Journal of Wildlife and Ecology (2024). 8(3):196-205

Review **Open Access**

Status of Indian Pangolin (*Manis crassicaudata*): the most trafficked mammal in Pakistan

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Citation: Muhammad, N., B. Saddam, N. Irshad, M. Altaf, M. Kabir, and M. S. H. Khan. 2024. Status of Indian Pangolin (*Manis crassicaudata*): the most trafficked mammal in Pakistan. Journal of WIldlife and Ecology. 8: 196-205.

SUMMARY

Out of eight extant species of pangolins, Pakistan has only one species known as Indian pangolin (*Manis crassicaudata*). This species is solitary, nocturnal, fossorial and insectivorous in nature. It is endemic in South Asia Region and recorded from different habitats like plains to middle hills, rainforests, grasslands, deserts, barren areas and mountains. This species prefers soft and semi-sandy soil for feeding and living burrows. They are usually seen near agricultural land and open area in hilly habitats. *M. crassicaudata* is hunted for flesh, scales, and skin; which is used for food, medicine and leather goods. Due to overexploitation, population of Indian pangolin is continuously decreasing day by day and facing high risk of extinction hence it is included in Red list category as; Endangered by IUCN. Indian Pangolin plays key ecological role and serve as biological control of many agricultural pest.

Keywords: Pakistan, Indian Pangolin, Status, Distribution

Received: 15-06-2024	**Revised**: 28-07-2024	**Accepted**: 29-08-2024

INTRODUCTION

Indian Pangolin (*M. crassicaudata*) belongs to class Mammalia, order Pholidota (scaled animal), family Manidae and eight extant species of pangolin are reported in the world. It is solitary, nocturnal, fossorial and insectivorous. It is toothless with long protrusive tongue. It has e 11 to 13 rows of overlapping horny large scales on their body. Tail is prehensile tail with terminal scales on its ventral side (Heath, 1995; Roberts, 1997).

Objectives of the study

The main objectives of the study is to know the present status, distribution and threats to Indian pangolin (*Manis crassicaudata*) in Pakistan.

MORPHOLOGY

The Indian pangolin (*M. crassicaudata*) has relatively small head, humped backed body and thick tapering tail with equal length of body. The top of the head, upper neck, trunk and limbs sides are covered with scales. Both ventral and dorsal surface of the tail are covered with overlapping pointed horny scales and which are made up of the keratin (Prater, 1965; Heath, 1995). These are olive-brown or dark yellowish in color. The scales have longitudinal striations on surface. Scales are very sharps on edges and have scattered reddish bristles intermingled between the scales. Female has one pair of teats (Roberts, 1997; Mohapatra and Panda, 2014; Irshad, 2015; Irshad et al., 2015; Mahmood et al., 2020).

They have external ear and muzzle tapers to a down-curving trunk like a snout. The external ear pinna consists of a thin crescent like vertical fold at uncovered skin and covered with short bristles. A very small mouth is present at vertical side of the muzzle and jaws cannot be opened wide. The tongue is long, cylindrical and narrow; it can protrude out 25.25 cm and is about 5 mm broad. The inside of all legs, with lower part of the face, throat along with belly is covered with soft uncovered pinkish-white skin with reddish-blond hairs. The hind legs are heavy and rather columnar with five blunt pinkish toe nails and are covered by a roughened black spongy pad-like elephant's foot. The inner sides of the hind legs are also covered with scales while inside of fore limbs are not very much protected. The fore feet are also shorter like hind feet and have five digits; the three middle ones have powerful elongate claws. The third digit has a claw measuring upto 50 mm and second and fourth digits have claws about 40 mm in length. The pangolins walk on knuckles of the fore feet along with huge claws bent backwards and pointing toward ground. The palms of fore feet are soft like that of hind feet. Male maximum size was noted as; 147 cm in length and maximum weight was as; 20 kg while female has maximum length as; 137 cm in length and maximum weight was as; 19.3 kg (Roberts, 1997; Irshad, 2015).

BIOLOGY

The Indian pangolins are specialized feeders and seem to be feed completely on termites and ants as well as on their eggs. Indian pangolins are not social in general; they live in single burrows; however social behavior is seen during reproductive season only. They are nocturnal and rest at daytime in the burrows. Sometime they come out from burrows for feeding at day time. They are very slow mover on land and can also climb up trees with the full force of tail and gripping firmly with their fore-limbs (Roberts, 1997; Mahmood et al., 2012a; Mohapatra and Panda, 2014; Irshad, 2015).

