Chapter - 8

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Sholas are the montane subtropical wet evergreen residual forests confined to the sheltered sites such as valleys, glens, hollows and depressions where moisture is good. They are one of the unique features of Nilgiris and generally distributed between the altitudes 1700 and 2200m above msl. Species richness at floral, faunal and microbial levels is very higher in sholas. In addition to diverse tree species, the shola understories are characterized by the presence of many plants with economic importance. The sustainable utilization and conservation of such herbaceous bioresources need the information on their ecological status in the communities.

Keeping this fact in mind, 4 sholas such as Thiashola, Korakundah, Kammand and Kolacombai at Manjur, the Nilgiris, Western Ghats, India which are spread over an area of 1600, 700, 80 and 140 hectares respectively were selected for the present study. The study was carried out over a period of 3 years from April, 2002 to March, 2005 in the understories of these sholas. The major objectives of the study includes the identification of ecologically weaker economically important herbs through phytosociological analysis, diagnosing the reasons responsible for their poor ecological condition and making a case study for in vitro regeneration by employing tissue culture technique.

The climatic conditions and altitudinal position showed that the study sholas are the subtropical montane wet evergreen forests, receiving the average annual rainfall of ca.3000mm and the maximum of which was brought by both south-west and north-east monsoons. The minimum and maximum temperatures during the study period were prevailed between 10
and 18°C and 16 and 30°C respectively. The relative humidity was noted between 75 and 98%. Frosty nights are common during the months, November – December. The direct impact of man on the study forests is meagre because they are coming under protected region of Nilgiri Biosphere Reserve.

The soil physical characters (moisture, water holding capacity, bulk density and texture) and chemical characters (contents of nitrogen, phosphorus, potassium and organic carbon and pH) in the study sholas were found to be highly favourable and form suitable microclimate for the growth of the plants. The higher content of CO$_2$ evolved during soil respiration also indicates the presence of adequate microbial wealth in the soils of sholas.

In community analysis to know the ecological position of constituent plant species at understorey level, various quantitative characters such as frequency, density, abundance, dominance and their relative values, importance value index and relative value of importance were studied at monthly intervals for a period of one year. The study revealed that a total of 107 species were found in the understories of all the four sholas collectively. Thiashola recorded a higher number of 98 species followed by Korakundah, 91 species, Kammand, 82 species and Kolacombai, 80 species. In the floristic list, 70% of the species were common to all the four sholas. The families like Asteraceae, Poaceae and Urticaceae generally contributed higher number of more than 9 species each to the communities. The community density was higher during rainy months and it was widely varied across the sholas (9008 / 100m$^2$ in Thiashola and 6788 / 100m$^2$ in Kammand.

The degree of endemism and rarity of species are also notable in the communities. It was known that 11 species were endemic and 4 species were rare in the sholas. Further, it was identified that a fairly good number of 75 species (70%) were economically important also. The index of dominance in
all the four sholas showed that there was no single species dominance in the communities. On the other hand, the species diversity was higher. The sholas are highly similar to each other owing to the higher value of similarity index (80%). In addition, the sholas were homogeneous also because the FICC obtained was 60%.

In general, the species viz., *Cyrotococcum deccanense*, *Oplismenius burmannii* and *O.compositus* were made even distribution at all times of samplings in the sholas by obtaining over 90% frequency value. However, many species such as *Calanthe triplicata*, *Ageratina adenophora*, *Carex foliosa*, *Desmodium scalpe*, *Drostenia indica*, *Elatostemma sessile*, *Leportea terminalis*, *Myriactis wightii*, *Ophiopogon intermedius*, *Pilea wightii* and *Piper branchystemon* showed even distribution only during rainy seasons. Very few site specific species also exhibited higher frequency values during rainy season. On the other hand, the species like *Cynoglossum furcatum*, *C.zeylanicum*, *Galinsoga parviflora* and *Hypochaeris glabra* showed restricted distribution in all the four sholas. Some of the other species like *Acmella calva*, *Agrostis pilosula*, *Cayratia pedata*, *Fragaria vesca*, *Gnaphalium indicum*, *Lycianthes bigeminata* etc also exhibited poor frequency value in the respective sholas.

The density of constituent species in the shola understories varied widely. The orchid, *Calanthe triplicata* showed the highest density of 8.6/m² and the species, *Lycianthes bigeminata* was present with the lowest density of 0.04/m². The grasses generally occurred with higher densities in all the four sholas. In dicots, the two species, *Centella asiatica* and *Hydrocotyle javanica* contributed higher densities to the shola understories. In addition to *Lycianthes bigeminata*, the species like *Galinsoga parviflora*, *Gnaphalium indicum*, *Anaphalis beddomii*, *Cynoglossum zeylanicum*, *Rubus*
fairholmianus, Helichrysum bracteatum etc have also present with poor densities.

Basal area, the character used to assess the dominance was also differed widely across the species. The Orchidaceae member, *Calanthe triplicata* distributed in Thiashola and Korakundah obtained the highest basal cover value (280454.6 mm²/100m²) followed by *Ageratina adenophora* (43117.4 mm²/100m²) and *Arisaema leschenaultii* (36910.3 mm²/100m²). On the other hand, few dicots like *Lycianthes bigeminata*, *Laurembergia coccinia* and *Galinsoga parviflora* have occupied smaller basal area of less than 50 mm² / 100m². The relative values of frequency, density and dominance secured by the constituent species were parallel to the values of frequency, density and basal area obtained by the respective species.

