Chapter 17
Species Distribution Models (SDM) – A Strategic Tool for Predicting Suitable Habitats for Conserving the Target Species: GIS and Special Distribution Modelling (SDM)

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ABSTRACT

Conservation of the species in their native landscapes required understanding patterns of spatial distribution of species and their ecological connectivity through Species Distribution Models (SDM) by generation and integration of spatial data from different sources using Geographical Information System (GIS) tools. SDM is an ecological/spatial model which combines datasets and maps of occurrence of target species and their geographical and environmental variables by linking various algorithms together, that has been applied to either identify or predict the regions fulfilling the set conditions. This article is focused on comprehensive review of spatial data requirements, statistical algorithms and softwares used to generate the SDMs. This chapter also includes a case study predicting the suitable habitat distribution of Gnetum ula, an endemic and vulnerable plant species using maximum entropy (MaxEnt) species distribution model for species occurrences with inputs from environmental variables such as bioclimate and elevation.

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INTRODUCTION

Tropical forest loss is increasing every year, which is primary driven by the anthropogenic pressure through illegal logging, overexploiting of forest resources, shifting cultivation, forest fire and urbanization. This leads to the fragmentation of habitat of native species. The intrusion of invasive species adds to the negative consequence to this, resulting in biodiversity loss and species extinction. It is strongly considered essential to protect the individual species within the natural landscapes including the whole habitat. Effective management of habitat especially endemic/rare/key stone species requires an understanding of their ecology, which is useful to predict the occurrence of species, and the likelihood that the species will occur at a given specific site condition, as it is fundamental (Falk & Olwell, 1992). Detailed knowledge of species distribution in relation to their environment, habitat alteration, conservation planning and fore-casting (Rushton *et al.,* 2004) are essential parameters for setting conservation priorities (Scotts & Drielsma, 2003; Liu *et al.,* 2011). Wide spread research is on to protect individual species (Corsi *et al.,* 1999), overall biodiversity (Gioia & Pigott, 2000) and estimating the geographic distribution that is suitable for target species which is a common strategy (Cayuela *et al.,* 2009). Characterization of habitat i.e., ecological or spatial modeling approach requires spatial data from different sources and scales (Store & Jokimaki, 2003) using Geographical Information technologies such as GIS, Remote Sensing and GPS for generation of Species Distribution Models (SDM) by using different softwares . The present chapter focuses on:

1. Reviewing the various spatial data requirements, statistical algorithms and softwares used for SDM.
2. Prediction of suitable habitat distribution of an endemic and vulnerable Gymnosperms - *Gnetum ula* (Gnetaceae) using species occurrence, bioclimate and altitude as input variables in maximum entropy (MaxEnt) model.

BACKGROUND

Integrated GIS and remote sensing are being successfully integrated to map the distribution of several plant and animal species, their ecosystems, landscapes, bio-climatic conditions etc., (Stow *et al.,* 1989). Advanced geographic mapping software's allow us to model the distribution of a particular species by analyzing the environmental characteristics of its known localities (Elith & Burgman, 2003). Geographical Information technology such as Remote Sensing, Geographical Information System (GIS) and Global Positing System (GPS) are now extensively used to predict or generate species distribution maps using ecological niche and environment of the region as a base. GPS is generally used to collect the geographic coordinates of species occurrences and satellite data in the GIS environment is useful to identify the habitat conditions and generate the environmental predictors. SDMs thus generated using species occurrence data are correlated with environmental predictors using Geostatistics methods and tools. GIS provides platform to develop the models using data on species–environment associations (Valavanis *et al.,* 2004).

SDM give the information on the ecological requirements for the species survival and for suggesting effective conservation management strategies. SDM uses empirical data to describe and predict the occurrence of individual species, essentially by quantifying statistically their broad ecological niche