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Full Length Article

Distribution and Habitat Analysis of Indian Pangolin (*Manis crassicaudata*) in District Malakand, Khyber Pakhtunkhwa Province, Pakistan

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Abstract

The Indian pangolin (*Manis crassicaudata* Geoffroy 1803), is the sole representative of the Pholidota order found in Pakistan, the species is threatened due to rampant trade, leading to its classification as "Endangered" since 2014. The current study investigated the distribution and habitat analysis of the Indian pangolin in three selected sites (Kot Manzare, Bazdara and Naro Ubu) of Malakand district, Pakistan. The study involved traversing different transects within the study area. Confirmation of the presence of the Indian Pangolin in the area was achieved through the identification of living and feeding burrows, scats, and footprints around the burrows. This study not only documented every tree, shrub, and herb species present but also recorded their densities per hectare (D/ha), along with relative density (RD), relative frequency (RF), relative cover (RC), and importance value index (IVI) at each of the three sites. Additionally, coordinates of feeding and living burrows were noted. A total of 37 burrows, consisting of 25 feeding and 12 living burrows, were observed across the study area; specifically, 14 burrows were recorded at site II (Naro Obu), 13 at site III (Bazdara), and 10 at site I (Kot Manzare). Results of vegetation analysis revealed that *Dalbergia sissoo*, *Ziziphus nummularia*, *Acacia nilotica*, *Berberis lycium* and *A. modesta* were the dominant tree species, while *Carissa opaca*, *Dodonaea viscosa*, *Lantana camara*, *Maytenus royleanus* and *Justicia adhatoda* were dominant shrub species. Herb species such as *Cynodon dactylon*, *Saccharum bengalense*, *Carthamus oxyacantha*, *Cannabis sativa* and *Convolvulus arvensis* were also documented. This study represents a pioneering effort in understanding the distribution, habitat, and threats faced by the Indian pangolin in District Malakand, Khyber Pakhtunkhwa, Pakistan. Study findings on pangolin distribution, habitat preferences, population trends, and awareness will help prioritize conservation in key habitats.

Keywords: Indian pangolin; Malakand; Distribution; Habitat analysis; Threats

Introduction

The pangolin, also known as the scaly anteater (*Manis crassicaudata* Geoffroy 1803), is a fossorial, "Endangered" mammalian species found in Pakistan that faces a high risk of extinction in the wild. The primary threat to the species is the illegal poaching and trafficking of pangolins for their scales by both local and foreign poachers (Mahmood *et al.* 2019; Waseem *et al.* 2020). In Asia the pangolin is found in Pakistan, India, Nepal, Bangladesh and Sri Lanka (Challender *et al*. 2014). In Pakistan, this species is locally distributed and occurs on the right bank of Indus, in the hilly region in the western part of the Larkana and Dadu districts in Sind, its distribution extends southwards through Lasbella and Makran in Balochistan but entirely absent in Indus riverine plains. It also occurs in Gujrat, Sialkot and Jhelum districts including Potohar Plateau in the Punjab. In Khyber Pakhtunkhwa, it occurs in Mardan, Kohat and Peshawar districts (Roberts 1997). Pangolin lives in mountains, desert and some species of pangolin live in grass, hallow tree and burrows, depending on the species (Gaudin *et al*. 2006). Indian pangolin digs two types of burrows: living or resting

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burrows and feeding burrows. Resting burrows are used for sleeping/resting during the daytime and breeding, while feeding burrows are dug to reach or expose prey species. Parameters such as burrow depth, burrow-opening diameter and the presence of prey remain as well as faecal matter are considered as useful signs to distinguish the two types of burrows (Waseem *et al*. 2020). Habitat features such as tree species composition, vegetation cover and geological features (such as the presence of rock boulders, water sources and soil characteristics) have been identified as important parameters worth considering in the characterization of burrowing habitats of pangolins (Karawita *et al*. 2018). Throughout its range, the pangolin has been declared by the IUCN as an endangered species. Due to its nocturnal fossorial habit, very little is known about its habit of breeding (Waseem *et al*. 2020). On one hand the of biology of pangolin is not adequate in Pakistan and it is necessary to know about the abundance and distribution of this animal who is facing the issue of population decline due to negative perception of the local people (Akrim *et al*. 2017). The Indian pangolin (*M. crassicaudata*) is an endangered species in Pakistan due to a lack of comprehensive ecological data, hindering the development of effective conservation measures. The declining population of the Indian pangolin underscores the urgent need for conservation efforts (Irshad *et al.* 2015). Illicit trade in pangolins, their parts, and derivatives remains rampant and widespread, driven to a large extent by business sectors in China and Southeast Asia. Despite international restrictions and enforcement efforts, this illegal trade continues to pose a grave threat to the survival of these endangered animals (Shepherd 2009). The present study was designed to investigate the status of pangolins in the Malakand District of Khyber Pakhtunkhwa. The majority of the area in Malakand district is dry, providing an ideal habitat for the pangolin population. The selected area for the study is occupied by tropical sub-thorn forest. The main objectives of the study were to record the tree, shrub, and herb species present at each survey site. To calculate the density, relative density, relative frequency, relative cover, and importance value index (IVI) of each tree, shrub and herb species. The objectives of this study are (i) to use the survey data to identify key habitats for Indian pangolins, (ii) To estimate the population size and density of Indian pangolins in the study area, (iii) To develop and implement a conservation awareness program for Indian pangolins in the study area.

