

The North Pole



Beyond the Third Pole



“Projected changes in global temperatures and local precipitation patterns could significantly alter the altitudinal ranges of important species within existing mountain belts and create additional environmental stresses on already fragile mountain ecosystems” - Guisan et al., 1995

Assessment and Monitoring of Climate Change Effects on Wildlife Species and Ecosystems for Developing Adaptation and Mitigation Strategies in the Indian Himalayan Region



S. Sathyakumar



Department of Science & Technology
Ministry of Science & Technology
Government of India

NMSHE NATIONAL MISSION FOR
SUSTAINING THE HIMALAYAN
ECOSYSTEM



भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Goal and Objectives

Identify the drivers of landscape change

(climatic and anthropogenic) in the IHR and their effects on the ecological systems

Conduct focussed research on terrestrial and aquatic fauna and their habitats, microbial communities and their role in flow of ecosystem services in the IHR

Develop monitoring and Decision Support Systems (DSS) for selected indicator species in the IHR

Develop spatial and inter-operable database to facilitate and policy decision making

Undertake climate change scenario analyses and visualization for predicting potential effects on fauna, micro-flora and their habitats

Build capacities within WII and of other stakeholders for **sensitization** and to enhance capabilities for negotiations at the national and international forums

Goal: *Develop strategies to mitigate climate change effects on wildlife species and their habitats in the Indian Himalayan Region (IHR)*

Conceptual Framework

Approach

Desk Review & Secondary Data



Inputs from networking partners



Field Surveys in the Selected River Basin



Integration of Data from all Themes



Development of Inter-operable Spatial Database



Analysis of Field Data and Report



Analysis of Secondary Data and Report



Integration of Analyzed and Report Outputs Interim Policy briefs

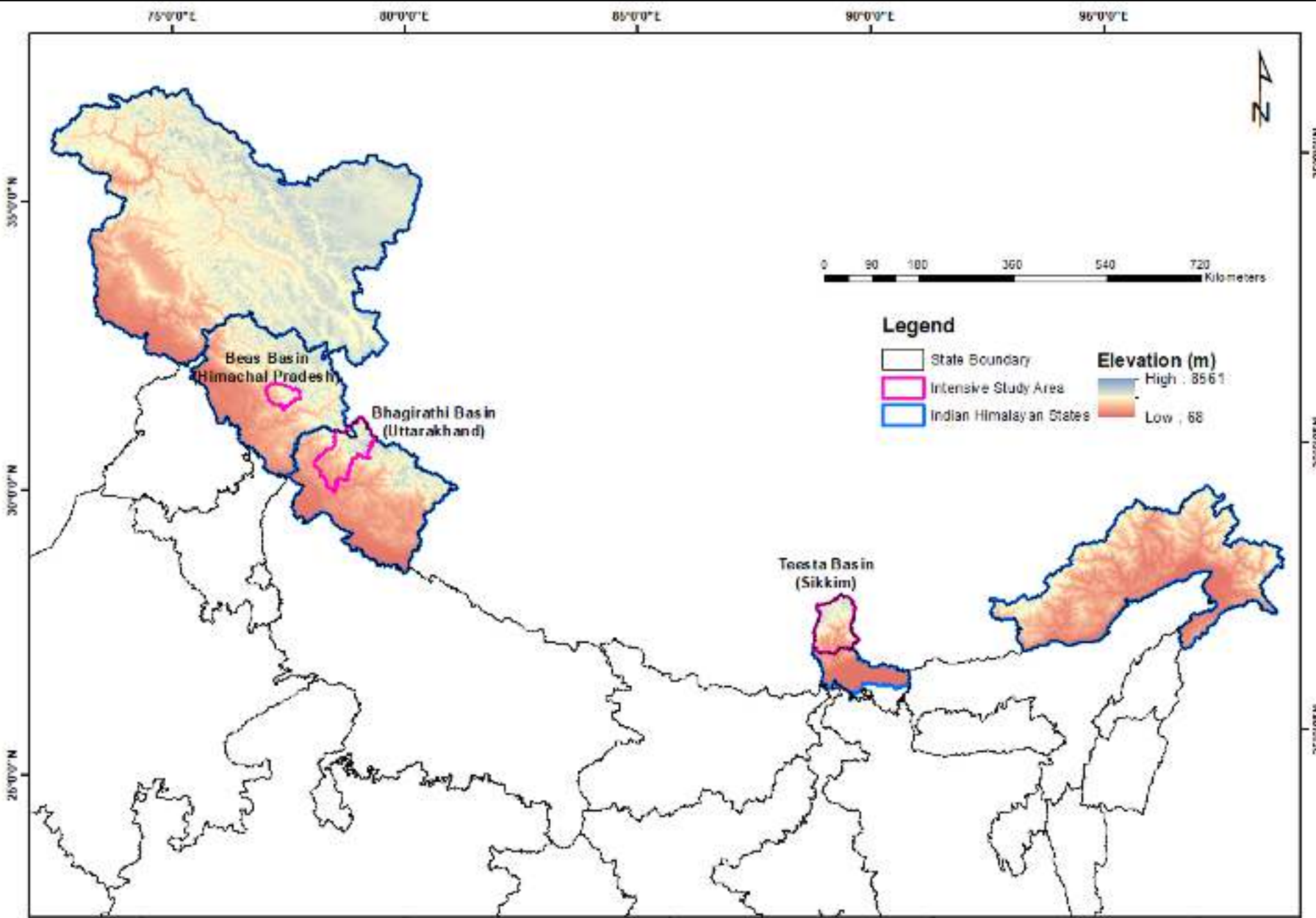


Scenario Building and Visualization of Outputs

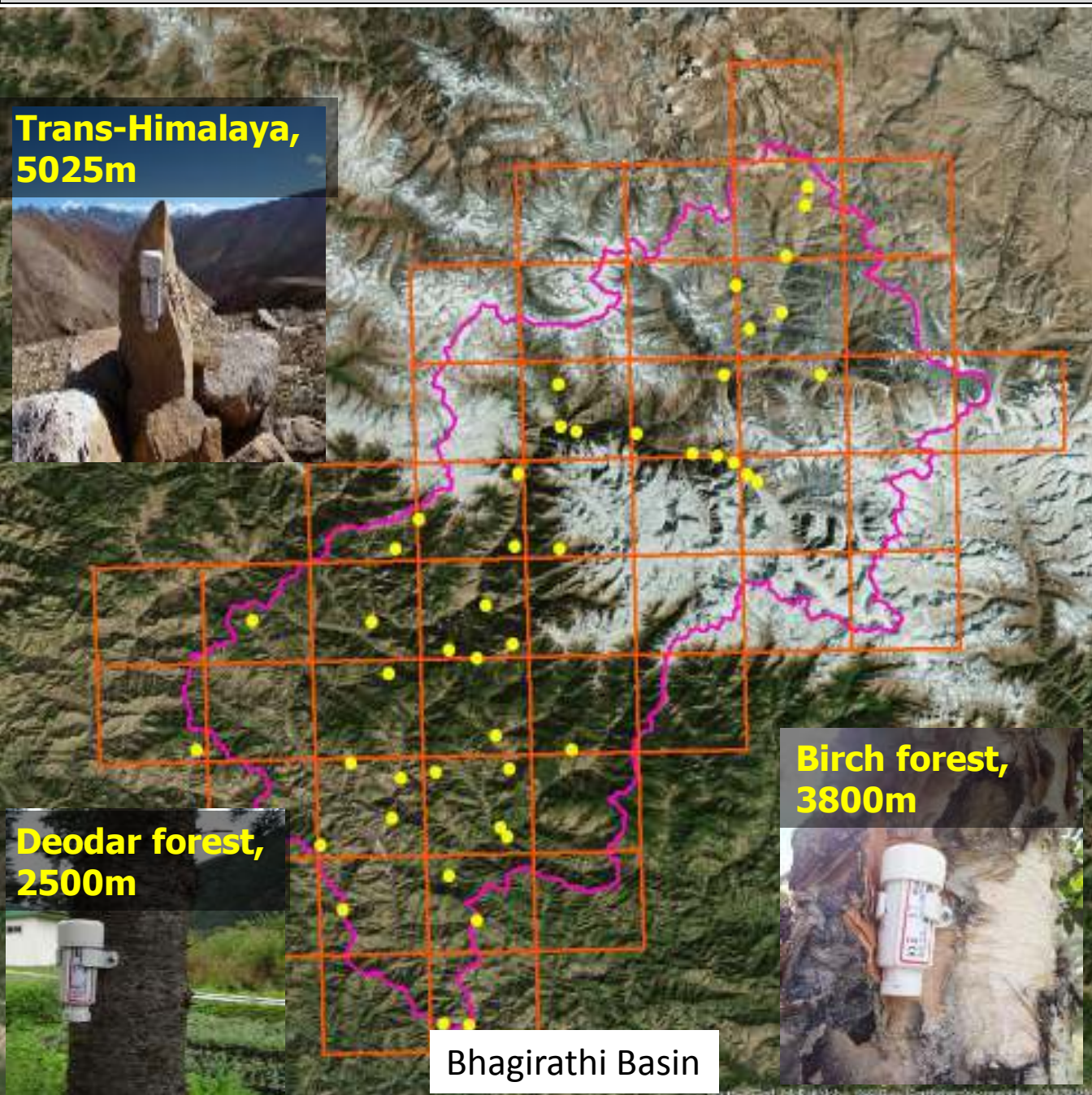
Comprehensive Report on Vulnerability Indices

Enhanced Capacity for Policy formulation and climate change negotiations

Study Area: three river basins in three Biogeographic zones in the Indian Himalayan Region



