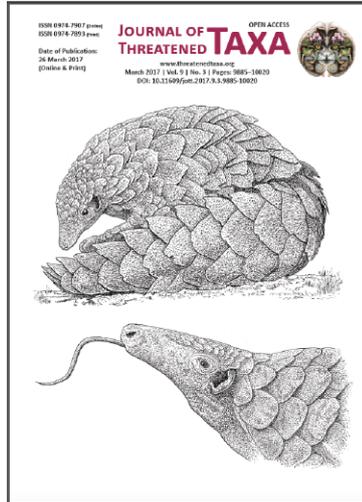


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DISTRIBUTION PATTERN, POPULATION ESTIMATION AND THREATS TO THE INDIAN PANGOLIN *MANIS CRASSICAUDATA* (MAMMALIA: PHOLIDOTA: MANIDAE) IN AND AROUND PIR LASURA NATIONAL PARK, AZAD JAMMU & KASHMIR, PAKISTAN

OPEN ACCESS

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Abstract: Baseline knowledge of distribution and abundance of a species whose population is facing decline throughout its distribution range is vital for its conservation planning. The Indian Pangolin *Manis crassicaudata* is such a species, which is imperiled and lacking key biological studies in the northern locale of Pakistan. We investigated distribution, abundance and threats faced by the Indian Pangolin in and around Pir Lasura National Park, Azad Jammu & Kashmir, Pakistan. The Indian Pangolin has a patchy distribution in the study area ranging from 590–1,540 m elevation. A very low population (0.77 ± 0.34 individuals/km²) of Indian Pangolin were recorded from the Park. Local perception towards the Indian Pangolin was to a great extent negative. A total of 446 pangolins were killed during 2013–2015. We recovered 12 dead pangolins and 10 jackets of scales. Furthermore, 111 live captures, 313 killing and selling of 26kg scales were reported by the local community. Groups involved in killing of Indian Pangolin included local hunters (90.3%), farmers (8.2%) and labours (1.5%). We propose more studies should be carried out to improve the baseline data on the ecology of species and awareness education programs both by government and private sectors, to educate local communities living in and around Pir Lasura National Park for getting support for the conservation of the Indian Pangolin.

Keywords: Distribution, Indian Pangolin, Pir Lasura National Park, population, threats.

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Author Details: FARAZ AKRIM is actively involved in educating local communities for getting their support for wildlife conservation in Pakistan. His research interests are application of non-invasive genetic sampling to understand ecology of wildlife. TARIQ MAHMOOD is Assistant Professor in Department of Wildlife Management PMAS AAUR and actively involved in conservation of Indian Pangolin in Pakistan. RIAZ HUSSAIN is working on conservation of mammals and birds in Pakistan. SIDDIQA QASIM is working on conservation of mammals and reptiles. IMAD-UL-DIN ZANGI is working on conservation of mammals and vultures.

Author Contribution: FA, TM and RH conducted the study. SQ and IUDZ helped in literature searches.

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INTRODUCTION

The Indian Pangolin *Manis crassicaudata* is the only member of the order Pholidota existing in Pakistan. The Indian Pangolin is distributed in southern Asia from eastern Pakistan through most of India, south of the Himalaya (with exception of northeastern India), southern Nepal, Bangladesh and Sri Lanka (Schlitter 2005; Srinivasulu & Srinivasulu 2012). Historical records suggest the species occurs in western China (Yunnan Province) (Heath 1995; Smith & Xie 2008) and there have been dubious records in Myanmar (Allen 1938).

The Indian Pangolin is locally called “Salla” in Pakistan (Prater 1971). It is reported in four provinces and occurs in Sialkot, Jhelum and Gujrat locale in northwestern Punjab and stretches out over the Salt Range into Kohat area, furthermore from Attock region up to Mardan and Peshawar in the Khyber Pakhtoonkhwa (KPK) territory. There is no confirmation of its occurrence in lower Indus waterway plain, Thar Desert and Bahawalpur. Its distribution is likewise reported from Dadu and Larkana districts of Sindh and Mekran and Lasbela regions of Baluchistan (Roberts 1997). A fossil ancestor of *Manis crassicaudata* had been found close to Manchar Lake, Dadu area (Colbert 1935). Fossil pholidotes have also been found in Asia, Africa, Europe and North America (Heath 1992).

