Review

Appraising carnivore (Mammalia: Carnivora) studies in Bangladesh from 1971 to 2019 bibliographic retrieves: trends, biases, and opportunities

Muntasir Akash & Tania Zakir

26 November 2020 | Vol. 12 | No. 15 | Pages: 17105–17120
DOI: 10.11609/jott.6486.12.15.17105-17120

The opinions expressed by the authors do not reflect the views of the Journal of Threatened Taxa, Wildlife Information Liaison Development Society, Zoo Outreach Organization, or any of the partners. The journal, the publisher, the host, and the partners are not responsible for the accuracy of the political boundaries shown in the maps by the authors.
Appraising carnivore (Mammalia: Carnivora) studies in Bangladesh from 1971 to 2019 bibliographic retrieves: trends, biases, and opportunities

Muntasir Akash¹ & Tania Zakir²

¹,²Department of Zoology, University of Dhaka, Dhaka 1000, Bangladesh.
¹ akashmuntasir10@gmail.com (corresponding author), ² zakirtania60@gmail.com

Abstract: In contrast to <7% natural forest covers and >1,000 people living km⁻², Bangladesh, one of the smallest countries in Asia, shelters 28 carnivorous mammals. The species are of six families, nearly half of the entire carnivore diversity of the Indian Subcontinent. Carnivores of Bangladesh are little understood and they are disappearing fast despite receiving stern protection. Yet, there has been no assessment on the status of existing knowledge. A review was aimed to assess the existing knowledge and evaluate the research trends in country's mammalian carnivores. Peer-reviewed works published from 1971 to 2019 were skimmed and categorized systematically according to five traits: publication type, research topic, time of publication, region, and species of study. In a total of 95 works examined, substantial numbers were on tiger (n=45) and the Sundarbans (n=47). In imbalance to action plans procured for tiger conservation, 14 carnivores have never been exclusively studied in Bangladesh. Of the research topics, preference was evident for wildlife management and conflict analyses as there were 31 scientific papers out of 63 in these categories. Inventory compilation for books (18 of 24) comprised the next preferred subject. The assessment could identify gaps in related knowledge in different regions of the country. Eastern region has experienced a meagre amount of work, although its mixed evergreen forests have larger combined area than the Sundarbans, and is known for its higher richness of diversity. Exclusive works outside legally defined protected areas were also low. We found no works in northwestern and southern Bangladesh. In the last two decades, the temporal trajectory of research effort has been more, and the topics have started to diversify. In order to improve conservation practices, we stress that gaps in knowledge pertaining to region or subject may be bridged with contemporary study techniques. This is crucial to highlight the status of carnivore species that are otherwise ‘elusive’, ‘apparently absent’, or ‘least-known’.

Keywords: Bibliography, conservation priorities, meta-analysis, review.
INTRODUCTION

Carnivora that constitute the fifth largest mammalian order faces taxon-wide existential crisis (Inskip & Zimmermann 2009; Ripple et al. 2014). According to IUCN (2019), 88 species are threatened with a trend of decreasing population. Conserving carnivores is now a major concern worldwide (Treves & Karanth 2003).

The concern is in recognition of the fact that for a stable and diverse community of wild animals, carnivorous mammals exert intangible influences. They can act as apex predators and their absence often leads to trophic cascades (Prug et al. 2009; Ripple et al. 2014; Suraci et al. 2017). As the ecosystem services of a carnivore can be of an umbrella or keystone to conserve an ecosystem in its entirety (Sergio et al. 2008; Baker & Leberg 2018), human intervention in wildlife management practices cannot supersede or bypass a carnivore’s natural impact in the wild (Gittleman & Gompper 2005; Ripple et al. 2014).

Bangladesh is the world’s 92nd largest country covering an area of 147,610km² and the 8th most populous with about 165.6 million people. Also, the country is rich in biodiversity and harbors 138 extant mammals; 28 of which are carnivores (IUCN Bangladesh 2015; Khan 2015, 2018).

Geographically, Bangladesh is traversed by the Tropic of Cancer, and there exists a transition zone between the Indo-Himalayan and the Indo-Chinese sub-regions of the Oriental realm, which are considered advantageous to form wildlife habitats (Corlett 2007; Feeroz 2013; Khan 2018). Historical anecdotes indicate about the rich presence of carnivores all over Bangladesh once. Many carnivore species have now become restricted to certain areas or are known only from sporadic encounters (Khan 2015).

The carnivores of Bangladesh are in six terrestrial families: Viverridae, Felidae, Herpestidae, Canidae, Ursidae, and Mustelidae. The Bengal Tiger *Panthera tigris* is the country’s national animal. Three other large carnivores, the Indian Wolf *Canis lupus*, Striped Hyena *Hyaena hyaena*, and Sloth Bear *Melursus ursinus* are deemed to be extinct in Bangladesh (Khan 2018). If compared to more diverse carnivore assemblages of neighboring India (57 species), Nepal (47), and Bhutan (39) and their respective habitat diversity, the inventory of Bangladesh is still considerable given its <7% natural forest cover and >1000 people living km² (Wangchuk 2004; NFA 2007; Menon 2014; Amin et al. 2018).

Carnivores are still present in all the three major forest types of Bangladesh (IUCN Bangladesh 2015) (Fig. 1). The Sundarbans mangroves support the only stable Tiger population in the country. Wet deciduous forests which once swathed from central to north and northwest, is now extremely fragmented, but continue to be known for civets, mongooses, *Felis* and *Prionailurus* cats. Concentrations of mixed evergreen forests are in eastern regions typified by hills, streams, rugged terrain, and, in cases, tea-gardens on the periphery. Eastern forests are long credited for every native carnivore. Apart from the forests, homestead jungle and wetland vegetation support small mammals. Although protected under several formal definitions, here, threats to wildlife and wildlife habitats are surmounting because of encroachment, altercation, destruction, high-dependency on forest products, agro-industries, trafficking, persecution, and retaliatory killings, to name but a few (Khan 2015, 2018).

We find no comprehensive assessment of the status of existing knowledge on mammalian predators of Bangladesh. But on global or regional scales, extensive reviews tend to highlight species in critical research needs, and steer conservation interventions to new perspectives as exemplified by Dalerum et al. (2008), Inskip & Zimmermann (2009), Periago et al. (2014), Broto & Mortelliti (2018).

For instance, Broto & Mortelliti (2018) highlighted the pattern of researches on mammals of Sulawesi Island in Indonesia with high insular endemism. Similarly, Periago et al. (2014) assessed the pattern and consequence of losing mammalian herbivores and frugivores in savanna woodland of Central South America. On a larger scale, Inskip and Zimmerman (2009) evaluated the nature and level of conflict between human and each of the wild feline species. Whereas, Dalerum et al. (2008) reviewed the status and decline of carnivore guilds in continental perspective. All these reviews were systemic in assessing literary works. These have stressed on knowledge gap and research bias only to envisage better and bolder scheming of conservation pursuits.

