ABSTRACT

Podostemaceae is a unique family of angiosperms comprising rheophytic, herbaceous members with thalloid plant body. The plants are distributed in the tropical and subtropical fresh water streams and water falls. The vegetative and reproductive features of the members of the Podostemaceae in Kerala have been studied with particular reference to the autecological and reproductive biological aspects. The work is mainly based on the spot study of the plants and observations in the laboratory.

The role of Podostemaceae in the formation of a biotic structure for algae and associated animal forms was studied. Analysis of chemical and physical parameters of water from collection spots done on all seasons. Adaptive characters in the reproductive structures have been studied. A preliminary evaluation was done on the ecological significance of podostemads in their erratic habitat.

Scientific evaluation of the level of endemism and chance of extinction is highly needed for wetland flora such as Podostemaceae. Timely assessment of physical, chemical and organic pollution of water bodies must be made. Adequate environmental and biological awareness based on intellectual property rights should be generally provided to the tourists as well as local people to enhance the effective protection of these wetlands in an ecologically sustainable manner.
1. INTRODUCTION

Wetlands of Indian subcontinent are rich in aquatic macrophytes. The family Podostemaceae often called the ‘River Weed Family’ consists of a unique group of thalloid rheophytic angiosperms restricted to the tropical and subtropical riverine habitats. They grow attached to rocks, boulders, pebbles or even wooden logs in fresh water streams and waterfalls (Willis 1902 a). Podostemads are pantropical, represented by forty eight genera and two hundred and seventy species (Philbrick & Novelo,1995; Cook, 1998). Willis, the pioneer in the work of Podostemaceae described them as a special group with highly varied morphological structure. This refers to the strange combination of simple undifferentiated thallus, perplexing polymorphism and number of growth forms surviving in the most erratic habitats.

Sculthorpe (1967) opined that Podostemaceae is the strongest and the most provocative family. They also constitute the largest family among aquatic flowering plants. However their taxonomic, ecological and evolutionary patterns contrast markedly with other families. The family name comes from the type genus Podostemum (Podos-foot, stamum-stamen, prominent foot like stamen supported by a stalk). The first member of the family to be reported was Mourera fluvitalis by Aublet (1775) from

Tropical fresh water ecosystems represented by ponds, rivers and canals have the greatest diversity of aquatic angiosperms (Philbrick, 1987a). The survey of literature shows that there is not much work done on the aquatic flora. This may be due to the difficulty in collection and preservation of these specimens.

Such hydrophytes were even excluded from floristic surveys of a region. Considering them as weeds, the preliminary studies on these taxa were concentrated more on their eradication and control, rather than on their survival strategies (Mohan Ram & Kakkar, 1983; Gopal, 1990). The highly productive nature of wetlands and the prominent role of hydrophytes in that ecosystem were accepted in course of time. The role of wetlands in shaping the social, economic and environmental status of any region is of active discussion recently. It is noteworthy that after the Ramsar convention (1971), wetlands have gained international attention.

Aquatic plants are species that perpetuate their life cycle in still or flowing water, or on inundated or noninundated hydric soils (Philbrick &
According to their habitat, they show many adaptations such as the presence of aerenchyma cells for buoyancy, extreme reduction of leaf vascular tissue, total absence of stomata and mechanical tissues. Though the rushing currents make the habitat of Podostemaceae unstable, the seasonally high and low water levels make it a predictable habitat where the river-weeds flourish (Philbrick & Novelo, 1995). They also provide shelter, organic food and oxygen for small insects and phytoplanktons.

Podostemaceae with many exceptional characters from hydrophytes are grouped under torrenticolous rheophytes by van Steenis (1981). Cook (1990) classified them as haptophytes, which are plants attached to rocks but do not penetrate the substratum. Grubert (1975) viewed that podostemads are able to withstand enormous tensile strength, that higher and larger plants cannot. Earlier, these plants were believed to be attached to the rocks by a cementing substance excreted by their haptera (Vidyashankari & Mohan Ram, 1987). However, Jäger Zürn & Grubert (2000) suggested that the strong attachment of Podostemaceae to the substratum was effected through the EPS (extra polymeric substance) of the bacterial biofilm.

