Chapter 2

Review of Literature

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2.1 INTRODUCTION

The global biodiversity has given rise to growing concern at the prospect of a rapidly accelerating loss of species, populations, domesticated varieties, and natural habitats such as tropical rain forests and wetlands (Wilson, 1985). Recent estimates suggest that more than half the habitable surface of the planet has already been altered by human activities and were on the verge of mass extinction of species (Myers, 1979, 2000, Whitmore, 1990). Species and their populations vary widely in their abundance and geographical distribution because each region has unique phylogenetic, geographical, and ecological conditions (Odum, 1996). The forest cover is inequitably distributed on earth and mostly concentrated to 18 hot spots of diversity (Myers, 1988). Many of these hotspots occur in tropical belt, which are the most diverse and ecologically the most complex of land communities (Lewin, 1986). Two such hotspots have been identified in India, viz. the Western Ghats and the Eastern Himalaya.

The Tropical rainforest of the world are extremely diverse in the floristic and faunal composition in spite of their similarity and structure and physiognomy (Richards, 1976, Whitmore, 1984, 1990). Tropical forests occupy 7% of the earth’s total area and 43.63% of the total forest area, while the rainforests cover 1468 million ha (FRA, 2002). They are centers of the evolutionary activity that has been considered the direct or indirect source of origin of temperate region plants (Richards, 1976). In spite of
that, still little is known about their structure, functioning, and their processes of rainforest formation (Whitmore, 1990). The over exploitation of rainforest was unprecedented in past 100 years because of high value of such forests for commercial timber. In many areas destruction is also done for the need of agricultural expansion (mainly shifting cultivation), commercial plantation, and human settlement (Whitmore, 1984, 1990). Such multidimensional pressure had an adverse effect of the volume of rainforest in space and time that resulted in the change in the climax and seral stages (Richards, 1976, FRA, 2002).

In Asia, the rainforests spread is about 303 million ha land area (forming 20.64% of the world’s rainforest) of which 272 million ha is found in South East Asia, while remaining 31 million ha occurred in South Asia. The Himalaya holds the most contagious stretch of tropical and temperate forest in the world that is facing severe deforestation due to consequences of the land use change (Shah, 1982, Ashish, 1983, Bajracharya, 1983, Singh et al., 1984, Schroeder, 1985, Moench and Bandopadhyay, 1986, Tiwari and Singh, 1987, Byers, 1987, Rai et al., 1994). The Northeastern region and the Eastern Himalaya, is extremely rich in biodiversity (Rao, 1996). The region has at least 7500 flowering plants, 700 orchids, 64 citrus, 28 conifers, 500 mosses, 700 ferns, and 728 lichens (Rao and Hajra, 1986, Rao, 1996). The uniqueness of the region’s biodiversity has been attributed to its biogeographically unique location, which is at the
transition point of Indian, Indo-Malayan and the Indo-Chinese biogeographical zones as well as the confluence of the Himalayan region with the Peninsular India (Khoshoo, 1992). This region is so important that about 50% of the total Indian flora is considered to be here with 30% of total flora endemic to the region (Rao, 1996). A large variety of such biodiversity exists in the rain forests on North East India as they are considered among the most diverse animals and plant life sites (Chauhan et al., 1996, Ghosh, 1987, Proctor et al., 1998).

The land use change from forest to other usage has been quite conspicuous in the last few decades in the Himalayan region (Singh and Singh, 1992). The reduction of original forest cover already amounts to at least 21% in Asian countries and Australia (Jackson, 1993, Rubinoff, 1983). In the northeast region as well, the biodiversity of the region is dwindling fast due to increasing population pressure and injudicious exploitation. About 700 species of the region have fallen under different categories of threats (Jain and Sastry, 1980). Thus, the protected areas become the only refuge of the pristine vegetation harboring the rich biodiversity of the region.

2.2 LITERATURE REVIEW

Indeed, Osmaston (1922) was the first person who emphasized the need for detailed ecological study of Garhwal Himalaya and his plea was
supported by Dudgeon (1923), Dudgeon and Kenoyer (1925) and Gupta (1966).

Champion (1933, 1936) has made a preliminary survey of the forest types of India, which was later revised by Champion and Seth (1968) in which they discussed the regeneration and management of different forest types in Himalaya. Singh (1985) reviewed the work done on the environmental regeneration of forests in the Central Himalaya.

