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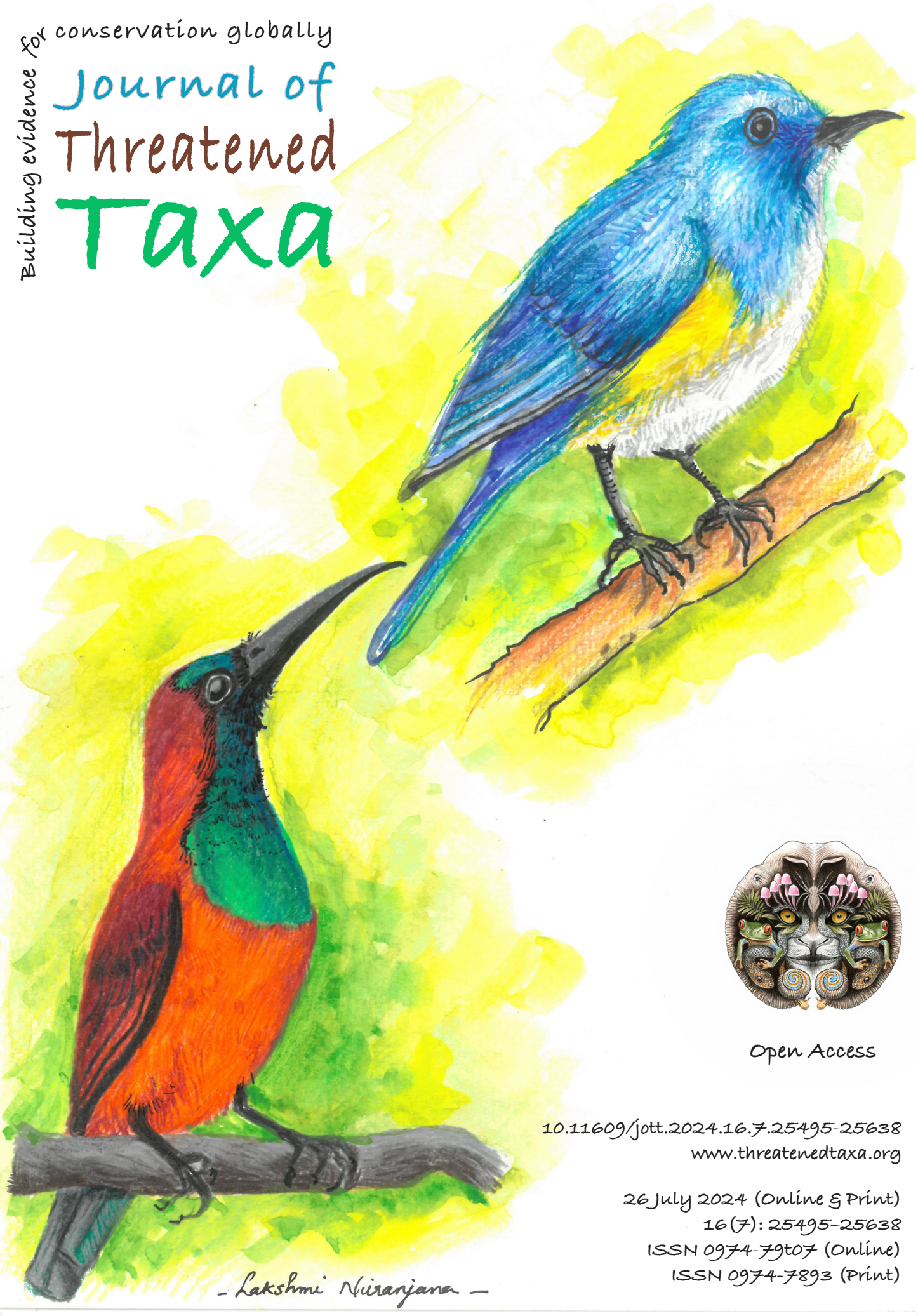

Open Access

10.11609/jott.2024.16.7.25495-25638
www.threatenedtaxa.org

26 July 2024 (Online & Print)
16(7): 25495-25638
ISSN 0974-7907 (Online)
ISSN 0974-7893 (Print)

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

Publisher
Wildlife Information Liaison Development Society
www.wild.zooreach.org

Host
Zoo Outreach Organization
www.zooreach.org

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Cover: Mixed media illustration of a Blue bird and Sunbird. © Lakshmi Niranjana.

Journal of Threatened Taxa | www.threatenedtaxa.org | 26 July 2024 | 16(7): 25507–25515

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

https://doi.org/10.11609/jott.8247.16.7.25507-25515

#8247 | Received 31 October 2022 | Final received 05 July 2024 | Finally accepted 09 July 2024

OPEN ACCESS

ARTICLE

Current conservation status of Bengal Florican *Houbaropsis bengalensis* in Manas National Park, Assam, India

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Abstract: This study aimed to examine the current conservation status of the 'Critically Endangered' bird species *Houbaropsis bengalensis* (Gmelin, 1789), commonly known as the Bengal Florican or Bustard, in Manas National Park in Assam. The grasslands of this park, once home to the largest population of Bengal Floricans in India, are undergoing natural and anthropogenic changes. Field surveys conducted from February to April 2021 to assess florican populations recorded 50 males and 17 females, while a 2009 survey estimated 24 males in Manas NP (Brahma et al. 2009), indicating long-term population increase. Land use and land cover change maps of florican habitats were created using supervised classification. Grassland habitats face several threats, including uncontrolled natural succession coupled with livestock grazing, growth of invasive alien plants and collection of non-timber forest products (NTFPs) by local people. These disturbances reflect the condition of grasslands that are home to a wide variety of wildlife, including grassland specialists like Pygmy Hog *Porcula salvania*, Hispid Hare *Caprolagus hispidus*, Hog Deer *Axis porcinus,* and mega herbivores like Indian Rhino *Rhinoceros unicornis*, wild Water Buffalo *Bubalus arnee*, Eastern Swamp Deer *Rucervus duvaucelii ranjitsinhi*, Gaur *Bos gaurus,* and Asian Elephant *Elephas maximus*. These findings indicate an urgent need to protect and restore grasslands for conservation of the Bengal Florican and other grassland-dependent species.