The scales of pangolin are made of keratin arising from fused hairs which originate from a thick skin, and continue to grow from the base throughout life. Scales are yellow-brown or yellow-grey in color (Aiyappan 1942). Scales cover all surfaces of the animal body except the footpads, ventral side of the head and trunk, and the inner surface of the limbs. Those surfaces not covered by the scales are sparsely populated with white or gray hairs. Scale size, shape, and ridge pattern are species-specific characteristics (Kuehn 1986). Jentink (1882) reported considerable intra- and interspecific variation in the number and pattern of scales on the tail, head, or trunk region. The normal body length of the Indian Pangolin is very nearly 105–120 cm including 60–75 cm head and body and 45cm tail segment (Prater 1971). On average, the tail length is around seventy percent (70%) of the head and body length (Roberts 1997). The species has 11–13 rows of scales around the body (Prater 1971).

The Indian Pangolin is categorized as “Endangered” according to IUCN Red List of Threatened Species (Baillie et al. 2014). It is listed in Appendix-I of (The Convention on International Trade in Endangered Species of Wild Fauna and Flora). The Indian Pangolin

faces a massive pressure of illegal killing due to a high demand of its scales in the market (Broad et al. 1988; Mahmood et al. 2012). It is believed that the scales of the Indian Pangolin have medicinal importance (Israel et al. 1987) and ornamental uses (Prater 1980). The flesh and fat of the pangolin is used in medicines (Indian Wildlife Club Ezine 2004). The skin of the pangolin is used in manufacturing clothes and shoes (Broad et al. 1988). The animal, its scales and products are traded internationally with many countries of the world (Broad et al. 1988; Nowak 1999; Mahmood et al. 2012). Killing of the Indian Pangolin is evident from many countries of the world, which include Sumatra, Indonesia (Sopyan 2009), peninsular Malaysia (Chin & Pantel 2009), and Potohar region of Pakistan (Mahmood et al. 2012). During eight years (from 2000 to 2007) about 30,000 pangolins were killed in Southeast Asia (Chin & Pantel 2009). The killing of the pangolin is evident from many other studies like Mitra (1998), Mishra et al. (2004, 2011), Challender (2011), Mohanty (2011), Gubbi & Linkie (2012), Baillie et al. (2014), and Challender et al. (2014). In Pakistan it is believed by local ethno-medical practitioners (hakims) that the Indian Pangolin is a valuable source of traditional medicines (Roberts 1997).

The Indian Pangolin is an important mammal in its biological niche. It lives in burrows and feed on ants and termites and acts as biological pest control. Furthermore, burrowing activity of the Indian Pangolin creates breeding habitat and shelter for many other animals (Hansell 1993). The ecological data on distribution and population and threats to the Indian Pangolin is scanty generally in Pakistan; however, it is well studied in Pothwar region of Pakistan by Mahmood et al. (2012, 2014, 2015a), and Irshad et al. (2015). The Indian Pangolin in Azad Jammu & Kashmir has not been studied yet and baseline data on ecology is necessary for national action planning and global action planning. The current study was designed to investigate distribution, population estimates and threats to the species in and around Pir Lasura National Park, Azad Jammu & Kashmir, Pakistan.

MATERIALS AND METHODS

Study area

The current study was carried out in and around Pir Lasura National Park (PLNP) Tehsil Nakyal, District Kotli, Azad Jammu & Kashmir, Pakistan. The area is located in the northeastern part of Pakistan, close to the Line of Control between 33°25.92–33°29.31'N &

