





Assessing the conservation status of and challenges facing Asiatic black bears and Malayan sun bears in Bangladesh

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Abstract South of 25°N, the rugged, riparian, mixed evergreen forests of eastern Bangladesh mark the western edge of the ranges of the globally Vulnerable Asiatic black bear *Ursus thibetanus* and sun bear *Helarctos malayanus*. According to the IUCN Red List, the distribution of bears in Bangladesh is unclear: black bears are described as ‘scattered’ and ‘likely to be very low in number’ and sun bears as ‘vagrants’ entering from the adjoining north-east Indian forests. These statements are not based on any population or habitat assessments, impeding focused research and conservation investment. We compiled recent evidence of bear presence in Bangladesh based on camera trapping, literature reviews and analysis of media reports. From peer-reviewed and grey literature published during 2010–2022 we traced 43 verifiable accounts of black bears in the country. Our camera-trap survey in Rajkandi Reserve Forest produced the first ever evidence of a small population of black bears in north-eastern Bangladesh. Two field studies (in 2016 and 2021) reported camera-trap observations and multiple incidents of poaching of sun bears in Kassalong Reserve Forest and Sangu-Matamuhuri Reserve Forest in south-eastern Bangladesh. Media reports on conflict incidents presented 83 human casualties (80 injured, three dead) and 13 bear casualties (six dead, seven rescued) during 2003–2023. The incidents peaked in the summer (17); 79% were reported during 2018–2023. Cognizant of the fact that the absence of evidence is not evidence of absence, our study calls for systematic conservation measures for both of these bear species in unprotected hill forests in eastern Bangladesh.

Keywords Asiatic black bear, Bangladesh, bear conservation, camera trap, *Helarctos malayanus*, human–bear conflict, sun bear, *Ursus thibetanus*

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Introduction

Bangladesh has two extant species of bears: the Tibetan black bear *Ursus thibetanus thibetanus* (a subspecies of the Asiatic black bear *Ursus thibetanus*) and the Malayan sun bear *Helarctos malayanus malayanus* (a subspecies of the sun bear *Helarctos malayanus*; Alam, 2015a; Naher, 2015). In the most recent regional assessment of the IUCN, the sloth bear *Melursus ursinus* was assessed as locally extirpated in Bangladesh, which has been linked to the disappearance of the wet deciduous forests of northern and central Bangladesh that were rich in termite mounds and formed the primary habitat of this myrmecophagous species in the country (Alam, 2015b). The shal *Shorea robusta*-dominated wet deciduous forests that once sprawled across the northern and central floodplains of Bangladesh have been decimated over the last 5 decades through deforestation, illegal encroachment and felling of primary stands. The remnant patches, consisting mostly of secondary growths, are now the most degraded and fragmented forest type in the country (Khan, 2018). Furthermore, across the international border in India, the sloth bear does not occur in Tripura and Mizoram, and its presence is uncertain in Meghalaya (Dharaiya et al., 2020; Garshelis et al., 2022a). This localized extinction of sloth bears was predicted in various studies (Garshelis et al., 1999; Ahmed et al., 2009; Islam et al., 2013).

The Asiatic black bear and the sun bear are categorized as Vulnerable globally (Scotson et al., 2017; Garshelis & Steinmetz, 2020) and as Critically Endangered in Bangladesh (Naher, 2015; Alam, 2015a). The riparian, hilly, mixed evergreen forests of eastern Bangladesh are their last refuges in the country (Fig. 1a,b; Islam et al., 2013; Alam, 2015a; Naher, 2015; Khan, 2018). Despite the threats such as habitat loss and the conflict that the bears are facing in Bangladesh, there has been a lack of pertinent research and conservation investment. To our knowledge (Akash & Zakir, 2020), there is only one peer-reviewed study (Islam et al., 2013) that has assessed the status of bears in Bangladesh. That study was the outcome of a project

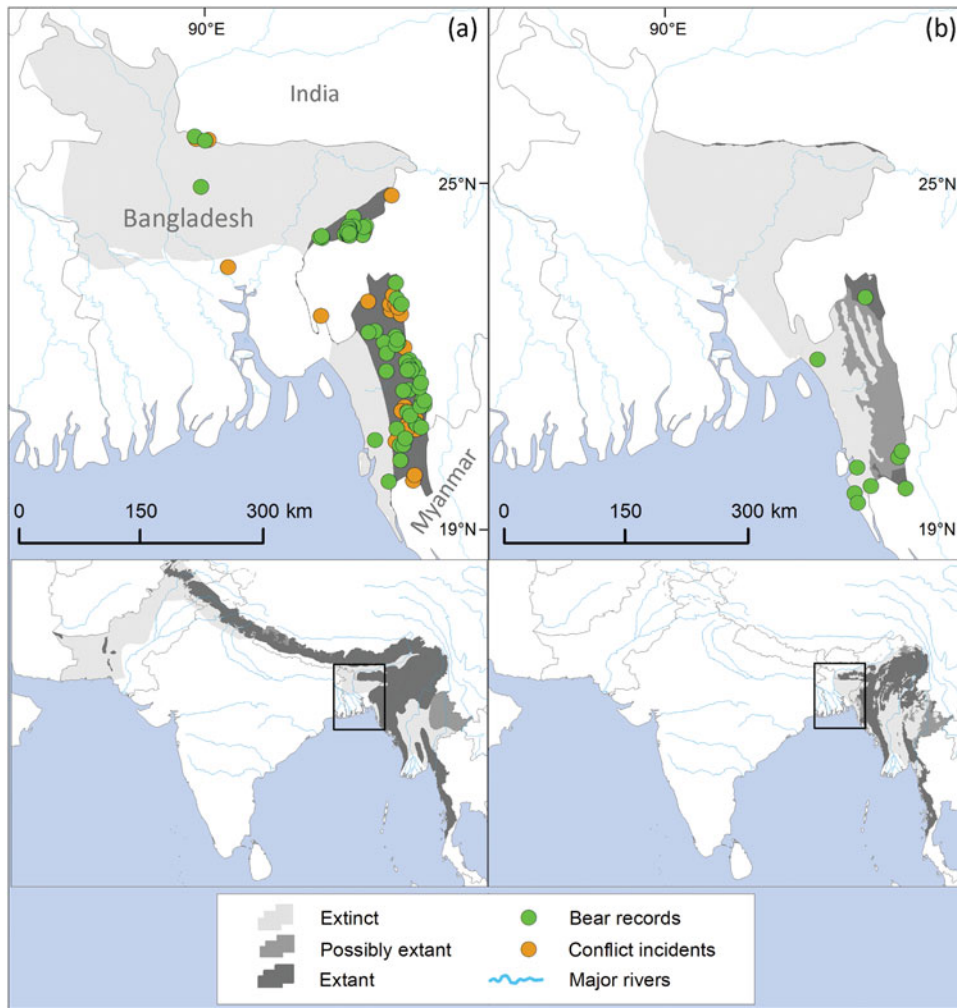


FIG. 1 Distribution range and evidence of bears in Bangladesh: (a) Tibetan black bear *Ursus thibetanus thibetanus*, (b) Malayan sun bear *Helarctos malayanus malayanus*. Distribution maps for both the Indian subcontinent and Bangladesh were adapted from Scotson et al. (2017) and Garshelis & Steinmetz (2020), respectively. Bear records were compiled from Islam et al. (2013), Sarkar (2016), Chakma (2016), Creative Conservation Alliance (2016) and this study. Conflict incidents were compiled from media reports (Table 1).