Keywords: Aves, conservation threats, grassland specialists, habitat supervised classification, habitat disturbance, Otididae, sub-Himalayan grassland.

Editor: Hem S. Baral, Ullens School, Lalitpur Nepal.

Date of publication: 26 July 2024 (online & print)

Citation: Thakur, M., J. Kalita, N. Brahma, K. Rajbongshi, K. Bhattacharyya, A.C. Sarmah, A. Sinha, D.K. Dutta, D. Das & B.P. Lahkar (2024). Current conservation status of Bengal Florican *Houbaropsis bengalensis* in Manas National Park, Assam, India. *Journal of Threatened Taxa* 16(7): 25507–25515. https://doi.org/10.11609/jott.8247.16.7.25507-25515

Funding: The Habitats Trust, WCS Cambodia.

Competing interests: The authors declare no competing interests.

Author details: See end of this article.

Author contributions: MT and JK contributed to data collection, scientific analysis, and manuscript writing. KR, AS, and KB contributed to data collection. NB, DD, and BPL critically analyzed all findings. ACS led the team, supported by DKD, DD and BPL.

Acknowledgements: We thank Manas National Park range officers Babul Brahma, Kameswar Boro and the frontline staff for their support throughout the survey. We would also like to express our gratitude to Dr. Jyoti Das, Dr. Biswajit Chakdar, Dr. Joydev Mandal, Dr. Hilloljyoti Singha, Mr. Udayan Borthakur, and Mr. Rustom Basumatary for their assistance during the survey period. We are grateful to the Habitats Trust for their financial support through the Pygmy Hog Conservation Programme and to WCS Cambodia for enabling us to undertake the field survey and other activities.

INTRODUCTION

Bengal Florican, *Houbaropsis bengalensis* (Gmelin, 1789), is a 'Critically Endangered' grassland bird (IUCN 2022) belonging to the family Otididae. In India, it is protected under Schedule I of the Wildlife Protection Act, 1972. The population of Bengal Florican is 350–400 in India, <100 in Nepal (Collar et al. 2017; Baral et al. 2020) and <500 individuals in Cambodia (BirdLife International 2022). In India, the population of Bengal Florican is restricted to the sub-Himalayan region of the Indo-Gangetic floodplains and the Brahmaputra floodplains (Rahmani et al. 2017). They are extremely habitat specialists and are restricted to grasslands (Prasai et al. 2021). Bengal Floricans were once distributed from Uttar Pradesh, Bihar, and West Bengal to the foothills of Assam and Arunachal Pradesh in India. However, at present, it is confined to a few protected areas in India including Manas National Park (MNP), Kaziranga National Park, Orang National Park, Dibru-Saikhowa National Park, Burachapori Wildlife Sanctuary in Assam, D'Ering Wildlife Sanctuary in Arunachal Pradesh, and Dudhwa National Park in Uttar Pradesh. The species is confined to only these few protected areas and appears nowhere outside these areas (BirdLife International 2022).

In 1989–90, the Bombay Natural History Society (BNHS) conducted a survey in India and found that Manas National Park had the highest Bengal Florican population. Around 80 birds were estimated during the study, which is perhaps the largest known population of Bengal Florican in any single locality. However, the population of Bengal Floricans declined from 1990–2000 because of the socio-political unrest created during Bodo agitation in the areas adjoining Manas. However, according to reports, the population has shown an increasing trend from 2003–2012 (Brahma et al. 2009). The population of Bengal Florican was estimated to be around 50 individuals in Manas National Park (Brahma et al. 2009). Since 1989–1990, approximately 40% of the Bengal Florican population has been lost, and grass height was the main factor. It is assumed that these birds are site-selective in establishing their territory, and prefer wet alluvial grassland for breeding, which is reduced by 47% and succeeding towards savanna grassland (Brahma 2013). The global population of the species has been rapidly declining, and the IUCN Red List for Threatened Species has upgraded Bengal Florican from 'Endangered' to 'Critically Endangered' (BirdLife International 2010).

The highest number of Bengal Floricans was reported from Kokilabari Agriculture Farm (KAF) (Brahma et al. 2009). The KAF is 9 km^2, which is a large grassland site. The KAF is under extensive agricultural practice and leased to local communities for paddy cultivation. Paddy cultivation began in June and harvested in December. It has been reported that the Bengal Florican population was established during 2000–2001, the period when the farm was not under cultivation. One reason for the selection of these sites by Bengal Floricans is the lack of waterlogging (Brahma et al. 2009).

The aim of this study is to address the lack of information on the populations and habitats of the Bengal florican in Manas National Park through a systematic approach, thereby contributing to the development of long-term conservation strategies. This research serves as a stepping stone for further research and education aimed at preserving the Bengal florican and its habitat.

METHODS

Study site

Manas National Park

Manas National Park (MNP) is a World Heritage Site, a Tiger Reserve, a Biosphere Reserve, and an Elephant Reserve located in the state of Assam (Das et al. 2022). MNP ((26.583–26.833 ^{0}N, 90.750–91.250 ^{0}E) is the core area of Manas Tiger Reserve with an area of 500 km^2, located in Baksa and Chirang districts of the Bodoland Territorial Council, Assam (Figure 1). Apart from Bengal Floricans the grasslands are home to a wide variety of wildlife including grassland specialist like Pygmy Hog *Porcula salvania*, Hispid Hare *Caprolagus hispidus*, Hog Deer *Axis porcinus* and other mega herbivorous like Indian Rhino *Rhinoceros unicornis*, Brahma et al. 2009 Wild Water Buffalo *Bubalus arnee*, Eastern Swamp Deer *Rucervus duvaucelii ranjitsinhi*, Gaur *Bos gaurus,* and Asian Elephant *Elephas maximus*. It is a regional priority site for the conservation of charismatic species, including 55 mammals, 50 reptiles, and more than 450 bird species (Sarma et al. 2008; Das et al. 2022). A total of 462 plant species have been reported from within the national park, but the region is rich in plant life with about 622 plant species reported from the larger Manas Biosphere region. This includes 429 dicotyledons, 162 monocotyledons, 30 pteridophytes, and one gymnosperm (Hajra & Baishya 2002). It lies at an altitude of 57–280 m. The temperature ranges from 6–37 °C. The rainfall lies between 3,000 mm to 4,000 mm per year. The rainfall reaches its peak in July and