In order to make an appraisal of the works on mammalian carnivores of Bangladesh, here we have proceeded with three objectives: (1) to construct a systematic compilation of peer-reviewed researches, (2) to identify taxonomic and knowledge bias in these studies, and (3) to assess their geographic trend within the country and the temporal trajectories.
MATERIALS AND METHODS

Extent of the review

Within a period of four months between April 2019 and July 2019, we carried out the literature search. In order to meet our objectives, we picked five traits for any work: publication type, research topic, region in Bangladesh, time (year of publication), and the studied species. We have investigated the pattern in publication types and research themes. We recognized the most-studied and the least-studied carnivores. We compared the relevance of research to threatened status of the species. We have examined the geographic distribution of works, their aforementioned traits, and consideration for protected areas. Similarly, we have examined plots over year bands to understand a temporal trend. On any pertinent bias and gap, we conjectured on the possible factors in discussion.

Consideration of literature

We restricted our search to the following types of publications: peer-reviewed scientific papers, peer-reviewed book/book chapters, conservation action plans, and doctoral theses completed from 1971 to 2019. We observed project reports within this period but excluded them from analyses. We did not consider conference abstracts, MS theses and non-scholarly articles.

We have considered only mammalian carnivores reportedly living within the geopolitical boundary of Bangladesh. To enlist the extant carnivores for consideration, we consulted Khan (2018, 2015), and Ahmed et al. (2009). To obtain insight to assessment of threat at the regional and global levels, respectively, we used IUCN Bangladesh (2015) and IUCN (2019).

Sourcing literature

Works were collected using three primary research databases, i.e., Google Scholar, BioMedCentral, and Web of Science. To intensify in-depth search, we followed preset keywords in English. Our search protocol was based on Pullin & Stewart (2006), and we included ‘species name’ (scientific or common) and ‘Bangladesh’ in every attempt. In addition to the pair of obligatory words we used the following keywords in combination: ‘attitude’, ‘behavior’, ‘camera-trap’, ‘coexistence’, ‘conflict’, ‘depredation’, ‘distribution’, ‘diversity’, ‘ecology’, ‘mortality’, ‘new record’, ‘prey’, and ‘zoonotic disease’. We followed the search pattern for every extant carnivore species of the country. We also looked for key wildlife biologists of Bangladesh during searches to obtain maximum results.

In addition to the three primary searches online, relevant books and journals were accessed from Professor Yousufzai Seminar Library repository of the Department of Zoology, University of Dhaka. This was carried out to acquire older works that could have missed digital indexing.

Categorization under pre-defined themes

We observed the respective aims and outcomes of the obtained works. Then, we categorized them under six pre-determined research themes. We construed the categorization after consulting verde Arregoitia (2016), Broto & Mortelliti (2018), and Inskip & Zimmermann (2009). The definition and scope for each category are given in Table 1.

Studies were examined to ascertain whether each of these dealt with a single species or multiple species or any particular group (taxa higher than genus). If multiple

\[
\text{Table 1. Terminologies applied for categorization of published studies on carnivore mammals of Bangladesh.}
\]

| Research Topic | Scope of study |
|----------------|----------------|
| 1. Inventory   | Checklist of mammals of any study area. |
| 2. Discovery and distribution update | Discovery, distribution update, new records, sighting documentations. |
| 3. Ecology     | Ecological study, breeding behavior, feeding behavior, territorial behavior, activity pattern, home range, habitat preference. |
| 4. Wildlife management and conflict analysis | Ethno-zoological aspects, human-carnivore interactions, threat analysis, environmental impact, climatic impact, wildlife poaching and trade, anthropogenic effects and perceptions, conservation genetics, research in recovery strategies, conservation action plan. |
| 5. Population dynamics | Population status, population size, population density. |
| 6. Zoonotic and anthroponotic disease | Case studies on these diseases. |
| 7. Consideration of protected area (PA) | Researches that considered any protected area declared under international or regional definition, i.e., national park, wildlife sanctuary, reserve forest, ecologically critical area, eco-park, RAMSAR site as study site. |
| 7.1. Inside PA | Researches that did not consider any of the above as study site. |
| 7.2. Outside PA | Researches that did not consider any of the above as study site. |
| 7.3. Both | Researches that encompassed study area covering both protected and non-protected habitats. |
| 8. Regions: As per Khan (2018) | 8.1. Central, 8.2. North, 8.3. South, 8.4. Northeast, 8.5. Northwest, 8.6. Southeast and 8.7. Southwest |
species names were specified in a single work, we added the work to tally count of each pertinent species, however, if any study approached a group (for example, a taxonomic family), we kept it to the mentioned group. For example, Islam et al. (2013) assessed bears of Bangladesh, we counted the work for the ‘ursids’ rather than each of the three bears of the country. We also considered the works that covered all wildlife or all mammals or all carnivores of Bangladesh and kept the count to ‘wildlife’, ‘mammals’, and ‘carnivores’, consecutively (Table 1; Appendices 1–2).

Spatial and temporal classification

We followed Khan (2018) where seven geographical regions have been defined to characterize wildlife distribution in Bangladesh and recreated the map for the review (Table 1). We put a particular work to a specific region, considering whether the respective work’s study area fell within the geographic region. If multiple regions were specified in a single work, we added the work to tally count of each respective region, however, if any work considers the country, we accredited the count to ‘Bangladesh’.

The works were also classified on their consideration of protected area (PA) and assorted into three groups: outside PA, inside PA or both (Table 1).

To assess the research trajectory in time, we considered two trends: year-wise pattern and a cumulative rate. We assigned a study to the year it was published. For tracking changes in publication types and research topics, works were classified into six time periods, each of a decade: 1971–1980, 1981–1990, 1991–2000, 2001–2010, 2011–2019. Time trajectory was initiated from 1971; this was when Bangladesh had gained independence.

Analyses

We summed the total number of works for each pertinent species, and, thus, identified the most-studied and the least-studied species. We summed the number of studies tallied for a research topic to check the bias among topics. In manner alike, to point out the geographic/temporal pattern, we considered the total number of works assigned to a region or a year.

RESULTS

A brief on the reviewed literature

We found 95 peer-reviewed works on carnivores of Bangladesh completed within the considered timeframe, i.e., 1971–2019. Of these, 63 (66.3%) were peer-reviewed scientific papers, six (6.3%) doctoral theses, 24 (25.3%) books. There were two action plans (2.1%) on Tiger. In addition, we came across seven project reports (Appendix 1) that were excluded from our analysis. All these 102 works we extracted through literature search are provided in Appendix 2.

Out of total 95 references used for analysis in the study, ‘wildlife management and conflict analysis’ (n=42, 44.2%) appeared to be the most prolific research topic among all types. Topics dedicated to other studies are: Ecology (n=15, 15.8%); discovery and distribution update (n=9, 9.5%), inventory (n=24, 25.3%), population dynamics (n=3, 3.1%), and investigation of zoonotic and anthroponotic diseases (n=2, 2.1%) (Fig. 1).

