Macrophytes of Dal and Nigeen Lake and Succession After Invasion of Azolla

[1]Shahnawaz Ahmad (F.S.E.Sc), [2] NayaraTaban
1 Fellow society of Environmental Sciences, University of Dumka.
Technical Asst, J&K Lakes and waterways development Authority, Srinagar, Kashmir.
2 Scientist-A, J&K Lakes and waterways development Authority, Srinagar, Kashmir.

Abstract

Succession of macrophytes in the lake became more dramatic and dynamic after invasion of Azola ie 2004.

The weed pushes and smothers other free-floating macrophytes like lemna sp. It then provides substrates for the emergent weeds, which later reduces its population by competition for light and nutrients.

Keywords: *Dal Lake, Macrophytes, zonation, succession*

I. INTRODUCTION

Macrophytes are higher plants that grow in ecosystems whose formation has been dominated by water and whose processes and characteristics are largely controlled by water. Factors that influence the establishment of macrophytes include: depth, topography, type of substrate, exposure to currents and/or wind and water turbidity. The distribution of macrophytes is often related to their mode of attachment (Sculthorpe, 1976). The distribution, permanency and quality of the water bodies available for their occupation govern the distribution and ecology of these plants.

The most variable environmental factors of basic Ecological importance for aquatic plants are the Length of the period during which water is present, whether the water is still or moving, the availability of plant nutrients and the quality and quantity of light penetrating into the water. Macrophytes can be subdivided into four groups on the basis of their water requirements and habitats.

Submerged macrophytes are those that are completely covered with water. These have leaves that tend to be thin and finely divided adapted for exchange of nutrients with water. Floating leafed macrophytes are those that are rooted but have floating leaves while free floating are those that float

On the water surface. The last group is the emergent macrophytes. These are rooted plants with their principal photosynthetic surfaces projecting above the water. Emergent macrophytes dominate the shoreline flora while the middle and lower littoral zones supports stands of floating-leafed macrophytes. Macrophytes usually show a succession of zones between the dry land and water, each zone with a dominating plant species.

Variation in the latter depends on the duration of the flooding and may also be affected by ecological succession - where a plant community alters environmental conditions in a way that makes the habitat less favourable for its own survival but more favourable for the development of a different community. The present study was carried out to determine the distribution, affect on nutrients and succession Patterns of macrophytes in Dal Lake after the invasion of Azolla**.**

II. MATERIALS AND METHODS

The Dal Lake has been divided in to four Basins for the study purpose which include Nishat Basin,Hazratbal Basin,Nehrupark Basin and Nigeen Basin. Monitoring and surveillance of
Macrophytes in the lake were done monthly using a Boat with an outboard engine. Macrophyte species occurring in the various sites were recorded and the depths at which they occurred. Specimens were collected for herbarium preparation and further identification. To estimate the macrophyte population densities within the lake. Random quadrant method was used.

III. RESULTS AND DISCUSSION

A total of 20 families and 28 species common Macrophytes were recorded from the different sites in the lake (Table 1). This was probably so because most of the back waters are covered with Radhs and land masses were these weeds get suitable nutrients to grow. Comparison of open water sites and peripheral areas of the lake, macrophytes show very much different distribution not only in terms of species and family but also in their density as well. Stations within the periphery were dominated by *cryspus (september to March),hydrilla(April to August) and cerotophylleum(through out the year)* while those in the open waters were dominated by *lucens,nymphoids and natans*. Sediment deposition from different input channels such as telbal, pishpaw, Botakul and Meraksah has shown lot of effect on the Macrophytic

pattern of the lake. And most importantly azolla weed which was under study in this particular studies shows its first existence through these channels, where from at least 70% of the Azolla found in the lake come from these channels and 30% of this weed grows over the lake surface, thus forming mat like structure and covering the water surface.

Lamarck established the name Azolla in 1785 (Svenson (1944) as cited by Quebral, 1989). It was derived from the Greek words azo (to dry) and ollyo (to kill) meaning, "When it dries it dies".

Fossil record of Azolla Lam. dates back around 100 million years ago (Fowler (1975) as cited by Payawal, 1989) and seven extant Azolla species (A.filiculoides, A. caroliniana, A. mexicana, A. pinnata, A. nilotica, A. microphylla,A. rubra) are reported (Armstrong, 1998; Bergersen ed., 1980; College of Tropical Agriculture and Human Resources, 2000; Croft, 1986; Darbyshire, [n.d.]; Kay and Hoyle, 2000; Ladha and Watanabe 1987; Pacific Island Ecosystems at Risk, [n.d.]; Payawal, 1989; Singh, [n.d.]; University of Wisconsin, 1999; Watanabe, 2001).

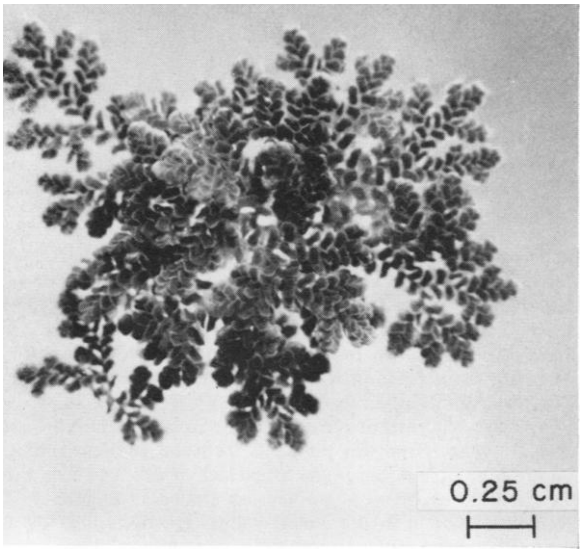
Azolla is commonly described as small, floating aquatic fern, capable of Rapid vegetative reproduction by fragmentation and forms a mat on still waters like rice paddies, canals or ponds (Lumpkin, 1987). It is found both in the temperate and tropical regions of the world (Armstrong, 1998; Examining any sample of Azolla under a microscope shows it to have filaments of Anabaena living within ovoid cavities inside the leaves (Arms trong, 1998; Bergersen ed., 1980; Brady and Weil, 1996; College of Tropical Agriculture and Human Resources, 2000;