(Islam et al., 2010) that investigated the status of bears in Bangladesh during 2008–2010 using semi-structured interviews and sign survey methods. Islam et al. (2013) remarked that black bears were ‘scattered’ and ‘likely to be very low in number’. Because of the lack of verifiable evidence of sun bears, this species was reported as ‘vagrant’ and moving into trans-border forests from India.

As it has been more than a decade since this first country-wide survey, the distribution and conservation status of bears in Bangladesh warrants an update. There has been a steady increase in media reports of human–bear conflicts in recent years, which Islam et al. (2013) reported to be an uncommon issue. Garshelis et al. (2022a) reported the Asiatic black bear to be ‘fairly widespread’ in Bangladesh, in contrast to the findings of Islam et al. (2013). There have been several recent camera-trap records of sun bears from south-eastern Bangladesh (e.g. Creative Conservation Alliance, 2016). In addition, Sarker (2016) highlighted multiple sun bear localities in the country.

The absence of adequate and focused research investment on the least-known carnivores (Akash & Zakir, 2020; Srivathsa

et al., 2022) and the inconsistencies between various sources concerning the distribution of bears in Bangladesh highlight the need to systematically reassess the conservation status and distribution of bears in the country.

In this study, we compiled verifiable accounts of bears in Bangladesh from peer-reviewed studies and grey literature produced by local conservation organizations. We provide evidence of a small population of the Asiatic black bear from a camera-trap survey carried out during March–July 2022 in north-eastern Bangladesh. We also compare verifiable reports of human–bear conflicts in Bangladesh from various sources to findings of previously published studies.

Study area

The mixed evergreen forests of eastern Bangladesh, together with the forests of southern Assam, Tripura and Mizoram states of India, form the south-western boundary of the Indo-Burma Biodiversity Hotspot (Myers et al., 2000). In the north, the transboundary forests of Bangladesh constitute the northern fringes of the anticlinal Baramura-

Atharamura-Longtharai-Jampui Hills (Akash et al., 2021b). After traversing Tripura, these low-lying hill ranges re-emerge in Bangladesh and gain elevation in the Chattogram Hill Tracts (Figs 2 & 3). Southwards, the Hill Tracts become contiguous with the Rakhine Yoma mountain range, Myanmar; to the east, they cross the border, merging with the Dampa Tiger Reserve in Mizoram, India (Akash et al., 2021b).

Of the c. 5,000 km² of forested landscape in eastern Bangladesh, c. 500 km² are located in north-eastern Bangladesh (Khan, 2018; Rahman et al., 2021). These landscapes are largely classified as reserve forests, set aside for the sustainable use of forestry resources (Chakma, 2016). North-eastern Bangladesh has six separate reserve forests (maximum altitude: 335 m), each of which is a combination of plantation forests and secondary natural mixed evergreen succession, characterized by seasonal and perennial streams and interspersed with tea plantations and villages (Zakir et al., 2020). The south-eastern reserve forests are primary dipterocarp-dominated forest patches on undulating topography (maximum altitude: 1,055 m), characterized by boulder-strewn stream networks (Chakma, 2016; Akash et al., 2021b). Approximately 9.2% of these reserve forests is categorized as IUCN-designated protected

area (IUCN category II national park/category IV wildlife sanctuary) to conserve and protect wildlife (Khan et al., 2022).

We carried out a camera-trap survey in the 62 km² Rajkandi Reserve Forest, which is one of the six north-eastern reserve forests of Bangladesh (Fig. 2). Vegetation in this reserve forest comprises mosaics of thick bamboo patches, primary forests (dominated by *Artocarpus* spp., *Ficus* spp., *Holigarna caustica* and *Tetrameles nudiflora*) and plantations (dominated by *Acacia* spp., *Albizia* spp., *Tectona grandis* and indigenous medicinal and fruiting plants). To the south and east, this reserve forest shares a border with India; it is heavily riparian, rugged (altitude: 80–245 m) and boulder-strewn. To the north and west, it is bordered by villages and betel-leaf *Piper betle* plantations (Rahman et al., 2021).

Methods

Camera-trap survey

We carried out a non-baited camera-trap survey to assess the diversity of terrestrial medium and large mammals for

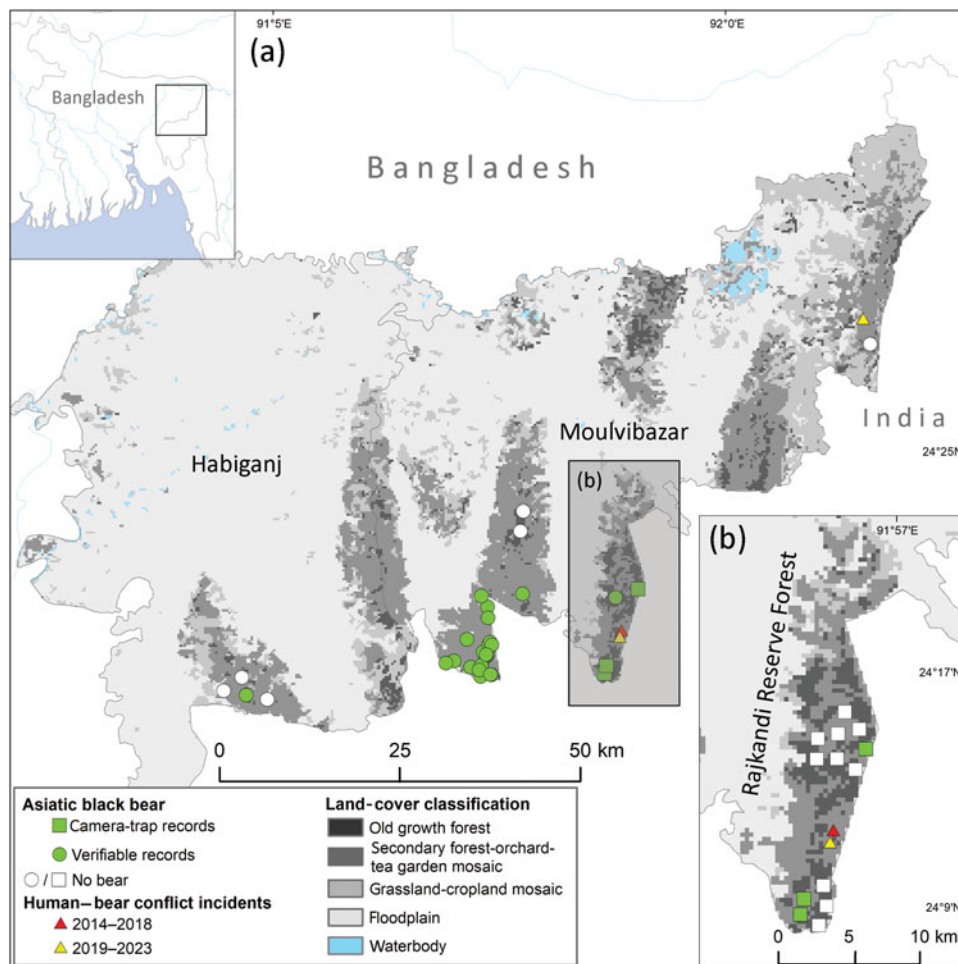


FIG. 2 Verifiable evidence of the Asiatic black bear in north-east Bangladesh: (a) Habiganj and Moulvibazar, two north-eastern districts, and (b) Rajkandi Reserve Forest. Circles denote the locations extracted from the literature; squares denote the camera-trap locations of this study. Land-cover features were adapted from Donlon et al. (2012; Supplementary Table 1). (Readers of the printed journal are referred to the online article for a colour version of this figure.)

