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COVER PAGE

Stump-tailed Macaque *Macaca arctoides* mother grooming infant. Khao Tao Mo, Phetchaburi, Thailand. Photo by Neil Challis Photography

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GUEST EDITORIAL: THE ROLE OF THE RESCUE CENTRE IN INDONESIAN SLOW LORIS CONSERVATION

In the early 2010s, the illegal pet trade in Indonesian slow lorises was in full swing. For decades, protected slow lorises had been traded openly in domestic wildlife markets across Indonesia. In Jakarta's notorious Jatinegara market, dozens of slow lorises could be observed on display at any one time. The conservation community had begun to cite wildlife trade as the greatest threat to the survival of Indonesian slow lorises, particularly the Critically Endangered Javan species. Unfortunately, the dire situation took another turn for the worse: online trade was gaining momentum, and then, in 2013, it eclipsed the physical market trade and continued to rise exponentially.

While prized among wildlife pet owners for their cute and exotic appearance, they remained relatively unknown to the general public and conservation authorities alike. Law enforcement officials, often with limited capacity and resources, tended to overlook slow lorises in trade in favour of apprehending traffickers of higher-profile species such as tigers and orangutans. Lack of law enforcement and increasing demand from online pet-lover communities drove up trade. Something needed to be done.

Yayasan IAR Indonesia's (YIARI) Ciapus Primate Rescue Centre in West Java opened in 2008 and immediately started receiving slow lorises from trade, providing them with specialist care, medical treatment and housing. A translocation programme was established in 2010. However, maximising success in translocation projects can be an arduous, costly and drawn-out affair. Unsurprisingly, the inflow of slow lorises to the centre remained greater than that which could be appropriately and safely returned to the wild. The rescue centre was reaching full capacity.

In 2012, YIARI implemented a holistic strategy based on the Jane Goodall Institute's 'Triangle Approach', featuring three connected components: law enforcement, education, and sanctuary. Support was provided to the government through sharing intelligence and by increasing capacity in a series of workshops for conservation law enforcement agencies and prosecutors across the country. A national slow loris campaign was launched in 2014 to raise public awareness about slow lorises and highlight successful law enforcement action.

As the numbers of seizures, arrests and convictions for slow loris trade began to rise, so did the coverage of these efforts in local and national media. Even during the most prolific law enforcement efforts by the authorities (2016-18), YIARI's rescue centre managed to keep up with the growing influx of animals by expanding its facilities. Over 1300 slow lorises were rescued, and suitable individuals were released back into the wild.

Through a decade of trade monitoring, the effect of the strategy was evaluated. In 2018, the number of slow lorises in trade sharply reduced and continued in a downward trend in subsequent years. Once ubiquitous in wildlife markets across Indonesia, slow lorises are now rarely seen, and their presence has reduced significantly on online trade platforms. By 2022, a 93% reduction in trade volume had occurred since its peak in 2017.

We contend that the combination of improved law enforcement, education and sanctuary contributed directly to this reduction. Had any of these key components been absent, the impact of this approach would not have been so powerful. Rescue and rehabilitation centres often receive criticism for their debatable conservation value; however, their contribution can be significant when integrated into a larger and longer-term species-specific conservation strategy. Evidently, rescuing wildlife alone is not the solution to the root cause of the problem; it merely addresses the symptoms. The goal of the YIARI rescue centre is to no longer have to receive slow lorises from trade; ironically, it strives for redundancy.

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TEMPORARY FISSIONS IN A GROUP OF LION-TAILED MACAQUES *Macaca silenus* IN THE WESTERN GHATS, INDIA

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ABSTRACT

Group living primates sometimes split into smaller subgroups for varying periods and merge again. Intragroup competition for food appears to be one of the main reasons for such temporary splits. We here report 11 instances of temporary fissions in a group of Lion-tailed Macaques *Macaca silenus* in the Western Ghats of India. More group splits occurred in the dry season than in the wet season. The frequency of fissions was higher in the mornings than in the afternoons. The subgroup that initiated the group fission was always smaller than the main subgroup, defined as the subgroup with the alpha male. The average duration of the splits was 133.6 minutes. The second subgroup travelled greater distances during fission events than the main subgroup. We infer that *M. silenus*, especially larger groups, form fission-fusion social groups, especially when resources are scarce.

Keywords: *Macaca silenus*, temporary group fission, season, day time, Western Ghats

INTRODUCTION

Most primate species live in groups and experience associated costs and benefits (Markham & Gesquiere, 2017). In many group-living animal species, some individuals stray from the main group for periods ranging from a few hours to several days and then join the group again. If this is a frequently repeated phenomenon, such a social system is called a fission-fusion society (Kummer, 1971). Fission-fusion can be found in many species of primates, including Golden Snub-Nosed Monkeys *Rhinopithecus roxellana* (Milne-Edwards) (Qi et al., 2014), Hamadryas Baboons *Papio hamadryas* (Linnaeus) (Henriquez et al., 2021), Spider Monkeys *Ateles geoffroyi* (Kuhl) (Pinacho-Guendulain & Ramos-Fernández, 2017; Hartwell et al., 2018) and Black-and-White Ruffed Lemurs *Varecia variegata* (Kerr) (Holmes et al., 2016).

In general, the fission-fusion social organization has been explained as a response to environmental constraints, constrained by social relationships and the trade-off between the benefits and costs of association. Group living offers several advantages, such as decreased risk of predation, increased foraging efficiency, and ease of finding mates. However, living with other individuals in a group also leads to within-group competition for food resources, with larger groups predicted to experience higher costs (Janson, 1988). For example, larger groups in Mountain Gorillas *Gorilla beringei beringei* (Matschie) tend to have larger home ranges and core areas but show less core area fidelity, indicating that they experience greater within-group feeding competition (Seiler & Robbins, 2020). When a group does not have sufficient food resources to meet the requirements of all of its members, it is likely to split into smaller subgroups that forage in different places (Sueur & Maire, 2014). Fission may also become permanent, resulting in the formation of separate groups. In recent years, many authors have discussed the dynamics of fission-fusion social groups (Aureli et al., 2008) and analyzed the context and consequences of fission-fusion grouping, considering proximate factors favouring temporary fission, collective decision-making by individuals initiating the split, and the relationships among individuals that split into groups. For example, Sueur et al. (2010) demonstrated that in Rhesus Macaques *Macaca mulatta* (Zimmermann), which have a nepotistic social structure, fission tended to be structured along kinship lines. In contrast, in the more non-kin tolerant Tonkean Macaques *M. tonkeana*

(Meyer), sub-grouping was structured by patterns of affiliation, which did not map perfectly onto kinship. Using group size, nutritional needs, and changes in social network after a temporary fission, Sueur & Maire (2014) modelled group fission and demonstrated that irreversible group fission should occur in fewer days if the nutritional needs were great and the network of social relationships was weak among group members. Species differ in their probability of having more than one subgroup at a given time. Using Shannon's entropy for quantification of temporal variation in subgroup composition, Ramos-Fernandez et al. (2018) demonstrated that the composition of Gelada *Theropithecus gelada* (Rüppell) subgroups was more stable than those of Chimpanzees *Pan troglodytes* (Blumenbach) and Spider Monkeys *Ateles geoffroyi* (Kuhl). However, more field studies are required on fission-fusion systems for models to be developed based on the field data.

The Lion-tailed Macaque *M. silenus* (Linnaeus) is endemic to the rainforests of the Western Ghats of India, and has been categorized as Endangered (Singh et al., 2020) by the IUCN Red List. *Macaca silenus* has a modal group size of about 18 in large forest complexes, though the group size varies significantly in forest fragments (Singh et al., 2002). Most groups have only one adult male with several adult females and immature individuals (Kumar, 1987). They are primarily frugivorous, but faunal components account for about 19% of their total diet (Kumara et al., 2000). Here, we report systematic observations of temporary group splits in a group of *M. silenus* in Nelliyampathy Forest Reserve and add to the growing literature on fission-fusion behaviour in group-living species. In Nelliyampathy Forest Reserve, the wet season has the highest resource abundance, and the dry season is a period of relative scarcity for *M. silenus* (Erinjery et al., 2015). *Macaca silenus* groups increase their home range and daily path length during the dry season when compared with the wet season. Since meeting their nutritional needs appears to be more challenging in the dry season, we predicted that *M. silenus* would fission more frequently during the dry season than the wet season.

MATERIALS AND METHODS

The study was conducted on a single group of *M. silenus* from December 2010 to October 2012 in the Nelliampathy Reserve Forest, which is located at $10^0$25'–$10^0$30'N and $76^0$35'–$76^0$45'E, Western Ghats, Kerala, India (Fig. 1). Nelliyampathy Reserve Forest is inhabited by at least five large groups (>25 individuals) of *M. silenus*. Nilgiri Langurs *Semnopithecus johnii* (J. Fischer) and Bonnet Macaques *M. radiata* (É. Geoffroy) are sympatric with *M. silenus* in the area. In the Anamalai Tiger Reserve, an area adjoining Nelliyampathy with similar forest types, *M. radiata* and *M. silenus* were observed competing for flowers of *Cullenia exarillata* (A. Robyns) for about two months in the rainforest habitat of *M. silenus*, but during the rest of the year, *M. radiata* ranged only in the adjoining dry forests (Sushma & Singh, 2006); *S. johnii*, being primarily folivorous, had very little food niche overlap with macaques, but spatially overlapped with *M. silenu*s. June to November is considered the wet season in this region, and December to May is the dry season. *Artocarpus heterophyllus* (Lamarck) and *C. exarillata* in the wet season, and *Ficus amplissima* (Smith) in the dry season, accounted for about 74% of the diet of *M. silenus* (Erinjery et al., 2015). For the present study, we observed *M. silenus* for a total of 845 hours, comprising 430 hours in the wet season and 415 hours in the dry season. The study group was followed from 08:00 h to 17:00 h, which was the main activity period of these macaques in this region. The study group comprised 38 animals, including three adult males (10 years+), 21 adult females (5 years+), two sub-adult males (5–10 years), nine juveniles (1–4 years) and three infants (<1 year) (age classifications based on Kumar, 1987). We collected data on group fissions *ad libitum* during a long-term study on the ecology and behaviour of the group. In the present study, we considered the group to have split if the distance between the two nearest individuals in the subgroups was at least 110 metres, which is the maximum group spread in *M. silenus* as reported by Kumara et al. (2014). In an earlier study (Sakthivelou & Kumar, 1998), a group was considered to be split if the two subgroups were at a minimum distance of 100 m which was almost the same as in the present study. We also recorded the season, time of the day, number of individuals in each subgroup, and duration of the temporary fissions.

DATA ANALYSIS

We used an independent-sample t-test to compare the number of animals in the two subgroups caused by temporary group fissions, with Subgroup 1 identified as the group that contained the alpha male. We ran a chi-square test to determine the association between the number of group splits and hourly time slots. We calculated Pearson product-moment correlation (Pearson's r) to determine the relationship between the number of individuals in the subgroup and the distance

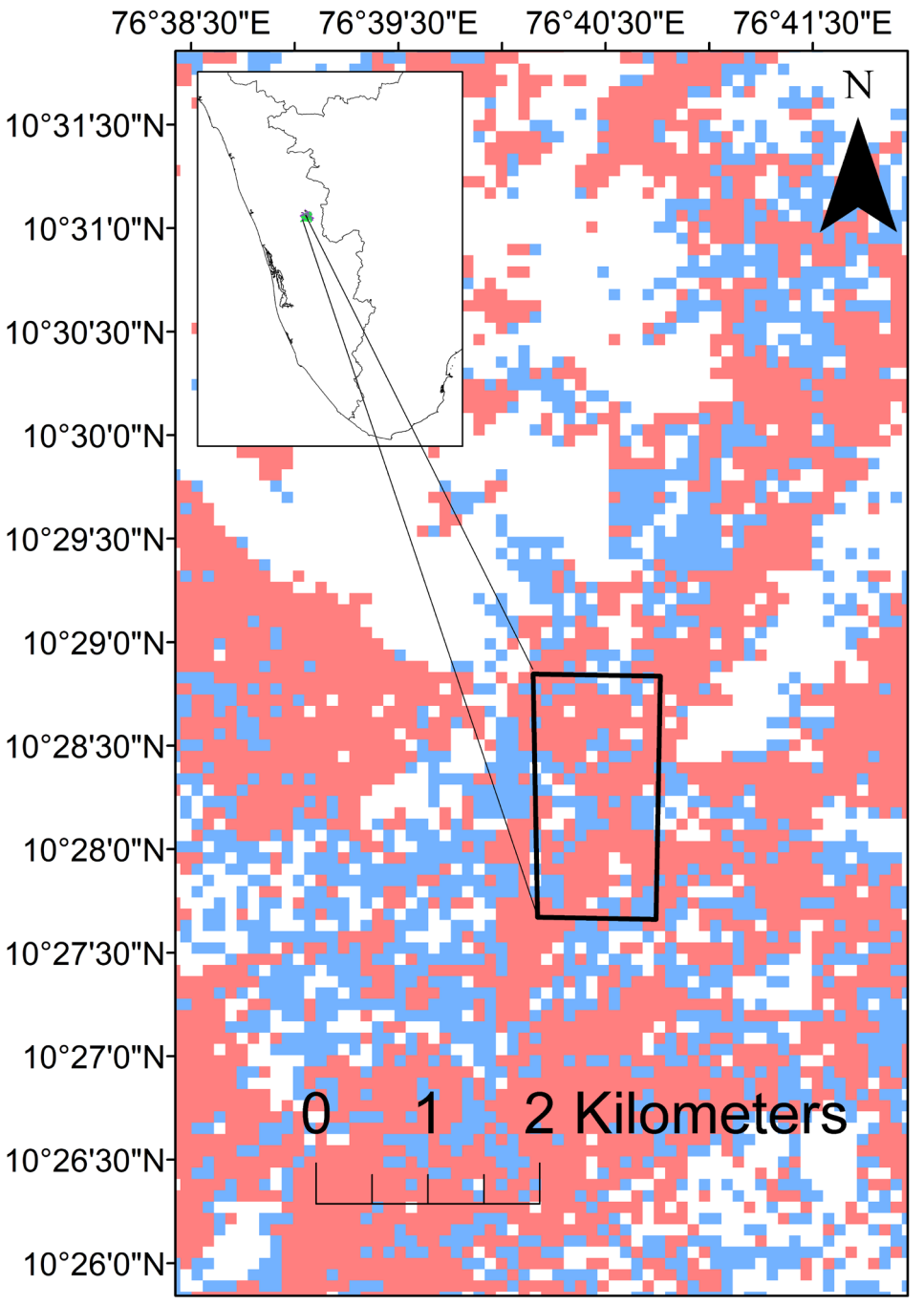

Fig. 1. Map showing the location of the study site in the Nelliyampathy hills with forest and shade plantation cover indicated (Inset: Map of South India). Red pixels indicate forest cover; blue pixels indicate shade plantation cover; white pixels indicate other land cover types.

travelled. All statistical analyses were carried out in SPSS ver. 10.

