Species distribution mapping and sustainability measures for a fungus economy in the Indian Himalaya.

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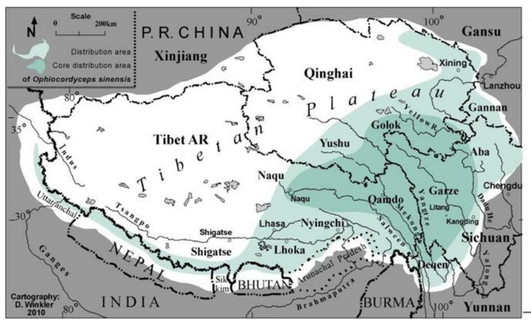
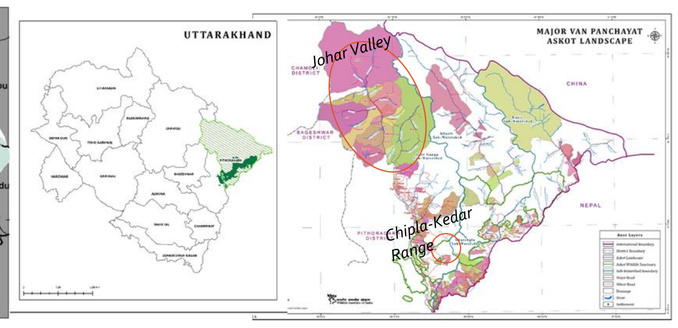
ABSTRACT

A entomopathogenic fungus, a fungus that kills its host caterpillar to proliferate. This fungus cures a plethora of ailments. It is one of the most expensive natural resources of the world and a resource that emancipated many from poverty in remote mountains in the Tibetan plateau and the adjoining high altitude areas of Central and Eastern Himalaya. Geographically, a fine resolution information is lacking for majority of its distribution area. We explored a small region Askot landscape in the state Uttarakhand in Western Himalaya in India. The quest culminated in an extensive questionnaire survey with the villagers and harvesters. A current distribution map based on survey and a predicted suitable zone map using MaXent was produced. The concept is based on distributional ecology of a species which cross sections into concepts of species distribution model and ecological niche modelling. The inputs included both abiotic and biotic factors, albiet complexity. After repeated calibration and manual evaluation analysis, we chose elevation, aspect, slope and 12 PCA inputs of 68 MODIS 13Q1 NDVI layers(2012-2013) as the input data. Presence only data distributed as 10 random replicate pairs is used for training data and evaluation. Occurrence data is error free as it is a primary source data. Model evaluation returned a AUC ratio >1 values for each, indicating that Maxent curve was significantly elevated above the null expectations. The process of generating a suitability map convinced us of a sustainable harvest approach for safeguarding direct benefit to people's livelihood and indirectly the local environment.

STUDY AREA

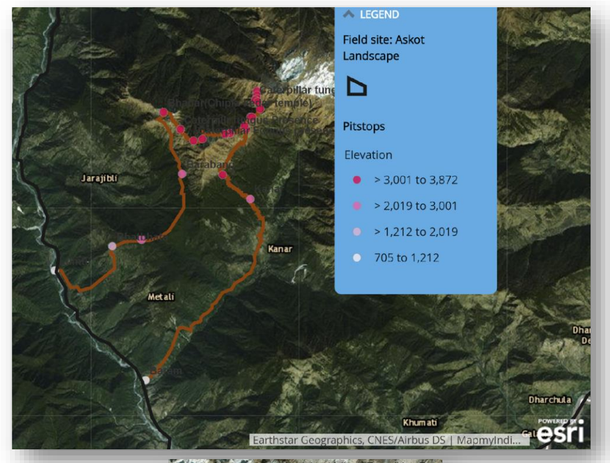


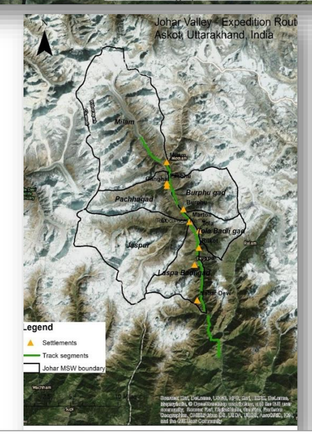


The location of the landscape is where the bio-geographic elements of the Western Himalaya, the Central Himalaya and the Tibetan Plateau converge. (Peace, 2007). Ground truthing of Chipla-Kedar ranges and Johar valley was conducted for the predicted suitability map generated.

