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COMMUNICATION

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COMMUNICATION

Population assessment of the endangered Western Hoolock Gibbon *Hoolock hoolock* Harlan, 1834 at Sheikh Jamal Inani National Park, Bangladesh, and conservation significance of this site for threatened wildlife species

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Abstract: Sheikh Jamal Inani National Park (Inani) is a wildlife habitat in Bangladesh located under the Cox's Bazar South Forest Division, Cox's Bazar. It constitutes significant habitat for the charismatic and globally 'Endangered' Western Hoolock Gibbon *Hoolock hoolock* in Bangladesh. Here, we show that Inani is a poorly-known gibbon habitat with a population of seven groups, comprising a total of 18 individuals. Among them, 77.8% were adults (males and females), and 11.1%, 5.6%, and 5.6% were sub-adults, juveniles, and infants, respectively, indicating low reproductive output. Five of seven groups had no offspring present in the group, and the mean group size of 2.57 individuals/group is low compared to other habitats in Bangladesh. Beside Western Hoolock Gibbon, Inani is home to many threatened wildlife species. The first record of the Slaty-backed Flycatcher *Ficedula erithacus* in Bangladesh occurred in Inani, adding this new species to the national bird checklist of Bangladesh. The presence of the globally 'Endangered' Asian Elephant *Elephas maximus*, Phayre's Langur *Trachypithecus phayrei*, & Elongated Tortoise *Indotestudo elongata* and the globally 'Vulnerable' Northern Pig-tailed Macaque *Macaca leonina*, Capped Langur *Trachypithecus pileatus*, Indian Leopard *Panthera pardus*, & Asiatic Softshell Turtle *Amyda cartilaginea* highlight the importance of Inani as a conservation area in Bangladesh. The Western Hoolock Gibbon and other threatened wildlife of Inani are now on the verge of local extinction due to a sharp increase in forest resource extraction resulting from the recent influx of large numbers of Rohingya refugees from Myanmar, many of whom have settled around Inani. Through stakeholder interviews in the area, we have identified feasible and measurable conservation actions at Inani that are urgently needed to prevent further loss of wildlife and to protect this important gibbon habitat.

Keywords: Cox's Bazar South Forest Division, Rohingya, Slaty-backed Flycatcher.

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INTRODUCTION

Sheikh Jamal Inani National Park (short: Inani) is the southern-most natural, although heavily degraded, forest in Bangladesh. It was previously known as Inani Reserved Forest, and was declared a National Park in 2019 by the Bangladesh Government. Inani includes the last remnants of degraded natural forest in Cox's Bazar South Forest Division and supports many globally threatened wildlife species (Kabir et al. 2014, 2015, 2017). These forests also form a wildlife corridor between Myanmar and Bangladesh that is recognized in Bangladesh as a prominent Asian Elephant corridor (IUCN Bangladesh 2018).

Rohingya refugees are defined by the People's Republic of Bangladesh as 'forcibly-displaced Myanmar nationals' (UNDP Bangladesh and UN WOMEN Bangladesh 2018). About a million Rohingya refugees have settled in Bangladesh in successive waves of displacement since the early 1990s (https://www.unhcr.org/rohingya-emergency.html), of which 716,915 are new arrivals since 25 August 2017 (https://data2.unhcr.org/en/situations/myanmar_refugees). They have settled at Ukhia and Teknaf upazila (sub district) under the Cox's Bazar District of Bangladesh. The majority of them have settled around or inside the Ukhia Reserved Forest, Sheikh Jamal Inani National Park, and Teknaf Wildlife Sanctuary, administered by the Bangladesh Government and UNHCR. Makeshift camps and fuel-wood collection have had significant impacts on forested areas, resulting in forest degradation and habitat loss, wildlife habitat fragmentation, loss of wildlife corridors, and an increase in elephant-human conflict (UNDP Bangladesh and UN WOMEN Bangladesh 2018).