RESULTS

We recorded a total of 11 temporary group splits (Table 1). In ten of these instances, the group split into two subgroups and it split into three in one instance. The number of individuals in subgroups varied among fission events. The subgroup with the alpha male (Subgroup 1) always had more individuals (mean 24.55 ± 5.57) than Subgroups 2 (mean 12.36 ± 4.34) (independent samples t-test: t=5.92, p<0.01) and 3 (12 individuals). In each instance, it was Subgroup 2 (and, where relevant, Subgroup 3) that moved away from Subgroup 1. Group fission occurred more frequently in the dry season (N=10, 91%) than in the wet season (N=1, 9%). During the dry season, the group had five sleeping sites, and nine of the ten fissions occurred on days when the group slept at one particular sleeping site during that night. All instances of group fission occurred between 08:00 h and 14:00 h (Fig. 2). Significantly more instances of splits occurred between 10:00 h and 12:00 h (42.86 %, a*), and 08:00 h and 10:00 h (39.29 %, b), than between 12:00 h and 14:00 h (17.86%, c) (Marascuilo's procedure for multiple proportions : χ^2= 16.44, df=2, p<0.05; *Post-hoc tests; p-value was kept based on Bonferroni correction: a-b: χ^2= 0.26, p=0.87; a-c: χ^2= 15.96, p<0.017; b-c: χ^2= 11.92, p<0.017). The mean fission duration of each group was 133.6 ± 71.5 minutes. During the splits, the average distance covered by Subgroup 1 was 498±181 m and by Subgroup 2 was 693±239 m (Fig. 3). In Subgroup 1 and Subgroup 2, the number of individuals in the subgroup and the distance travelled were not correlated (Pearson's r: r=0.28, N=11, p=0.28; r=0.12, N=11, p=0.74). Either one or two adult males other than the alpha male were present in Subgroup 2 during five of the six splits where we could identify all animals. Females with infants less than one year old always remained in Subgroup 1. Most of the splits occurred when the animals were feeding on fruits of *C. exarillata* and *Toona ciliata* (M. Roem). The group members generally maintained lower inter-individual distances in the wet season than in the dry season (Fig. 4).

DISCUSSION

Temporary fissions in the study group occurred mostly in the dry season and during the hours before noon. The average duration of the split was a little more than two hours. A smaller subgroup usually travelled away from and moved a longer distance than the subgroup with the alpha male. Although temporary group splits have been observed by many researchers working on wild *M. silenus*, prior to this study, there has been only one published report of systematic recording of group fissions (Sakthivelou & Kumar, 1998) which showed that group splits occurred more in fragmented habitats than in contiguous forests, probably due to the scarcity of resources and higher predation pressure

Table 1. Number of individuals in each of the subgroups during each fission event

Event No.	Subgroup 1	Subgroup 2	Subgroup 3
1	26	12	
2	25	13	
3	19	19	
4	34	4	
5	30	8	
6	14	12	12
7	27	11	
8	19	19	
9	27	11	
10	26	12	
11	23	15	
Mean	24.5	12.4	-
SD	5.6	4.3	-

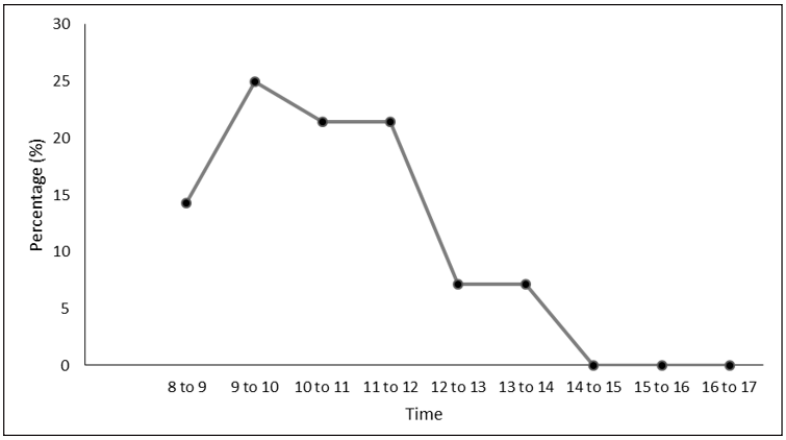

Fig. 2. The percentage of temporal temporary group fission events.

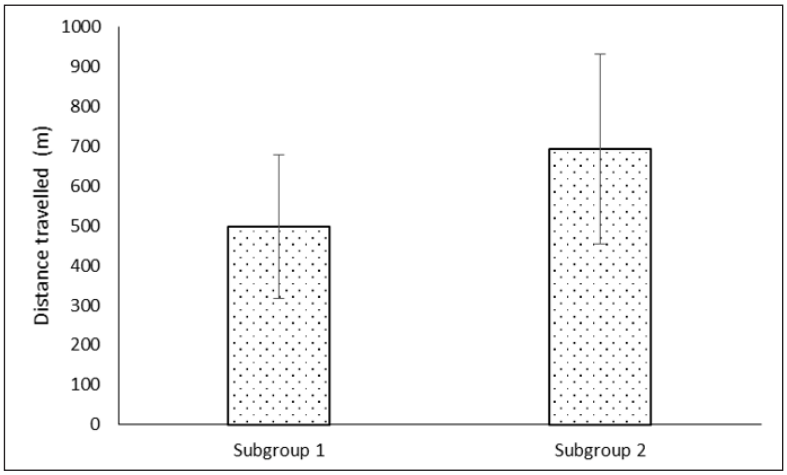

Fig. 3. Distance (in metres) travelled by different subgroups during temporary group fission.

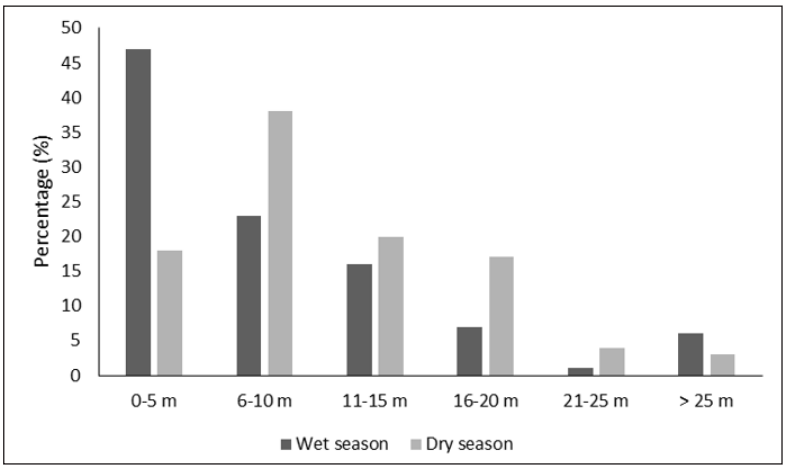

Fig. 4. Percentage of inter-individual distances in each distance class in the wet and dry seasons.

in fragmented habitats than in continuous forests. In the present study, we observed that group splits in *M. silenus* occurred mainly in resource-scarce dry months.

As intragroup competition for food is one of the major factors explaining temporary group fissions (van Schaik & van Hooff, 1983; Koenig, 2002), more splits are expected to occur when food resources are scarce. In the Yunnan Snub-nosed Monkey *R. bieti* (Milne-Edwards), group fission events were highly seasonal, occurring during only two months of the year, and appeared to be triggered by the presence of bamboo shoots, a seasonally important food item in their diets (Ren et al., 2012). In the rainforest habitats of *M. silenus* in the Western Ghats, food resources are far more abundant during the wet season than in the dry season (Singh et al., 2011; Roy et al., 2013; Erinjery et al., 2015). Low dry-season food availability may explain why more than 90% of the group splits observed during this study happened during the dry season. Most of the splits also occurred when the monkeys were feeding on fruits of *C. exarillata* and *T. ciliata* which are two of the most important foods for the wild *M. silenus*. The larger inter-individual distances also indicated more exploration for food during the dry season than in the wet season. Since most fissions occurred from a single sleeping site (see Erinjery et al., 2015 for information about sleeping sites, the frequency of use of each sleeping site, home range size, etc.), it appears that resource distribution around that sleeping site was the important factor for the split. A previous study (Erinjery et al., 2015) showed that macaques used this sleeping site more than other sleeping sites between September and January, and they spent more time around this sleeping site (while ranging; although they used multiple sleeping sites for sleeping during this period) between February and that May. *Macaca silenus* were more likely to feed on *C. exarillata* and *T. ciliata* when they used this sleeping site than when they used other sleeping sites, likely because of a higher abundance of *Cullenia* and *Toona* near this sleeping site (Erinjery et al., 2015). The higher rate of group fission before noon than after noon in the present study can be explained by the fact that in *M. silenus*, more feeding and foraging occurred during the morning hours than during the remainder of the day. In the earlier study on group splits in *M. silenus* (Sakthivelou & Kumar, 1998), most fissions also occurred during the morning hours.

In each case of group split, females with dependent infants remained in the larger Subgroup 1 with the alpha male, suggesting that the group split involves some amount of risk for infant-carrying females, which may become more vulnerable in the smaller subgroup. For example, predation risk might be higher in the smaller than in the larger subgroup. Also, the costs due to travelling, access to high-quality resources etc., may influence the behaviour of females carrying infants. The average distance covered by Subgroup 2 was more than that covered by Subgroup 1. However, regardless of the number of individuals in Subgroup 2, they covered approximately the same area (from visual observation) and travelled the same distance when separated from the main group, indicating that they foraged in a restricted area during the split. Although we do not have data on resource abundance and quality in the areas visited by the subgroups during fissions, previous studies show that subgroup size during fission is correlated with availability, abundance and quality of food in other primates (Asensio et al., 2009; Di Fiore et al., 2011).

Since temporary group fission was observed only 11 times during the relatively long-term field study, the frequency appears to be quite low. Furthermore, the present study area was in a relatively large patch of contiguous forest. Kumar (1987) also observed a low frequency of group splits in a similar continuous forest. On the other hand, in a group inhabiting a forest fragment interspersed with coffee plantations, the frequency of temporary fissions was very high (Sakthivelou & Kumar, 1998) probably due to the scarcity of food in such forests. Since the number and identities of individuals during the temporary fissions kept changing, it may be concluded that these splits were not a precursor to permanent group fission but instead represented a pervasive foraging strategy.

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FIRST RECORD OF MELANISTIC RHESUS MACAQUE *Macaca mulatta* FROM THE FIRST ADDITION TO MANAS NATIONAL PARK, ASSAM, INDIA

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ABSTRACT
During an anti-snare walk, a team from the Wildlife Trust of India and Forest Department encountered a melanistic Rhesus Macaque *Macaca mulatta* from the First Addition to Manas National Park in Assam, India. This is the second case of melanism recorded in *M. mulatta* from the Northeastern part of India.

Keywords: Melanism, Primate, India.

Melanism can be defined as the excessive production of the dark-coloured pigment known as melanin in an individual's skin, plumage or fur, which makes it distinct from the entire population. Rhesus Macaque *Macaca mulatta* (Zimmermann) is a cercopithecine primate that is widely distributed across South Asia, Southeast Asia, and China (Koyama & Shaker, 1981; Southwick & Siddiqi, 1983; Wada, 2005). The species is protected under Schedule II of the Wildlife Protection Act of India, 1972. However, due to uncontrolled population growth and nuisance activities, *M. mulatta* are often regarded as pests by the public. During the 1960s the population was at risk as they were captured and exported for biomedical research but this was banned in 1978 (Imam & Ahmed, 2013). The ecology, distribution and feeding habits of *M. mulatta* have been well studied in India (Koyama & Shaker, 1981; Southwick & Siddiqi, 1983; Malik et al., 1984; Wada, 1984). However, studies of variation in pelage colouration were not the centre of focus. Melanism appears to be rare in primates. A case was reported from Tamil Nadu in India in Tufted Sacred Langur *Semnopithecus priam* (Blyth) by Samson et al. (2021), and King et al. (2014) reported melanism in a Crowned Sifaka *Propithecus coronatus* (Milne-Edwards) from Madagascar. A case of total albinism was also reported from Goa, India, in a Bonnet Macaque *M. radiata* (Geoffroy) (Mahabal et al., 2012). Melanism was recently reported in a young *M. mulatta* from Lakhimpur district in Assam (Barhadiya, 2021). Its occurrence in *M. mulatta* has not been previously recorded in Manas National Park. Here, we report the first observation of a melanistic *M. mulatta* from Manas National Park and the second record from India.

MATERIALS AND METHODS
The Greater Manas Landscape (26°35'00" N to 26°50' 00" N & 90°45'00" E to 91°15'00" E) lies in the districts of Chirang, Baksa and Udalguri of the Bodoland Territorial Council (BTC) of Assam and encompasses Manas National Park (950 km^2), the First Addition to Manas National Park (350 km^2), declared in 2016, and Raimona National Park (422 km^2), declared in June 2021 (Choudhury, 2021). Manas National Park is also a UNESCO World Heritage Site, a Biosphere Reserve, Tiger Reserve and an Important Bird Area (IBA) (Nath et al., 2009) and part of Chirang-Ripu Elephant Reserve. The indigenous population consists of Bodo, Rajbangshi, Nepali, Adivasi and others (Das et al., 2009). The area is rich in floral and faunal diversity but due to a socio-political crisis in the late 1980s suffered major vegetation loss (Nath et al., 2009). However, present conservation strategies have been effective in restoring habitat in the region.

