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Cover: Digital illustration of *Impatiens chamchumroonii* in Krita by Dupati Poojitha.

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COMMUNICATION

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Vulture diversity and long-term trends in the Ranikhet region, Kumaon Himalaya, Uttarakhand, India

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Abstract: Vultures are keystone species in maintaining ecosystem health, but their populations have experienced catastrophic declines across the Indian subcontinent in last three decades. The study was conducted in the Ranikhet region of Kumaon Himalaya, Uttarakhand, India in 2021–2024 covering different seasons. Through opportunistic sightings we documented 90 distinct records comprising 326 individuals representing six species: Himalayan Griffon *Gyps himalayensis*, Egyptian Vulture *Neophron percnopterus*, Red-headed Vulture *Sarcogyps calvus*, White-rumped Vulture *Gyps bengalensis*, Cinereous Vulture *Aegypius monachus*, and Eurasian Griffon *Gyps fulvus*. Himalayan Griffon and Egyptian Vulture dominated the observations (92.7% of total individuals). Critically Endangered species showed alarmingly low numbers, and no breeding or nesting activity was observed for any species. Historical comparison spanning nine decades (1931–2024) revealed local extirpations of Bearded Vulture *Gypaetus barbatus* and Slender-billed Vulture *Gyps tenuirostris*. Our findings highlight urgent conservation needs and emphasize the necessity of monitoring primary regional threats including NSAIDs and poison baits, while waste disposal sites offer opportunities for targeted surveillance and intervention.

Keywords: Diclofenac, *Gyps himalayensis*, Kumaon, local extirpation, *Neophron percnopterus*, NSAIDs, *Sarcogyps calvus*, scavengers, seasonal occurance, waste disposal sites.

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Author contributions: Mr. Mirza Altaf Baig: Conceptualization, field data collection, data analysis, writing the manuscript, and corresponding author responsibilities including manuscript submission and communication with the journal. Dr. Nazneen Zehra: Supervision of the research, critical review and editing of the manuscript. Prof. Jamal Ahmad Khan: Co-supervision, overall research direction, funding acquisition, institutional support, and final review and approval of the manuscript.

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INTRODUCTION

The decline in vulture populations across the Indian subcontinent depicts one of the most severe biodiversity crises of recent times. These declines, particularly during the last three decades, have resulted in population reductions of more than 99.9% for some species (Prakash et al. 2007). As vultures are primary scavengers providing vital ecosystem services such as disease management and nutrient cycling, this catastrophic loss possesses serious consequences to the ecosystem health and function (Ogada et al. 2012). The primary factors of vulture decline have been identified as the widespread use of veterinary non-steroidal anti-inflammatory drugs (NSAIDs), particularly diclofenac, that causes renal failure in vultures consuming treated livestock carcasses (Oaks et al. 2004). Additional factors documented across the Indian subcontinent include unintentional poisoning through poison baits, mortality from power grid infrastructure through electrocution & collisions and habitat degradation at nesting sites (Botha et al. 2017). This has led International Union for Conservation of Nature to classify four species as 'Critically Endangered' (CR): White-rumped Vulture *Gyps bengalensis*, Indian Vulture *Gyps indicus*, Slender-billed Vulture *Gyps tenuirostris*, and Red-headed Vulture *Sarcogyps calvus*. One species, the Egyptian Vulture *Neophron percnopterus*, is listed as 'Endangered' (EN), while three species—Himalayan Griffon *Gyps himalayensis*, Cinereous Vulture *Aegypius monachus*, and Bearded Vulture *Gypaetus barbatus*—are categorized as 'Near Threatened' (NT). The Eurasian Griffon *Gyps fulvus* remains in the 'Least Concern' (LC) category (IUCN 2025). Moreover, the Indian government announced a ban on the veterinary use of the non-steroidal anti-inflammatory drug (NSAID) diclofenac in 2006 and more recent bans of three other vulture-toxic drugs in 2023 and 2024 (SAVE 2025) to halt the precipitous declines, and these bans have been partially but not completely successful so far (Prakash et al. 2012, 2019).

