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VULTURES OF UTTARAKHAND: A REVIEW OF DISTRIBUTION, NESTING ECOLOGY AND CONSERVATION PERSPECTIVES

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ABSTRACT

Vultures are considered 'nature's clean-up crew' because they clean carcasses and recycle nutrients back into the environment for the ecosystem service they provide. In the Western Himalayan state of Uttarakhand, there are nine species of vulture, of which several are highly threatened. We review the distribution and nesting ecology of vultures in different habitats of Uttarakhand, factors regulating their spatial distribution, breeding parameters and population trend. This paper details the presence of critically endangered species within the study area, such as Egyptian Vultures *(Neophron percnopterus),* White-rumped Vultures (*Gyps bengalensis*) and other near-threatened species. To summarise, we identify key ecological characteristics of the nesting site, note pharmacological toxicity from NSAIDs, and see habitat disturbance as the key threats and imperatives for vulture conservation. We suggest that proactive and holistic conservation measures (protection of nesting sites, reduction of threats, long-term post-treatment monitoring, and community involvement) are essential to conserve vultures in a detailed socio-ecological landscape of Uttarakhand.

Keywords: vultures, Uttarakhand, distribution, nesting ecology, conservation, Western Himalaya, *Neophron percnopterus, Gyps bengalensis*

INTRODUCTION

The Western Himalaya is an important biodiversity hotspot recognised for its great species richness, vast variety of elevations and various biological zones from tropical to alpine habitats (Joshi et al. 2020). Uttarakhand, situated in this area, features a great diversity of bird species scattered over varied habitats like deciduous woods, coniferous forests, riparian zones, agricultural plains, and alpine meadows. Within this avian community, vultures are especially important because they are obligate scavengers that contribute to the health of ecosystems by consuming dead animals, which stops the spread of disease and promotes nutrient cycling (Kumar et al. 2022).

Since the 1990s, vulture populations throughout South Asia have seen unheard-of drops. Diclofenac exposure, a non-steroidal anti-inflammatory medication (NSAID) frequently used in animal treatment, was the primary cause of a 95% or higher decline in several species (Shrivastava, 2023). Diclofenac builds up in the tissues of vultures that eat the corpses of cattle treated with the medication, resulting in nephrotoxicity, renal failure, and avian gout, all of which finally cause the vultures to die (Shrivastava, 2023). Diclofenac was outlawed in Nepal, Pakistan, and India in 2006 as a result of this problem. Since safer substitutes like meloxicam and formulations based on it were introduced, vulture populations have stabilised in certain areas (Shrivastava, 2023).

Recent comprehensive bird surveys in Uttarakhand have identified 231 species from 54 groups (Joshi et al. 2020). Among these, vulture species represent critically important taxa requiring immediate conservation attention. The state harbours several

species with varying conservation statuses, including the critically endangered White-rumped Vulture and the globally endangered Egyptian Vulture (Joshi et al., 2020). Furthermore, studies from adjacent biogeographic regions provide insights applicable to understanding Uttarakhand vulture populations, as these species range across the broader Himalayan and trans-Himalayan landscapes (Kandel et al. 2018).

Noted for its ecological and conservation significance, the vultures of Uttarakhand have a poor understanding of their distribution and nesting ecology. The few studies done so far are mainly concentrated on their habitats or for short time periods; this is certainly the case with those conducted on their nesting habits. This lack of knowledge aids little in an effective management and conservation strategy. The present review aims to summarise the distributional and nesting ecology of vultures in Uttarakhand based on the available literature. The distributional aspects are evaluated for forest, agriculture and riparian habitats, the nesting characteristics with regard to nesting site selection, anthropogenic and ecological threats, with suitable science-based conservation measures. In fact, the present work aims at integrating the knowledge of the state and adjoining areas, which has been generated so far, and thus providing a basis with which the various degrees of understanding of the vultures of Uttarakhand, whilst pinpointing various areas of research and conservation potential.