During the foraging, they completely depend upon their sense of smell and have less developed sense of hearing. They are very good excavator and find their prey by excavating the ants and termites nests. They dig the soil by powerful strokes of fore-feet which have firm claws and they excavate the soil on the basis of sense of smell. They push backward loose soil by their hind feet and feed the ants and termites with their thin, long and cylindrical protrusible tongue (Prater, 1965; Roberts, 1997; Mohapatra and Panda, 2014).

The tongue is largely lubricated with saliva so that insect adheres to it. During this process, a large amount of rotting wood may also be swallowed. Pangolin has special throat gland which lubricates the tong during feeding. The tongue has muscular roots which pass down through chest cavity and anchor at pelvis (Walker et al., 1975). Prater (1965)observed that tongue has sticky substance, while Underwood (1945) stated that his pet pangolin lick his finger, which is not sticky.

Pangolins usually excavate the dwelling burrows under large rocks or boulders when they are present inside, they seal up burrows entrance with loose soil so that burrows is difficult to identify. Burrows have depth 2.1m in arid soil, while 6 m in soft soil (Prater, 1965; Mahmood et al., 2013). The pangolins are inoffensive creature. They have only one defense system which consists of turn their head toward their belly and also curling up their scaly tail so that all parts are protected by scales, it is nearly impossible to uncurl by the other animals. Because they are slow mover, the roads accidents of these animals are commonly observed (Roberts, 1997; Mahmood et al., 2013; Mohapatra and Panda, 2014; Akrim et al., 2017).

NOMENCLATURE

Indian pangolin also called scaly anteater and thick-tailed pangolin and it belongs to family Manidae and genus *Minus given* by Linnaeus, 1758; while scientific name is *Manis crassicaudatus* given by Geoffroy, 1803 (Roberts, 1997; Mahmood et al., 2019b). In Pakistan, it is known as *Salla, Sipple and Sippa*.

STATUS

The Indian pangolin was uncommon in Sri Lanka (Perera et al., 2017), vulnerable in India (Mishra and Panda, 2012), rare in Bangladesh (Heath, 1995; Trageser et al., 2017), also relatively uncommon in Pakistan (Irshad et al., 2015; Akrim et al., 2017; Iftkhar et al., 2018; Mahmood et al., 2019a; Mahmood et al., 2019b; Mahmood et al., 2020; Mahmood et al., 2021)and its status are unknown in Nepal (Gurung, 1996; Suwal et al., 2020). This species has globally threats and was earlier included in the Near threatened (NT) category of the IUCN Red list (Baillie and Groombridge, 1996). Now this species is included in the Endangered IUCN Red list category (Baillie et al., 2014) and high risk of extinction (Mahmood et al., 2019a; Mahmood et al., 2020; Mahmood et al., 2021). It is listed on Appendix-I of the Convention on International Species of Wild Fauna and Flora (CITES) which includes those species which are threatened due to their international trade.

DISTRIBUTION

Global distribution

M. Sindiensis Lydekker (1876), a fossil ancestor of the *M. crassicaudata*, was discovered in Manchar Lake in the Dadu area (Colbert). Its range is from Pakistan to Nepal, east to West Bengal in India and Yunnan in southwest China, south to Sri Lanka, and north to Nepal (Roberts and Vielliard, 1971). Domestic and international demand for live pangolins, as well as their skin, scales, and meat, is putting their numbers in danger across their range. Indian pangolins are vulnerable to overexploitation due to their nature, which includes a low reproduction rate and a vast

distribution (Mishra and Panda, 2012). This species is endemic in South Asia, parts of Pakistan, India, Bangladesh, Southern Nepal and Sri Lanka (Mahmood et al., 2019b), historical records of Indian pangolin in southwest China (Heath, 1995) and unsure records in Myanmar (Mahmood et al., 2019a; Mahmood et al., 2019b).

Regional distribution

From India, Indian pangolins are recorded from the plains areas as well as in Himalayan hilly areas (Tikader, 1983; Iftkhar et al., 2018; Waseem et al., 2020). They are also recorded from Madhya Pradesh, Nadu, Delhi, Karnataka, Rajasthan, Orissa, Goa, Gujarat, Kotgarh and Sunabedh Plateau (Mishra and Panda, 2012). Srinivasulu and Srinivasulu (2012) recorded this species from Chhattisgarh, Jharkhand, Andhara Pradesh, Bihar, Uttarakhand and Maharashtra. From Nepal, these animals are recorded historically from southern and western Nepal (Baral and Shah, 2008), also recorded from Suklaphanta Wildlife Reserve in the west (Baral, 2013) and Bardia National Park, Parsa Wildlife Reserve, Chitwan National Park and Banke National Park. From Bangladesh, Indian pangolins are recorded historically throughout the country excluding marine wetlands (Heath, 1995). From Sri Lanka, Indian pangolins are recorded from the whole country (Perera and Karawita, 2020).