The Himalayan region, serving as a crucial habitat for multiple vulture species, requires particular attention in conservation efforts due to its unique ecological characteristics and relatively lower human population density (Paudel et al. 2016). Long-term monitoring of vulture populations is essential to understand population dynamics and developing effective conservation strategies (Prakash et al. 2019). However, comprehensive studies comparing current population status with historical records are rare. This study bridges this gap by focusing on the Ranikhet region of Kumaon Himalaya, an area historically known for its diverse vulture populations.

MATERIAL AND METHODS

Study Area

Ranikhet (29.630–29.660 ^{0}N and 79.410–79.440 ^{0}E) region of Almora District, Uttarakhand, India (Figure 1) is situated on one of the ridges of the Kumaon Himalaya, which stretches half way across the district west to east and forms the northern boundary of Kosi basin. With an average altitude of 1,800 m, its southern summit at Chaubatia attained a height of 2,100 m. The area comprises of round and flat ridges with gentle to moderate slopes featuring numerous springs and streams at breast level. The Gagas and Kosi river valleys occupy the lower portions. It covers 389.9 km^2 (12.3% of Almora District). The region experiences moderate heat, increasing in valleys, with mean annual temperature of 21.5^{0}C (range: 14.44–25.23 ^{0}C). Ranikhet receives ~1,300 mm annual rainfall, with 75% during monsoon (July–September). Over 90% of forested area is dominated with *Pinus roxburghii*, along with patches of *Quercus leucotricophora*, *Cedrus deodara*, and *Cupressus torulosa*. The fauna includes four amphibians, 11 reptiles, and 15 mammal species (Baig et al. 2025a). The area serves as habitat for approximately 209 bird species and functions as a stopover point for migratory birds during summer and winter seasons (Bhatt & Joshi 2011; Sathyakumar et al. 2011; Baig et al. 2025a,b).

Survey Methods

The data on the status of vultures was recorded opportunistically between August 2021 and June 2024. As part of a broader biodiversity assessment program, all the incidental encounters of vultures during vegetation sampling, bird counts, herpetofauna records, and mammal searches were recorded by the first author. Observations were not based on predetermined transects or fixed survey schedules, and coverage across the region was uneven, with greater efforts in areas accessible for broader biodiversity monitoring. Most sightings were concentrated around waste disposal sites, particularly the SWM Plant at Ghingarikhal, though observations were recorded across the entire study area when encountered. However, observations spanned all the 12 months of the year, providing complete seasonal coverage across summer, monsoon, and winter periods. For each vulture observation, either in flight or on the