VULTURE DIVERSITY AND DISTRIBUTION IN UTTARAKHAND

Species Composition and Conservation Status

Uttarakhand harbours nine vulture species documented from the Indian subcontinent, representing members of the Old-World vultures (family Accipitridae), all species of obligate scavengers dependent on carrion for survival. Three near-threatened species were found in the Dehradun Valley, including the Alexandrine Parakeet *(Psittacula eupatria*), Black-necked Stork (*Ephippiorhynchus asiaticus*), and River Lapwing (*Vanellus duvaucelii*), as well as one globally endangered species, the Egyptian Vulture (*Neophron percnopterus*) (Joshi et al. 2020). Additionally, the Woolly-necked Stork (*Ciconia episcopus*), classified as vulnerable by the IUCN, has been documented in the region, representing a significant conservation priority (Joshi et al. 2020).

The presence of these species in Uttarakhand, in particular those which formerly have been considered as having limited limits of existence or as local rarities, seems to suggest that the habitat in the region may now be extending as regards them. This is noteworthy since it shows that Uttarakhand is becoming a significant habitat of refuge to some of the endangered species (Joshi et al. 2020). Discoveries of small and remote groups of birds, like the Mistle Thrush, Sulphur-bellied Warbler and White-rumped Munia in Dehradun, are inclined to suggest that this locality may be a key to the conservation of birds which are restricted to this or that locality, or face the risk of losing their niche elsewhere. (Joshi et al. 2020).

A significant priority as far as conservation is concerned is the White- rumped Vulture (*Gyps bengalensis*) which is currently critically endangered. It was among the largest numerous large raptors in the South Asian region in the early 1990s, however its population collapsed by more than 99.9 percent before 2002 (Majgaonkar et al. 2018). The fact that the nesting groups in the safeguarded area proves the significance of the reserve in helping the species in their recovery. Recent studies show that these vultures often go back to their usual nesting spots, and it has been observed that the breeding numbers are now near their nesting areas (Bhusal et al. 2023). Ongoing monitoring shows that some of the places have level or slightly increasing levels.

Elevational Distribution Patterns

The elevation-specific pattern in the spatial distribution of vultures in Uttarakhand is also influenced by such variables as temperature, precipitation, vegetation, and food sources. A study conducted in the Nainital district in 2017-2020 examined the species of birds in the forest areas across the Western Himalayan area at varying heights (Joshi et al. 2021). According to the diversity indices and non-parametric estimators, such as Chao1, Chao2, and Jackknife, the results indicate that the species diversity was high at the mid-elevations, of approximately 1,500 meters above the sea level (Joshi et al. 2021).

Having such diversity of flora types and a complex ecosystem that host numerous species, the great diversity of the middle-elevations implies that this area has the best conditions to sustain biodiversity. Density of shrubs and diversity of trees are also under direct reliance with the amount and versatility of birds in this region (Joshi et al. 2021). The importance of these forests in conservation and why special management and preservation efforts are needed can be highlighted by vulnerable species such as the endangered Egyptian

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Vulture and by the Cheer Pheasant *(Catreus wallicki*) (Joshi et al. 2021).

Vultures' dispersion due to altitude also depends on carrion supply, which varies due to factors such as cattle production, the population of wild animals, and seasonal migrations. The Egyptian vultures were primarily observed at the altitudes of 523 to 1,644 meters in the Pokhara Valley in Uttarakhand, and their nesting habitats were highly correlated with the diversity in the landscape that was observed at these altitudes (Gurung et al. 2022).

