CHAPTER 7

CONCLUSION

Conclusion of the study and further research potentials

7.1 Conclusion

The following conclusions are made from the study carried out in Sonai Rupai Wildlife Sanctuary:

I. The vegetation composition of the tropical semi-evergreen forest in the Eastern Himalayan foothill region is characterized by the presence of species like *Aesculus assamica, Aglaia spectrabilis, Bauhinia purpurea, Clerodendrum infortunatum, Chukrasia tabularis, Dillenia indica, Gmelina arborea, Magnolia hodgsonii, Osbeckia nepalensis,* etc. The phytosociological parameters of the study site reveal high plant diversity and low dominance by selective species. Apart from the native plant species, several non-native plant species with high IVI were also recorded within the study site. The presence of plants like *Ageratum houstonianum, Axonopus compressus, Chromolaena odorata, Digitaria ciliaris, Lantana camara, Mimosa pudica,* etc. indicates their successful establishment due to the occurrence of disturbances within the forest area. Although the diversity indices do not indicate the occurrence of invasion, however, the non-native plants can potentially alter the vegetation composition through invasion and selective recruitment of species in the near future.

II. The overall phenological patterns of the selected tree species displayed that the vegetative phenophases correlated with one or more climatic variables, whereas, not all the reproductive phenophases correlated with the climatic variables. The phenophases – flower initiation, fruiting and fruit fall – did not exhibit any association with the selected climatic variables – precipitation, temperature, relative humidity and photosynthetically active radiation. This implies that several phenophases specifically the reproductive phenophases are species specific responses to the climatic variables. The Rayleigh's test for the overall also revealed that only leaf initiation and flowering displayed non-uniform occurrence signifying seasonality with the peaks during the month of August and May, respectively.

III. The study revealed that the seasonal variations in the environmental conditions such as precipitation, temperature, litter fall, etc. significantly altered the

physicochemical properties of the top soil. Although the MFA individual representation plots displayed some extent of overlap for the physicochemical properties of soil sample from the forest and scrub patches, however, a distinct difference related to the vegetation cover was observed in the seasonal fluctuation of soil moisture, bulk density and the concentration of available nitrogen. The remaining physicochemical properties displayed seasonal fluctuations for both the forest and scrub patches. These variations indicate the presence of a complex interplay between the top soil, vegetation cover, and climatic conditions within the protected area.

IV. The study of the phenophases – leaf initiation and flowering – revealed that although the phenophases of trees are species-specific response to the climatic conditions of the region, however, the occurrence of certain phenophases coincide for the overall tree community. The occurrence of the phenophase are not responses to the temporal fluctuations in a single climatic variable but rather a cumulative effect of the fluctuations in all the climatic variables such as precipitation, temperature, relative humidity and photosynthetically active radiation. Although the simple regression-based analyses are basic and efficient techniques to model the potential relationships between the phenophases and climatic variables, however, certain issues like normality of data set and collinearity among the variables can persist and reduce the accuracy and reliability of the models. The presence of non-normality among the residuals in simple linear regression models makes them inefficient, however, even if normality of the residuals exists, these models are limited to determine the relationship between the observed variable and a single independent variable. Meanwhile, multiple regression models are an effective technique to reflect the collective role of climatic variables, given the dataset has residual normality. However, the presence of collinearity among the climatic variables makes these models redundant. Generalized linear modeling of phenophases is another approach to generate regression-based models for non-normal data set but similar to multiple regression models, these are also negatively affected by the collinearity of variables. Although stepwise removal or addition of variables is an effective technique to address this issue, it reduces the usefulness of the models. Therefore, the ridge regression is an efficient technique to study the relationship between the phenophases and climatic variables as it suppresses the collinearity and allows the inclusion of all the relevant variables.

7.2 Further research potential

The present study encompasses the floristic diversity, the phenological patterns of the tree species, and the seasonal dynamics of the physicochemical properties of the top soil. Additionally, the study also incorporates the application of ridge regression to understand the relationship between the phenophases and the climatic variables in the region. However, several other associations and properties that characterized the tropical semi-evergreen forest were not included in this study. Therefore, the following studies can be done to obtain a deeper understanding of the vegetation in the foothills of the Eastern Himalaya region:

I. A study on the impact of the presence of non-native plant species on the regeneration and growth of the native plant species.
II. The impact of native and non-native plant species on the physicochemical properties of the soil.
III. The lag between the changes in the climatic conditions and the occurrences of the phenophases, along with the subsequent statistical and mechanistic modeling to establish their relationships.