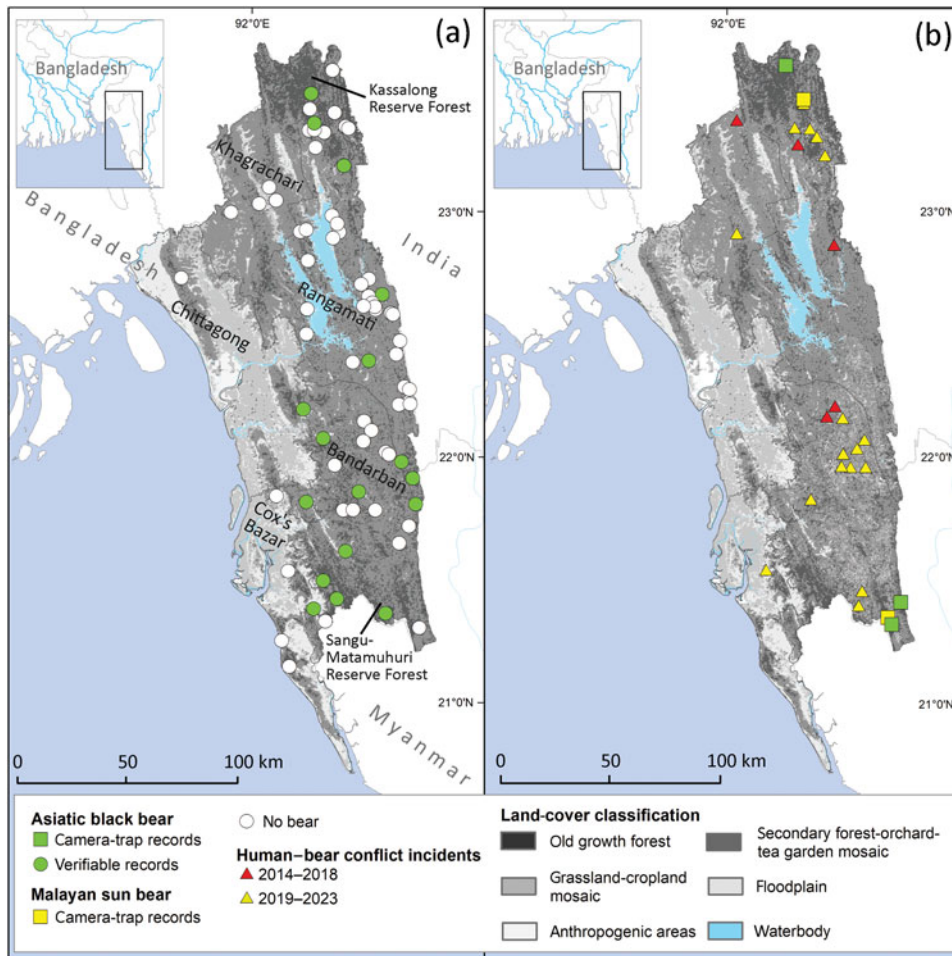


Fig. 3 Verifiable evidence of the Asiatic black bear and the sun bear in south-east Bangladesh. (a) Records extracted from the literature overlaid on the land-cover features of south-eastern districts, and (b) human-bear conflict incidents and camera-trap records overlaid on the land-cover features of south-eastern districts, also showing 2000–2019 forest-cover loss and patch effects near the Myanmar border. Data on land-cover features and loss of forest cover were adapted from previous studies (Donlon et al., 2012; Hansen et al., 2013; Supplementary Table 1). (Readers of the printed journal are referred to the online article for a colour version of this figure.)

5 months (March–July 2022) in Rajkandi Reserve Forest as part of a larger project studying the mammalian carnivores of eastern Bangladesh. We followed a grid-based approach (1×1 km) and deployed one camera trap within each of 13 grid cells. Before the deployment of the camera traps we conducted a reconnaissance survey traversing 65 km of transects and attempted to map the major animal trails within the Reserve Forest. We also noted geocoordinates of trees that were marked by bears. We identified c. 20 trees of two species, *H. caustica* and *Artocarpus chama*, with both old and fresh claw marks of bears. Claw-width measurements of young Asiatic black bears are indistinguishable from those of sun bears (Steinmetz & Garshelis, 2008; Garshelis et al., 2022a). Claw-rake marks can also vary significantly depending on the climbing postures of the bears. Thus, we relied on other methods such as camera traps to confirm species presence. We based the selection of cells and locations of the camera traps on these field observations.

We deployed camera traps close to forest streams, cliffs and wildlife trails at a height of 25–100 cm above the ground. The mean distance between camera traps was 2 km. If the deployment was at > 45 cm height, we directed the angle

of view of the camera trap down at c. $20\text{--}40^\circ$ relative to its vertical axis. We programmed each camera-trap unit to capture 3–5 photographs per trigger, with a capture delay period of 1–3 s between consecutive triggers. We organized the camera-trapping data following Niedballa et al. (2016) and considered capture events to be independent if at least 30 min had elapsed between two consecutive photographs of the same species at the same station (Meek et al., 2014).

We identified animal species following Menon (2014) and Hunter & Barrett (2018). Asiatic black bears have a longer muzzle, bigger, visible and round pinnae and a shaggier coat, whereas sun bears have a short and blunt muzzle, smaller pinnae that give an almost earless appearance in camera-trap photos and a shorter, velvety coat. Whenever visible on camera-trap photos, we also noted the shape of chest marks: Asiatic black bears have a cream-coloured V-shaped mark, whereas sun bears have orange- or yellow-coloured marks of variable shape, or sometimes no marks at all. We shared the camera-trap photos with experts of the IUCN Species Survival Commission Bear Specialist Group for further verification of the species.

Human–bear conflict incidents

We searched online databases of Bangla and English newspapers, web-based news portals and social media sites for reports of human–bear conflict incidents. In addition, we identified relevant grey literature (e.g. project reports and book chapters) using Google Scholar (Google, 2022) and reviewed wildlife guidebooks of Bangladesh (Khan, 2015, 2018).