Materials and Methods

Study Area

The current study was conducted in District Malakand, Khyber Pakhtunkhwa, which is located at 34.57° N/71.93° E. The district comprises two tehsils, Dargai and Batkhela. The lower region of Malakand falls within the subtropical thorn forest, with elevations up to 304 m, while the upper region is characterized by subtropical broadleaf evergreen and subtropical Chir pine forests. It is bordered by District Buner to the East, District Swat and Lower Dir to the North, District Bajawar and Mohmand to the West, and District Mardan to the South. The area is predominantly dry with arid conditions and an annual rainfall of less than 250 mm. The average annual temperature ranges around 19.9°C. Rainfall in Malakand occurs mostly in winter, with relatively low precipitation in the summer. June is the warmest month, while January is the coldest (Fig. 1) The floristic composition of Malakand includes species such as *Acacia modesta*, *Albizia lebbeck*, *Gymnosporia royleana*, *Melia azedarach*, *Morus alba*, *Morus nigra*, *Robinia pseudoacacia*, *Zizyphus mauritiana*, *Dodonea viscosa*, *Pinus roxburgii*, *Bauhinia variegata*, *Dalbergia sissoo* and *Eucalyptus camaldulensis* (Barkatullah and Ibrar 2011). Additionally, fauna in the area includes *Canis aureus*, *Vulpes vulpes*, *Herpestes edwardsii*, *Hystrix indica*, *Lepus nigricollis* and *Pteropus giganteus* (Akhtar *et al*. 2018).

Study sites

Based on the presence of burrows, waste materials, and interviews with local communities, the following potential sites were identified.

Site-I ("Kot Manzare") is located at 34.627222° N/73.020278° E, with an elevation of 490 m above sea level. Situated at the Western side of Malakand District, it consists of diverse types of habitats.

Site-II ("Naro Obu") is positioned at 34.568056° N/73.435° E, with an elevation of 447 m above sea level. Located at the Western and Southern sides of Malakand, it encompasses varied sorts of habitat.

Site-III ("Bazdara") is found at 34.502956° N/71.904419° E, with an elevation of 495 m above sea level. Positioned on the Eastern side of Malakand, it features diverse types of habitats (Fig. 2).

Study design

The current study was conducted from November 2017 to December 2018. During the survey, the presence of the Indian pangolin was confirmed, particularly around newly dug burrows, through indirect signs such as feeding and living burrows, fecal matter, scales, footprints and body prints. Key informants were also contacted to collect information on the three selected study sites. To construct a distributional map of the species in District Malakand, geographical coordinates of different transects were recorded using a GPS (Garmin eTrex Vista H made in Taiwan, China) during surveys and distribution maps were prepared for all three sites. For habitat analysis, regular visits were conducted at the three selected sites. Vegetation analysis was carried out for tree, shrub, and herb species, and the activity of the scaly anteater was compared with

