ANS-LHS

OPEN ACCESS

Advanced Natural Sciences: Life and Health Sciences,
ISSN: 3107-636X, Vol-3, Issue-2,
July-Dec, 2026, 1-12
https://www.indjournals.com

Research Article

Bridging Indigenous Ecological Knowledge and Quantitative Analysis for Community-Based Conservation of the Chinese Pangolin (*Manis pentadactyla*) in Arunachal Pradesh, India

Parveen Kumar, Tayang Oken and Yangzom Dorjee

Department of Zoology, Indira Gandhi Government College,
Tezu Arunachal Pradesh – 792001

Article Info:

Correspondence:
Parveen Kumar
Department of Zoology, Indira Gandhi Government College, Tezu Arunachal Pradesh, India–792001

DOI:10.5281/zenodo.21526932

[Received 29-05-2026,
Accepted 20-07-2026,
Published 24-07-2026]

Publisher's Note: Natural Science Association stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Abstract

The Chinese pangolin (*Manis pentadactyla*) is a Critically Endangered species threatened by habitat loss, hunting, and illegal wildlife trade. Despite its conservation importance, information on Indigenous ecological knowledge (IEK) and community perceptions remains limited in Arunachal Pradesh, India. This study assessed local ecological knowledge, ecological literacy, economic value recognition, legal awareness, and conservation attitudes toward the Chinese pangolin using structured questionnaires administered to 45 respondents between September 2022 and February 2023. Descriptive statistics, Spearman's rank correlation, and Non-metric Multidimensional Scaling (NMDS) were used to analyze the data. Most respondents correctly identified the pangolin as a mammal (77.8%) and recognized its characteristic morphology (82.2%). Ecological and economic importance was acknowledged by 88.9% of respondents, while 75.6% supported pangolin conservation. A significant positive correlation was observed between ecological literacy and legal awareness (r_s = 0.373, p = 0.012). NMDS produced a reliable two-dimensional ordination (Kruskal Stress = 0.09), revealing distinct perception patterns primarily associated with ecological literacy and legal awareness. The findings demonstrate that Indigenous ecological knowledge provides valuable information on the ecology, perceived threats, and conservation of the Chinese pangolin. Integrating community knowledge with scientific approaches can strengthen biodiversity monitoring and support effective, community-based conservation strategies for this threatened species in the Eastern Himalayas.

Keywords: Chinese pangolin; *Manis pentadactyla*; Indigenous ecological knowledge; community perception; NMDS; Spearman's correlation; Arunachal Pradesh; conservation.

Cite this article: Parveen Kumar, Tayang Oken and Yangzom Dorjee, 2026. Bridging Indigenous Ecological Knowledge and Quantitative Analysis for Community-Based Conservation of the Chinese Pangolin (*Manis pentadactyla*) in Arunachal Pradesh, India. Advanced Natural Sciences: Life and Health Sciences, ISSN: 3107-636X, 3 (2), 1-12.

Introduction

Pangolins are among the most evolutionarily distinctive and globally threatened mammals and are recognized as Evolutionarily Distinct and Globally Endangered (EDGE) species because of their unique evolutionary history and high conservation importance [1,2]. Belonging to the order Pholidota and family Manidae, they are characterized by overlapping keratinized scales, toothless jaws, and a long protrusible tongue specialized for feeding on ants and termites. Of the eight extant pangolin species, four occur in Asia and four in Africa. In northeastern India, the Chinese pangolin (*Manis pentadactyla*) is the principal species reported from Arunachal Pradesh, including East Kameng, Papum Pare, Lower Subansiri, and East Siang districts [3,4]. Although the state's tropical and subtropical forests provide suitable habitat, the species is rarely encountered because of its nocturnal, cryptic, and burrowing behaviour.

The Chinese pangolin has undergone severe population declines due to habitat degradation, hunting, and illegal wildlife trade [1,5]. Its scales are widely traded for traditional medicinal purposes, while its meat remains a high-value commodity in illegal markets, resulting in continued hunting using methods such as burrow excavation, smoking, and trained dogs [2]. Consequently, the species is classified as Critically Endangered on the IUCN Red List, included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and protected under Schedule I of the Wildlife (Protection) Act, 1972 in India. Nevertheless, illegal hunting and trafficking continue across northeastern India, including Arunachal Pradesh, where both subsistence use and commercial exploitation have been documented [7,10]. In addition, limited field investigations and the species' secretive behaviour make reliable assessments of its distribution, ecology, and population status particularly challenging [8,9].

