

From Crop Raiding to Cultural Symbol: Reconciling Golden Langur (*Trachypithecus geei*) Conservation with Rural Livelihood in the Eastern Himalaya

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From Crop Raiding to Cultural Symbol: Reconciling Golden Langur (*Trachypithecus geei*) Conservation with Rural Livelihood in the Eastern Himalaya

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Abstract

The Golden Langur (*Trachypithecus geei*), one of the world's 25 most endangered primates, faces mounting pressure from habitat fragmentation and human-wildlife conflict across its restricted range in Bhutan and northeast India. Yet populations persist in agricultural landscapes—a paradox rarely documented in critically endangered primates. This study examined population dynamics, spatial distribution, and human attitudes toward golden langurs in human-dominated landscapes to understand the mechanisms that enable coexistence. We surveyed 13 sample plots across two gewogs (Trong and Nangkhor) in Zhemgang Dzongkhag using line transects and double-observer methodology, encountering 241 individuals across 25 groups over 21 observation days. We also interviewed 80 local residents (30% household sampling) using semi-structured questionnaires to assess perceptions and attitudes toward conservation. Population estimates indicated 304.8 individuals ($SE \pm 9.804$) with a mean group size of 10.24 ($SE \pm 0.46$) and detection probability of 84%, yielding a local population density of 1.5 individuals/km², substantially higher than the published Bhutanese average of 0.88 individuals/km². Critically, hotspot analysis revealed concentrated distributions (Z-score: 1.559) along Tingtibi and Dakphel roads, areas of high human activity and agricultural interface. Habitat utilization showed a negative correlation between elevation and group size ($r = -0.335$), indicating larger groups in resource-rich lowland agricultural areas. Despite significant conflicts, 46% of respondents reported crop raiding and household disturbance, and 60% of local communities held positive attitudes toward langurs, citing cultural significance (35%), tourism potential (52%), and rarity (28%). However, 40% opposed conservation, driven primarily by destructive behaviours (78% of opponents). This study reveals that golden langurs have adapted to agricultural margins through flexible habitat use, yet their persistence depends critically on maintaining positive human attitudes despite tangible livelihood costs. We identify a narrow coexistence window in which conservation success hinges not on habitat expansion but on mitigating human-langur conflict through targeted crop protection and on promoting indigenous cultural values that already favour conservation. These findings challenge the assumption that endangered primates require wilderness isolation, offering a scalable model for the persistence of endangered species in the human-dominated tropics, where protected areas are increasingly fragmented, and communities bear disproportionate conservation costs.

Keywords: Golden Langur, Human-Wildlife Coexistence, Endangered Primates, Agricultural Landscapes, Crop Raiding, Conservation Attitudes, Himalayan Biodiversity, Human Dimensions of Conservation

Introduction

Golden Langur are endemic to six districts in Bhutan and western Assam. They are found at elevations ranging from 199 to 2600 meters above sea level (Dorji et al., 2021). According to Davi (2018), the total range is less than 30,000 sq. km in both countries. Assam, in northeast India, is home to approximately 5,000 Golden Langurs, and Bhutan has over 6,000 of them (Yonten, 2020). They spend 99% of their time in trees and, on average, move 200 to 700 meters per day using forest canopies (Sahana, 2020). They are found in fragmented forests; therefore, protecting their natural habitat is considered important given their restricted distribution in India and Bhutan (Biswas, 2008). A study conducted in India by Goswami (2022) shows that, compared with bioclimatic influences, the Golden Langur is more sensitive to land-use and land-cover changes. Hence, people are the main drivers of the decrease in the Golden Langur population. In India, across the southern range of Assam, suitable areas for the Golden Langurs are scattered, and these habitats are vulnerable to deforestation driven by agricultural and urban expansion (Goswami, 2022). With species populations in Assam brutally affected by deforestation and habitat loss, Bhutan is the last bastion for their survival.

The population of the Golden Langur has declined in Bhutan, and it is now less than the current IUCN estimate of 4000 individuals (Thinley et al., 2019). Despite the population decline, there is no comprehensive conservation strategy for the Golden

Langur across its habitat, particularly in Bhutan (Biswa, 2008), where increasing numbers of Golden Langur deaths have been documented. Between June 2012 and June 2019, there were 107 recorded incidents in Bhutan concerning Golden Langur (Mercy, 2019). According to Yonten (2020), most of the Golden Langur's deaths occurred along the Dakphel and Tingtibi roads of Zhemgang. There is limited study on how developmental activities alter its group size or how these Golden Langurs respond to surrounding threats (Dorji, 2020).

This research assesses species distribution in agricultural landscapes, human-Golden Langur interactions, and conservation perspectives on the Golden Langur in Zhemgang, Bhutan.

Materials and methods

Study area

Located in the country's South-central region, the study area covers 847 sq. km at altitudes ranging from 500 to 3000 masl. Trong and Nangkor have 22 villages with a total population of 8281 (RGoB, 2022).