The importance value index (IVI), a character used to express the ecological success of any species, was also varied from species to species in the shola understories. The two species, *Calanthe triplicata* and *Ageratina adenophora* secured the IVI value of more than 50. The other species like *Achyranthes bidendata*, *Anemone rivularis*, *Arisaema leschenaultii*, *Carex beccans*, *Centella asiatica*, *Myriactis wightii*, *Pilea trinervia* etc were also considered to be the successful elements in the communities of shola forests because of the considerable IVI secured by them. In all the four shola many species were present with no functional role because of their poor IVI value. Some of the important plants included in this category are *Lycianthes bigeminata*, *Ageratum haustorianum*, *Galinsoga parviflora*, *Eragrostis nigra*, *Acmeila calva*, *Ageratum conyzoides*, *Agrostis peninsularis*, *A.pilosula*, *Anaphalis beddomeii*, *A.elliptica*, *Biophytum sensitivum*, *Bromus catharticus*, *Cayratia pedata*, *Ceropegia pussilla*, *Clinopodium umbrosum*, *Cynoglossum zeylanicum*, *Fragaria vesca* etc.
Out of the 75 economically important plant species present in the four study sholas, 12 species such as *Ageratina adenophora*, *Cyrtococcum deccanence*, *Oplismenus burmanni*, *O.compositus*, *Piper brachystemon*, *Strobilanthes kunthiana*, *S.foliosus* and *Toddalia asiatica* were established well in the communities because they obtained higher IVI. On the other hand, 22 plant species include *Ageratum conyzoides*, *A.haustonianum*, *Acmella calva*, *Anaphalis elliptica*, *Bidens pilosa*, *Cayratia pedata*, *Clinopodium umbrosum*, *Cynoglossum zeylanicum*, *Digitaria violescense*, *Euphorbia rothiana*, *Fragaria vesca*, *Gnaphalium indicum*, *Hypochaeris glabra*, *Lycianthes bigeminata* etc were considered to be ecologically weaker in the communities owing to their poor IVI of less than one.

To diagnose the reasons responsible for poor ecological status of economically important plants, autecological studies were carried out for a period of one year. Among the 22 plants of weaker ecological status, based on certain attributes such as non grassy type, indigenous form, distribution in shola proper and high degree of human pressure, six species such as *Acmella calva*, *Cayratia pedata*, *Clinopodium umbrosum*, *Cynoglossum zeylanicum*, *Fragaria vesca* and *Lycianthes bigeminata* were selected for autecological studies. The study covered the aspects, phenology, population dynamics, reproductive potential and biomass allocation to reproductive parts.

The phenological observations showed that the flowering phase occurred generally during the months, July – September and fruiting was happened between the months September and November. The seed maturation was noted during the months of November and December and the dispersal of seeds generally happened during February and March months. The population size was very small and it varied between 0.01 and 0.51/m² when all the 6 species were considered together. The species, *Lycianthes bigeminata* registered the smallest population size among the 6 species analysed. It was
further noted that the recruitment and lose of individuals in the population of all the six species were mainly through seeds and seedling death respectively. The growth of the population size of all the 6 species was positively correlated with the environmental variables such as temperature, rainfall, relative humidity and soil wetness.

The observations on seed output showed that the species, Cayratia pedata and Lycianthes bigeminata produced a higher number of 3696 and 2555 seeds per plant respectively. However, the size of the seeds of these two species was tiny. The other four species, Fragaria vesca, Clinopodium umbrosum, Cynoglossum zeylanicum and Acmella calva produced 910, 176, 136 and 38 seeds per plant respectively. The percentage survival of seedlings was less than 50% in all the six species and among them the solanad, Lycianthes bigeminata recorded the lowest seedling survival percentage of 23.72. The attributes regarding reproductive potential such as percent germination, reproductive capacity and aggressive capacity were also poor for all the six species. The allocation of biomass to reproductive parts was generally very lower for the six species studied.

The results of the autecological investigations revealed that the low population size of all the six species may be due to the factors like less germination percentage, lower survival rate of seedlings and exploitation of adults by local public for their medicinal importance. The continuous availability of wetness in the soil may also kill the tiny seeds and reduced the population size to some extend. Since the reproductive potentiality for all the six species are not at considerable level, mass multiplication of plantlets by applying tissue culture technology is needed.

For the case study of in vitro regeneration upto plantlet formation, one of the weakly established plants in the shola understorey, Lycianthes bigeminata was taken. Leaf explants alone were tried for this purpose. The
observations made during the study indicate that the concentration of hormones, BAP and NAA at the level of 0.5mg/l each in the MS medium induced callus formation in all the leaf discs. The sub-culturing experiments showed that the basal medium containing the BAP at 0.5mg/l level was found to be the optimum for higher shoot formation. The further experiments for root initiation exhibited that the basal medium supplemented with the auxin, NAA at the level of 1mg/l induced the maximum of 90% shoots for root initiation.

Standardization of MS medium for the appropriate explants of the remaining 5 plants is needed to produce high frequency of plantlets. The introduction of huge number of such plantlets at suitable microclimatic locations in the sholas and subsequent care through still intensive habitat protection will increase the population and ensure the conservation as well. However, further hardening experiments on survivability rate of seedlings are suggested to confirm the fact of improvement in population size of all the six species before implementing the conservation measure.