When we compared the research topics to publication types, Figure 1 also showed a preference for books in terms of inventory build-ups (n=18). Although a few books covered the topic of wildlife management and conflict analysis, we found no book on other topics. We came across only nine papers on discovery and distribution update whereas 14 papers were there on ecology.

Species-wise trend in studies

Of the 28 extant carnivores of Bangladesh, seven are Critically Endangered (CR), three Endangered (EN), six Vulnerable (VU), five Near Threatened (NT), four Least Concern (LC), and two are Data Deficient (DD) (IUCN Bangladesh 2015). Large-toothed Ferret Badger *Melogale personata* was recorded for the first time from northeastern Bangladesh in 2008 (Islam et al. 2008), although it is not assessed or included in the IUCN Bangladesh (2015).

After segregating the number of publications which targeted at threatened carnivores on both national and global assessments, we found that 14 species were without any dedicated work at all. Table 2 shows the comparison and the species without any research. On the other hand, 66 studies were found exclusively dedicated to 14 carnivore species. The studies covered six felids, four mustelids, two herpestids and one for each of a canid and a viverrid species. There are 29 studies which considered higher or multiple taxa: two for the felids, two for the ursids, one for all carnivore mammals of Bangladesh, six for all mammals, and 18
were inclusive of wildlife of Bangladesh (Appendix 1, Fig. 2, Table 2).

**The most- and the least-studied species**

The highest number of publications (n=45) was on Tiger. It experienced all types of publications. Considering the topic, wildlife management and conflict analysis were the most common subjects for studies on Tiger (Fig. 2). In Bangladesh, Tiger is the only carnivore with a conservation action plan that has been formulated twice (Ahmad et al. 2009; Aziz et al. 2018).

There were seven works on the Asian Golden Jackal *Canis aureus*, three on Fishing Cat *Prionailurus viverrinus*, two on Smooth-coated Otter *Lutrogale perspicillata*, one combined study on Masked Palm Civet *Paguma larvata*, and Small Indian Mongoose *Herpestes javanicus*. Only one study was found for each of the Asian Golden Cat *Catopuma temminckii*, Crab-eating Mongoose *Herpestes urva*, Yellow-throated Marten *Martes flavigula*, Large-toothed Ferret Badger, Leopard *Panthera pardus*, Leopard Cat *Prionailurus bengalensis*, Marbled Cat *Pardofelis marmorata* and Oriental Small-clawed Otter *Aonyx cinereus* (Fig. 2).

**Region-wise trend in studies**

A total of 47 studies were found in southwestern region, followed by 12 studies in southeast, 10 from northeast, and seven from central region (Table 3). Among all 95 references there are three studies accomplished by combining different regions in the works by Feeroz et al. (2011), Islam et al. (2013) and Al-Razi et al. (2014). Bangladesh is considered as the study site in 22 studies (Appendix 1). We projected the regions according to number of works and number of species exclusively targeted across regions (Fig. 3). Since 1971, there is no study from southern and northwestern regions (Fig. 3a). Figure 3b indicates the inadequacy in consideration of the number of species in different regions.

Of the 95 works considered for the analyses, 25 carried out the research in both protected and non-protected areas, and 57 of these exclusively considered the protected areas. Only 13 works took non-protected areas as study sites (Appendix 1).

**Year-wise trend in studies**

Only after the year 2000, the number of scientific publications has started to show a noticeable increase (Fig. 4). The highest number of publications were in 2008, 2013, and 2018 (n=7 for each year) (Fig. 4a). We could not find any particular reason behind these spikes; 10 publications on Tiger were found from these three years (n=4 in 2008, 4 in 2013, 2 in 2018). No scientific paper, however, was found until 1974, perhaps because it took some time for the conditions to become conducive for field research after the independence. It was the two recent decades (2001–2010 and 2011–2019) when carnivore studies in Bangladesh gained momentum. These periods were also a leap for conservation science and inventory compilation ventures. Only the current
Table 2A. Number of species in different categories of status

| Global status | Number | Regional status | Number | Global status | Number | Regional status | Number |
|---------------|--------|-----------------|--------|---------------|--------|-----------------|--------|
| EN            | 1      | CR              | 4      | EN            | 1      | CR              | 3      |
| VU            | 5      | EN              | 1      | VU            | 4      | EN              | 2      |
| NT            | 1      | VU              | 3      | NT            | 2      | VU              | 3      |
| LC            | 7      | NT              | 3      | LC            | 7      | NT              | 2      |
|               |        | LC              | 2      |               |        | DD              | 1      |
|               |        | NE              | 1      |               |        |                 |        |

Table 2B. Status of carnivores with no exclusive study in Bangladesh

| Carnivore species                     | Global status | Regional status |
|---------------------------------------|---------------|-----------------|
| Binturong Arctictis binturong         | VU            | VU              |
| Small-toothed Palm Civet Arctogalidia trivirgata | LC            | DD              |
| Common Palm Civet Paradoxurus hermaphroditus | LC            | LC              |
| Large Indian Civet Viverra zibetha    | LC            | NT              |
| Small Indian Civet Viverricula indica | LC            | NT              |
| Indian Grey mongoose Herpestes edwardsi | LC            | LC              |
| Jungle Cat Felis chaus                | LC            | NT              |
| Clouded Leopard Neofelis nebulosa     | VU            | CR              |
| Dhole Cuon alpinus                    | EN            | EN              |
| Bengal Fox Vulpes bengalensis         | LC            | VU              |
| Sun Bear Helarctos malayanus          | VU            | CR              |
| Asiatic Black Bear Ursus thibetanus   | VU            | CR              |
| Hog Badger Arctonyx collaris          | VU            | VU              |
| Eurasian Otter Lutra lutra            | NT            | CR              |

Table 3. Comparison of works across regions of Bangladesh based on publication types and research topics of carnivore mammal studies.

| Region          | Book | Scientific Paper | Doctoral Thesis | Action Plan | Discovery and distribution update | Ecology | Inventory | Zoonotic and anthropo- tonic disease | Population dynamics | Wildlife management and conflict analysis |
|-----------------|------|------------------|-----------------|-------------|----------------------------------|--------|----------|-------------------------------------|---------------------|----------------------------------------|
| Central         | 7    |                  |                 |             | 4                                | 2      | 1        |                                     |                     |                                        |
| Northeast       | 1    | 9                |                 |             | 6                                | 2      | 2        |                                     |                     |                                        |
| North           | 1    |                  |                 |             | 1                                |        |          |                                     |                     |                                        |
| Southeast       | 5    | 6                | 1               |             | 3                                | 8      | 1        |                                     |                     |                                        |
| Southwest       | 5    | 37               | 5               |             | 10                               | 3      | 34       |                                     |                     |                                        |
| Whole Bangladesh| 13   | 7                |                 |             | 2                                | 1      | 1        | 14                                  |                     | 6                                      |
Figure 2. Species-wise preference in carnivore mammal studies in Bangladesh: a—based on different types of publication: action plan, book, scientific paper, and PhD Thesis | b—based on different research topics: discovery and distribution update, inventory, ecology, population dynamics, wildlife management and conflict analysis, and zoonotic & anthroponotic diseases. Appendices 1 and 2 detail out the works and the classification scheme used in these projections.
decade is the period in which we found all seven considered research topics (Fig. 4).

