



Review Article

Conservation Status and Habitat Use of Indian Pangolin (*Manis crassicaudata*) in Punjab, Pakistan: A Critical Review of Emerging Threats and Future Prospects

Ghulam Asghar* and Iqra Kalsoom

Department of Biological Sciences, Thal University Bhakkar, Bhakkar-30000, Punjab, Pakistan

ABSTRACT

Evolutionarily distant and ecologically significant Indian pangolin *Manis crassicaudata* is at a critically endangered stage. The Indian pangolin contributes to ecological balance by controlling the insect population. The IUCN classified it as one of the trafficked mammals in the world. The findings of recent peer reviewed articles describe the current status, ecological needs, population status and threats to the species. All these findings are documented in areas of Pakistan such as Bhakkar, Gujrat, Chakwal, and Margalla Hills. Habitat suitability models indicate that the pangolin prefers a semi-arid thorn forest and agricultural borders where the soil contains large populations of ants and termites. High market demand for pangolin scales, illegal poaching, unsustainable hunting, and the non-beneficial cultural myths may cause the pangolin to become extinct in future. Field research, however, documents not only appalling distribution densities (de-routine 0.29/km²) but also balkanized inhabitancy. The article laments the worrying cracks in ecological records and the implementation of conservation measures. The review also presents a counter to this trend, which includes: the establishment of anti-poaching conservation zones, community-based wildlife surveillance, and enhancement of anti-poaching and awareness-raising campaigns.

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Authors' Contribution

GA conceptualized the study collected data and prepared the original draft and IK contributed to data interpretation, critical revision of the manuscript and final editing.

Key words

Manis crassicaudata, High demand, Poaching, Burrow ecology, Conservation strategies, Habitat modelling

INTRODUCTION

The Indian pangolin, *Manis crassicaudata* or the scaly anteater, is a rare and secretive creature. It is a solitary and nocturnal mammal of the order Pholidota. It has horny scales covering its body and an expert diet of ants and termites. It is among eight species of pangolins in the rest of the world and the sole one in Pakistan. Despite the high ecological significance of pangolins, especially their contribution to natural pest control, there is little effort to conserve the species. In Pakistan, where pangolins are critically endangered due to habitat destruction, the illegal wildlife trade, and the widespread misconception on a

cultural basis. Semi-arid land and a wide variety of flora characterize Northern Punjab, and it is therefore believed that it may be a relatively important habitat for this species. Nevertheless, there is a strong need to synthesize available scientific data to underscore research gaps and determine conservation interventions. This review critically analyses the state of threats and habitat of the Indian pangolin in Northern Punjab based on the recent field-based research and advice given on the long-term protection of the species.

DISTRIBUTION IN PAKISTAN

Indian pangolin is common all-over South Asia, and there is a reported population found in India, Nepal, Sri Lanka and Pakistan. In Pakistan, it has been reported from different ecological zones such as the Potohar Plateau, Margalla Hills National Park, Salt Range, Jhelum, Chakwal and various southern Punjab districts, Bhakkar and Layyah and districts in Sindh. Although it had quite a large historical range, recent records have revealed a worrying decline in its range and numbers, caused by anthropogenic factors. Field surveys in southern Khyber Pakhtunkhwa prove that the Indian pangolins still occupy

* Corresponding author: ghulamasghar.tub@gmail.com
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fragmented habitats, especially in D. I. Khan and Bannu districts, but in a significantly diminished number (Awan *et al.*, 2019). Field measurements in Margalla Hills National Park have revealed that there are two forms of burrowing of the Indian pangolin, i.e., shallow feeding and the deeper sleeping burrows with the average depth of 30- to more than 100-cm. Activity and distribution of the two are significantly different as well (Mahmood *et al.*, 2015).