Fine-scale weather information collection



Bhagirathi Basin



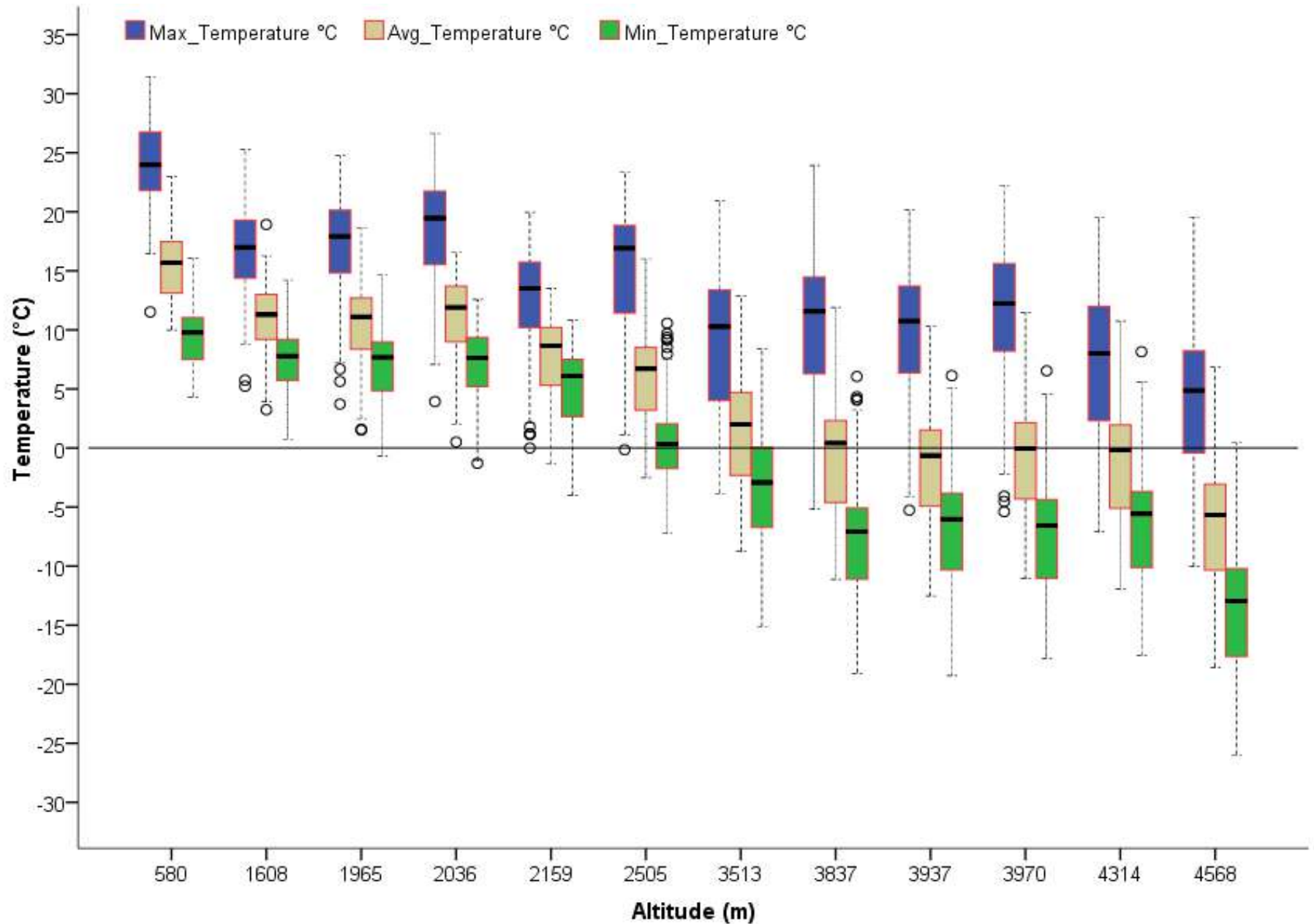
Proposed Sites
Beas Basin



Teesta Basin

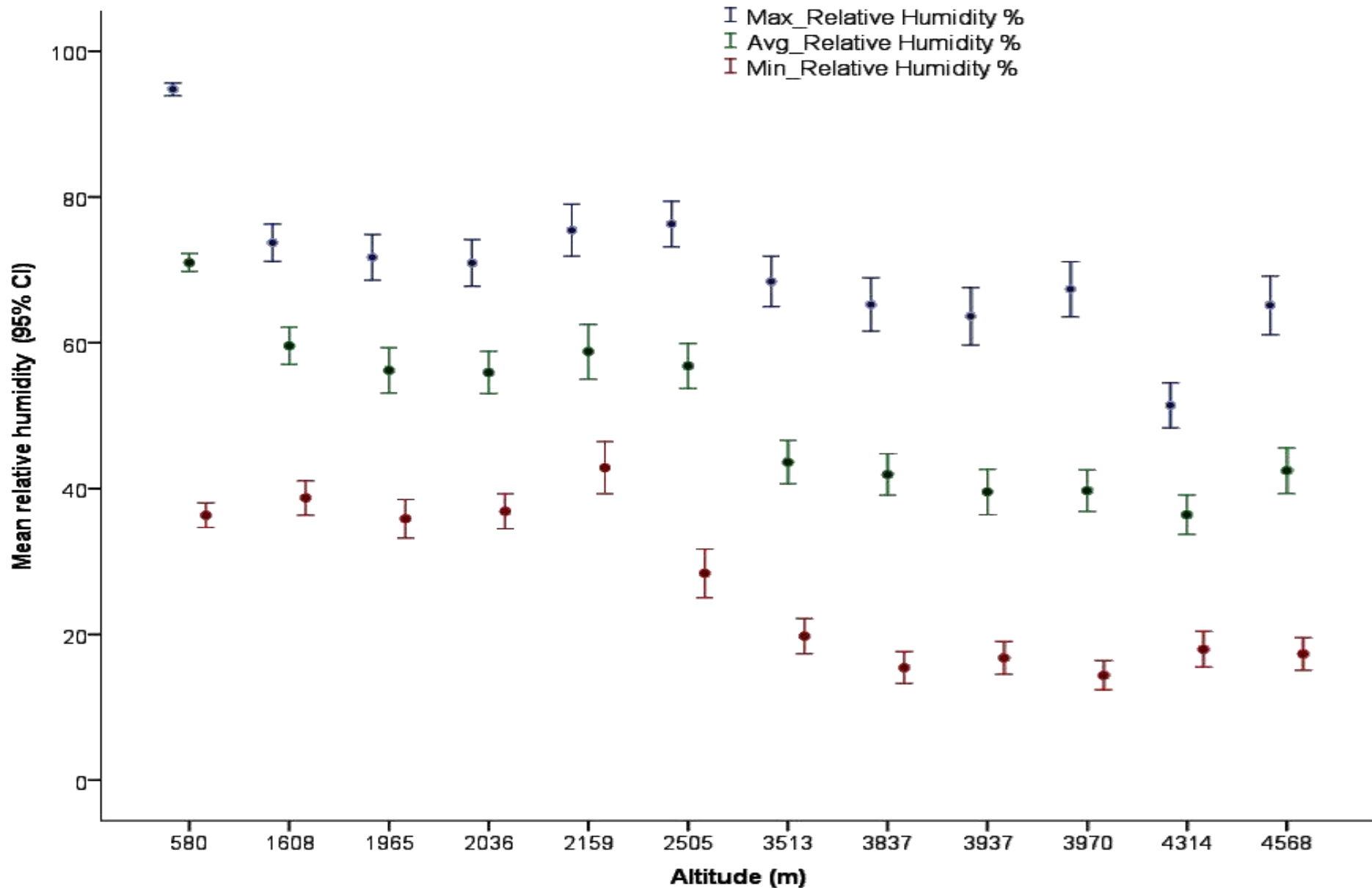
Fine-scale weather information: preliminary results

Temperature in Bhagirathi Basin in Autumn and Winter (Oct 2016 to Feb 2017)



Fine-scale weather information: preliminary results

Relative humidity (%) in Bhagirathi Basin (Oct 2016 to Feb 2017)



Conduct focussed research on **terrestrial and aquatic fauna** and their habitats, **microbial communities** and their role in flow of **ecosystem services** in the IHR

Thematic Areas

Terrestrial ecology

Microflora and fauna
(**Lichen, soil bacteria, soil nematods**)

Insects (**Odonates**)

Herpetofauna (**Amphibians**)

Birds (**Galliformes**)

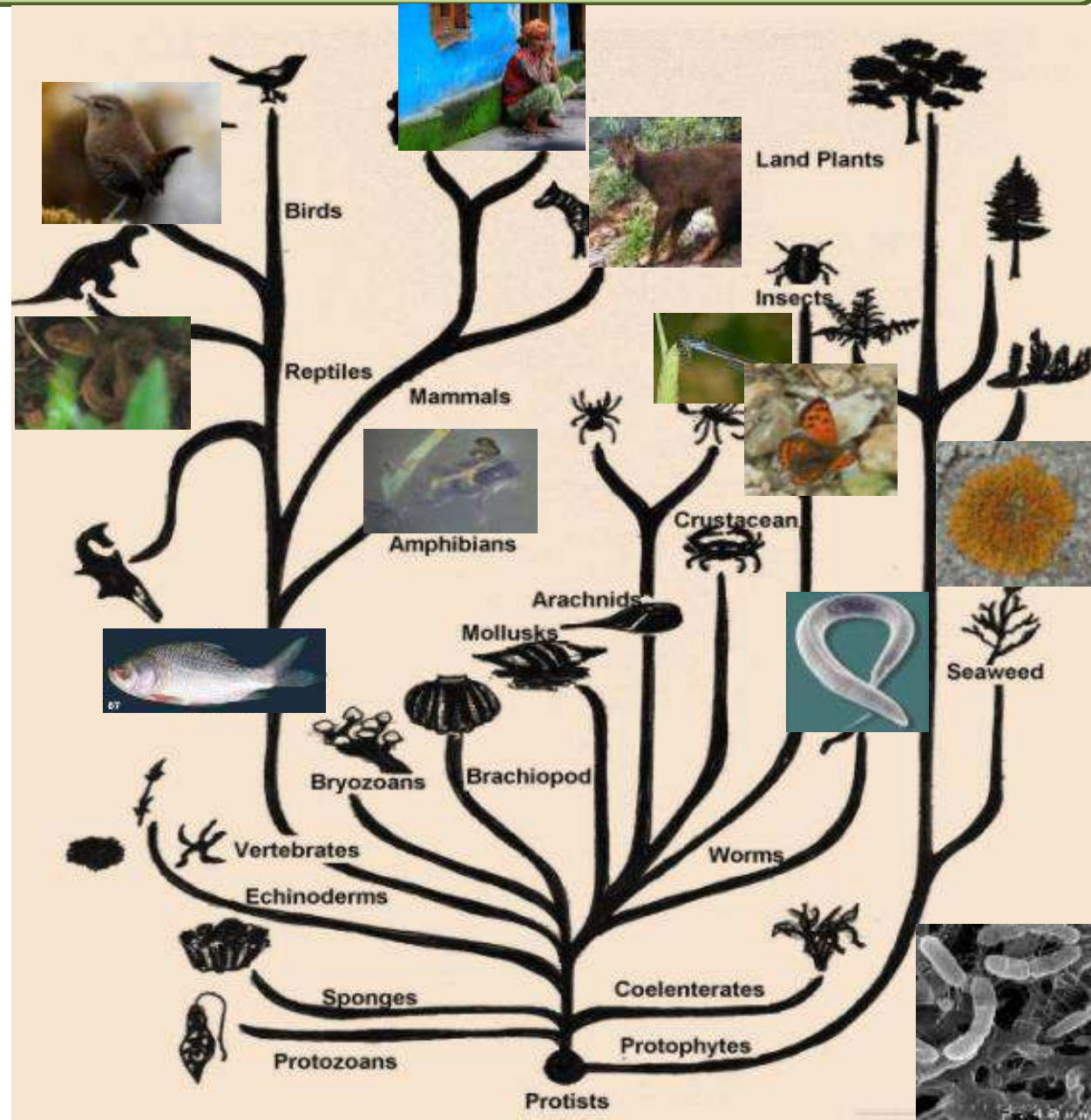
Mammals (**non-volant**)