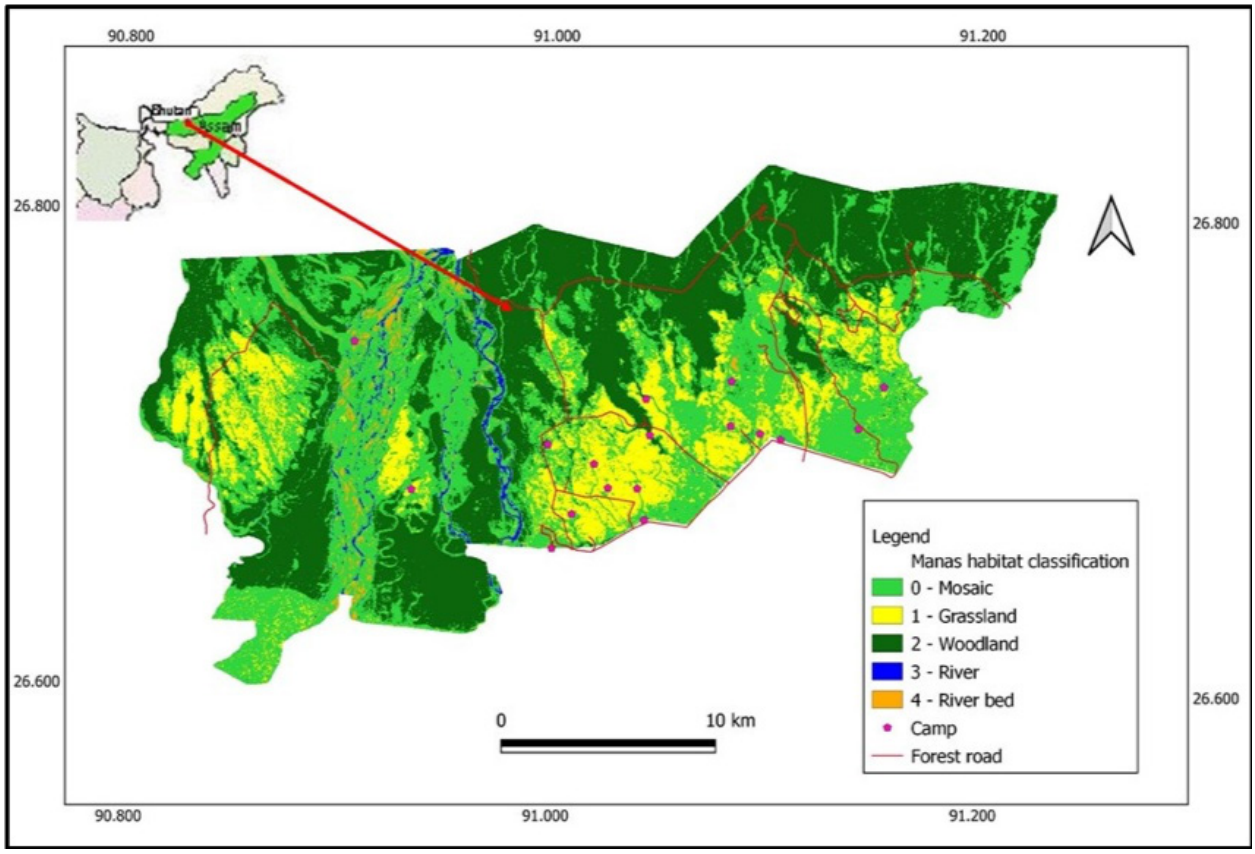

Figure 1. Map of Manas National Park in Assam.

August. The vegetation of the park is moist deciduous forest, early successional woodland grassland, and dry-wet alluvial grassland (Sarma et al. 2008; Banerjee et al. 2021). Due to resource extraction by local communities and livestock grazing, MNP experiences biotic pressure. Local people may start fires to encourage the growth of fresh grass, but processes are mostly initiated by park managers to control woody plant encroachment into grassland areas. However, the dynamics of fires after ignition are not controlled by forest managers, and the spatial patterns and extent of fires are determined by habitat factors (Banerjee et al. 2021).

Methods for population assessment

The survey was conducted based on habitat maps and past records of the complete population census of Bengal Florican. The surveys were carried out in the three ranges, namely, Bansbari, Bhuyanpara, and Panbari of Manas National Park during the peak breeding season of the Bengal Florican from 20 February–22 April 2021. Birds were observed using vehicles, walking on foot, or from elevated forest towers. Sightings and GPS locations were recorded. Field surveys were carried out during the early morning (0600–0930 h) and late evening (1500–1800 h). On certain days, the survey was conducted until noon. The number of Bengal Floricans spotted, the number of males and females sighted, the time of sightings, along with the location of the species were recorded. Since, the species is territorial in nature during the breeding season, the display site of a male, was considered as an individual male territory and each displaying male was recorded as an individual male and the females are difficult to locate (Images 1 & 2). The breeding territories were identified and marked using handheld GPS (Garmin etrex 30x) and GIS-based map of identified Bengal Florican territories was prepared using QGIS (QGIS Development Team 2020).