PREFERENCE OF HABITATS AND ECOLOGICAL IMPORTANCE

Indian pangolin is essentially found in tropical thorn forest, semi-arid scrub land and on agricultural fringes. Over South Asia, Indian pangolins are in general experiencing declining population patterns due to habitat destruction, overhunting and inadequate law enforcement, particularly in India, Pakistan and Sri Lanka (Yasmeen *et al.*, 2021). Plant species in pangolin habitats were determined to be led by *Dalbergia sissoo*, *Acacia modesta*, and *Pinus roxburghii*, which indicated mixed shrub-tree cover preference (Mahmood *et al.*, 2015). It is highly dependent on the availability of prey (ants and termites), soil (loamy or sandy) type, the height (400-1300 m), and distance to the water body. Ecologically, pangolins are very useful in the control of insects, hence very important in the stability of biodiversity in degraded habitats.

BURROW ECOLOGY AND BEHAVIOURAL ADAPTATIONS

Pangolins dig two kinds of burrows, shallow, temporary feeding burrows and deep permanent sleeping burrows. At Margalla Hills and Chakwal field studies report burrow depth 14.56 inches (36.98cm) of an average feeding and 46.03 inches (116.92cm) of average sleeping burrow depth. The permanent burrows are usually found under thickets or close to termite nests. The use of burrows in isolation, except when breeding, is highly habitat selective. This adds to the susceptibility of the species to any alteration of the habitat.

POPULATION ESTIMATE AND DISTRIBUTION PATTERN

Subsequently, recent studies based on field observations in Pakistan estimate the pangolin density as 0.11336 individuals per square mile (0.2936 individuals/square kilometer), which is low and decreasing for instance, more than 60 individuals were poached or illegally hunted in Chakwal District over two years (Irshad *et al.*, 2015). The thin distribution of the Indian pangolin populations

and the low mean density of 0.29 individuals/km² in Kohat District and Khyber Pakhtunkhwa represent disturbing pressure on Indian pangolins as a result of habitat fragmentation and poaching (Mahmood *et al.*, 2023). Local extirpation is observed in some parts of northern Punjab, and this can be a result of uncontrolled poaching and land use practices. These data are compelling evidence that it can no longer afford to have disparate populations that are being monitored in different ways. A total of 37 pangolin burrows were recorded in Malakand, including 25 feeding and 12 living burrows, confirming the species' active presence in areas like Kot Manzare, Bazdara, and Naro Obu (Muhammad *et al.*, 2024).

KEY INDIAN PANGOLIN SURVIVAL THREATS

Illegal wildlife trade, the Indian pangolin is targeted because its scales are believed to cure a wide range of ailments through folklore medicine, which is not true. In Pakistan, the Indian pangolin has been categorized as Endangered in the IUCN Red List because of the rapid drop in population attributable to overexploitation, unlawful hunting, grabbing of habitats and other reasons (Muhammad *et al.*, 2024). The global demand for pangolin scales, as well as the domestic one, is fueling a black-market trade, with prices going as high as Rs 100,000 per pangolin in certain provinces, thus ensuring the status of pangolins as the most trafficked mammalian Pakistan (Waseem *et al.*, 2020). In Pakistan, pangolins are valued at high prices in the black markets, where they can gain up to Rs 2,000/ kg, and live pangolins can be sold at Rs 80,000 to 100,000 per individual. Poaching is promoted by lax law enforcement and porous borders that allow international trade. Illegal hunting is a serious issue affecting numerous wildlife species across Pakistan (Khan *et al.*, 2024) and similar trends have been observed in the case of Indian pangolin.

HABITAT LOSS AND ENVIRONMENTAL DEGRADATION

Rapid urbanization, deforestation, pesticide use and agricultural encroachment has resulted in extreme habitat degradation. It has been reported that the poor institutional mechanisms and absent species-specific protective policies are the key constraints of the pangolin conservation efforts in Pakistan (Umar *et al.*, 2020). Data obtained through remote sensing reveal a decrease in vegetation and paucity of termites, which impacts the available shelter and food source of pangolins. The species has been painted in poor lights in the local folklore itself, which also plays a big

role in its persecution. The review suggests that these misconceptions and myths have a significant influence on the human-pangolin conflict in rural populations (Umar *et al.*, 2020).