Aquatic ecology

Fish

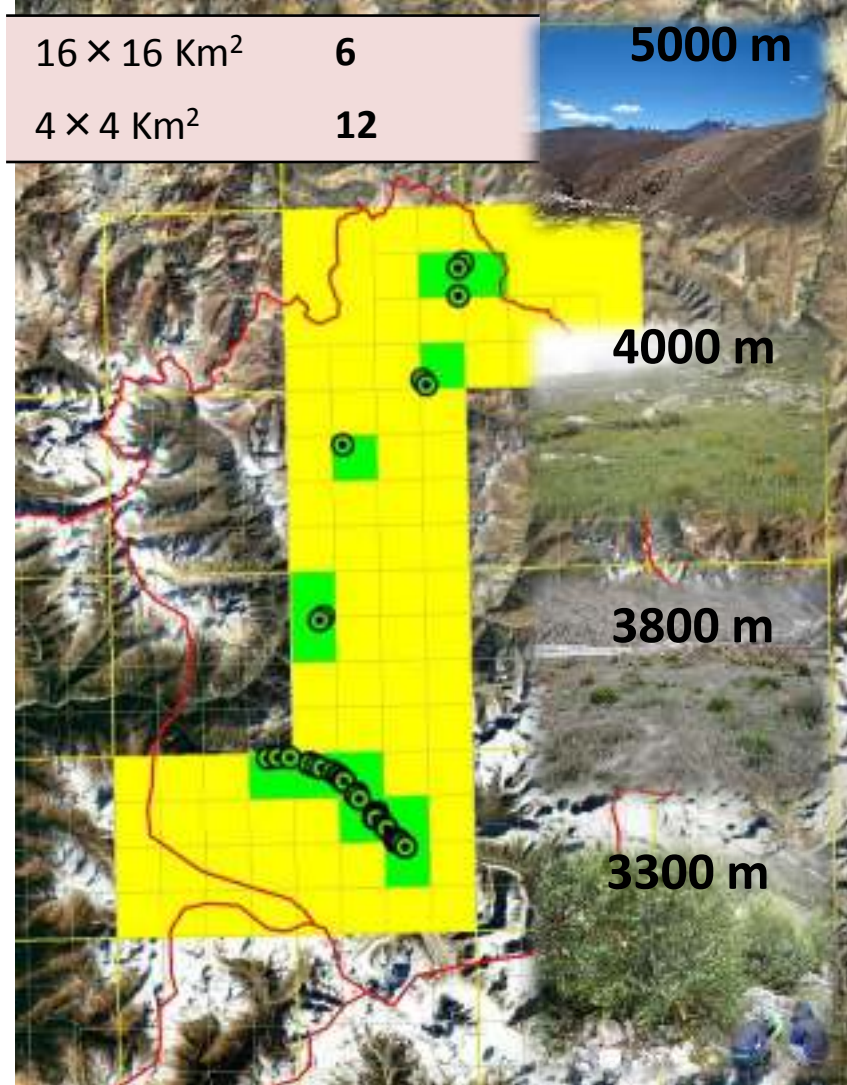
Human ecology

Livelihood and ecosystem services

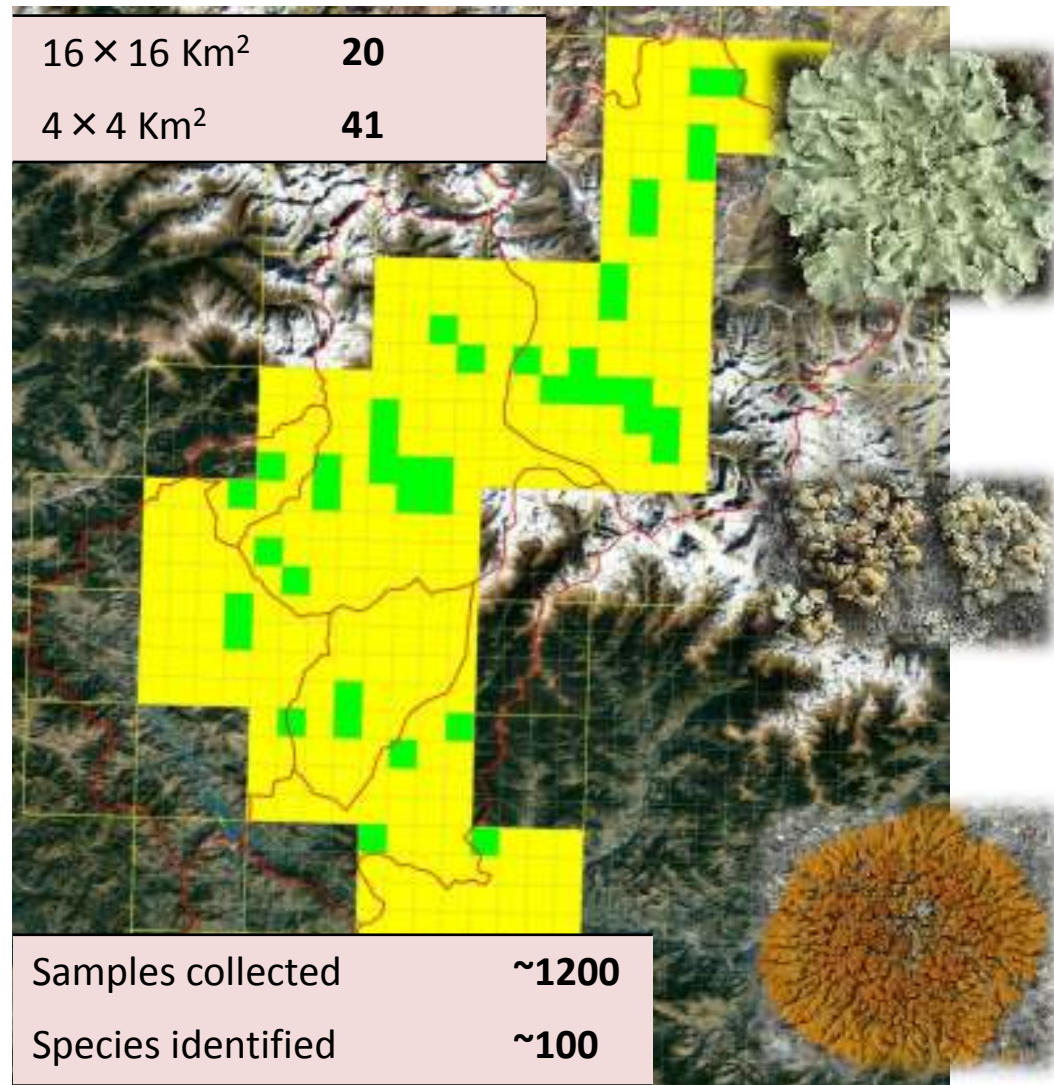


Objective Conduct focussed research on **terrestrial and aquatic fauna** and their habitats, **microbial communities** and their role in flow of **ecosystem services** in the IHR

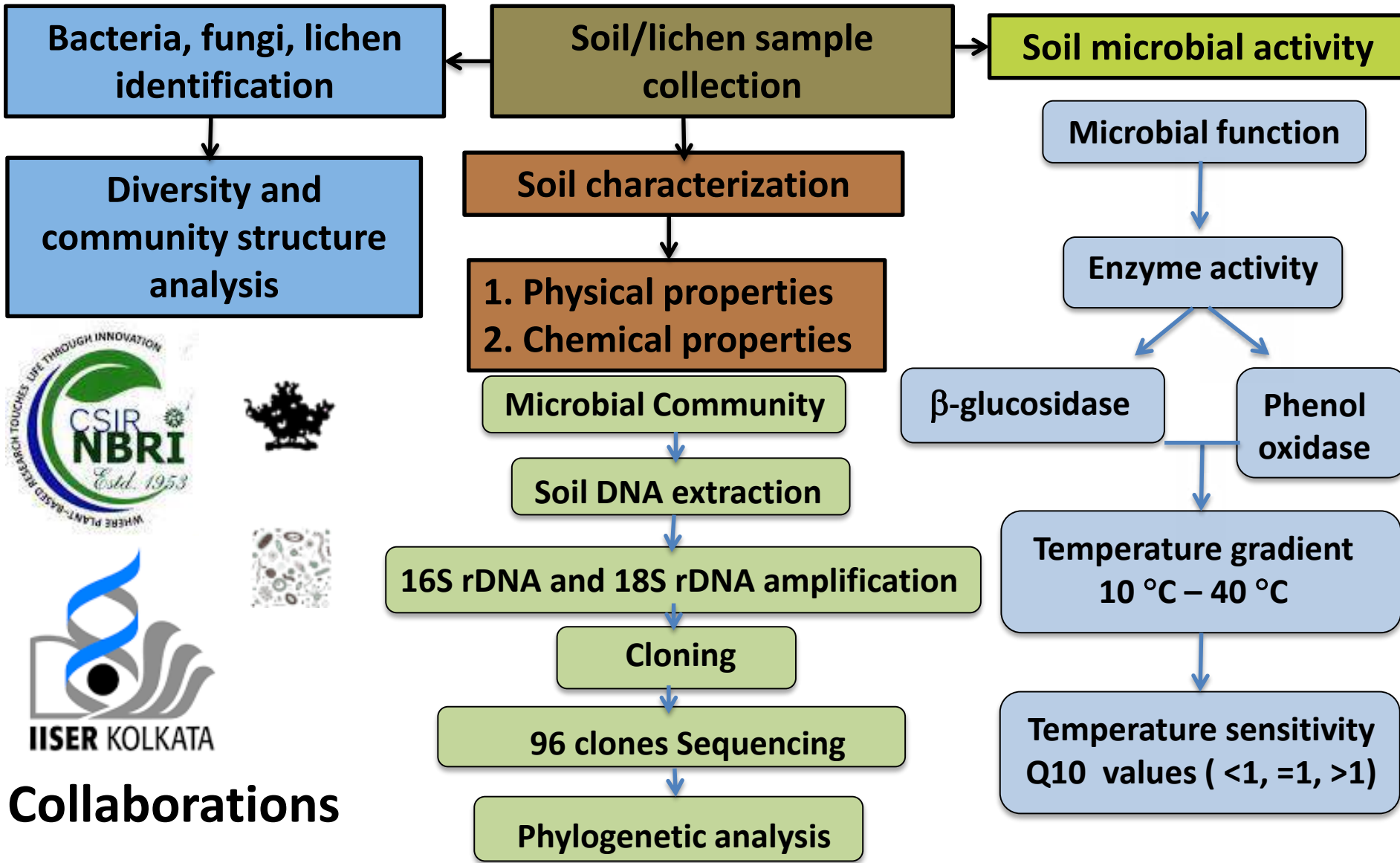
Soil sample collection



Lichen sample collection



Framework for micro-flora status assessment

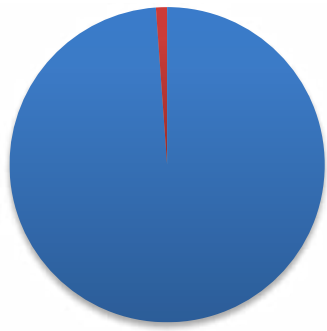


Collaborations

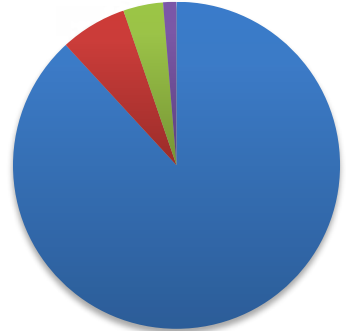


Bacterial genus identification

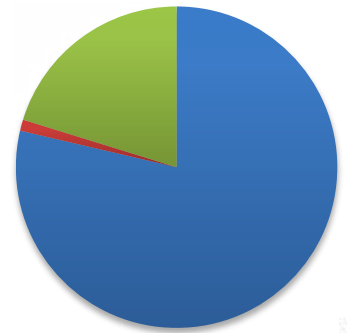
(n=4 habitats): 384 clones



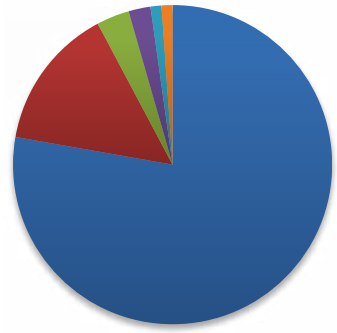
- Proteobacteria
- Bacteroidetes



- Proteobacteria
- Gemmatimonadetes
- Actinobacteria
- Acidobacteria



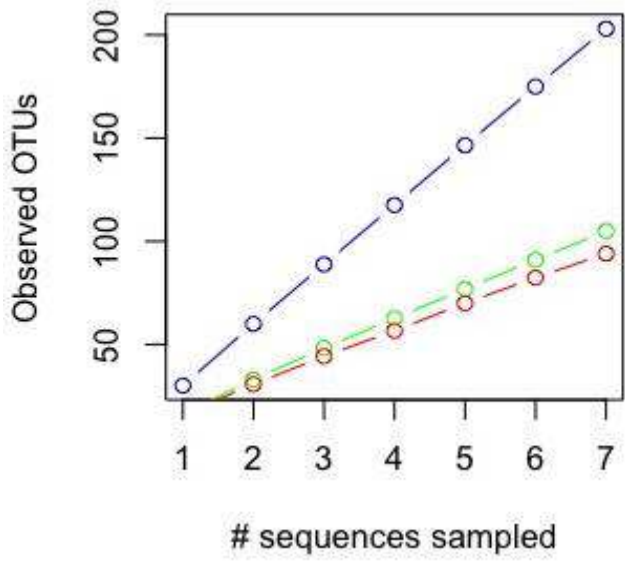
- Proteobacteria
- Cyanobacteria
- Unclassified



- Proteobacteria
- Firmicutes
- Actinobacteria
- Gemmatimonadetes
- Acidobacteria
- Unclassified

Alpine

Sub alpine

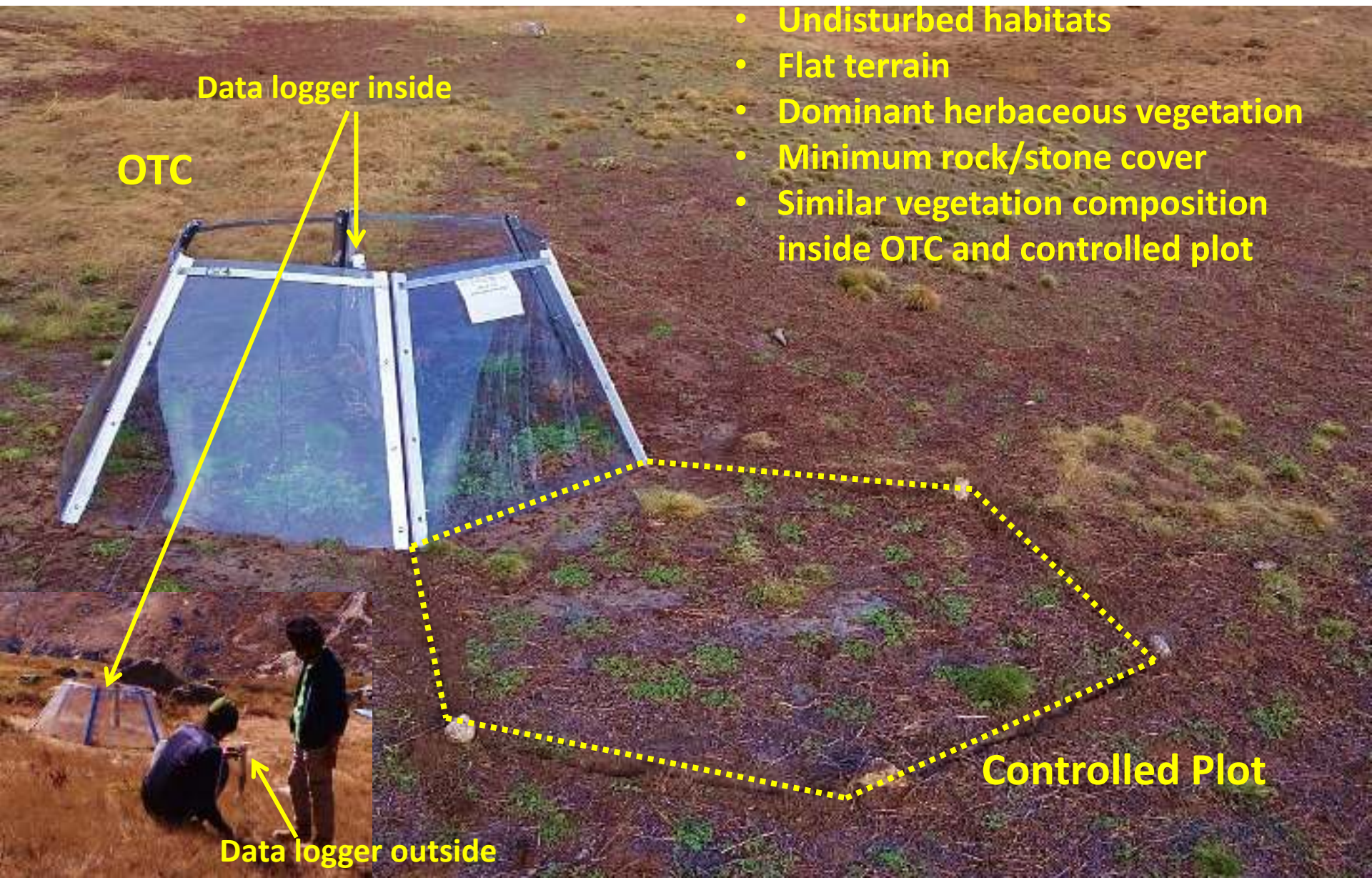


Warming experiment: Open Top Chamber (OTC)