Chinese pangolin contributes to ecosystem functioning by regulating ant and termite populations and enhancing soil turnover through its burrowing activities [6]. However, important aspects of its ecology, habitat use, reproductive biology, movement patterns, and population dynamics remain poorly understood, particularly in the forests of Arunachal Pradesh and the eastern Himalayas. These knowledge gaps highlight the need for region-specific studies that can support evidence-based conservation planning. Because direct detection of pangolins is difficult, researchers increasingly combine conventional ecological methods, including camera trapping, with local ecological knowledge (LEK) to improve understanding of species distribution, habitat use, conservation status, and threats [11–16]. Indigenous communities possess valuable ecological knowledge developed through long-term interactions with local ecosystems, which can complement scientific surveys and strengthen biodiversity monitoring and conservation planning [16,17]. Positive community perceptions can encourage species protection, whereas limited awareness, fragmented stakeholder engagement, and poor integration of traditional knowledge into conservation programmes may reduce conservation effectiveness and increase the risk of overexploitation [17–21].

Arunachal Pradesh lies within the Eastern Himalayan Biodiversity Hotspot and retains nearly 80% forest cover (83,743 km²), supporting exceptional biological diversity [31]. Part of this forest is managed by Indigenous communities through traditional governance systems. Among these, the Adi community of the Siang River basin has maintained a close relationship with the surrounding forests for generations and possesses extensive knowledge of local wildlife. In spite of the ecological importance of the Chinese pangolin, only a few studies have examined community perceptions and Indigenous ecological knowledge related to its ecology and conservation in Arunachal Pradesh. Understanding local knowledge is essential because it can reveal information on species occurrence, habitat preferences, perceived threats, and conservation challenges

that may not be detected through conventional ecological surveys alone [11–21]. Therefore, our study aimed to document community perceptions and Indigenous ecological knowledge of the Chinese pangolin in Arunachal Pradesh, evaluate ecological literacy, economic value recognition, legal awareness, and conservation attitudes, and examine relationships among these variables using descriptive statistics, Spearman's rank correlation, and Non-metric Multidimensional Scaling (NMDS). The findings are likely to support evidence-based, community-centred conservation strategies for the long-term conservation of this Critically Endangered species in the Eastern Himalayas.

Ethical considerations: This study was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to data collection, and the confidentiality and anonymity of respondents were maintained throughout the study.

Materials and Methods

Study Site

The study was conducted in Arunachal Pradesh, northeastern India, a state located within the Eastern Himalayan Biodiversity Hotspot**.** The region is characterized by rugged mountainous terrain, deep river valleys, and extensive forest cover comprising tropical semi-evergreen, subtropical broadleaf, and temperate forests. These diverse ecosystems provide suitable habitat for the Chinese pangolin **(***Manis pentadactyla***)** and other threatened wildlife species. Arunachal Pradesh shares international boundaries with China, Bhutan, and Myanmar, making parts of the region vulnerable to transboundary wildlife trafficking. The landscape is also influenced by traditional shifting cultivation (*jhum*) and increasing infrastructure development, resulting in frequent interactions between Indigenous communities and surrounding forest ecosystems. These ecological and socio-cultural characteristics make the region particularly suitable for investigating local ecological knowledge and community perceptions related to Chinese pangolin conservation.

Data Collection Framework

In our study field operations were carried out over a six-month window from September 2022 to February 2023. Our study used a local ecological knowledge (LEK) and ethnozoological survey framework. However, while prior literature relied on virtual ethnography techniques via social media networks due to pandemic restrictions, the unique geographical isolation and limited digital connectivity of remote mountainous villages in Arunachal Pradesh required a transition to direct, face-to-face field interviews. Primary data were gathered using a standardized questionnaire containing a combination of open-ended and closed-ended items to thoroughly evaluate respondent perspectives. The inquiries focused on four core analytical variables

- People’s foundational knowledge regarding the physical and ecological traits of the pangolin.
- Perceived socio-economic and cultural utility values within the local framework.
- Community compliance with and understanding of existing wildlife protection laws.
- The perceived urgency of protecting the target species under local and national conservation policies.

The final study sample comprised 45 respondents. To navigate the sensitive legal realities surrounding local hunting and wildlife extraction, a dual-track participant selection model was implemented, maintaining strict ethical standards and informed consent protocols. The inclusion of key informants through snowball sampling was intended to obtain specialized traditional ecological knowledge that would not be captured through random sampling alone.

In first track involved 42 randomly selected community members living within rural landscape blocks who agreed to complete the socio-ecological questionnaire. Within this

randomized cohort, gender distribution was carefully monitored to limit demographic bias, resulting in 14 female respondents (31.1%) and 31 male respondents (68.9%).

The second track focused on key informants with specialized field experience, specifically 3 active or historical traditional hunters. Because these actors are difficult to identify through standard random sampling, a non-probabilistic snowball sampling technique was used to establish trust and ensure safe data tracking, matching the target group selection

Statistical and Data Analysis

The questionnaire responses were coded and converted into quantitative data for statistical analysis. Community knowledge regarding the ecological importance, socio-economic value, legal awareness, and conservation urgency of the target species was assessed using a standardized three-point ordinal scale, where 1 = low, 2 = moderate, and 3 = high. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were calculated to summarize respondents' perceptions and knowledge levels.