From Pakistan (Figure 1), Indian pangolin is recorded from Sialkot, Jhelum and Gujrat Districts, from the northwest of the Punjab, from the Salt Range along with Kohat Districts, from Attock District to Mardan and Peshawar (Roberts, 1997; Iftkhar et al., 2018; Mahmood et al., 2019b) and also recorded from Nowshera and Swabi (Mahmood et al., 2020). It also recorded from Potohar Range to the Himalayan foothills. This species is also observed from the districts of Mirpur, Kotli and Bhimber (AJK) (Waseem et al., 2020). Further south, these are records from the Indus River floodplain and also from Bhakar and Jhang districts (Mahmood et al., 2019b), and records from the western part of the Dadu and Larkana, Las Bela and Mekran. It also recorded from Hyderabad, Tharparkar and Kutch areas (Roberts, 1997).

HABITAT

This species has been recorded from different habitats like plains to middle hills, rainforest, grasslands, deserts, barren areas and mountains (upto 2300 meters elevation). Indian pangolins prefer soft and semi-sandy soil because it is easy for digging their burrows (Iftkhar et al., 2018; Karawita et al., 2018). Burrows of pangolin are classified into two types: feeding burrows and dwelling burrows. Feeding burrows are often smaller than living burrows. Living burrows are deeper, larger, and circular, and they are occupied for a longer period of time than feeding burrows since they are used to sleep and rest during the day. After a short period, the pangolins abandoned the tunnel and dug a new one near a food source. However, pangolins frequently return to previous burrows (Mahmood et al., 2013; Mahmood et al., 2020). Pangolins prefer to dig burrows near herbs, bushes, and trees because it is easier to dig burrows near these habitats. The qualities that increase the population of ants and termites (such as grasses, tree bases, bare ground, shrubs, roots, fallen logs, leaf litter, and elephant excrement) are typically present near pangolin habitats (Mahmood et al., 2013; Mahmood et al., 2014).