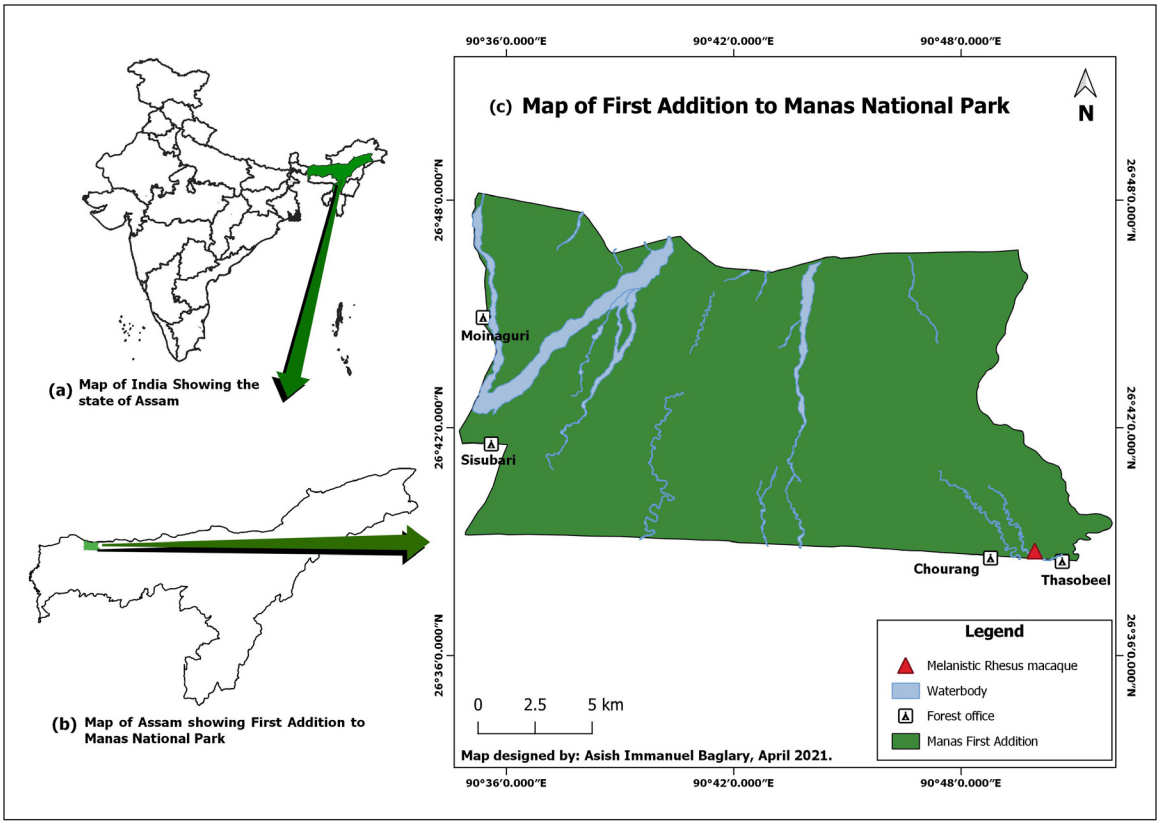

Fig 1. (a) Map of India showing the state of Assam; (b) Map of Assam showing the First Addition to Manas National Park; (c) Map showing geo-location of melanistic Rhesus Macaque in the First Addition to Manas National Park.

RESULTS

On 18 March 2021 at 10:22 h during an anti-snare survey walk in a line transect, we encountered a troop of *M. mulatta* with an estimated 17 individuals. We identified a dark-coloured (blackish) adult female with a young juvenile near Jiapagla river bed (26°38'45.132" N, 90°49'56.712" E). The young juvenile had the normal coat colour. The dorsal part of the adult female's body was black in colour with a gradient of silky golden yellow and a blackish tail. Unlike other individuals, the inner thigh of the hindlimb was reddish and the buttock was red due to oestrous. Hence, we concluded that the individual had melanism. We photographed the individual for further consideration.

DISCUSSION

Macaques of several species vary in colour from light to dark brown (e.g., Japanese Macaques *M. fuscata* [Blyth] and *M. mulatta*), whereas others are entirely black (e.g., Sulawesi Crested Black Macaques *M. nigra* [Desmarest] [Bradley et al., 2013]). Habitat fragmentation, stress and inbreeding, and even global warming (temperature & humidity) can be contributory factors to melanism (Tougias, 2011; Mahabal et al., 2012; Ramakrishnan et al., 2016). Close observation and genetic analysis of the melanistic individual might yield more information about this phenomenon. In conclusion, further studies are encouraged to understand the incidence of melanism and albinism in populations of wild primates and to understand the ecological and physiological implications for their survival in the wild (Samson et al., 2021).

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Fig. 2. The melanistic Rhesus Macaque with a young juvenile and another member of the troop. © Asish Immanuel Baglary.

Fig. 3. The melanistic adult female with a young juvenile. © Sanatan Deka

Fig. 4. The melanistic individual with a young juvenile. ©Asish Immanuel Baglary.

Fig 5. The melanistic individual with reddish medial hindlimb ©Tiken Ray.

of No 1 Chaurang village under Chirang District and Shri Pankaj Mandal, a member of the casual forest staff who joined us during the work. Finally, we thank the reviewers and editors for improving the manuscript.

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TIPS FOR THE FIELD PRIMATOLOGIST: PHOTOGRAPHING PRIMATES

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INTRODUCTION

Photographing primates can be tricky. Conditions are rarely ideal, and even when you track down your subjects, they never quite do what you want. But having the ability to capture a good photograph of your study species is a worthwhile skill to support the communication of your work. Whether you are trying to document a particular behaviour, record phenotypic variation or compile images to support community engagement endeavours, a sharp, well-exposed image will undoubtedly be of benefit.

The following tips are certainly not rigid rules but guidelines. Hopefully, when they become second nature to you, the joys will far outweigh the headaches.

ETHICS

Before you even pick up your camera and head out, look at *Best Practice Guidelines for Responsible Images of Non-Human Primates* (Waters et al., 2021). This guide was produced by the IUCN Primate Specialist Group Section for Human-Primate Interactions and sets out important principles we all need to be aware of to avoid creating images that encourage harmful behaviour.

RESEARCH

As with any wildlife photography, knowing your subject makes for safer photography and increases your chances of a good shot. Even if you already understand your subject's general behaviour, it is vital you learn how to read the signs of a stressed or potentially aggressive animal and know how to conduct yourself to put your subjects more at ease.

GEAR

You can spend a fortune on photographic gear, but you don't need to go mad. One essential is a lens with medium-to-long focal length – something in the 200-300 mm range will often let you get 'close' enough to habituated or semi-habituated groups. There are reasonably priced zoom lenses on the market offering the necessary focal lengths, good optical quality and decent light capture capability.

When using longer focal-length lenses and working in low-light forest conditions, we sometimes have to use shutter speeds below what is sensible for handheld photography. Tripods offer stability but can prove awkward in dense forest habitats. A lighter, more flexible monopod may do the trick even if less stable than a tripod.

FIELDCRAFT

Once you locate your target, carefully choose the spot from which you will take your pictures/ Remember - safety first! Don't back yourself into a corner, and make sure your subject has an escape route in the event of something like a fight. Avoid prolonged, direct eye contact. I tend to monitor my target animal out of the corner of my eye or with fleeting glances. And be aware of what is happening within the target group. Feeding times are often periods of high drama, so be ready to back away if necessary. I will often sit down to take pictures around the primates in the right circumstances. This tends to put them more at ease. Rather than walking straight toward your subject, approach gradually at an angle. It is less threatening. Similarly, I will initially point my camera at an angle and gradually swing the lens onto my subject, giving them more time to get comfortable.

Trees, the natural home of many primate species, create various photographic challenges. Often you find yourself craning your head back and pointing your lens to the heavens. Unfortunately, it is hard to get an appealing composition if all you can see is a monkey's backside. Also, shooting upwards into the canopy can make it difficult to get the proper exposure, risking your primate being underexposed or the background sky being over-exposed or 'blown out'.

So, wherever possible, find terrain that gets you more level with your subject and seek a background with less contrast, such as dense foliage. Ideally, find a spot that offers an unobstructed view of the subject. If that is not possible, look for gaps in the foliage and

Fig. 1. A poor image with bad composition and an over-exposed sky, showing the problems of shooting up into the canopy.

Fig. 2. While still shooting up into a tree, the background foliage allows for a more balanced exposure

Fig. 3. Although not necessarily wrong, the placement of the subject in the centre of the frame, in this case, makes for a less appealing image.

Fig. 4. Using the rule of thirds, the viewer's eye is drawn to the macaque's head, and this provides for a more attractive composition.

try to anticipate your subject's movement, so you are ready to fire off a few shots.

COMPOSITION

The rule of thirds is a widely used compositional tool in photography, film and painting. Imagine your frame sub-divided by two equally spaced vertical lines and two equally spaced horizontal lines. The rule of thirds says you should place the key compositional elements either along these lines (e.g., the horizon) or at their intersections (e.g., the face of your target primate). Yes, it would be monotonous if every shot followed this rule, but it is a useful guideline.

Another concept to think about is what's called "breathing space" – the space between the subject and the edges of the image. Generally speaking, it is best to frame your image so there is more breathing space in the direction in which your subject is looking, i.e., looking into the frame rather than out.

Try to get your camera at their eye level If you are lucky enough to photograph species closer to or on the ground. This makes for a much more engaging shot and will often ensure a less cluttered and distracting background.

LIGHTING

This, of course, is a whole subject on its own, but the safest bet is to have the sun behind you and slightly off to one side. This usually makes for the easiest exposures. But if you want to be more adventurous and artistic and it is early morning or later afternoon, try some back-lit shots. Hide the sun behind your subject or a tree to avoid the harshest light, and with a little experimentation, you can get some very appealing rim-lighting.

EXPOSURE MODE

Unless you are taking pictures on a mobile device, you will probably have one of the many DSLR or mirrorless cameras on the market. Even those at the beginners' end of the spectrum will often allow you some degree of flexibility with respect to the three fundamental exposure camera settings – aperture, shutter speed and ISO, or what is referred to as the 'exposure triangle'. You will find lots of good advice on websites. Still, in most circumstances with wildlife, we are looking to have a shutter speed fast enough to freeze the action and an aperture setting that provides enough depth of field to have the bulk of our subject

Fig. 5. In this image the macaque is looking out of the frame, creating a sense of imbalance

Fig. 6. Here, the macaque is looking into the frame creating breathing space and a better composition

Fig. 7. Two Dusky Langurs with fairly flat light from behind and to my right.

Fig. 8. The same two langurs, but this time with the setting sun behind them, creating a rim light effect.

in focus – but not so much that our background is in sharp focus, as this can distract the eye.

As a general rule for primates at rest, my camera is set to manual mode, and I start with a shutter speed of around 1/500th and an aperture of f/6.3. Then, I set the ISO to auto, which means the camera uses the lowest ISO setting based on available light for the corresponding shutter and aperture settings. These days, camera technology and picture processing software are progressing at an amazing speed, allowing excellent picture quality even at higher ISO settings.

I adjust the shutter and aperture settings for the circumstances as I work. If the targets are on the move, I increase the shutter speed to 1/1000th or above. For example, a brachiating gibbon will probably need a shutter speed of 1/2000th or more to be sure of freezing the movement.

If I want to focus the viewer's eye on a particular point of interest (perhaps the primate's hands), I will adjust the aperture to – say – f/4, thereby reducing the depth of field. Conversely, if I am going for a wider shot of a primate and want to convey a sense of the surrounding environment, I will use an aperture of maybe f/8 to f/11.

If you are not comfortable in manual mode, I suggest you choose Aperture Priority, where you primarily want to control the depth of field, e.g., for a nice soft, blurry background. On the other hand, if your subjects are on the move and the biggest concern is freezing the action, go with Shutter Priority mode. As a general rule, when hand-holding your camera, use a minimum shutter speed of 1/focal length of your lens (i.e., 300 mm lens = min 1/300th of a second).

METER MODE

In most circumstances, I recommend sticking to the Matrix or Evaluative meter mode.

FOCUS MODE

When available, use Continuous or AI Servo (Canon) autofocus mode to track the subject's movement. I mostly use single point focus mode – this allows you to focus more accurately on a particular feature (perhaps the eyes) or pick out your primate subject amongst dense vegetation.

MOTOR DRIVE MODE

Continuous mode allows multiple shots to be taken as you hold down the shutter. While this is generally the preferred mode and helps capture a particular moment

Fig. 9. With a shutter speed of 1/2500th, I could freeze the movement of this leaping Dusky Langur.

Fig. 10. A shutter speed of only 1/320th was not enough to capture a sharp image of this macaque. While the surrounding rocks are sharp, the macaque's body is blurred

Fig. 11. In this image, an aperture of f/7.1 was enough to keep the macaques in the foreground in focus but allow a suitably blurred background.

Fig. 12. Using f/4 in this image created a shallow depth of field so that only the face of the infant Stump-tailed Macaque is in focus.

in action, I caution against its overuse. It is very easy to get 'trigger-happy' and either run out of memory or having to spend hours sorting through shots at the end of the day. Short bursts around key points of behavioural interest tend to work best.

I do hope you find these brief tips for wildlife stills photography useful. However, nothing beats getting out in the field, taking pictures, and discovering your own preferred techniques when it comes to honing your skills.

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Editors' Notes

Neil Challis is a wildlife photographer and cameraman based in western Thailand with a particular interest in primates. He supports wildlife conservation groups, researchers and scientists using filmmaking and photography to communicate and drive conservation understanding and action. Neil is affiliated with the Long-tailed Macaque Project, a registered charity aiming to raise awareness about and conserve vulnerable long-tailed macaque populations in South and Southeast Asia. To find out more about Neil's work, visit www.neilchallisphotography.com

EVIDENCE OF ILLEGAL TRADE OF THE CRITICALLY ENDANGERED BLACK CRESTED MACAQUE *Macaca nigra* FROM INDONESIA TO THE PHILIPPINES

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Keywords: CITES, exotic, exploitation, primates, wildlife conservation, wildlife trade, wildlife trafficking

ABSTRACT

The Black Crested Macaque *Macaca nigra* (Desmarest) is a Critically Endangered species endemic to Indonesia. Populations are in decline due to habitat loss and hunting for the wild meat and exotic pet trade. International trade data involving this species is lacking, though anecdotal information suggests it is being smuggled to the Philippines. To verify this, we conducted online and physical market surveys of publicly accessible wildlife facilities in the Philippines and analysed seizure data for *M. nigra* in Indonesia and the Philippines from 2010 to 2019. This study reveals insights into illegal trade in *M. nigra*, which is enabled by laundering illegally sourced animals through zoos and wildlife breeding facilities. Surveys of publicly accessible wildlife facilities in the Philippines confirmed the presence of at least 36 individuals in the country, and an additional 12 were exported from the Philippines to China in 2014-2015. The acquisition of this species by wildlife facilities such as zoos in the Philippines is a concern, as there are no records of legal export to the Philippines. We also documented evidence of smuggling of at least 30 *M. nigra* individuals to the Philippines through seizure analysis. These findings warrant further research and investigation by authorities to determine the origins of *M. nigra* in captive wildlife facilities to assess whether they were legally acquired and to prevent the laundering of illegally acquired wildlife.