Site selection:

- Undisturbed habitats
- Flat terrain
- Dominant herbaceous vegetation
- Minimum rock/stone cover
- Similar vegetation composition inside OTC and controlled plot



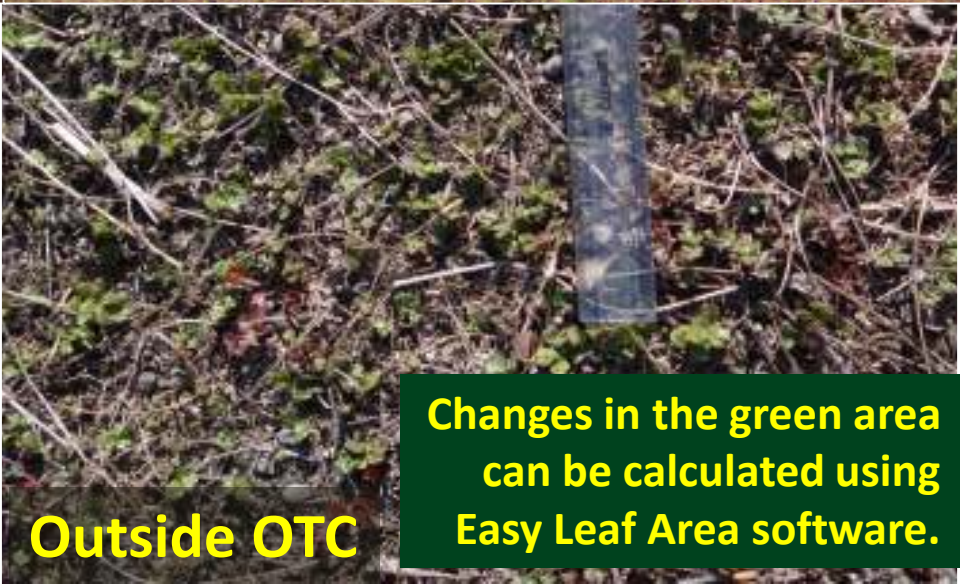
OTC

Data logger inside

Data logger outside

Controlled Plot

Warming experiment: Open Top Chamber (OTC)



Inside OTC

Outside OTC

Changes in the green area can be calculated using Easy Leaf Area software.

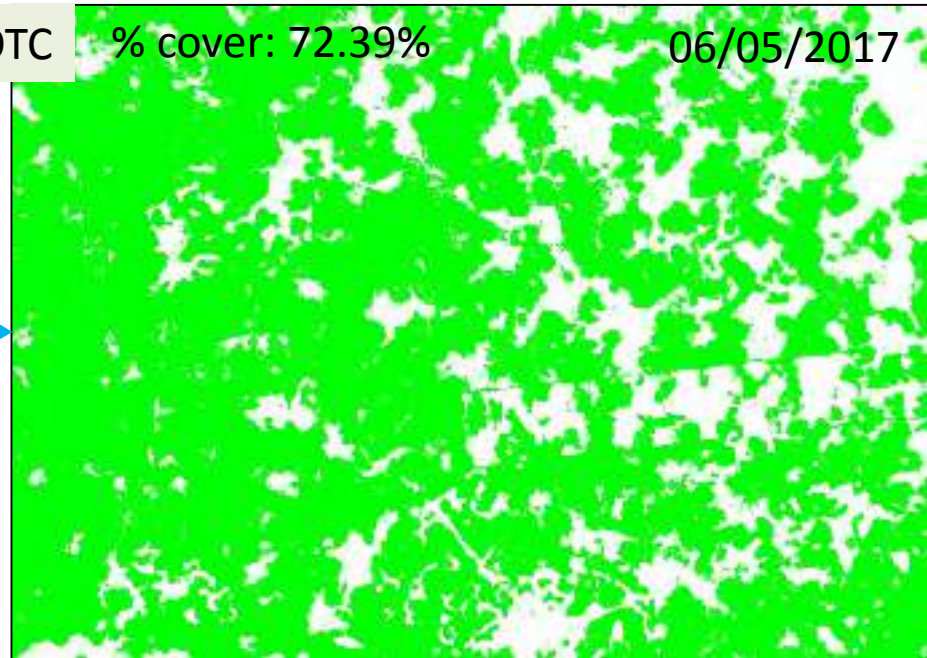
Preliminary Observations: Green cover



Inside OTC

% cover: 72.39%

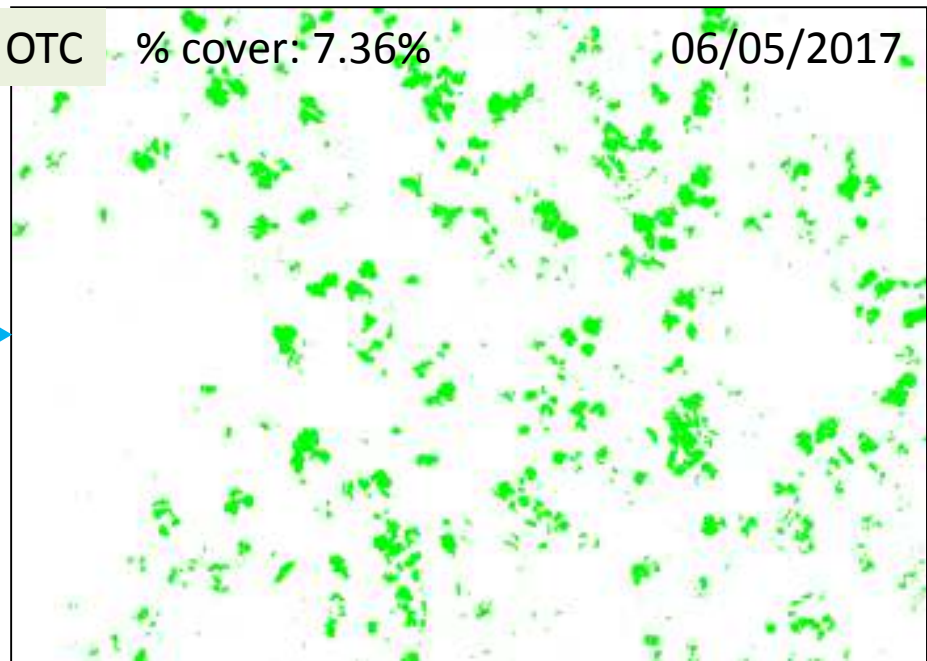
06/05/2017



Outside OTC

% cover: 7.36%

06/05/2017

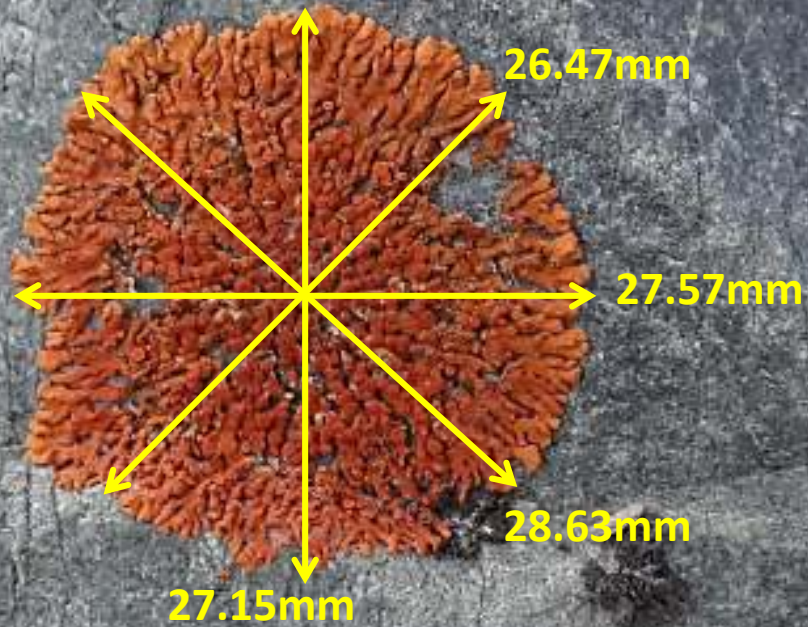


Lichenometry





Xanthoria elegans



Installation of Open Top Chambers & Data loggers



Soil sampling along elevation & OTCs



Slide preparation & Identification

Soil physiochemical analysis

Processing of samples were done by Cobb's sieving & decantation technique



Collection & Fixation



Correlation with soil parameter Abundance, Diversity, Distribution, Richness

Picking & Dehydration

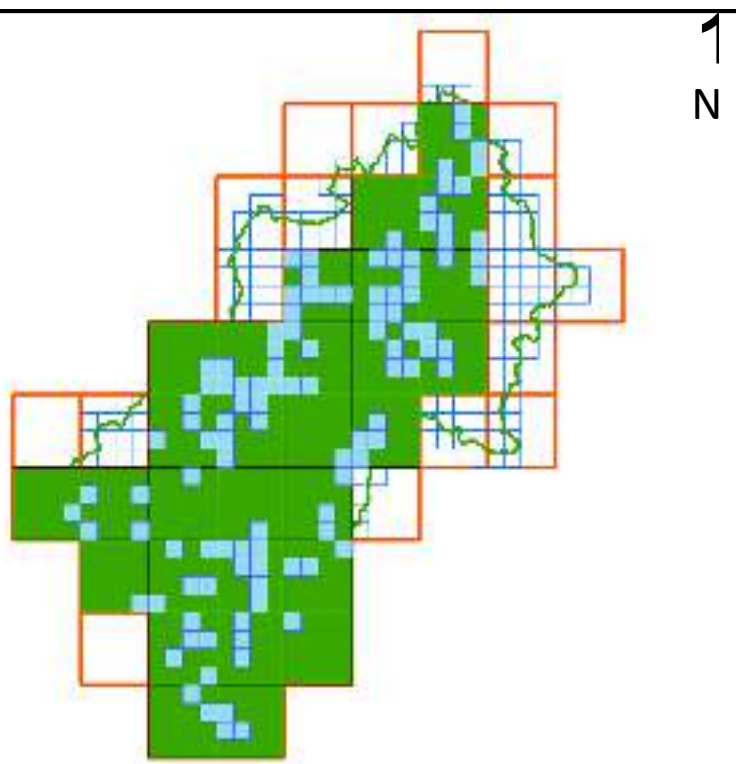


Assessing impact of climate change on soil micro fauna

Collaboration



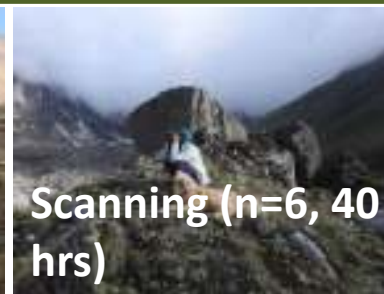
Conduct focussed research on **terrestrial and aquatic fauna** and their habitats, **microbial communities** and their role in flow of **ecosystem services** in the IHR



**Trail
Sampling (n=15,
228 km)**



**Scanning (n=6, 40
hrs)**



**Galliformes
(9 species)**

**Camera
Trapping (n=290
locations, 3057
trap nights)**



**Mammals
(39 species)**

Odonates (85 species)



Fish (15 species)