To construct our search string, we followed the guidelines of Pullin & Stewart (2006) and the methods used by Akash et al. (2021a,b). We included the common name of the species ('bear' OR 'Malayan sun bear' OR 'Asiatic black bear') AND country name ('Bangladesh') AND relevant keywords ('bear attack' OR 'bear rescue' OR 'mauled by bear') AND the name of regions where bears were reported to be present ('Bandarban' OR 'Rangamati' OR 'Khagrachhari' OR 'Cox's Bazar' OR 'Chittagong' OR 'Moulvibazar' OR 'Habiganj' OR 'Sherpur'). To extract data from Bangla media reports, we used this search string in the Bangla language.

We considered a media report as valid only if it included a verifiable image (i.e. a bear dead or alive, tree marked by bears, human casualty with typical signs of being mauled by a bear), was accompanied by a detailed report and/or expert opinion, and if the reported location was within the geopolitical boundary of Bangladesh.

Categorization of data

We categorized these refined data according to spatial (up to district and subdistrict, the first- and the second-order administrative units of Bangladesh, respectively) and temporal (year, month, season) characteristics. We noted the type of incident (i.e. 'conflict' involving a confrontation between a human and bear or 'poaching' including occasions of bear hide confiscation and/or rescues of bear cubs from traffickers). We noted the number of human casualties (deaths and/or injuries), the number of bears involved (death, escape or rescue) and the causes or activities stated in the news reports as leading to these incidents. We did not classify the incidents to the species level unless there was verifiable evidence such as photographic records or DNA analysis.

We grouped the data obtained from the literature into non-verifiable (based on local information or interviews) and verifiable records (construed from camera-trap data or signs such as claw-marked trees, latrines or trophies). We extracted the geocoordinates of the sites described in Islam et al. (2013). We ascertained the geocoordinates for several data points provided by Islam et al. (2010) but determined that these were outside the international border of Bangladesh. No geocoordinates were provided in the observations of Chakma (2016), Sarkar (2016) and Creative Conservation Alliance (2016); in these cases we assigned

the observations to the relevant subdistrict and district as described in the pertinent literature.

Preparation of maps

We plotted the data using *ArcGIS 10.5* (WGS 1984 geodatum; Esri, USA). We followed the regional classification scheme of Khan (2018) for discussing bear presence in north-eastern and south-eastern Bangladesh (Figs 2 & 3). We used the range map for both bear species of Scotson et al. (2017) and Garshelis & Steinmetz (2020). We extracted land-cover data for eastern Bangladesh from the Sentinel-3 Sea and Land Surface Temperature Radiometer (SLSRT) level 2 dataset (Donlon et al., 2012) following the instructions of Polehampton et al. (2021), and we then reclassified the data into seven land-cover categories: floodplain, grassland–cropland mosaic, secondary forest, old growth forest, mangrove, urban area and waterbody (Supplementary Table 1). We used the Global Forest Change 2000–2019 v. 1.7 dataset (Hansen et al., 2013) to calculate forest-cover loss in eastern Bangladesh. We adapted the elevation gradient and the distribution of waterbodies in eastern Bangladesh from the Shuttle Radar Topography Mission (SRTM) dataset (Farr & Kobrick, 2000) and the Global Wetland v. 3 dataset (Gumbricht et al., 2017).

Results

Records from the literature

Asiatic black bear From four studies (Islam et al., 2010, 2013; Chakma, 2016; Creative Conservation Alliance, 2016) we extracted 101 sites as being in eastern Bangladesh (Figs 1a, 2a & 3a). Of these, the Asiatic black bear was reported to be present in 88 sites, 59 of which are in south-eastern Bangladesh, 26 in north-eastern Bangladesh and three in northern Bangladesh (Figs 1a, 2a & 3a; Supplementary Table 2). However, verifiable evidence was available for only 43 of these sites (20 in south-eastern Bangladesh and 23 in north-eastern Bangladesh; Figs 2a & 3a; Supplementary Table 2). Chakma (2016) and Creative Conservation Alliance (2016) provided the first camera-trap evidence of Asiatic black bears in Bangladesh (Fig. 3b), with records from Kassalong Reserve Forest (northern section of south-eastern Bangladesh) and Sangu-Matamuhuri Reserve Forest (southern section of south-eastern Bangladesh; Fig. 3b). Islam et al. (2013) was the only study that provided information on Asiatic black bears in the north-eastern part of Bangladesh.

Sun bear We found 11 potential sites reported by previous studies. The records provided by Islam et al. (2013) and Sarkar (2016) were, however, non-verifiable. Sarkar (2016) noted that Malayan sun bears had been reported in eight sites (without giving details of these observations) in the

region (Fig. 3a) since 1970. The study by Creative Conservation Alliance (2016) provided the first camera-trap evidence of this species in Bangladesh, which was recorded in Sangu-Matamuhuri Reserve Forest (Fig. 3b). During a study conducted by IUCN Bangladesh, a Malayan sun bear was camera-trapped in Kassalong Reserve Forest (Fig. 3b; Haque, 2021). Islam et al. (2013) mentioned a captive Malayan sun bear in south-eastern Bangladesh but did not provide any further details. We found no verifiable evidence of the occurrence of Malayan sun bears in north-eastern Bangladesh.

Results from the 2022 camera-trap survey

We obtained 45 photographs of the Tibetan black bear in four independent events from three out of 13 deployed camera traps (totalling 988 camera-trap nights; Fig. 2b; Plate 1). All but one (Plate 1d) of these captures indicated nocturnal/crepuscular activity of the bears. In addition to the black bears, the survey recorded 13 other mammal species, including eight carnivores (two felids, three viverrids and three mustelids), three ungulates (red serow *Capricornis rubidus*, wild boar *Sus scrofa* and barking deer *Muntiacus muntjak*) and two primates (rhesus macaque *Macaca mulatta* and northern pig-tailed macaque *Macaca leonina*). Among the sympatric carnivores, the Asiatic golden cat *Catopuma temminckii* was the second largest (by body mass) after the black bear.

We identified four different individuals in the four independent capture events. We identified two black bears based on their different chest marks (Plate 1a,b). Both of them crossed the same camera-trap station travelling in the same direction on 18 May 2022 within 1 h of each other (03.10–04.11). One of these bears (Plate 1b) had an old scar above the left eye.

From the camera-trap photos taken on 24 June 2022 we noted two black bears visiting a station together, feeding on fruits of *A. chama*. The photographs were captured within 1 min of each other (19.26–19.27). We inferred that these were distinct individuals based on the difference in body size and snout (Plate 1e,f). Another capture of an adult black bear occurred at this station at 04.35 on 10 June 2022 (Plate 1d), and a smaller individual was recorded at a different camera-trap station at 05.58 on 14 May 2022 (Plate 1c). Although these may have been the same two individuals that were photographed on 24 June 2022, we were unable to confirm this.

Conflict incidents

From media reports published during 2003–2023 we collated 29 human–bear conflict incidents in Bangladesh (Table 1; Supplementary Table 3). All but two records (one in 2003 and another in 2005) were from 2014 onward, of which 23 took place in the last 6 years (2018–2023). These incidents resulted in 83 human casualties (80 injured, three



PLATE 1 Photographs of the Tibetan black bear *Ursus thibetanus thibetanus* obtained during the 2022 camera-trap survey in Rajkandi Reserve Forest, north-eastern Bangladesh. Images (a–f) show representative photographs from each capture event of the species.