INTRODUCTION

Primates worldwide are facing a perilous future, with at least 60% of species in decline (Estrada et al., 2017). Illegal and unsustainable wildlife trade is among the principal threats to primates (Nijman et al., 2011; Estrada et al., 2017). Primates are traded as pets for consumption, traditional medicines, bio-medical research, wildlife collections, and the entertainment industry (Alves et al., 2010; Nijman et al., 2015; Mardiastuti et al., 2021; Svensson et al., 2021). Southeast Asia is a significant source of primates to meet these demands (Kavanagh, 1984; Soehartono & Mardiastuti, 2002). Indonesia, in particular, is in the top four countries with the highest diversity of primate species (Rosenbaum et al., 1998; Estrada et al., 2018), and a major hub for wildlife trade and a significant country of origin for illegally traded primates (Shepherd, 2010; Nijman et al., 2017). Primates are openly traded in markets on Sumatra, Java, Bali, Sulawesi, and Indonesian Borneo (Kalimantan) (Shepherd, 2010; Estrada et al., 2018). One affected species is the Black Crested Macaque *Macaca nigra* (Desmarest), a Sulawesi Island endemic.

Macaca nigra, also known as the Celebes Crested Macaque, occurs in the northeast of Sulawesi and the adjacent islands of Manado Tua and Talise (Lee et al., 2020). There is also an introduced population on the Bacan islands (Lee et al., 2020). *Macaca nigra* is listed as Critically Endangered on the IUCN Red List of Threatened Species (hereafter the Red List), and populations continue to decline, predominantly due to hunting pressure and habitat loss (Hilser et al., 2013;

Lee et al., 2020). *Macaca nigra* is protected under two Indonesian wildlife laws, *Act of the Republic of Indonesia No.5 of 1990 concerning conservation of living resources and their ecosystem and Government Regulation No.7, 1999 concerning the preservation of flora and fauna*. As a protected species, it cannot be caught, injured, killed, kept, possessed, cared for, transported, or traded, whether alive or dead. *Government Regulation No.8 1999 Concerning the utilisation of wild plants and animals*, however, allows trading of protected species provided they are captive bred to the second and subsequent generations. Under the Decree of the Ministry of Forestry, No P.19/Ministry of Forestry-II/2005, all breeders must be registered with the Ministry of Environment and Forestry's Department of Forest Protection and Nature Conservation (for breeders that are also exporters) or the Natural Resources Conservation Agency (breeders supplying to exporters but not exporting themselves). No commercial captive breeding for this species has been permitted in Indonesia.

Despite being a protected species, *M. nigra* is commercially hunted for the local bushmeat trade as it is considered a delicacy and believed to have medicinal properties that enhance physical strength and cure skin diseases (Lee, 1999; Lee et al., 2005; Hilser et al., 2013; Mittermeier et al., 2013). Demand for *M. nigra* as pets is also a threat but has been poorly documented (Rosenbaum et al., 1998; Hilser et al., 2013). It appears that pets are mostly infants obtained either through opportunistic capture or as a result of hunting and killing of the mother (Hilser et al., 2013). While some infants are kept solely as pets, others are kept for relatively short periods prior to consumption (Hilser et al., 2013).

International trade dynamics involving *M. nigra* are largely unknown, though individuals have been seized in the nearby Philippines. This is not surprising, as the smuggling of live animals, including Sulawesi endemic species, from Sulawesi to the Philippines has been documented for over 30 years, with at least 30 cases in the last 12 years alone (Riley, 2003; Sy et al., in prep.). Illegal international trade is facilitated by the close proximity of the two countries and insufficient enforcement efforts (Shepherd, 2005; Shepherd et al., 2018). The main objective of this study is to compile evidence of illegal trade in *M. nigra* from Indonesia to the Philippines that can be used to prioritise national and international actions against the trafficking of *M. nigra* between these two countries.

METHODS

To assess international trade in *M. nigra* from Indonesia to the Philippines, we conducted online surveys as well as physical surveys of publicly accessible wildlife facilities in the Philippines. In addition, we extracted trade data from the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Trade Database to determine whether there were legal exports of M. nigra from Indonesia to the Philippines. We also collected information on seizures of *M. nigra* resulting from enforcement actions in the Philippines and Indonesia to identify and understand illegal trade dynamics such as trafficking routes and trade hotspots.

Online Surveys

We surveyed online trade in *M. nigra* on Facebook in the Philippines from March to August 2020. This involved a survey effort of four hours per week over the study period encompassing 25 Facebook groups (21 private and four public) specialising in the trade of live animals. We used the following keywords for the search: *Macaca nigra*, Black Crested Macaque, Celebes Crested Macaque, black ape, *yaki* (the local name in Indonesia), and black monkey. Manual searches of the groups were also conducted to detect posts that did not include the keywords or descriptions.

Survey of wildlife facilities

We compiled a list of publicly accessible wildlife facilities such as zoos, wildlife safari/parks, and wildlife rescue centres across the Philippines that could potentially hold captive *M. nigra*. An initial list was generated using online searches and followed up by requesting information from colleagues residing in various parts of the Philippines. Subsequently, to determine whether these facilities held captive *M. nigra* and the quantities held, we conducted: (1) physical surveys of facilities, where possible, between February 2020 and April 2021; (2) interviews with owners or employees of facilities that could not be physically visited; and (3) reviews of video footage taken in wildlife facilities or that we found posted online (i.e., Facebook, YouTube). Each facility was surveyed only once during the study period.

Seizure Data

Philippines

We extracted seizure data for *M. nigra* in the Philippines for 2010-2019 from Sy (2021), which

provided a current account of the illegal wildlife trade in the Philippines through an analysis of seizure data. The data in Sy (2021) were a collation of datasets from relevant government agencies, published literature, open-source news and social media.

Indonesia

Seizures and prosecution records relating to *M. nigra* in Indonesia were collected for 2010 - 2020. Data were extracted from the Indonesian government website, Sistem Informasi Penelusuran Pekara (SIPP) (https://sipp.pn-negara.go.id/), an open access information database of the courts for each district in the country. Information was also collected from published online media articles. Searches for related seizures were conducted in both English (search terms: hunting, trapping, trade, illegal trade or wildlife trade in *Macaca nigra*, Black/Celebes/Sulawesi Crested Macaque, Yaki, black ape, black monkey) and Indonesian (search terms: 'BKSDA', 'penyelundupan'/'perdagangan' *Macaca nigra*/monyet hitam Sulawesi /yaki /yaki monyet hitam /monyet yaki).

Data Analysis

From each record obtained, we extracted, where available, information on the date of seizure, commodity (live animals, body parts), quantities of each commodity seized, the purpose of hunting/trade (i.e., for consumption, pets, trophies, etc.), location of seizures and trafficking routes, suspects arrested and prosecution outcomes. Species identification was based on information extracted from seizure records, and is assumed to be accurate, as additional verification was impossible. In addition, all reported seizures were carefully checked to avoid duplication by cross-referencing and comparing incident details, e.g., date of seizures, commodities seized and quantities.

CITES Trade Data

Macaca nigra was included in Appendix II of the CITES in 1977 as part of listing all non-human primates not in Appendix I (UNEP-WCMC, 2018). Therefore, to be legal, all exports of this species from Indonesia require an export permit, which should be recorded in the CITES Trade Database. Data on international trade in *M. nigra* from Indonesia to the Philippines and from the Philippines to other countries were extracted from the CITES Trade Database (https://trade.cites.org) in April 2021. Table 1 refers to the search terms used to extract data from the CITES Trade Database.

RESULTS

Online Survey

There were no advertisements for the sale of *M. nigra* in any of the Philippine Facebook groups surveyed.

Survey of wildlife facilities (zoos, wildlife collections, places of entertainment)

A total of 57 wildlife facilities were surveyed, and 12 were found to hold *M. nigra*, amounting to 36 animals. The majority of these were found in Cebu and Luzon (Table 2, Fig. 1). Most facilities held between one and three animals except for the one facility in Cebu, which had 14. One video reviewed revealed a troop of *M. nigra* containing a mixture of adults, juveniles and infants.

Seizure Data Analysis

There were a few reported seizures of *M. nigra* in Indonesia and the Philippines, with 16 incidents reported from 2010 – 2020. Of these, only one occurred in the Philippines, involving four live *M. nigra* seized in Surigao del Norte, Mindanao, on 20 March 2016. Five suspects were arrested, but the city prosecutor dismissed the case in May 2016, who cited a lack of probable cause. The four *M. nigra* were subsequently donated to Albay City Zoo. However, these four individuals are no longer at the zoo and the Department of Environment and

Table 1. Search terms used to extract trade data of *M. nigra* from the CITES Trade Database

Year Range:	From: 1975 To: 2020
Exporting countries:	Indonesia and Philippines
Importing countries:	All Countries
Source:	All
Purpose:	All
Trade Terms:	All
Species:	*Macaca nigra* (Black crested macaque)

Table 2. Number of facilities with *M. nigra* and number of animals recorded in the Philippines between 2020 and 2021

Island	Wildlife Facility	Method	Individuals	Total
Cebu	Cebu Safari and Adventure Park	Interview/Video	**14**	**14**
Luzon	Zoobic Safari	Physical	**1**	**14**
	Animal World	Physical	**3**	
	Cavite City Botanical and Zoological Park	Physical	**1**	
	Laguna Wildlife Park and Rescue Center	Physical	**3**	
	Avilon Zoo	Physical	**3**	
	Manila Zoo	Physical	**3**	
Negros	El Toro Zoo de la Castellana	Physical	**3**	**4**
	Dreamland Nature and Adventure Park / Amlan Zoo	Physical	**1**	
Bohol	Bohol Python and Wildlife Park	Physical	**2**	**2**
Mindanao	Davao Crocodile Park & Zoo	Physical	**1**	**2**
	Genalin Park and Zoo	Interview	**1**	
Grand Total				**36**

Natural Resources (DENR) regional office does not have any records of zoological facilities in the region with *M. nigra*. Therefore, the status or whereabouts of the four individuals remain unknown.

In Indonesia, *M. nigra* was confiscated in 13 incidents (Table 3) and voluntarily handed over in three additional incidents. In total, these incidents involved 70 animals: 49 live, 15 dead, five skulls and one skin. Seven of the 13 incidents resulted in the arrests and prosecution of 12 individuals. In addition, potential international trafficking of *M. nigra* was revealed in at least two incidents, which implicated the Philippines as the destination country, involving 30 live animals (Table 3).

CITES Trade Data

There has been a relatively active international trade (>200 CITES Trade records) in *M. nigra* since its CITES listing in 1977. The UK, US, and Canada are the main exporting countries, with all specimens reported as captive bred. Export of the species from Indonesia was only first recorded in 1990. From 1990 to 2018, Indonesia exported 12 live captive-bred animals (source code C): five were exported to the US in 1990 (purpose and source not given) and seven to Singapore for zoo purposes (purpose code Z). Based on 11 records, Indonesia exported >10,000 wild sourced *M. nigra* 'specimens' (a term which could refer to dead animals or hair, blood samples, etc.) to the US and Germany, ten of which were for scientific purpose (purpose code S) and one for commercial purposes (purpose code T). According to the CITES Trade database, Indonesia has never issued a CITES permit for exporting *M. nigra* to the Philippines.

In 2014 and 2015, the Philippines exported six *M. nigra* to China each year. The Philippines reported these as being for breeding in captivity (purpose code B) and China importing them for zoo purposes (purpose code Z). However, all 12 animals were declared as being bred in captivity (source code C).

DISCUSSION

Our study documents evidence of the illegal trade of *M. nigra* from Indonesia to the Philippines. Seizure data revealed demand for the species revolving around the meat and pet trade in Indonesia and the zoological display and pet trade in the Philippines. These seizures also revealed evidence of international trafficking, from one seizure of this species in the Philippines that occurred in 2016 and two seizures in Indonesia that revealed the intended smuggling of the species to the Philippines.

The seizure in the Philippines occurred during the transportation of various wildlife that were all Philippine native species except for *M. nigra* and one Blyth's

Fig. 1. *M. nigra* is a Critically Endangered species with a restricted range in Indonesia. Though no import records exist in the CITES Trade Database, at least 36 individuals were recorded in the Philippines through surveys of publicly accessible wildlife facilities (zoos, wildlife collections, places of entertainment) throughout the country in 2020/2021

Hornbill *Rhyticeros plicatus* (Forster). The native species included six Long-tailed Macaques *Macaca fascicularis* (Raffles), four Brahminy Kites *Haliastur indus* (Boddaert), one Philippine Serpent-eagle *Spilornis holospilus* (Vigors), and one Philippine Deer *Rusa marianna* (Desmarest). Under the Wildlife Resources Conservation and Protection Act of 2001/Republic Act No. 9147, all terrestrial wildlife (native and non-native) are prohibited from being kept, transported, traded, etc., without a valid permit from the DENR.

The first incident in Indonesia occurred in 2015 when port authorities at Tahuna (North Sulawesi) found dozens of wild animals on a commercial vessel headed for the Philippines. Among the wildlife seized were two live *M. nigra* and 23 tarsiers. No suspects were arrested. The second incident occurred in 2018 when authorities on Bacan Island rescued 28 *M. nigra*, along with dozens of other species, including parrots and turtles, reportedly en route to the Philippines. At least four suspects were arrested and sentenced to one year in jail and a fine of IDR 30 million (~USD 2,000).