**DISCUSSION**

Severe discrepancies are evidently observed in research trends considering carnivore mammals of Bangladesh. Gaps and biases are present in every criterion that we considered. Species-wise preference, thematic trends, geographic distribution often leaned toward certain species or certain area, likely to have been influenced by conservation and management interests. Involvement in carnivore researches and interest in diverse species are on the rise. It is, however, worrisome that Bangladesh is at risk of losing more than half of its carnivore diversity, but, deployment of novel methodologies to study elusive and ‘apparently absent’ species is still very sketchy.

Highlighting the least-known and the least-understood species

Researches on Tiger, a flagship species of Bangladesh, make over half of all carnivore research counts. On the contrary, a single study was found on an occurrence record of leopard. The Indian Leopard *Panthera pardus* was thought to have been extirpated from Bangladesh. Among media reports, that may sometime form the beginning to a proper field research (Singh 2020), the term ‘leopard’ appears to be confused with that of Fishing Cat. In the last 12 years, based on verifiable media reports, however, there were instances of 16 Leopards appearing from northern and eastern corners of Bangladesh, each from different cases; six of which were killed as retaliatory responses (Akash et al. submitted). Bear is another charismatic carnivore yet got only one published scientific paper and one book chapter on status assessment (Sarker 2006; Islam et al. 2013; IUCN Bangladesh 2015). Some species are recorded in recent times (*Binturong Arctictis binturong*,
Crab-eating mongoose, Large-toothed Ferret Badger, Yellow-throated Marten, and Hog Badger _Arctonyx collaris_ or have only distant sightings (Small-toothed Palm Civet _Arctogalidia trivirgata_) but no further scientific investigations have been carried out. When the Tiger is the only carnivore to get its conservation action plan twice, 14 other extant carnivores of Bangladesh lack any sort of scientific documentation.

**Approaching contemporary study techniques**

Our review has highlighted the scattered and scarce data on 28 carnivores from 1971 to 2019 (Table 3, Fig. 4). It is also observed that IUCN Bangladesh (2015) assessed the country’s carnivores mostly through sighting records or expert opinions. Of course, as implied in Singh (2020), all technical accounts may not follow from planned, long-term field research. Figures 3 and 4 clarify the clear lack in study effort. For example, although southeastern region is known for many carnivores, studies in this region have targeted only two species. Again, while there appears a preference for works like mitigation of conflicts and assessment of biodiversity, there is a certain deficit in species- or taxa-oriented ecological studies (Fig. 4). These can be attributed to challenges of encountering wild carnivores and the rugged terrain in certain areas. Non-invasive and novel technologies such as remote camera-trapping, radio-collaring, and systematic analytical approaches (species distribution modelling, density estimates) which can resolve these difficulties are limited to studies on the Tiger and, to a lesser extent, the jackal (Poche et al. 1987; Khan 2012; Aziz et al. 2018). It is true that, in many cases, the duration allowed and funds available determine the type of research work. Sometimes, these are opportunistic...
or out of convenience to fulfil a target.

Emphasizing the hypothetical ‘empty forest’

We found that the majority of studies (n=47) carried out in the Sundarbans, exclusively focused on Tiger-related management and conflict issues (Table 3, Fig. 3a). Southeastern Bangladesh, though ranked the second, lagged far behind relative to the number of publications (n= 12), and performed mostly on the diversity and richness of certain protected areas (Feeroz et al. 2012; Feeroz 2013, 2014; Karim & Ahsan 2016; Khan et al. 2016; Kabir et al. 2017). Northeastern Bangladesh too (n=10) has received less than expected attention, having been investigated mostly for Fishing Cat (Giordano & Feeroz 2013; Rahman & McCarthy 2014). When compared to the mangroves, no other forest of the country has experienced likewise focus on carnivore research. In particular, the moist evergreen forests of Bangladesh are often ignored, deemed as ‘empty forest’ with no sustainable large carnivore population. On the contrary, eastern forests together stand larger than the Sundarbans. Furthermore, Khan (2012), Feeroz (2013, 2014), Chakma (2015), Khan (2015), and CCA (2016) showed the presence of apex predators and umbrella species from these areas. On further interesting note, in the recent years, Rahman (2017) and Zakir (2019), two unpublished MS theses, targeted least-known carnivores of northeastern Bangladesh, carried out camera-trap surveys, and showed some remarkable findings including the Asian Golden Cat and the Asian Wild Dog (Cuon alpinus). Therefore, it is necessary to plan for large-scale structured camera-trapping, that could reveal the status of the carnivore fauna and their ecological associates in these hypothetical ‘empty forests’.

Addressing newer research scopes

For northwestern, central, northern, and southern regions, Figure 3b depicted an extreme gap in knowledge. The regions support small carnivores, e.g., Bengal Fox (Vulpes bengalensis), Fishing Cat, Jungle Cat (Felis chaus), Leopard Cat, Large Indian Civet (Viverra zibetha), Small Indian Civet (Viverricula indica), and Common Palm Civet (Paradoxurus hermaphroditus) (Khan 2015; Khan 2018). The species are at risk, continuously persecuted across Bangladesh, at forest peripheries, fragmented patches and homestead jungles. Whereas Tiger in Bangladesh has been studied under broad spectra, their ecology, risk assessment, local perception and conflict management for these lesser species living outside protected areas have never been tried. Future research can put small carnivores as umbrella species for the fast disappearing village/peri-urban groves and wet deciduous forest.

Tiger is undoubtedly a flagship icon for Bangladesh, yet, the country harbors many other remarkable carnivores and unique habitats. Our knowledge on most of their ecology and management strategies are at a bare minimum. This paucity hinders adequate regional and global conservation attention and practices. Therefore, this assessment of the trend of research on mammalian carnivores highlights the gaps in research. Developing more comprehensive knowledge and researched data are expected to aid in future management across the regions where scientific investments have been traditionally low, the availability of data have been sparse and action for conservation is an exigency.

REFERENCES

Ahmad M.I.U., C.J. Greenwood, A.C.D. Barlow, M.A. Islam, A.N.M. Hossain, M.M.H. Khan & J.L.D. Smith (2009). Bangladesh Tiger Action Plan 2009–2017. Ministry of Environment and Forests, Bangladesh Forest Department, Dhaka.

Ahmed, A.T.A, S.M.H Kabir, M. Ahmad, Z.U. Ahmed, Z.N.T. Begum, M.A. Hassan & M. Khondker (eds.) (2009). Encyclopaedia of flora and fauna of Bangladesh, Vol. 27: Mammals. Asiatic Society of Bangladesh, Dhaka, 264 pp.

Akash, M., S. Trageser, T. Zakir, S.C. Rahman, F.T.Z. Khaleque & A. Ghose (2020). Detecting the spots: A review on leopard occurrences in Bangladesh. Cat News Submitted.