TABLE 1 Characteristics of human–bear conflict incidents in Bangladesh collated from 2003–2023 media reports. In the incidents marked with an asterisk (*), the bear species involved was reported to be the Asiatic black bear *Ursus thibetanus*; in all other cases the bear species was not reported.

Site name (by district)	Date of conflict	Type of incident	Reason for/activity leading to conflict	Outcome of incident
Bandarban district				
Rowangchhari	5 May 2014	Poaching	Hunting	1 man killed, 1 bear killed
Rowangchhari	8 Dec. 2015	Conflict	Logging	3 men injured, 1 bear killed
Ruma	22 May 2019	Conflict	Swidden cultivation	1 man injured, 1 mother bear and 2 cubs escaped
Lama*	24 June 2020	Conflict	Stray dog	1 bear cub rescued
Ruma	26 Feb. 2021	Conflict	Swidden cultivation	2 men injured, 1 bear escaped
Alikadam	15 Mar. 2021	Conflict	Fishing	1 man injured, 1 bear escaped
Ruma	20 Apr. 2021	Conflict	Swidden cultivation	1 man injured, 1 bear escaped
Ruma	30 July 2021	Conflict	Swidden cultivation	1 man injured, 1 bear escaped
Ruma	8 Oct. 2021	Conflict	Swidden cultivation	1 man injured, 1 bear escaped
Rowangchhari*	10 Apr. 2022	Poaching	Wildlife trade	1 bear cub rescued and sent to a safari park
Alikadam*	17 May 2022	Poaching	Wildlife trade	1 bear cub rescued, released into the wild
Ruma	19 July 2022	Conflict	Swidden cultivation	1 man injured, 1 bear escaped
Rangamati district				
Baghaichhari*	29 Aug. 2015	Poaching	Hunting	1 mother bear killed, 2 cubs captured (one cub survived and rescued, later sent to a safari park)
Barkal	7 June 2018	Conflict	Swidden cultivation	1 man injured, 1 bear escaped
Baghaichhari	10 May 2019	Conflict	Swidden cultivation	1 boy injured, 1 bear escaped
Baghaichhari	16 Nov. 2019	Conflict	Logging	1 man injured, 1 bear escaped
Baghaichhari	20 Dec. 2019	Conflict	Swidden cultivation	1 man injured, 1 bear escaped
Baghaichhari	25 May 2021	Poaching	Wildlife trade	1 bear cub rescued, released into the wild
Baghaichhari*	7 July 2021	Conflict	Logging	1 man injured, 1 bear escaped
Khagrachhari district				
Panchhari	5 May 2014	Conflict	Logging	1 man injured, 1 bear escaped
Guimara	23 May 2023	Conflict	Swidden cultivation	1 man injured, 1 bear escaped
Cox's Bazar district				
Chakaria*	23 Jan. 2023	Poaching	Wildlife trade	2 1-week-old cubs rescued, mother bear presumably killed
Feni district				
Parshuram	3 Apr. 2005	Conflict	Unknown	8 men injured, 1 bear escaped
Moulvibazar district				
Kamalganj*	Apr. 2018	Conflict	Honey collecting	1 man injured, 1 bear escaped
Juri	1 Aug. 2019	Conflict	Logging	1 man killed, 1 bear escaped
Kamalganj	Apr. 2022	Conflict	Honey collecting	1 man injured, 1 bear escaped
Sherpur district				
Jhenaigati	3 Apr. 2003	Conflict	Unknown	50 men injured, 1 bear killed
Nalitabari	12 Apr. 2020	Conflict	Logging	1 woman killed, 2 men injured, 1 bear escaped
Dhaka district				
Unknown*	13 Mar. 2016	Poaching	Wildlife trade	1 bear skin confiscated

dead) and 13 bear casualties (six dead, seven rescued). Notably, 58 human casualties occurred in just two incidents (Table 1). In both of these cases, a single Asiatic black bear strayed into human settlements, causing panic amongst the local inhabitants and leading to their retaliation against the bear. Poor management of the situation contributed to the high casualties; in addition, one Asiatic black bear was beaten to death (in Sherpur district; Table 1).

Details of the conflict incidents are provided in Table 1 and Supplementary Table 3. The districts of Moulvibazar (north-eastern Bangladesh), Khagrachari, Bandarban and

Rangamati (south-eastern Bangladesh) accounted for 24 incidents. In south-eastern Bangladesh most of the incidents were clustered in Rangamati (Baghaihat subdistrict) and Bandarban (Ruma subdistrict) districts (Fig. 3b; Table 1).

Different forms of incursion into forested habitats were reported as the predominant activities leading to these negative interactions, but there was no livestock depredation. Most commonly, people encountered a bear whilst working in swidden cultivation (an agrarian practice in the hilly region requiring slash-and-burn techniques), followed by interactions occurring during logging activities. Most incidents (60%) occurred in the summer (February–May).

There were reports of seven poaching incidents. In 2016 a bear skin was confiscated in Dhaka, the capital of Bangladesh; this was the only known incident of illicit trade in bear derivatives to be reported in the media (Table 1; Supplementary Table 3).

We noted a Malayan sun bear in captivity in a small menagerie in Jessore, south-western Bangladesh (Supplementary Plate 1). We also found at least two incidents involving the confiscations of three captive Asiatic black bears from unauthorized menageries by the Bangladesh Forest Department (Supplementary Plates 2 & 3). Seven cubs were rescued from south-eastern Bangladesh. In May 2022 two Asiatic black bear cubs were rescued at the India–Bangladesh border whilst being smuggled from south-eastern Bangladesh into India (Supplementary Plate 4; Mukherjee, 2022). In January 2023 two newborn bear cubs were rescued from a highway whilst being smuggled out of Bangladesh (Table 1; Supplementary Plate 5).

We found no evidence of sloth bears in Bangladesh.

Discussion

Presence of bears in Bangladesh

Our compilation of bear records, comprising 43 verifiable records from previous studies, 23 conflict incidents reported during 2018–2023 and the results from our camera-trap survey, shows that two species of bears still occur in Bangladesh. The findings can be substantiated by multiple factors. Firstly, the records were far from the international borders between Bangladesh and north-eastern Indian states (Fig. 3a). Secondly, we observed an increasing frequency of media reports on human–bear conflicts in south-eastern Bangladesh (Table 1). Furthermore, there were multiple reports of the hunting and trafficking of bears and bear cubs (Table 1; Creative Conservation Alliance, 2016). We found no evidence of sloth bears, corroborating the findings of previous studies (Garshelis et al., 1999; Ahmed et al., 2009; Islam et al., 2013).