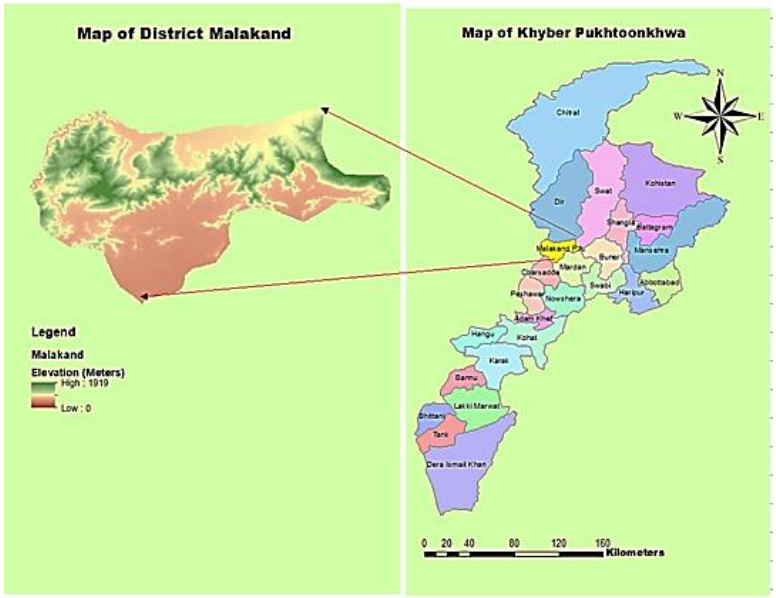

Fig. 1: Location of District Malakand, Khyber-Pakhtunkhwa, Pakistan

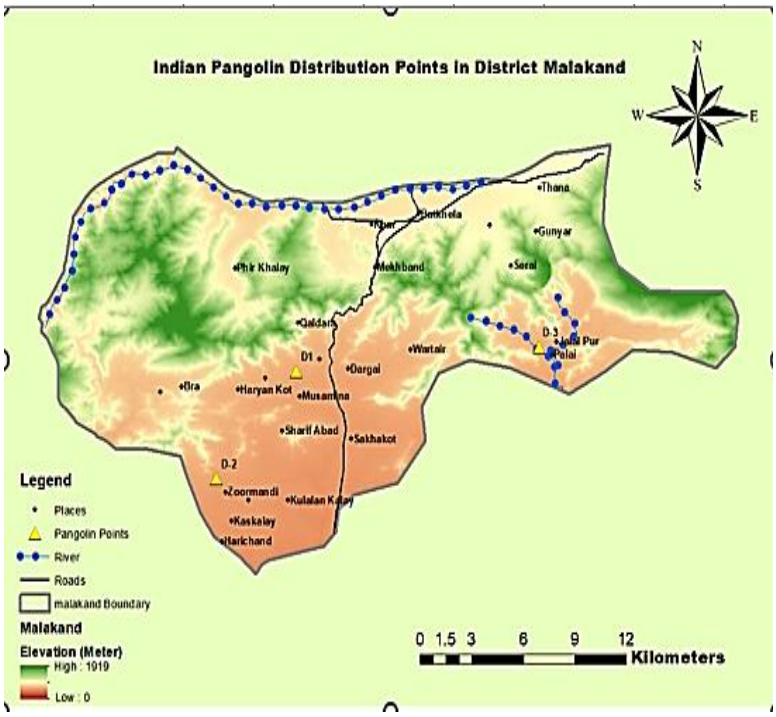

Fig. 2: Detail of study sites, site-I (Kot Manzare), site-II (Naro Obu) and site-III (Bazdara) in District Malakand during the current study period

specific vegetation in the area. At each site, plant species, including trees, shrubs, and herbs, were quantified and identified up to the species level (Ali and Qaiser 1993; Schmid *et al*. 2002; Barkatullah *et al*. 2015). Different transects of 1.4, 1.8, 1.6, 1.9, 2 and 1.6 km in length were established at the selected sites. Different points were marked at 50 m intervals on each transect to record data about trees, including their density, frequency, and relative cover in each study site. At all three selected sites, quadrats of 4 m x 4 m and 1 m x 1 m were established to calculate the density, frequency, and relative cover of shrubs and herbs, respectively. The following formulas were used for trees, shrubs, and herb species for various calculations (Mahmood *et al*. 2014).

For trees species formulae used were:

Density = Total number of individual species/Total number of quarters

$$\text{Relative density (tree species)} = \frac{\text{Quarter with a species}}{\text{Total No. of quarters}} \times 100$$

$$\text{Frequency} = \frac{\text{No. of sample points with a species}}{\text{Total number of quarters}} \times 100$$

$$\text{Relative frequency} = \frac{\text{Frequency of a species}}{\text{Total No. of frequencies of all species}} \times 100$$

$$\text{Relative cover} = \frac{\text{Total basal area of a species}}{\text{Total No. of all species in all quarters}} \times 100$$