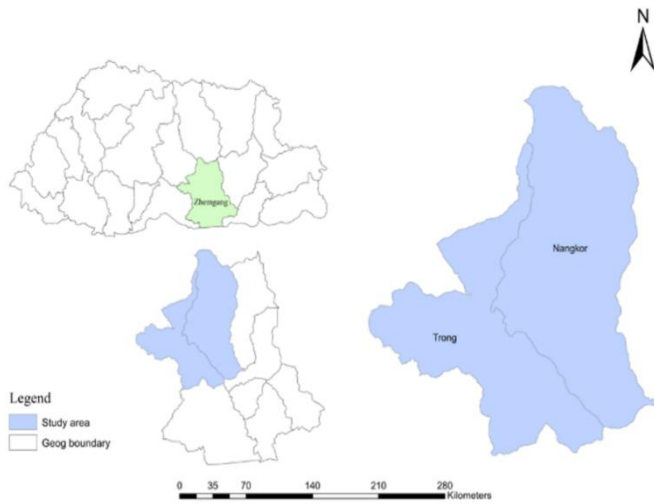


Figure 1: Map of Bhutan showing the research site at Zhemgang Dzongkhag

Sampling design

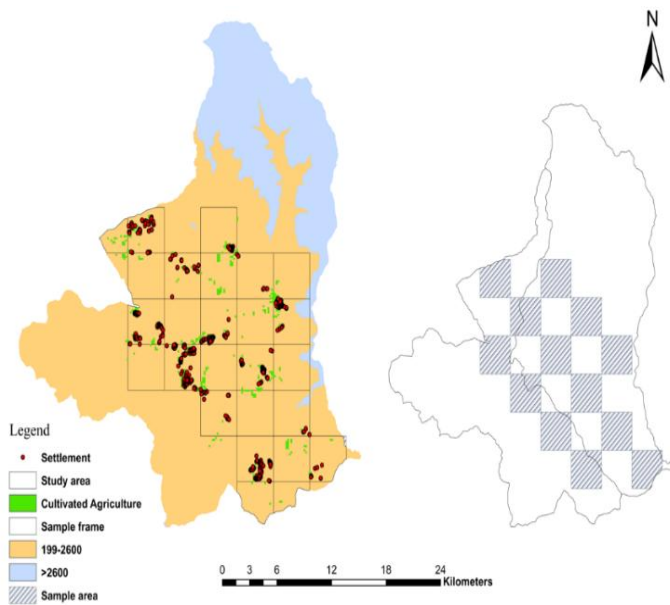


Figure 2: Map of study area showing the sample plot.

The 4 km x 4 km grid corresponding to the Bhutan biodiversity monitoring grid has been overlaid on the study area. To identify potential areas of Golden Langur occurrence, specific grids were selected with

elevations ranging from 199 to 2600 masl. These grids were selected based on the expected habitat of Golden Langurs, as mentioned by the Royal Society for Protection of Nature in 2021. To assess the distribution of the Golden Langur in human-dominated landscapes of Zhemgang, a sample frame of settlements and cultivated areas was selected. Surveys on Golden Langur and human interaction in agricultural landscapes, and on local people's perspectives towards Golden Langur conservation, were conducted with local people in the sample area.

To avoid the double counting of the same sample individuals, systematic sampling is done to choose the sample plots for data collection. In every sample plot, a trail transect was laid. The line transect survey method is a commonly used method to count primates (Plumptre, Sterling & Buckland, 2013). As prescribed by the biodiversity monitoring protocol (Department of Forest and Park Services, 2020), a 3-4 km trail transect, depending on area accessibility, was walked to cover major habitat types within the

grid. The data collection method used in this study was the ‘double-observer’ survey method, originally developed by Forsyth and Hickling (1997) and recently refined by Leki et al. (2018), who suggested it for surveying primates in rugged terrain. Furthermore, the mammal monitoring protocol using a double observer survey is also recommended by DoFPS (2021).

Data collection methods

Ecological data

Transects of 3-4 km were conducted depending on the area's accessibility. In inaccessible areas, shorter trail transects of at least 1 km were used to collect the ecological data. Direct sightings of Golden Langurs were recorded after we encountered Golden Langurs during the transect walk using the data sheet. Of the 24 groups of Golden Langur sighted in Zhemgang, 21 were identical and sighted by both observers. There were slight differences in the number of individuals observed by both observers. However, both observers agreed on the final number of individuals in each group composition. Each observer was able to distinctly spot only four groups of Golden Langur that stood out from the others - the first observer spotted two groups and the second observer spotted two as well. The group composition of the Golden Langur was recorded along the trail transect, including adult males, adult females, immature individuals, and infants.

We identified and classified the Golden Langur by observing its physical features. An adult male is characterized by a vibrant orange-gold

collared coat, black face and hands, and distinctive physical features such as a crest of hair on their head, a long tail, and a vocal pouch (Chhangani 2002). Adult males were also generally larger and more muscular than females (Srivasta, 2006). Adult female Golden Langurs had a paler golden coat. They had a small crest of hair on their head and shorter tails. Females were typically smaller and less muscular than males (Das et al., 2007). Immature Golden Langurs lacked the distinctive colouration of adults. They had a more muted coat colour and lacked the crest of hair on their head (Srivasta, 2006). Juvenile Golden Langurs were very young, and they still relied on their mother for protection and nourishment. (Chhangani, 2002).