Islam et al. (2013) considered the Malayan sun bear as a transient vagrant from the forests of north-eastern India bordering Bangladesh. However, the camera-trap images obtained in Kassalong Reserve Forest (by IUCN Bangladesh) and Sangu-Matamuhuri Reserve Forest (by Creative Conservation Alliance) indicate that the species could be a resident (Fig. 3b). Both locations are comparatively rugged and continuous with the forests of Mizoram state (India) and Chin state (Myanmar), which also harbour populations of the species (Gouda et al., 2020). Creative Conservation Alliance (2016) also provided multiple photographs showing sun bears hunted by Indigenous People, all from Sangu-Matamuhuri Reserve Forest. These observations require further investigation into whether Malayan sun bears are indeed vagrant or have resident, edge-of-range populations in the country.

In addition, the survey sites of Islam et al. (2010, 2013) form a cluster in north-eastern Bangladesh (all within 10–20 km²) and are scattered over a wide range of south-eastern Bangladesh (Figs 2a & 3a). These sites were surveyed based on local Indigenous knowledge. In places where bear populations occur in low density, signs, local knowledge and expert opinion are beneficial (Proctor et al., 2022); however, these approaches can lead to biased results as local knowledge is difficult to verify without empirical evidence and may sometimes be based on conjecture (Garshelis et al., 2022a,b).

Because of the lack of any habitat suitability modelling, and also considering the omnivorous nature of Asiatic black bears and their ability to survive in degraded forest patches (Sathyakumar et al., 2013), it is difficult to infer the extent to which the forests of eastern Bangladesh are suitable for bears. Remote camera trapping and/or DNA-based sampling are now considered to be the most reliable methods for assessing and monitoring bear distributions (Proctor et al., 2022). These methods can help determine population status and assess threats at a national level, which are often based on expert opinion because empirical evidence is lacking. For example, Alam (2015a) stated that the Asiatic black bear had disappeared from north-eastern Bangladesh, whereas our findings suggest the possible presence of a small population in this region.

Human–bear conflict

Eastern Bangladesh appears to be an area of frequent human–bear conflict, based on our analysis of media reports. During 2007–2010, 47 bears were reportedly killed in this region (Islam et al., 2013). The reported incidents mostly took place in summer, the harvesting season of fruits and crops (Fig. 3b; Table 1). However, we are also cognizant that drawing inferences from media reports has limitations. Incidents could be under-reported, leading to underestimation of the problem, whereas over-reporting may occur because of the popularity of such stories on social media and in news outlets, or because of increased human–wildlife contact as a result of human activities encroaching into forests. It has been reported that in Dachigam National Park, Kashmir, bear attacks on people intensify in winter, but the highest intensity of crop damage occurs in summer (Charoo et al., 2011). In Bhutan, incidents with bears have been reported in summer and autumn (Jamtsho & Wangchuk, 2016). Human–bear conflict intensity in northern Pakistan also reached its peak in summer (Khattak et al., 2022). However, one study noted that bear poaching incidents were most intense in winter in Siran and Kagan valleys, Pakistan (Ullah et al., 2020). The concentration of conflict incidents in summer suggests a possible correlation between the fruiting season and the activities of bears in these regions.

The increasing frequency of reported human–bear conflict in recent times probably indicates the presence of a larger, hitherto undocumented, edge-of-range population of the Asiatic black bear in eastern Bangladesh. The number of conflict incidents during 2018–2023 ($n = 23$) in Bangladesh was higher than in Bhutan and Pakistan. Jamtsho & Wangchuk (2016) noted an increase in human–bear conflict in Bhutan, totalling 19 incidents during 2013–2015. Similarly, Khattak et al. (2022) reported 14 cases within 2 years in northern Pakistan. Although Islam et al. (2013) did not elaborate on the underlying drivers and causes of this conflict, they noted that 47 bears were killed during 2007–2010 in Bangladesh. Together with the tiger *Panthera tigris*, the Asiatic black bear and sun bear are the only carnivore species for which, in the Bangladesh Wildlife (Security and Protection) Act 2012, under Clause 52, a compensation policy has been legislated should such conflict occur. However, there have been no studies or initiatives to systematically address the patterns and drivers of human–bear conflict incidents, although such activities have been conducted for conflicts involving tigers in the Sundarbans (Akash & Zakir, 2020).

Illegal trade of bears

This study emphasizes the hitherto unnoticed wildlife trade and poaching activities that target bears. This is a threat as demand for live bears (for use in menageries and circuses), bear trophies and bear derivatives (bear bile, claws, etc.) is high (Sarkar, 2016; Kabir, 2019). Both bear species are protected under Schedule I of the Bangladesh Wildlife (Security and Protection) Act 2012, however, Asiatic black bears are kept in various private and government zoos across the country, with the origin of these bears remaining undocumented.

Bear conservation in eastern Bangladesh

South of 25°N, Bangladesh forms the westernmost edge of the ranges of both Asiatic black bears and Malayan sun bears. Eastern Bangladesh, combined with Tripura and southern Assam in India, forms the western tip of the Indo-Burma Biodiversity Hotspot, an ecologically uncharted area that is exceptionally rich in carnivore diversity (Khan, 2018; Akash & Zakir, 2020; Akash et al., 2021b; Zakir et al., 2021). The region is reportedly home to all 27 Carnivora species known to be present in the country, which is nearly half of those occurring across the entire Indian subcontinent, including the leopard *Panthera pardus*, dhole *Cuon alpinus*, Asiatic golden cat, clouded leopard *Neofelis nebulosa*, marbled cat *Pardofelis marmorata* and binturong *Arctictis binturong*, amongst others (Chakma, 2016; Creative Conservation Alliance, 2016; Khan, 2018). The rugged, riparian, mixed evergreen forests of eastern Bangladesh are also the edge-of-range habitats for Asiatic elephants

Elephas maximus and rare forest ungulates such as gaur *Bos gaurus* and red serow (Creative Conservation Alliance, 2016).

Despite being more at risk of extinction than core populations, edge populations are especially valuable for their adaptability to marginal habitats, their genetic diversity and their ability to colonize new habitats and respond to abrupt environmental and climatic shifts (Hunter & Hutchinson, 1994). Edge populations have the evolutionary potential for future speciation events (Lesica & Allendorf, 1995; Razgour et al., 2013).

Bear conservation efforts in Bangladesh are far below the investments made to preserve the tiger in the Sundarbans, another large carnivore (Akash & Zakir, 2020). Bear research in the country suffers from a lack of research infrastructure and collaboration, inadequate funding and awareness-raising programmes, logistical difficulties and a lack of knowledge regarding the conservation of less charismatic wildlife amongst policymakers (Akash & Zakir, 2020). To address these shortcomings, it is important that the Bangladesh government involves members of the IUCN Species Survival Commission Bear Specialist Group in Bangladesh and the Asian Bear Monitoring Expert Team in future monitoring efforts. We also recommend involving young students in bear research and expanding Bear Specialist Group membership in Bangladesh by inviting a new generation of bear biologists.

The forests of eastern Bangladesh are often selected as substitute locations for plantations and development. Although there are protection schemes in place, only c. 10% of these forests are categorized as protected areas according to globally recognized standards, such as those defined by the IUCN protected area categories (Khan et al., 2022). It also appears that > 95% of the forested landscape in the country is yet to be systematically assessed for bears (Figs 2a & 3a). Our study shows that Sangu-Matamuhuri Reserve Forest and Kassalong Reserve Forest are the last strongholds of bears where they could still be elevated to flagship species for the conservation of the mammalian communities living there.