Formulae used for shrubs and herbs species were:

$$\text{Density} = \frac{\text{Total No. of individuals of a species}}{\text{Total No. of quadrates} \times \text{Area of one quadrate}} \times 100$$

$$\text{Relative density} = \frac{\text{Total No. of individuals of a species in all quadrates}}{\text{Total No. of all species in all quadrates}} \times 100$$

$$\text{Frequency} = \frac{\text{No. of quadrates with a species}}{\text{Total number of quarters}} \times 100$$

$$\text{Relative frequency} = \frac{\text{Frequency of a species}}{\text{Total frequencies of all species}} \times 100$$

$$\text{Relative cover} = \frac{\text{Frequency of a species}}{\text{Total cover of all species}} \times 100$$

Importance Value Index (IVI) for tree species = Relative density + Relative frequency + Relative cover

Results

Habitat analysis of study sites

A total of five tree species were recorded in all study sites, including *D. sissoo* (Sheesham), *Ziziphus nummularia* (Beer), *A. nilotica* (Kekar), *Berberis lycium* (Sumbal), and *A. modesta* (Phulahi). In site-I (Kot Manzare), *D. sissoo* had the highest relative density (49), followed by *Z. nummularia* (33), while *B. lycium* had the lowest density (8.2). In study site-II (Naro obu), *Z. nummularia* had the highest relative density (49), followed by *D. sissoo* (33), while *A. modesta* had the lowest density (8.2). Similarly, in site-III (Bazdara), the highest relative density was recorded for *D. sissoo* (49), followed by *A. modesta* (33) (Table 1).

Five species of shrubs were recorded from the study sites: *Carissa opaca, Dodonaea viscosa, Justicia adhatoda, Lantana camara* and *Maytenus royleanus*. In Site-I, *C. opaca* had the highest relative density (33.06), followed by *D. viscosa* (23.96). In Sites-II and III, *C. opaca* had the highest relative density, followed by *J. adhatoda* (Table 2).

Similarly, five herb species were recorded from all of the study sites: *Cannabis sativa* (Bhang), *Saccharum bengalense* (Saroot), *Convolvulus arvensis* (Lehli), *Carthamus oxyacantha* (Poli), and *Cynodon dactylon* (Khibal). In all three study sites, *C. dactylon* had the highest relative density, followed by *S. bengalense* (Table 3).

Distribution of Indian pangolin in study area burrows

Fortnightly visits were made to the three selected sites to thoroughly search for the presence of pangolin burrows. At each site, the number of burrows, their average height, width, and depth were recorded (Table 4). Two types of burrows were found in the proposed area: living or permanent or sleeping burrows and temporary or feeding burrows (Fig. 3). The feeding burrows were excavated by the Indian Pangolin during feeding on termites and ant species and were less deep, whereas the permanent burrows were deep and were used by the Scaly Anteater for resting/sleeping during the day. Direct and indirect signs were also observed to confirm the presence of the pangolin in the study areas. These signs included animal sightings, animal captures, fecal samples, living burrows, feeding burrows, and road-kill. During the study period, no road-kill was observed in any of the study areas (Table 5). However, the highest number of feeding burrows (25) and living burrows (12) were observed during the study period. Based on these signs, distribution maps of the pangolin for all three study sites were prepared (Fig. 4).

Discussion

The distribution and habitat analysis of the Indian pangolin in the Malakand district of Pakistan had not been previously studied. Therefore, a study was conducted from December 2017 to December 2018 to investigate its distribution and habitat in the Khyber Pakhtunkhwa province, specifically in the Malakand district. According to Baillie *et al.* (2014), pangolins are found in Pakistan, India, Nepal, Bangladesh and Sri Lanka. Roberts (1997) described their distribution in Pakistan. Indian pangolins prefer habitats with rocky terrain and boulders where they create underground burrows for shelter (Karawita *et al*. 2018). They are known to avoid open areas and dense vegetation, instead seeking out environments with moderate forest cover that provide protection from predators and harsh weather conditions (Khattak *et al*. 2023). Additionally, they tend to inhabit areas near water sources but without excessive moisture, and they generally avoid flatlands and steep slopes. Their habitat choices are influenced by various factors, including the presence of trees, vegetation cover and proximity to water sources (Shrestha *et al*. 2021; Khattak *et al*. 2023).