Al-Razi, H., S.M.I. Alam, M.A. Baki & N. Parves (2014). Notes on mating behaviour of two small carnivores in Bangladesh. Small Carnivore Conservation 50: 78–80.

Amin, R., H.S. Baral, B.R. Lamichhane, L.P. Poudyal, S. Lee, S.R. Jnawali, K.P. Acharya, G.P. Upadhyaya, M.B. Pandey, R. Shrestha, D. Joshi, J. Griffiths, A.P. Khattarwada & N. Subedi (2018). The status of Nepal’s mammals. Journal of Threatened Taxa 10(3): 11361–11378. http://doi.org/10.11609/jott.3712.10.3.11361-11378

Aziz, M.A., M.J. Kabir, M. Shamsuddoha, M.M. Ahsan, M.M.R. Chowdury & S.M. Rahman (2018). Second Phase Status of Tigers in Bangladesh Sundarbans 2018. Bangladesh Forest Department, Government of People’s Republic of Bangladesh.

Baker, A.D. & P.L. Leberg (2018). Impacts of human recreation on carnivores in protected areas. PLoS ONE 13(4): e0195436. https://doi.org/10.1371/journal.pone.0195436

Broto, B. & A. Mortelliti (2018). The status of research on the mammals of Sulawesi, Indonesia. Mammal review 49(1): 78–93. https://doi.org/10.1111/mam.12141

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, 52pp.

Chakma, S. (2015). Assessment of large mammals of the Chittagong Hill Tracts of Bangladesh with emphasis on Tiger (Panthera tigris). PhD Thesis. Department of Zoology, University of Dhaka, Bangladesh, 189pp.

Corlett, R.T. (2007). What’s so special about Asian tropical forests? Current Science 93(11): 1551–1557.

Dalerum, F., E.Z. Cameron, K. Kunkel & M.I. Somers (2008). Diversity and depletions in continental carnivore guilds: implications for prioritizing global carnivore conservation. Biology letters 5(1): 35–38. https://doi.org/10.1098/rsbl.2008.0520

Feeroz, M.M. (eds.) (2013). Biodiversity of protected areas of Bangladesh, Vol. III: Teknaf Wildlife Sanctuary. Bio Track, Arannayk
Feeroz, M.M. & S. Siddique (2014). Status and ecological effects of the world’s largest carnivores. Science 343(6167): 1241484. https://doi.org/10.1126/science.1241484

Sarker, M.S.U. (2006). The status and conservation of bears in Bangladesh, pp. 41–44. In: Japan Bear Network (compiler). Understanding Asian Bears to Secure Their Future. Japan Bear Network, Ibaraki, Japan, 145pp.

Sergio, F., T. Caro, D. Brown, B. Clucas, J. Hunter, J. Ketchum, K. McHugh & F. Hiraldo (2008). Top predators as conservation tools: ecological rationale, assumptions, and efficacy. Annual review of ecology, evolution, and systematics 39: 1–19. https://doi.org/10.1146/annurev.ecolsys.39.110707.173545

Singh, L.A.K. (2020). The State of Wildlife and Protected Areas in Maharashtra: News and Information from the Protected Area Update 1996–2015. Journal of Threatened Taxa 12(3): 15405–15406. https://doi.org/10.11690/jtt.5791.12.3.15405-15406

Suraci, J.P., M. Clinchy & L.Y. Zanette (2017). Do large carnivores and mesocarnivores have redundant impacts on intertidal prey?. PLoS ONE 12(1): e0170255. http://doi.org/10.1371/journal.pone.0170255

Treves, A. & K.U. Karanth (2003). Human-carnivore conflict and perspectives on carnivore management worldwide. Conservation biology 17(6): 1491–1499. https://doi.org/10.1046/j.1523-1739.2003.00059.x

Verde Arregoitia, L.D. (2016). Biases, gaps, and opportunities in mammalian extinction risk research. Mammal Review 46(1): 17–29. https://doi.org/10.1111/mam.12049

Wangchuk, T. (2004). A Field Guide to The Mammals of Bhutan. Mammals of Bhutan. Department of Forestry, Ministry of Agriculture, Royal Government of Bhutan.

WDPA (2016). Satrachi National Park. WDPA, World Database on Protected areas, United Nations Environment Programme, Nairobi.

Zakir, T. (2019). Diversity and activity patterns of mammalian carnivores in the Satrachi National Park, Bangladesh. MS Thesis (unpublished). Department of Zoology, University of Dhaka, Bangladesh, 150pp.
### Appendix 1. Reviewed literature with different categorization schemes.

| Taxa/Species/Group | Theme                                         | Region          | Author                                                                 |
|--------------------|------------------------------------------------|-----------------|----------------------------------------------------------------------|
| **(A.) Peer-reviewed scientific papers** |                                                |                 |                                                                      |
| Tiger              | Ecology                                        | Southwest       | Reza et al. (2001a,b), Khan & Chivers (2007), Khan (2008a), Barlow et al. (2010, 2011) |
|                   | Population dynamics                             | Southwest       | Khan (2012a), Aziz et al. (2017)                                      |
|                   | Wildlife management and conflict analysis       | Southwest       | Gani (2002), Reza et al. (2002a,b), Azad et al. (2005), Islam et al. (2007), Muhammed et al. (2007), Barlow et al. (2008, 2010, 2013), Khan (2009), Loucks et al. (2010), Neumann-den Zau & Denzau (2010), Aziz et al. (2013, 2017, 2018), Inskip et al. (2013, 2014, 2016), Mohsanin et al. (2013), Khanom & Buckley (2015), Rahim et al. (2015), Saif et al. (2016, 2018), Hossain et al. (2018), Mukul et al. (2019) |
| Leopard            | Discovery and distribution update              | Southeast       | Kabir et al. (2017)                                                  |
| Asian Golden Cat   | Wildlife management and conflict analysis       | Southeast       | Khan (2008b)                                                         |
| Marbled Cat        | Discovery and distribution update              | Northeast       | Khan (2015)                                                          |
| Leopard Cat        | Ecology                                        | Southwest       | Khan (2004a)                                                         |
| Fishing Cat        | Discovery and distribution update              | Northeast       | Giordano & Feeroz (2013)                                             |
|                    | Ecology                                        | Northeast       | Rahman & McCarthy (2014)                                             |
|                    | Wildlife management and conflict analysis       | Whole Bangladesh| Chowdhury et al. (2015)                                              |
| Asiatic Golden Jackal | Ecology                                      | Whole Bangladesh| Sarker & Ameen (1990)                                                |
|                    | Central                                        |                | Jaeger et al. (1996, 2007)                                           |
|                    | Investigation of zoonotic and anthroponotic disease | Central      | Khan et al. (2012), Yousuf et al. (2014)                             |
|                    | Wildlife management and conflict analysis       | Whole Bangladesh| Brooks et al. (1993)                                                 |
| Oriental Small-clawed Otter | Ecology                              | Southwest       | Aziz (2018)                                                          |
| Smooth-coated Otter | Ecology                                      | Central, Southwest| Feeroz et al. (2011)                                                |
| Yellow-throated Marten | Discovery and distribution update            | Northeast       | Hasan et al. (2019)                                                  |
| Large-toothed Ferret Badger | Discovery and distribution update          | Northeast       | Islam et al. (2008)                                                  |
| Crab-eating Mongoose | Discovery and distribution update           | Northeast       | Hasan et al. (2018)                                                  |
| Small Indian Mongoose and Masked Palm Civet | Ecology                               | Central, Northeast| Al-Razi et al. (2014)                                                |
| Felid              | Discovery and distribution update              | Whole Bangladesh| Khan (2004b)                                                         |
| Ursid              | Discovery and distribution update              | North, Northeast, Southeast | Islam et al. (2013)                                                |
| Carnivore mammals  | Wildlife management and conflict analysis      | Whole Bangladesh| Rawshan et al. (2012)                                                |
| All mammals        | Inventory                                      | Northeast       | Aziz (2011)                                                          |
|                    | South East                                     |                | Ahsan et al. (2008), Karim & Ahsan (2016)                            |
| All wildlife       | Discovery and distribution update              | Southeast       | Khan (2012b)                                                         |
|                    | Inventory                                      | Whole Bangladesh| Husain (1974), Gittins (1982)                                        |
| **(B.) Books/Book chapters** |                                                |                 |                                                                      |
| Tiger              | Wildlife management and conflict analysis       | Southwest       | Seidensticker (1986), Khan (1987a), Khan et al. (2003), Reza et al. (2004), Saif & MacMillan (2016) |
### Appendix 2. Publications on carnivores of Bangladesh in chronological order (1971–2019).