NESTING ECOLOGY AND HABITAT SELECTION

Cliff-Nesting Specialists: Egyptian Vulture

The Egyptian vulture habitually nest on specific sites along cliffs, and intensive research in the Himalayas area has gradually provided much information about nest sites and ecological choices. 21 active Egyptian vulture nests were observed within a 346 km² study area in Nepal in the Pokhara Valley, which is ecologically similar to the areas of western Uttarakhand (Gurung et al. 2022). The nests were found on 20.1 ± 12.2 peak cliffs, and the height of these cliffs was between 523 and 1,644 meters above sea level. Most of the nests (76) were located in safe and secure caves, and the other 24% were located on open ledges (Gurung et al. 2022).

Three main descriptors that vultures use to determine where they nest are the height of the cliffs, the accessibility of the food sources, such as the carcasses of the animals and the elevation change around the nesting sites and in a study that used the generalised linear modelling as a research tool (Gurung et al. 2022). The selection of smaller cliffs near food sources by vultures is likely an attempt to conserve energy when they feed young and reduce competition among food with other species with the limited nesting sites. The Egyptian vultures like having a diverse topography, which causes favourable air currents to soar in their flight and reduces human interference, as reflected by the significant difference in the height of these locations (Gurung et al. 2022).

Recent investigations of the Egyptian vulture nesting places in Nepal suggest that the most favourable places to nest, roost, and feed are the places near forests and towns. The probability of identifying favourable nesting grounds is greater in Nepal in its mid and western regions, which are hillier because of precipitation. These results reflect the difficulty of vulture habitat selection, which consider macroclimate elements such as precipitation, landscape factors such as accessibility of feeding sites, and microhabitat factors such as nest substrate.

Tree-Nesting Vultures: White-rumped Vulture

Tree-nesting vultures constitute the bulk of the vulture population in Uttarakhand and South Asia, excepting the masters of the cliff-nesting vultures, due to the nest being a critical part of successful vulture reproduction. The endangered white- rumped Vulture *(Gyps bengalensis)* usually constructs its nest in the massive trees with some of the structural characteristics of the old-growth trees. *Adina cordifolia, Dalbergia latifolia*, and *Stereospermum tetragonum* are three tree species that were reported to have nest sites in the Wayanad Wildlife Sanctuary in Kerala (Vishnu O, et al. 2024). Average heights of these nests were between 820 and 860 meters, which was 14 to 28 meters above the ground. This implies that the vultures not only pick their nesting sites, but that they tend to go back to their nesting sites each year (Vishnu O, et al. 2024).

The success rate of white- rumped vultures nesting in Wayanad was 64.7% indicating that such populations are mostly vulnerable and should be handled with care even in the conserved areas where the right habitat is present (Vishnu O, et al. 2024). Vultures usually nest in bigger trees, and most of the nest failures happened due to failures before the hatching, as a study done in Western Maharashtra revealed (Majgaonkar et al. 2018). According to the same study, smaller colonies had more successful nests, which means that the size of the colony should not be considered the sole factor determining the definition of conservation goals. Instead, specific habitat traits and geographical factors contributing to nesting success should be placed in the limelight (Majgaonkar et al. 2018).

In Raisen District, Madhya Pradesh, the nesting preferences of White-rumped Vultures have been demonstrated to have very special patterns. Sacred fig (*Ficus religiosa*) and the teak *(Tectona grandis*) are two high trees with high canopy, which these vultures are fond of using to breed and rest (Choudhury SR, et al. 2024). It was found that there were twelve nests on *Ficus religiosa* in an area of approximately 800 meters

of Baairukhhar Village, and it was observed that 98-102 vultures used these tall trees (Choudhury et al. 2024). The very existence of such an endangered species in areas of human influence creates two issues of utmost importance: the reduction of breeding success due to human intervention and the issue of potential persecution of the vultures when they collide with the local populations.