In district Chakwal, the animal species is uniformly distributed in the district, including all four Tehsils and its occurrence was recorded at high elevations around Basharat hills. The soil of the area was soft and semi sandy, suitable for digging burrows. The animal species' burrows were confirmed based on diameter, depth, and shape, revealing two types: feeding and living/permanent. Living burrows averaged a depth of 56.0 ± 1.15 inches, while feeding burrows were 11.01 ± 0.90 inches deep. The diameter was 8.61 ± 0.26 inches for feeding burrows and 10.5 ± 0.35 inches for living ones. The estimated population density of

Table 1: Density per hectare (D/ha), relative density (RD), relative frequency (RF), relative cover (RC) and importance value index (IVI) of tree species at three selected study sites in the Malakand district of Pakistan during the study period

Sites	Trees	D/ha	RD	RF	RC	IVI
	Dalbergia sissoo	2.9	49	36.9	53.70	142.5
	Ziziphus nummularia	1.7	33	34.8	5.20	74.70
Site-I	*Acacia modesta*	0.2	6	6.2	31.98	44.38
	Acacia nilotica	0.3	11	15.2	0.98	27.48
	Berberis lycium	0.3	4	8.2	6.04	18.54
	Mean ± SE	1.1 ± 0.53	20.6 ± 8.78	20.3 ± 6.55	19.6 ± 10.13	61.5 ± 22.40
	Ziziphus nummularia	2.9	49	36.9	53.70	142.5
	Dalbergia sissoo	1.7	33	34.8	5.20	74.70
Site-II	*Berberis lycium*	0.2	6	6.2	31.35	43.75
	Acacia nilotica	0.3	11	15.2	0.97	27.47
	Acacia modesta	0.3	4	8.2	6.01	18.51
	Mean ± SE	1.1 ± 0.53	20.6 ± 8.78	20.3 ± 6.55	19.4 ± 10.10	61.4 ± 22.42
	Dalbergia sissoo	2.9	49	36.9	53.70	142.5
	Acacia nilotica	1.7	33	34.8	5.20	74.7
Site-III	*Berberis lycium*	0.2	6	6.2	31.35	43.75
	Ziziphus nummularia	0.3	11	15.2	0.97	27.47
	Acacia modesta	0.3	4	8.2	6.01	18.51
	Mean ± SE	1.1 ± 0.53	20.6 ± 8.78	20.3 ± 6.55	19.4 ± 10.10	61.4 ± 22.42

Table 2: Density per hectare (D/ha), relative density (RD), relative frequency (RF), relative cover (RC) and importance value index (IVI) of Shrub species at three selected study sites in the Malakand district of Pakistan during the study period

Sites	Shrubs	D/ha	RD	RF	RC	IVI
	Carissa opaca	166.6	33.06	22.72	20.93	243.31
	Dodonaea viscosa	120.83	23.96	22.72	36.63	204.14
Site-I	*Justicia adhatoda*	112.5	22.32	18.19	19.19	172.2
	Lantana camara	70.83	14.05	22.72	16.15	123.75
	Maytenus royleanus	33.34	6.61	13.64	6.00	59.59
	Mean ± SE	100.8 ± 22.7	20.0 ± 4.5	20.0 ± 1.8	19.8 ± 4.9	160.6 ± 31.96
	Carissa opaca	162.3	32.2	21.1	18.56	234.16
	Dodonaea viscosa	118.3	21.1	19.9	34.13	193.43
Site-II	*Lantana camara*	71.2	13	23.2	17.10	124.5
	Maytenus royleanus	31.1	5.2	11.9	5.50	53.7
	Justicia adhatoda	11.3	23.3	16.8	2.5	53.9
	Mean ± SE	78.8 ± 27.8	19 ± 4.6	18.6 ± 2	15.6 ± 5.6	131.9 ± 36.4
	Carissa opaca	165.1	36.1	24.3	20.13	245.63
	Dodonaea viscosa	121.1	21.1	21.3	37.02	200.52
Site-III	*Justicia adhatoda*	112.5	25.3	18.19	18.86	174.85
	Lantana camara	68.5	17.9	20.1	15.50	122
	Maytenus royleanus	35.7	4.9	11.3	6.60	58.5
	Mean ± SE	100.6 ± 22.32	21.1 ± 5.08	19 ± 2.17	19.6 ± 4.95	160.3 ± 32.36

Table 3: Density per hectare (D/ha), relative density (RD), relative frequency (RF), relative cover (RC) and importance value index (IVI) of Herbs species at three selected study sites in the Malakand district of Pakistan during the study period

