Figure 31. *Anabaena.*

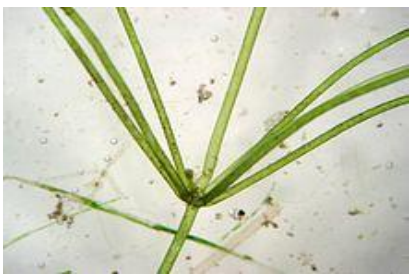

Figure 32. *Nitella.*

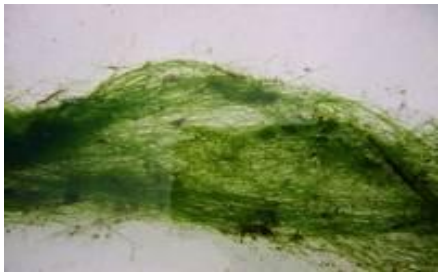

Figure 33. ***Spirogyra.***

Figure 34. ***Chlorella.***

Figure 35. ***Euglena.***

4. Conclusions

Bangladesh agricultural University campus has a lot of ponds. The result showed that the ponds were rich in aquatic weeds. The environment of this area was very suitable for the growth of weeds. Young fish and amphibians used aquatic plants as a source of protection from predatory fish and birds. This, coupled with the abundant food supply, mad aquatic plants important nurseries for young fish and frogs. The sturdy emergent plants provided nest building materials for many birds. People constructed baskets, mats, boats, and even dwellings from cattail and bulrush stems. Submersed and emergent plants protected shorelines from erosion due to wave action or currents. They can also help to stabilize the sediment which can increase water clarity. Aquatic plants helped to form a vital part of the complex system of chemical cycling in a water body. They can also influence the supply of oxygen in the water. Recently aquatic plants had received a lot of attention for their ability to soak up pollutants from contaminated water. They utilized nutrients that would otherwise be used by algae, thereby improving water clarity. Increasing attention is being paid towards their possible use as indicators of water quality. Along with preventing or eliminating pollution, plant community changes would be estimated by collecting and identifying aquatic plants on year basis. This is also a good way to detect detrimental changes at an early stage when control or elimination of problem is both less complicated and less costly. Collecting and preserving plants is not difficult, and the result is an increased awareness of aquatic plants, as well as a valuable historic record of what grows in the pond. However, proper identification of the plant is very important for controlling them.

Conflict of interest

None to declare.

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