Factors Influencing Breeding Success

The suitability of breeding habitat of the White-rumped Vultures is a multi-factual phenomenon that is not based on the location of the nest alone. In the central lowlands in Nepal where maximum entropy modelling has been applied, land use-land cover (LULC) variables represented over half of the predictive variables of habitat suitability (Baral et al. 2025), as in the foothills of Uttarakhand. The analysis revealed that there was a negative correlation between agricultural land and the appropriate breeding habitat, which was probably as a result of higher human disturbance and reduced nesting trees (Baral et al. 2025). On the other hand, there was a positive association between the forest cover and favourable breeding location.

Biome features, especially tropical and subtropical grasslands, savannas, and shrublands, accounted for 21.8% of breeding habitat suitability. Additionally, Euclidean distance from water sources contributed 12.8% to the model predictions (Baral et al. 2025). These results highlight that vulture breeding habitats depend on multiple factors, including vertical structure such as tall trees, landscape diversity, closeness to water resources and particular vegetation arrangements.

The presence of vulture restaurants (feeding sites with regularly supplied livestock carcasses) has emerged as an important conservation tool, providing reliable food sources to support breeding populations and reduce exploitation pressure on wild carcass availability. Vulture populations in proximity to vulture restaurants showed more stable population trajectories and improved breeding success compared to populations dependent entirely on wild carcass availability (Baral et al. 2025).

Nest-Site Characteristics Across Vulture Species

Studies comparing nesting habits of different species of vultures show that each species has its own peculiar requirements of habitat, depending on its earlier evolution and adaptation to the environment. Information relating to the tree-nesting species of vultures is supplied by the Hooded Vulture (*Necrosyrtes monachus*), which occurs in neither of the areas of Uttarakhand, but gives information as to the nesting places of tree-nesting vultures, which is so important. It is suggested by the use of camera traps that these vultures almost invariably build their nests at a considerable height in tall trees, *viz*. on the average about 25 meters, and they build their nests about 18 to 19 meters above the ground, usually at the fork in which at least three large branches meet (Deikumah et al. 2025). The nests occur principally in the part of the tree with a dense covering overhead and are usually near water and also in places surrounded by much taller trees than places in which there are no nests (Deikumah et al. 2025).

Even though the Hooded Vulture lives in different regions and belongs to a different evolutionary group, its nesting preferences are similar to those of the White-rumped Vulture found in Uttarakhand and nearby areas. This pattern suggests that certain habitat features, like tall trees, strong branch supports, and closeness to water, are consistently important for the nesting success of tree-nesting vulture species across different locations (Deikumah et al. 2025).

THREATS TO VULTURE POPULATIONS IN UTTARAKHAND

Pharmacological Threats: NSAID Poisoning

The diclofenac crisis is the single most serious anthropogenic threat to vulture populations over Uttarakhand and, more generally, South Asia. Diclofenac ingestion by vultures through livestock carcasses of treated animals causes renal failure and avian gout through renal tubular degeneration and hyperuricaemia, which may lead to visceral gout and death (Kumar et al. 2022). Population crashes of > 95% in affected areas occurred within a decade of the widespread introduction of diclofenac for livestock treatment (Shrivastava 2023).

Although diclofenac was officially banned in India in 2006, it continues to threaten vulture conservation. The current assessment in Uttarakhand shows that it is still important to find and reduce any remaining sources of diclofenac while also promoting the use of safer alternatives like meloxicam (Kumar et al. 2022). Studies on the availability of veterinary medicines within vulture-safe zones around breeding and feeding areas have found that the ban is not fully enforced, especially in smaller veterinary pharmacies that serve

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rural communities dependent on livestock (Molur et al. 2024).

The Long-billed Vulture population monitored systematically over four nesting colonies in Nilgiri Biosphere Reserve showed breeding success rates of 62.5% to 83.33% in different years, and NSAID poisoning and poison baits targeting carnivores were detected to impact the population negatively (Molur et al. 2024). The emphasis of the study was to make vulture-safe zones having 100-km radii around the breeding colonies to combat the large-scale movement pattern of highly mobile vulture species (Molur S, et al. 2024).