**Aerial
Netting
(n=220 plots)**



**Drag
Netting (n=128 points)**

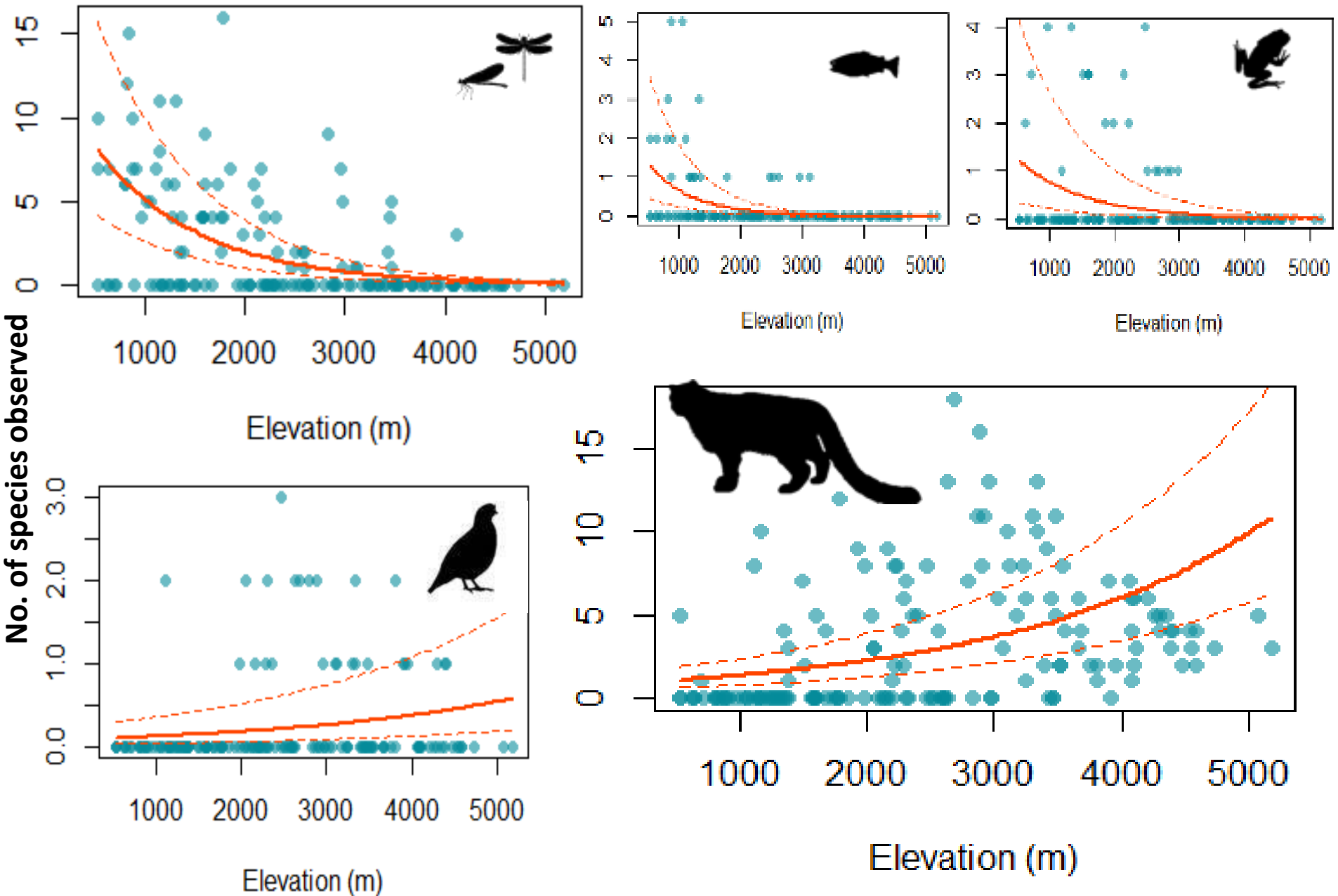


**Visual search
and Temp /
RH
Recording
(n=108 plots)**

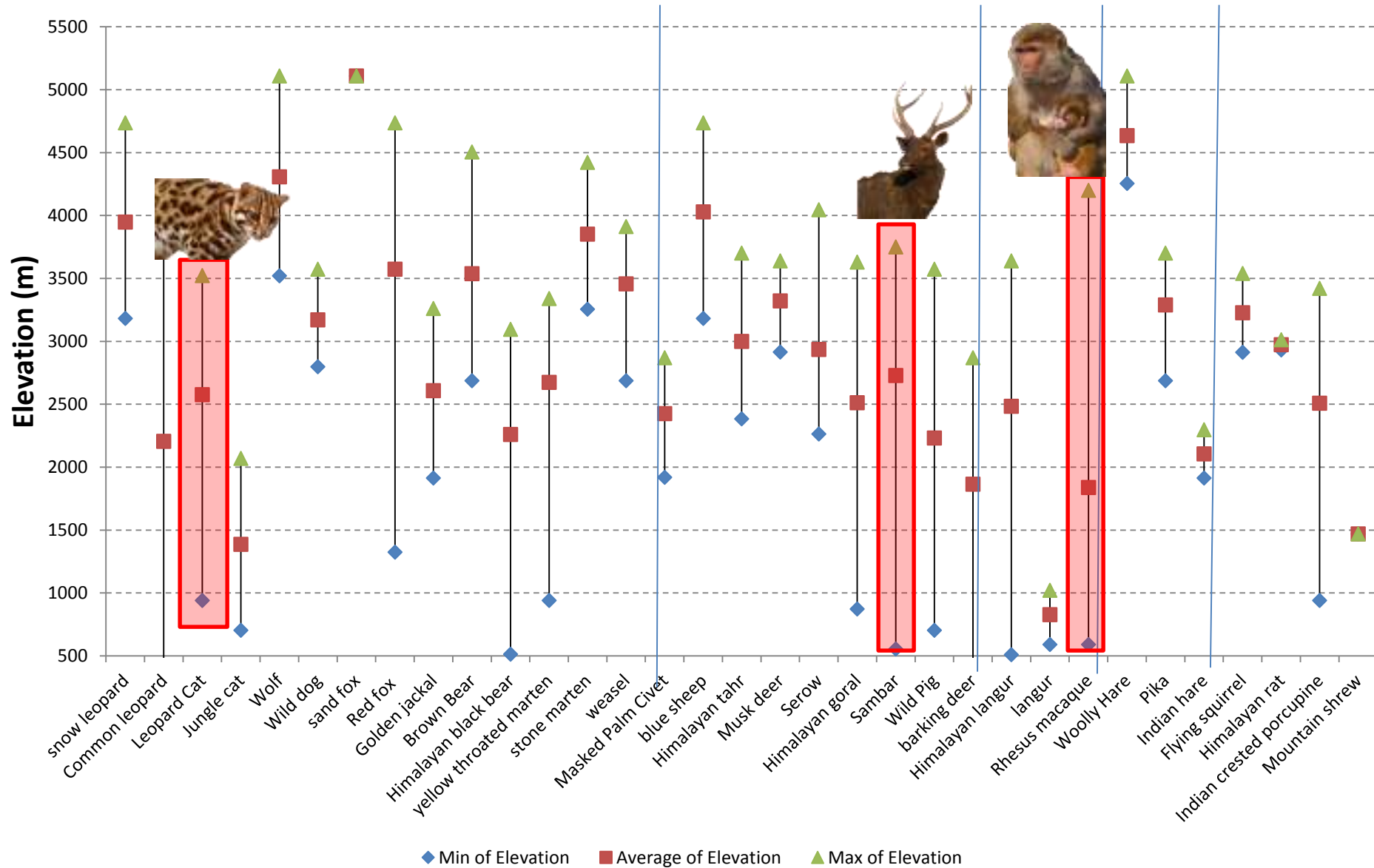


Amphibians (12 species)

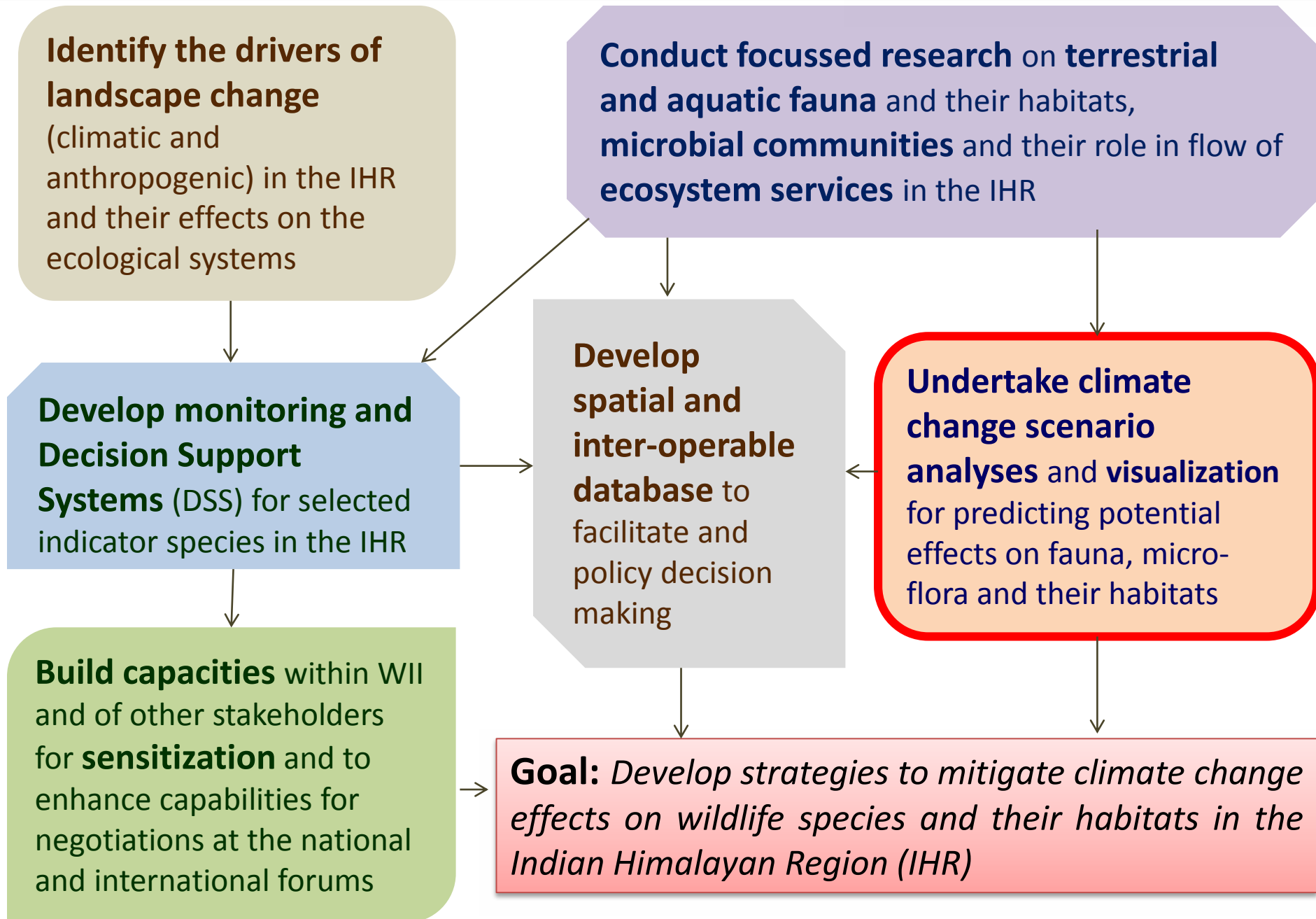
Species richness along the elevation gradient



Elevation range



Goal and Objectives



Landscape Ecology & Visualization Laboratory (LEVL)

The LEVL is established under the **National Mission for Sustaining the Himalayan Ecosystem** (NMSHE), a program being coordinated by the **Department of Science and Technology** (DST), Govt. of India

- The aim of this centre is to disseminate the research findings to the public and other stakeholders through **2D and 3D visualization** outputs to influence the policy and decision making

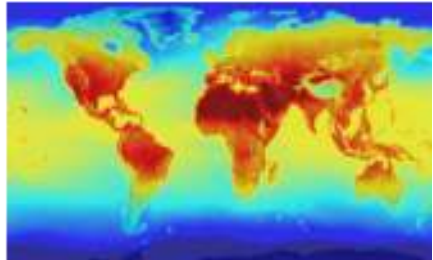
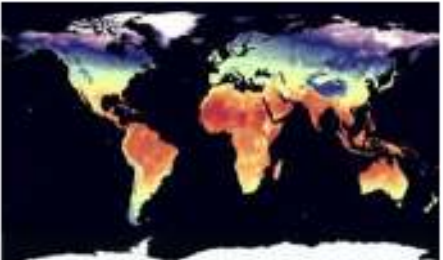
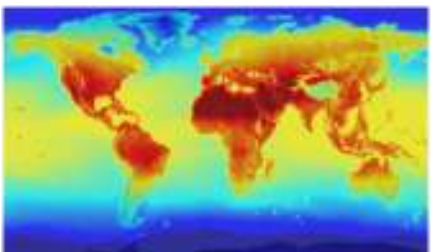


Output of 19 Global Climate Models (GCMs) from IPCC Worldclim

Future (2050s)

Baseline (1960-1990)

Future (2080s)