Social data

We surveyed 30% of the total households within the sample plot using semi-structured questionnaires. Across 11 villages, we interviewed 80 people per household (30 from Trong and 50 from Nangkhor). The interview aimed to assess their behaviour towards the Golden Langur and was conducted using a comprehensive semi-structured survey format (Annexure 1).

The survey form was divided into four parts to identify distinct social aspects and determine the prevailing anthropogenic threats in the area. The first two parts of the survey were to record details of the enumerators and the respondents. Part three aimed to identify local people's perceptions of the Golden Langur, whereas part four aimed to document the threats to Golden Langur conservation. The survey provided information on human-primate conflict

within two Geog, its threats, and human attitudes towards conserving the Golden Langur population.

Data analysis

Ecological data analysis

Computing Golden Langur abundance and density

The projected population abundance of the Golden Langur was figured as the product of the estimated number of langur groups ($\hat{G}$) and the mean group size ($\hat{\mu}$). “Group” was defined as a separate assembly of individuals at a specific place (Horwich et al., 2013).

As per Suryawanshi et al. (2012), the number of groups ($\hat{G}$) was estimated as:

$$\hat{G} = \frac{(L+S_1+1)+(L+S_2+1)}{L+1} - 1$$

Where:

G = number of groups

L= number of groups of Golden Langur seen by both of the observers

S_1 = number of groups of GL seen by the 1st observer

S_2 =number of groups of GL seen by the 2nd observer

The mean group size ($\hat{\mu}$) of the Golden Langur was calculated as the average of all group sizes.

$$\hat{\mu} = \frac{\sum X_n}{n}$$

Where:

μ = the mean group size

$\sum X_n$ = sum of individuals in group ($\hat{G}$)

n = total number of groups

To compute the detection probability for each observer, we divided the number of groups the observer has seen by the average number of groups seen by both observers.

$$P1 = \frac{L}{(L+S_1+S_2)}$$

Where:

P1= Detection Probability of the 1st observer

L = groups of GL seen by both observers

S_1 = number of groups of GL seen by 1st observer

S_2 =number of groups of GL seen by the 2nd observer

Hotspot analysis for Golden Langur distribution

We used hotspot analysis to identify statistically significant clusters of Golden Langur in Zhemgang, based on occurrence data collected during field surveys. Hotspot analysis using Inverse Distance Weighting (IDW) is a widely used spatial analysis technique to identify regions with a significant concentration of a specific occurrence (Srikanth & Srikanth, 2020). It is based on the principle of spatial autocorrelation, which refers to the degree to which neighbouring locations are similar or dissimilar with respect to the phenomenon being studied (Sharma & Sharma, 2021).

The analysis was performed using geographic information system (GIS) software and

involved calculating the G_i^* statistic. The G_i^* statistic quantifies the degree of clustering of high or low values of a phenomenon relative to adjacent cells, yielding a z-score that indicates the statistical significance of the clustering. According to Jana and Sar (2016), positive z-scores show high spatial clustering (hotspots), while negative z-scores indicate low spatial clustering (cold spots).

Social data analysis

To examine the social aspects of people's perceptions of the Golden Langur and the conflicts between people and the Golden Langur, a social database was created in Microsoft Excel. Data was entered into Excel and organized with variables in columns and observations in rows. Graphs and charts were created in Excel to visualize and identify patterns in the data. The database was then converted to a CSV (comma-separated values) file format, which enabled easy import and analysis in R. The data were subjected to various descriptive statistical analyses to reveal insights into people's attitudes, behaviours, and perceptions of people-Golden langur conflicts.

Results and discussion

Ecological studies

Population structure of Golden Langur

Across 13 sample plots, we sighted 25 groups totaling 241 individuals over 21 observation days. From the 241, 26 (10.8%) were adult males, 68 (28.22%) were adult females, 110 (45.63%) were immature, and 37 (15.35%) were infants. The group sizes ranged from 5 to 19 individuals (Figure 3). Of

the groups sighted, 88% had fewer than 13 individuals, and only 12% had more than 13. The largest group, with 19 individuals, was sighted at Dunmang tsachu in Namgkor geog.

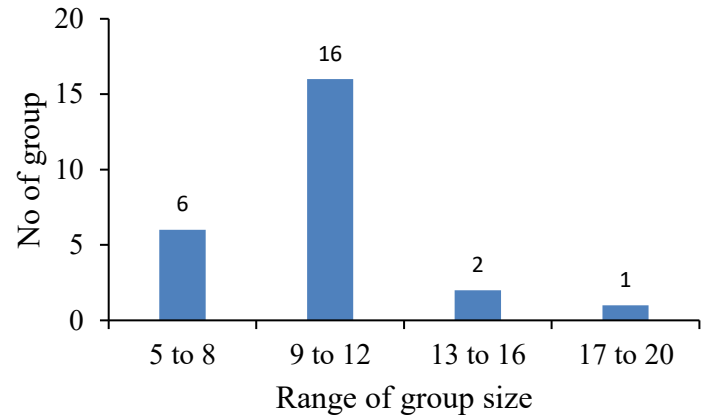


Figure 3: GL group sizes observed in Zhemgang.

