2. Project title: Butterflies associated with different forest types/sub-types in Uttarakhand
Name of PI :   Dr. Arun Pratap Singh
Year of Project duration :   2017-2021
Funding agency's full name :   ICFRE

Overview of project : Champion and Seth (1968) classified Indian forests into different forest types and subtypes, based on their similarity of dominant vegetation and structural arrangement of species. However, it was not known if the species composition and community structure of lower groups of animals i.e. butterflies within them, is also similar within each forest-sub-type or different in each forest sub-type. If this is the case then, each forest sub-type harboring rare species can be taken as unique habitats or units of conservation at the lower level on a sub-regional scale and can be used to identify gaps in the current protected area network of the state.

Objectives
Long term:
▪ Conservation planning for biodiversity based on butterfly-forest-sub type associations in Uttarakhand

Short term
▪ To study the seasonal abundance of butterflies, outbreak of pest species and their impact on the forest, if any.
▪ To evaluate the species and communities of butterflies (lepidoptera) under different forest sub-types of Uttarakhand.
▪ To determine the geographical distribution (altitudinal, latitudinal and longitudinal) of butterflies in Uttarakhand.
▪ To identify the larval food plants of butterflies present in different forest sub-types.
▪ To identify threatened, protected species and restricted range species in different forest sub-types.
▪ Evaluate butterfly species and forest areas of conservation concern in the state, and identify gaps, if any, in the present conservation planning i.e. protected area network and suggest new areas for conservation.
▪ To development of a butterfly-forest type database for Uttarakhand, along with their images and GIS based distribution maps.

Significant findings / outcome :

Important forest sub-types evaluated in the state in terms of rich butterfly diversity and species of conservation priority were evaluated as '12/C1a Ban oak Forest' followed by '12/C2cMoist Temperate Deciduous forest' in the Western Himalayan zone and '3C/C2 Moist Shiwalik Sal Forest'and '3C/C2c Moist Terai Sal Forests', respectively, that hold maximum number of these species including rare ones. Many of the species of conservation concern where located in forested areas our side the existing Protected Area Network of the state which consistsof 17 PA's. It is recommended that 10 clusters of butterfly sites identified in this study which harbour butterfly species of conservation concern outside the PA network may be taken up for long term conservation as biodiversity rich habitats and corridors that form a link to fill the remaining gaps in the protected area network of the state. This will ensure long term conservation at a landscape level in the state before forests outside the PA network become more degraded. A GIS database created gives forest sub-types distribution maps for each of the 370 butterfly taxa in 20 different forest types found in the state along with baseline information on their seasonality, larval host plants, relative abundance, altitudinal distribution taxonomic nomenclature and coloured images of each butterfly for identification published in the form of a book online at ICFRE website at the following link - **https://icfre.gov.in/books-file/book25.pdf**

Extension aspect / Practical utility of the findings : The database created in the form of GIS based maps for each butterfly taxa with site specific locations in each forest sub-type can be used as baseline/reference data for comparison in the future for changing range margins of species due to climate change and shrinkage of habitat sensitive species due to fragmentation and destruction of native forests. The database is online and is free download at ICFRE website.

Identification of habitats with species conservation priority to be included for restoration of corridors and filling gaps in the current PA Network.

Identification of biodiversity rich habitats outside the PA network can also be used for promoting butterfly inclusive ecotourism.

Finding s published as research papers are available at these link

Singh, A.P. (2022). Associations of butterflies across different forest types in Uttarakhand, western Himalaya, India: implications for conservation planning. *Journal of Threatened Taxa* 14(1): 20346–20370. **https://doi.org/10.11609/jott.7711.14.1.20346-20370**
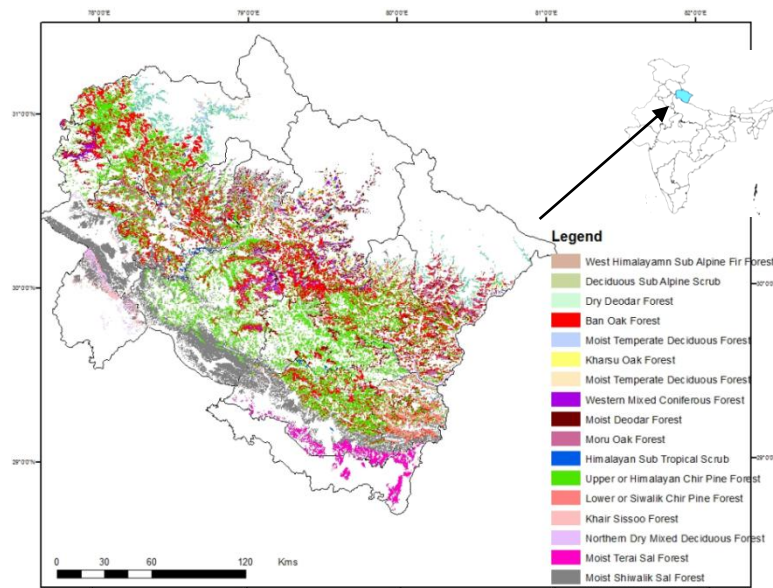
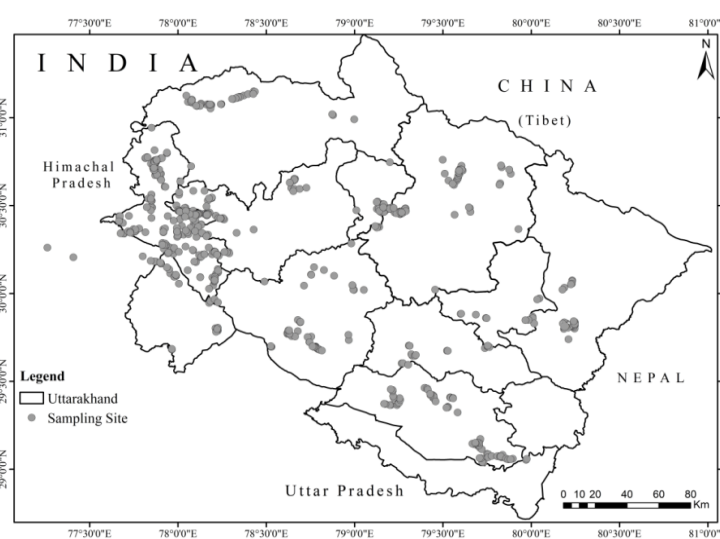**Fig.1. Different Forest types occurring in Uttarakhand state**