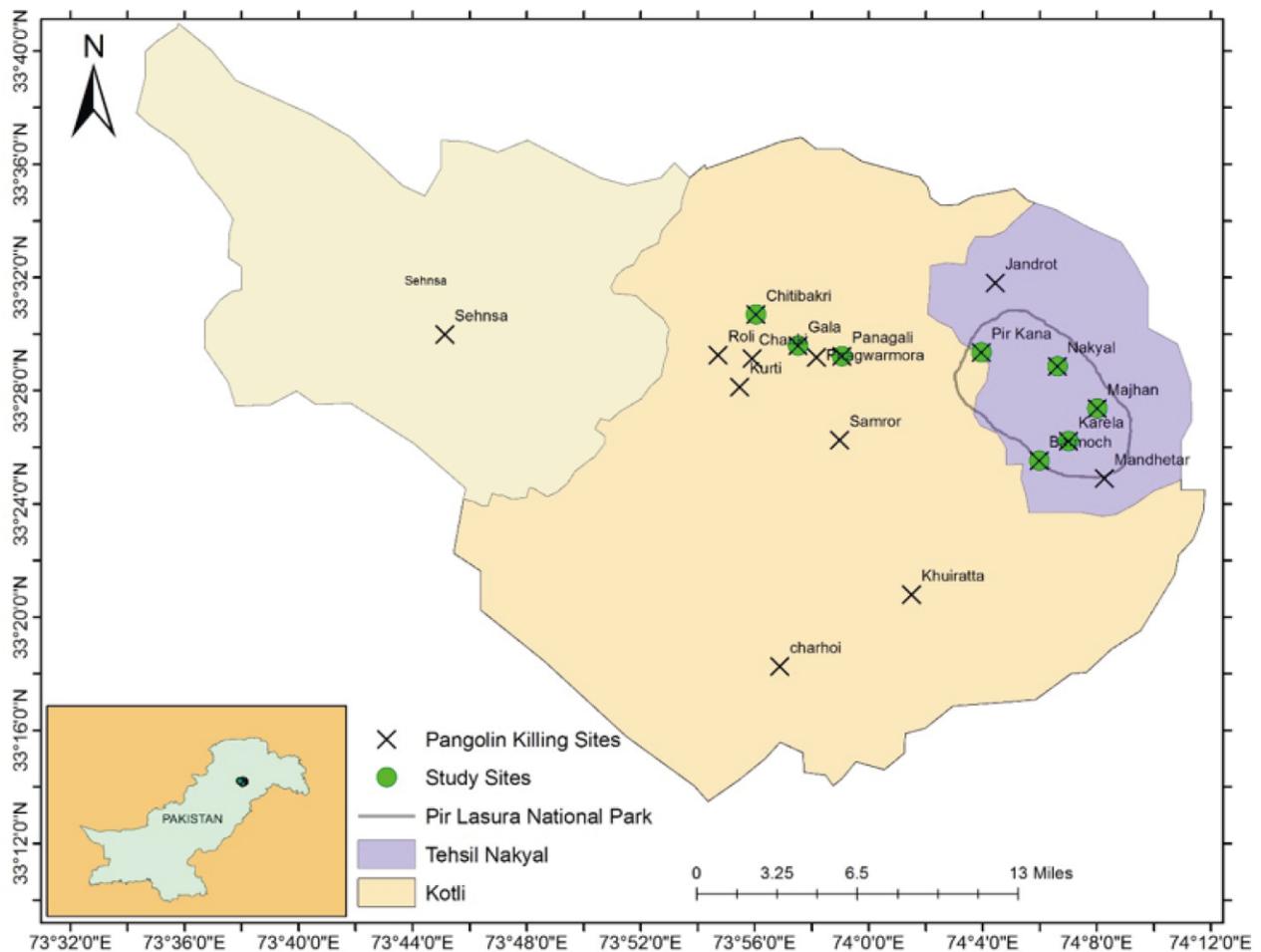


Figure 1. Locations of study sites and killing of Indian Pangolin *Manis crassicaudata*.

74°05.64–74°03.02'E. The park encompasses 1,580ha area with elevation ranging between 1000–2000 m (Fig. 1). The valleys of the park have subtropical pine forest vegetation, and the tops/mountains have subtropical dry evergreen forest pattern. It has been categorized as cold and humid forest with respect to its climate. The average annual rainfall is 1,500mm. Major wildlife species reported from the park include the common Leopard, Rhesus Macaque, Asiatic Jackal, Red Fox, Mongooses, Barking Deer, Indian Pangolin, Kaleej Pheasant, Koklas Pheasant and Cheer Pheasant (GoAJ&K 2014).

Study design

The duration of the current research study was one year from 2014–2015. The field surveys were conducted five days a month (06:00–23:00 hr) consecutively in and around PLNP (Image 1). Extensive surveys were conducted in the whole study area and all sites having signs of pangolin were selected for population



Image 1. Authors observing burrow of Indian Pangolin

estimation study.

Distribution

Distribution of the Indian Pangolin in the study

area was determined by conducting extensive surveys of different parts of the study area. The whole park was searched for direct and indirect signs of the Indian Pangolin (burrows, foot tracks, faecal material). The sites having occurrence of animal species were marked as positive and their geographical coordinates were recorded using the global positioning system (GPS) and the distribution map was developed using Quantum Geographical System (Q-GIS) software version 1.8.0, Lisboa.

