

# Dhauladhar Wildlife Sanctuary – Research Methods Summary

## Overview

This summary highlights the methodological framework used to assess mammalian diversity in Dhauladhar Wildlife Sanctuary, Himachal Pradesh. The study incorporated multi-scale surveys, non-invasive sampling, acoustic monitoring, and advanced analytical workflows to generate a baseline understanding of mammal communities and ecological patterns.

## Camera-Trapping Framework

- Grid-based sampling ( $4 \times 4 \text{ km}^2$ ) across subtropical, temperate, and alpine habitats using ArcGIS.
- Infrared Cuddeback cameras positioned along trails, nullahs, and sign-rich locations.
- Cameras deployed for 30–32 days, monitored biweekly for battery and memory card changes.
- Independent photographic events defined following O'Brien et al. (2003).
- Bat surveys integrated using Wildlife Acoustics SM4BAT-FS across 12 locations.

## Trail & Line Transect Surveys

- Transects walked along animal/human trails and riverbanks across three beats.
- Five replicates per transect (~6 km each) covering dense forests and alpine terrain.
- Species ID, group size, sighting angle (compass) and distance (rangefinder) recorded.
- Line transect protocols (Karanth et al. 2004) applied for ungulate density estimation.

## Presence–Absence Monitoring

- Detection/non-detection data collected via direct sightings and indirect signs (scats, pellets, pugmarks).
- Sampling units defined based on natural catchments and species-specific home range requirements.
- Presence–absence maps generated for each target species.

## Scanning & Vantage Point Surveys

- 106 vantage-point surveys conducted across open grassy slopes and cliff habitats.
- 10-minute visual scans using binoculars during peak activity hours (06:00–09:00, 15:00–18:00).
- Ideal for detecting Himalayan Ibex, Tahr, and Goral.

## Scat Sampling & Diet Analysis

- 84 scats collected (Brown Bear, Red Fox, Leopard Cat, Marten, potential Snow Leopard).
- Samples dried, sieved (0.7 mm), and separated into hair, bone, seed, fibre, and insect components.
- Plant parts identified using herbarium references; carnivore prey identified via hair microstructure

keys.

- Genetic analysis recommended for distinguishing snow leopard scats from sympatric carnivores.

## Camera Trap Distance Sampling (CTDS)

- Distance sampling applied using 2-second snapshot intervals following Howe et al. (2017).
- Radial distances estimated through regression models calibrated at 31 camera stations.
- Detection functions modelled using half-normal, hazard-rate, and uniform functions in DISTANCE.
- Empirical field-of-view ( $\theta$ ) estimated via controlled walkthrough experiments.

## Analytical Workflow

- Species richness computed from independent photographic events.
- RAI1, RAI2, and RAI3 used to evaluate detectability and sampling effort.
- SECR applied for identifiable carnivores using single-flank capture histories.
- Species accumulation curves generated using R (vegan package).
- Temporal activity modelling conducted with kernel density estimation (Ridout & Linkie 2009).
- Hotspot mapping integrated LULC and EVI layers using GIS tools.

**Summary:** The study's rigorous, multi-method design—combining non-invasive tools, remote sensing, behavioural analysis, and geospatial modelling—set the first comprehensive monitoring framework for mammalian ecology in Dhauladhar Wildlife Sanctuary.