Habitat Loss and Fragmentation

Beyond pharmacological threats, habitat degradation represents a substantial threat to Uttarakhand's vulture populations. Rapid development, forest fragmentation, and conversion of natural habitats to agricultural or urban uses reduce the availability of suitable nesting sites and foraging areas. The dependency of vultures on specific microhabitats for roosting and breeding makes them particularly vulnerable to habitat fragmentation patterns characteristic of intensifying land-use change in Himalayan regions.

For tree-nesting species, the loss of large, mature trees by selective logging, mortality from disease and by natural processes directly decreases the availability of breeding habitat. For cliff-nesting species like the Egyptian Vulture, quarrying, road building, and mining work that is carried out pose a direct threat to the integrity of the nesting sites and the stability of the cliffs. Studies have shown that vultures depend on a variety of habitats to survive (Rodriguez et al. 2017). When land is made too intensively productive and therefore more uniform, so that the variety of habitats is decreased, the area becomes less suitable for the healthy support of vulture populations throughout Uttarakhand.

Research from Central India has shown that protected areas play a major role in helping vulture populations survive. The chances of finding vultures were much higher in protected areas (44–51%) compared to unprotected forests (17.6–17.8%) and farmland (0.03%) (Jha et al. 2021). Vulture density was also much greater in protected areas (0.529 ± 0.228 km^{-2}) than in unprotected forests (0.014–0.012 km^{-2}) (Jha K, et al. 2021). These findings clearly show how important it is to set up more protected areas and manage them properly to ensure the long-term conservation of vultures.

Anthropogenic Persecution and Human-Vulture Conflict

Studies of the perceptions of the vultures in the Western Himalayan region show that they have an opinion that is synonymous depending on their educational background, livestock dependability, and their culture. In the Pokhara Valley in Nepal, habitat loss had been named by 58 percent of the respondents as the main threat of vultures, although 97 percent of respondents knew nothing about the diclofenac effect (Gurung et al. 2022). This means that there are numerous inhabitants especially those involved in agricultural activities and keeping livestock in the vulture areas who are not aware of the principal dangers to the birds.

The perception and perception of vultures vary across cultures based on cultural beliefs. Research along the Egyptian Vultures migratory route, which runs between the Balkans and the Middle East into Africa demonstrates that most communities have recognised vultures as important to keep the environment healthy. However, the level of consciousness and cultural significance that is assigned to vultures is quite different among countries (Sharma et al. 2023). The Egyptian Vulture with its boldly white feathers and migratory pattern has been a famous species that facilitates the attraction of the greater protection of vultures (Sharma et al. 2023).

In many areas, human actions like destroying nests and cutting down nesting trees have become major threats to vultures (Deikumah et al. 2025). In some places, beliefs linked to religion, superstition, and witchcraft have also led to the killing of vultures. A study in northeastern Benin found that 60% of people associated vultures with witchcraft, and 70% admitted to using their bones and brains for traditional or spiritual purposes (Hounnouvi et al. 2025). Because similar cultural beliefs might exist in Uttarakhand, conservation programs there need to be sensitive to local traditions and find ways to protect vultures without clashing with community values.

CONSERVATION INITIATIVES AND PROTECTED AREA EFFECTIVENESS

Role of Protected Areas in Vulture Conservation

Vulture occupancy rates in protected areas of central India are remarkably higher than in unprotected forests and agricultural habitats, particularly those found in the states adjoining Uttarakhand (Jha et al. 2021). Protected area establishment and management are one of the most important conservation strategies. The likelihood of vulture occupancy was significantly greater in protected areas (44-51%) than it was in agricultural areas (0.03%) and unprotected forests (17.6-17.8%), and vulture density values in protected areas (0.529 ± 0.228 km^{-2}) were significantly higher than those of unprotected forests (0.014-0.012km^{-2}) (Jha K, et al. 2021).