Several recent publications over the last 12 years describe wildlife diversity and conservation in Inani (e.g., Akhter et al. 2009; Ahmed et al. 2011; Rahman & Mannan 2011; Kabir et al. 2014, 2015, 2017; Haidar et al. 2017). Drastically decreasing habitat quality at Inani due to forest loss and other threats, such as encroachment and extraction of forest products by nearby local and Rohingya communities, however, are driving the Western Hoolock Gibbon, as well as other wildlife species, to the brink of local extinction.

No recent information has been published on the population status of Western Hoolock Gibbon *Hoolock hoolock* Harlan, 1834 at this site (Image 1). New information is provided in this paper on the population status of Western Hoolock Gibbons at Inani, and we report the occurrence of other globally threatened wildlife species, indicating the value of the site. Through stakeholder interviews in the area, we identified in situ conservation initiatives that should be undertaken immediately to protect Western Hoolock Gibbon and other threatened species at Inani.

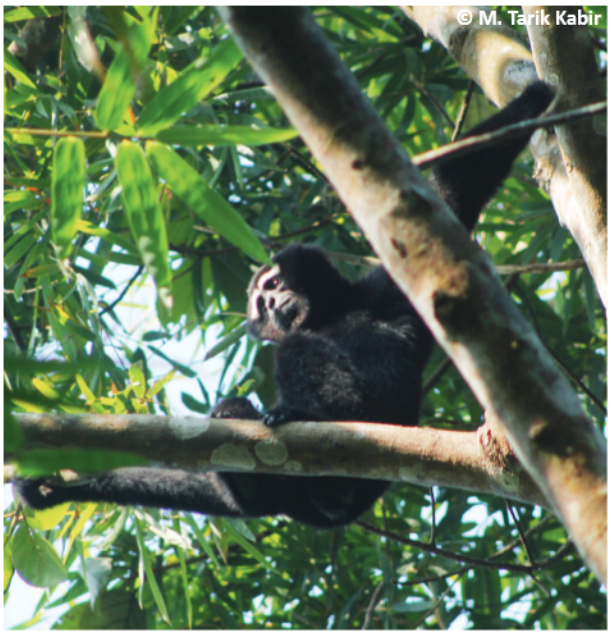


Image 1. Western Hoolock Gibbon *Hoolock hoolock*

MATERIALS AND METHODS

Study Area

The Sheikh Jamal Inani National Park (21.226642 N and 092.081416 E) covers an area of 7085.16 ha of hill forest in the Inani Forest Range under the Cox's Bazar South Forest Division of Cox's Bazar District of Bangladesh. It is bordered by the Himchhari National Park in the north, Teknaf Wildlife Sanctuary in the south, Ukhia Reserved Forest in the east, and the Bay of Bengal in the west.

The vegetation of Inani is mixed-evergreen forest dominated by degraded secondary forests. Major tree species are Garjan *Dipterocarpus* spp., Chapalish *Artocarpus chama*, Chundul *Tetrameles nudiflora*, Civit *Swintonia floribunda*, Telsur *Hopea odorata*, Shimul *Bombax* spp., Pitraj *Aphanamixis polystachya*, Koroi *Albizia* spp., Bandorholla *Duabhanga grandiflora*, Jam *Syzygium* spp., Rata *Amoora wallichii*, Nageshwar *Mesua ferrea*, Uri-am *Magnifera longipes*, Bhadi/Jiol *Lannea coromandelica*, Jarul *Lagerstroemia* spp., Gamar *Gmelia arborea*, Figs *Ficus* spp., and Ajuli *Dillenia pentagyna* (Kabir 2012).

The composition of the undergrowth, including bamboos, varies considerably from place to place. The most common species are Mulibansh *Melocanna bambusoides*, Mitinga *Bambusa tulda*, Ground Orchid

Geodorum spp., Galla Bet *Daemonorops jenkinsianus*, and Bet *Calamus* spp.. There is an abundance of creepers, lianas, and epiphytes, including *Tinospora cordifolia*, *Vitis* spp., *Spatholobus roxburghii*, *Entada pursaetha, Derris* spp., *Ipomoea* spp., *Passiflora* spp., *Oberonia* spp., and others.