Sites	Herbs	D/ha	RD	RF	RC	IVI
	Cynodon dactylon	1700	64.15	21.05	42	1827.2
	Saccharum bengalense	416.67	15.73	21.05	13.2	466.65
Site-I	*Cannabis sativa*	233.34	8.8	21.05	21.9	285.09
	Convolvulus arvensis	233.34	8.8	21.05	16.6	279.79
	Carthamus oxyacantha	233.34	8.8	21.05	16.6	279.79
	Mean ± SE	563.3 ± 286.4	21.3 ± 10.8	21.3 ± 0.0	22.1 ± 5.2	627.7 ± 302
	Cynodon dactylon	1800	55.2	21.05	35.97	1912.22
	Saccharum bengalense	420	13.73	19.3	13.43	466.46
Site-II	*Cannabis sativa*	240.3	8.5	17.3	22.30	288.4
	Convolvulus arvensis	231.1	5.8	23.3	16	276.2
	Carthamus oxyacantha	67.4	3.52	13.2	6.38	90.5
	Mean ± SE	551.8 ± 317	17.4 ± 9.6	18.8 ± 1.7	18.8 ± 5	606.8 ± 331.7
	Cynodon dactylon	1500	63.15	21.05	39	1623.2
	Saccharum bengalense	425.3	11.73	25.05	14.34	476.42
Site-III	*Cannabis sativa*	229.3	7.7	23.05	21.09	281.14
	Convolvulus arvensis	233.34	7.8	25.05	16.2	282.39
	Carthamus oxyacantha	55.3	4.52	13.8	5.3	78.92
	Mean ± SE	488.6 ± 259.5	19 ± 11.10	21.6 ± 2.1	19.2 ± 5.6	548.4 ± 276

Table 4: Detail of height (H), width (W), depth (D) and standard deviation (SD) of the two types of burrows of the Indian pangolin at three selected study sites in the Malakand district of Pakistan during the study period

Sites	Burrows (n)	Burrows Number	Mean (H) ± SD	Mean (W) ± SD	Mean (D) ± SD
Kot Manzare	Feeding	7	9.61 ± 0.67	8.81 ± 0.47	16.04 ± 0.49
(Study site-I)	Living	3	9.20 ± 0.20	8.74 ± 0.57	48.06 ± 2.00
Naro Obu	Feeding	9	9.47 ± 0.54	8.71 ± 0.45	16.04 ± 0.38
(Study site-II)	Living	5	9.61 ± 0.67	8.97 ± 0.51	50.00 ± 3.81
Bazdara	Feeding	9	9.61 ± 0.77	8.75 ± 0.39	15.90 ± 0.66
(Study site-III)	Living	4	9.80 ± 0.91	9.26 ± 0.27	47.74 ± 2.13

Table 5: Detail of the areas having direct and indirect signs of the pangolin in District Malakand, Khyber Pakhtunkhwa, Pakistan, during current study

Location	Geographic Coordinates	Animal Sighting	Animal Capture	Fecal Sample	Living Burrows	Feeding Burrows	Road Kill
Kot Manzare	N: 34.507380°						
	E: 71.866879°	----	----	1	3	7	----
	Elev: 490m						
Naro Obu	N: 34.430817°						
	E: 71.799842°	1	----	----	5	9	----
	Elev: 447m						
Bazdara	N: 34.524413°						
	E: 72.07402°	----	1	----	4	9	----
	Elev: 495						
Total		1	1	1	12	25	00

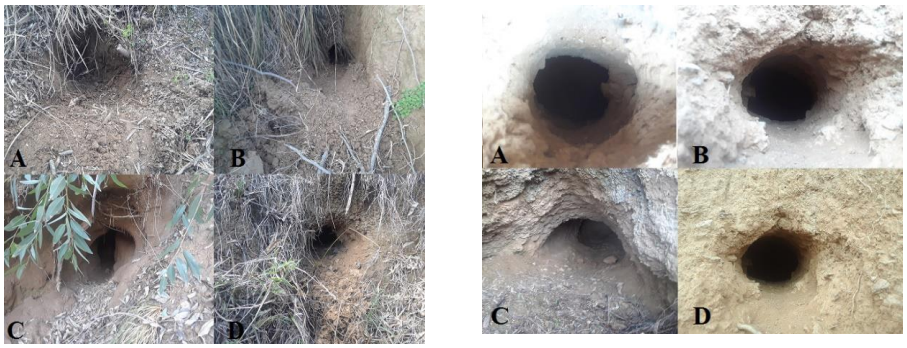

Fig. 4: Detail of the two types of burrows of the Indian Pangolin in three selected sites *i.e*., site-I (Kot Manzare), site-II (Naro Obu) and site-III (Bazdara) of District Malakand during current study. **Left**: Feeding burrows observed at Site-1 (A), Site-II (B) and Site-III (C and D). **Right**: Living burrows observed at Site-1 (A), Site-II (B) and Site-III (C and D).