| Scientific Papers |
|-------------------|
| 1 Husain K.Z. (1974). An Introduction to the Wildlife of Bangladesh. Motijheel, Dhaka, Bangladesh. |
| 2 Gittins, S.P. & A.W. Akonda (1982). What survives in Bangladesh? Oryx 16: 275–281. https://doi.org/10.1017/S003060530001752X |
| 3 Poche, R.M., S.J. Evans, P. Sultana, M. Haque, M.E, R. Sterner & M.A. Siddique (1987). Notes on the golden jackal (Canis aureus) in Bangladesh. Mammalia 51: 259–270. |
| 4 Sarker, N.J. & M.N. Ameen (1990). Food habits of jackals (Canis aureus). Journal of Zoology 18: 189–202. |
| 5 Brooks, J.E., M.E. Haque & S. Ahamad (1993). Status of the golden jackal as an agricultural pest in Bangladesh. Crop Protection 12(8): 563–564. https://doi.org/10.1016/0261-2194(93)90118-3 |
| 6 Jaeger, M.M., R.K. Pandit & E. Hawque (1996). Seasonal differences in territorial behavior by golden jackals in Bangladesh: howling versus confrontation. Journal of Mammalogy 77(3): 768–775. https://doi.org/10.2307/1382682 |
| 7 Reza, A.H.M.A., M.M. Feeroz & M.A. Islam (2001a). Food habits of the Bengal tiger (Panthera tigris tigris) in the Sundarbans. Journal of Zoology 29(2): 173–180. |
| 8 Reza, A.H.M.A., M.M. Feeroz & M.A. Islam (2001b). Habitat preference of the Bengal tiger, Panthera tigris tigris in the Sundarbans of Bangladesh. Bangladesh Journal of Life Science 13: 215–217. |
| 9 Gani, M.O. (2002). A study on the loss of Bengal tiger (Panthera tigris) in five years (1996–2000) from Bangladesh Sundarbans. Tigerpaper 29: 7–12. |
| 10 Reza, A.H.M.A., M.M. Feeroz & M.A. Islam (2002a). Man-tiger interaction in the Sundarbans. Bangladesh Journal of Life Sciences 14(1–2): 75–82. |
| 11 Reza, A.H.M.A., M.M. Feeroz & M.A. Islam (2002b). Prey species density of Bengal Tiger in the Sundarbans. Journal of Asiatic Society Bangladesh, Science 28: 35–42. |
| 12 Khan, M.M.H. (2004a). Food habit of the leopard cat Prionailurus bengalensis (Kerr, 1792) in the Sundarbans East wildlife sanctuary. Bangladesh. Zoons’ Print Journal 19(5): 1475–1476. |
| 13 Khan, M.M.H. (2004b). Status and distribution of wild cats in Bangladesh. Bangladesh Journal of Life Sciences 17(1): 69–74. |
| 14 Azad, M.A.K., M.A. Hashem & M.M. Hossain (2005). Study on human Royal Bengal tiger Interaction of in situ and ex situ in Bangladesh. Journal of Biological Sciences 5(3): 250–252. |
| 15 Islam, M.W., M.S. Alam & M.M. Islam (2007). Study of human casualties by Bengal tigers (Panthera tigris tigris L.) in the Sundarban forest of Bangladesh. Tiger Paper 34: 11–15. |
Reviewing carnivore studies in Bangladesh

Akash & Zakir

Human-Fishing Cat Conflicts and Conservation Needs of Fishing Cats in the Sundarbans, Bangladesh. *J. Mammal.* 98(1-2): 291.

First confirmed record of marbled cat in Bangladesh. *Cat News.* 24(5): 1338–1347.

Female tiger *Panthera tigris* in Bangladesh with special reference to tiger–human conflict. *Journal of Social Research and Development.* 4: 86–91.

Behavioral change due to climate change effects accelerate tiger human conflicts: a study on Sundarbans mangrove forests, Bangladesh. *International Journal of Conservation Science.* 6(4): 669–684.
Reviewing carnivore studies in Bangladesh

Khan, M.A.R. (1985). Mammals of Bangladesh: A Field Guide. Dhaka, Bangladesh, 92pp.

Khan, M.A.R. (1987a). Mammals of Bangladesh. Vol. 3. Mammals of Bangladesh, Vol. 3. IUCN- The World Conservation Union, Dhaka, Bangladesh, 264pp.

Khan, M.A.R. (1987b). Bangladesher Banyaprani (Wildlife of Bangladesh), Vol-2. Bangladesh Forest Department, Dhaka, Bangladesh, 167pp.

Khan, M.A.R. (1988). eyebrow-throated marten Martes flavigula in Satchari National Park, Sylhet, Bangladesh. Journal of the Bombay Natural History Society 115: 57–58.

Khan, M.A.R. (1996). Bangladesher Banyaprani (Wildlife of Bangladesh), Vol-1. Bangladesh Forest Department, Dhaka, Bangladesh, 167pp.

Khan, M.A.R. (2000). Red book of threatened mammals of Bangladesh. IUCN Bangladesh, Dhaka.

Khan, M.A.R. (2010). Red Book of threatened mammals of Bangladesh. IUCN Bangladesh, Dhaka.