Methods

Western Hoolock Gibbon habitats in Bangladesh consist only of small habitat fragments, in contrast to the larger, more continuous habitats of the species in other countries (Ahsan 1994; Geissmann et al. 2013; Ray et al. 2015). A gibbon population census was conducted by the total-count method and groups were detected at established listening posts (following Brockelman & Ali 1987; Cheyne et al. 2007; Brockelman et al. 2009). One observer sat at one listening post carefully noting the singing times and durations of singing bouts of gibbon pairs, taking compass bearings, and estimating the distance from the singing pair to the listening post. Upon visual encounters, observer(s) assessed the group composition. Adult males, adult females, subadult males, subadult females, juveniles, and infants were estimated on the basis of the body size and coat colour (Kakati et al. 2009), and behavioral pattern (Ahsan 1994). Groups were distinguished by location, group composition and distance between groups, and all groups identified were given a distinct identification number for long-term monitoring. Gibbon groups were monitored from January 2017 to January 2021 to confirm group compositions. Gibbon population monitoring was conducted from early morning to early afternoon (0600 to 1400 h) for a period of four consecutive days/month from October to April during the monitoring period. The occurrence of other threatened wildlife species was confirmed opportunistically through direct visual observations during field trips from January 2013 to January 2021.

Threat assessment was conducted through direct field observations and feasible conservation measures were identified in discussions with focus groups, including forest-dependent people, nearby communities and villagers, community patrol groups, local community leaders and other relevant stakeholders, such as forest department staff (BOBLME 2013; Alam et al. 2014). Three focus-group discussions (FGD) were conducted with the participants at Boro Inani, Patuartake, and Swankhali between March and June 2018. There were 10–12 participants in each FGD. Participants were selected in consultation with the local forest department and village headmen. Predefined questionnaires were completed to assess the perceived impact of the huge Rohingya influx to Inani and to identify possible conservation measures to save the wildlife at Inani, including its Western Hoolock Gibbons (Alam et al. 2014).