Adult females were demographically dominant in the groups, with an approximate male-to-female ratio of 0.3889. It means there are approximately 0.39 males per female, and that for every 1 male, there are approximately 2.57 females (1:2.57). According to Thinley et al. (2019), the male-to-female sex ratio of Golden Langur is 1:1.97, which was the same in other primates: chimpanzees (1:1.21) and spider monkeys (1:2.25), where the population has a skewed sex ratio or a female-biased sex ratio, indicating the higher proportion of females compared to males in the population (Srivastava et al., 2001)

A female-biased sex ratio in Golden Langurs can result from male dispersal. According to Thinley et al. (2019), male golden langurs tend to depart from their birth groups at a relatively earlier age than their female counterparts. As a consequence of this behaviour, the number of males within the

population is lower than that of females. As a result, male dispersal is regarded as one of several causes contributing to a female-biased sex ratio throughout time (Schwanz & Robert, 2014).

Estimates of population abundance and density

From the 25 langur groups sighted in Zhemgang, 21 groups were seen by both observers. However, the first observer observed 2 groups, and the second observer observed 2 other groups, with no overlap between the groups observed by each observer. We estimated the total number (N) of the Golden Langur in Zhemgang at 304.7 (SE $\pm$ 9.804; Table 1). This estimate was found to be reliable, with a detection probability (p) of 84% by both observers (Table 1). The mean group size (μ) was 10.24 (SE $\pm$ 0.46), and the estimated number of groups was 26.18 (SE $\pm$ 0.21).

According to Dunbar, Mac Carron, and Shultz (2018), the population density of the Golden Langur in the study area is estimated from a total of 256 sighted individuals and the species' potential habitat in Zhemgang (i.e., 204.09 sq. km). The density of the species is estimated at 1.5 individuals per sq. km, which is higher than that reported by Thinley et al. (2019), who estimated the population density of the Golden Langur at 0.88 individuals per km². This may be due to factors such as high habitat quality, abundant resources, and the absence of threats to the species that could affect population density (Fan et al., 2021). However, it is difficult to determine whether a population density of 1.5 Golden Langurs per square kilometre is good or not

with reference to earlier studies, as a healthy population depends on many other factors like human activities, availability of resources, disease and predation, and habitat quality, as presumed by Gonzalez et al. (2001).

Table 1: Golden Langur abundance estimate using the double observer methods (L = number of groups seen by both observers (1st and 2nd observer); S1 = number of groups seen only by the first observer; S2 = number for groups seen only by the second observer; G = estimated group number of Golden Langur; μ = mean group size of the species; N = estimated abundance Golden Langur; p1 = detection probability of the first observer; p2 = detection probability of second observer).

variable	value
L	21
S1	2
S2	2
G	26.18
μ	10.24
Var(μ)	0.212
P1	0.84
P2	0.84
N	304.8
Var(μ)	0.212
SE(μ)	0.46
SE(N)	9.804

Habitat utilization by Golden Langur

Different groups of the Golden langur were sighted between the elevations ranging from 240.4 m to 1858.5 m in Zhemgang. Most sightings were

obtained within the elevation class of 1,000 m – 1,400 m. The fewest sightings were at the elevation between 600- 1000 m and 1800- 2200 m.

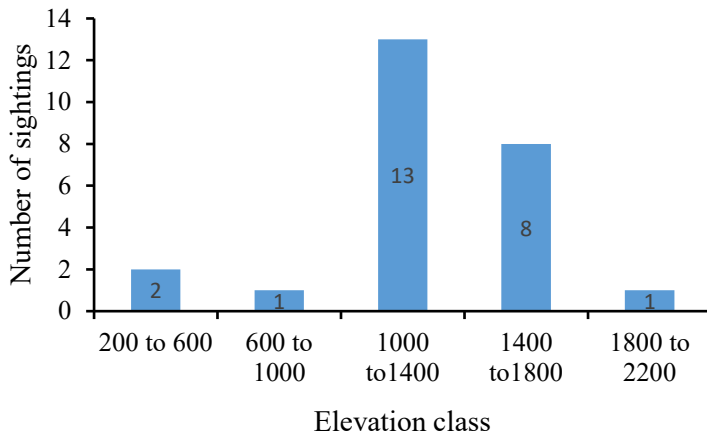


Figure 4: GL sightings in different elevation classes in Zhemgang

Relationship between elevation and GL group size

There was a negative correlation ($r = -0.335$) between the group size of Golden langur and the elevation (m asl), indicating a decrease in the group size of Golden langur with the increase in elevation. There may be other factors influencing the size of their groups (Hayes, 2023). According to Ma et al. (2020), the allocation of the desired food sources is essential in determining the areas utilized by *Trachypithecus* species. This correlation is also represented in the graphs below (Figure 5). The regression line in the graphs represents the strong negative correlation between elevation and the Golden Langur's group size. The uniform distribution of points on the graphs also indicates a negative correlation between elevation and the Golden Langur group size.