The methodologies employed in this survey were consistent with those used in the studies by Brahma (2013) and Narayan (1992). Similar techniques and area coverage were utilized to ensure comparability between the current and previous surveys. No higher conservation technologies were employed during this survey, maintaining the same level of effort and methodological approach as in the earlier studies.

Method for land cover change

Satellite images from 2000 and 2020 were analyzed to detect the change in land cover using remote sensing and geographic information system tools. The open-source satellite images were obtained from Landsat 7 and Landsat 8 through https://earthexplorer.usgs.gov. Landsat 7 and Landsat 8 images were used for classification at 30 x 30 m resolution and I, II III, IV, V, VII and II, III, IV, V, VI, VII bands were used respectively. Open-source QGIS software (QGIS Development Team 2020) was used to classify the image objects. Using supervised classification, Bengal Florican record sites were classified and land cover changes were analyzed and the classified habitat into three classes: grassland, woodland, and grassland woodland mosaic.

Method for vegetation survey

First, a grid map of Florican locations was prepared using GIS. The standardized grid size was 1 × 1 km. The total area of grassland was divided into 10; 1 x 1 km blocks. Within each 1 x 1 km grid area, 10 quadrats of × 1 m were placed centrally. To fulfill the objectives, quadrat sampling method (Stohlgren et al. 1995) was used for the quantitative study of the vegetation of Bengal Florican.

Method for disturbance study

To study the disturbance drivers of the Bengal florican and their habitats, the same 1 x 1 km grids were used for data collection. Cattle grazing, the presence of invasive alien plant species, problematic native species, and other human-induced disturbances were recorded.

RESULT

Distribution and population status

Houbaropsis bengalensis were recorded from Bansbari, Bhuyanpara, and Panbari grasslands. (Figure 3, Table 1). 50 males and 17 females were observed in Kuribeel, Rupahi, Sidajhar, Kokilabari, Bhumuk, Abiwidora, Agrang, and Murabari (Table 1). Eighteen males were sighted displaying: nine in Kokilabari, four in Rupahi, three in Agrang, and two in Kuribeel. The highest number of individuals were sighted in Kokilabari located in the Bhuyanpara range of the National Park, followed by Rupahi and Kuribeel. Seven males were observed during flight, looking at their flight direction. Females are difficult to spot, and direct observations estimate the total count of Bengal Floricans to be 74 (Table 2). No floricans could be sighted in areas such as Kasindaha, Mahout Camp Fields, Palsiguri, Uchila-Bongali Hathdhowa, Bura Buri Jhar, Dighlatari, and Pohu Field, where floricans had been previously reported (Narayan 1992; Brahma 2013).

Table 3 list the names of grassland blocks located in Manas National Park where Bengal Floricans have been reported in the past and in the current study. The map was generated using QGIS to study and compare Bengal Florican locations in grasslands over the last few decades. The results of past surveys carried out in 1989 (Narayan 1992), 2011 (Brahma 2013), and 2021 were used to compare the data with those of the current study (Figures 2 & 3).

Land cover change

The results indicated habitat changes in vegetation within the recorded site. In the year 2000; 11.7 km^2 area of grassland represent 79%, 3.03 km^2 area of grassland woodland mosaic represent 21%, and 0.036 km^2 area of woodland are represent 0.24 % (Table 4, Figures 4 & 6). In the year 2020; 7.3 km^2 area of grassland represent 49.6%, 0.75 km^2 area of woodland represent 5.1%, and 6.67 km^2 area of grassland woodland mosaic represent 45.3% (Table 5, Figures 5 & 6). From 2000–2020; 4.7 km^2 of grassland area was converted to mosaic representing 32%, 0.49 km^2 of grassland area was converted to woodland representing 3.4%, 0.0009 km^2 of the mosaic area was converted to a waterbody representing 0.01%,

Table 1. Bengal Florican sightings along with GPS locations.

	Locations	Area	Number of males sighted	Number of territories established (Female)
1	N26.74857, E91.17289	Kokilabari	20	7
2	N26.68549, E91.02865	Kuribeel	5	2
3	N26.68469, E91.04027	Bhumuk	2	0
4	N26.71303, E91.08633	Rupahi	7	4
5	N26.72930, E91.08080	Abiwidora	3	3
6	N26.71128, E91.15022	Agrang	7	0
7	N26.68044, E90.91007	Murabari	2	1
8	N26.69722, E90.92653	Sidhajhar	4	0

Table 2. Total count of Bengal Florican population.

	Bengal Florican	Population
1	Male	50
2	Female	17
3	Additional male sighted in flight	7
	Total	74

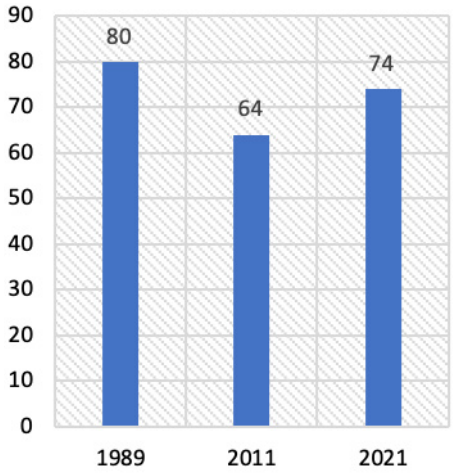

Figure 2. Bengal Florican recorded in 1989, 2011, and 2021.

Table 4. Classification of L7 Satellite imageries of 2000.

Class ID	Class name	Pixel sum	Area [km^2]	Percentage [%]
0	Mosaic	3368	3.031	20.57
1	Grassland	12960	11.664	79.17
2	Woodland	40	0.036	0.244

0.81 km^2 of the mosaic area was converted to grassland representing 5.5%, 0.24 km^2 mosaic area converted to woodland representing 1.63%, and 0.02 km^2 woodland area converted to mosaic representing 0.13% (Table 6).