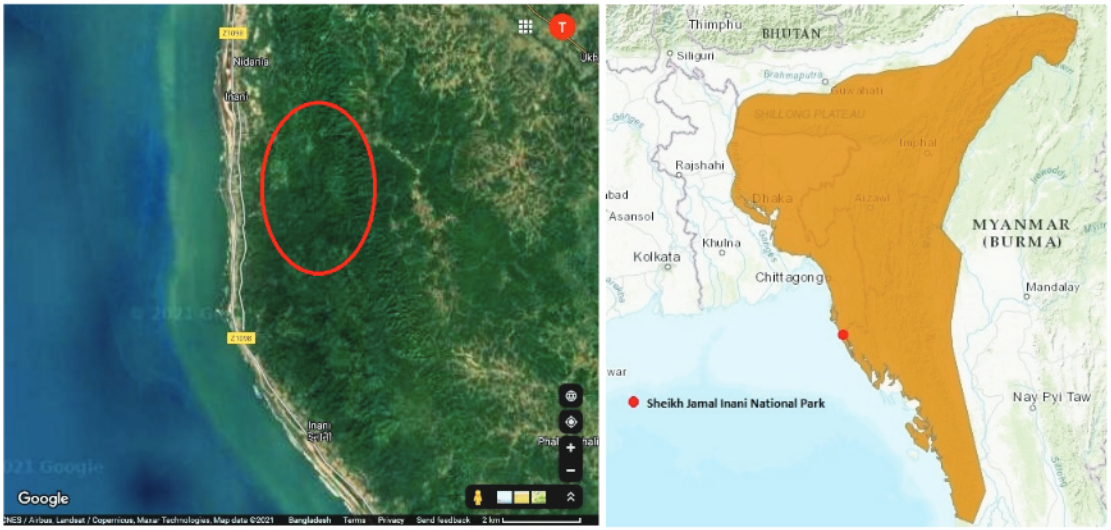
RESULTS

Seven groups of Western Hoolock Gibbons consisting of 18 individuals were confirmed to reside in Sheikh Jamal Inani National Park during the study period (Table 1). Six groups were reported from Inani Forest Beat (local administration unit of Bangladesh Forest Department) and one from Swankhali Forest Beat (Inani Forest Range). Only two of these groups (Groups 3 and 4) showed evidence of reproduction during the study period, including an adult pair with a subadult and an infant, and an adult pair with a subadult and a juvenile (Table 1). The mean group size was 2.57 individuals (n= 7). Synchronous singing by Groups 1, 2, 3, & 4 was heard at least twice,

Table 1. Group sizes and composition of Western Hoolock Gibbons at Shekih Jamal Inani National Park, Bangladesh in January 2021.

Forest jurisdiction	Area	Group number	Group composition						Total individuals
			AM	AF	SaM	SaF	Ju	In	
Inani Range	Inani Beat	1	1	1	-	-	-	-	2
Inani Range	Inani Beat	2	1	1	-	-	-	-	2
Inani Range	Inani Beat	3	1	1	1	-	-	1	4
Inani Range	Inani Beat	4	1	1		1	1	-	4
Inani Range	Inani Beat	5	1	1	-	-	-	-	2
Inani Range	Inani Beat	6	1	1	-	-	-	-	2
Inani Range	Swankhali Beat	7	1	1	-	-	-	-	2
Total			**7**	**7**	**1**	**1**	**1**	**1**	**18**

*AM—Adult male | AF—Adult female | SaM—Sub-adult male | SaF—Sub-adult female | Ju—Juvenile | In—Infant.