The relationships among the evaluated variables were examined using Spearman's rank correlation coefficient (rs) because the questionnaire responses were measured on an ordinal scale and did not require the assumption of normal data distribution. Correlation coefficients were interpreted according to their strength and direction, and statistical significance was determined at $p < 0.05$.

To investigate similarities in respondents' perceptions and identify underlying response patterns, Non-metric Multidimensional Scaling (NMDS) was performed using a Euclidean distance matrix. NMDS reduced the multidimensional dataset into a two-dimensional ordination space in which respondents with similar perception profiles were positioned closer together, whereas those with contrasting perceptions were located farther apart. The quality of the ordination was evaluated using Kruskal's Stress value, with lower stress values indicating a better representation of the original dissimilarity matrix. Stress values below 0.20 were considered indicative of an acceptable ordination, while values below 0.10 represented an excellent fit. The NMDS ordination converged with a Kruskal Stress value of 0.09, indicating a good representation of the multidimensional data.

All descriptive statistics and correlation analyses were performed using IBM SPSS Statistics version 29.0 (IBM Corp., Armonk, NY, USA). The NMDS ordination and visualization were generated using Orange Data Mining version 3.39 (Bioinformatics Laboratory, University of Ljubljana, Slovenia).

Results and Discussion

Table 1. Demographic profile of respondents (n = 45)

Variable	Category	Frequency	Percentage (%)
Gender	Male	31	68.9
	Female	14	31.1
Age	18–30 years	20	44.4
	31–45 years	25	55.6
Occupation	Farmer	34	75.6
	Hunter	3	6.7
	Others	8	17.8

Table 1 summarizes the socio-demographic characteristics of the respondents. Of the 45 participants, males constituted the majority (68.9%), while females accounted for 31.1%. More than half of the respondents (55.6%) were between 31 and 45 years of age, whereas 44.4% belonged to the 18–30 years age group. Farming was the predominant occupation (75.6%), followed by other occupations

(17.8%), while only three respondents (6.7%) identified themselves as hunters. The inclusion of experienced hunters provided additional insights into traditional ecological knowledge of the Chinese pangolin.

Socioeconomic Evaluation and Customary Policy Disconnect

The social and economic value profiles of the species show a strong reliance on traditional medicinal usage. When tracking how local populations perceive the primary value of the pangolin, traditional medical treatments and local health solutions represented the largest share at 51.11% (n = 23).

The remaining views were divided among agricultural pest management (11.11%, n = 5), opportunistic cash-flow options via underground trading networks (11.11%, n = 5), and local dietary consumption (2.23%, n = 1). The remaining 24.44% (n = 11) of participants expressed no clear knowledge of its domestic utility.

Table 2. Survey responses describing the ecological dimensions of the pangolin (n = 45)

Semi-Structured Survey Question	Coded Respondent Answer	Response Percentage (%)	Absolute Count (n)
What taxonomic group does the pangolin belong to?	1. Mammal	77.8%	n = 35
	2. Reptile	22.2%	n = 10
Can you describe the physical appearance and behavioral traits of a pangolin?	1. Body armored with scales; elongated snout, long tail, and sharp claws	82.2%	n = 37
	2. Specific defensive mechanisms (rolling into a tight sphere/ball)	11.1%	n = 5
	3. General forest insectivore features	4.4%	n = 2
	4. Unsure / do not know	2.2%	n = 1
What is the reproductive mode of the species?	1. Viviparous (gives birth to live young)	84.4%	n = 38
	2. Oviparous (lays eggs)	13.3%	n = 6
	3. Do not know	2.2%	n = 1
What are the primary environmental functions or benefits of the pangolin in nature?	1. Ecosystem balancers (important unit in the local food web)	35.6%	n = 16
	2. Natural insect/pest controllers (regulates termite and ant colonies)	20.0%	n = 9
	3. Soil aerators (improves organic turnover through foraging activity)	15.6%	n = 7
	4. Unaware of any specific ecological functions	28.9%	n = 13
Total Aggregate Responses		**100.0%**	**n = 45**

Table 2 summarizes respondents' knowledge of the biology and ecological characteristics of the Chinese pangolin (*Manis pentadactyla*). Most respondents (77.8%, *n* = 35) correctly identified the pangolin as a mammal, while 82.2% (*n* = 37) accurately described its distinctive morphology, including its scaly body, elongated snout, long tail, and sharp claws. A large majority (84.4%, *n* = 38) correctly recognized that the species is viviparous, whereas only 13.3% incorrectly believed that it lays eggs. Regarding ecological functions, 35.6% (*n* = 16) identified the pangolin as an important component of the food web, 20.0% (*n* = 9) recognized its role in regulating ant and termite populations, and 15.6% (*n* = 7) acknowledged its contribution to soil aeration through foraging activities. However, 28.9% (*n* = 13) were unaware of the species' ecological functions. Overall, the findings indicate a relatively high level of local ecological knowledge regarding the Chinese pangolin, although knowledge gaps remain concerning its ecological role within forest ecosystems.