THE PERCEPTION OF CULTURE AND HUMAN-WILDLIFE CONFLICT

Survey-based research indicates that more than 70 per cent of the rural respondents perceive pangolins as bad or of ill-fortune and hence persecute them. Surveys administered in the form of questionnaires throughout the areas of Jhelum, Chakwal, Rawalpindi, and Islamabad demonstrated large-scale poaching of pangolins, as well as the knowledge of continuing poaching in more than 70 per cent of the respondents in Jhelum and 78 % within Islamabad. Deviations from the truth are usually founded on myths rather than ecological knowledge. Ignorance and illiteracy promote negative human-pangolin interaction.

ADVANCED HABITAT SUITABILITY MODELLING

Habitat suitability modelling with the MaxEnt software suggested that the major factors controlling pangolin presence include the elevation (400-1300 m), being close to water (500 m), vegetation density and soil composition. The predictive modelling of MaxEnt in the current and future climate context indicates a remarkable change in the habitat of Indian pangolin, with the possibility of reallocating core areas moving towards the upper latitudes because of rising temperature and changing rainfall patterns (Qasim *et al.*, 2024). In Chakwal District, the landscape is rated highly suitable (7.8 %). Suitability areas where pangolin is found include conservation areas such as Chinji National Park, which, however, does not provide direct protection measures to pangolins. A habitat suitability model in Chakwal District, where MaxEnt software has been used to demonstrate elevation, vegetation density, and soil type as crucial predictors of the distribution of pangolin, whereby the most significant suitability occurs in places that were 450-1200 meters in elevation (Safi and Varriano, 2024).

RESEARCH GAPS AND THE IMPORTANCE OF LOCAL COMMUNITIES

Wildlife; Pangolins are vital for food production because they are responsible for controlling pests, mainly termites and ants, which in turn benefit the crop production

and conservation of the forests. Despite the growing ecological knowledge of Indian pangolin, significant knowledge gaps exist with regard to reproductive biology, dispersal behaviour and population trends in the long term. Social action has been minimally used but records indicate that local people are ready to be part of conservation efforts when they are well rewarded. By undertaking a review, it is possible to outline general regional threats such as the trade in traditional medicine, scientific ignorance, and the weak coordination of Trans boundary conservation (Yasmeen *et al.*, 2021). Tapping into indigenous knowledge and training in wildlife volunteers can be a significant boost to the monitoring and protection of pangolins.

POLICY ACTIVATES AND RECOMMENDATIONS FOR CONSERVATION

- Label Bhakkar, Layyah and some parts of Salt Range as Pangolin Conservation Zones.
- Specific campaign aiming at: clearing the negative myths through public education.
- Increase the capacity of enforcement with the Punjab Wildlife Department.
- Integrate pangolin conservation with the national biodiversity and resilience plans.
- Support collaborative interdisciplinary research among local universities, non-government organizations and conservation agencies.

INDIAN PANGOLIN IN BHAKKAR, GUJRAT, MARGALLA HILLS AND CHAKWAL

The article covered Indian pangolin distribution, habitat use, and threats to life in Pakistan with a focus on Bhakkar, Gujrat, Margalla Hills and Chakwal, where quantitative surveys were carried out (Table I). Data were obtained regarding the habitat type, burrow features, vegetation colluding, poaching and population performance. The data included habitat modelling methods (e.g. MaxEnt) and field-based indices of ecology. The available literature was evaluated qualitatively to acquire patterns in ecological conditions and discover gaps in conservation. The academic databases were searched selectively with search engine queries using specific keywords like Indian pangolin, *Manis crassicaudata*, Pakistan, Punjab, conservation, poaching, habitat, ecology. The selection criteria of the available studies were: (1) peer-reviewed publications, (2) direct relevance to Indian pangolin ecology or Indian pangolin conservation in Pakistan, (3) publication date representing recent

Table I. Indian Pangolin (*Manis crassicaudata*) studies in Punjab and adjacent areas.