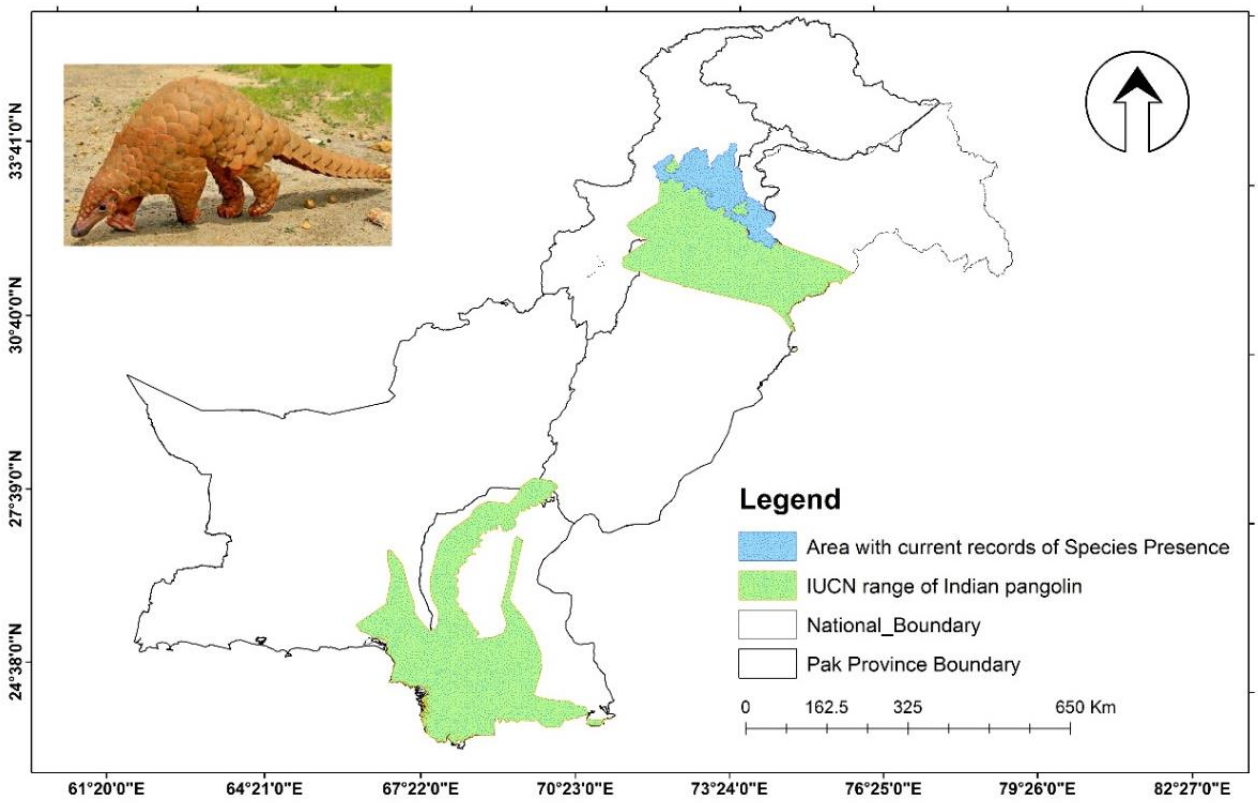

Figure 1: Map of the recent distribution of Indian Pangolin in World.

BEHAVIOR

M. crassicaudata is a solitary, nocturnal, terrestrial species. They may be more arboreal in settings, using their claws and prehensile tails as supports to re-adjust forelegs as they climb. Indian pangolins dig burrows in the ground at depths ranging from 1.5 m to 6 m; these burrows can be found beneath boulders. They have two types of burrows: temporary and permanent. Temporary burrows are used for foraging, while permanent burrows are used for habitation. During danger, they roll up like a ball; scales protect them from the predators and move toward the burrows. These are not often observed from the wild because they are nocturnal and solitary in nature. A voice of a hissing has been recorded when *M. crassicaudata* is frightened or angry. They have anal glands which produce strong and musky-smell with yellow fluid, used it for scent marking (Mahmood et al., 2013; Mohapatra and Panda, 2014).

Indian pangolin spend more time inside burrows during winter than summer and rainy season, they prefer corner area during sleeping, and remain open their eyes during rest. When they come out from burrows then they show anterior half body and sniffing behavior. They are climber and climb tree in search of ants and termites. They use fore-limb to grip the tree and stand up on the hind limb with the help of tail. They spread urine on tree trunks and soil; this is for marking of territory (Roberts, 1997; Mahmood et al., 2013; Mohapatra and Panda, 2014; Mahmood et al., 2019a).

During reproductive behavior; Indian pangolin traces the female and move toward the opposite sex. Male chase and mount female and start copulation, after retreat they coil themselves into a ball on substrate. Indian pangolin usually gives

birth to one or two young ones, which are attached on the dorsal side of the female. Females take care of their young ones; and sniffing behavior is also noted when young ones are moved away from the mother. Aggressive behavior observed that males injured the other male pangolin which leads to death. This injury was due to fore-limbs claw. For defense, Indian pangolin curls like armored ball and shows an enormous muscular power; nobody can uncoil them. They rotate their body and push hind-limb to escape when they captured from the tail (Roberts, 1997; Mohapatra and Panda, 2014; Mahmood et al., 2019b).

ECOLOGY

Indian pangolins occur in various types of tropical forests, grasslands, open land, degraded habitat, and near to villages. Indian pangolin adapt to modified habitats. They are usually seen near *Eucalyptus* species, cultivated fields, *Capparis decidua*, *Ziziphus nummularia*, *Cyprus rotundus*, *Tribulus terristris*, *Chenopodium alleum*, *Acacia nilotica*, *Prosopis cineraria*, *Lantana camara* and *Avera javanica*; and also recorded that feeding habitats of Indian pangolin may include bare grounds, grasses, shrubs, roots, bases of trees, fallen logs and leaf litter while this species has arboreal adaptation in few habitats (Mahmood et al., 2014; Pabasara et al., 2015; Karawita et al., 2018).