Table 3. Perceived ecological and economic value of the Chinese pangolin (n = 45)

Perceived value	Frequency	Percentage (%)
Ecological importance	40	88.9
Medicinal value	38	84.4
Cultural importance	21	46.7
Economic value	40	88.9

Table 3 illustrates respondents' perceptions of the ecological, medicinal, cultural, and economic importance of the pangolin. Ecological and economic values were each recognized by 88.9% of respondents, highlighting widespread awareness of the species' ecological role and perceived economic significance. Medicinal value was acknowledged by 84.4% of participants, reflecting the persistence of traditional beliefs regarding the species. In contrast, cultural importance was recognized by only 46.7% of respondents, indicating comparatively lower cultural relevance within the surveyed communities.

Table 4. Community awareness and attitudes towards pangolin conservation (n = 45)

Statement	Agree n (%)	Neutral n (%)	Disagree n (%)
Pangolins should be protected	34 (75.6)	10 (22.2)	1 (2.2)
Hunting should be prohibited	30 (66.7)	2 (4.4)	13 (28.9)
Conservation education is important	27 (60.0)	12 (26.7)	6 (13.3)

Table 4 summarizes respondents' attitudes toward Chinese pangolin conservation. A large majority (75.6%) agreed that pangolins should be protected, with only one respondent expressing disagreement. Similarly, 66.7% supported the prohibition of hunting, although nearly one-third (28.9%) disagreed, suggesting that hunting remains acceptable to some community members. Regarding conservation education, 60.0% agreed that awareness programs are important, while 26.7% remained neutral and 13.3% disagreed. These findings demonstrate generally positive conservation attitudes but also indicate the need for enhanced community-based education and awareness initiatives.

Table 5. Spearman's rank correlation among ecological literacy, economic value recognition, legal awareness, and conservation urgency (n = 45)

Variables	Ecological Literacy	Economic Value Recognition	Legal Awareness	Conservation Urgency
Ecological Literacy	1.000	-0.034	**0.373***	0.109
Economic Value Recognition	-0.034	1.000	-0.097	-0.086
Legal Awareness	0.373*	-0.097	1.000	0.116
Conservation Urgency	0.109	-0.086	0.116	1.000

* Significant at $p < 0.05$.

Ecological knowledge within various communities serves as a foundation for environmental management [22]. Local knowledge offers practical wisdom to address environmental challenges [23], [24] and bridges traditional understanding and conservation science, fostering community-driven conservation initiatives [25].

Spearman's rank correlation analysis demonstrated a statistically significant positive association between ecological literacy and legal awareness ($r_s = 0.373$, $p = 0.012$), indicating that respondents with greater knowledge of the Chinese pangolin also possessed better awareness of wildlife protection legislation. No significant relationships were observed between ecological literacy and economic value recognition ($r_s = -0.034$, $p = 0.822$), ecological literacy and conservation urgency ($r_s = 0.109$, $p = 0.475$), economic value recognition and legal awareness ($r_s = -0.097$, $p = 0.525$), economic value recognition and conservation urgency ($r_s = -0.086$, $p = 0.575$), or legal awareness and conservation urgency ($r_s = 0.116$, $p = 0.449$).

Baseline Distribution of Local Knowledge

The present assessment revealed that local familiarity with the pangolin is relatively high across the rural landscapes of Arunachal Pradesh, despite the species' elusive nature. Only 4.4% (n = 2) of the total interview cohort claimed to have never seen a pangolin first hand. Meanwhile, 11.1% (n = 5) reported encountering the species exclusively through external media spaces, such as academic literature, television broadcasts, or internet platforms.

The majority of respondents 84.4% (n = 38) had encountered the animal directly in the wild, indicating a deep, connection to the local forest ecosystem.

When evaluated across a standard 1–3 grading index, the collective knowledge profile of the community stabilized at a moderate mean score of 1.91. Statistical dispersion metrics indicated that knowledge regarding ecological functions and shared social values maintained the lowest variance among respondents.

Conversely, steep variance was observed regarding commercial market values and the specifics of formal state conservation regulations. This gap points to an uneven distribution of information: while everyday ecological observation is shared openly within the community, awareness of legal frameworks remains restricted to specific administrative or urban-exposed groups.

