Progress report

Coexistence among the apex predators (Himalayan wolf, Snow leopard), scavenging vultures and people in the central Himalayan ecosystem of Nepal

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Figure 1: Livestock grazing on rangeland within the study area

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Submitted by

Deu Bahadur Rana

Biodiversity research Institute (CSIC-University of Oviedo-Principality of Asturias), 33600, Mieres, Spain

Himali Anusandhan Kendra (Himalayan Research Center), Kathmandu, Nepal

Implementation area: Upper Mustang, Annapurna Conservation Area, Nepal

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1. INTRODUCTION

High altitude Himalayan ecosystems are shaped by extreme climatic conditions, low primary productivity, and scarce, seasonally fluctuating resources. In such environments, ecological relationships among apex predators and obligate scavengers are shaped by seasonal prey redistribution, snow cover constraints and livestock husbandry practices (Koju et al., 2023). Resource limitation during winter influences carnivore foraging strategies and spatial ecology often increasing reliance on livestock and altering movement patterns (Chetri et al., 2017). Carcases availability, prey distribution, snow cover, and human livestock practices collectively structure trophic interactions.

The central Himalaya, particularly within the Upper Mustang, Annapurna Conservation Area Project (ACAP), supports sympatric populations and spatial ecology of three ecologically significant trophic actors:

- Snow leopard *Panthera uncia*
- Himalayan wolf *Canis lupus chanco*
- Himalayan griffon *Gyps himalayensis*

Snow leopards and Himalayan wolves represent apex predators in the region, opportunistically preying on livestock (Chetri et al., 2017; Sharma et al., 2021). Himalayan griffons act as key carrion recyclers, delivering critical ecosystem services via rapid carcass removal and nutrient redistribution (Acharya et al., 2016). The persistence of the genetically distinct Himalayan wolf lineage in Upper Mustang confirms the ecological importance of this species within ACAP (Chetri et al., 2016). Despite this, there remains a notable lack of empirical research quantifying spatial overlap, carcass-sharing dynamics, and seasonal coexistence among these taxa in the Central Himalaya.

Winter represents a particularly sensitive ecological window, heavy snow cover restricts prey modality, concentrates ungulates in lower valleys, and potentially increases livestock vulnerability. These factors may intensify predator movements and elevate carcass availability for vultures. Understanding these seasonal interactions is fundamental for:

- Quantifying spatial occurrence and overlap between Snow leopard and Himalayan wolf using systematic camera trapping.
- Assess predator presence relative to livestock use areas and wild prey sign indices.
- Exploring the vulture roosting, nesting sites and their migration pattern

The present November-December 2025 field phase represents the field structured winter dataset of this doctoral research. By deploying systematic camera trapping and conducting transect-based sign surveys, this study aims to generate robust spatial data that will later be integrated with occupancy modelling, kernel density analysis, and landscape-lever GIS assessments.

This research contributes to a broader conservation objective: developing a holistic framework for coexistence among apex carnivores, scavengers, and pastoral communities in high-altitude Nepal. In landscapes where ecological resilience is tightly coupled with

human livelihoods, evidence-based understanding of trophic interaction becomes not just academically relevant but strategically essential for long-term conservation planning.

2. FIELD METHODOLOGY

2.1. CAMERA TRAPPING

Camera trappings were assessed through technical collaboration in-between the University of Oviedo, and the Himalayan Wolf Project under the formal Memorandum of Understanding (MoU), with co-authorship provisions for future peer-reviewed publications. Academic collaboration and supervisory support were strengthened through engagement with faculty from the University of Oviedo.

PRE-FIELD COLLABORATION INCLUDED:

- Sensor sensitivity testing (Supervisors - Dr. José Vicente López Bao & Dr. Patricia Mateo-Tomás; Deu Bahadur Rana, and Krishna Prasad Bhusal)
- Deployment planning in western block within a 5*5 (2.5*2.5) km grid system
- Snow-adjusted placement strategy

CAMERA TRAP DEPLOYMENT:

- Total camera traps deployed: 41 units
- Design: Systematic grid-based placement (2*2 under 5*5 km framework)
- Target species:
  - Himalayan wolf
  - Snow leopard
- Placement Strategy:
  - Wildlife trails
  - Ridge lines
  - Livestock herding/human routes
  - Habitat edges and movement corridors

In an exhilarating surprise, a pair of Himalayan wolves were unexpectedly observed in the Sangbochen area of Lo-Ghekar Damoderkunda Rural Municipality.