Importantly, the presence of active, inactive and abandoned nests in protected areas provided evidence of suitable habitat conditions for breeding, potential breeding and floater categories of vultures, while disturbance factors were shown to be negligible in their significance within the boundaries of protected areas (17). The importance of landscape-scale threat treatment is evidenced by the fact that the legislative ban on the use of diclofenac enhanced vulture populations significantly within protected areas, while this had no effect in the immediately adjacent areas (Jha K, et al. 2021).

Vulture Safe Zones and Landscape-Scale Conservation

Establishing vulture-safe zones is a crucial measure for their conservation. By prohibiting harmful NSAIDs near feeding and nesting sites, we can lower the chances of vultures consuming toxic carcasses approach includes: Vulture populations are successfully increased by combining stringent drug control, habitat protection, and community involvement, according to research conducted in the Nilgiri Biosphere Reserve (Molur et al. 2024).

1. Researching veterinary pharmacies existing in areas within a 100-km radius of vulture breeding and forage sites for NSAID stocks
2. Initiation of community schemes, which promote livestock products that are vulture-safe livestock.
3. Continuously monitoring vulture populations over time to measure how well conservation actions are working.
4. Tackling different threats, such as poisoned baits, power line hazards, and forest fires, through cooperation between various groups and stakeholders

The multifaceted relationship of ecological needs and economic and social conditions in Uttarakhand requires conservation approaches that are inclusive of both species protection and support for rural communities that depend on livestock production for their livelihoods (Molur et al. 2024).

COMMUNITY ENGAGEMENT AND KNOWLEDGE ENHANCEMENT

Comparative Analysis: Vulture Ecology Across Habitat Types

Local communities should be involved in order to achieve success in conservation. A survey was done in the north-east of Benin to study the attitude of the community to vultures and conservation problems. It established that 86 percent of the respondents were in support of preserving and rehabilitating major vulture nesting areas, 84 percent of the respondents acknowledged that there was a need to create awareness to people about the threats posed to vultures, and 65 percent of the respondents supported the idea of educating and arming eco-guards to patrol and protect the vulture nesting areas (Hounnouvi FEK, et al. 2025). The young people (18-30) were more supportive of such activities compared to older ones and this indicates that an educational initiative focused on the youth can enhance support of vulture conservation even better (Hounnouvi et al. 2025).

Forest Habitat Vultures

The bird surveys conducted in the forests of Uttarakhand indicate that the distribution of the vultures depends on the type and vertical layers of the forest. The existence of such endangered species as Egyptian Vultures and the endangered Cheer Pheasant confirms the role of properly designed habitats (Joshi and Kumar 2021). Such forests are important roosting areas and in the case of certain species, important feeding areas where carcasses accumulate in reasonable numbers to sustain populations of vultures. The western Himalayan forests, which range from subtropical to temperate mixed and subalpine coniferous forests, are quite diverse in providing a range of habitats that can support different species of vultures at different altitudes.

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Agricultural Habitat Utilisation and Livestock Carcasses

In Uttarakhand, the farmlands play an important role in sustaining the vultures as livestock farming is a reliable source of carcasses upon which the birds rely to get food. Nevertheless, research shows that vultures are not common in the farming lands as much as they are in forests that are under protection (Jha et al. 2021). This means that intensive farming can render these areas less conducive by decreasing the topography and boosting the unrest of anthropogenic action. Livestock medicines also lead to the highest risk of diclofenac exposure to the vultures and the creation of the dangerous situation where food seems plenty, but in fact, it is poisonous and the dangers are hidden in the form of the toxic effect on it.

Riparian and Water Stream Habitats

The Dehradun Valley waterways are also crucial habitats to many bird species, some of which are endangered or threatened (Joshi et al. 2021). The fact that these habitats are the home of the near-threatened River Lapwing (Vanellus duvaucelii) highlights the significance of these environments to species that require a particular environment. Researchers have documented 44 species of waterbird in 15 families in the Chambal River system near Mukundra Hills National Park in Uttarakhand; three of the species, including the Near Threatened Woolly-necked Stork, were observed to be breeding (Molur S, et al. 2024). They also provide drinking, bathing and resting places to different types of vultures, hence showing the importance of sound stream ecosystems in promoting the conservation of the vultures.