Ensemble of 17 models

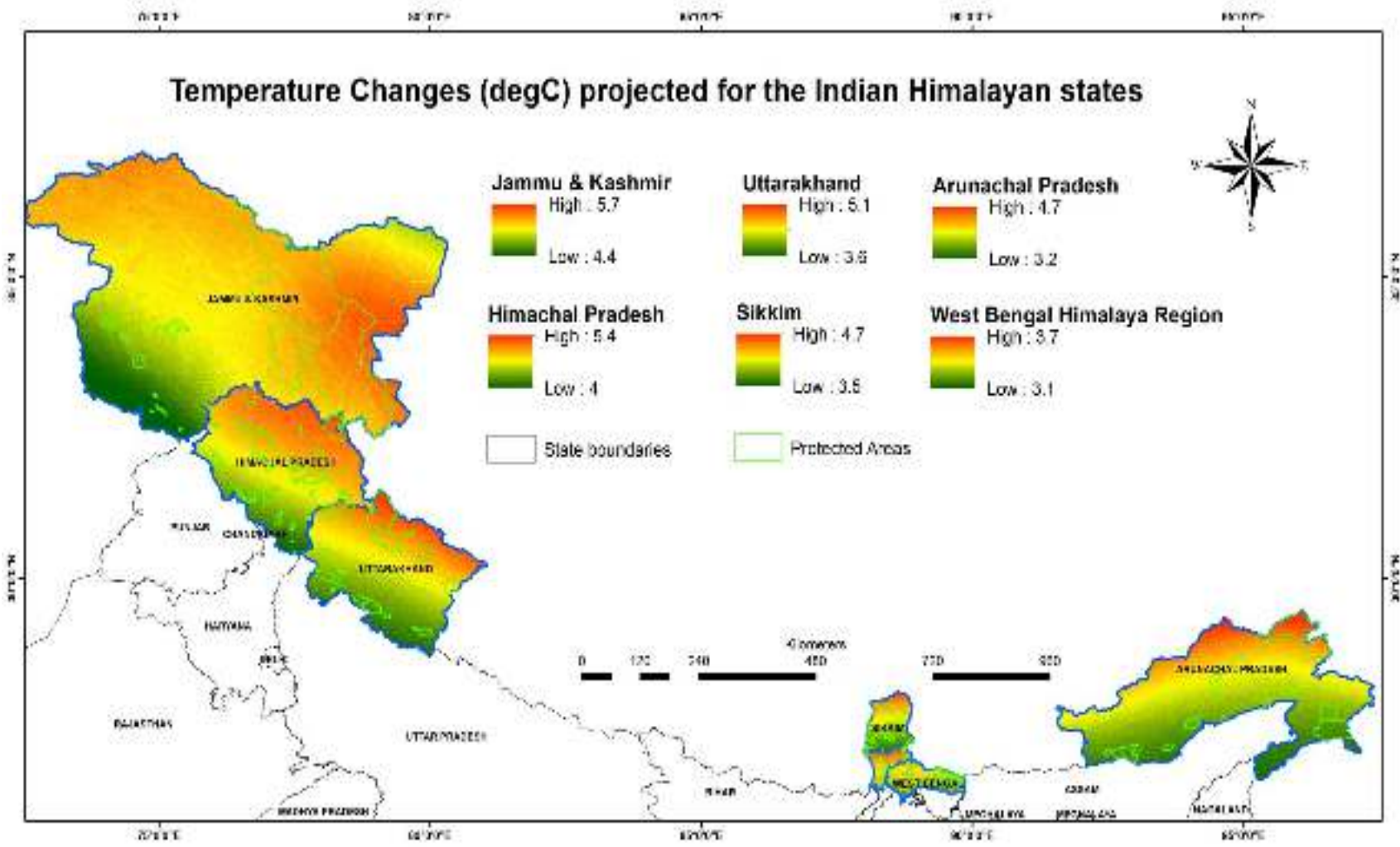
Ensemble of 17 models

Ensemble of 17 models

Baseline and Future Projections for IHR states

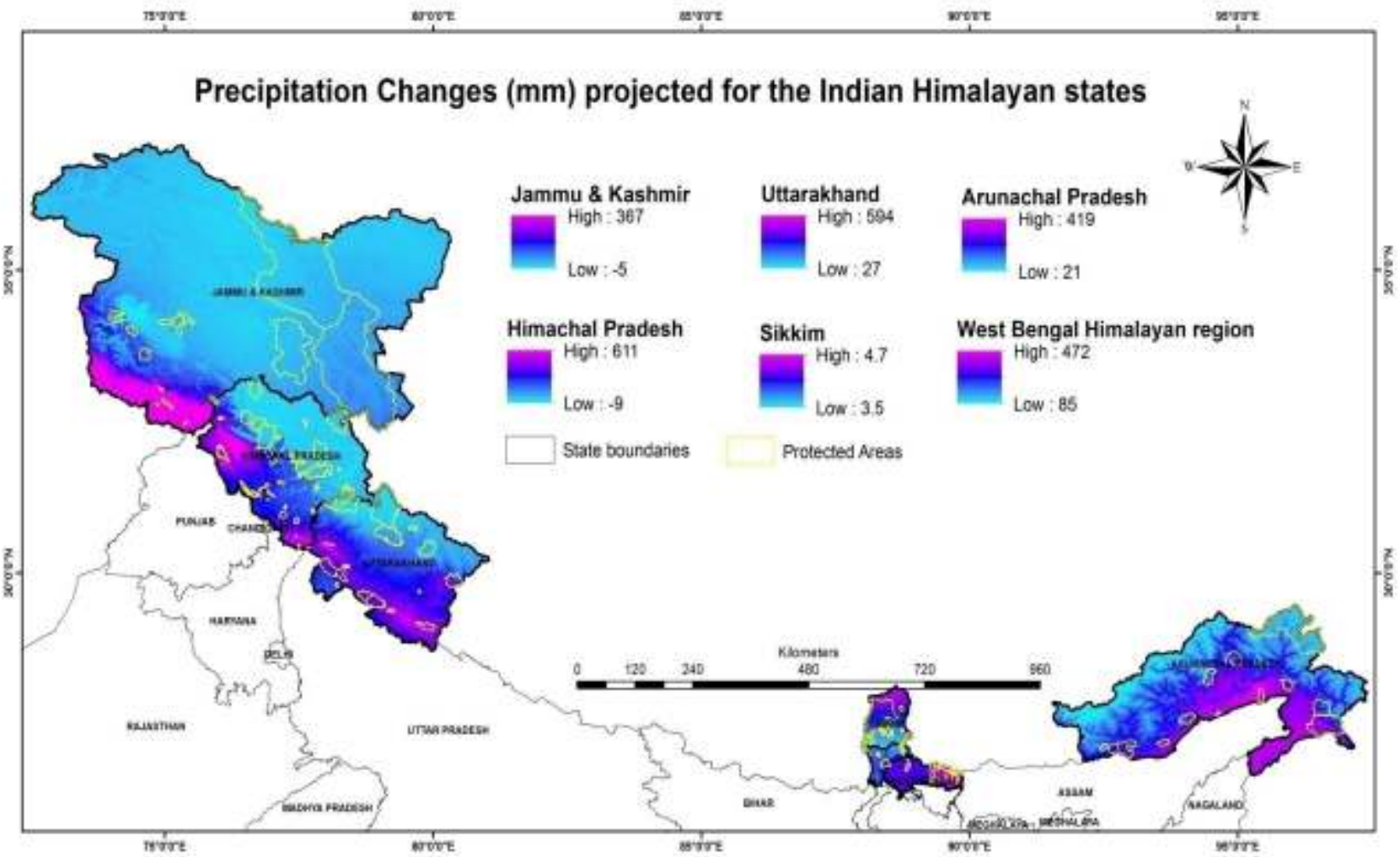
Change Maps (changes from the Baseline 1960-90)

Climate Change Scenarios and Projections: IHR states



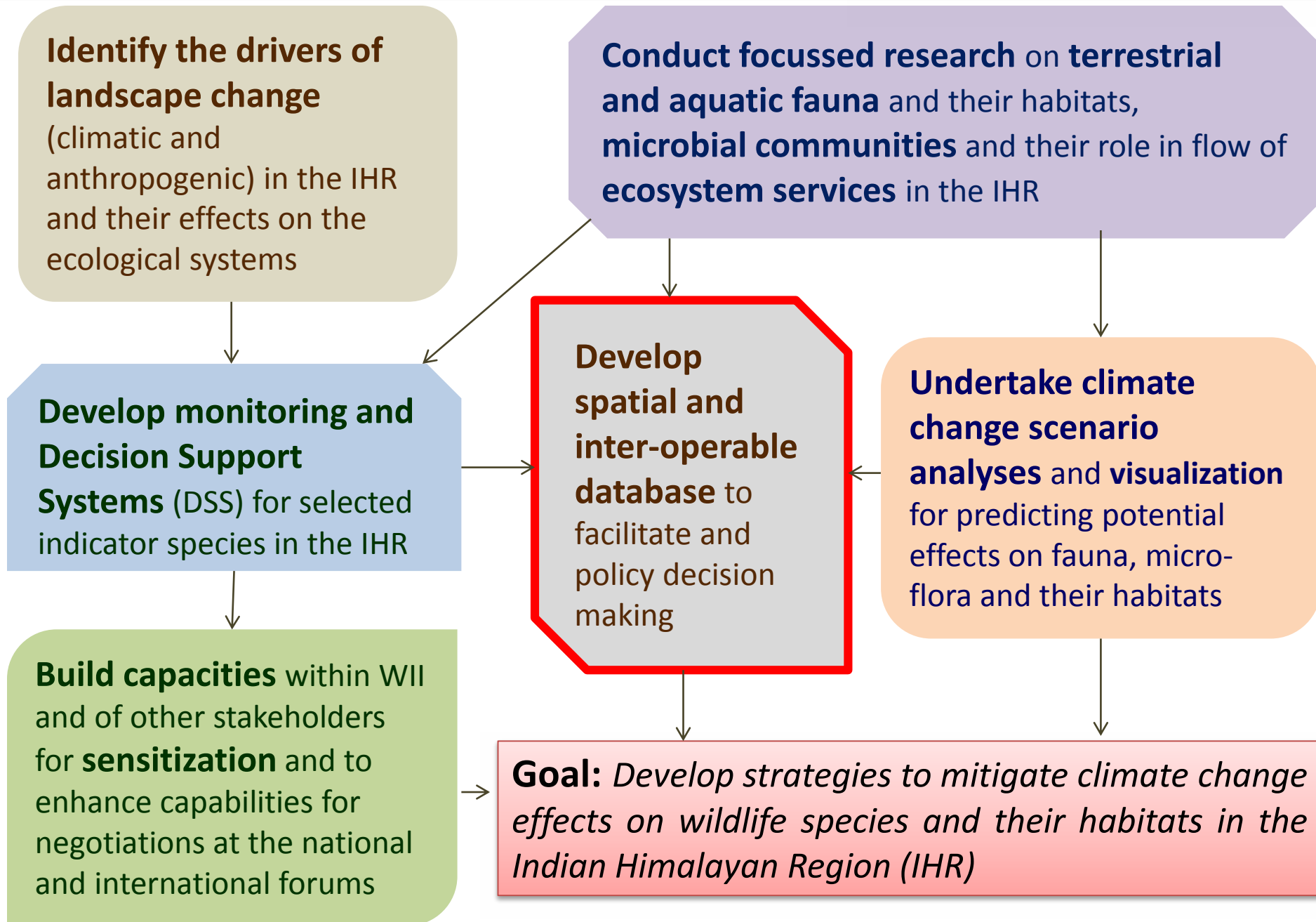
Temperature change database generated DISTRICTWISE and PROTECTED AREA wise

Climate Change Scenarios and Projections: IHR states



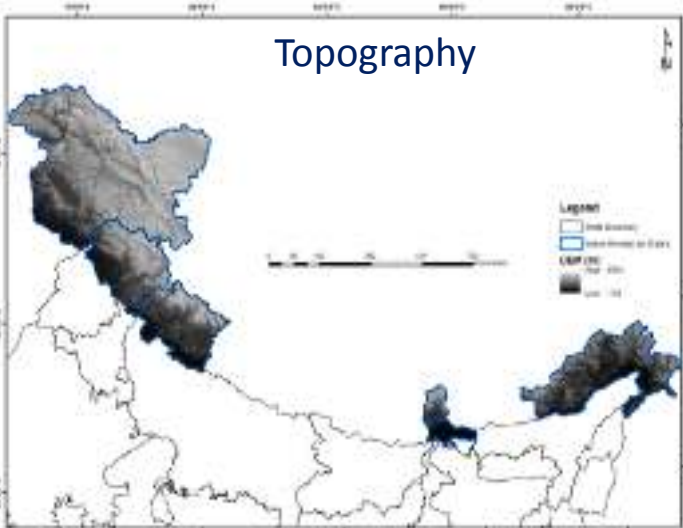
Precipitation change database generated district wise and Protected Area wise