No export records of *M. nigra* from Indonesia to the Philippines were reported in the CITES Trade Database. Indonesia and the Philippines have been parties to CITES since 1979 and 1981, respectively. As such, both countries have implemented mechanisms to control, regulate and report international trade in wildlife listed in the Appendices of the Convention. Yet, surveys of publicly accessible wildlife facilities in the Philippines revealed that at least 36 *M. nigra* are present in the country, and an additional 12 were exported from the Philippines to China in 2014-2015. The acquisition of this species by wildlife facilities such as zoos in the Philippines is an issue of concern, as

Table 3. Seizures of *M. nigra* in Indonesia between 2010 and 2020

Year	Seizure Location	Destination	Commodity	Quantity	Suspects arrested	Prosecution
2014	Mongondow, North Sulawesi		dead; live	12; 4	4	Sentenced to 8 months in jail and IDR 10,000,000 fine/ additional 1 month jail
2014	Manado, North Sulawesi		Dead	1	4	no sentence
2015	Sangihe Islands, North Sulawesi	Philippines	Live	2	-	-
2015*	Garut, West Java		Live	3	1	Sentenced to 1 year 6 months in jail and IDR 5,000,000 fine/ additional 1 month jail
2016*	Bandung, West Java		Skin	1	2	Sentenced to 1 year 4 months in jail and IDR 2,500,000 fine/additional 3 months jail; Sentenced to 1.6 years in jail and IDR 1,000,000 fine/additional 3 months jail
2017*	Makassar, South Sulawesi		Live	3	1	Sentenced to 9 months in jail and IDR 50,000,000 fine/additional 3 months jail
2018	North Maluku	Philippines	Live	28	2	Sentenced to 1 year in jail and IDR 30,000,000 fine/additional 4 months jail
2019	Minahasa Regency, North Sulawesi		Live	2	-	-
2019*	West Java		Live	1	1	Sentenced to 1 year 3 months in jail and IDR 50,000,000 fine/additional 2 months jail
2019*	Manadao, North Sulawesi		Skull	5	1	Sentenced to 7 months in jail and IDR 25,000,000 fine or additional 3 months in jail.
2020	Palu, Central Sulawesi		Live	1	-	-
2020	North Sulawesi		Live	2	-	-

*incidents involving the sale of *M. nigra* on social media

how and when the Philippines first acquired these animals is unclear. No *M. nigra* has been reported as being imported by the Philippines or exported by any other country to the Philippines since *M. nigra* was listed in 1977. The lack of import records or export permits to the Philippines implies that some of these animals may have been smuggled into the country. Further indications of trafficking were described by a former veterinarian at one of the wildlife facilities in the Philippines, who suspected that three *M. nigra* were brought to the Philippines approximately four years ago in a wire cage with dividers similar to ones used by smugglers from Indonesia. It is uncertain whether the facility still has these animals.

We did not find *M. nigra* for sale on social media during the study period. However, this study monitored at least two Facebook groups that advertised three individual *M. nigra* for sale in 2015 and 2016 (Fig 2). A possible reason for the apparent absence of advertisements for animals for sale during the study period is that it coincided with the emergence of COVID-19, which resulted in international border closures, restrictions on travel and movement of people, and increased surveillance and security at international borders. We expect this may have impacted the trafficking of wildlife from Indonesia to the Philippines and the availability of non-native species for sale in the Philippines. For example, a wildlife trafficker in the Philippines posted an advertisement pre-selling Indonesian reptiles and mammals on Facebook in March 2020, unaware that the lockdown would last more than a year. During the study period, many of these Facebook groups were also exposed by a conservation advocate for facilitating illegal trade in wildlife. As a result, one group removed all members after being exposed, and a further five groups were deactivated. The awareness that Facebook groups were being monitored could have also potentially deterred the advertising of illegally sourced wildlife. Based on TRAFFIC monitoring data, the remaining surveyed groups were among the more than 1,000 Facebook Philippine wildlife trade groups that Facebook permanently deactivated between January and May 2021 for violating Facebook's policy on the trade of protected animals/wildlife (TRAFFIC, 2021).

While we know that illegal trade of *M. nigra* from Indonesia to the Philippines has occurred, it is not possible to determine whether all individuals currently present in the Philippines are of illegal origin. During the initial implementation of the Philippines' Wildlife Resources Conservation and Protection Act of 2001 / Republic Act No. 9147 in 2004, private individuals and wildlife facilities were required to register wildlife in their possession. Wildlife with dubious origins, including Critically Endangered and CITES-listed species without legal import records, were allowed to be registered (i.e., legalised) (Sy, 2018). The action may have resulted in the legalisation of *M. nigra* held in private collections and commercial wildlife facilities in the Philippines. However, it is not possible to determine how many were legalised at this time. Further, governmental authorities in provinces or regions in the Philippines with limited or no rescue centres often rely on private wildlife facilities' assistance for short-term or long-term care of rescued or confiscated wildlife. Some *M. nigra* in publicly accessible zoos documented in this study may have been acquired from the wildlife authorities. Private individuals and wildlife facilities with DENR-issued Wildlife Farm Permits can engage in domestic and international commercial trade in wildlife. So, despite there being no legal importations of *M. nigra* to the Philippines, registered individuals of the species are present in the country (legalised through legislative changes as mentioned above), and a few wildlife facilities in the Philippines have apparently bred the species in captivity. Captive breeding of wildlife is legal with a valid permit, but there are restrictions on trade in threatened wildlife. For instance, Wildlife Farm Permit holders are permitted to sell second-generation (F2) captive-bred individuals but not personal wildlife permit holders (individuals with registered wildlife in their possession). As such, this complicates efforts to distinguish illegally sourced *M. nigra* from those legalised and subsequently captive-bred. It also potentially provides an opportunity to launder illegally sourced animals through zoos and wildlife breeding facilities. This possibility merits concern, considering that seizure data provide current evidence of illegal international trafficking of *M. nigra* from Indonesia to the Philippines.

CONCLUSION

Clearly, trafficking of *M. nigra* from Indonesia to the Philippines is taking place. We strongly recommend that the authorities in the Philippines investigate and determine the origins of all *M. nigra* held in captive wildlife facilities to assess their legality. Appropriate penalties should be handed down to all individuals or organisations found guilty of trafficking or illegally keeping this species. While wildlife facilities can play an important role in providing sanctuary for confiscated or seized species, there needs to be greater scrutiny of such facilities, such as regular physical inspections and wildlife inventory audits, to ensure that the system

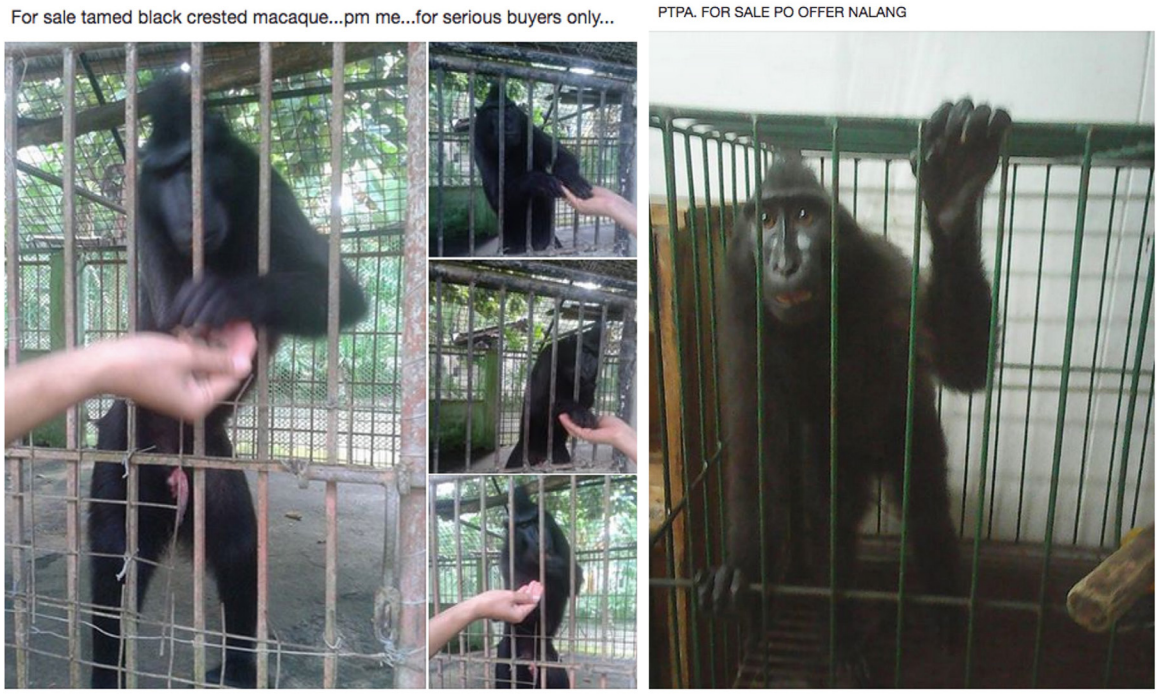

Fig. 2. Screenshots of *M. nigra* for sale on Facebook Groups in the Philippines in 2015 and 2016

is not being exploited or manipulated to facilitate trade in protected species with illegal origins.

One of the greatest threats to *M. nigra* is illegal capture and killing for trade in Indonesia and as such, enforcement efforts in Indonesia needs to be enhanced to better protect this species not only from local exploitation but also from illegal international trade. We recommend that the CITES Management authorities of both Indonesia and the Philippines increase collaboration to reduce the trafficking of this species and all wildlife between the two countries. Finally, we recommend that monitoring of the trade in *M. nigra* continue to support enforcement efforts, to guide future policy interventions and to better inform conservation strategies.

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FIRST PHOTOGRAPHIC EVIDENCE OF STUMP-TAILED MACAQUE (*Macaca arctoides*) IN PHOU HIN POUN NATIONAL PROTECTED AREA, LAO PDR, WITH A NOTE ON OTHER PRIMATE SPECIES RECORDED USING CAMERA TRAPS

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ABSTRACT

We present the first confirmed record and photographic evidence of Stump-tailed Macaque *Macaca arctoides* (Geoffroy) in Phou Hin Poun National Protected Area (PHP NPA), formerly known as Khammouan Limestone National Biodiversity Conservation Area, in Khammouan province, Lao PDR. Furthermore, we present a complete list of all other primate species recorded by camera traps inside the protected area.

Keywords: camera-trapping, limestone landscape, karst forest, Laos, *Macaca arctoides*

INTRODUCTION

The ecosystem with the second highest global biodiversity importance in Lao PDR is the massive karst formations of central Lao PDR, best represented in Hin Nam No National Park (NP) and Phou Hin Poun National Protected Area (NPA). Better known as the Indochina karst or Central Indochina limestone landscape. The drier western karst, which encompasses PHP NPA is ecologically different from the wetter eastern karst. The rugged karst terrain gives this area a degree of protection, resulting in a somewhat lower priority than typical forest ecosystems for protection and management. To date, only a few biodiversity surveys have been conducted in PHP NPA (Timmins, 1997; Steinmetz, 1998a; Brakels & Somdachit, 2020), some of which focused only on the Laotian Langur *Trachypithecus laotum* (Thomas) and Hatinh Langur *Trachypithecus hatinhensis* (Dao Van Tien) (Nadler, 2009; Phiapalath, 2010; Souwideth et al., 2021) or the Southern White-cheeked Gibbon *Nomascus siki* (Delacour) (Phiapalath et al., 2012). The presence of *Macaca arctoides* (Geoffroy Saint-Hilaire) in PHP NPA had previously been reported based on local community knowledge derived from semi-structured interviews (Steinmetz, 1998b; Phiapalath et al., 2012), but no observations by scientists or photographic evidence have been collected during previous surveys. Apart from local reports, so far at least six species of primates have been confirmed to occur in PHP NPA during past surveys, either through visual observations, in the case of *T. laotum*, *T. hatinhensis*, Assamese Macaque *Macaca assamensis* (McClelland) and Northern Pig-tailed Macaque *Macaca leonina* (Blyth), or through calls in the case of *N. siki* (Timmins, 1997; Steinmetz, 1998a; Phiapalath, 2010; Phiapalath et al., 2012). In addition, there was a report of an observation of two groups of primates described as "all silver coloured with a long tail," which the authors provisionally identified as a Long-tailed Macaque *Macaca fascicularis* (Raffles) with a less preferred alternative identification as Indochinese Gray Langur *Trachypithecus crepusculus* (Elliot) (Phiapalath et al., 2012). This latter species has been reported by local people (Steinmetz, 1988b), and it is, therefore, more likely to be the species that was observed by Phiapalath et al. (2012), since the known range of *M. fascicularis* lies much further south in the country (Hansen et al., 2022). Steinmetz (1998a) saw a single slow loris – although there was no mention of which species, in a personal communication, it was confirmed to be a Bengal Slow Loris *Nycticebus bengalensis* (Lacépède). At least two species are known to occur in Laos, *Nycticebus bengalensis* and the Northern Pygmy Slow Loris *Xanthonycticebus intermedius* (Dao Van Tien) (Blair et al., 2023). Both species were reported to occur in several village areas throughout the protected

area (Steinmetz, 1988b). While it is clear from these reports that PHP NPA is home to a diverse primate fauna, the species composition is poorly understood. Here, we report opportunistic observations of primates in camera trap data from PHP NPA.

METHODS

Study area

PHP NPA is situated at 17°26'–18°10' North and 104°24'–105°11' East and covers approximately 225,000 ha (see Fig. 1.), mostly of sparsely vegetated karst at 180–900 m asl, with pockets of tall forest in depressions in the rock and valleys. It is part of an extensive limestone formation stretching from central Annam (Vietnam) to north of the Nam (= river) Hinboun in Central Lao PDR. Although most of the area is sparsely vegetated karst and mixed deciduous forest patches, there is a large area of gentler limestone terrain in the eastern-central part of the protected area, which is predominantly covered in quite mature secondary semi-evergreen forest, with some areas of shorter younger secondary growth. Water sources in this area are very limited. There are no permanent streams within the survey area. The only available water sources throughout the dry season in November–May (approximately 6–7 months), consist of water in caves and water holes in the rocks.