Population

Sampling transects (each of 1km length and variable width) were established in different localities of the study area to estimate population using burrowing density method. Burrows of Indian Pangolin were distinguished as two different types, i.e., feeding and living burrows. Feeding burrows are less deep and are excavated during feeding on ants and termite nests; living burrows are deep and serve for living or resting. Living burrows can be further categorized into active and inactive burrows. The number of active living burrows recorded in transects were utilized for estimating the population of the species following Begon (1979). The number of pangolin individuals in each burrow was determined by establishing footprints outside of each burrow during the survey. For population estimation we used formula $D=n/A$; where n represents number of active living burrows and A stands for area sampled in each study site. We also conducted night surveys of transects with the help of searchlights to confirm presence of the Indian Pangolin at each study site.

Threats

Data on threats faced by the Indian Pangolin in and around PLNP were collected using close-ended questionnaires (n=268) and group discussions with local communities of the study area. We sampled our respondents using consecutive sampling method. The locals were taken into confidence before starting the questionnaire survey to avoid any bias. They were informed about the study objectives and were persuaded to cooperate by telling them that data would not be used against them. The main objective of the questionnaire survey was to explore different aspects of threats faced by the Indian Pangolin in the study area. We collected data on demographic and socio-economic characteristics of respondents, perception towards Indian Pangolin, pangolin encounter experiences, action taken when encountering the pangolin, the number of pangolins killed, the method of killing pangolins either by

humans or by dogs, reasons for killing pangolin, group of local involved in killing either farmers, hunters, nomads or any other group, local knowledge about population of Indian Pangolin either increased or decreased, tolerance of local community towards Indian Pangolin were tested by asking them if they want to conserve Indian Pangolin or not, data regarding their knowledge about the authority responsible for conserving Indian Pangolin and conservation status of species were also acquired.

Statistical Analysis

We used one sample t test to compare population of Indian Pangolin in different study sites. We used chi-square goodness-of-fit test to test perception of local people about Indian Pangolin either positive or negative, we repeated analysis for testing local myth that its scales bring good luck to livestock or not? Number of respondents who encountered Indian Pangolin versus who did not and action taken against Indian Pangolin, we compared data of different groups of local people including trained local hunters, farmers and labor involved in pangolin killing. We also repeated same analysis for local knowledge regarding increase or decrease in pangolin population in their surrounding during past few years and then knowledge of respondents regarding authority responsible for conservation of pangolin and its conservation status were tested. All analysis was performed using IBM SPSS STATISTICS version 23.

RESULTS

Distribution

We recorded distribution of Indian Pangolin up to 1,540m elevation and above this elevation no signs were recorded in any study site. The signs of Indian Pangolin were recorded from Kurti, Roli, Chitibakri, Chauki, Samror, Phagwarmora, Panagali, Kamroti, Gala, Barmoch, Mandetar, Karaila, Majhan, Pir Kana, Jandrot and Nakyal area (Fig. 1). We did not record signs of Indian Pangolin from Tarkundi, Palani, Pir Kalanger, Thruti and Lanjot areas.

Population estimates

The average estimated population of Indian Pangolin in nine different selected study sites was 0.77 ± 0.34 individuals/km². The highest population of Indian Pangolin was observed at Kamroti and Barmoch (3 individuals/km² each), and, the lowest population was observed at Panagali (0.33 individuals/km²). There was

Table 1. Population estimates of Indian Pangolin in and around Pir Lasura National Park, Azad Jammu & Kashmir, Pakistan during 2014–2015.

Study sites	Area surveyed (km ²)	No. of active burrows	Estimated population/km ²
Chitibakri	3	5	1.66
Panagali	3	1	0.33
Kamroti	2	6	3
Gala	1	2	2
Barmoch	1	3	3
Pir Kana	2	1	0.5
Karela	2	4	2
Majhan	2	2	1
Nakyal	2	1	0.5
Total	18	25	13.99
Mean±SE	2±0.23	2.77±0.61	0.77±0.34

statistically significant difference between populations of Indian Pangolin in different study sites ($t=7.066$, $df=27$, $p<0.001$) (Table 1).

Threats

We interviewed 268 respondents for collecting the data on threats to Indian Pangolin in and around PLNP. The respondents (71%; $n=191$) belonged to the main classes of rural livelihood which included; farmers, labor, shopkeepers, drivers, private jobs and government employees.

Killing record: Killing of Indian Pangolin due to wrong myths and for its scales was the biggest threat. Killing records of 446 pangolins were collected. We recovered 12 dead pangolins, 10 jackets of scales during our study (Images 2–4). Furthermore, selling of 26kg scales, 111 live pangolin captures and 313 killings were reported during 2013–2015 (Table 2).