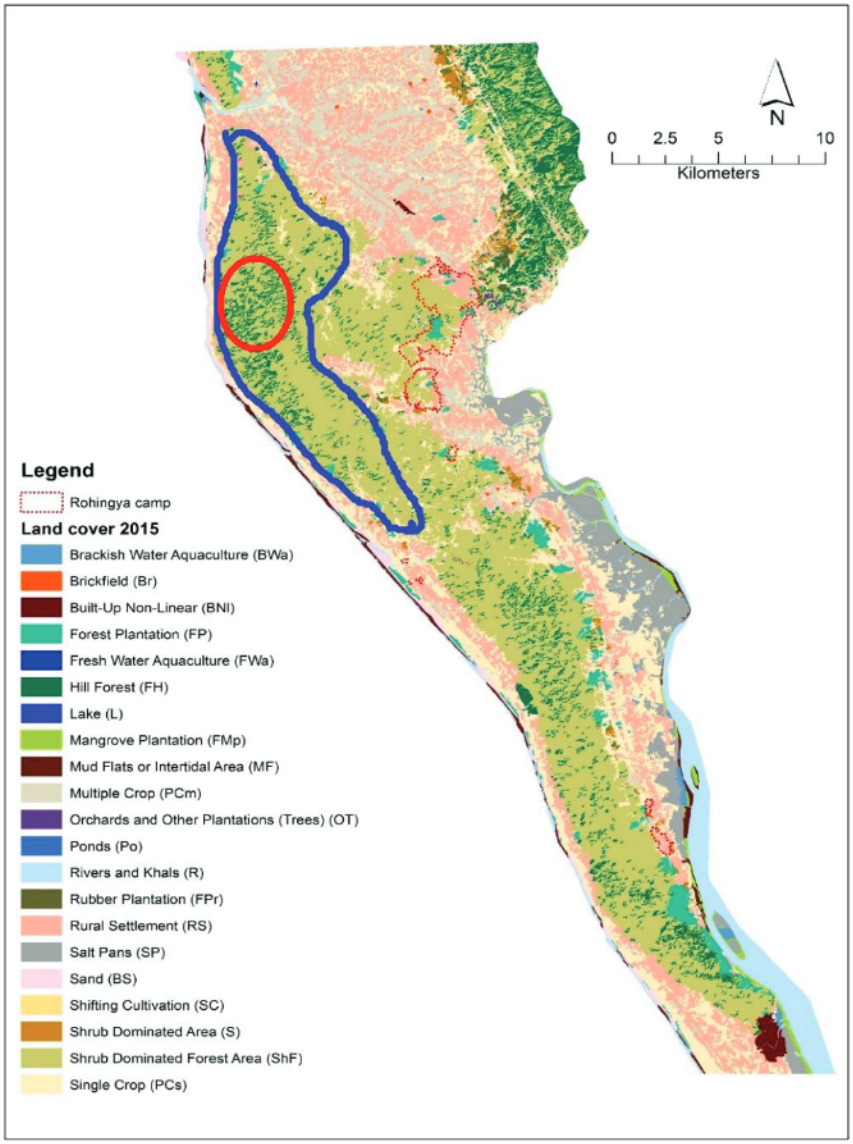


Figure 1. Sheikh Jamal Inani National Park. Top left: satellite image with proposed conservation core area (red area). Top right: IUCN distribution map of *Hoolock hoolock*. Bottom: Sheikh Jamal Inani National Park (blue outline) with proposed conservation core area (red circle). (Sources: top left: Google Earth; top right: www.iucnredlist.org; bottom: UNDP Bangladesh and UN WOMEN Bangladesh 2018)

which indicates that they were separate groups. The area inhabited by Groups 1–4 is considered as the core area for immediate conservation action (Figure 1). Groups 1, 2, 3, 5, 6, & 7 were first observed in 2014 during an opportunistic wildlife survey at Inani and at that time, each group consisted of only an adult male and female. Group 3 produced an offspring in early 2015 and again in January 2021.

Inani is a significant habitat for many globally threatened wildlife species, which also require immediate conservation initiatives. The presence of the Indian Leopard *Panthera pardus fusca* in Cox's Bazar District of Bangladesh was first confirmed in 2014 in the core gibbon habitat of Inani (Kabir et al. 2017), with additional sightings in 2017 and 2018 (M. Tarik Kabir, pers. obs. 2017 & 2018). During the gibbon surveys, we also made the first observations of the Slaty-backed Flycatcher *Ficedula erithacus* in Bangladesh (Image 2). It was identified by its orange underparts, deep blue upperparts and black tail with white base in males (Image 2). This species was previously reported as having a global distribution in Bhutan, China, India, Laos, Myanmar, Nepal, Vietnam, and Thailand (BirdLife International 2016) and now we confirm that its range extends into Bangladesh. It was first sighted in January 2014 in an area dominated by shrubs and homestead vegetation near human habitations and was sighted again at the same place in February 2016.

The globally 'Endangered' Asian Elephant *Elephas maximus*, Phayre's Langur *Trachypithecus phayrei*, & Elongated Tortoise *Indotestudo elongata* and the 'Vulnerable' Capped Langur *Trachypithecus pileatus*, Northern Pig-tailed Macaque *Macaca leonina*, Indian Leopard *Panthera pardus*, & Asiatic Softshell Turtle *Amyda cartilaginea* were also observed in the core gibbon habitat of Inani.