Study location	Density (ind/km ²)	Burrow type/Depth	Threats identified	Key vegetation
Chakwal	0.34	Feeding: ~37cm Sleeping: ~117cm	High poaching, habitat loss	Acacia modesta, Dalbergia sissoo
Bhakkar	0.31	Similar to Chakwal	Medium poaching, agriculture expansion	Semi-arid scrub
Layyah	0.30	Shallow burrows in termite-rich soil	Habitat degradation, pesticide use	Thorn forest, termite mounds
Gujrat	0.29	Low burrow density	Urbanization, deforestation	Mixed shrub tree (<i>Lantana camara</i>)
Margalla hills	0.32	Feeding and sleeping burrows clearly documented	Legal protection, low awareness	<i>Pinus roxburghii</i> scrub forest
Kohat (KPK)	0.29	Similar patterns, declining trends	Community unawareness, weak enforcement	Forest-shrub borders
Malakand (KP)	Active burrows: 37	25 feeding, 12 sleeping burrows	Poaching, perceptionbased killing	Agricultural fringe
Potohar plateau	Sparse reports	N/A	Traditional medicine trade, illegal collection	Mixed scrub forest
Chinji NP (Modelled)	High suitability (7.8%)	Modelled via MaxEnt	No direct protection, habitat shift due to climate change	Elevation-based, loamy soils
Punjab overview	Avg: 0.29	Consistent burrow patterns	Poaching, habitat loss, cultural myths	Soil + vegetation density based

field-based studies (the identified list includes mostly the publications of 2015-2024). Preference is given to quantitative survey research, especially that of Bhakkar, Gujrat, Margalla Hills and Chakwal. Extracted data involved the descriptions of habitat type, burrow structure, vegetation associations, examples and reasons of poaching, and any population-performance measurements (e.g. density estimates). When available information relating to habitat modelling techniques (e.g. MaxEnt) and field-based population estimates. The chosen publications were assessed qualitatively with the aim of defining the patterns that repeat in ecological issues, evaluating the presented level of threats and understanding what gaps occur among the research activities and the applied conservation measures. In the given qualitative synthesis, the goal was not to simply summarize the results of each of the studies but rather to establish some similarities, differences, and scope of future research.

Distribution and density

The population of pangolin was reported in Bhakkar, Layyah, Gujrat, Margalla Hills, and some areas of the Potohar Plateau, where the lowest population density (0.09/ha) was recorded in Dhurnal, while a relatively higher presence was noted in Bhaun Forest areas (Mahmood *et al.*, 2020). Basharat Village Forest Patch and Chakwal Low population density was witnessed, as illustrated

with 0.29-0.36 individuals per km². There are fragmented reports stating that the majority of people are confined to the boundaries of forests, and also on the fringes of agricultural areas. More than 60 pangolins were poached in two years in Chakwal (Irshad *et al.*, 2015). After surveying the whole 474 km² of Chakwal district, found evidence of the animals presence along 20 road transects in each of the five tehsils (Irshad *et al.*, 2015).

Habitat preferences

Pangolins had strong preferences for semi-arid thorn forests, agricultural boundaries and areas with high ant and termite activity. Favored sites were mild canopy visibility loamy soil and an altitude of 400-1300 meters. Active burrows were frequently linked with *Lantana camara*, *Dalbergia sissoo* and *Acacia modesta*.