Gender-stratified mapping showed minimal variance in ecological or economic literacy between male and female participants within the broader community cohort. However, a clear divergence emerged regarding local and national policy awareness, where female respondents demonstrated significantly lower baseline scores.

This pattern is consistent with local divisions of labor observed during the study, in which men were more frequently engaged in forest-based activities, hunting, and interactions with wildlife enforcement agencies, resulting in greater exposure to formal legal information.

Ecological Literacy and Species Behavioral Insights

The empirical data demonstrates overlap between accurate biological observation and persistent morphological misconceptions among local populations

NMDS Ordination of Respondents' Perceptions

Non-metric Multidimensional Scaling (NMDS) was performed to examine the multidimensional relationships among respondents based on ecological literacy, economic value recognition, legal awareness, and conservation urgency. The two-dimensional ordination provided an interpretable representation of respondents' perception profiles, with individuals sharing similar response patterns positioned closer together and those with contrasting perceptions located farther apart (Fig. 1).

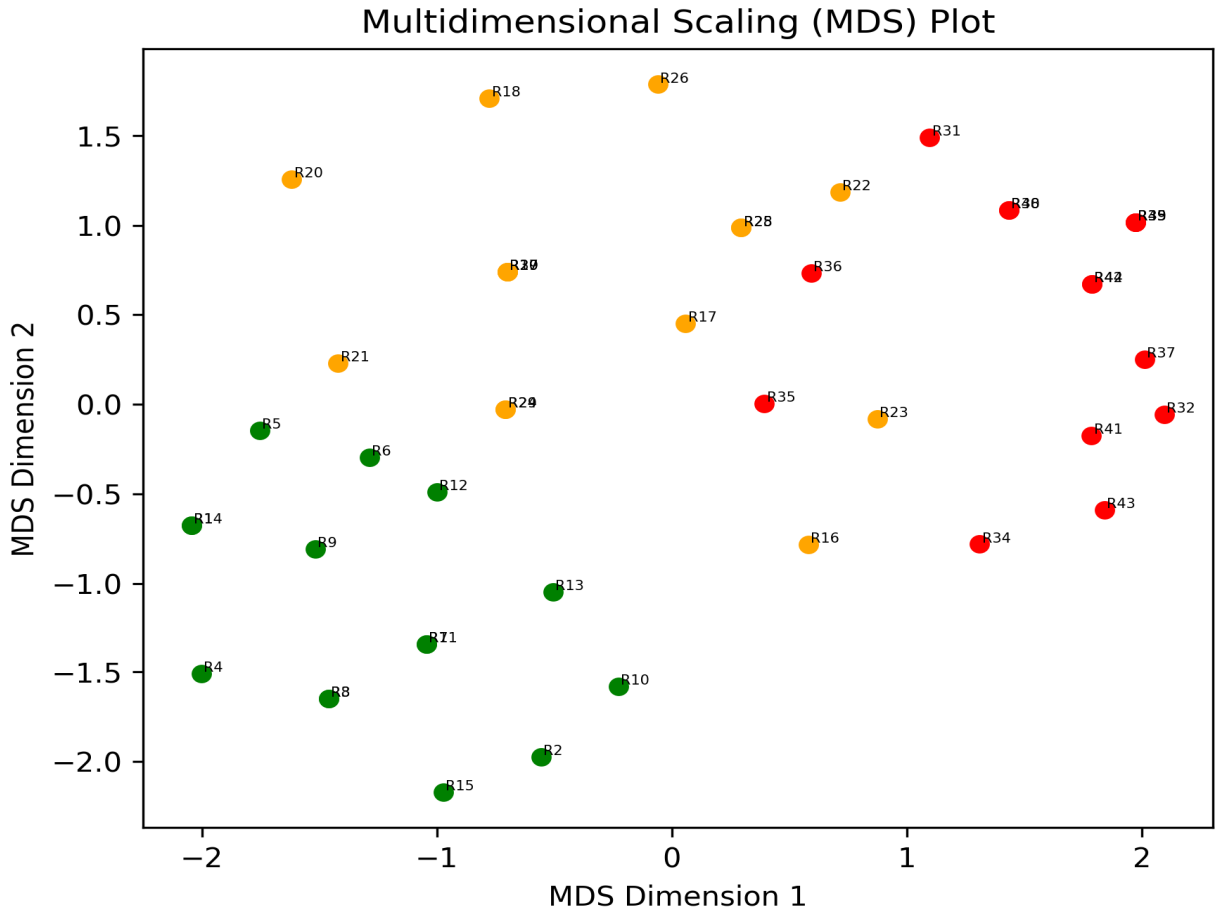

Fig. 1. Multidimensional Scaling (MDS) plot showing the distribution of respondents according to their perceptions of the Chinese pangolin's value. Each point represents one respondent (n = 45). Respondents with similar perceptions are positioned closer together, while those with different perceptions are located farther apart. Green, orange, and red symbols indicate Clusters A, B, and C, representing high, moderate, and low levels of ecological literacy, economic value recognition, legal awareness, and conservation urgency, respectively.