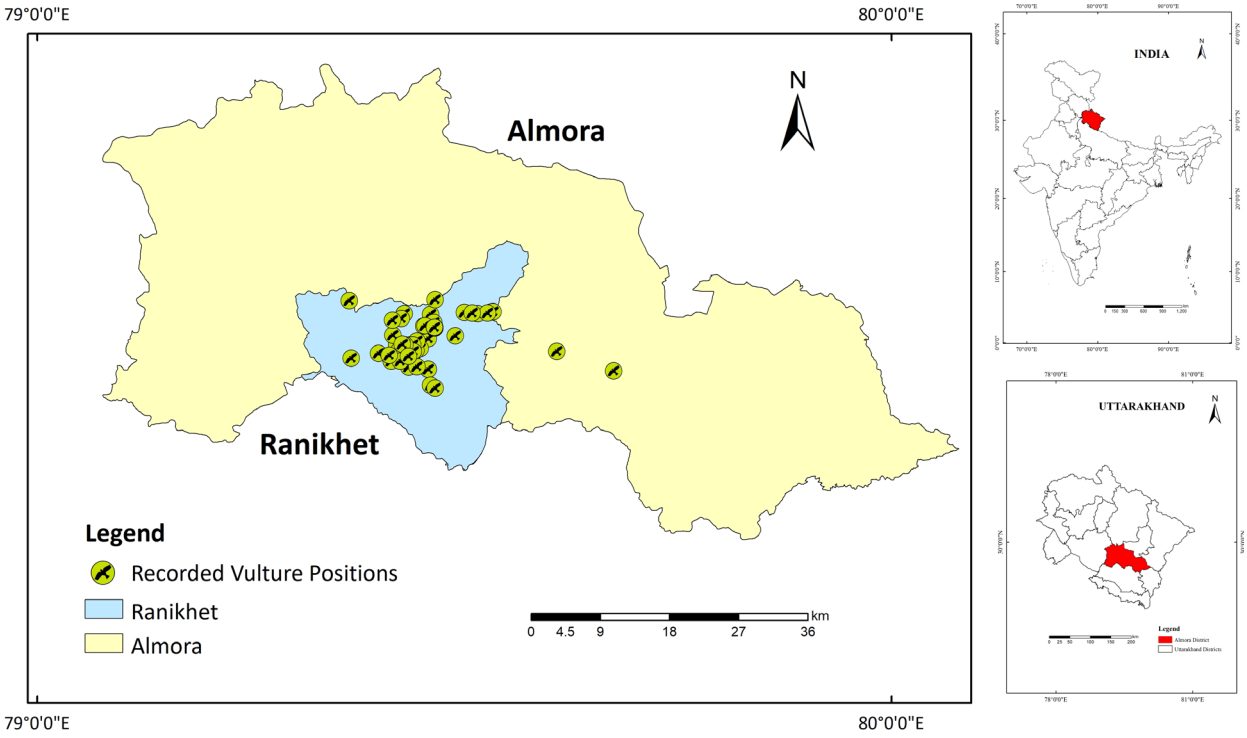

Figure 1. Map showing recorded vulture locations in Ranikhet region of Almora District, Uttarakhand, India.

ground or trees, we recorded geographical location, species composition, individual counts, flock size & composition, activity patterns (such as roosting, feeding, and flying), habitat characteristics, and any interspecific associations observed. The maximum number of individuals of vultures sighted from various sites was added to give some indication of vulture abundance in the area (Shafi et al. 2020).

To establish historical context and evaluating long-term changes in species composition and population trends, we made comparisons with previous studies from the region, despite a lack of directly comparable methodology. These span almost a century, and included Briggs's 1931 pioneering survey of Ranikhet birds, Ganguli's mid-century assessment from 1966, Sharma's late-century bird documentation in 1995, and Baig's recent bird assessment conducted in 2019. This historical comparison provided valuable insights into the temporal dynamics of vulture populations in the region spanning more than nine decades (similar to approaches by Prakash et al. 2012).

RESULTS

Our surveys documented 326 individual vultures through 90 distinct sightings, representing six species (Table 1). The Himalayan Griffon and Egyptian Vulture dominated observations, collectively accounting for 92.7% of all individuals. The Himalayan Griffon showed the highest abundance (156 individuals, 48 sightings), followed by Egyptian Vulture (146 individuals, 27 sightings). Critically Endangered species showed markedly lower numbers: Red-headed Vulture (11 individuals, 8 sightings) and White-rumped Vulture (1 individual, 1 sighting) (Table 1). Two species, Cinereous Vulture (5 individuals, 3 sightings) and Eurasian Griffon (7 individuals, 3 sightings), were documented during our surveys, although these species, despite being within their known distributional range, had not been recorded in any previous studies of the region (Table 3).

Vulture species showed distinct seasonal patterns in occurrence. Himalayan Griffon was present year-round but with higher observations during winter periods. In contrast, Egyptian Vulture being summer visitor at Ranikhet, predominantly recorded during summer and monsoon periods with complete absence during winter months. Red-headed Vulture was observed in all seasons but in low numbers. The three less frequently recorded

Table 1. Current status of vulture diversity in Ranikhet region (August 2021–June 2024).

	Species	No. of sightings	No. of individuals	Flock size	IUCN Red List status	Population Trend	Location of sighting
1	Egyptian Vulture	27	146	1 to 20	EN	Decreasing	SWM Plant Ghingarikhal, Tipola
2	Red-headed Vulture	8	11	1 to 3	CR	Decreasing	SWM Plant Ghingarikhal, Mall Road, Ardee Estate
3	White-rumped Vulture	1	1	1 to 1	CR	Decreasing	Chaubatia
4	Himalayan Griffon	48	156	1 to 21	NT	Decreasing	SWM Plant Ghingarikhal, Majkhali, Sadar Bazar, Thapla, Mall Road, Jhula Devi Temple
5	Cinereous Vulture	3	5	1 to 2	NT	Decreasing	Majkhali, Chaubatia
6	Eurasian Griffon	3	7	1 to 4	LC	Increasing	SWM Plant Ghingarikhal (29.66431^{0}N; 79.46511^{0}E)
	Total	**90**	**326**				

CR—Critically Endangered | EN—Endangered | NT—Near Threatened | LC—Least Concern

Table 2. Vulture species associations observed in Ranikhet region.