Goal and Objectives

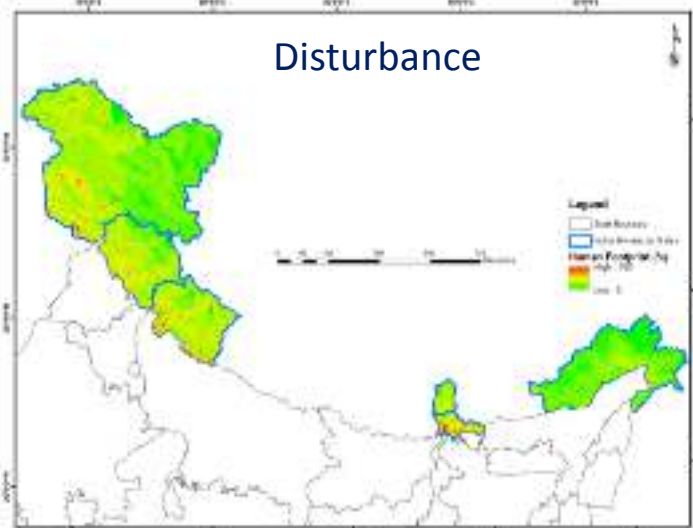


Interoperable Database Generation

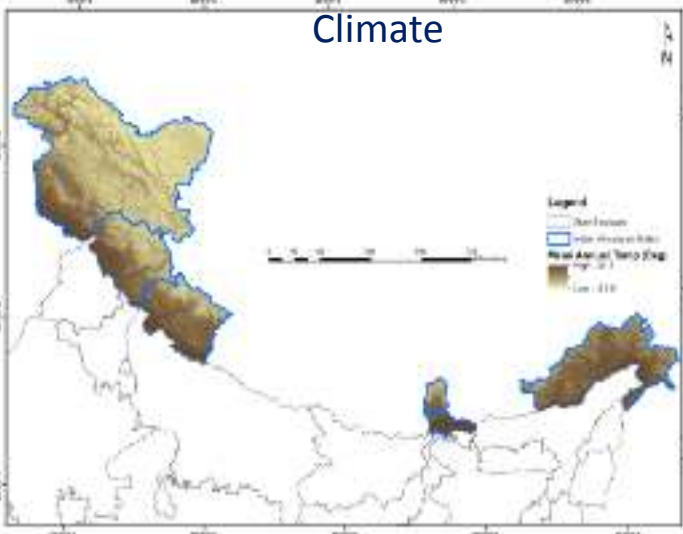
Compiled 35 datasets under 7 themes



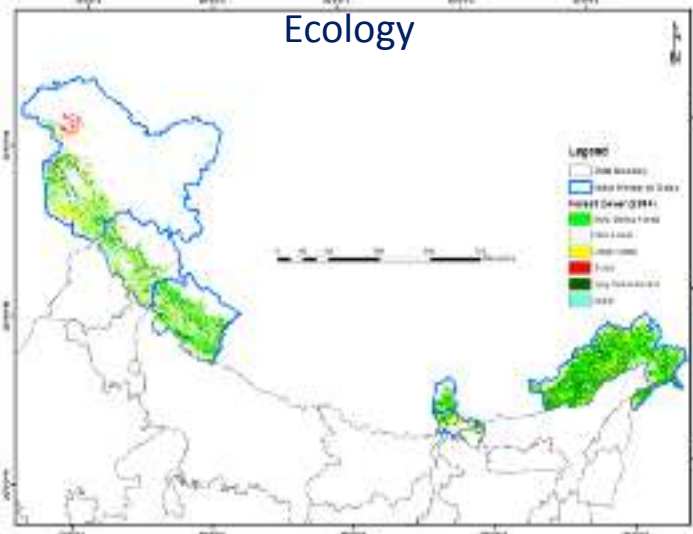
Topography



Disturbance



Climate



Ecology

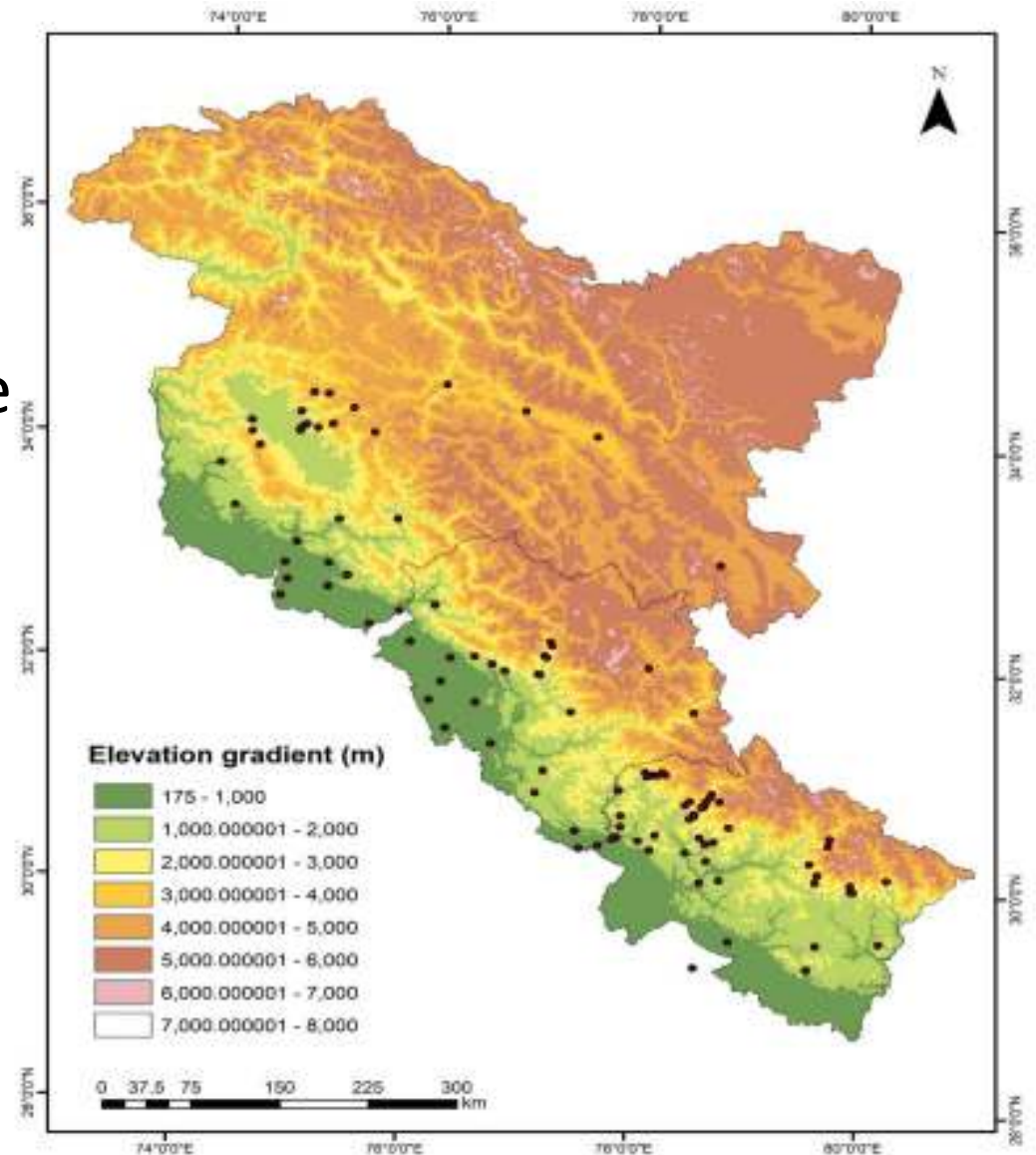
- Topography
 - Administrative Boundary
 - Disturbances
 - Climate
 - Hydrology
 - Socio Economic
 - Ecology
- field data is being added to the database

Amphibian Distribution (1872 to 2016)

(North-Western , Western Himalaya)

- 36 species

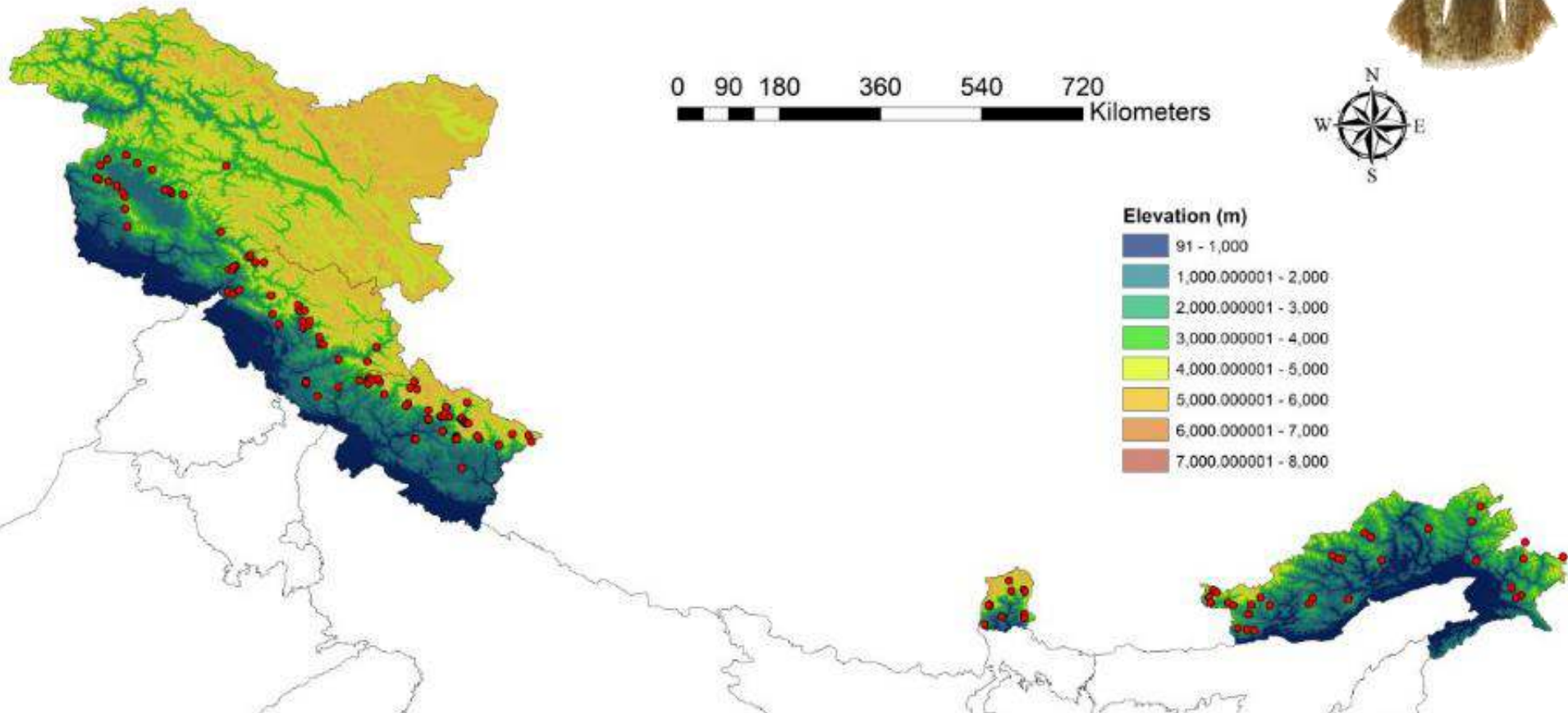
More than 40% records are doubtful and requires taxonomic re-evaluation



Musk deer (*Moschus spp.*) distribution in IHR

1981 to 2015

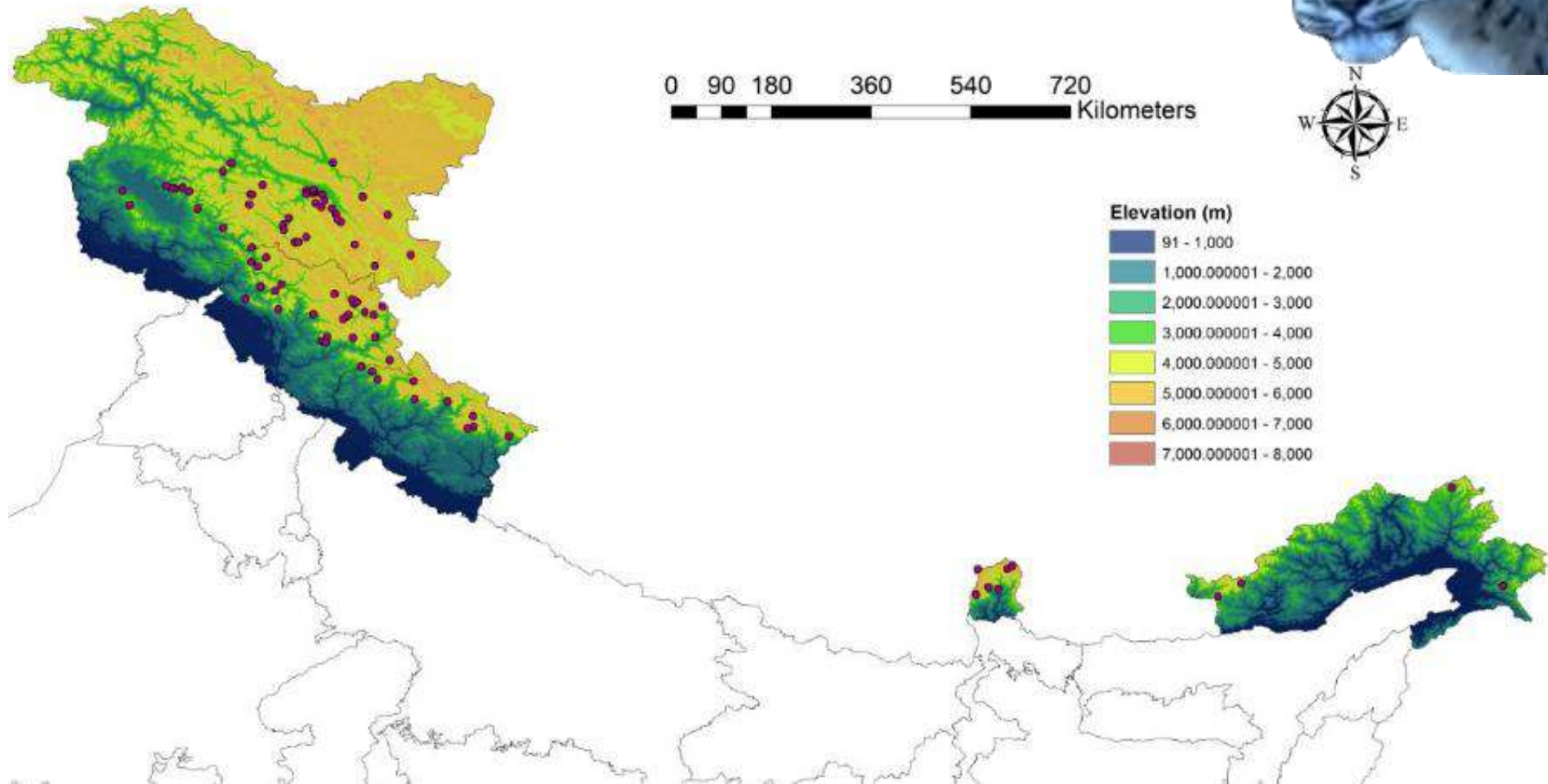
39 Secondary data sources reviewed



Snow leopard (*Panthera uncia*) distribution in IHR

1923 to 2014

36 Secondary data sources reviewed



Research papers published	6
Reports/Monographs/Internal publications	3
Workshop/ conferences/ seminars/capacity building programmes organised	6
Number of personnel trained by the Task force	610
Number of Task force personnel trained	8
International Exposure	4