CONCLUSIONS AND CONSERVATION RECOMMENDATIONS

Synthesis of Distribution and Ecology

In Uttarakhand, nest several vultures of the utmost importance to conservation, including globally endangered species, which are found mainly in the Himalayan range. The distribution of vultures in this area depends on different environmental variations and the diversity of habitats in the Western Himalaya, while the principal species occupy the mid-elevation forest regions, where they meet the most favourable environmental conditions. Their nesting haunts vary with different species, according to whether or not they are cliff or tree-nesters, the structure of the type of forest availed to them, and the configuration of the adjoining landscape to foster their needs. The nesting sites chosen are of a less disturbed nature and with greater food supplies. The White-rumped Vulture, a bird that is critically endangered, and the Egyptian Vulture, a bird regarded as endangered, need special and immediate conservation attention. Recent investigations prove that in protected and well-managed areas, the breeding population of these species is stable or increasing, which goes to prove that restoration is possible under the right conservation attention. The populations, however, are still seriously endangered by human activities, and strong and concerted conservation protection is necessary to save them.

Integrated Conservation Strategy

Conservation of Uttarakhand's vultures requires integrated, multifaceted approaches addressing ecological and socioeconomic dimensions of vulture conservation. Specific recommendations include:

1. **Pharmacological Threat Mitigation:** Pharmacological Threat Mitigation: We should have better mechanisms to control the use of veterinary medicine and encourage the community to shift to alternative of vultures that are harmless instead of using NSAIDs that are harmful (Molur et al. 2024). Also, it is important to develop and implement vulture-safe zones with at least a 100-kilometre radius surrounding the key vulture habitats as they move across large territories (Molur et al. 2024).
2. **Habitat Protection and Enhancement:** Network more significant nesting sites, especially to cliff-nesting Egyptian Vultures and tree-nesting White-rumped Vultures. It would be essential to restore landscape connectivity in order to allow the movement of the vultures through the fragmented habitats safely. Protection of large mature trees in forests which are used by vultures as nesting areas should also be done through limiting logging and conserving of the dead trees where possible.
3. **Community Engagement and Education:** Educate community culturally regarding knowledge gaps on the subject of vulture ecology, of vultures, conservation risks, and local conservation responsibilities (Dhakal et al. 2022). These programs

are supposed to focus on the younger generations mostly, as they are the ones that are more willing and encouraging towards conservations (Hounnouvi et al. 2025). Also, it is necessary to introduce livelihoods programs that would promote the use of vulture-safe livestock and develop new job opportunities in other sectors, including vulture monitoring and veterinary care.

4. **Long-term Monitoring:** Develop consistent and clear-cut ways of monitoring vulture populations across Uttarakhand, and numbers of breeding, nesting success, fledgling success, and other crucial population patterns (Jha et al. 2021). Possible toxicity of the carcass and the presence of toxic NSAIDs should also be assessed regularly.

5. **Research and Science-Management Integration:** Focus on research that addresses knowledge gaps in terms of population demographics, microhabitat requirements, climate change impacts and threat interactions of the vulture. Make sure that new research is rapidly translated into practice in managerial practice by developing close relationships between scientists and policymakers and through the adoption of flexible management practices that can keep up with new information.

6. **Vulture Restaurant Establishment:** Design and manage vulture restaurants, which are special feeding areas and which frequently replenish safe carcasses of livestock. These places give the vultures a steady and reliable food supply especially around their breeding areas. Moreover, it is important to ensure that every carcass is tested to contain harmful NSAIDs to ensure that the birds have safe food supply.

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