Camera trap survey

Opportunistic camera trap surveys were carried out from March to December in 2018 and in the dry season of 2022-2023 to confirm the presence of small to medium-sized mammals of conservation concern. This was part of a rapid biodiversity assessment of different parts of the protected area intended to prioritize conservation areas for different levels of protection. In 2018, from March to December, 12 camera traps were deployed (model RECONYX, Inc. PC900 Hyperfire Professional IR) across 23 trapping sites, and from November 2022 to May 2023, 55 camera traps (model Big eye D3N from Bushwhacker) were deployed at an equal number of 55 trapping sites. Our survey area overlaps five different administrative districts: from north to south, Khounkham, Hinboun, Nakai, Thakhek,

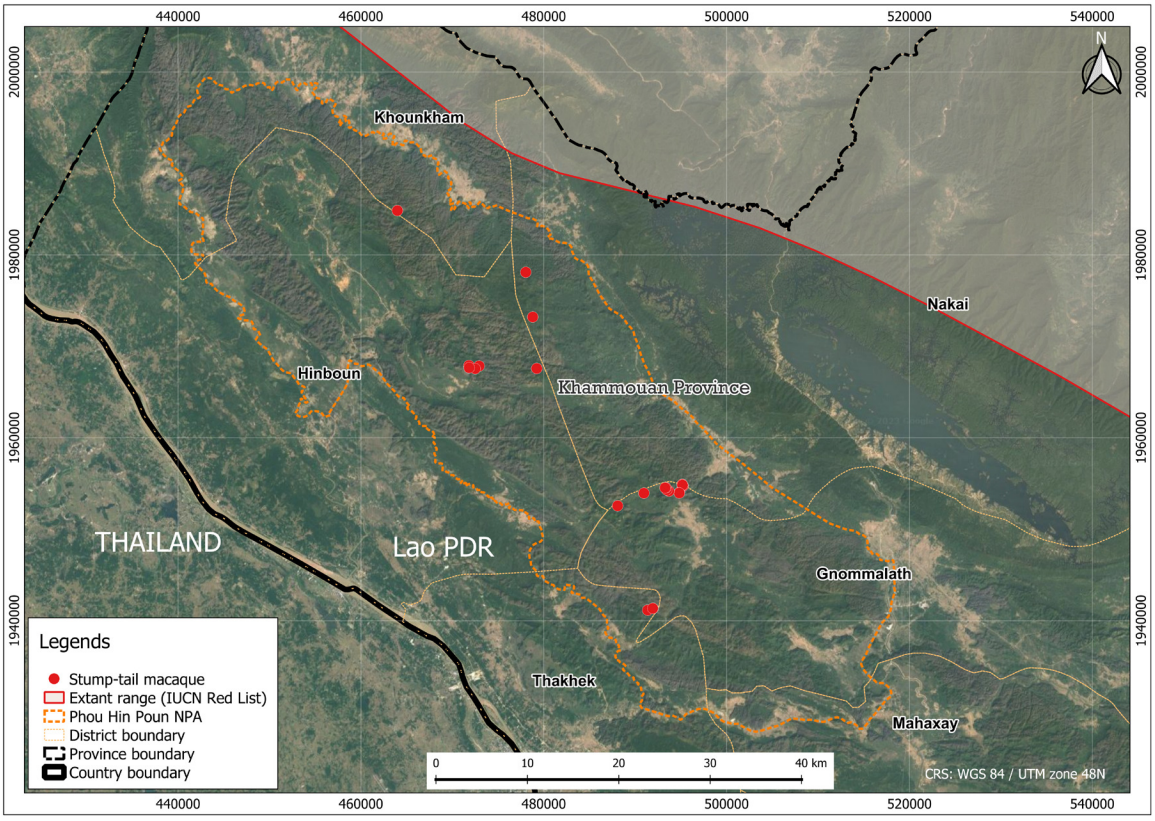

Figure 1. Map with the locations where *Macaca arctoides* was recorded in Phou Hin Poun NPA and its previously known range.

and Yommalath. The survey areas in Khounkham and Hinboun districts combined are approximately 45 km² in size; the survey area in Nakai is approximately 79 km²; in Yommalath, three distinct sites were surveyed totaling 18 km²; and lastly, in Thakhek District, an area approximately 4 km² was surveyed. All camera traps were set at a height of approximately 50 cm from the ground, the majority near waterholes or wildlife trails to opportunistically record small to medium-sized mammals in the vicinity. Total survey effort (in camera trap days, CTD) is the sum of days cameras were operational for all cameras. In 2018, there were 316 trapping days, and during the dry season of 2022-2023, there were 6,972 trapping days.

RESULTS

In Table 1, we report the occurrence (presence only) for each newly recorded species in PHP NPA as the number of locations or "distinct sites = dist. site" where each was recorded rather than solely the number of camera trap (CT) stations recording their presence, as some CTs were located in close proximity to each other at a single site. "Distinct sites" refer to sites separated by at least the size of the maximum known home range of the species concerned. Five species of primates were recorded on the camera traps (see Table 1). *Macaca arctoides* was the most frequently recorded species across 23 trap stations (Fig. 2), followed by *M. assamensis* (11), *T. laotum* (3), and *M. leonina* and *T. hatinhensis*, which were recorded at

Table 1. Number of camera trap sites, distinct sites, and districts where each of the primate species was recorded during the 8.288 camera-trap-day period.

Species	# trap stations	# distinct sites	# districts
Macaca arctoides	23	6	5
Macaca assamensis	11	8	5
Macaca leonina	2	1	1
Trachypithecus laotum	3	2	2
Trachypithecus hatinhensis	2	2	2

Figure 2. Camera trap photo depicting a family group of *Macaca arctoides* near a cave entrance in Phou Hin Poun NPA.

only two trap stations each. However, *M. assamensis* was recorded at the highest number of distinct or different sites (n=8). *Macaca arctoides* was found in syntopy with *M. assamensis* at four sites, of which one trap station also recorded *T. hatinhensis*. *Macaca arctoides* was recorded in syntopy with *M. leonina* at one site. Lastly, only *M. assamensis* was found at a single site in syntopy with *T. laotum*. Both *M. arctoides* and *M. assamensis* were found in all five administrative districts that overlap the protected area. Both *T. laotum* and *T. hatinhensis* were only recorded in two different districts.

DISCUSSION

Since our survey approach was highly opportunistic and the study area represents just a little over 6% of the total area of PHP NPA, we therefore cannot speculate about the abundance or status of any of these primate species. No conclusions can be drawn on our encounter rates because our camera trap survey focused on ground-dwelling mammal species, and therefore these primates can only be considered as "bycatch." Apart from *M. arctoides*, all the other species are, to various degrees, arboreal and are, therefore, expected to be infrequently recorded by ground-level camera trapping. *Macaca assamensis* and *M. leonina* are primarily arboreal but may use both terrestrial and arboreal pathways; both species are known to use the ground when crossing clearings and roads to forage, feed in degraded areas and feed on crops (Boonratana et al., 2020; Boonratana et al., 2022). This contrasts with both langur species recorded in this study, considered strictly arboreal species that rarely venture on the ground. This likely explains the low encounter rate of both langur species on the camera traps in this study, rather than a lower abundance compared with *M. arctoides* and *M. assamensis*. In fact, both langur species are primarily arboreal but spend a considerable amount of time on steep karst cliffs and mountainsides (Nguyen, 2006; Haus et al., 2009; Steinmetz et al., 2011). This is true in particular for *T. laotum*, which is strongly associated with precipitous terrain in both non-calcareous escarpments and limestone karst, where it has been sighted on rocks within patches of tall (semi-) evergreen forest and in open rock-face scrubby areas (Steinmetz et al., 2011).

Our results show that *M. arctoides* occurs widely throughout PHP NPA and is likely much more common than previously thought (Steinmetz, 1998a). PHP NPA currently falls outside the extant range of *M. arctoides*, as shown on the IUCN Red List of Threatened Species 2020 (Chetry et al., 2020).

Only one group of *M. leonina* was recorded by Steinmetz (1998a); however, it was assumed that both *M. leonina* and *M. assamensis* would be the most common syntopic species to be found in PHP NPA. However, in our survey, *M. leonina* was only recorded at two sites, which were in close proximity to each other; this species, therefore, appears to be relatively rare in PHP NPA.

The observed primate fauna differs in comparison with Hin Nam No National Park (HNN NP), which lies approx. 70 km to the southeast of PHP NPA and is part of the same karst landscape, the Central Indochina Limestone landscape. Here the Rhesus Macaque *Macaca mulatta* (Zimmermann) was found to be the most common macaque species with 14 groups encountered, followed by *M. arctoides* (6 groups), and only two groups of *Macaca assamensis* were observed during line transect surveys (Le et al., 2019). According to local knowledge, assessed through semi-structured interviews, *M. arctoides* was believed to be the most common macaque species. At the same time, *M. assamensis* and *M. leonina* were reported to be much less common and only occasionally sighted in HNN NP. *Macaca mulatta*, while believed to be less common than *M. arctoides*, could still be found easily, especially near important water sources in the dry season in HNN NP (Le et al., 2019). This partly corresponds with our survey data in that *M. arctoides* appears to be widespread and relatively common, while *M. leonina* seems to be rare in both karst limestone protected areas. *Macaca mulatta* was not recorded on any camera traps in our survey. This species was also not reported by Steinmetz (1998a), who suggested that the species probably does not exist here. *Macaca mulatta* is said to be associated with riverine forests in Laos (Ruggeri & Timmins, 1996), which was also confirmed by the villagers of HNN NP (Le et al., 2019). This likely explains why no *M. mulatta* was recorded by the cameras since our study area did not include any riverine habitats. Since a few rivers flow through PHP NPA, it is not impossible that *M. mulatta* still occurs here.

Macaca assamensis was previously expected to be the most common and widespread macaque species in the protected area (Steinmetz, 1998a; Timmins & Duckworth, 2013). This corresponds with our findings, as the species was recorded at eight sites across the area, while *M. arctoides* was recorded at only six sites. *Macaca assamensis* is known to have a small home range of 50–65 ha and mean daily path length

of 590–782 m (Zhou et al., 2014). Food distribution influences the Assamese Macaque's more frequent occurrence on cliffs (71.7% of total location records) and hillsides (20.2%), both of which are often covered with bamboo, the primary preferred leaf source of *M. assamensis* (Zhou et al., 2011; 2014; 2018). Although the home range of *M. arctoides* is unknown, it is considered closely related and very similar to the Tibetan Macaque *Macaca thibetana* (Milne-Edwards) in terms of its ecology and behaviour (Fooden, 1990). Therefore, the two species are expected to share similar home range sizes, which for *M. thibetana* can be up to 1300-1400 ha (Li, B.W. et al., 2022; Li, W.B. et al., 2022). In addition, previous studies suggest that *M. thibetana,* a primarily terrestrial species, can migrate over large areas and needs an extensive home range of more than 700 ha for one group to thrive (Wang et al., 1989; Wang et al., 1994). Regardless of the actual home range of *M. arctoides*, in comparison with *M. assamensis* it is expected to be significantly larger. Therefore, although *M. arctoides* was recorded at a higher number of trap stations than *M. assamensis*, due to its much larger expected home range, it was recorded at fewer distinct sites, each likely occupied by a different family group. However, it is premature to draw conclusions due to the nonsystematic sampling design and opportunistic approach of this survey, wherein at the majority of the survey sites, several camera traps were placed in relatively close proximity to one another.

To conclude, based on our camera trapping survey and past surveys, we can confirm the occurrence of eight species of primates in Phou Hin Poun NPA, including the Southern White-cheeked Gibbon *N. siki*, Hatinh Langur *T. hatinhensis*, Laotian Langur *T. laotum*, Bengal Slow Loris *N. bengalensis*, Northern Pygmy Slow Loris *X. intermedius*, Stump-tailed Macaque *M. arctoides*, Northern Pig-tailed Macaque *M. leonina*, and Assamese Macaque *M. assamensis*. There could possibly be ten species, pending confirmation of the occurrence of the Rhesus Macaque *M. mulatt*a and the Indochinese Gray Langur *T. crepusculus*; the former is more likely to persist than the latter. The population of *T. laotum* is evidently of global significance as it is the main site for this species (Steinmetz et al., 2011). The population of *M. assamensis* is most certainly nationally significant, probably much more so than *M. arctoides*, which is also known to be common in neighbouring sites.

This study showed that predominantly ground-dwelling primates, like *M. arctoide*s, and more arboreal species, like *M. assamensis* may be effectively detected and surveyed using camera traps. To estimate occupancies and abundance, a larger systematic and standardized sampling design is needed (Abrams et al., 2018).

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STATUS AND DISTRIBUTION OF ASSAMESE MACAQUE *Macaca assamensis* IN BANGLADESH

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ABSTRACT

Assamese Macaques *Macaca assamensis* are nationally Endangered in Bangladesh, yet limited information is available on their status and distribution throughout the country. We surveyed the distribution of *M. assamensis* in their known extant range between January 2019 and February 2022. Population status was estimated by either line transect or point transect sampling. A total of 11 groups were recorded from eight localities, including one solitary male from the Satchari National Park in the country's northeast region. The group size ranged from three to 15 individuals, with a mean of 7.83 ± 4.65 (n = 11). The study found no significant difference in group size of *M. assamensis* between protected and non-protected forests. The adult sex ratio was almost equal (1 male to 1.10 females), and the ratio between adults and non-adults (immatures) was 1 to 0.45. We collected information from three sleeping sites, one in the Doluchari Village Common Forest of Rangamati District and another two in the Baraiyadhala National Park of Chattogram District. The height of the sleeping sites ranged from 50 m to 70 m, with a mean of 61 m (n = 3) above the stream bed.

INTRODUCTION

Bangladesh is located at the junction of the Indo-Himalayas and Indo-China biotic subregions, and it is home to ten species of primates, including five species of macaques, three species of langurs, one species of lorises, and one species of small ape (IUCN Bangladesh, 2015). Due to its geographic location, it has diverse habitat types that support a unique combination of species (Stanford, 1991). Many wildlife species typical to each of these biotic subregions occur in Bangladesh. The ranges of two langur genera can be taken as an example: the Northern Plains Gray Langur *Semnopithecus entellus* (Dufresne) is distributed in the Indo-Himalayas subregion, with its easternmost range in Bangladesh, whereas the Phayre's Langur *Trachypithecus phayrei* (Blyth) is distributed in the Indo-China subregion, with its westernmost range in Bangladesh (Khan, 2018; Chetry & Ahmed, 2021).

Macaca assamensis is distributed from Nepal through the Himalayas to southernmost China and north-central Southeast Asia, including Bangladesh, India, Bhutan, Myanmar, Thailand, Vietnam, and Laos (Fooden, 1982; Boonratana et al., 2020). *Macaca assamensis* is in appearance and body mass like the Rhesus Macaque *Macaca mulatta* Zimmermann (Smith & Jungers 1997; Francis, 2008), but the two differ in fur coloration, i.e., *M. assamensis* have dark to yellowish-brown hair, and adults have red skin. Although *M. assamensis* is a widespread species, few field studies have been conducted (Timmins & Duckworth, 2013). *Macaca assamensis* is categorized as globally Near Threatened (Boonratana et al., 2020) and Endangered in Bangladesh (IUCN Bangladesh, 2015). The species occurs, although low in numbers, in mixed evergreen forests in the northeast and southeast regions of the country. It has been sighted in the Gazipur Tea Estate of Rajkandi Forest, Shuvolong of Kaptai, and Baraiyadhala National Park of Chattogram (Ahsan, 1994; Feeroz, 2015; Karim & Ahsan, 2016). However, although some sighting reports are available in Bangladesh, there is no information on its overall population, group size and composition, sleeping sites, day range, home range, distribution in protected and non-protected forests, and other ecological parameters.

We carried out systematic field surveys on the occurrence, distribution, and population of *M. assamensis* in Bangladesh and reported the

population status, group size, and composition across elevational gradients. This study also sheds some light on its sleeping ecology in a low-elevation habitat in Bangladesh.