FEEDING HABITS

The Indian pangolins are fully insectivorous and myrmecophage-like mammals (ant or termite specialist). Diet of this species includes cockroaches, termites, beetles, and worms, but ants and termites are its primary food source. It consumes the eggs, larvae, and adults of its prey, but prefers ant and termite eggs. Indian Pangolins use stones, sand, plant matter and clay for the better performance of the stomach. They are nocturnal and use sense of smell to locate ants and its nests and termite mounds. They usually forage at night at ground areas; they use claws to search food. During feeding, the pangolin's tongue is quickly entered and withdrawn to capture prey and same movement is also seen for drinking water (Mishra and Panda, 2010; Mahmood et al., 2013; Irshad, 2015; Irshad et al., 2015).

BREEDING

The males of the Indian pangolin are heavier than their female (Payne and Francis 1998). They reach sexual maturity at the age of 2 years. Their gestation period is 70 to 80 days; they usually breed from July to October, and produce one to two offspring at a time. The now born have 45 cm length, 1 lb weight and soft body scales (Mohapatra and Panda, 2014; Hua et al., 2015; Mahmood et al., 2016; Mahmood et al., 2019b).

ANTHROPOGENIC IMPACTS

Although Indian pangolins are protected in many in Asian countries throughout its range, but they are hunted (Table 1 and 2) for whole body (Vijayakumar et al., 2015), bile (Dixit et al., 2010), meat (Vijayakumar et al., 2015; Altaf et al., 2017), scales (Kulkarni and Adwait, 2011; Bagde and Jain, 2013; Betlu, 2013; Altaf et al., 2017; Altaf et al., 2018; Iftkhar et al., 2018; Khan et al., 2020) and skin (Khan et al., 2020).

These parts are used for food, medicine (Iftkhar et al., 2018) and leather goods (Mahmood et al., 2012b). Illegal demand of Indian pangolin's parts has increased since 1990s (Mahmood et al., 2014); in 1996 Indian pangolin was sold at 100 US dollar/kg later its price increased, and now it is sold at 130 US dollar/kg (Chinlampianga et al., 2013). Due to overexploitation, population of the Indian pangolin has decreased day by day (Mahmood et al., 2019b; Perera and Karawita, 2020).

Table 1: Medicinal uses of parts of Indian Pangolin in different countries.

Body Parts	Medicinal uses	References
Whole body	Blood pressure, Asthma	(Vijayakumar et al., 2015)
Bile	Swelling and inflammation	(Dixit et al., 2010)
Meat	Feet swelling, Sexual power, Nerves tension, Wheezing trouble	(Vijayakumar et al., 2015; Altaf et al., 2017)
Scales	Feet swelling, Sexual power, back pain, armpit boils, to remove hook worm	(Kulkarni and Adwait, 2011; Bagde and Jain, 2013; Betlu, 2013; Altaf et al., 2017; Altaf et al., 2018; Iftkhar et al., 2018; Khan et al., 2020)

Table 2: Indian Pangolin Trade and seizures in Pakistan.

Year	Seizures	References
2018	On 26th October, 2018 Sindh Wildlife Department Seized 200 Kg of pangolin scales in a raid in Karachi.	(Guriro, 2018)
2014	145Kg scales of Pangolin were seized from Benazir "Bhutto International Airport, Islamabad".	(CUSTOMS, 2014)
2014	April, 2014, Recent Seizure Highlights Pangolin Trafficking from Pakistan to China.	(Annamiticus, 2014)
	More than 118 specimens in Chakwal, 24 specimens in Rawalpindi were seized in Attock district in 2013.	(Mahmood et al., 2019a)
2012	More than 47 specimens in Jhelum, 7 specimens in Chakwal, 2 specimens in Rawalpindi, 115 specimens were seized inAttock district, and 24 kg scales were also seized in 2012.	(Mahmood et al., 2012b; Mahmood et al., 2019a)
2011	More than 12 individuals were captured in district Jhelum, 15 in Chakwal district, 2 individuals from Rawalpindi in 2011.	(Mahmood et al., 2012b; Mahmood et al., 2019a)

ZOONOTIC DISEASES AND COVID-19

The "severe acute respiratory syndrome Coronavirus 2" (SARSCoV-2) phylogenetic analysis is based on a single isolate of bat Coronaviruses (bat CoVs), which does not sufficiently represent genetically related Coronaviruses. RaTG13, a unique bat Coronavirus, is the only sequence genetically linked to SARS-CoV-2. The scarcity of bat coronavirus sequences raises concerns about various key experimental and biostatistician features, such as sequence repeatability and intra-species differences in

crucial gene areas, such as the spike protein's receptor-binding domain. Although the Sunda pangolin has been considered as an intermediate host and source of "SARS-CoV-2," no pangolin coronavirus samples have been discovered. The majority of pangolin coronaviruses were isolated from pangolins arrested during illegal animal trafficking, raising concerns about the trustworthiness and quality of such isolates. Problems with pangolin coronavirus sampling are also linked to poor quality deposited sequences. Field investigations of bat coronaviruses and possible intermediate hosts, such as pangolins, ferrets, and civets, are urgently needed in Southeast Asia to examine the genetic origins of SARS-CoV-2 and estimate potential future hazards for fresh outbreaks (Altaf, 2020; Zhang et al., 2020; Adil, 2021; Bilal et al., 2021; Seyran et al., 2021).