In chipla-kedar, the caterpillar fungus exploration trek constituted of 5 specialists from WII, from 2nd June - 8th June 2015. Our destination was Teejam khaya (Chipla-kedar range), one of the many harvest sites in the Askot landscapee, took 3 days to reach and we experienced altitude change from 900 m to 4200 m.

In Johar valley, Surveys were conducted across 6 of the VPs namely 10 out of 14 villages in 15 days. Along the trek route, the porters aided in the extraction of caterpillar fungus, thereby, directing us to suitable and unsuitable zones for data collection.





METHODS

Input

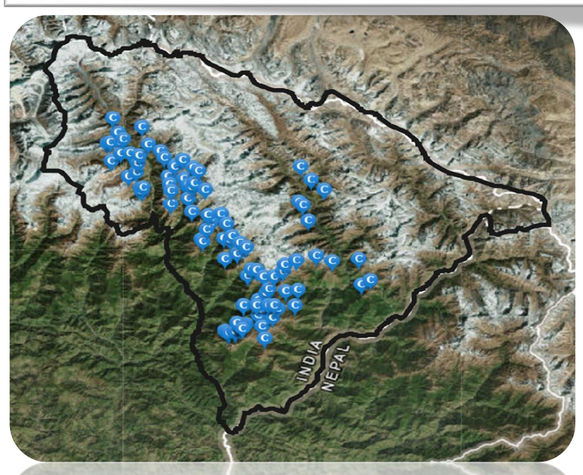
- Carefully curated to conform with diverse factors affecting its distribution like history, environment interactions with other species, dispersal capacity and dispersal barriers.
- Occurrence points subset random sampling – training data sets.
- Continuous co-variate data used: Elevation, Aspect, Slope and MODIS 13Q1 (NDVI)
- The input variable dataset are georeferenced and converted to ASCII format to be used in MaxEnt using ArcMap or QGIS software.

MaXent - Species distribution model

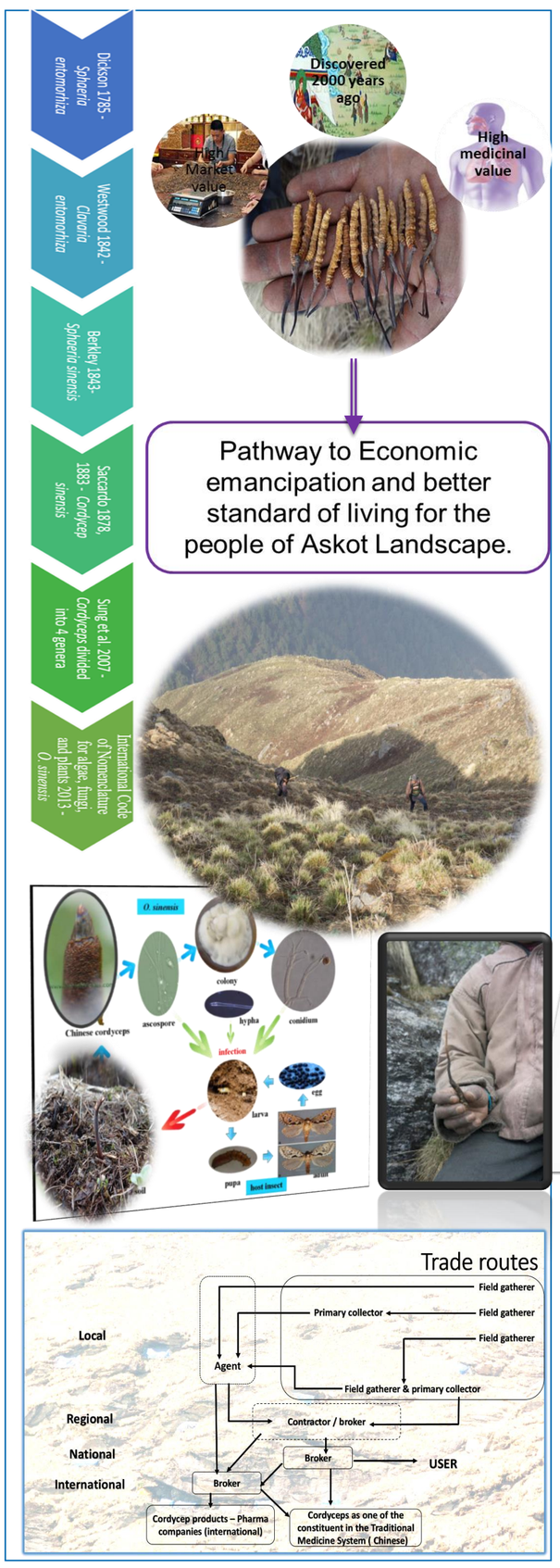
- 12 training data set x 7 input combinations x 10 random model replicates produced 840 model results.
- Minimum presence thresholding for binary model predictions.
- The model performance evaluation was measured externally and it was significant in case of all the subsets.
- The partial ROC curve analysis results of all the sub samples have AUC ratio > 1.
- Proportion of omission is 0.03.