As suggested by Garshelis et al. (2022b) and McShea et al. (2022), we recommend the following: systematic monitoring of bears in eastern Bangladesh using advanced camera trapping and genetic methods; government-level support, encouragement and endorsement of bear research and conservation initiatives in these locations; the preparation of comprehensive human–bear conflict mitigation guidelines, implementation plans and rapid response teams; systematic documentation of human–bear conflict casualties at district hospitals in eastern Bangladesh and a centralized repository of these data at the Bangladesh Forest Department; stringent measures to protect the forest habitats in eastern Bangladesh and reduce poaching; and the implementation of specific actions for the welfare of captive bears in governmental and private collections.

Author contributions Conceptualization, methodology, validation, data collection, writing: MA, SS; data collection, data curation, writing: SA, AGC, TZ; field survey: HD, SA, KNMDS; supervision: SS.

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Conflicts of interest None.

Ethical standards This research abided by the *Oryx* guidelines on ethical standards. The camera-trapping work was a non-invasive survey carried out under the permission of the Bangladesh Forest Department and did not involve people. Images of people captured inadvertently on camera traps were stored in a protected database to ensure their privacy.

Data availability The data supporting the findings of this study are available within the article and its Supplementary Materials.

References

- AHMED, A.T.A., KABIR, S.M.H., AHMED, M., AHMED, Z.U., BEGUM, Z.N.T., HASSAN, M.A. & KHONDKER, M. (eds) (2009) *Encyclopedia of Flora and Fauna of Bangladesh, Volume 27: Mammals*. Asiatic Society of Bangladesh, Dhaka, Bangladesh.
- AKASH, M. & ZAKIR, T. (2020) Appraising carnivore (Mammalia: Carnivora) studies in Bangladesh from 1971 to 2019 bibliographic retrieves: trends, biases, and opportunities. *Journal of Threatened Taxa*, 12, 17105–17120.
- AKASH, M., DHEER, A., DLONIAK, S. & JACOBSON, A.P. (2021a) The faded stripes of Bengal: a historical perspective on the easternmost distribution of the striped hyena *Hyaena hyaena*. *European Journal of Wildlife Research*, 67, 1–12.
- AKASH, M., TRAGESER, T., ZAKIR, T., RAHMAN, S.C., MILA, F.-T.-Z.K. & GHOSE, A. (2021b) Detecting the spots: a review on leopard occurrences in Bangladesh. *Cat News*, 73, 21–27.
- ALAM, M.I.A. (2015a) *Helarctos malayanus*. In *Red List of Bangladesh, Volume 2: Mammals*. IUCN, Dhaka, Bangladesh. portals.iucn.org/library/node/46323 [accessed June 2024].
- ALAM, M.I.A. (2015b) *Ursus thibetanus*. In *Red List of Bangladesh, Volume 2: Mammals*. IUCN, Dhaka, Bangladesh. portals.iucn.org/library/node/46323 [accessed June 2024].
- CHAKMA, S. (2016) *Assessment of large mammals of the Chittagong Hill Tracts of Bangladesh with emphasis on tiger (Panthera tigris)*. PhD thesis. University of Dhaka, Dhaka, Bangladesh.
- CHAROO, S.A., SHARMA, L.K. & SATHYAKUMAR, S. (2011) Asiatic black bear–human interactions around Dachigam National Park, Kashmir, India. *Ursus*, 22, 106–113.
- CREATIVE CONSERVATION ALLIANCE (2016) *A Preliminary Wildlife Survey in Sangu-Matamuhuri Reserve Forest, Chittagong Hill Tracts, Bangladesh*. Unpublished report submitted to Bangladesh Forest Department, Dhaka, Bangladesh.
- DHARAIYA, N., BARGALI, H.S. & SHARP, T. (2020) *Melursus ursinus* (amended version of 2016 assessment). In *The IUCN Red List of Threatened Species 2020*. dx.doi.org/10.2305/IUCN.UK.2020-1.RLTS.T13143A166519315.en.
- DONLON, C., BERRUTI, B., BUONGIORNO, A., FERREIRA, M.H., FEMENIAS, P., FERRICK, J. et al. (2012) The Global Monitoring for Environment and Security (GMES) Sentinel-3 mission. *Remote Sensing of Environment*, 120, 37–57.
- FARR, T.G. & KOBRICK, M. (2000) Shuttle radar topography mission produces a wealth of data. *Eos, Transactions American Geophysical Union*, 81, 583–585.
- GARSHELIS, D. & STEINMETZ, R. (2020) *Ursus thibetanus* (amended version of 2016 assessment). In *The IUCN Red List of Threatened Species 2020*. doi.org/10.2305/IUCN.UK.2020-3.RLTS.T22824A166528664.en.
- GARSHELIS, D.L., DHARAIYA, N., SHARP, T.R. & PIGEON, K.E. (2022a) Investigating co-occurrence among look-alike species: the case of three bears in northeast India. *Diversity*, 14, 717.
- GARSHELIS, D.L., JOSHI, A.R. & SMITH, J.L. (1999) Estimating density and relative abundance of sloth bears. *Ursus*, 11, 87–98.
- GARSHELIS, D.L., PIGEON, K., HWANG, M.H., PROCTOR, M., MCSHEA, W.J., FULLER, A.K. & MORIN, D.J. (2022b) The need to step-up monitoring of Asian bears. *Global Ecology and Conservation*, 35, e02087.
- GOOGLE (2022) *Google Scholar*. Google, Mountain View, USA. scholar.google.com [accessed 26 June 2022].
- GOUDA, S., CHAUHAN, N.S., SETHY, J. & SAHU, H. (2020) Daily activity pattern of Malayan sun bear in Dampa Tiger Reserve, Mizoram, India. *Journal of Wildlife and Biodiversity*, 4, 56–64.
- GUMBRIGHT, T., ROMAN-CUESTA, R.M., VERCHOT, L., HEROLD, M., WITTMANN, F., HOUSEHOLDER, E. et al. (2017) An expert system model for mapping tropical wetlands and peatlands reveals South America as the largest contributor. *Global Change Biology*, 23, 3581–3599.
- HANSEN, M.C., POTAPOV, P.V., MOORE, R., HANCHER, M., TURUBANOVA, S.A., TYUKAVINA, A. et al. (2013) High-resolution global maps of 21st-century forest cover change. *Science*, 342, 850–853.
- HAQUE, A. (2021) Are there tigers in Chattogram Hill Tracts? IUCN finds out. *The Daily Business Standard*, 31 July 2021. tbsnews.net/bangladesh/are-there-tigers-chattogram-hill-tracts-iucn-finds-out-281782 [accessed 16 May 2022].
- HUNTER, L. & BARRETT, P. (2018) *Field Guide to Carnivores of the World*, 2nd edition. Bloomsbury Publishing, London, UK.
- HUNTER, M.L. & HUTCHINSON, A. (1994) The virtues and shortcomings of parochialism: conserving species that are locally rare, but globally common. *Conservation Biology*, 8, 1163–1165.
- ISLAM, M.A., MUZAFFAR, S.B., AZIZ, M.A., KABIR, M.M., UDDIN, M., CHAKMA, S. et al. (2010) *Baseline Survey of Bears in Bangladesh*. WildTeam, Dhaka, Bangladesh.
- ISLAM, M.A., UDDIN, M., AZIZ, M.A., MUZAFFAR, S.B., CHAKMA, S., CHOWDHURY, S.U. et al. (2013) Status of bears in Bangladesh: going, going, gone? *Ursus*, 24, 83–90.
- JAMTSHO, Y. & WANGCHUK, S. (2016) Assessing patterns of human–Asiatic black bear interaction in and around Wangchuck Centennial National Park, Bhutan. *Global Ecology and Conservation*, 8, 183–189.
- KABIR, M.K. (2019) Wildlife–human conflicts in some parts of Bangladesh. *International Journal of Research Studies in Zoology*, 5, 8–14.
- KHAN, M.A.R. (2015) *Wildlife of Bangladesh: Checklist and Guide*. Chayabithi Publisher, Dhaka, Bangladesh.
- KHAN, M.A.R., HAQUE, E.U., KHAN, M.M.H., AHMED, I., CHAKMA, S., NAHER, H. et al. (2022) A proposed safari park in a subtropical forest in northeastern Bangladesh will be detrimental to native biodiversity. *Conservation*, 2, 286–296.
- KHAN, M.M.H. (2018) *Photographic Guide to the Wildlife of Bangladesh*. Arannayk Foundation, Dhaka, Bangladesh.
- KHATTAK, R.H., MEHMOOD, T., TENG, L., AHMAD, S., REHMAN, E.U. & LIU, Z. (2022) Assessing human–Asiatic black bear (*Ursus thibetanus*) conflicts in Kumrat Valley—western flanks of Hindu Kush Region, northern Pakistan. *Global Ecology and Conservation*, 38, e02230.
- LESICA, P. & ALLENDORF, F.W. (1995) When are peripheral populations valuable for conservation? *Conservation Biology*, 9, 753–760.