	Association	Flock size	Occasions	Activity
1	Egyptian Vulture – Red-headed Vulture	10, 5	2	Roosting
2	Egyptian Vulture – Himalayan Griffon	6, 3	2	Roosting
3	White Rumped Vulture – Red-headed Vulture – Himalayan Griffon	3	1	Flying
4	Cinereous Vulture – Himalayan Griffon – Eurasian Griffon	15, 4	2	Resting, Flying
5	Red-headed Vulture – Himalayan Griffon – Egyptian Vulture	5	1	Flying
6	Eurasian Griffon – Egyptian Vulture	21	1	Roosting

species showed limited temporal occurrence: Cinereous Vulture (winter only), Eurasian Griffon (winter and summer), and White-rumped Vulture (single summer record in June 2022).

Our observations revealed that vultures were concentrated around waste disposal sites, particularly the SWM Plant, Ghingarikhal (29.66431^{0}N; 79.46511^{0}E). Mixed-species associations were observed (Table 2), particularly centered around feeding and roosting sites. The most common associations involved Egyptian Vulture with other species, suggesting this species' role in social facilitation (consistent with findings by Cortés-Avizanda et al. 2014). Group sizes varied considerably between species, with Egyptian Vulture showing the largest average group size (5.4 individuals) and White-rumped Vulture the smallest (1.0 individuals).

Comparison with historical records revealed significant changes in vulture community composition (Table 3). Two species previously recorded (Slender-billed Vulture and Bearded Vulture) were not observed during our study, representing local extirpations. Bearded Vulture, described as 'very numerous' with documented nesting by Briggs (1931), was completely absent during three years of continuous year-round observations, indicating the species has been extirpated from the immediate Ranikhet region. Similarly, Slender-billed Vulture, recorded by Briggs (1931), was not recorded during this study. Two species absent in the 2019 survey (Red-headed Vulture and White-rumped Vulture) were recorded again, though in critically low numbers. Notably, while Cinereous Vulture and Eurasian Griffon were documented in our current surveys, these species had remained unrecorded in all previous studies of the region despite being within their known distributional range (Grimmett et al. 2011).

DISCUSSION

Population Status and Conservation Implications

Our findings reveal a highly skewed vulture community dominated by two species (similar to patterns observed by Ganguli 1966), with critically endangered species persisting at alarmingly low numbers. Throughout the study period, we found no active nests or breeding activity, contrasting with the historical nesting site record of Bearded Vulture by Briggs (1931). The complete absence of breeding activity, contrasting with historical records of successful nesting, suggests serious reproductive limitations that threaten long-term

Table 3. Comparison of vulture species records in Ranikhet region across different time periods.

	Species	Briggs (1931)	Ganguli (1966)	Sharma (1995)	Baig (2019)	This study
		April–June 1931	Oct–Nov 1965	April–May 1995	April–June 2019	Aug 2021–June 2024
1	Red-headed Vulture	P	P	P	-	P
2	Himalayan Griffon	P	P	P	P	P
3	Slender-billed Vulture*	P	-	-	-	-
4	White-rumped Vulture	P	P	P	-	P
5	Egyptian Vulture	P	P	P	P	P
6	Bearded Vulture	P	P	P	-	-
7	Cinereous Vulture	-	-	-	-	P
8	Eurasian Griffon	-	-	-	-	P

P—species presence | -—indicates species absence or no record | *—Recorded as Long-billed Vulture *Gyps indicus* in Briggs (1931). Taxonomic split in 2001 suggests this was Slender-billed Vulture *Gyps tenuirostris* based on geographical range.

population viability (similar to patterns observed by Thakur et al. 2018).

The concentration of vultures around waste disposal sites presents both opportunities and challenges for conservation. While these sites provide reliable food sources, they potentially expose vultures to harmful substances, including pharmaceutical drugs (Plaza & Lambertucci 2020). This suggests the need for careful management of waste disposal practices and consideration of supplementary feeding programs using uncontaminated carcasses (similar to approaches by Morales-Reyes et al. 2017).