IUCN Bangladesh (2018) has estimated that the total population of elephants in the five forest ranges of the Cox's Bazar South Forest Division includes only 38 individuals (31–45). Elephants are now isolated in Inani, Ukhia, Shilkhali, Whykheong, and Teknaf forest ranges due to the blocking of the Ukhia-Ghundhum Elephant Corridor by Rohingya settlements since 2017 (Irfanullah 2018). Focus-group discussions with the relevant stakeholders showed that elephant-human interaction has dramatically increased at Inani, in the area of Mohammad Shafir Beel, after the recent influx of Rohingya refugees who live around the forest and collect firewood and other forest resources on an unsustainable level. The interviewees also agreed that the wildlife habitat of Inani will vanish in a short period of time if the current situation is not mitigated. Beside the negative impacts on wildlife and habitat quality resulting from the influx of refugees, the gibbon habitat in Inani has also been destroyed and degraded by illegal resource harvesting and encroachment by local communities and forest-dependent people. Local communities collect the stems of saplings of various tree species and use them as poles for their betel-leaf vineyards. The interviewees stated that they think that habitat destruction and degradation may be mitigated through regular patrolling of the forest department and with direct involvement of the local community, more dialogue among policy makers and the forest-living people, and an extensive habitat restoration programme.

DISCUSSION

The Western Hoolock Gibbon is a 'Critically Endangered' species in Bangladesh (IUCN Bangladesh 2015) and an 'Endangered' species globally (Brockelman et al. 2019). About 282 individuals were reported in Bangladesh in surveys over a decade ago (Islam et al. 2006). Islam et al. (2006) observed two groups of gibbons in the Inani Range and five in the Ukhia Range during eight-day (Inani) and nine-day (Ukhia) survey periods. Based on our survey results, it seems likely that Inani supported a larger gibbon population during the 2003–2004 survey period, and that not all gibbon groups were observed within the short survey period. Moreover, at that time, the habitat quality was much better than presently, but gibbons have now become locally extinct in Ukhia (M. Tarik Kabir, pers. obs. 2020).

It was revealed in this study that Sheikh Jamal Inani National Park supports the fourth largest population of Western Hoolock Gibbons in Bangladesh, after the larger populations in Lawachara National Park, Adampur Reserved Forest, and Kaptai National Park (Islam et al. 2006). Ahsan (2001) reported that the mean group size of Western Hoolock Gibbons was 3.0 (n= 8) at West Bhanugach in northeastern Bangladesh, whereas Feeroz & Islam (1992) estimated a mean group size of 3.17 (n= 6) in the same area. Comparison between group sizes in Inani and other habitats suggest a lower reproductive output at Inani. Loss of adequate food sources and changes in the habitat structures have led to low encounter rates and small group sizes at the fragmented Western Hoolock Gibbon habitats in eastern Assam, India (Kakati et al. 2009). Low population densities have also been reported among primates in Mexico and Brazil due to reduced food resources and habitat fragmentation (Estrada & Coates-Estrada 1996; Chiarello & Melo 2000). Gibbon habitat in

Image 2. A—Slaty-backed Flycatcher *Ficedula erithacus* from Inani, the first record of this species in Bangladesh | B—Western Hoolock Gibbon *Hoolock hoolock* at Inani | C—Pugmark of Indian Leopard *Panthera pardus* at Inani | D—Phayre's Leaf Monkey *Trachypithecus phayrei* at Inani | E—Fire wood collection from gibbon habitat in Ukhia | F—Loss of gibbon habitat at Ukhia. © M. Tarik Kabir.

Inani is highly degraded and fragmented without upper canopy trees, which is likely the main reason for their low reproductive output. We suggest that an extensive habitat restoration programme (Hossain et al. 2008) and the total protection of gibbon habitats at Inani are required to ensure the survival of the gibbons in this area.

Many globally threatened wildlife species, including the Western Hoolock Gibbon, are now on the verge of extinction at Inani due to sharply increased pressure on natural forest resources due to the recent influx of large numbers of Rohingya refugees from Myanmar into the area. The total number of registered Rohingya refugees in Cox's Bazar district is 866,457, according to the Bangladesh Government and UNHCR, of which 716,915 are new arrivals since 25 August 2017 (https://data2.unhcr.org/en/situations/myanmar_refugees).