CONCLUSIONS AND RECOMMENDATIONS

Population of Indian pangolin is continuously decreasing day by day and facing high risk of extinction. They are extremely useful for the healthy ecosystem and act as biological control for agricultural pests, because they eat termites and other insects. They are hunted for the skin, scales and flesh because the parts are important and valuable and used in making products (Mahmood et al., 2014; Mohapatra et al., 2015), medicines (Kulkarni and Adwait, 2011; Bagde and Jain, 2013; Betlu, 2013; Altaf et al., 2017; Altaf et al., 2018; Iftkhar et al., 2018; Khan et al., 2020) and food (Chinlampianga et al., 2013). The parts of this species are used as national and international trade (Mahmood et al., 2013; Mahmood et al., 2019b).

Reference

Adil, S. 2021. Animals use to enhance immunity during a COVID-19 Pandemic-a mini review. Journal of Wildlife and Ecology. 5: 100-103.

Akrim, F., T. Mahmood, R. Hussain, and S. Qasim. 2017. 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. Journal of Threatened Taxa. 9: 9920-9927.

Altaf, M. 2020. Wild animals as source of Zoonotic diseases-a review. Journal of Wildlife and Ecology. 4: 71-84.

Altaf, M., A. Javid, M. Umair, K. J. Iqbal, Z. Rasheed, and A. M. Abbasi. 2017. Ethnomedicinal and cultural practices of mammals and birds in the vicinity of river Chenab, Punjab-Pakistan. Journal of ethnobiology and ethnomedicine. 13: 41.

Altaf, M., M. Umair, A. R. Abbasi, N. Muhammad, and A. M. Abbasi. 2018. Ethnomedicinal applications of animal species by the local communities of Punjab, Pakistan. Journal of ethnobiology and ethnomedicine. 14: 55.

Annamiticus. 2014. Recent Seizure Highlights Pangolin Trafficking from Pakistan to China.

Bagde, N., and S. Jain. 2013. An ethnozoological studies and medicinal values of vertebrate origin in the adjoining areas of Pench National Park of Chhindwara District of Madhya Pradesh, India. Ind Int J Life Sci. 1: 278-283.

Baillie, J., D. Challender, P. Kaspal, A. Khatiwada, R. Mohapatra, and H. Nash. 2014. *Manis crassicaudata*, International Union for Conservation of Nature.

Baillie, J., and B. Groombridge. 1996. IUCN Red List of Threatened Animals, IUCN, gland, Switzerland, Washngton DC.

Baral, H. S., and K. Shah. 2008. Wild mammals of Nepal. Himalayan Nature.

Betlu, A. L. S. 2013. Indigenous knowledge of zootherapeutic use among the Biate tribe of Dima Hasao District, Assam, Northeastern India. Journal of ethnobiology and ethnomedicine. 9: 1-16.

Bilal, A., M. K. Ullah, M. S. Khan, A. Fatima, K. Iqbal, S. S. Abbasi, A. Hafeez, S. Hussain, and I. Nazar. 2021. Impacts of covid-19 pandemic on wildlife-mini review Journal of Wildlife and Ecology. 5: 135-138.

Chinlampianga, M., R. K. Singh, and A. C. Shukla. 2013. Ethnozoological diversity of Northeast India: Empirical learning with traditional knowledge holders of Mizoram and Arunachal Pradesh. Indian J. Tradit. Knowl. 12: 18-30.

CUSTOMS. 2014. Customs held 2 Chinese smuggling Pangolin scales. http://www.customstoday.com.pk/customs-held-2-chinese-smuggling-pangolin-scales/.

Dixit, A., K. Kadavul, S. Rajalakshmi, and M. Shekhawat. 2010. Ethno-medico-biological studies of South India. Indian Journal of Traditional Knowledge. 9: 116-118.

Guriro, A. 2018. Sindh Wildlife Dept recovers pangolin and turtle remains from a shop in Lyari Daily Time. Daily Time, Pakistan.