Indian pangolins was 0.010 ± 0.003/ha across seven selected sites in the district (Mahmood *et al.* 2014). In Khyber Pakhtunkhwa, it occurs in Mardan, Kohat and Peshawar districts (Irshad *et al*. 2015; Mahmood *et al*. 2023). The distribution of Indian pangolins in District Kohat, Khyber Pakhtunkhwa, was found to be patchy, with field signs observed at only three out of seven surveyed sites: Mondori, Jabber and Tilkan. These signs were found at elevations ranging from 390 m to 471 m, with no signs recorded above 500 m (Ghumbat site). Two types of burrows were recorded at the positive sites: feeding and living burrows. Feeding burrows were observed at Mondori and Tilkan, while living burrows were found at Jabber. Seven living burrows were recorded across the three positive sites. No living burrows were observed at the other four sites surveyed. Termites and insect colonies were observed near each recorded burrow (Mahmood *et al*. 2023). During the present study, the investigation of the study area revealed two types of burrows: permanent for sleeping/resting and temporary for feeding, dug by Scaly Anteaters while consuming termites and ants. Various signs confirmed the presence of pangolins, including direct sightings, captures, fecal samples, living and feeding burrows, despite no observed roadkill. Distribution maps were then created for all three study sites based on these observations.

Habitat analysis carried out by Mahmood *et al.* (2014) found major tree species (*A. nilotica*, *Eucalyptus*, *Z. mauritiana*, *Capparis decidua*, *Tamarix aphylla* and *Dilbergia sissoo)*, three major shrub species (*Z. nummularia*, *Calotropis procera* and *Prosopis cineraria)* and seven major species of herbs (*Alhagi maurorum, Heliotropium europaeum, C. oxyacantha, Amaranthus hybridus, Tribulus terrestris, Cyperus rotundus). Prosopis, Zizyphus,* and *A. nilotica* could be crucial for Indian pangolins due to abundant termite mounds and ant colonies observed on their soil and trunks, potentially