Refugees have temporarily settled in the area by clearing forests on both sides of the Cox's Bazar-Teknaf highway, mostly residing in the fringes of Ukhia Reserved Forest, Inani and Teknaf Wildlife Sanctuary, which is increasing human-wildlife conflict in the area (Irfanullah 2018). About 3,713 acres of forest land were completely cleared to make Rohingya settlements in Ukhia, Whykheong, and Teknaf forest ranges in 2017 (UNDP Bangladesh and UN WOMEN Bangladesh 2018). According to the Bangladesh Forest Department, an additional 6,163 acres of forest land was damaged in the areas affected by Rohingya settlement, with no up-to-date information on the habitat status (ADB 2019).

Deforestation and forest fragmentation, changes

in forest cover, biomass reduction, loss of species, loss of wildlife habitat, shrinkage of wildlife corridors and increased mortality risk for wildlife are expected to result from the large influx of migrants into Inani (UNDP Bangladesh and UN WOMEN, Bangladesh 2018). The area influenced by Rohingya refugees is estimated to cover 44% of the 60,000 ha landscape encompassing Sheikh Jamal Inani National Park, Ukhia Forest Range and Teknaf Wildlife Sanctuary (UNDP Bangladesh and UN WOMEN Bangladesh 2018), putting enormous pressure on this landscape and the remaining forests. For example, an estimated 6,800 tons of fuel wood is required each month by the refugee population, of which approximately 50% is collected from the forests (UNDP Bangladesh and UN WOMEN Bangladesh 2018). Fortunately, the Rohingya community does not hunt the gibbons. Liquefied petroleum gas (LPG) and improved cooking stoves have been distributed since August 2018 to Rohingya refugees and host communities to reduce the demand for firewood from the nearby forest (IUCN Bangladesh 2019). Firewood demand dropped by 79 % among the Rohingya families after the LPG was provided (IUCN Bangladesh 2019), but small-scale fuel-wood collection will continue to pose huge pressure on natural resources at and around Inani.

RECOMMENDATIONS

Western Hoolock Gibbons are likely to disappear from Sheikh Jamal Inani National Park in the near future, if the current trend of habitat destruction continues. The presence of large Rohingya refugee settlements have created a critical situation that puts pressure on threatened species. Management and conservation by the Bangladesh Forest Department of the whole of Inani is not possible due to socio-political issues and the pressure being placed on natural resources by people living around the forest. The Forest Department also has a shortage of manpower and other resources to protect the large forest area. Nonetheless, the following steps can be considered for protection and management of the gibbon habitats of Inani:

1. Community members are urged to take immediate action to demarcate one designated area of about 2,000 ha in the core gibbon habitat of Narikella Jhuri-Bairuntali (21.229074N, 92.070104E) as a totally protected zone. Regular monitoring and patrolling of this zone should be prioritized by the Bangladesh Forest Department as extensive monitoring and patrolling to the whole Inani area is not possible;
2. Any resource harvesting from this core areas should be strictly prohibited and wide public awareness campaigns must be organized to develop a positive response among the forest-dependent people, especially fuel and timber wood collectors;
3. Regular patrolling and habitat monitoring by the Forest Department should be conducted in partnership with community patrol groups, comprising community members and local leaders, to create a sense of stewardship and enhance protection of forests as well as wildlife;
4. Highly degraded areas identified by the Forest Department should be rehabilitated and enriched by extensive habitat restoration programmes with native tree species, including important food items for gibbons;
5. Alternative and long-lasting poles for betel vineyards should be provided by NGOs and the Government of Bangladesh at reasonable prices to prevent over-harvesting of tree saplings from the forest. Extensive awareness programmes should be conducted to discourage the collection of forest wood for poles;
6. Proper use of alternative sources of fuel wood for refugees should be ensured and regularly provided by concerned authorities; and
7. General public education and awareness programs for different stakeholders should be implemented to help to manage the globally threatened wildlife habitat of Bangladesh on a larger scale.

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