Khan, M.A.R. (2016). Toward human-carnivore coexistence: understanding tolerance for tigers in Bangladesh. PLoS ONE 21(1): 1–20. https://doi.org/10.1371/journal.pone.014591

Khan, A.H., M.A. Feeroz, M.K. Hasan, M. Ahmad, M. Naheem, M.R. Islam & J.J. Groombridge (2017). Effects of climate change and sea-level rise project dramatic habitat loss of the globally endangered Bengal tiger in the Bangladesh Sundarbans. Science of the Total Environment 663: 830–840. https://doi.org/10.1016/j.scitotenv.2019.01.383

Khan, M.A.R. (1986). The status and distribution of the cats in Bangladesh, pp. 43–49. In: Miller, S.D. & D.D. Everett (eds.). Cats of the World: Biology, Conservation and Management. National Wildlife Federation, Washington DC.

Khan, M.A.R. (2010). Large carnivores and the consequences of habitat insularization: ecology and conservation of tigers in Indonesia and Bangladesh, pp. 11–13. In: S.Kh. Abdullah & E. Seidensticker (eds.). Large carnivores and the consequences of habitat insularization: ecology and conservation of tigers in Indonesia and Bangladesh, pp. 11–13. UNESCO, World Conservation Monitoring Centre, Cambridge, 160pp.

Khan, M.A.R. (1982). Using non-invasively collected genetic data to estimate density and population size of tigers in the Bangladesh Sundarbans. Global Ecology and Conservation 12: 272–282. https://doi.org/10.1016/j.gecco.2017.09.002

Khan, M.A.R. (1983). Toward human-carnivore coexistence: understanding tolerance for tigers in Bangladesh. PLoS ONE 21(1): 1–20. https://doi.org/10.1371/journal.pone.014591

Khan, M.A.R. (2010). Red Book of threatened mammals of Bangladesh. IUCN Bangladesh, Dhaka.

Khan, M.A.R. (2000). Red book of threatened mammals of Bangladesh. IUCN Bangladesh, Dhaka.

Khan, M.A.R. (2016). Toward human-carnivore coexistence: understanding tolerance for tigers in Bangladesh. PLoS ONE 21(1): 1–20. https://doi.org/10.1371/journal.pone.014591

Khan, M.A.R. (2010). Red Book of threatened mammals of Bangladesh. IUCN Bangladesh, Dhaka.

Khan, M.A.R. (2000). Red book of threatened mammals of Bangladesh. IUCN Bangladesh, Dhaka.

Khan, M.A.R. (2016). Toward human-carnivore coexistence: understanding tolerance for tigers in Bangladesh. PLoS ONE 21(1): 1–20. https://doi.org/10.1371/journal.pone.014591

Khan, M.A.R. (2010). Red Book of threatened mammals of Bangladesh. IUCN Bangladesh, Dhaka.

Khan, M.A.R. (2000). Red book of threatened mammals of Bangladesh. IUCN Bangladesh, Dhaka.

Khan, M.A.R. (2016). Toward human-carnivore coexistence: understanding tolerance for tigers in Bangladesh. PLoS ONE 21(1): 1–20. https://doi.org/10.1371/journal.pone.014591

Khan, M.A.R. (2010). Red Book of threatened mammals of Bangladesh. IUCN Bangladesh, Dhaka.

Khan, M.A.R. (2000). Red book of threatened mammals of Bangladesh. IUCN Bangladesh, Dhaka.

Khan, M.A.R. (2016). Toward human-carnivore coexistence: understanding tolerance for tigers in Bangladesh. PLoS ONE 21(1): 1–20. https://doi.org/10.1371/journal.pone.014591

Khan, M.A.R. (2010). Red Book of threatened mammals of Bangladesh. IUCN Bangladesh, Dhaka.

Khan, M.A.R. (2000). Red book of threatened mammals of Bangladesh. IUCN Bangladesh, Dhaka.

Khan, M.A.R. (2016). Toward human-carnivore coexistence: understanding tolerance for tigers in Bangladesh. PLoS ONE 21(1): 1–20. https://doi.org/10.1371/journal.pone.014591

Khan, M.A.R. (2010). Red Book of threatened mammals of Bangladesh. IUCN Bangladesh, Dhaka.

Khan, M.A.R. (2000). Red book of threatened mammals of Bangladesh. IUCN Bangladesh, Dhaka.

Khan, M.A.R. (2016). Toward human-carnivore coexistence: understanding tolerance for tigers in Bangladesh. PLoS ONE 21(1): 1–20. https://doi.org/10.1371/journal.pone.014591

Khan, M.A.R. (2010). Red Book of threatened mammals of Bangladesh. IUCN Bangladesh, Dhaka.

Khan, M.A.R. (2000). Red book of threatened mammals of Bangladesh. IUCN Bangladesh, Dhaka.

Khan, M.A.R. (2016). Toward human-carnivore coexistence: understanding tolerance for tigers in Bangladesh. PLoS ONE 21(1): 1–20. https://doi.org/10.1371/journal.pone.014591

Khan, M.A.R. (2010). Red Book of threatened mammals of Bangladesh. IUCN Bangladesh, Dhaka.

Khan, M.A.R. (2000). Red book of threatened mammals of Bangladesh. IUCN Bangladesh, Dhaka.
| Source | Reference |
|--------|-----------|
| 85 | Khan, M.A.R. (1987a). The problem tiger of Bangladesh, pp. 92–96. In: Seal, U.S. & R.L. Tilson (eds.). Tigers of the World. Noyes Publications, New Jersey, USA. |
| 86 | Sarker, M.S.U. (2006). The status and conservation of bears in Bangladesh, pp 41–44. In: Japan Bear Network [complier]. Understanding Asian Bears to Secure Their Future. Japan Bear Network, Ibaraki, Japan, 145pp. |
| 87 | Saif, S. & D.C. MacMillan (2016). Poaching, trade, and consumption of tiger parts in the Bangladesh Sundarbans, pp. 13–32. In: Potter, G., A. Nurse & M. Hall (eds.). The Geography of Environmental Crime: Conservation, wildlife crime and environmental activism. Palgrave, London. |
| PhD Theses | |
| 88 | Reza, A.H.M.A. (2000). Ecology of Bengal tiger, Panthera tigris tigris (Linn. 1758) in the Sundarbans. PhD Thesis. Jahangirnagar University, Dhaka, Bangladesh, 114pp. |
| 89 | Khan, M.M.H. (2004c). Ecology and conservation of the Bengal tiger in the Sundarbans mangrove forest of Bangladesh. PhD Thesis. University of Cambridge, UK, 297pp. |
| 90 | Barlow, A.C.D. (2009). The Sundarbans tiger: evolution, population status and conflict management. PhD Thesis. University of Minnesota, Minnesota, USA, 205pp. |
| 91 | Chakma, S. (2015). Assessment of large mammals of the Chittagong Hill Tracts of Bangladesh with emphasis on Tiger (Panthera tigris). PhD Thesis. Department of Zoology, University of Dhaka, Bangladesh, 189pp. |
| 92 | Saif, S. (2016). Investigating tiger poaching in the Bangladesh Sundarbans. PhD Thesis. University of Kent, Canterbury, UK, 89pp. |
| 93 | Aziz, M.A. (2017). Population status, threats, and evolutionary conservation genetics of Bengal tigers in the Sundarbans of Bangladesh. PhD Thesis. University of Kent, UK, 252pp. |