Output

- Calibration and Evaluation data were used independently.
- Based on similar MaXent settings, the model is calibrated with all occurrence points for the final output.
- QGIS is used for layer generation and analysis.

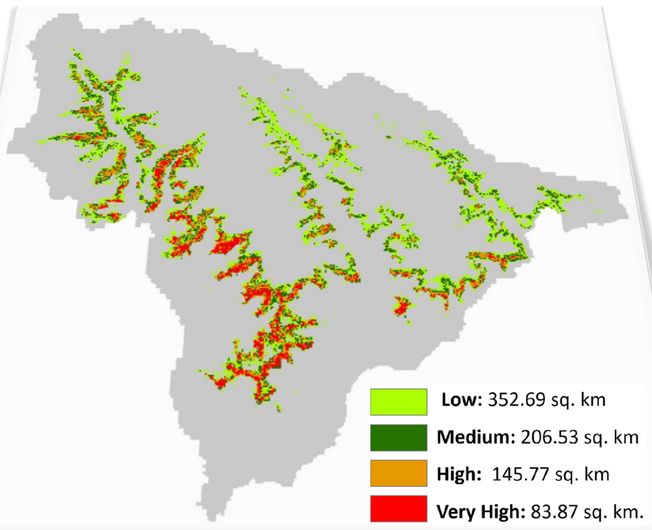


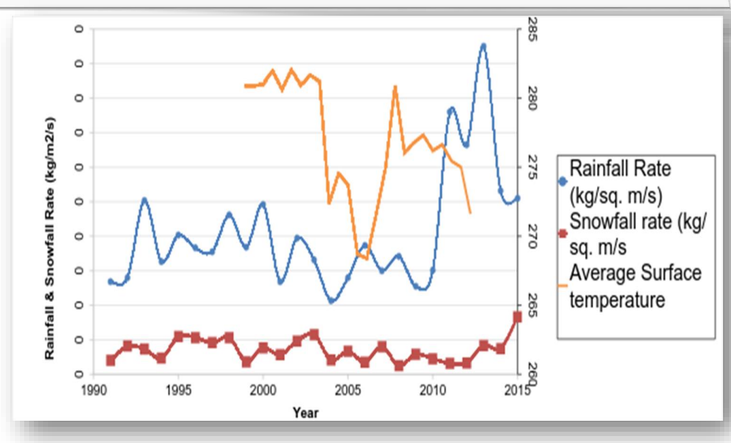
BACKGROUND

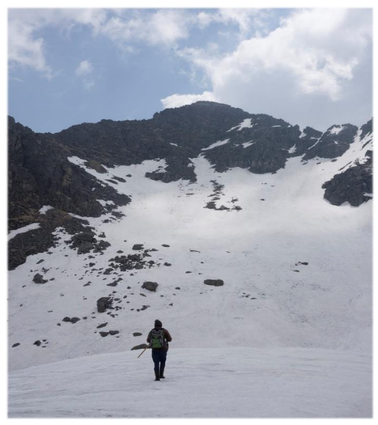


RESULTS

Predicted suitable area map identified the important zones and hotspots for dedicating our ground assessment resources. The climatic variability data was process from GLDAS data which was used to substantiate comments on decline in harvest.







CONCLUSIONS

Identification of suitable zones is imperative to prioritize the regulation of the harvest and techniques for preserving the ecosystem Information regarding harvest practices, areas of collection, expenses incurred for harvesting O. sinensis and ways of utilization of earnings from the same was also noted. The data were analyzed to envisage the extent of resource dependency and ascertain at which point harvesting would be ecologically detrimental. In the last 25 years climatic variability is visible, as seen here, and emphatically felt by the locals of Askot LS. The high resource dependence and improved quality of life of the locals are risked by a decline in harvest quantity. Mindless harvest practice and climate change both are suggestive of the decline. Thus, amplifying the need to develop sustainable harvesting practices and participatory monitoring.

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