- MCSHEA, W.J., HWANG, M.-H., LIU, F., LI, S., LAMB, C.T., MCELLELLAN, B. et al. (2022) Is the delineation of range maps useful for monitoring Asian bears? *Global Ecology and Conservation*, 35, e02068.
- MEEK, P.D., BALLARD, G., CLARIDGE, A., KAYS, R., MOSEBY, K., O'Brien, T. et al. (2014) Recommended guiding principles for reporting on camera trapping research. *Biodiversity and Conservation*, 23, 2321–2343.
- MENON, V. (2014) *Indian Mammals: A Field Guide*. Hachette, Delhi, India.
- MUKHERJEE, K. (2022) Bear cubs rescued, lens on cross-border wildlife trade. *The Times of India*, 6 March 2022. timesofindia.indiatimes.com/city/kolkata/bear-cubs-rescued-lens-on-cross-border-wildlife-trade/articleshow/90022812.cms?from=mdr [accessed 16 May 2022].
- MYERS, N., MITTERMEIER, R.A., MITTERMEIER, C.G., DA FONSECA, G.A. & KENT, J. (2000) Biodiversity hotspots for conservation priorities. *Nature*, 403, 853–858.
- NAHER, H. (2015) *Melursus ursinus*. In *Red List of Bangladesh, Volume 2: Mammals*. IUCN, Dhaka, Bangladesh. portals.iucn.org/library/node/46323 [accessed June 2024].
- NIEDBALLA, J., SOLLMANN, R., COURTIOL, A. & WILTING, A. (2016) *camtrapR*: an R package for efficient camera trap data management. *Methods in Ecology and Evolution*, 7, 1457–1462.
- POLEHAMPTON, E., COX, C., SMITH, D., GHENT, D., WOOSTER, M., XU, W. et al. (2021) *Copernicus Sentinel-3 SLSTR Land User Handbook*. European Space Agency, Paris, France.
- PROCTOR, M.F., GARSHELIS, D.L., THATTE, P., STEINMETZ, R., CRUDGE, B., MCELLELLAN, B.N. et al. (2022) Review of field methods for monitoring Asian bears. *Global Ecology and Conservation*, 35, e02080.
- PULLIN, A.S. & STEWART, G.B. (2006) Guidelines for systematic review in conservation and environmental management. *Conservation Biology*, 20, 1647–1656.
- RAHMAN, H.A., MCCARTHY, K.P., MCCARTHY, J.L. & FAISAL, M.M. (2021) Application of multi-species occupancy modeling to assess mammal diversity in northeast Bangladesh. *Global Ecology and Conservation*, 25, e01385.
- RAZGOUR, O., JUSTE, J., IBÁÑEZ, C., KIEFER, A., REBELO, H., PUECHMAILLE, S.J. et al. (2013) The shaping of genetic variation in edge-of-range populations under past and future climate change. *Ecology Letters*, 16, 1258–1266.
- SARKER, M.S.U. (2006) The status and conservation of bears in Bangladesh. In *Understanding Asian Bears to Secure Their Future*, pp. 41–44. Japan Bear Network, Ibaraki, Japan.
- SATHYAKUMAR, S., SHARMA, L.K. & CHAROO, S.A. (2013) *Ecology of Asiatic Black Bear in Dachigam National Park, Kashmir, India*. Wildlife Institute of India, Dehradun, India.
- SCOTSON, L., FREDRIKSSON, G., AUGERI, D., CHEAH, C., NGOPRASERT, D. & WAI-MING, W. (2017) *Helarctos malayanus* (errata version published in 2018). In *The IUCN Red List of Threatened Species 2017*. dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T9760A45033547.en.
- SRIVATHSA, A., BANERJEE, A., BANERJEE, S., CHAWLA, M.M. & DAS, A. (2022) Chasms in charismatic species research: seventy years of carnivore science and its implications for conservation and policy in India. *Biological Conservation*, 273, e109694.
- STEINMETZ, R. & GARSHELIS, D.L. (2008) Distinguishing Asiatic black bears and sun bears by claw marks on climbed trees. *Journal of Wildlife Management*, 72, 814821.
- ULLAH, Z., ULLAH, I., ULLAH, I., MAHMOOD, S. & IQBAL, Z. (2020) Poaching of Asiatic black bear: evidence from Siran and Kaghan valleys, Pakistan. *Global Ecology and Conservation*, 24, e01351.
- ZAKIR, T., DEBBARMA, H. & AKASH, M. (2020) Dhole *Cuon alpinus* in Satchari National Park: on the first verifiable evidence from northeast Bangladesh. *Mammalia*, 84, 587–593.
- ZAKIR, T., DEBBARMA, H., MAHJABIN, R., DEBBARMA, R., KHAN, Z., MINU, M.R. et al. (2021) Are northeastern forests of Bangladesh empty? Insights from camera-trapping into spatiotemporal activity pattern of mammals in a semi-evergreen national park. *Mammal Study*, 46, 323–339.