Local perception: Local perception was very negative—86% respondents ($n=231$) thought that Indian Pangolin excavate graves and feed on human dead bodies and only 13.80% respondents ($n=37$) did not think so, and this difference was statistically significant ($X^2=140.43$, $df=1$, $p<0.001$). The majority of respondents did not like the pangolin and thought of it as a useless creature which only caused harm to local people. Majority of respondents (73%, $n=196$) reported that besides selling scales they also use scales of Indian Pangolin as necklace for their livestock as it brings good luck, and rest of the respondents (26.86%) considered it as a myth. This difference was also statistically significant ($X^2= 57.37$, $df=1$, $p<0.001$).

Pangolin encounter experience: Only 27% of



Images 2–3. Indian Pangolin killed by local community

respondents ($n=73$) had encountered the Indian Pangolin living in the field while the majority of them did not (72.76%, $n=195$) and it was statistically different ($X^2=55.53$, $df=1$, $p<0.001$). When encountered 70% of respondents ($n=188$) tried to kill Indian Pangolins, while the remaining 30% were afraid ($n=80$). This difference was statistically significant ($X^2= 43.52$, $df=1$, $p<0.001$).

Killing tools and groups involved: Locals killed pangolins by hitting them with bricks, stones, hammers, axe, pickaxe, by throwing into boiling water, and by burning. Local hunters (90%; $n=242$) were mainly involved in capturing and killing of Indian Pangolin who sell them to nomads (first purchasers) who later on sold the scales to bigger parties involved in the illegal trade of pangolins. Hunters were followed by local farmers 8% ($n=22$) and then laborers 1% ($n=4$). This difference was significant that hunters killed more pangolin than other groups ($X^2= 393.16$, $df=2$, $p<0.001$).

Local knowledge of population decline: Among the respondents 88% ($n=238$) thought that population of Indian Pangolin has decreased over the past three years due to massive capturing and killing and rest

Table 2. Massive illegal killing and capture record of Indian Pangolin *Manis crassicaudata* in district Kotli, Azad Jammu & Kashmir, Pakistan from 2013–2015.

Site/Location	# dead pangolin recovered	# jackets recovered	reported selling of scales (kg)	Reported live captures (n)	Reported killings (n)
Kurti	1	1	-	1	7
Roli	3	-	1.5	5	8
Chitibakri	2	1	-	1	3
Chauki	-	-	3.5	-	11
Samror	-	-	-	17	26
Phagwarmora	-	-	-	2	3
Panagali	-	-	-	-	1
Kamroti	1	-	1	-	2
Gala	-	-	-	3	4
Barmoch	-	-	-	-	7
Mandhetar	-	-	-	-	5
Karaila	-	-	-	-	4
Majhan	-	-	-	-	1
Pir Kana	-	-	1	-	2
Jandrot	-	-	-	-	3
Nakyal	-	-	-	-	1
Khuiratta	-	7	15	55	164
Sensa	5	1	3	6	27
Charhoi	-	-	1	21	34
Total (n=446)	12	10	26	111	313

**Image 4. Scales of Indian Pangolin recovered from locals in Pir Lasura National Park**

of respondents did not think so. It was statistically significant ($X^2=161.43$, $df=1$, $p<0.001$).

Conservation status: Majority of local community 93% ($n=251$) knew about authority responsible for conservation of wildlife in their surrounding and rest of them did not, this difference was also statistically significant ($X^2=204.31$, $df=1$, $p<0.001$). Only 5% ($n=14$)

knew about the conservation status of Indian Pangolin and (95%) had no idea about it and this difference was statistically significant ($X^2=214.92$, $df=1$, $p<0.001$).

DISCUSSION

The Indian Pangolin is listed as “Endangered” according to IUCN Red List of Threatened Species (Baillie et al. 2014). It is listed in Appendix-I of (Conventional on International Trade in Endangered Species). In Pakistan, this species is protected under the Islamabad Wildlife (Protection, Preservation, Conservation, and Management) Ordinance, 1979 (Schedule III) and the North-West Frontier Province Wildlife (Protection, Preservation, Conservation, and Management) Act, 1975. It is being hunted for its scales in Pakistan (Mahmood et al. 2012) and due to this reason its population is facing a sharp decline. Despite very low reproductive output it is being killed and traded in incredible numbers (Roberts 1997; Mitra 1998; Mishra et al. 2004, 2011; Challender 2011; Mohanty 2011; Gubbi & Linkie 2012; Mahmood et al. 2012, 2015b; Baillie et al. 2014; Challender et al. 2014). There is paucity of information available on

population trends of Asian pangolins. There is a lack of research on population densities and on local, national and global populations (WCMC et al. 1999, 2000). Therefore, it is vital to document the distribution and population throughout its range. The Indian Pangolin has remained neglected for a long time period, therefore, very little information on its distribution and population is available (Robert 1997; Baillie et al. 2014).