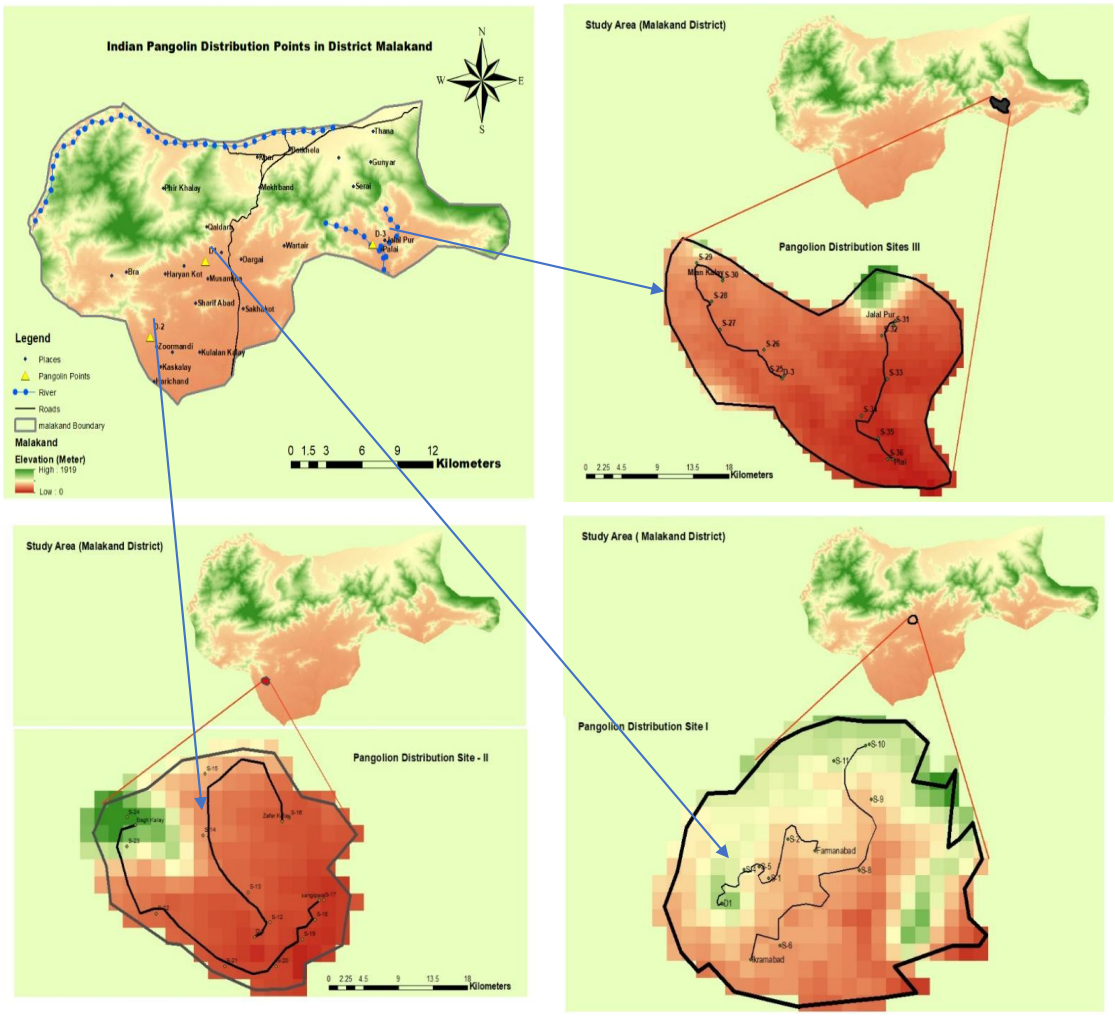

Fig. 4: Distribution of the Indian pangolin at site-I, site-II and site-III in District Malakand during the current study period

providing food resources (Mahmood *et al*. 2014). In another study, vegetation analysis conducted by Mahmood *et al*. (2015) in Margalla Hills National Park, Islamabad, Pakistan, identified *D. sissoo, A. modesta,* and *Pinus roxburghii* as dominant tree species, *D. viscosa* and *L. camara* as dominant shrubs, and *C. dactylon* as the dominant herb species. The Indian pangolin was found to have a phyto-association with *L. camara* and *Punica granatum* for constructing its permanent burrows, while it relied on *D. sissoo* and *A. modesta* trees for obtaining its insect food (Mahmood *et al*. 2015). The present study identified the dominant tree, shrub, and herb species in the area, along with their density, relative density, relative frequency, relative cover and importance value index. The results revealed that *D. sissoo, Zizyphus nummularia, A. nilotica, B. lycium* and *A. modesta* were the dominant tree species, while *C. opaca, D. viscosa, L. camara, M. royleanus* and *J. adhatoda* were the dominant shrub species. Additionally, herb species such as *C. dactylon, S. bengalense, C. oxyacantha, C. sativa* and *C. arvensis* were documented. The study provides valuable insights into the distribution and habitat preferences of the Indian pangolin in the region, which can aid in prioritizing conservation efforts. The findings of the study indicate that pangolins prefer a combination of trees, shrubs, and herb species for their permanent habitat (living burrows). However, feeding burrows (habitat) may differ due to their temporary The findings of the study indicate that pangolins prefer a combination of trees, shrubs and herb species for their permanent habitat (living burrows). However, feeding burrows (habitat) may differ due to their temporary nature.

Conclusion

The Malakand district offers suitable habitat for the Indian pangolin. However, further research is needed to understand the population dynamics and threats to this endangered species in the region. The information generated from this study will be valuable for developing and implementing

effective conservation strategies for the Indian pangolin in the study area. The study identified three sites with the highest number of pangolin burrows, indicating their importance for the species' survival. This information can be used to prioritize conservation efforts in these areas. Additionally, the study identified the dominant tree, shrub, and herb species in the study area, which can be used to better understand the pangolin's habitat preferences and develop management plans that protect and restore these habitats. The study also provides baseline data on the pangolin population in the study area, which can be used to monitor population trends over time and assess the effectiveness of conservation measures. Finally, the study raises awareness of the presence of the Indian pangolin in Malakand district and the threats it faces, which can be used to educate local communities and stakeholders about the importance of conserving the species.

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Author Contributions

Sultan Muhammad and Shams ur Rahman collected data, visited the study area, and wrote the Manuscript. Kaleem Muhammad design the material and methods, reviewed and approved the manuscript. Also provide guidance during study. Muhammad Tayyab Khan: Data Analysis. Faiz Ur Rehman: Manuscript Review Najeeb Ullah: helped in data collection and provided accessibility to the study area; Mohammad Salim: Supervision.

Conflicts of Interest

"The authors have declared that there is no conflict of interest regarding the publication of this article".

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Not applicable

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Not applicable

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