Transect surveys uncovered multiple evidences of pugmarks and scats from apex predators, the majestic Himalayan wolf and stealthy snow leopard, ranging from fresh to aged. These findings indicates frequent carnivore activity in the landscape. However, information on livestock loses was limited or absent. This informs the need for targeted engagement in monitoring kill incidents, including timely reporting from herdsman and local to alter effective carcass monitoring.

Approximately 30% of the designated western block study area was surveyed during this winter phase. Heavy snow cover influenced site selection, prioritizing wind-exposed ridges and lower-elevation corridors for optimal access and sightings.

Figure 2: A pair of Himalayan wolf roaming at Sangbochen area of Upper Mustang

2.2. TRANSECT SURVEY

- Method: Foot-based sign survey
- Data recorded:
  - Scats
  - Pugmarks
  - Kill sites

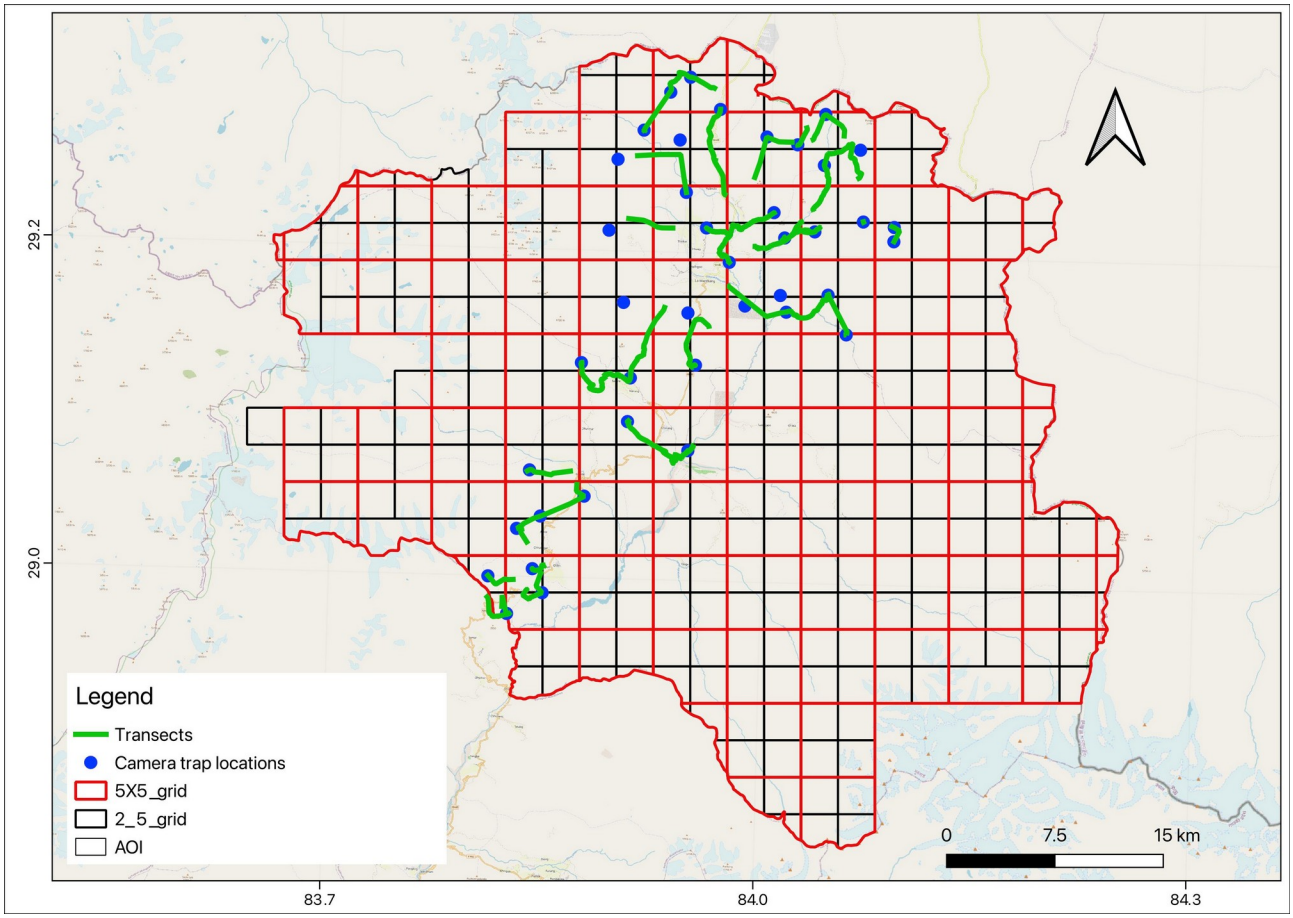
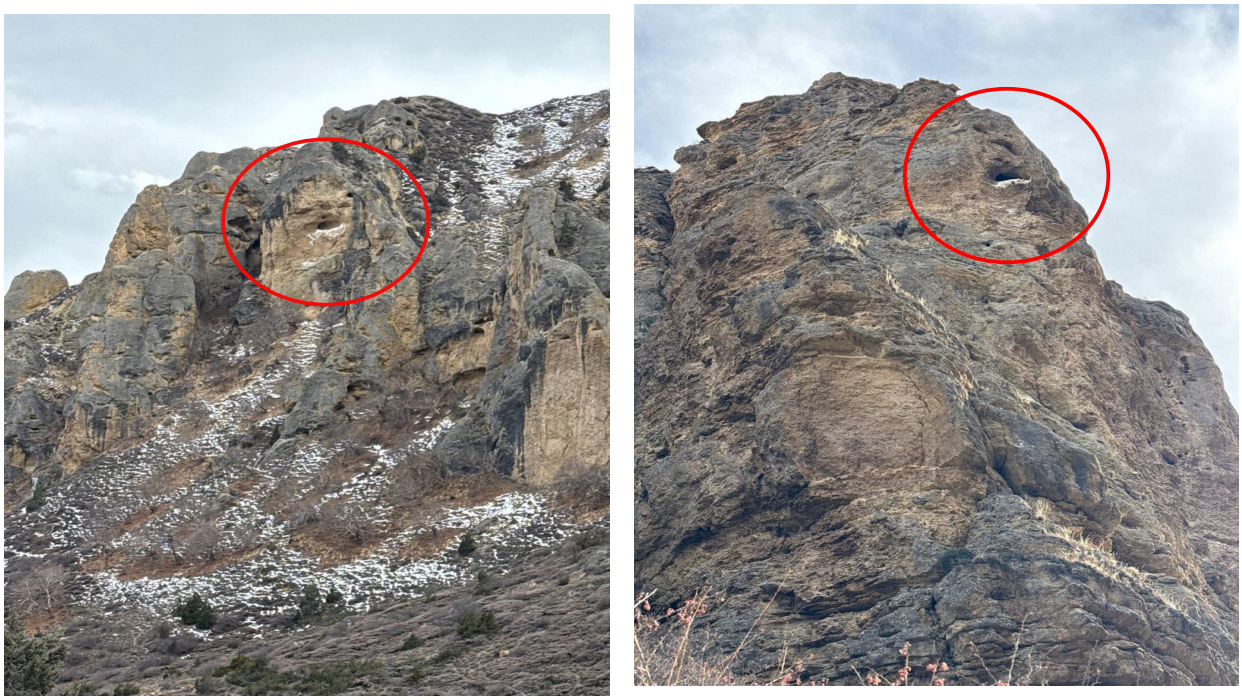