Gurung, J. B. 1996. A pangolin survey in Royal Nagarjung Forest in Kathmandu, Nepal. Tigerpaper. 23: 29-32.

Heath, M. E. 1995. *Manis crassicaudata*," Mammalian Species.

Hua, L., S. Gong, F. Wang, W. Li, Y. Ge, X. Li, and F. Hou. 2015. Captive breeding of pangolins: current status, problems and future prospects. ZooKeys. 99.

Iftkhar, A., M. Umair, A. R. Abbasi, S. Ashraf, S. M. Bashir, S. Afsheen, H. Aslam, S. Ijaz, and S. Adil. 2018. Status and cultural uses of Indian Pangolin (*Manis crassicaudata*) in selected sites of Pakistan. Journal of Wildlife and Ecology. 2: 23-30.

Irshad, N. 2015. Population, distribution and food habits of Indian pangolin (*Manis crassicaudata*) in Potohar Plateau, Pir Mehr Ali Shah Arid Agriculture University Rawalpindi Pakistan.

Irshad, N., T. Mahmood, R. Hussain, and M. S. Nadeem. 2015. Distribution, abundance and diet of the Indian Pangolin (*Manis crassicaudata*). Animal Biology. 65: 57-71.

Karawita, H., P. Perera, P. Gunawardane, and N. Dayawansa. 2018. Habitat preference and den characterization of Indian Pangolin (*Manis crassicaudata*) in a tropical lowland forested landscape of southwest Sri Lanka. PloS one. 13: e0206082.

Khan, M. S. H., S. Ullah, M. H. Hamed, and M. Altaf. 2020. A study of illegal wildlife trade and seizures in Pakistan. Journal of Wildlife and Ecology. 4: 193-210.

Kulkarni, B., and D. Adwait. 2011. Folk therapies of Katkaries from maharashtra. Indian Journal of Traditional Knowledge. 10: 554-558.

Mahmood, T., F. Akrim, N. Irshad, R. Hussain, H. Fatima, S. Andleeb, and A. Aihetasham. 2019a. Distribution and illegal killing of the Endangered Indian pangolin *Manis crassicaudata* on the Potohar Plateau, Pakistan. Oryx. 53: 159-164.

Mahmood, T., S. Andleeb, and F. Akrim. 2021. Habitat preference of the Indian Pangolin *Manis crassicaudata* inhabiting Margalla Hills National Park, Islamabad, Pakistan. Journal of Threatened Taxa. 13: 18148-18155.

Mahmood, T., D. Challender, A. Khatiwada, S. Andleeb, P. Perera, S. Trageser, A. Ghose, and R. Mohapatra. 2019b. *Manis crassicaudata*, IUCN.

Mahmood, T., R. Hussain, N. Irshad, F. Akrim, and M. S. Nadeem. 2012a. Illegal mass killing of Indian pangolin (*Manis crassicaudata*) in Potohar region, Pakistan. Pakistan J. Zool. 44: 1457-1461.

Mahmood, T., R. Hussain, N. Irshad, F. Akrim, and M. S. Nadeem. 2012b. Illegal mass killing of Indian pangolin (*Manis crassicaudata*) in Potohar region, Pakistan. Pakistan Journal of Zoology. 44: 1457-1461.

Mahmood, T., N. Irshad, and R. Hussain. 2014. Habitat preference and population estimates of Indian pangolin (*Manis crassicaudata*) in District Chakwal of Potohar Plateau, Pakistan. Russian journal of ecology. 45: 70-75.

Mahmood, T., N. Irshad, R. Hussain, F. Akrim, I. Hussain, M. Anwar, M. Rais, and M. S. Nadeem. 2016. Breeding habits of the Indian pangolin (*Manis crassicaudata*) in Potohar Plateau, Pakistan. Mammalia. 80: 231-234.

Mahmood, T., K. Jabeen, I. Hussain, and A. R. Kayani. 2013. Plant species association, burrow characteristics and the diet of the Indian pangolin, *Manis crassicaudata*, in the Potohar Plateau, Pakistan. Pakistan Journal of Zoology. 45.

Mahmood, T., R. K. Mohapatra, P. Perera, N. Irshad, F. Akrim, S. Andleeb, M. Waseem, S. Sharma, and S. Panda. 2020. Indian Pangolin Manis crassicaudata (Geoffroy, 1803) Pangolins. p 71-88. Elsevier.