The NMDS analysis converged successfully and produced a two-dimensional solution with a Kruskal Stress value of 0.09, indicating an excellent representation of the original multidimensional dissimilarity matrix according to the criteria proposed by Kruskal [30]. Stress values below 0.10 indicate excellent goodness-of-fit, whereas values below 0.20 are generally

considered acceptable for ecological ordination analyses [29].

The ordination revealed three distinct respondent groups, representing different perception profiles. Cluster A comprised respondents with relatively high ecological literacy and legal awareness, indicating greater familiarity with the ecological importance of the Chinese pangolin and stronger awareness of wildlife protection legislation. Cluster B represented respondents with intermediate perception scores, reflecting moderate awareness of ecological functions, economic value, and conservation issues. Cluster C consisted of respondents exhibiting comparatively lower ecological literacy and legal awareness, suggesting reduced understanding of both ecological significance and conservation regulations.

Overall, the NMDS analysis demonstrated that ecological literacy and legal awareness were the principal variables influencing respondent grouping, whereas economic value recognition and conservation urgency exhibited greater individual variation. These findings indicate that differences in ecological knowledge and awareness of wildlife legislation play an important role in shaping community perceptions toward Chinese pangolin conservation.

Study limitations

This study was based on a relatively small sample (n = 45) drawn from selected communities in Arunachal Pradesh. Although the respondents possessed direct knowledge of the Chinese pangolin, the findings may not be representative of all indigenous communities in northeastern India. Future studies involving larger sample sizes, multiple districts, and long-term monitoring are recommended to improve the generalizability of the findings and strengthen conservation planning.

Discussion

The NMDS analysis revealed three clearly distinguishable respondent clusters representing different levels of ecological literacy, economic value recognition, legal awareness, and conservation urgency. Respondents with similar perception profiles were positioned close together, whereas individuals with contrasting views were located farther apart, indicating considerable heterogeneity in community perceptions toward Chinese pangolin conservation. The relatively low Kruskal Stress value (0.09) indicates that the two-dimensional ordination accurately represented the multidimensional relationships among respondents, thereby supporting the reliability of the clustering pattern observed in this study [29,30].

The clustering pattern observed in the NMDS ordination is consistent with the Spearman's rank correlation analysis**,** which identified a significant positive association between ecological literacy and legal awareness (r_s = 0.373, p = 0.012)**.** This relationship suggests that respondents possessing greater ecological knowledge of the Chinese pangolin were also more familiar with wildlife protection legislation. Consequently, individuals grouped within Cluster A exhibited comparatively higher ecological literacy and stronger legal awareness, whereas respondents in Cluster C demonstrated lower levels of both variables. The absence of significant correlations between ecological literacy and economic value recognition (r_s = –0.034, p = 0.822), ecological literacy and conservation urgency (r_s = 0.109, p = 0.475), economic value recognition and legal awareness (r_s = –0.097, p = 0.525), economic value recognition and conservation urgency (r_s = –0.086, p = 0.575), and legal awareness and conservation urgency (r_s = 0.116, p = 0.449) further indicates that these dimensions varied independently among respondents. These findings demonstrate that ecological knowledge was more strongly associated with legal awareness than with perceived economic benefits or conservation concern in the present study.

The concentration of respondents within Cluster A further suggests that individuals possessing greater ecological knowledge also demonstrated stronger awareness of wildlife protection

legislation and greater support for conservation. Similar relationships between ecological knowledge and positive conservation attitudes have been reported in community-based conservation studies, where increased understanding of species ecology promoted greater appreciation of ecosystem services and willingness to participate in conservation programmes [28].

The combined use of Spearman's correlation and NMDS provided complementary insights into community perceptions of the Chinese pangolin. While Spearman's correlation quantified the relationships among ecological literacy, economic value recognition, legal awareness, and conservation urgency, NMDS effectively visualized the multidimensional structure of respondents' perceptions. Together, these analyses indicate that ecological literacy and legal awareness are closely linked and should be considered priority components of future community-based conservation programmes in Arunachal Pradesh.

Public outreach should emphasize the species' vital role in ecological systems and its direct impact on social and economic aspects. Massivedissemination at the local level can strengthen cultural identity and participation, improveliteracy, and promote sustainable social and economic development [26]. Ultimately, increasingawareness of pangolins' ecological and economic significance can drive public support forconservation efforts, potentially reducing illegal hunting and habitat destruction [27].