METHODS

Data collection and analysis

We conducted 48 field surveys between January 2019 and February 2022, in 15 sites in the northeast and 30 sites in the southeast regions of Bangladesh (Table 1; Fig.1). The northeast and southeast regions are hilly areas covered with mixed-evergreen forests. The dominant plants in these forests are Garjan *Dipterocarpus turbinatus* (Gaertn), *D. pilosus* Civit, *Swintonia floribunda* (Griff.), Rock Dammar *Hopea odorata* (Roxb.), Dhakijam *Syzygium grande* (Wight) Walp., Silk Cotton Tree *Salmalia insignis* (Wall.) Schott & Endl., Wight's Crest-petal *Lephopetalum wightianum* (Arn.), and Duabanga *Duabanga sonnerationides* (Roxb. Ex DC.) Walp. Among the large to medium-sized predators, Leopard *Panthera pardus* (Linnaeus), Clouded Leopard *Neofelis nebulosa* (Griffith), Marbled Cat *Pardofelis marmorata* (Martin), Dhole *Cuon alpinus* (Pallas), Burmese Python *Python bivittatus* Kuhl and Reticulated Python *Malayopython reticulatus* (Schneider) are reported from these areas (IUCN Bangladesh, 2015; Khan, 2018).

Table 1. List of sites surveyed for Assamese Macaques in Bangladesh.

No.	Site*	Vegetation Type
1	West Bhanugach Reserve Forest, Moulvibazar District	Mixed evergreen
2	Lawachara National Park, Moulvibazar District	Mixed evergreen
3	Adampur, Moulvibazar District	Mixed evergreen
4	Kalinji, Sylhet	Mixed evergreen
5	Rajkandi, Moulvibazar District	Mixed evergreen
6	Horin Chara, Moulvibazar District	Mixed evergreen
7	Patharia, Moulvibazar District	Mixed evergreen
8	Barlekha, Moulvibazar District	Mixed evergreen
9	Lathitila, Moulvibazar District	Mixed evergreen
10	Sagarnal, Moulvibazar District	Mixed evergreen
11	Gazipur Tea Estate, Moulvibazar District	Tea garden
12	Jhimai Tea Estate, Moulvibazar District	Tea garden
13	Chautoli, Moulvibazar District	Mixed evergreen
14	Rema-Kalenga, Habiganj District	Mixed evergreen
15	Satchari, Habiganj District	Mixed evergreen
16	Chunati, Chattogram District	Mixed evergreen
17	Fashiakhali, Cox's Bazar District	Mixed evergreen
18	Satghar, Chattogram District	Degraded hill with bush
19	Padua, Chattogram District	Mixed evergreen
20	Hazarikhil, Chattogram District	Mixed evergreen
21	Baraiyadhala, Chattogram District	Mixed evergreen
22	Bhomarighona, Cox's Bazar District	Degraded hills with bush
23	Ukhia, Cox's Bazar District	Degraded mixed evergreen

24	Himchari, Cox's Bazar District	Degraded mixed evergreen
25	Teknaf, Cox's Bazar District	Degraded hills with bush
26	Dighinala, Khagrachari District	Mixed evergreen
27	Pablakhali, Rangamati District	Mixed evergreen
28	Ramgar, Khagrachari District	Degraded hills with bamboo thickets
29	Korerhat, Chattogram District	Mixed evergreen
30	Baishari, Cox's Bazar District	Mixed evergreen
31	Bengdepa, Cox's Bazar District	Mixed evergreen
32	Kaptai National Park (Karnafuli Range & Rampahar), Rangamati District	Mixed evergreen
33	Bamu, Bandarban District	Mixed evergreen
34	Thanchi, Bandarban District	Mixed evergreen
35	Dopachari, Chattogram District	Mixed evergreen
36	Sangu. Bandarban District	Mixed evergreen
37	Inani, Cox's Bazar District	Degraded mixed evergreen
38	Khudukhoza, Rangamati District	Degraded mixed evergreen
39	Alikadam, Bandarban District	Degraded mixed evergreen
40	Rajghat, Cox's Bazar District	Degraded mixed evergreen
41	Upper Rezu, Cox's Bazar District	Degraded mixed evergreen
42	Shuvolong, Rangamati District	Degraded mixed evergreen
43	Rimiak Hill Ali Kadam, Bandarban District	Evergreen
44	Sitakunda Ecopark, Sitakunda District	Mixed evergreen
45	Doluchari Village Common Forest, Rangamati District	Mixed evergreen

*Northeast region = sites number 1-15; Southeast region = sites number 16-45

Four to six days were spent in each field survey, totaling 208 days. Three to five permanent line transects were established at each study site (Feeroz, 2001; Hasan, 2003; Hasan et al., 2007, 2013) based on the size of the forest and habitat condition. In the northeast, some of the forests are surrounded by tea gardens; therefore, the existing roads or trails of those tea gardens were used as transect lines. A total of 13 forests in the northeast, 30 in the southeast, and two tea gardens were surveyed. Two observers surveyed each site twice throughout different seasons, and each transect was surveyed repeatedly at different times of the day. Point sampling was used if the line transect survey was difficult to perform in inaccessible terrain. GPS coordinates of all detected *M. assamensis* groups were recorded along with the group size and composition. We avoided repeated counting of the same group by identifying social groups using group size, composition, and noticeable markings of members (injuries, abnormalities, or other characteristic morphological features). We used five age-sex classes to characterize *M. assamensis* group composition: adult male, adult female, sub-adult, juvenile, and infant.

To understand the relationship between elevational gradients and demographic characteristics, we recorded the number of groups and individuals observed at different elevational ranges. Populations and groups were also classified based on their presence in protected or non-protected areas. Sleeping trees were initially detected by observing the

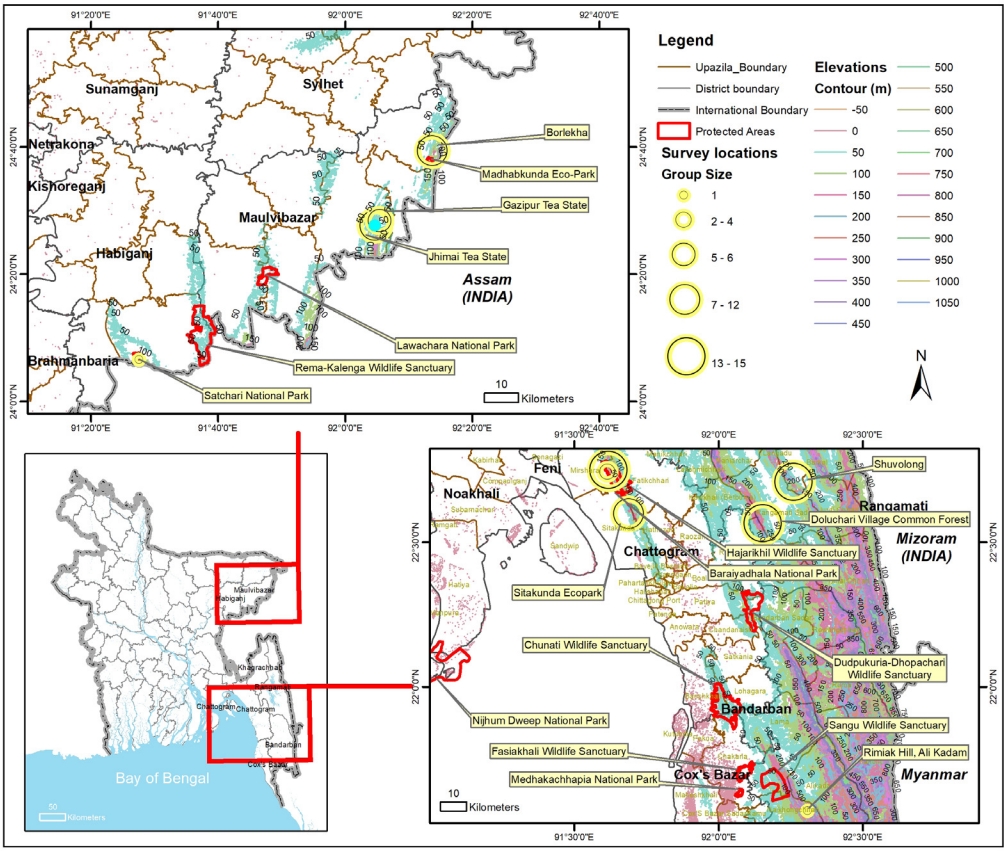

Fig. 1. Distribution of Assamese Macaque in Bangladesh.

physical condition of the habitat and the presence of feces under the tree. Repeated visits were made to confirm that a candidate tree was used for sleeping, and camera traps were also deployed to confirm the use of sleeping sites. A distribution map was prepared in ArcMap (version 10.3). Relevant descriptive statistics and figures were computed in R version 3.4.4 (R Core Team, 2021).

RESULTS

Population status

A total of 94 *M. assamensis* individuals from ten groups and one lone individual were recorded from nine sites (Table 2). Four groups of *M. assamensis* were recorded from Baraiyadhala National Park. In contrast, only one group of *M. assamensis* was recorded in each other site where the taxon occurred, except for Satchari National Park, where only one adult male was observed with a *M. mulatta* troop of 46 individuals. Among the nine sites, five were in the southeast (seven groups), and another three groups and one lone individual were recorded at four sites in northeast Bangladesh.

Group size and composition

Macaca assamensis group size ranged from 3 to 15 (mean 8.45±4.32, n=10) individuals. The largest group (15 individuals) was found in Shuvolong of Rangamati District, while the smallest group (3 individuals) was located at Baraiyadhala National Park of Chattogram District (Table 1). An adult male was found with a *M. mulatta* group at Satchari National Park of Habiganj District. Overall, the surveyed population of *M. assamensis* comprised 33% adult males, 36% adult females, 5% sub-adults, 17% juveniles, and 9% infants. About 69% of the population were adults, while 31% were non-adult. The ratio of adults to non-adults was 1:0.45, the adult male-female sex ratio was 1:1.1, and the adult female-infant ratio was 1:0.26.

Table 2. Group size and composition of Assamese Macaque in Bangladesh

Location	Group size	AM:AF	Group Composition				
			AM	AF	SA	JUV	INF
Baraiyadhala National Park 1	14	1:1.25	4	5	-	3	2
Baraiyadhala National Park 2	3	-	3	-	-	-	-
Baraiyadhala National Park 3	9	1:1.33	3	4	-	2	-
Baraiyadhala National Park 4	13	1:1.67	3	5	1	2	2
Sitakunda Ecopark	6	1:1.50	2	3	-	1	-
Doluchari Village Common Forest	12	1:1.33	3	4	1	2	2
Shuvolong	15	1:1.25	4	5	2	3	1
Borlekha	6	1:1	3	2	1	-	-
Gazipur Tea Estate	4	1:0.67	1	2	-	1	-
Jhimai Tea Estate	6	1:2	2	2	-	1	1
Satchari National Park	1	1:1	1	-	-	-	-
	89		**29**	**32**	**5**	**15**	**8**

AM=Adult males; AF=Adult females; SA=Subadults; JUV=Juveniles; INF=Infants

Population distribution in protected and non-protected areas

Out of 94 individuals sighted during the survey, 46 were observed in protected areas (national parks and an eco-park), and 48 were observed in non-protected forest areas. The average group size was 7.67±5.28 and 8±4.43 in protected and non-protected forests, respectively (Fig. 2). The study found no significant difference in the group size of *M. assamensis* in protected and non-protected forests (t=-0.12, df=10, p=0.9).

Population distribution in different elevation zones

Macaca assamensis were distributed in areas ranging from 51 m to 550 m above sea level (asl). About 5% of individuals were found above 200 m, 26% between 150 and 200 m asl, and 43% between 100 m and 150 m asl. The remaining 26% of individuals were observed to be <100 m asl. No significant differences in the probability of occurrence were found across elevational zones in Bangladesh (Kruskal-Wallis Test, Chi square= 3.1, df= 2, p=0.37; Fig. 3).

Sleeping sites

Three *M. assamensis* sleeping sites were observed: one in Doluchari Village Common Forest of Rangamati District and another two in Baraiyadhala National Park of Chattogram District. All three sleeping sites were overhanging trees in steep hills over streams (Fig. 4). The height of the sleeping trees ranged from 50 m to 70 m with a mean of 60.7 m (n=3) from the ground. The slopes of the hills were 85-90 degrees, likely making it difficult for predators to access the trees. All individuals of the different *M. assamensis* groups were found to sleep in the same tree or nearby tree branches hanging from steep hills. Camera trap photos (Fig. 5) from Baraiyadhala National Park showed that one of the *M. assamensis* groups regularly climbed onto their sleeping site just with the onset of sunset (Fig. 6) and left the site for foraging with the onset of sunrise. The whole group followed the adult male and foraged together.

DISCUSSION

Macaca assamensis is one of the least studied primates in Bangladesh and had previously been reported to occur in only three localities. The current study reports the occurrence of *M. assamensis* at six additional sites. The outcome of the study will bridge an information gap for the reassessment of the species in the next national Red List assessment. It will also aid in setting priorities for conservation planning for their protection.

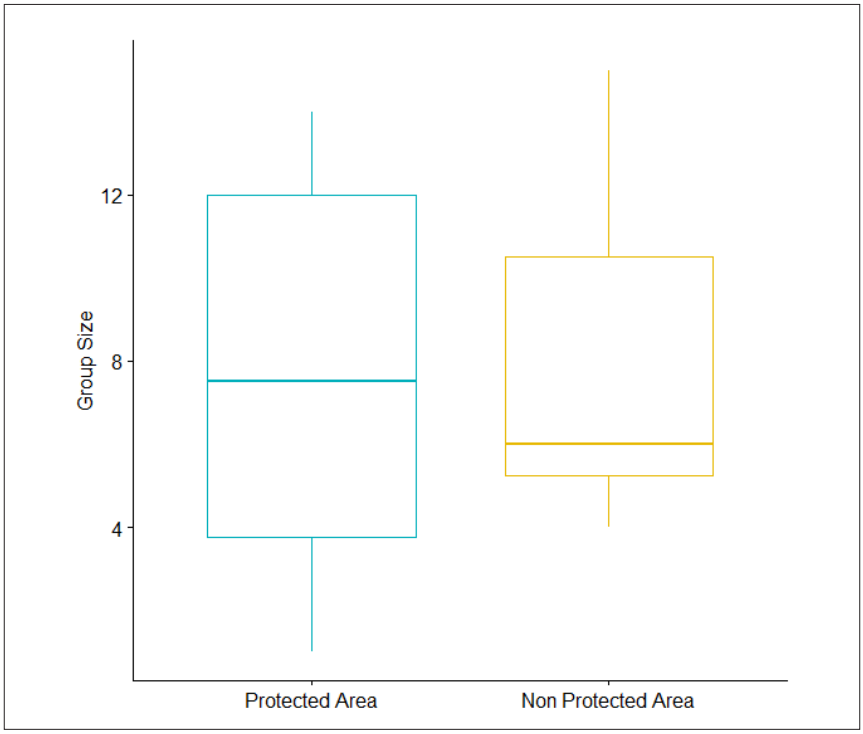

Fig. 2. Distribution of Assamese Macaque groups in protected and non-protected forests in Bangladesh.