In Garhwal Himalaya, Tiwari (1989) surveyed the forests and concluded that a detailed analysis of forests is needed considering different elevations, aspects, and factors acting thereupon. Bhandari et al., (2000) reviewed the work on dominance and diversity relations of woody vegetation structure along an altitudinal gradient in a mountain forest of Garhwal Himalaya. They emphasized that the elevation range of 300 to 2200 m in the Garhwal Himalaya reflects three vegetational regimes, viz., *Shorea robusta* in the submontane zone (up to 1000 m), *Quercus leucotrichophora* (>1500 m) in the low montane to mid montane zone and *Pinus roxburghii* regime in between the first two regimes (Bhandari et al., 1997).

It would be worth to mention here that in 1911 of the total area of Kumaon and Garhwal Himalayas there was 86% forest cover, however, in 1971 it was reduced to 38% (Tiwari, 1981). This shows a dramatic reduction in
the forest cover in the Himalayan zone and it needs the studies on environmental regeneration of tree species and other quantitative community analysis of different forests at different elevations. Owing, the facts the present investigation has been undertaken.

### 2.3 TREE REGENERATION

Forest resources are renewable only because they regenerate (Poorter, 2003). The pace at which the older trees are replaced by the younger ones is very important; therefore, regeneration dynamics forms a major thrust area of the study in the management on natural forests (Coates, 2002, Dekker and de Graaf, 2003). The recent trend in forest management research centers on the concept of sustainable management of multiple resources conserving the rich natural diversity (Bawa and Krugman, 1986). Precise knowledge of the intrinsic structure of the dynamics of the ecosystems is a sine qua non in developing practical methods for sustainable management. Thus, researches on acquiring basic information on ecosystem dynamics have been conducted in various parts of the world (Bawa, 1974, Frankie et al., 1974a, 1974b, Janzen, 1978, Bawa, 1979, Chan, 1981, Leigh et al., 1982, Bawa, 1983, Sutton et al., 1983, Johnkers and Schmidt, 1984).

Regeneration is the process of sylvogenesis (meaning forest building) by which trees and forest survive over time (Halle et al., 1978). Unlike
homogeneous artificial plantations, management of natural forests rely largely on natural regeneration, successful management, therefore, depends on good natural regeneration of valuable species (Barik et al., 1996, Dias et al., 2004). The practice of natural regeneration over many decades has contributed a vast store of know how of silvicultural practices in forest management (Nair, 1961). Many international forums are making efforts to develop suitable methods for practicing the concept of sustained yield in forestry and the subject of natural regeneration is receiving increasing attention (UNESCO, 1975, McLaren and McDonald, 2003). Organisms have different kinds of regenerative strategies (i.e. by genets) although some species also show vegetative regeneration (i.e., by ramets) (Poorter, 2003).

of forest communities in part of Kumaon Himalaya. Beniwal and Haridson (1992b) investigated the natural distribution, regeneration and growth statistics of gymnosperms and poplars in Arunanchal Pradesh and reported high regeneration in sub tropical and temperate forests. Regeneration studies on selected species and specific categories of taxa are also numerous (Sinha and Bawa, 2001, Graham et al., 2001). Efforts were also made to review the literature on various aspects of natural regeneration (Fox, 1976).

Regeneration of tropical forests has also been a focus of major attention (Swamy et al., 2000). All these studies have shown that the forest regeneration is a key process for the existence of species in the community, thus, plays a critical part in forest management, because regeneration maintained the desired species population and stocking after biotic and abiotic disturbances. Changes in seedling composition in a stand is a result of changes among species through several regeneration process, such as seed production, dispersal and seedling emergence, survival and growth (Streng et al., 1989, Schupp 1990,). The regeneration status/potential of a species in a community can be assessed from the population dynamics of seedling and saplings in the forest community (Ashton and Hall, 1992, Boraiah et al., 2003, Gunatileke et al., 2001, Uma Shankar, 2001). Tree population structure and its implication for their regeneration has been studied for different forest stands of the Himalaya,
such as Western Himalaya (Baduni and Sharma, 2001, Pande et al., 2003, Bhandari, 2003), Eastern Himalaya (Sundriyal and Sharma, 1996) and North Eastern region (Bhuyan, 2002, Bhuyan et al., 2003). There is a need to extend similar studies in other natural forests to assess as to how the top, mid and lower canopy species behave as far as their regeneration potential is concerned and also how these species behave in protected stands.

In natural forests of India, various studies were conducted by several workers on seed characteristics, seed germination, seedling growth and their population dynamics in response to various environmental conditions and disturbance (Bhuyan, 2002, Saxena and Singh, 1982, 1984). Many studies have emphasized on natural regeneration of forest related to the spatial structure of different trees in different forest types (Khan and Tripathi, 1991, Saberwal, 1996).

There are few reports available on regeneration status of few forest types and tree species of north-east India (Khan and Tripathi, 1987a, b, Maram and Khan, 1998, Khan and Uma Shankar, 2001, Rao 1992, Barik et al., 1996).