Vegetation survey

The grasslands were burned in the month of February and a fresh flush of grasses emerged soon after establishing a suitable habitat for the Bengal Floricans to breed. The following plant species were observed during the survey (Table 7). And most of the Bengal Florican habitats where they are recorded in the grassland have short grass *Imperata cylindrica* and moderately tall and dense grasses like *Saccharum spontaneum* and *Saccharum narenga.*

Threats

The grasslands of the park are subjected to a number of natural and anthropogenic disturbances. The conversion of grasslands into woodlands is a serious threat to grassland species. *Bombax ceiba* (Simul), a tree species was found growing extensively in the grasslands. Cattle grazing is one such disturbance that has been observed in the National Park. The grazing of livestock by communities living in the fringes of the National Park is one of the major causes of habitat degradation. *Premna herbacea*, a medicinal herb that grows profusely in the grasslands of Manas is a major non-timber forest products (NTFPs). Local communities depend on these products for their livelihoods. The presence of humans in these grasslands inhabited by Bengal Floricans is another cause of disturbance to the species. The presence of invasive alien plants is another major disturbance to the habitat. *Chromaelaena odorata* a shrub was found growing extensively in the grasslands of the national park occupied by Bengal Floricans.

Table 3. Male Bengal Florican sightings over the last four decades (Narayan 1992; Brahma 2013).

	Grassland Block	1989	2011	*2021*
1	Kasindaha	7	NA	NA
2	Mahout Camp Fields	4	NA	NA
3	Palsiguri	3	NA	NA
4	Kuribeel	6	5	5
5	Uchila-Bongali Hathdhowa	1	NA	NA
6	Bura Buri Jhar	1	NA	NA
7	Lafasari	NA	4	NA
8	Kapur-pura/ Sidhajhar	8	5	4
9	Pohu Field	NA	2	NA
10	Dighlatari	NA	4	NA
11	Agrang	NA	4	7
12	Kokilabari	NA	8	20
13	Murabari	NA	NA	2
14	Abiwidora	NA	NA	3
15	Rupahi	NA	NA	7
16	Bhumuk	NA	NA	2
Total		**30**	**32**	**50**

Table 5. Classification of L8 Satellite imageries of 2020.

Class ID	Class name	Pixel sum	Area [km^2]	Percentage [%]
0	Mosaic	7421	6.6789	45.33
1	Water	1	0.0009	0.0061
2	Grassland	8110	7.299	49.54
3	Woodland	836	0.7524	5.10

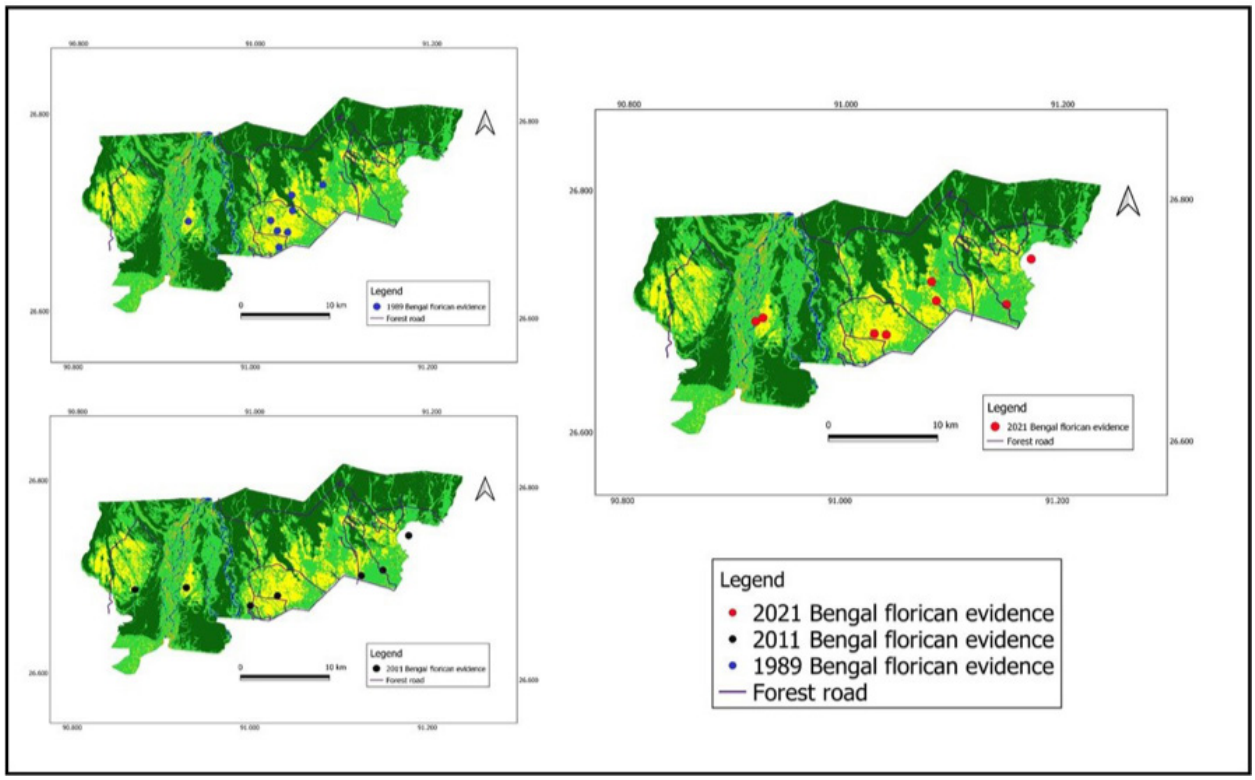

Figure 3. The distribution of Bengal Florican in the surveys carried out in 1989, 2011, and in the current study 2021.

Table 6. Land cover change between 2000 and 2020.