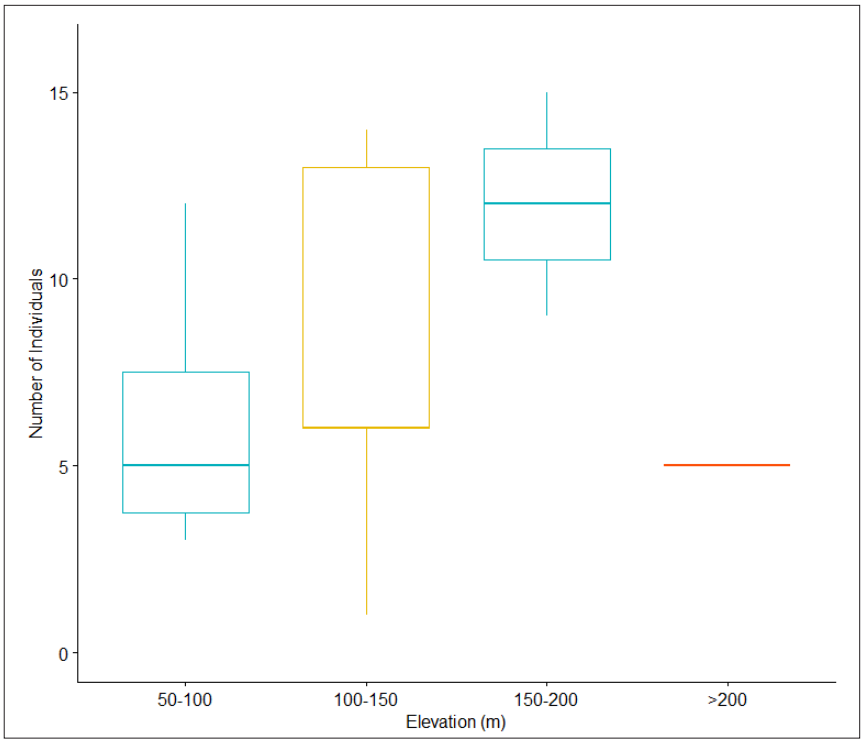

Fig. 3. Elevational distribution of Assamese Macaque based on their occurrence in different study sites.

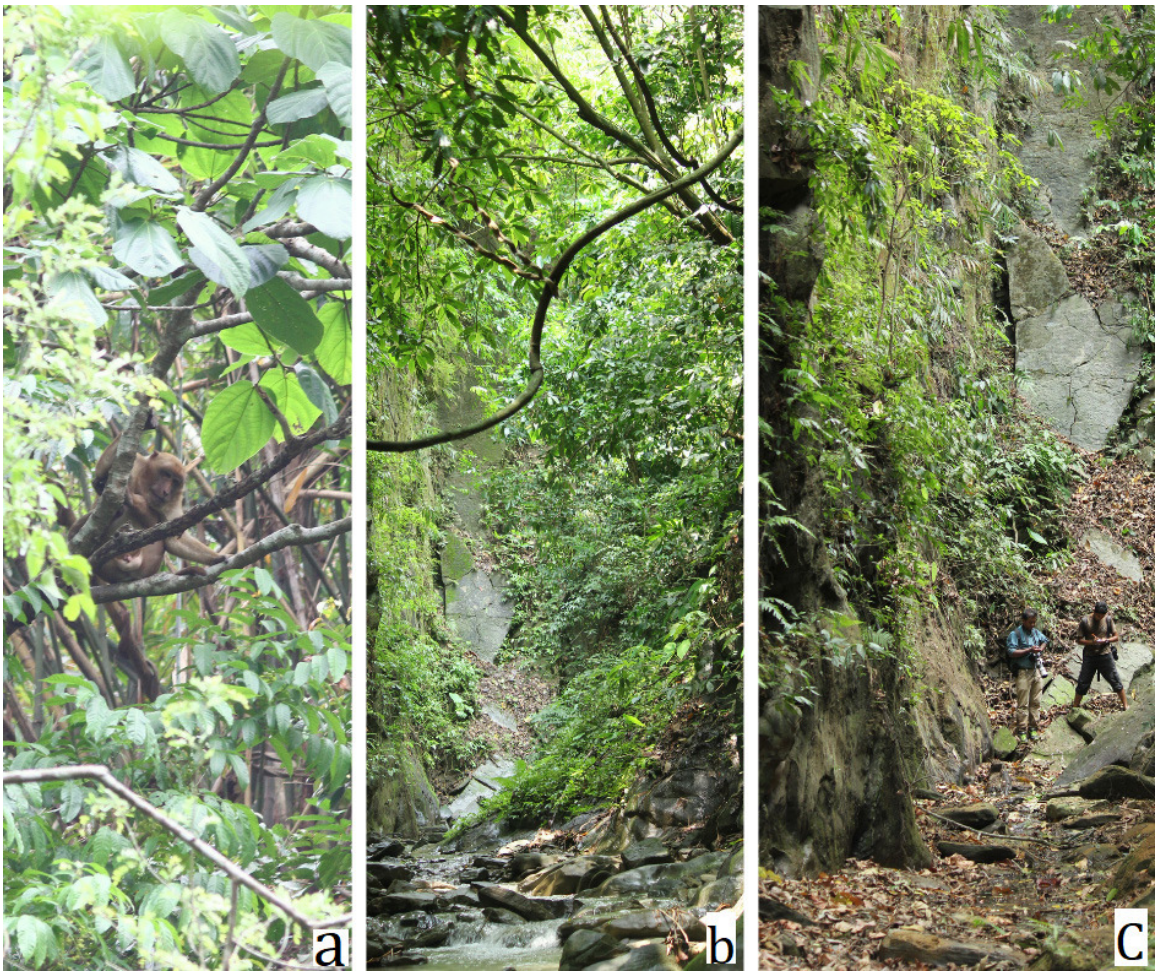

Fig. 4. Assamese Macaque at Doluchari Village Common Forest. a) an adult male in a sleeping tree, b) a sleeping tree and its adjacent habitat, and c) sleeping site data collection by the field survey team. ©Ashis Kumar Datta

The present study identified ten groups of *M. assamensis* with group sizes ranging from three to 15 individuals. They are reported to occur in much larger groups (3-50 individuals per group) in Thailand (Carpenter, 1942; Fooden, 1971; Aggimarangsee, 1992) in Nepal and India (Paudel & Chalise, 2018; Khanal et al., 2019; Chalise, 2000, 2003, 2013).

Different studies have reported different sex ratios for *M. assamensis* populations. In Nepal, Chalise (2000) reported the ratio of adult males to adult females as 1:2.03, although in 1998, from the same study area, he reported a 1:1.9 ratio. However, Paudel & Chalise (2018) reported an adult sex ratio at another site in Nepal as 1:0.81. A nationwide survey covering all of Nepal found a ratio of 1:1.91 adult males to females (Khanal et al., 2019). In our study, the *M. assamensis* adult and non-adult sex ratio was 1:0.45, and the sex ratio of adult males and females was 1:1.1. The present study found adult females were the largest contingent (36%) in the observed population. Chalise & Pandey (2010) found a similar demographic structure in a study in Nepal. However, Paudel & Chalise (2018) observed the opposite trend, where adult males constituted the largest component (23%).

In South Asia, *M. assamensis*, also known as hill macaque or upland macaque, inhabits low-elevation forests (Choudhury, 2008; Khanal et al., 2019), whereas in Southeast Asia, the records are from mid- to high-elevation forests (Fooden, 1982; Timmins & Duckworth, 2013). In Bangladesh, we did not find any significant difference between the occurrence of *M. assamensis* at different elevational zones <550 m asl.

During the present study, we found all *M. assamensis*

Fig. 5. Camera trap photos of Assamese Macaque troops at Baraiyadhala National Park.

Fig. 6. Sleeping site of Assamese Macaques at Baraiyadhala National Park. ©Md. Kamrul Hasan

in forests <550 m asl. In other range countries, it is often found above 500 m asl, mostly 150-1900 m, with the highest distributional record at 3,500 m asl (Fooden, 1982, 1986, Timmins & Duckworth, 2013).

The present study observed that *M. assamensis* in Bangladesh are currently found in both protected and non-protected areas with no significant difference in occurrence between them. Baraiyadhala National Park supports the highest *M. assamensis* population (four groups of 39 individuals) among all national populations.

This study identified three sleeping sites for *M. assamensis*, all in hilly habitats on hanging trees in steep hills. Using hanging trees or steep hills could be a strategy to avoid potential predators. Chalise (2003) found that *M. assamensis* generally uses steep cliffs as sleeping sites, usually along steep river or stream banks. This area might provide protection from carnivores (Chalise, 2003). The distribution of food resources is also a determining factor for habitat and sleeping site use by *M. assamensis* (Zhou et al., 2011). Further studies on *M. assamensis* habitat use and ranging patterns, habitat preferences, and seasonal variation are recommended.

In Bangladesh, evergreen and mixed evergreen forests, where most primate populations are found, mainly remain in the northeast and southeast parts of the country (IUCN Bangladesh, 2015). In recent years, many planned and unplanned development works have continued in these regions, and linear infrastructure such as roads and rail lines traversing wildlife habitats is being built (The Business Standard, 2019). *Macaca assamensis* distribution is uneven in Bangladesh, with about 43% (n=39) of the population residing in a single protected forest (Baraiyadhala National Park). Although more likely to be related to the level of human disturbance, to better understand why Baraiyadhala National Park maintains approximately half of the national population, more in-depth research on its population and behavioral ecology, interactions with other animals, habitat, sleeping site, and tree selection pattern is needed. Also, it is notable that more than half of the *M. assamensis* population resides outside

protected areas. Considering these potential habitats and populations, conservation efforts should identify and protect sleeping trees, and prioritise habitat restoration, community awareness, and environmental education programmes.

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LEGACY OF A SCHOLAR AND CONSERVATIONIST

This tribute is in loving memory of Associate Professor Dr Sompoad Srikosamatara, a distinguished scholar and passionate conservationist. Born on 16 June 1955 in Ratchaburi Province, Thailand, his impactful journey through academia and conservation left an indelible mark on the realms of biodiversity and wildlife research.

Dr Srikosamatara's academic prowess unfolded with the completion of his B.Sc. in Biology from Mahidol University in 1977, followed by an M.Sc. in Environmental Biology from the same institution in 1980. His M.Sc. thesis, focusing on The Ecology and Behaviour of the Pileated Gibbon (*Hylobates pileatus*) in Khao Soi Dao Wildlife Sanctuary, Thailand, was published in The Lesser Apes: Evolutionary and Behavioural Biology in 1984. Subsequently, he earned a Ph.D. in Zoology from the University of Florida in 1987, supported by a prestigious Fulbright scholarship.

Embarking on a dedicated career, Dr Srikosamatara joined the Department of Biology at Mahidol University as a lecturer on 9 November 1987. His commitment and contributions led to promotions to Assistant Professor on 30 January 1990 and Associate Professor on 18 May 1993. Recognizing his immense scholarly achievements, the University Council of Mahidol University approved his professorial appointment on 21 April 2021, which was awaiting a royal appointment from His Majesty the King of Thailand, per the country's regulations for a professor position.

Beyond his academic milestones, Dr Srikosamatara significantly contributed to ecological research and conservation. His extensive work includes studies on biodiversity and sustainable practices by local communities in Mae Hong Son and Kanchanaburi provinces. His research also delved into the ecology and conservation of large mammals, such as wild elephants and gaurs, in the Western Forest Complex and Dong Phayayen – Khao Yai Forest Complex. His commitment extended to serving as a member of the IUCN SSC Asian Wild Cattle Specialist Group, promoting eco-literacy on wetlands and urban ecosystems, and contributing his expertise to organizations like the National Research Council of Thailand (NRCT), Thailand Research Fund (TRF), Thailand Environment Institute (TEI), Green World Foundation and the Bird Conservation Society of Thailand (BCST).

As Assistant Director of the Biodiversity Research and Training Program (BRT) from 2000 to 2005, Dr Srikosamatara was pivotal in advancing academic knowledge on Thai biodiversity and nurturing future researchers.

His exemplary service garnered esteemed recognition, marked by the receipt of two high-class insignias from His Majesty (the late) King Rama IX, namely the Knight Grand Cordon (Special Class) of the Most Noble Order of the Crown of Thailand and the Knight Grand Cross (First Class) of the Most Exalted Order of the White Elephant.

Upon retirement, Dr Srikosamatara found solace and joy in agriculture in Ratchaburi province. Tragically, on 16 January 2024, a fatal accident occurred. In honour of his legacy, His Majesty King Rama X graciously provided an octagonal funerary urn for the funeral, and a solemn royal cremation took place on 24 January 2024 at Wat Ban Pong Temple in Ratchaburi Province. May his contributions to science and conservation continue to inspire future generations, and may he rest in eternal peace.

Prepared by friends, colleagues, and students of Assoc. Prof. Dr Sompoad Srikosamatara

Instructions to Contributors

Scope

This journal aims to provide information relating to conservation of the primates of Asia. We welcome manuscripts on any relevant subject, including taxonomy and genetics, biogeography and distribution, ecology and behaviour, active threats and primate-human interactions. Submissions may include full articles, short articles and book reviews.

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Taxonomy

Both the common name and the scientific nomenclature should be used at the first mention of any species or subspecies. The scientific nomenclature at first mention should also include its taxonomic authority, e.g., Bornean Orangutan *Pongo pygmaeus* (Linnaeus), Sumatran Orangutan *Pongo abelii* Lesson, North-east Bornean Orangutan Pongo *pygmaeus morio* (Owen). Subsequent mention should include only the scientific nomenclature, i.e., *Pongo pygmaeus* or *Pongo pygmaeus morio* at start of a sentence, or *P. pygmaeus* or *P. p. morio* within the sentence. Authors are referred to IUCN (or more recent/authoritative sources) for up-to-date animal nomenclature and the Plants of the World Online (https://powo.science.kew.org) for up-to-date plant nomenclature. The up-to-date common name and the scientific nomenclature of Asian primates acceptable to the Asian Primates Journal are available at the journal's webpage (www.primate-sg.org/asian_primates_journal/).

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Acknowledgements

Remember to thank those who have contributed substantially to your paper, not forgetting (in the final submission) the reviewers.

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