CLIMATE CHANGE RESEARCH IN HIMALAYA

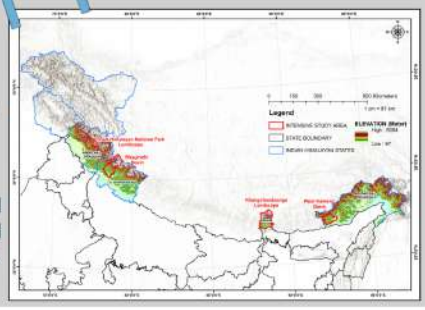
Task force-IV

DST-NMSHE (National Mission for Sustaining the Himalayan Ecosystem)

under the

National Action Plan on Climate Change

Long-term research in the Indian Himalayan Region reveals interesting patterns of species responses



Climate change and **ecological processes** are being linked across four basins

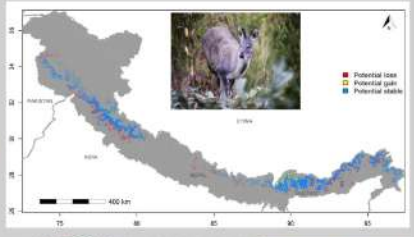
Altered Soil Respiration & Microbiota

Soil respiration remains resilient to warming, but ecosystem respiration is projected to increase

Warming experiments: Reduced predatory soil nematode abundance

Climate feedbacks through soil respiration across elevational gradients will buttress future climate trajectories

Range Shifts Across Himalaya

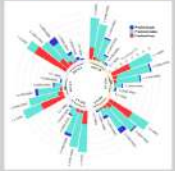


Musk deer predicted to shift upwards with concurrent loss below 3000masl by year 2050 (RCP 8.5)

Habitat connectivity necessitated between protected areas and high altitude peaks for **snow leopard**

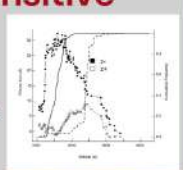
Headwaters Provide Climate Refugia

Snow trout is predicted to seek cooler refugia upstream which will result in a high-altitude squeeze. Similar fate predicted for many cold-stenothermal species



Future **Greenhouse Gas Emission** scenarios & **Global Circulation Model** ensembles indicate species' movements towards higher elevations

Climate Sensitive Zones



Benthic macroinvertebrate community patterns indicate zones where first responses to climate can be tracked

Training & Capacity Building

Outreach & training activities for monitoring climate change impacts on Himalayan wildlife

Dissemination of Scientific Outputs

Climate change research at WII has resulted in intellectual contributions forming **54 peer-reviewed publications** besides technical reports, citizen science manuals, bibliographies & books

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Wildlife Institute of India

Department of Science & Technology
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NMSHE

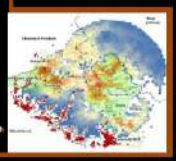
NMSHE'S CLIMATE RESEARCH – EMERGING PATTERNS

The NMSHE forms one of the eight missions under India's first National Action Plan on Climate Change (NAPCC) launched in 2008, under the aegis of Prime Minister's Council on Climate Change. NMSHE's Task Force-IV was entrusted to WII, which focuses exclusively on climate change impacts on wild fauna and micro flora of the Indian Himalayan Region (IHR).

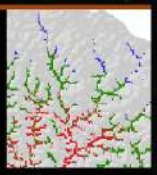
Phase I (2015-2020) of the DST-NMSHE Task Force-IV was pioneer in collating multi-taxa baselines on species' distributions, environmental niches and phenological attributes, thus enhancing the understandings on climate change vulnerabilities of Himalayan wildlife, hitherto unknown. Three river basins – Beas, Bhagirathi and Teesta were investigated across the IHR.

This brochure presents a crux of research findings underpinned by the 38 peer-reviewed papers published till 31 March 2022 by WII-NMSHE, and portrays research advancement into Phase-II of the project.

Snow Leopard Habitat Connectivity:
Suitable habitats in upper Bhagirathi landscape are connected to protected areas through high-elevation peaks–corridors in future climate scenarios.



Snow Trout Climate Refugia:
High-altitude squeeze predicted for the years 2050 & 2070.



Most habitats below 1000 masl predicted to be lost. High-elevation streams predicted to act as future climate refugia.

OTC Experiments:
Soil Nematode Communities – Lower predatory nematode abundance, channel ratio & plant parasitic Index. *Bacterial Communities*–Resilient to changes in the environment over the selected time window.

Drivers of landscape change identified:
Human population & Human footprint – primary drivers of decline in NDVI at the regional scales. At finer scales, the seasonal extremities act as primary drivers of NDVI decline

Bumble bees range shifts:
Loss in suitable habitats across Great Himalayan National Park by 2050.

Phenology, age & growth:
'Fast' life-history plasticity in snow trout under invasion. This is also a typical response to warming temperatures. Its phenology will now be monitored for long-term.

New species & records:
New species of frog (*Amolops adicola*) discovered from Siang. Intensive monitoring revealed new distribution records of mammals from Uttarakhand

Delineating invasion refugia:
Dendritic prioritization of Himalayan headwaters as current invasion & future climate refugia.

Deformities in Amphibians:
Indicative of environmental perturbations. Climate might trigger similar malformations

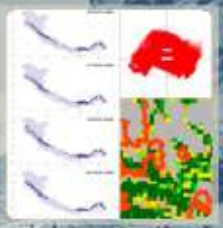
Training & capacity building:
NMSHE contributed to capacity building with:
650 personnel trained
8 international exposures
8 PhDs awarded/ongoing
1 National award (DST-AWSAR)

Human adaptive capacity & vulnerability:
Vulnerability status of villages (11- Bhagirathi, 4-Teesta, 4 -Beas) changed from higher to lower resilience in future scenarios.

Macroinvertebrates community turnovers:
Elevational bands with narrow climate tolerances delineated across watersheds. These will serve as cost-effective climate monitoring sites.

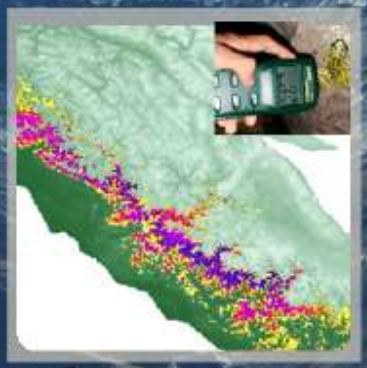
PROGRESSING INTO PHASE II

Web-based Decision Support System (DSS)



Identification of critical climate refugia and movement corridors under future climate

Generation of microclimatic patterns through automated fine-scale data



Expanding field study sites into four river basins (Beas, Bhagirathi, Teesta & Kameng)

Generation of spatially-explicit information on observed and predicted impacts of climate change on wildlife populations through field-based mesocosm experiments

and

Mechanistic/correlative ecological niche modeling

Establishment of permanent monitoring sites/plots for phenology assessment

and

training/capacity building of local stakeholders for long-term data generation

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