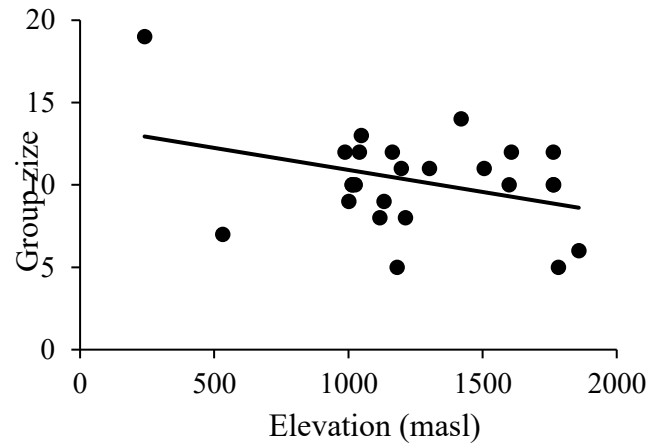


Figure 5. Group size against elevation

A study by Lussier (2022) further supports the idea that the size of golden langur groups is largely influenced by resource abundance associated with habitat elevation.

Lower elevations offer more food and resources, and Golden Langur groups are larger, with up to 20 members. In contrast, at higher elevations, where food and resources are scarce, groups tend to be smaller, with only 2-3 individuals (Sahana, 2020).

Distribution of Golden Langur

Distribution of Golden Langur based on sightings

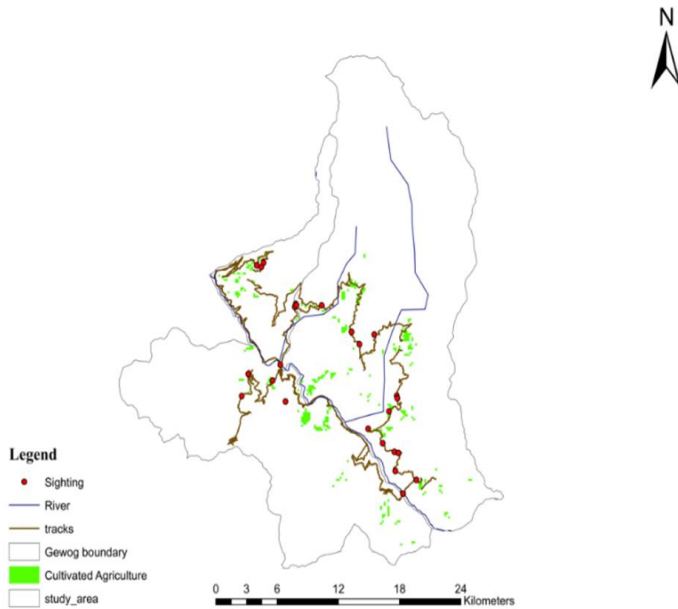


Figure 6: Golden Langur sightings in Zhemgang in December of 2022.

Within Trong and Nangkhor Gewog, we sighted Golden langur in 15 villages: Ringdibi, Kamjong, Dunmang, Tseldang, Buli, Zhobling, Tali, Tingtibi, Bermo, Tamala, Tsanglajong, Zurphey, Gomphu, Dunmang Tsachu, and Dakphel. Within 13 sample plots, we sighted 241 Golden Langurs in 25 groups in 21 observation days, i.e., from December 6, 2022, to December 26, 2022.

The lowest altitude of Golden Langur sightings in Zhemgang was 240.359 masl at Dunmang Tsachu. Within 21 observation days, the largest group size was also recorded in Dunmang Tsachu, at 19 individuals.

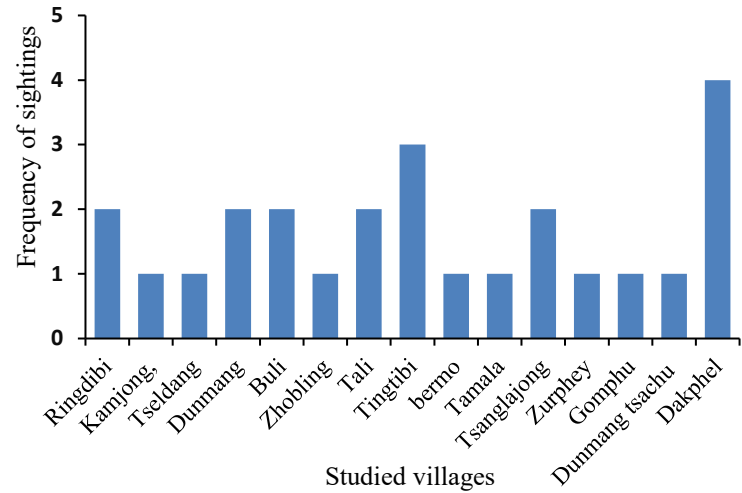


Figure 7: Frequency of Golden Langur sightings in different villages of Zhemgang

The distribution of sighting points among the villages was not uniform. The majority of the recorded sightings occurred in Dakphel and Tingtibi, with 4 in Dakphel and 3 in Tingtibi. In these locations, Golden Langurs were primarily observed salt-licking on exposed rocks and soil near the roadside. The higher number of sightings in Dakphel and Tingtibi helps explain why Yonten (2020) documented more Golden Langur deaths in the earlier years along the Tingtibi and Dakphel roads.