Cross class code	Reference class (L7)	New class (L8)	Pixel sum	Area [km²]	Percentage of change (%)
6	Mosaic	Mosaic	2202	1.98	13.45
10	Mosaic	Water	1	0.0009	0.01
14	Mosaic	Grassland	898	0.8082	5.49
18	Mosaic	Woodland	267	0.2403	1.63
7	Grassland	Mosaic	5197	4.6773	31.78
15	Grassland	Grassland	7212	6.4908	44.10
19	Grassland	Woodland	551	0.4959	3.37
8	Woodland	Mosaic	22	0.0198	0.13
20	Woodland	Woodland	18	0.0162	0.11

DISCUSSION

Our survey estimated 74 Bengal Floricans in Manas, which compared to 2011 represents an increase (Figure 3). The Florican number 74 is higher than the result of the last survey conducted in 2011 (Brahma 2013), but lower than the result of a previous survey conducted in 1989 (Narayan 1992). Interestingly, at least 20 male floricans and seven female floricans were recorded at the Kokilabari Agriculture Farm (KAF). The highest number of floricans was recorded in KAF. Thus, there is a long term need to conserve such sites such as the KAF for long term conservation of the species.

The survey for Bengal Floricans in Manas National Park provides important evidence for the presence of Bengal Floricans at the study site. It also indicates an increasing trend since the last survey carried out in 2011 which is encouraging (Brahma 2013). This survey also provided new information from previously surveyed areas such as Murabari, Abiwidora, and Bhumuk grassland areas,

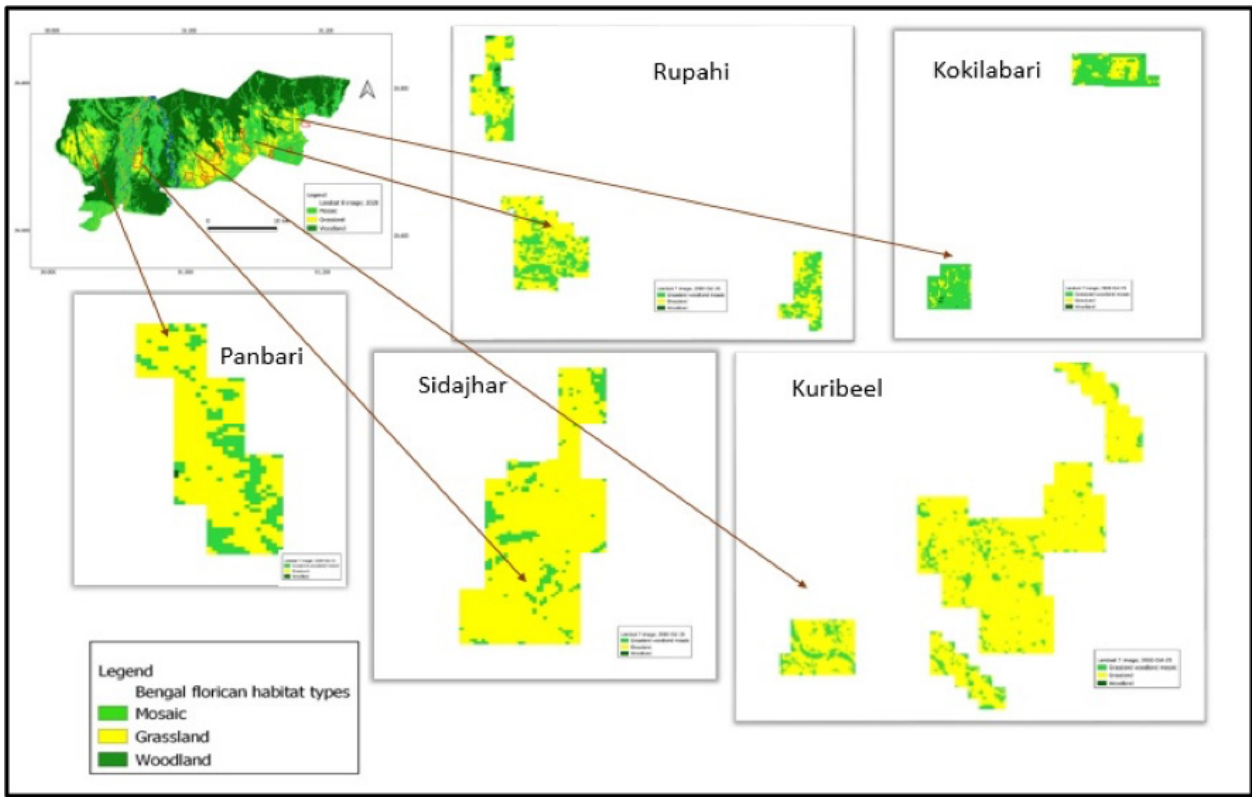

Figure 4. Land use map of Bengal Florican habitat as in 2000.