World Bank Report (1996) states that Kerala is the only freshwater mega diversity hotspot in Asia. Forty four rivers arising from the Western Ghats and a combination of north east and south west monsoon make it an ideal place for growth of hydrophytes, especially rheophytes. Cook (1990) reported 10 genera and 19 species of Podostemaceae from India. Nayar (1987) suggested that many Podostemaceae are endemic to Western Ghats,
though a few are reported from Arunachal Pradesh, Sikkim, Meghalaya, Assam, Maharashtra and Goa (Vartak & Bhadbade, 1973).

According to Dobson & Fridy (1998) geology of the catchment areas and aquatic floral composition are the major factors determining the composition of a water body. Climate, rainfall, temperature and humidity are certain other factors affecting the flora of the region. For plants such as Podostemaceae whose main attaching substrata are rocks, the geology of rocks becomes more decisive. In the present study area rock formation is reported to be of charnockite-gneiss association. Despite all these evidences, studies in these interdisciplinary areas are done the least.

In earlier days, floristic surveys of aquatic ecosystems were more restricted to North India. Works of Subramanyan (1962), Vartak & Bhadbhade (1973), Mohan Ram & Kakkar (1983), and Mohan Ram & Sehgal (1997) are notable among them. A preliminary study on hydrophytes of South India is believed to have been be done by Henrick Van Rheede in the 17th century (Manilal, 1980). Contributions by Cook et al., (1974), Manilal & Sivarajan (1975), were some of the further attempts in the study area. Nagendran et al., (1976, 80, 81) have reported many new species and their embryology. Histotaxonomic study of Podostemaceae in Kerala made by Raveendran (1995) and vegetative and reproductive features of Podostemaceae in Kerala by Mathew & Satheesh (1997) are noteworthy. Nileena (2001) studied the curious interrelationships of genera and species in Podostemaceae, with special reference to polymorphism. Of Mathew et al., (2001) have reported that the species Dalzallia gracilis links the genera Indotristicha and Dalzallia. Still many of the systematic controversies and structural variations remain
unexplained. These may be due to the lack of studies in an ecological perspective.

According to Misra (1960), each organism or population is regarded as influencing ecosystem according to its own ecological life history. Its autecology refers to the requirements and reactions in relation to its environment. Reproductive biology is another important aspect in that study. Here the long term, short-term adaptations and survival strategies helping the organism to establish in its niche are assessed (Khosla, 1995). The floral and palynological adaptations together with seed and seedling establishment are all directives to the features of the whole ecosystem itself.

The higher prevalence of rheophytes in tropical and subtropical regions is ecologically related (van Steenis 1981). Tropical river rapids are the most productive regions of rivers harboring diverse assemblage of aquatic invertebrates, fishes, amphibians, algae and mosses (Sculthorpe 1967). Macrophytic colonies of plants such as Podostemaceae possibly alter the surface flow patterns of riverine habitats (Grimm 1994). However, a comprehensive documentation and assessment of components of these lotic ecosystems is lacking (Philbrick et al., 1997). In the new world, Podostemaceae forty eight percent shows high local species endemism, being located in a single river or a single spot. In such a situation negative impacts of global climatic changes, occurring in these rivers will directly affect these riverweeds (Grim 1994; Allan 1995). Sioli (1986) suggested that tropical rivers are the heavily polluted among aquatic habitats, since they are utilized to the maximum. Demographic and developmental pressures show a thorough ascending pattern in the tropics. Hence sewage
and agricultural as well as industrial pollution also increase correspondingly. Influence on water level manipulation due to hydroelectric dams lead to extreme siltation and unpredicted floods. These are least assessed. Further, an empirical ecological analysis linking these irreversible alterations to Podostemaceae population is not available. Quiroz et al. (1997) worked on the relation between water quality and podostemad population in Mexican rivers for the first time. Complete loss of habitat is a major threat to endangered flora. This may happen due to natural or anthropogenic causes. Willis (1902 a) has reported similar loss of population for Hydrobryum griphithii in Sikkim owing to floods. Large number of dams for hydroelectric purposes, in a single river erratic climate and unsustainable tourism might be some of the factors causing irreversible changes in the riverine ecosystem of Kerala.

The broad objectives of the present work are

1. To collect Podostemaceae from selected river spots in Kerala for further studies in autecology and reproductive biology.

2. To find out the role of Podostemaceae in the formation of a biotic structure for algae and associated animal forms.

3. To analyse the chemical and physical parameters of water from the collection spots.

4. To ascertain the adaptations in the reproductive structures for the survival of these plants in the erratic habitat.

5. To find out the attenuation of the habitats of Podostemaceae in the study area.