*Figure 3: Spatial layout of camera trap installations and transect survey routes within 2*2 km sampling units nested inside the 5*5 km study area*

2.3. VULTURE MONITORING

On transect surveys and in route to grid sites, we checked roosting sites and potential nesting colonies for any activity. The focus on winter roost patterns and how carcass are used. This helped us scout possible nesting site and plan stronger monitoring going forward.



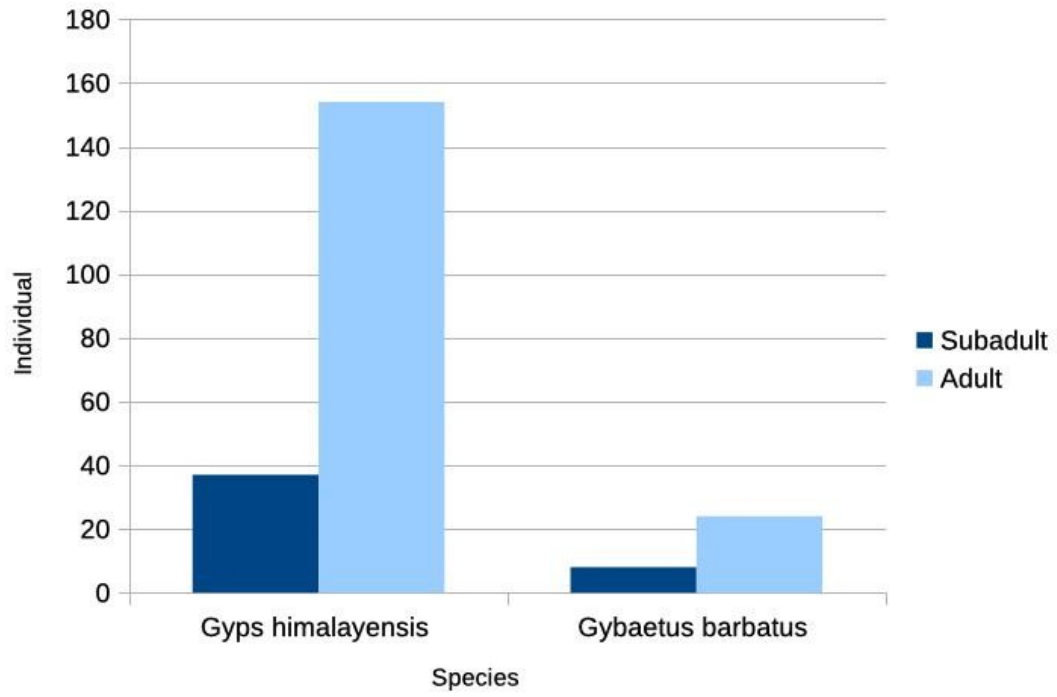
A

B

Figure 4: A. Nesting and B. Foraging activity of Himalayan griffon and Bearded vulture in Upper Mustang, Annapurna Conservation Area, Nepal

Key observed species included:

- Himalayan griffon *Gyps himalayensis*
- Bearded vulture *Gybaetus barbatus*



The image presents a bar chart illustrating opportunistic records of two vulture species observed during field visits conducted for camera trap installation and transect surveys. The species recorded include the Himalayan Griffon (Gyps himalayensis) and the Bearded Vulture (Gypaetus barbatus), categorized into subadult and adult individuals. Adult individuals were more frequently observed in both species, particularly Himalayan Griffon, which showed substantially higher counts compared to Bearded Vulture. Observations from a fixed vantage point indicated directional flight movement, suggesting limited spatial overlap in vulture activity during the survey period.

2.4. FIELD TEAM COMPOSITION

- Principal Researcher: Deu Bahadur Rana, PhD scholar
- Field Assistant and 2 local field Support (logistics and terrain navigation)
- Transportation: Jeep, Horses (essential for equipment transport in snow-covered terrain)

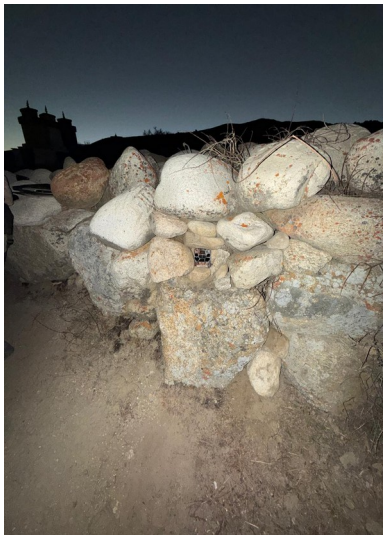
The western block required extended travel time due to inaccessible topography and winter constraints.



A



B


C

Figure 5: Indirect field evidence of A. Snow leopard B. Himalayan wolf pugmarks, scats, and territorial scratch marks systematically documented during transect surveys and C. camera trap deployment

CONCLUSION

The November-December 2025 winter field phase marks a strong operational start to the apex predator-scavenger coexistence study in the Central Himalayan ecosystem (Upper Mustang) under ACAP. Despite significant winter constraints, 41 camera traps were successfully deployed covering 30% of the study landscapes, combined with transect and vulture colony assessments.

The project remains scientifically on track, logistically efficient, and institutionally supported. The upcoming March 2026 retrieval phase will generate the first substantial dataset for spatial and trophic interaction analysis.

UPCOMING ACTIVITIES:

- Retrieve cameras from surveyed grids and reinstall in the remaining block.
- Conduct community interviews to gather local insights on Entho-biological ecology.
- Vulture monitoring at key roost, nesting sites
- Carcass monitoring
- Continue transect survey

ACKNOWLEDGEMENT

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