The Azolla-Anabaena association can fix nitrogen proportional to its Biomass produced (National Azolla Action Program, 1990). It can fix from 450 kg N/ha/yr to as much as 600 kg N/ha/yr (Quebral, 1989).
With this the light penetration becomes very difficult and in turn submerged weeds get less light and do not grow at their natural pace. These channels also bring with them the slit from the catchment areas thus changing the bed of the lake which also in turn affect the Macrophytic or weed pattern of the lake. The study was carried for one complete year starting from April-2014 to March 2015.During the study along the Macrophytic growth pattern the water qulity of the lake on the particular sites was also studied,which showed variations in some of the physico-chemical properties and nutrients present in the water. The physico-chemical properties which showed variation were pH, conductivity, Nitrate-Nitrogen and Ammonical-Nitrogen.The weeds which were affected by the inclusion of Azolla were Lemna-sp.Salvinia-sp.Myriophylleum-sp.and all the submerged plants like Potomogetan Lucens,Hydrilla etc. as Azoola when spreads over the suface of the water covers it and restricts the light to penetrate in to the water thus slowing down the process of photosynthesis. Some common macrophytes recorded in Dal and Nigeen Lake. (Dal lake booklet-Dr. Mrd Kundangar, Dr.S.G.Sarvar-1997).

Phragmites cummins
Typha Angustata
Sparganium erectum
Sagittaria sagitifolia
Rumex martimus
Azolla pinnata
Ceratophyllaceae
Ceratophyllum demersum
Rananuculus scleratus
Potentilla repans
Polygonum hydropiper
Myosotis sylratica
Menyanthes trifoliata
Galium hertifolium
Epilobium hirsutum
Alisma plantigina
Equisetum diffusum
Marsillia qudrifolia
Najas graminia
Juncus sp.
Hydrocharis morus-ranae
Hydrocharis dubia
Myrriophylleum verticillatum
Myriophyleum spicatum
Nelumbo nucifra
Nymphea alba
Nymphoids peltatum
Trapa natans
Trapa bispinosa
Potamogeton crispus
P. pectinatus
P.lucens
P.pucillus
Cerotophyleum demersum
Utricularia flexuosa
Salvinia
Lemna minor

During the study it was observed that the Azolla develops in two types of environment, one in the channels which are the source of water for the lake and have marshy type of habitat and when these channels are filled with water this developed Azolla comes into the lake with the flow of the water. Another one is the development of Azolla within the lake itself where the already present spores of the weed (Azolla) develop on the peripheral areas of the lake which adds with the incoming Azolla from the channels thus forming the mats on the surface of the lake which actually created the problems for the lakes flora and fauna. Azolla is a

genus of small aquatic ferns with a world-wide distribution. The sporophyte consists of a pinnately branched floating stem. Simple roots, which hang down into the water, occur at some nodes. The branches and stem are covered with small, alternate, overlapping leaves.



The Physico–chemical analysis of the water with the influx of Azolla shows nitrate nitrogen increase in its level which confirms the relation between Azolla and Anabaena to absorb nitrogen from the atmosphere. With the increase in nitrate nitrogen, Ammonical Nitrogen level showed decrease.

S.No	Parameters	Units	pre	post
1.	pH	--	8.1	7.1
2.	Conductivity	µs/cm	250	284
3.	Nit-Nitrogen	mg/l	0.3	0.5
4.	Amm.Nitrogen	mg/l	0.3	0.20
5.	T.Phosphorous	mg/l	0.4	0.35

IV. SUCCESSION

Until the invasion of Azolla only small Changes were seen in the macrophyte composition during the summer season. Before azolla Invasion, the only common floating macrophyte was Lemna and to a lesser extent Salvinia sp. However, after the invasionof Azolla sp salvinea and lemna sp were either smothered or dominated by Azolla in the run for existance.

Azolla also reduced the populations of floating leafed and submerged macrophytes by cutting light And competition for nutrients. The other macrophytes whose communities were decimated by Azolla included N. lotus, Ceratophyllum demersum, Najas and Trapa natans.

V. CONCLUSION

The invasion of Dal Lake by Azolla led to the initial decrease in the population of emergent Macrophytes as the Azolla, which doubles its Population in two weeks under favourable conditions, out-competed them by slowing down the process of photosynthesis due to stopping of penetration of light. However, this trend was reversed with the reduction of Azolla population due to manual control. Macrophytes such as Salvinia and Lemna sp quickly increased in population along the shores of the lake.

These, however, cannot survive in the lake once total decomposition and disintegration of the heterotrophic layer of the floating mats takes place. Lemna and Salvinia, which were the only floating macrophytes ferns found in stagnant pockets and channels along the lake shore and not in the main lake. Azolla ‘hot-spot’ areas have been observed in the lake and unless environmental degradation around the lake is reduced, then the weed is expected persist and dominate these areas. Meanwhile the life cycle of the Azolla is also needed to be studied briefly.

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