# ECOLOGICAL NICHE MODELLING: AN IMPORTANT TOOL FOR PREDICTING SUITABLE HABITAT AND CONSERVATION OF THE HIMALAYAN MEDICINAL HERBS

**L. Singh*, Mohd. Tariq, K. Chandra Sekar, I.D. Bhatt and S.K. Nandi**

G.B. Pant National Institute of Himalayan Environment and Sustainable Development,
Kosi- Katarmal, Almora, Uttarakhand, India

***Correspondence:** laxmansingh@kunainital.ac.in

Himalaya is one of the largest and youngest mountain chains of the world and is considered as an unique repository of medicinal and aromatic plants. The Indian Himalayan region (IHR), spread over 12 states, covering nearly 16% of total area of the country's geographic area, accounts for about 46% of the endemic plant species. The IHR, recognized one among the 34 biodiversity 'hot spots' in the world, is known for its uniqueness, richness and representatives at all levels (gene, species and ecosystem). The presence of rich biodiversity is mainly attributed to diverse habitat types, which is influenced by wide altitudinal range (300-8000 m), varied climatic conditions, temperature regime and complex topographical features.

Over the years, rapid increase in human populations, habitat fragmentation, over exploitation of natural resources, changing climatic conditions and invasion of alien species, and other factors have resulted in degradation of various ecosystems worldwide. The changing scenario over the years, enforces us to identify species rich sites and areas where they can be reinforced and reintroduced not only to sustain the biodiversity loss, but also to reap economic benefits for ensuring livelihood.

Species reintroduction is one of the successful ecological engineering techniques in developing effective restoration programmes for degraded habitats and ecosystems including some high value and medicinally important species of the IHR. Recent advancement in the field of biodiversity conservation is the use of Geographical Information System (GIS)/remote sensing (RS) modelling techniques to identify species distribution sites and suitable areas for re-augmentation programmes. One such modelling technique is Ecological Niche Modelling (ENM), which is basically a conceptual framework for understanding and anticipating geographic and ecological phenomenon related to biodiversity. ENM uses occurrence data in conjunction with environmental data to make a correlative model of the environmental conditions that meet a species ecological requirement and predict the relative suitability of habitat using computer algorithms. In short, it is sum of organism's tolerance and requirements. The main assumption of this approach is that if a species can be found in certain conditions at a particular area, then it should be able to survive and reproduce in other places under similar conditions.

The rich diversity of the Himalaya with different biogeographic locations and varied climatic conditions currently faces extreme threats. Among others the anthropogenic activities is predominant, and as a result, most of the species of this region are now being in the limelight of threatened categories. Hence need of the hour is to prioritize conservation, using best strategies for species reintroduction and rehabilitation.

Keeping in view the relevance and importance of the Himalayan plants, the Dept. of Biotechnology (DBT), Govt. of India, New Delhi, under the National Networking Programme is funding this Institute a project entitled "Preventing extinction and improving conservation status of threatened plants through the applications of biotechnological tools". The project is being carried out in over 37 institutes/universities involving 76 scientists all across the country. Among various objectives, one such objective is the use of ENM tool to predict the probable distribution sites and quantitative assessment of four medicinal herbs, namely *Angelica glauca (Apiaceae)*, *Dactylorhiza hatagirea (Orchidaceae)*, *Paris polyphylla (Melanthiaceae)*, and *Podophyllum hexandrum* in different geographic regions of Uttarakhand, Western Himalaya (Fig. 1 a-d). All these species are of high medicinal value and are

listed under different threat category (CAMP) as: Endangered (*A. glauca*, *P. polyphylla* and *P. hexandrum*), and Critically Endangered (*D. hatagirea*).


**Fig.1.** The different target species being studied under the project (a) *A. glauca* (b) *D. hatagirea*, (c) *P. polyphylla* (d) *P. hexandrum*

Investigations on these species were undertaken in different districts of Uttarakhand to confirm their presence and to validate the model predictions. Based on the results obtained from the predicted modelling using Max Ent suggests, precipitation of the driest quarter, as the major influencing bioclimatic variable for occurrence of *A. glauca* and *P. polyphylla*, while for *D. hatagirea*, it was precipitation of warmest quarter; on the other hand for *P. hexandrum* the governing factor was temperature annual range. The different colour indices corresponds to the predicted habitat suitability index (0 to 1) and based on which maximum habitat suitability index (0.66- 1.00) has been represented by dark red patches; other colours indicate decreasing trends in habitat suitability (Fig. 2 a-d). Thus conclusion from our studies suggest that predicted habitats need not necessarily be occupied by the species, however it shows areas having similar climatic conditions, that is required to retain a species by it structural and functionalities.

Prime focus of today's research is on reintroduction of threatened species and rehabilitation in their respective ecosystems, thus detailed knowledge on the distribution of their potential habitats becomes essential; here the role ENM model comes in action. This approach is currently widely accepted tool for species reintroduction and in developing effective species conservation measures and restoration of critical habitat of various medicinal and high valued plants of the IHR.

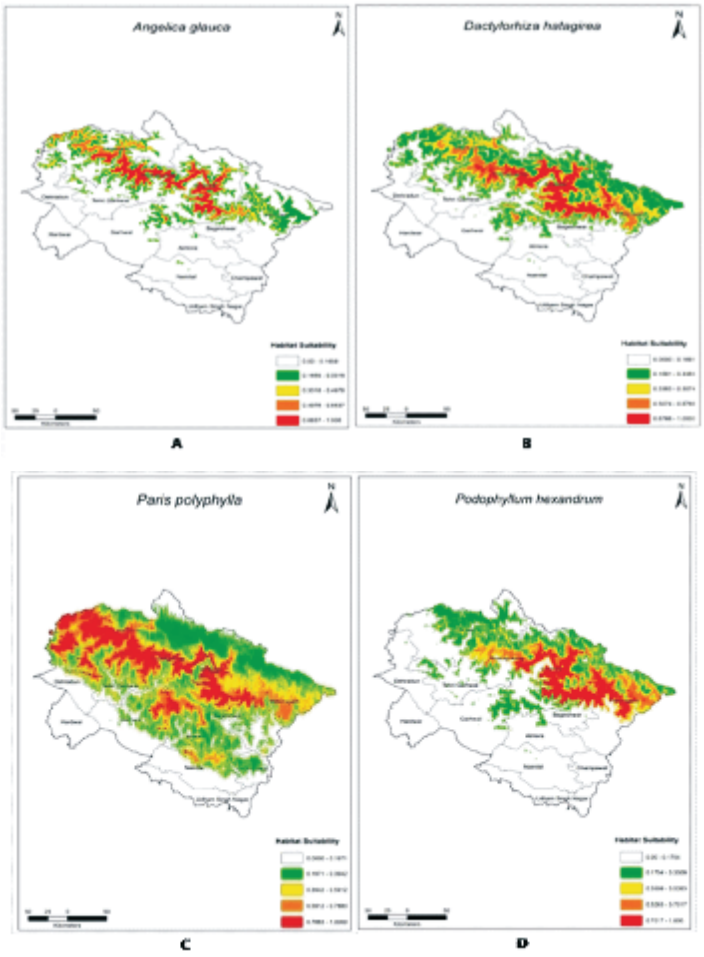


**Fig. 2.** Predicted niche for the target species in Uttarakhand, Western Himalaya (a) *A. glauca* (b) *D. hatagirea* (c) *P. polyphylla* (d) *P. hexandrum*