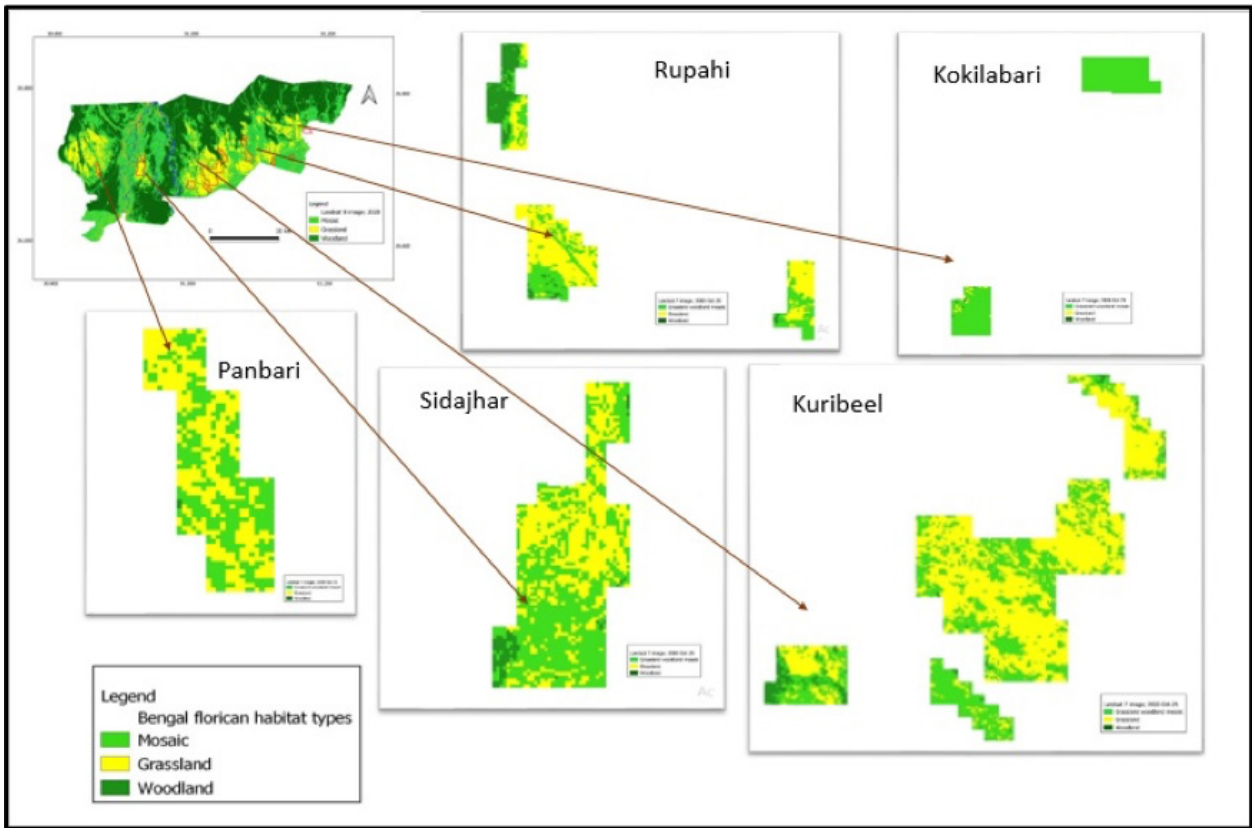

Figure 5. Land use map of Bengal Florican habitat as in 2020.

Table 7. List of plants observed in the habitats occupied by Bengal Florican.

	Scientific name	Local name	Family
1	*Saccharum narenga*	Barenga	Poaceae
2	*Saccharum spontanum*	Kohua	Poaceae
3	*Leea asiatica*	Athu bhanga	Vitaceae
4	*Cymbopogon flexuosus*	Gondho birina	Poaceae
5	*Imperata cylindrica*	Ulu kher	Poaceae
6	*Phragmites karka*	Khagori	Poaceae
7	*Premna herbacea*	Mati kaldhab	Lamiaceae
8	*Commelina* sp.	Konaximolu	Commelinaceae
9	*Bombax ceiba*	Simul	Bombacaceae
10	*Croton bonplandianus*	Bon tulsi	Euphorbiaceae
11	*Scleria terrestris*	Har kata	Cyperaceae
12	*Cyperus* sp.	NA	Cyperaceae
13	*Grewia sapida*	Mati phehura	Tiliaceae
14	*Senecio madagascariensis*	NA	Asteraceae
15	*Plectranthus ternifolius*	NA	Lamiaceae

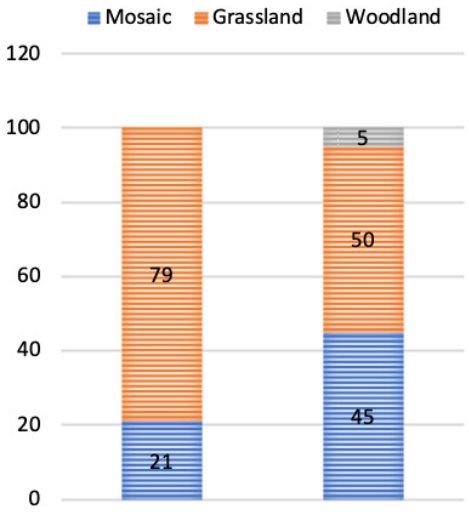

Figure 6. Percentage of land cover change in 2000 and 2020.

where Floricans have been recorded. The survey also clearly indicated the success of the method wherein the collaboration between forest frontline staff, invited experts and local guides was instrumental in obtaining a quick result.

The Bengal florican population in Manas has faced severe problems due to habitat loss and degradation, with grassland habitats decreasing alarmingly. Key factors contributing to this conservation challenge include the indiscriminate conversion of grasslands, domestic cattle grazing, unauthorized burning, opportunistic hunting, and egg collection. Invasive species such as *Chromolaena* and *Mikania* further exacerbate the problem by outcompeting native flora crucial for Bengal florican survival. Despite these challenges, our data shows a paradoxical increase in the Bengal florican population. This can be attributed to the concentrated conservation efforts by stakeholders, particularly within the KAF areas, which host sizable populations contributing to the overall increase in the park. However, the persistence of habitat issues necessitates robust management interventions to ensure sustainable population growth.

In Assam, most grasslands are confined to protected areas and a few in the Brahmaputra floodplains. Thus, conserving these grasslands is imperative to protect grassland-obligate avifauna (Brahma 2013). Scientific studies are essential to manage these remaining grasslands effectively. Our study involved mapping the habitat and assessing the current Bengal Florican population in Manas. While it is encouraging that the BF population is increasing in Manas, the concurrent decrease in grassland habitat is concerning. While an increase in vegetation cover is often beneficial for forests, in Manas, the increase in specific land cover types such as woodland and woody plant infested mosaic forest poses a serious threat to the unique grassland habitat (Das et al. 2022). Burning of grasslands conducted in January aimed to regenerate grasses and control invasive species. However, this practice is insufficient to reduce the encroachment of alien invasive plants and problematic native plants (Das et al. 2019). Therefore, appropriate habitat management actions must be undertaken to restore and conserve grassland habitats.