Fig.2. Map depicting the GPS locations of sampling sites for study on butterflies undertaken in Uttarakhand state
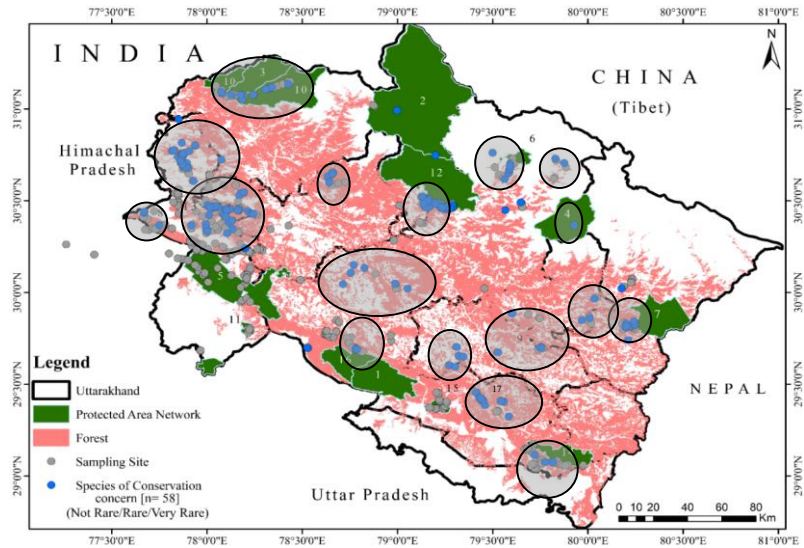

Fig.3- 17 clusters of sites spread across the state recommended as new sites for butterfly conservation and inclusive eco-toursim.
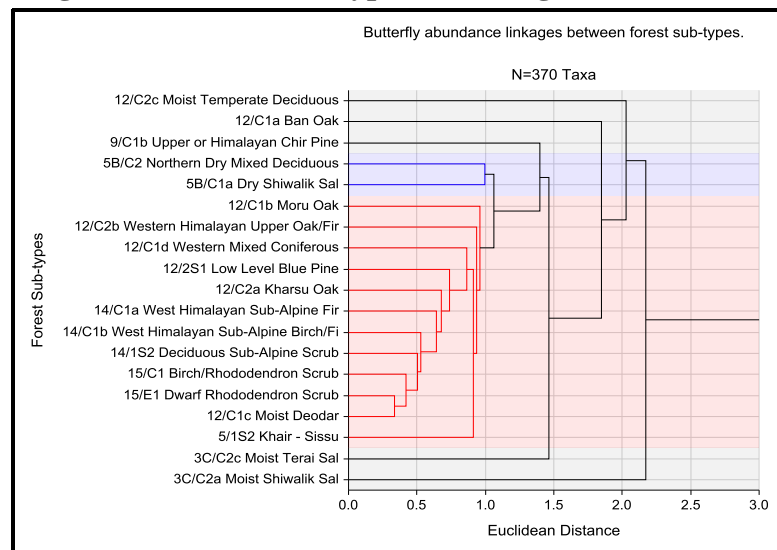

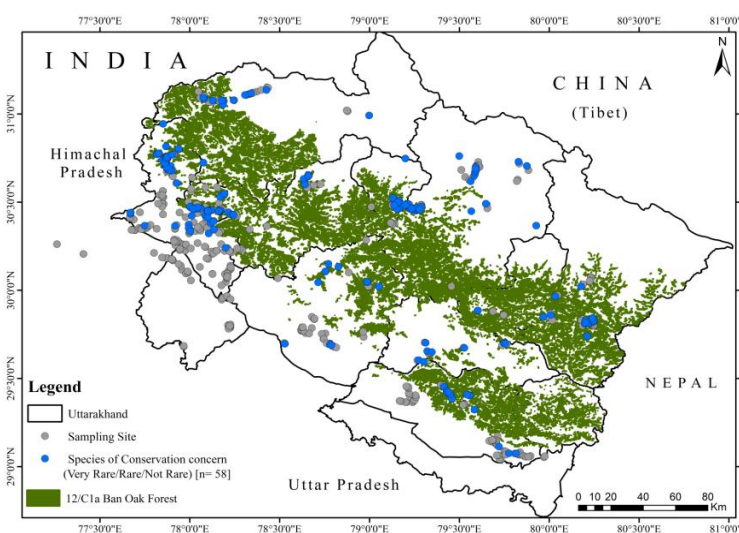**Fig.4 .Dendrogram showing hierarchical clustering of forest sub-types in terms of butterfly species in each**

Fig.5- Important forest Sub-type in the state12/C1a Ban oak Forest *Quercus leucotrichophora*)

Pale Green Sailer, *Neptis zaida*

White-spotted Hairstreak, *Shizuyaozephyrus ziha*

Water Hairstreak, *Euaspa milionia*

Grand Duchess, *Euthalia patala patala*

Fig.6-Butterfly species of conservation priority in Ban oak forests