Overall, the findings of the present study demonstrate that Indigenous ecological knowledge provides reliable insights into the ecology, distribution, perceived threats, and conservation of the Chinese pangolin in Arunachal Pradesh. The integration of community perceptions with statistical analyses highlights the importance of local participation in biodiversity monitoring and supports the development of effective, community-based conservation strategies for this Critically Endangered species.

References

1. Zhou, ZM, Zhou, Y, Newman, C and Macdonald, DW 2014 Scaling up pangolin protection in China, Frontiers in Ecology p 97- 98. doi:10.1890/14.WB.001.
2. Thapa, P (2014). "An Overview of Chinese Pangolin (*Manis pentadactyla*): Its General Biology, Status, Distribution and Conservation Threats in Nepal." The Initiation 5: 164-170.
3. Lyngdoh, S., Selvan, K. M., Habib, B., & Gopi, G. V. (2016). Hunting record of an Evolutionarily Distinct and Globally Endangered Chinese Pangolin (*Manis pentadactyla*) in Western Arunachal Pradesh. *Asian Journal of Conservation Biology*, 5(1), 59–60.
4. Pilia, C., Ratan, O., Datta, A., & Nijhawan, S. (2025). Indigenous ecological knowledge improves camera-trap detection rates for the Chinese pangolin in Arunachal Pradesh, India. *Oryx*. *59*(4), 472–476. https://doi.org/10.1017/S0030605324001546
5. Heath, M. E. (1992). *Manis pentadactyla*. *Mammalian Species, 414*, 1–6. https://doi.org/10.2307/3503896
6. Fang, L. X., and Wang, S. (1980). A preliminary survey on the habits of pangolin. Memoirs of Beijing Natural History Museum, 7:1-6
7. Gopi, G.V., Habib, B., Selvan, K.M and Lyngdoh, S (2012). Conservation of the endangered Asiatic Wild dog (Cuon alpinus) in Western Arunachal Pradesh: Linking ecology, ethnics and economics to foster better co-existence. Wildlife Institute of India, Dehradun. TR- 2012/003, 136 pp.
8. Challender, D. W. S., Wu, S., Kaspal, P., Khatiwada, A., Ghose, A., Ching-Min Sun, N., Mohapatra, R. K., & Laxmi Suwal, T. (2019). *Manis pentadactyla* (errata version published in 2020). *The IUCN Red List of Threatened Species 2019*: e.T12764A168392151.

https://doi.org/10.2305/IUCN.UK.2019-3.RLTS.T12764A168392151.en

9. Willcox, D. H. A., Nash, H. C., Trageser, S., Kim, H. J., Hywood, L., Connelly, E., Ichu Ichu, G., Kambale Nyumu, J., Mousset Moumbolou, C. L., Ingram, D. J., & Challender, D. W. S. (2019). Evaluating methods for detecting and monitoring pangolin (Pholidata: Manidae) populations**.** *Global Ecology and Conservation, 17*, e00539.
10. Gomez, L., Joseph, T., Heinrich, S., Wright, B., & D'Cruz, N. (2023). *Illegal trade of pangolins in India with international trade links: An analysis of seizures from 1991 to 2022***.** European Journal of Wildlife Research, 69, 85.
11. Newton, P., Van Thai, N., Roberton, S. & Bell, D. (2008) Pa ngolins in peril: using local hunters' knowledge to conserve elusive species in Vietnam. Endangered Species Research, 6, 41–53.
12. Nash, H.C., Wong, M.H. & Turvey, S.T. (2 016) Using local ecological knowledge to determine status and threats of the Critically Endangered Chinese pangolin (*Manis pentadactyla*) in Hainan, China. Biological Conservation, 196, 189–195.
13. Ingram, D.J., Willcox, D. & Challender, D. W. (2019) Evaluation of the application of methods used to detect and monitor selected mammalian taxa to pangolin monitoring. Global Ecology and Conservation, 18, e00632.
14. Archer, L.J., Papworth, S.K., Apale, C.M., Corona, D.B., Gacilos, J.T., Amada, R.L. e t al. (2020) Scaling up local ecological knowledge to prioritize areas for protection: determining Philippine pangolin distribution, status, and threats. Global Ecology and Conservation, 24, e01395.
15. Pradhan, S. & Pradhan, R. (2020) How does the Chinese Pangolin behave in the wild - observations on activities of Chinese Pangolin, *Manis pentadactyla* in the agroecosystems of Darjeeling, Eastern Himalaya, India. Biodiversity International Journal, 4, 175–180.
16. A. Mozer and S. Prost, "An introduction to illegal wildlife trade and its effects onbiodiversity and society," Forensic Science International: Animals and Environments, vol.3, pp. 1–12, 2022. https://doi.org/10.1016/j.fsiae.2023.100064
17. T. L. Suwal, S. Gurung, P. J. Johnson, M. B. Shrestha, K. Parker, and K. J. C. Pei, "Attitudesto pangolins and factors affecting their conservation in a human-dominated landscape inNepal," Conservation Science and Practice, vol. 5, pp. 1–12, 2023.https://doi.org/10.1111/csp2.13009
18. M. P. Yanou, M. A. F. Ros-Tonen, J. Reed, K. Moombe, and T. Sunderland, "Integratinglocal and scientific knowledge: The need for decolonising knowledge for conservation andnatural resource management," Heliyon, vol. 9, p. e21785, 2023.https://doi.org/10.1016/j.heliyon.2023.e21785
19. Á. Fernández-Llamazares, I. Teixidor-Toneu, C. G. Armstrong, J. Caviedes, J. T. Ibarra, D.Lepofsky, A. C. McAlvay, Z. Molnár, R. M. Moraes, G. Odonne, M. R. Poe, A. SharifianBahraman, and N. J. Turner, "The global relevance of locally grounded ethnobiology,"Journal of Ethnobiology and Ethnomedicine, vol. 20, pp. 1–12, 2024.https://doi.org/10.1186/s13002-024-00693-w
20. J. A. Ogunjobi and O. C. Surulere, "Sea turtles in Ilaje, Nigeria: Status, sighting periods andconservation awareness," Nature Conservation Research, vol. 5, pp. 28–35, 2020.https://doi.org/10.24189/ncr.2020.010
21. M. Djosetro and J. Behagel, "Including local knowledge in conservation planning: The caseof the western coastal protected areas in Suriname," Ecosystems and People, vol. 20,