**Action Plan**

| Source | Reference |
|--------|-----------|
| 94 | Ahmad M.I.U., C.J. Greenwood, A.C.D. Barlow, M.A. Islam, A.N.M. Hossain, M.M.H. Khan & J.L.D. Smith (2009). Bangladesh Tiger Action Plan 2009–2017. Ministry of Environment and Forests, Bangladesh Forest Department, Dhaka. |
| 95 | Aziz, M.A., M.J. Kabir, M. Shamsuddoha, M.M. Ahsan, M.M.R. Chowdhury & S.M. Rahman (2018). Second Phase Status of Tigers in Bangladesh Sundarbans 2018. Bangladesh Forest Department, Government of People’s Republic of Bangladesh. |

**Project Reports**

| Source | Reference |
|--------|-----------|
| 96 | 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, 52pp. |
| 97 | Dey, T.K., M.J. Kabir, M.M. Ahsan, M.M. Islam, M.R. Chowdhury, S. Hassan, M. Roy, Q. Qureshi, D. Naha, U. Kumar & Y.V. Jhala (2015). First Phase Tiger Status Report of Bangladesh Sundarbans, 2015. Bangladesh Forest Department, Ministry of Environment and Forests, Government of Bangladesh. |
| 98 | Rahman, A., P. Lehan, A.N.M. Hossain, M. Ahsan, S. Chakma, J. Probert, S. Mahmod, H.A. Kabir & R. Karim (2012). Bangladesh Sundarbans Relative Tiger Abundance Survey: Technical Report 2012, Dhaka, Bangladesh. |
| 99 | Hossain, A.N.M., P. Lahann, A.C. Barlow, M.A. Islam, C.J. Greenwood & I.U. Ahmed (2012). Bangladesh Sundarbans relative tiger abundance survey. Wildlife Trust of Bangladesh, Dhaka, Bangladesh. |
| 100 | Alam, M.M., M.A. Rahman, M.K. Islam, J. Probert & P. Lahann (2011). Bangladesh Sundarbans tiger human conflict report 2011. Wildlife Trust of Bangladesh, Dhaka, Bangladesh. |
| 101 | Rahman, H.A., A.C.D. Barlow, C.J. Greenwood, M.A. Islam & I.U. Ahmed (2009). Livestock depredation by tiger on the edge of the Bangladesh Sundarbans. Technical Report. Wildlife Trust of Bangladesh, Dhaka, Bangladesh. |
| 102 | Islam, M.A., S.B. Muzaffar, M.A. Aziz, M.M. Kabir, M. Uddin, S. Chakma, S.U. Chowdhury, M.A. Rashid, G.W. Chowdhury, S. Mohsanin & J. Jahan (2010). Baseline survey of Bears in Bangladesh. WildTeam, Dhaka, Bangladesh. |
The Journal of Threatened Taxa (JoTT) is dedicated to building evidence for conservation globally by publishing peer-reviewed articles online every month at a reasonably rapid rate at www.threatenedtaxa.org. All articles published in JoTT are registered under Creative Commons Attribution 4.0 International License unless otherwise mentioned. JoTT allows unrestricted use, reproduction, and distribution of articles in any medium by providing adequate credit to the author(s) and the source of publication.

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

November 2020 | Vol. 12 | No. 15 | Pages: 17063–17170
Date of Publication: 26 November 2020 (Online & Print)
DOI: 10.11609/jott.2020.12.15.17063-17170

www.threatenedtaxa.org

### Articles

**Status of Nahan's Partridge Ptilopachus nahani** (Dubois, 1905) (Aves: Galliformes: Odontophoridae) in Uganda
– Eric Sande, Sisiria Akoth, Ubaldo Rutazaana & William Olupot, Pp. 17063–17076

**Fish diversity in streams/ rivers of Kalakad-Mundanthurai Tiger Reserve, Tamil Nadu, India**
– K. Kannan & J.A. Johnson, Pp. 17077–17092

**Gastrointestinal helminth and protozoan infections of wild mammals in four major national parks in Sri Lanka**
– Chandima Sarani Sepalage & Rupika Subashini Rajakaruna, Pp. 17093–17104

### Review

**Appraising carnivore (Mammalia: Carnivora) studies in Bangladesh from 1971 to 2019 bibliographic retrieves: trends, biases, and opportunities**
– Muntasir Akash & Tania Zakir, Pp. 17105–17120

### Communications

**Diversity of scorpions (Arachnida: Scorpiones) in Polonnaruwa Archaeological Reserve, Sri Lanka**
– Kumudu B. Wijesooriya, Lakshani S. Weerasekara & Kithsiri B. Ranawana, Pp. 17121–17128

**A faunistic survey of tiger beetles (Coleoptera: Carabidae: Cicindelinae) in Chakrashila Wildlife Sanctuary and adjoining riverine ecosystem in Assam, India**
– Kushal Choudhury, Chandan Das & Amar Deep Soren, Pp. 17129–17137

**Occurrence of the Aporrectodea caliginosa caliginosa (Savigny, 1826) (Annelida: Clitellata: Haplotaxida) from Kashmir Valley, Jammu & Kashmir, India**
– Ishtiyaq Ahmed Najjar, Anisa B. Khan & Abdul Hai, Pp. 17138–17146

### Short Communications

**Avian congregation sites in the Gulf of Kachchh, Gujarat, India**
– Jigar D. Joshi, Sandeep B. Munjpara, Kinjal Joshi, Harshad Salvi & R.D. Kamboj, Pp. 17147–17152

**Checklist of brachyuran mangrove crabs of Kerala, India**
– Kurian Mathew Abraham & Apreshgi Kolothuthara Prakasan, Pp. 17153–17160

### Notes

**A new country record of Smooth-backed Gliding Gecko Gekko lionotum (Annandale, 1905) (Squamata: Gekkonidae) from Bangladesh**
– M. Rashedul Kabir Bhuiyan, M. Fazle Rabbe, Mohammad Firoj Jaman, Ananda Kumar Das & Samiul Mohsanin, Pp. 17161–17164

**Amblyomma gervaisi (Ixodida: Ixodidae: Amblyomma) infestation in a Rat Snake from northwestern Himalayan region: a case study**
– Aman D. Moudgil, Ankur Sharma, Adarsh Kumar, Amit Singla & Surender Bansal, Pp. 17165–17167

**Parasitic enteritis in the free-ranging Common Myna Acridotheres tristis (Aves: Passeriformes: Sturnidae)**
– Rakesh Kumar, Aman Dev Moudgil, Sameeksha Koundal, Rajendra Damu Patil & Rajesh Kumar Asrani, Pp. 17168–17170