RECOMMENDATIONS

- Maintenance of mosaic grassland: Which include both tall and short grasslands.
- Implement comprehensive habitat restoration programs to remove invasive species and native woody species.
- Strategic implementation of prescribed burning.
- Enforce stricter regulations against unauthorized land conversion, grazing, and burning.
- Promote conservation friendly agricultural practices adjacent to grassland areas, especially in KAF.
- Engage local communities in conservation efforts through education and incentivizing sustainable practices.
- Conduct long-term scientific studies to monitor the impact of management practices in BF population.

Image 1. Male Bengal Florican in flight.

Image 2. Male Bengal Florican in the grassland.

REFERENCES

Baral, H.S., T.R. Bhatt, S.R. Giri, A.K. Ram, S.K. Shah, L.P. Poudyal, D. Chaudhary, G. Bhattacharya & R. Amin (2020). Status of the Critically Endangered Bengal Florican *Houbaropsis bengalensis* (Gmelin, 1789) in Koshi Tappu Wildlife Reserve, Nepal. *Journal of Threatened Taxa* 12(9): 16006–16012. https://doi.org/10.11609/jott.4832.12.9.16006-16012

Banerjee, S., D. Das & R. John (2021). Grassland vegetation and roads have dominant influence on decadal-scale spatial-temporal patterns of fires in a species-rich protected Terai habitat in northeastern India. *Agricultural and Forest Meteorology* 304–305: 108411. https://doi.org/10.1016/j.agrformet.2021.108411

BirdLife International (2010). *Houbaropsis bengalensis*. The IUCN Red List of Threatened Species 2010: e. T22692015A29263371. https://datazone.birdlife.org/species/factsheet/bengal-floricanhoubaropsisbengalensis on 12/06/2020.

BirdLife International (2022). *Houbaropsis bengalensis*. *The IUCN Red List of Threatened Species* 2022. https://datazone.birdlife.org/species/factsheet/bengal-floricanhoubaropsisbengalensis on 15/03/2023.

Brahma, N. (2013). Ecological evaluation of grassland using Bengal florican as indicator species in Manas national park Assam. Ph.D. Thesis, Gauhati University.

Brahma, N., K. Choudhury, R.K. Sharma & M. Basumatary (2009). Bengal Florican Conservation and Research Initiative in BTAD, India. Aaranyak report, 63 pp.

Collar, N., H.S. Baral, B. Nyambayar, B. Gobind, N. Brahma, B. Robert, A. Choudhury, O. Combreau, P. Dolman, P. Donald, S. Dutta, D. Gadhavi, K. Gore, O. Goroshko, C. Hong, G. Jathar, R. Jha, Y. Jhala, M. Koshkin & M. Kessler (2017). Averting the extinction of bustards in Asia. *Forktail* 33: 1–26.

Das, D., S. Banerjee & R. John (2019). Predicting the distribution and abundance of invasive plant species in a sub-tropical woodland-grassland ecosystem in northeastern India. *Plant Ecology* 220: 935–950. https://doi.org/10.1007/s11258-019-00964-7

Das, D., S. Banerjee, J. Lehmkuhl, J. Krishnaswamy & R. John (2022). The influence of abiotic and spatial variables on woody and herbaceous species abundances in a woodland–grassland system in the Eastern Terai of India. *Journal of Plant Ecology* 15(1): 155–167. https://doi.org/10.1093/jpe/rtab080

Hajra, P.K. & A.K. Baishya (2002). Manas Biosphere Reserve, pp. 2627–2646. In: Singh, N.P. & K.P. Singh (eds.). Floristic Diversity and Conservation Strategies in India. Botanical Survey of India, Calcutta.

Narayan, G. (1992). Ecology, distribution and conservation of the Bengal Florican Houbaropsis begalensis (Gmelin) in India. PhD thesis, University of Bombay.

Prasai, R., H. Kafley, S. Upadhaya, S. Thapa, P. Shrestha, A. Dudley & Y.P. Timilsina (2021). Population status and distribution of the Critically Endangered Bengal Florican *Houbaropsis bengalensis* in the grassland of Koshi Tappu Wildlife Reserve, Nepal. *Journal of Threatened Taxa* 13(9): 19293–19301. https://doi.org/10.11609/jott.6503.13.9.19293-19301

QGIS Development Team (2020). QGIS Geographic Information System. Open Source Geospatial Foundation Project.

Rahmani, A.R., R.R.S. Jha, N. Khongsai, N. Shinde, R. Talegaonkar & M. Kalra (2017). Studying movement pattern and dispersal of the Bengal Florican (*Houbaropsis bengalensis*): A Satellite Telemetry Pilot Project. Final Report 2013-2016. Bombay Natural History Society, Mumbai, 157 pp.

Sarma, P., B. Lahkar, S. Ghosh, A. Rabha, J. Das, N. Nath & N. Brahma (2008). Land-use and land cover change and future implication analysis in Manas National Park, India using multi-temporal satellite data. *Current Science* 95(2): 223–227.

Stohlgren T.J., M.B. Falkner & L.D. Schell (1995). A modified-whittaker nested vegetation sampling method. Kluwer Academic Publishers. Printed in Belgium. *Vegetation* 117: 113–121.

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Journal of Threatened Taxa is indexed/abstracted in Bibliography of Systematic Mycology, Biological Abstracts, BIOSIS Previews, CAB Abstracts, EBSCO, Google Scholar, Index Copernicus, Index Fungorum, JournalSeek, National Academy of Agricultural Sciences, NewJour, OCLC WorldCat, SCOPUS, Stanford University Libraries, Virtual Library of Biology, Zoological Records.

NAAS rating (India) 5.64

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Tamil Nadu 641006, India
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Journal of Threatened Taxa

www.threatenedtaxa.org

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

July 2024 | Vol. 16 | No. 7 | Pages: 25495–25638
Date of Publication: 26 July 2024 (Online & Print)
DOI: 10.11609/jott.2024.16.7.25495-25638

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