Mishra, S., and S. Panda. 2010. Nocturnal behaviour of Indian pangolin (*Manis crassicaudata*) in captivity. Indian Zoo Year Book. 6: 128-136.

Mishra, S., and S. Panda. 2012. Distribution of Indian pangolin *Manis crassicaudata* Gray (Pholidota, Manidae) in Orissa: a rescue prospective. Small Mammal Mail. 3.

Mohapatra, R. K., and S. Panda. 2014. Husbandry, behaviour and conservation breeding of Indian pangolin. Journal of Vertebrate Biology. 63: 73-80.

Mohapatra, R. K., S. Panda, L. Acharjyo, M. Nair, and D. W. Challender. 2015. A note on the illegal trade and use of pangolin body parts in India. TRAFFIC Bull. 27: 33-40.

Pabasara, M., P. Perera, and N. Dayawansa. 2015. A Preliminary investigation of the habitat selection of Indian Pangolin (*Manis crassicaudata*) in a Tropical lowland forest in south-west Sri Lanka. In: Proceedings of International Forestry and Environment Symposium

Perera, P., and H. Karawita. 2020. An update of distribution, habitats and conservation status of the Indian pangolin (*Manis crassicaudata*) in Sri Lanka. Global Ecology and Conservation. 21: e00799.

Perera, P., K. Karawita, and M. Pabasara. 2017. Pangolins *Manis crassicaudata* in Sri Lanka A Review of Current Knowledge Threats and Research Priorities.

Prater, S. 1965. The book of Indian animals. Bombay Nat. Hist. Soc. and Prince of Wales Mus. of Western India.

Roberts, T., and J. Vielliard. 1971. Commentaires sur le grand pangolin indien *Manis crassicaudata*.

Roberts, T. J. 1997. The Mammals of Pakistan. Oxford University Press, New Yark.

Seyran, M., S. Hassan, V. N. Uversky, P. Pal Choudhury, B. D. Uhal, K. Lundstrom, D. Attrish, N. Rezaei, A. A. Aljabali, and S. Ghosh. 2021. Urgent need for field surveys of coronaviruses in southeast asia to understand the sars-cov-2 phylogeny and risk assessment for future outbreaks. Multidisciplinary Digital Publishing Institute.

Srinivasulu, C., and B. Srinivasulu. 2012. South Asian mammals: their diversity, distribution, and status. Springer Science & Business Media.

Suwal, T. L., A. Thapa, S. Gurung, P. C. Aryal, H. Basnet, K. Basnet, K. B. Shah, S. Thapa, S. Koirala, and S. Dahal. 2020. Predicting the potential distribution and habitat variables associated with pangolins in Nepal. Global Ecology and Conservation. 23: e01049.

Tikader, B. K. 1983. Threatened animals of India. Threatened animals of India.

Trageser, S. J., A. Ghose, M. Faisal, P. Mro, P. Mro, and S. C. Rahman. 2017. Pangolin distribution and conservation status in Bangladesh. PLoS One. 12: e0175450.

Underwood, G. 1945. A note on the Indian Pangolin (*Manis crassicaudata*). JBNHS.

Vijayakumar, S., S. Prabhu, J. M. Yabesh, and R. Prakashraj. 2015. A quantitative ethnozoological study of traditionally used animals in Pachamalai hills of Tamil Nadu, India. Journal of ethnopharmacology.

Walker, E. P., F. Warnick, S. E. Hamlet, K. I. Lange, M. A. Davis, H. E. Uible, P. F. Wright, and J. Paradiso. 1975. Mammals of the world. Volumes I and II. Johns Hopkins University Press.

Waseem, M., B. Khan, T. Mahmood, H. S. Hussain, R. Aziz, F. Akrim, T. Ahmad, R. Nazir, M. W. Ali, and M. N. Awan. 2020. Occupancy, habitat suitability and habitat preference of endangered indian pangolin (*Manis crassicaudata*) in Potohar Plateau and Azad Jammu and Kashmir, Pakistan. Global Ecology and Conservation. 23: e01135.

Zhang, T., Q. Wu, and Z. Zhang. 2020. Probable pangolin origin of SARS-CoV-2 associated with the COVID-19 outbreak. Current biology. 30: 1346-1351. e1342.

Competing interests: Authors have declared that no competing interests exist.
Funding: Authors have no source of funding for this work.
Authors' contributions: Muhammad, Saddam, Altaf have designed this project, collected data and written this article; while all authors have critically analyzed this article and approved as final.