2024.https://doi.org/10.1080/26395916.2024.2361683
22. R. D. T. Manningtyas and K. Furuya, “Traditional ecological knowledge versus ecologicalwisdom: Are they dissimilar in cultural landscape research?” Land, vol. 11, pp. 1–16, 2022.https://doi.org/10.3390/land11081123
23. Y. Kamakaula, A. Amruddin, Y. Demmanggasa, S. Saprudin, and R. J. Nugroho, “The roleof local knowledge in natural resources conservation: An environmental anthropological perspective in traditional agriculture,” Global International Journal of Innovative Research,vol. 1, pp. 97–106, 2024. https://doi.org/10.59613/global.v1i2.13
24. J. Iskandar, B. S. Iskandar, and R. Partasasmita, “The local knowledge of the rural peopleon species, role and hunting of birds: Case study in Karangwangi Village, West Java,Indonesia,” Biodiversitas, vol. 17, pp. 435–446, 2016.https://doi.org/10.13057/biodiv/d170206
25. P. Fabre, T. Bambridge, J. Claudet, E. Sterling, and A. Mawyer, “Contemporary Rāhui:Placing Indigenous, conservation, and sustainability sciences in community-ledconservation,” Pacific Conservation Biology, vol. 27, pp. 451–463, 2021.https://doi.org/10.1071/PC20087
26. L. Wantik, B. S. Laksmono, A. Lefaan, and O. M. Lumintang, “Education system forindigenous communities: A review of social ecology,” Indonesian Journal of AdvancedResearch (IJAR), vol. 3, pp. 1593–1604, 2024. https://doi.org/10.55927/ijar.v3i10.11944
27. Panta, B. Dhami, B. Shrestha, N. Kc, N. Raut, Y. P. Timilsina, B. B. Khanal Chhetri, S.Khanal, H. Adhikari, S. Varachova, and P. Kindlmann, “Habitat preference and distributionof Chinese pangolin and people’s attitude to its conservation in Gorkha District, Nepal,”Frontiers in Ecology and Evolution, vol. 11, pp. 1–12, 2023.https://doi.org/10.3389/fevo.2023.1081385
28. Bennett, N. J., Roth, R., Klain, S. C., Chan, K. M. A., Christie, P., Clark, D. A., Cullman, G., Curran, D., Durbin, T. J., Epstein, G., Greenberg, A., Nelson, M. P., Sandlos, J., Stedman, R., Teel, T. L., Thomas, R., Veríssimo, D., & Wyborn, C. (2017). Conservation social science: Understanding and integrating human dimensions to improve conservation. *Biological Conservation, 205*, 93–108.
29. Clarke, K. R. (1993). Non-parametric multivariate analyses of changes in community structure. *Australian Journal of Ecology, 18*(1), 117–143.
30. Kruskal, J. B. (1964). Nonmetric multidimensional scaling: A numerical method. *Psychometrika, 29*(2), 115–129.
31. Mittermeier, R. A., Myers, N., Mittermeier, C. G., & Robles Gil, P. (1999). *Hotspots: Earth's biologically richest and most endangered terrestrial ecoregions*. CEMEX, Mexico City.