Need for targeted education programme for preparedness and formulating adaptive strategies in the Indian Himalayan region

Nishikant Gupta, Asha Rayvanshi, S. Sathyakumar, J. A. Johnson, K. Sivakumar, G. S. Rawat and Vinod B. Mathur

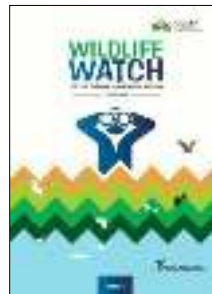
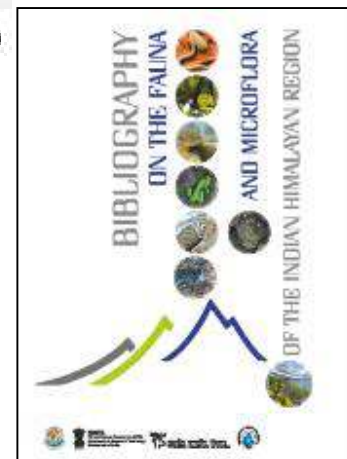
Perspective from the Field: Innovative Geographic Visualization for Improved Understanding and Effective Public Participation in Environmental Policy Making and Implementation

Dr. Parvati A. Gupta, Dr. J. A. Johnson, Dr. S. Sathyakumar, Dr. G. S. Rawat



Importance of monitoring soil microbial community responses to climate change in the Indian Himalayan region

Parvati Bhattacharjee, Gaurav Talwar, Gopal Singh Rawat and Samrat Mondal



New Range Records for Uttarakhand



Janak Tal
~ 4500 m

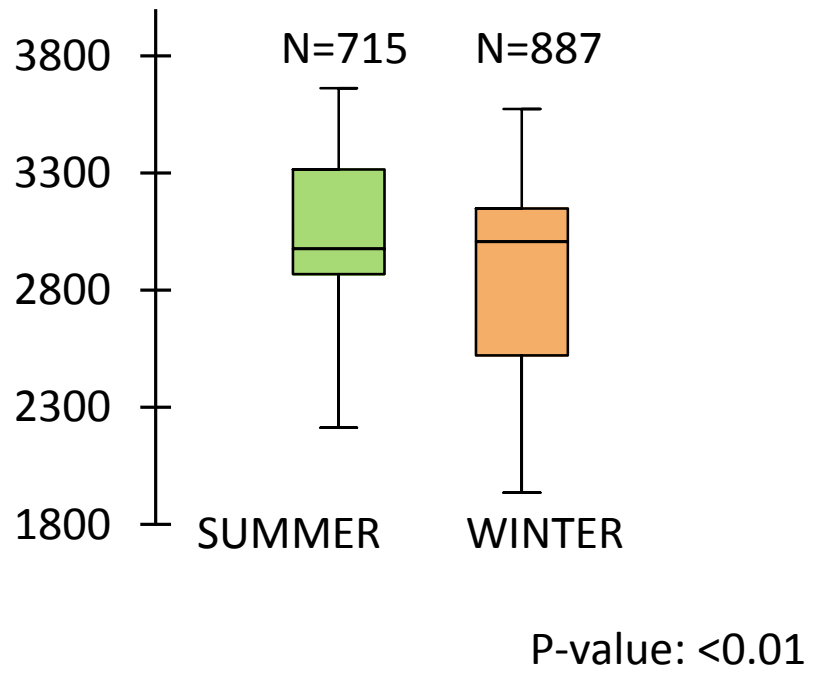
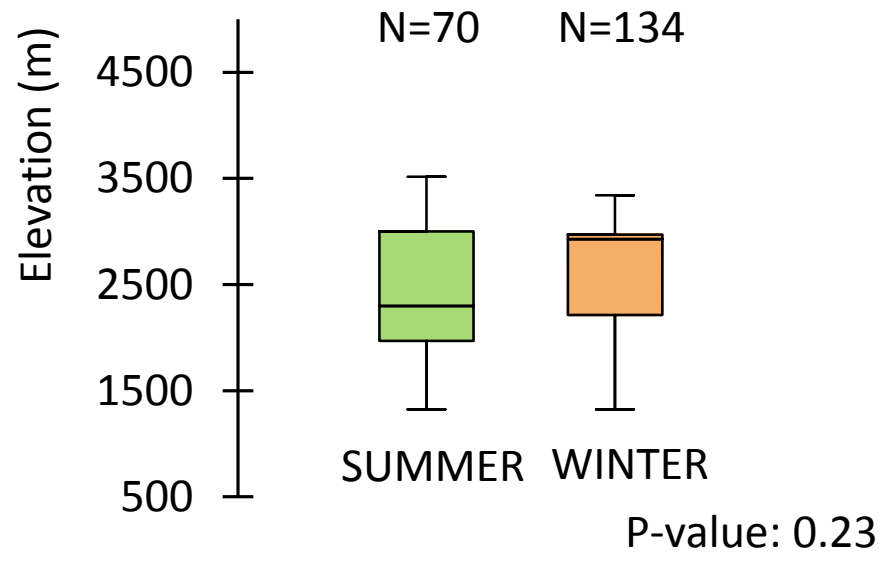


Kedar Tal
~4500 m

New Range Records for Uttarakhand



Leopard cat *Prionailurus bengalensis*



Sambar *Rusa unicolor*

New Records for Uttarakhand



Asiatic wild dog *Cuon alpinus*
~3500 m



Sand Fox *Vulpes ferrilata*
~5200 m



New Records for Uttarakhand



Argali Ovis ammon
~4500m



4/26/2017 11:22 AM



New Range Records for Bhagirathi Basin



Tiger Panthera tigris
~3000m





New Records for Uttarakhand (Anisoptera & Zygoptera)



Aeshna mixta (♂) (Latreille, 1805)

Ceriagrion fallax (♂) (Ris, 1914)



Pseudagrion microcephalum (♂) (Rambur, 1842)

Gynacantha subinterrupta (♂) (Rambur, 1842)



New to science species based on Morphometric analysis (Anisoptera)



Thorax & Body

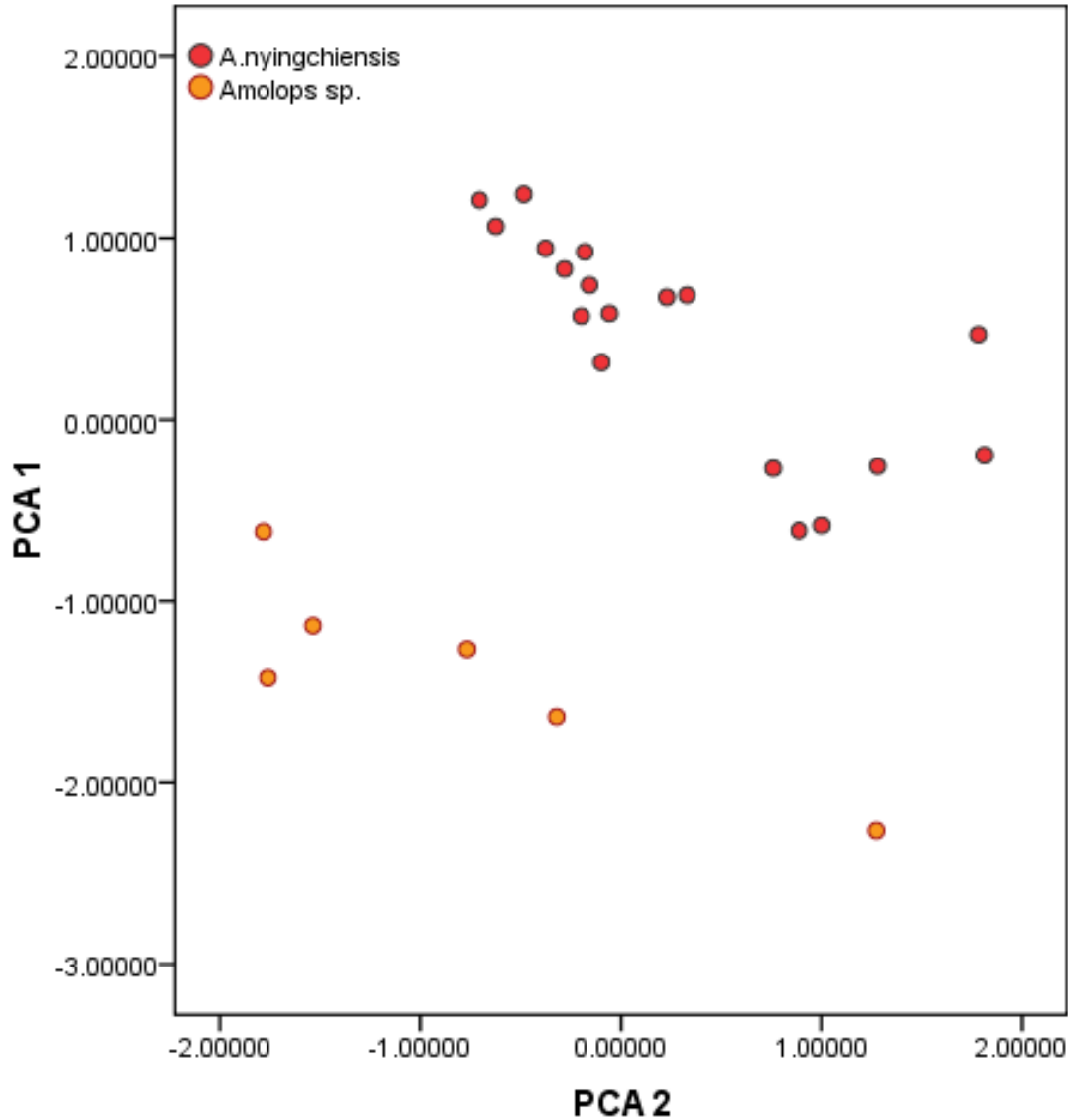
Anal appendages

Head

Anotogaster sp. September (♂) closely related to
Anotogaster basialis



New to science (*Amolops* sp)



Amolops nyingchiensis Jiang, Wang, Xie, Jiang, and Che, 2016



Future Plans

Identify the drivers of landscape change

Will be continued for other IHR States

Conduct focussed research on terrestrial and aquatic fauna, microbial communities, ecosystem services in the IHR **will be continued in Bhagirathi as well as other Basins** (initiated in Beas Basin for aquatic systems and mammals)

Develop monitoring and Decision Support System

Indicator species identification and vulnerability will be assessed

Develop spatial and inter-operable database

collation from all themes and task forces initiated

Undertake climate change scenario analyses

Predictive modelling will be initiated after finalization of modelling procedure

Build capacities

Will be continued and efforts will be enhanced

Goal: *Develop strategies to mitigate climate change effects on wildlife species and their habitats in the Indian Himalayan Region (IHR)*

Acknowledgements

- NMSHE Programme, Department of Science and Technology, Govt. of India, Grant No. DST/SPLICE/CCP/NMSHE/TF-2/WII/2014 [G] dated 26.08.2014
- Uttarakhand, Himachal Pradesh and Sikkim State Forest Departments
- Research Coordinator and Faculty Members, Non technical Staff, Library Staff, Laboratory Staff at WII
- Indo-Tibet Border Police
- Collaborators
- Field assistants and Drivers
- Interns and Volunteers

Thank You