Most of the sightings in Zhemgang also correspond to the warm broadleaved forest, as presumed by Biswa (2005); such forests provide them with a suitable habitat and food sources. The trees in these forests provide a variety of fruits, leaves, and flowers that constitute a significant part of their diet (Lhendup et al., 2018). Additionally, these forests have a diverse underwood of shrubs and herbs that provide cover and nesting sites for the Langurs (Srivasta, 2006). The warm climate in these

forests also provides a comfortable environment for the Langurs to live in (Christine, 2018)

Hotspot analysis for Golden Langur distribution

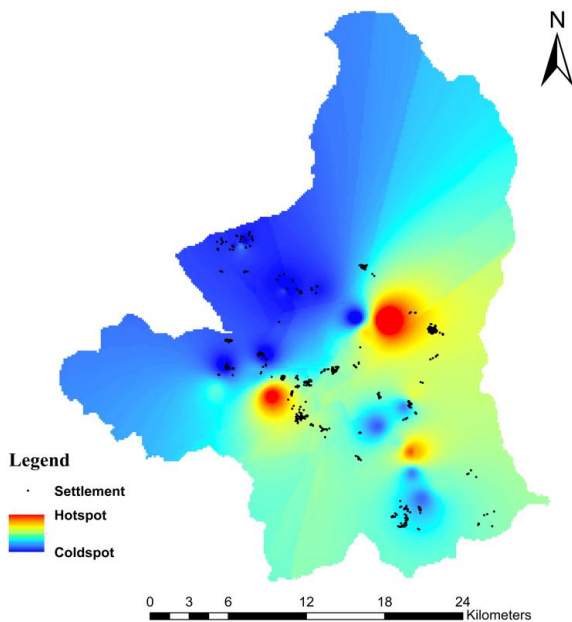


Figure 8: Hotspot of Golden Langur sightings in Zhemgang

Golden Langurs are an endangered species whose population has been declining due to habitat loss, fragmentation, and hunting (Goswami, 2022). By conducting a hotspot analysis, we identified areas where Golden Langurs are most likely to be found near human settlements. This can help conservationists target their efforts to protect and conserve these areas. Hotspot analysis provides valuable insights into the distribution of Golden Langurs near human settlements, which can inform conservation, conflict management, habitat restoration, and ecotourism planning.

The results showed the presence of a hotspot and a cold spot, with a Z-score of 1.559 and -1.306,

respectively. A Z-score of 1.559 indicates a higher-than-expected concentration of Golden Langurs in that area (Tingtibi and Dakphel). These areas were the main feeding grounds for the Golden Langurs, where they were typically found feeding on tree leaves and salt-licking. This hotspot could represent a forested area and human-dominated landscape where Golden Langurs have adapted and thrived (Lhendup et al., 2018). A Z-score of -1.306 indicates a lower concentration of Golden Langurs than expected in that area (Between Zhemgang and Dakphel). According to Lhendup et al. (2018), low Golden Langur sightings may indicate a human-dominated landscape unsuitable for their survival, with limited access to food and other resources in that area.

Social studies

Respondents' profile

We interviewed a total of 80 villagers (30 from Trong and 50 from Nangkhor) across 15 villages in the sample area. Among the respondents, 43 were males, accounting for 54% of the local people interviewed during the survey, and 37 were females, accounting for 46% of the villagers interviewed. More than half of the respondents were farmers (60%; $n=48$), 16.25% ($n=11$) were civil servants, 13.75% ($n=11$) were businessmen, and only 10% ($n=8$) were students.

Respondents' ages ranged from 20 years to 82 years. The age class 40–49 years had the highest number of respondents ($n=34$), while the age class

80+ years had the fewest ($n=2$). The other age classes also had a different number of respondents.

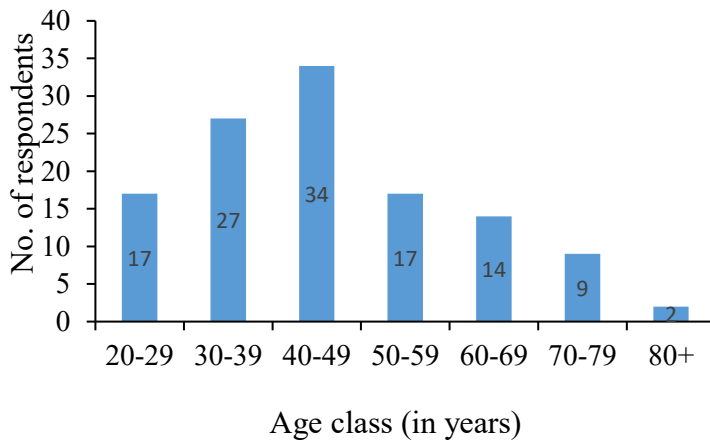


Figure 9: Number of respondents in different age classes.