Species-specific Concerns

The near-absence of White-rumped Vulture (single individual sighted on 07 June 2022) indicates potential local extirpation risk, requiring immediate conservation intervention. Similarly, the low numbers of Red-headed Vulture suggest a precarious population status. Historical comparison revealed local extirpations of Bearded Vulture *Gypaetus barbatus* and what was historically recorded as Long-billed Vulture *Gyps indicus*. It should be noted that during Briggs's 1931 survey, what is now recognized as two distinct species – Indian Vulture *G. indicus* and Slender-billed Vulture *G. tenuirostris* was considered a single species with two subspecies (*G. indicus indicus* and *G. indicus tenuirostris*). Briggs did not differentiate between these subspecies in his records, referring only to Long-billed Vulture *Gyps indicus*. Given the geographical location of Ranikhet in the Himalayan region, the locally extinct population most likely corresponds to what is now classified as Slender-billed Vulture *Gyps tenuirostris* (Rasmussen & Parry 2001). The local extirpation of Slender-billed Vulture and Bearded Vulture, historically present in the region, underscores the severity of vulture decline in the Himalayas (Paudel et al. 2016).

The documentation of Cinereous Vulture and Eurasian Griffon suggests possible range shifts, potentially driven by climate change or changes in food availability (Paudel et al. 2016). These new arrivals may indicate the region's continued importance as vulture habitat, despite overall population declines.

CONCLUSION

This study provides the first assessment of vulture populations in Ranikhet over an extended period, revealing significant changes in community composition and highlighting urgent conservation needs. The findings demonstrate a dynamic vulture community with recent local extirpations, recolonizations, and critically low populations of globally threatened species.

The spatial concentration of vultures around waste disposal sites, where cattle carcasses are often dumped, suggests both opportunities and challenges for conservation. While these sites provide reliable food sources, they potentially expose vultures to contaminants (Blanco et al. 2017). The multi-species action plan for African-Eurasian vultures identifies NSAIDs, poison baits, and power infrastructure as the primary threats to vulture populations across the Indian subcontinent, ranking ahead of nest habitat limitations, food scarcity, or human disturbance (Botha et al. 2017). The documented interspecific associations highlight the community structure of vultures in the region and suggest potential for multi-species conservation

Image 1. Red-headed Vulture perched on Pine Tree.

Image 2. Egyptian Vultures at SWM Plant, Ghingarikhal.

Image 3. Himalayan Griffons inspecting the carcass.

Image 4. Himalayan Griffon feeding on the carcass.

Image 5. Eurasian Griffon perched on Pine tree.

Image 6. Cinereous Vulture soaring near carcass dumping site.

approaches (Kane et al. 2014).

The complete absence of breeding activity during our three-year survey, contrasting with historical breeding records of Bearded Vulture (Briggs 1931), signals a critical reproductive limitation threatening long-term population viability (Prakash et al. 2012). Although this study focused on vulture diversity and population status rather than threat evaluation, several conservation priorities emerge from our findings. First, systematic monitoring is required to assess NSAID prevalence in the Ranikhet region, as these chemicals remain a major threat across many parts of India despite Government imposing ban on them (Prakash et al. 2019). Second, documentation of any poison bait incidents over the past decade would help evaluate this threat locally. Third, while food availability appears adequate given vulture concentrations at waste disposal sites, systematic assessment of carrion availability and quality-particularly regarding NSAIDs contamination-would inform targeted conservation interventions. Finally, although habitat loss is not generally considered a primary threat to vultures in regional assessments (Botha et al. 2017), the complete absence of breeding activity during this study warrants investigation into specific local limiting factors, which may include but are not limited to nest site availability.

The documented interspecific associations highlight the community structure of vultures in the region and suggest potential for multi-species conservation approaches (Kane et al. 2014). However, effective conservation requires addressing the documented primary threats through:

1. Monitoring and enforcement of NSAID regulations at local veterinary practices and livestock disposal sites,
2. Investigation of any poison incidents through systematic mortality surveillance, and
3. Assessment of power infrastructure risks in vulture foraging areas.

These actions, combined with protection of waste disposal sites that currently support the vulture population, could help stabilize populations while addressing the causes of vulture population decline identified in regional threat assessments.

While this study focused on diversity and population status of vultures in Ranikhet region, systematic assessments of specific threats particularly NSAID prevalence in livestock carcasses, poison bait incidents, and power infrastructure impacts was beyond the scope of this survey but represents a critical need for future research in this region.

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