Burrow characteristics

Two types of burrows were noted, viz, non-permanent, shallow feeding burrows (mean depth: 14.56 inches, 36.98 cm) and permanent burrows (mean depth: 46.03 inches, 1162.92 cm). Burrows were located close to termite colonies, and this formed the feeding burrows, whereas permanent burrows were upturned under the thick shrubs or close to a water source. AnalysisThreats that had been identified include: Illegal poaching (live trade and scale harvesting), 243 destruction of habitat through

urbanization and agricultural activities, as well as adverse public perception. Mostly due to fears or misconceptions, pangolins were continually murdered, mistakenly believing they were dangerous.

DISCUSSION

The results indicate that the Indian pangolin is an endangered species in Pakistan, especially in the Margalla Hills, Chakwal, Gujrat, Bhakkar and Layyah districts in Punjab. The low and remote population densities, high poaching and habitat destruction make the species vulnerable. This is made worse through cultural myths and ignorance. There are no specific conservation strategies in place to protect pangolins now. The existence of a relationship between the structure of vegetation and the position of the burrow highlights the lack of habitat restoration. Of no little importance is the fact that the liberal negative cultural perception about pangolin is deep-rooted, and surveys show that more than 70 % of the respondents in rural areas have held the negative cultural view of pangolins as evil or a bad omen. This far-reaching fallacy, which is usually born of ignorance and not of ecology, is in itself a driving force behind persecution and the human wildlife conflict, which increases the pressure due to poaching and habitat destruction. The lack of distinct pangolin protection measures in the present established protected areas, even at points where high suitability habitats are overlaid, is a serious policy gap which needs to be filled as soon as possible. Although high-resolution habitat suitability modelling (e.g., MaxEnt) gives critical insights into optimal environmental variables (elevation, distance to water, vegetation density, soil composition), in order to facilitate conservation action on the ground, the methodology requires assistance from conservation so that the two implementations can work hand in hand. Evidence based management has another problem in the identification of research gaps in reproductive biology, dispersal behaviour, and long-term population trends, highlighting the need to establish long-lasting scientific research. Mostly, any deliberate group or individual action that will be used towards conservation will be dependent on the reality of community interaction. The local communities, upon being offered motivated participation, demonstrate the willingness to contribute, which is a major opportunity to fill the gap between scientific knowledge and on-the ground application. Using the indigenous knowledge and empowering the local wildlife volunteers would be a tremendous assistance to efforts aimed at monitoring and protection, and would change the negative impressions towards stewardship. Thus, it is necessary to combine scientific evidence with the active involvement of

the local people, improve the functions of law enforcement agencies (including heavier penalties under the Punjab Wildlife Act), and use modern technologies to control them (such as camera traps and drones). The harmful attitudes can be transformed through education campaigns among school children and farmers. There is also a need to enhance law enforcement; this should be through enhanced field patrols and severe punishment based on Article 17 of the Punjab Wildlife Act.

CONCLUSION

Illegal poaching, habitat destruction and cultural misunderstanding are all contributing to a dire conservation crisis that the Indian pangolin is facing in Punjab. The review points to the necessity of science-driven and community-driven action. The creation of conservation zones, the intensification of anti-poaching efforts and the creation of awareness are vital efforts. The species extinction must be prevented through coordinated measures.

RECOMMENDATION

The increasing threat to one of the flagship species of both ecological and cultural significance in Punjab, the Indian pangolin, needs to be addressed because it is being impacted by poaching, habitat loss, and misinformation. Being a natural insectivore, Indian pangolin plays a crucial role in ecology, since they control the population of ants and termites in the agricultural areas and hilly environment (Muhammad *et al.*, 2024). The current review is a synthesis of the available literature, which offers an integrated view of the situation and survival complexities of the species. The review will help evidence-based conservation to be inclusive, adaptive, and regionally anchored by identifying scientific gaps as well as socio-cultural gaps, and providing pragmatic strategies. The paper proposes the formation of protected and climate-resilient areas and corridors to protect pangolin populations in case of the foreseen habitat loss in future climate change Representative Concentration Pathways (RCP) scenarios (Qasim *et al.*, 2024).

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