People's perception of the Golden Langur

Population status

Everyone ($n=80$) who was surveyed had seen a Golden langur in their village. When asked about their opinion on the population trend of Golden Langurs in their local areas over the past five years, 61.25% ($n=49$) felt the increase in Golden Langur population, 18.75% ($n=15$) said that the population of Golden Langur seems to be decreasing as they notice a decrease in group size. However, 20% ($n=16$) felt the population has remained the same

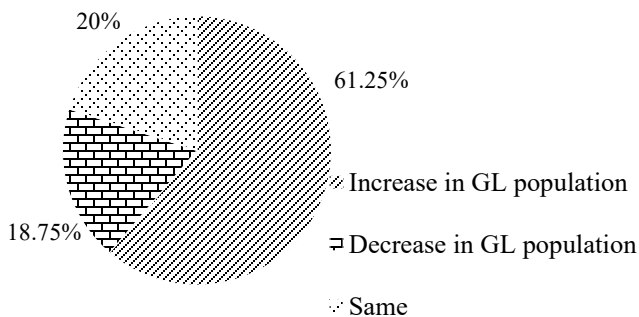


Figure 10: local people's opinion on population trend of Golden Langur.

The individuals who acknowledged the rise in the Golden Langur population were questioned about why they think there is growth in the Golden Langur population. They gave four justifications: Golden Langurs are present in previously unreported locations, are frequently sighted, have more infants in groups, and are seen near settlements (see Figure 11).

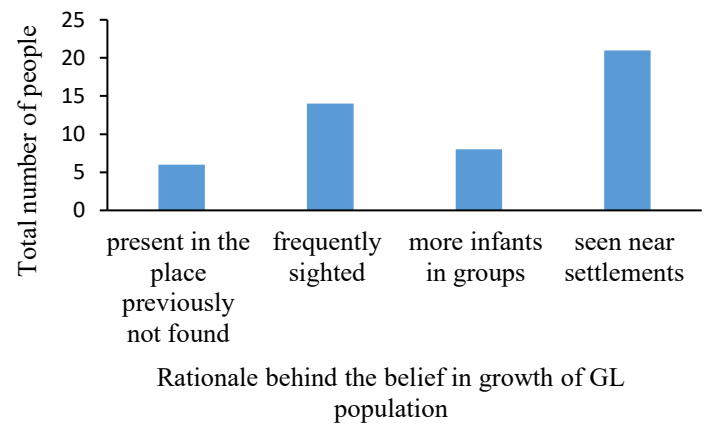


Figure 11: Rationale behind the belief in the growth of the Golden Langur population

When asked about the causes leading to the increase in the Golden Langur population, 46.9% said that there are no predators, 14.3% said there is an increase in birth rate, and 38.8% said that tolerant people prefer to chase them without harming. Local people perceived a decrease in the Golden langur population due to habitat destruction. Nonetheless, 20% of the locals claimed that the area's healthy forest cover supports the population of Golden Langurs at levels similar to those of earlier decades.

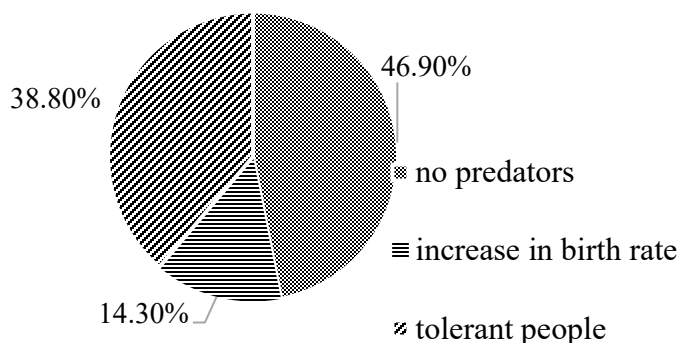


Figure 12: Factors leading to growth of Golden Langur population

Disturbance caused by Golden langur

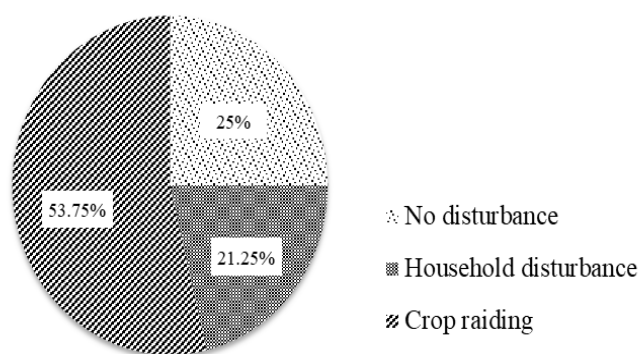


Figure13: Perceived disturbance percent caused by Golden Langur in Zhemgang

A majority of local individuals (53.75%) included in the survey said there is no disturbance caused by the Golden Langur. However, 46.25% of the respondents said there is a disturbance. Out of the total disturbance caused by Golden Langurs, 54% was attributed to household disturbance (see Figure 13), where they damage clothes in search of salt and enter homes for the same purpose. Crop raiding accounts for 46% of the disruption caused by Golden Langurs in Zhemgang, particularly oranges during the winter season, when food availability in their natural habitat is low.