Pie (2008) reported that Indian Pangolin utilize various habitat types which include moist, dry, thorn and grasslands. Similarly, Roberts (1997) recorded that Indian Pangolin inhabits barren hilly regions, sub-tropical thorn habitat type and its distribution is restricted up to 762m, in foothills of district Rawalpindi, Pakistan. Irshad et al. (2015) reported distribution of Indian Pangolin at 523–942 m in district Chakwal, 221–690 m in district Jhelum, 312–573 m in district Attock, and 500–650 m in district Rawalpindi, Punjab, Pakistan. Distribution of Chinese Pangolin *Manis pentadactyla* in Nepal and Bhutan is restricted to 1,524m (Frick 1968; Mitchell 1975). Prater (1980) also reported that the Indian Pangolin is distributed in both plain and hilly areas. Mahmood et al. (2015a) recorded distribution of Indian Pangolin in Margallah Hills National Park up to elevations ranging from 462–1,046 m. In our study we recorded distribution of the Indian Pangolin in PLNP up to an elevation of 1,540m, which is highest reported distribution elevation range of Indian Pangolin in Pakistan. Hutton (1949) reported the occurrence of pangolin at an elevation of 2,300m in India. We did not find any sign of species above 1,540m.

The average estimated population of the Indian Pangolin in nine different selected study sites in and around PLNP was 0.77 ± 0.34 individuals/km². Irshad et al. (2015) reported a sharp decline in the population of Indian Pangolin in Pothwar region, Pakistan over a period of three years from 2010 to 2012. Mahmood et al. (2015a) recorded average population density of Indian Pangolin 0.36 individuals/km² in Margallah Hills National Park, Islamabad, Pakistan. Mahmood et al. (2014) reported average population density of Indian Pangolin as 1 individual/km² at seven selected study sites of district Chawal, Punjab, Pakistan. Generally, there exist few scientific studies, which have focused population data of any species of Asian pangolins. There are only a few reports regarding population of Chinese Pangolin *Manis pentadactyla*. These pangolins are rarely observed as they are secretive, solitary and nocturnal in habit. The data regarding population densities of pangolin is lacking globally (WCMC et al. 1999, 2000). Indian Pangolin was reported as common

in undisturbed hilly areas of Arunachal Pradesh, however very little is known about its population in India (Tikader 1983; Zoological Survey of India 1994). A few reports from Taiwan showed that its population was decreasing during 1980s and 1990s due to poaching and destruction of habitat (Chao 1989; Chao et al. 2005).

Mahmood et al. (2012) reported illegal massive killing of 118 Indian Pangolins during 2011–2012. Nomads and local hunters were involved in the killing pangolin with a selling price of US \$ 108–163 per animal. Indian Pangolin is hunted for its scales (Nowak 1991) and on average 1kg scales are obtained from one adult pangolin (Indian Wildlife Club Ezine 2004). Scales of Indian Pangolin are used in Chinese medicines (CITES 2000). In Bangladesh the Indian Pangolin is regularly captured for its scales and it has now disappeared from many parts due to illegal hunting (Khan 1985; 2000). In Pakistan the Indian Pangolin is protected under Islamabad Wildlife (protection, preservation, conservation and management) Ordinance, 1979 and North-west Frontier Province Wildlife (protection, preservation, conservation and management) Act, 1975 (Molur 2008). It is also protected according to AJK Wildlife Act (2014). Despite the regulation in its whole distribution range in Pakistan it is being killed by local hunters, farmers, nomads and labor either for its scales or due to myths.

CONCLUSION

Baseline ecological studies are vital for conservation and management of endangered species in areas where such data are lacking. In our study we have documented the distribution, population and threats faced by the Indian Pangolin in and around PLNP for the first time. This research is also important to national action planning as well as global action planning for conservation of pangolin. More studies on ecology of species in the study area should be conducted. There is need of educating local communities of Azad Jammu & Kashmir, Pakistan to turn their attitude from killing to conservation of Indian Pangolin.

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