People's attitude towards Golden Langur

When asked whether the respondents liked or disliked seeing a Golden langur around their localities, 57 (71.25%) said "like" and 23 (28.75%) said, "do not like". Among the respondents who liked seeing Golden Langur around, 28.25% said they are rare and precious, 34.75% said they have religious significance, 12% said they have economic value, and 25% said they beautify the surroundings and that they love to see them around.

Among those who disliked seeing langurs around, 78.25% disliked Golden Langurs because of their destructive nature. Just 2 claimed that their hatred stemmed from the fact that they were aesthetically unpleasant and looked cruel, while the other 3 claimed that the Golden Langur stirred fear in them and appeared destructive.

Conservation perspectives of Golden Langur

When asked about the conservation of the Golden Langur, 20% ($n=16$) of the residents in Zhemgang firmly agreed with its conservation, while 40% ($n=32$) just agreed. However, 33.7% ($n=27$) disagreed, and 6.25% ($n=5$) despised Golden Langurs due to their destructive behaviour and strongly disagreed with their conservation, stating that it would be better if there were no Golden Langurs

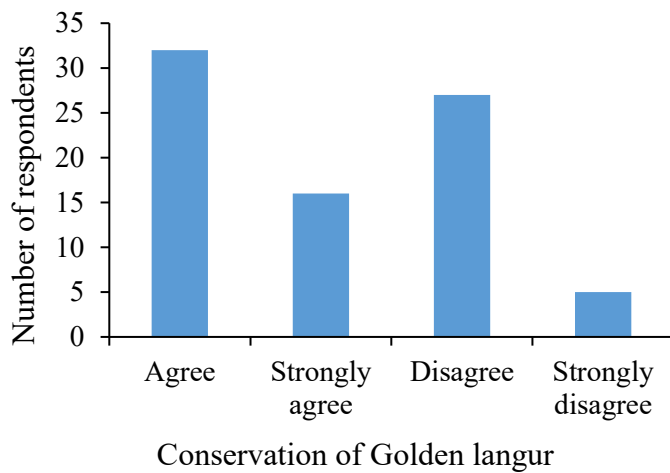


Figure 14: Conservation status of Golden Langur in Zhemgang

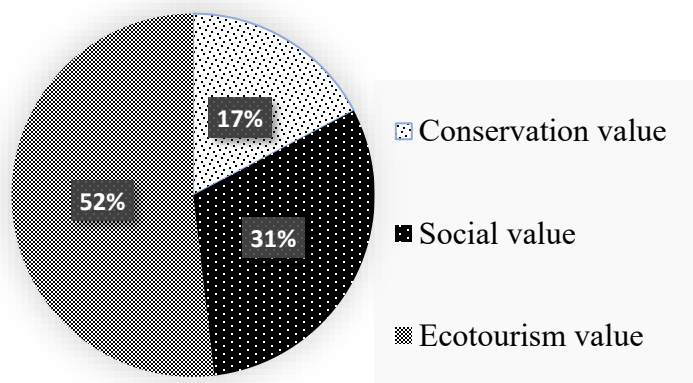


Figure15: People's opinion on the conservation of Golden Langur

Among the respondents who agreed with the conservation, more than half (52%) said they attract researchers and tourists, which helps in the country's economy, and by conserving Golden Langur, they can support sustainable tourism practices, 31% of the respondents said that Golden Langur have an important cultural symbol and have a local belief that encountering Golden Langur during their journeys is regarded as a good omen, 17% of the respondents

expressed that Golden Langurs are an endangered species and should be protected (figure 15).

Conclusion

The survey conducted in Zhemgang provided valuable information on the distribution and interactions of the Golden Langur in human-dominated landscapes. The majority of Golden Langur sightings were recorded along Tingtibi and Dakphel, which are areas characterized by high human activity and human-altered landscapes. Despite significant alterations to their natural habitat, the Golden Langurs have demonstrated resilience and the capacity to adapt to these changes.

However, the presence of Golden Langurs in close proximity to human settlements and agricultural fields has led to human-Golden Langur conflicts, primarily driven by the Langurs' crop-raiding behaviour. Conflicts arising from unfavourable interactions between humans and Golden Langurs are prevalent in human-dominated landscapes and affect the willingness of local people to actively participate in the conservation of the Golden Langur. This highlights the need for effective strategies and conservation efforts to address potential conflicts and promote coexistence between human communities and Golden Langur populations, ensuring the continued presence and well-being of the Golden Langur.

Acknowledgement

We would like to thank the College of Natural Resources, Zhemgang Forest Division, and Ugyen Wanchuck Institute for Research and Training (UWIFoRT) for their support during the research period.

Ethical Clearance

This research was approved by the Research Ethics Committee of the College of Natural Resources, Royal University of Bhutan, prior to commencement of fieldwork. All procedures involving human participants adhered to ethical guidelines for social science research, including obtaining informed consent from all respondents and protecting confidentiality. Wildlife survey methods followed the protocols prescribed by the Department of Forests and Park Services, Bhutan, in compliance with national wildlife research regulations. The study received no external funding and posed no significant risk to human or animal subjects.

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