

Research Article

**STUDY OF DIFFERENT FACTORS RESPONSIBLE FOR POPULATION
DECLINE OF THE BENGAL FLORICAN (*HOUBAROPSIS
BENGALENSIS*)**

***Kailash Chandra Yadav, Vivek Kumar Verma, Pushpendra verma and Dinesh Bhatt**

College of Fisheries, Science and research Centre, Etawah.

Janta Mahavidyalay, Ajitmal, Auraiya

Gurukul Kangari University Haridwar, Uttra Khand

**Author for Correspondence: Kailashyadav447210@gmail.com*

ABSTRACT

Bengal florican (*Houbaropsis bengalensis*) is an important species of the three bustard present in Indian subcontinent. It is critically endangered bustard of the family otididae. Bengal Florican is a medium size about 60 cm size at standing position bustard its basically ground niche. The Bengal florican (*Houbaropsis bengalensis*) basically preferred open grassland dominated with *Imperata cylindrical*, *Saccharum munja* and *Desmostachya bipinnata*, the population of the Bengal florican due to habitat loss through environmental change and anthropologic activities. During the study period in Dudhwa National Park we observed only 13 males and 3 females of Bengal Florican. Total 80 grasslands covering 206.85 Km² areas were surveyed. Out of this presence of Bengal Florican was found only in seven large grasslands (12.63 ± 9.12 Km²). In the adjoining small grasslands (1.14 ± 2.81 Km²) Bengal Florican was not found. Island biogeography model indicates that large island will have a greater number of species than Small Island. Species-area relationship has been used to predict the number and percentage of those species that would become extinct if habitats destroy.

Keywords: *Bengal Florican, Bustard, Critically Endangered*

INTRODUCTION

Bengal florican (*Houbaropsis bengalensis*) is an important species of the three bustard present in Indian subcontinent. It is critically endangered bustard of the family otididae. In worldwide distribution the bustards of Asia are one of the most threatened group of birds (Collar et al, 2017). It is a globally threatened bustard species found in low grass land area. In India it is mostly found in Traibelt area. Bengal Florican is a medium size about 60 cm size at standing position bustard its basically ground niche bird. Bengal Floricans are terrestrial, and require large expanses of relatively flat, open habitat to enable them to spot predators, and so that their courtship displays can be seen from great distance (Collar et al., 2017). It has sexual dimorphism that the adult male with black head, neck, body and white wings. The feeding habits of Bengal Florican is omnivorous feeds upon seeds, grains, grasses and insects like ants beetles grasshoppers in some time also feeds small chordates like frogs. It is critically endangered (Bird Life International, 2018)

The population of the Bengal Florican is common in Nepal and north east India like Assam tarai belt foot hills Wally of Himalaya (Rahmani et al., 1991). The Bengal florican (*Houbaropsis bengalensis*) basically preferred open grassland dominated with *Imperata cylindrical*, *Saccharum munja* and *Desmostachya bipinnata*, the population of the Bengal florican due to habitat loss through environmental change and anthropologic activities (Rahmani, 2001).

MATERIALS AND METHODS

Ocular survey was conducted in the study area with the help of binocular (10X32) to assess the population status and occurring threats on surviving population of Bengal florican. Annotations on heads count of the species involved in grazing activity were documented during the survey.

Research Article

Distribution of Bengal Florican is almost known hence stratified sampling (Wilkinson *et al.*, 2002, Wotton *et al.*, 2002) was used and sampling was carried out in whole grasslands of the study area. We divided grasslands in 3 strata.

1. Pure *Imperata* grasslands
2. *Saccharum* grasslands
3. Tall wet grasslands

If a small patch of *Imperata* grassland was found inside *Saccharum* grasslands, it was counted under *Saccharum* grasslands. During survey total 400 point transects were taken every year with consideration of vantage point (i.e. *Machan*, tree). Each point, covering 500 meter radius, was surveyed by binocular. Minimum distance between two adjoining points was one kilometer. Grasslands with previous records of Bengal Florican were also visited during survey. In small grasslands (less than 1 Km²) only one sample point was visited (Sutherland, 2000). Detailed methodology is described in chapter two.

Agriculture field between Dudhwa National Park and Kishanpur Wildlife Sanctuary was also surveyed to understand the movement pattern of herbivores and carnivores within the overlapping area of agriculture field and grassland during study period. Through observations were made on direct and indirect interventions of human activities in and around the species habitat. Previously published information was used to compare the pattern of land use change.

Land use change pattern was also studied with the help of QGIS and Grass GIS. Habitat conversion across the Dudhwa Tiger Reserve was assessed by relating land cover, manually delineated declassified maps of British Indian Army (1:250000; constructed between 1914-23 by field survey), satellite imagery of Landsat 5 (30x30 meter pixels) from USGS earth explorer and topographic data from Cartosat Liss-IV. Georeferencing of the declassified British Indian army's map of Dudhwa Tiger Reserve was carried out with QGIS coordinates of all the populated places (i.e. *Gaurhis* and villages) surveyed during 1914-23 were extracted.

During field survey coordinates of villages and *Gaurhis* (cattle settlement) in study area were also collected. These coordinates were used to calculate proximity distance for all villages and *Gaurhis*. The mean proximity is used as the mean radius of a village/*Gaurhi*.

We collected information on grazing area required per cattle, number of cattle per *Gaurhi* and their altitudinal and seasonal movement. This information was used to evaluate the total area covered by villages and *Gaurhis*. Statistical analysis was performed by the R and QGIS. Results are shown as mean±SD.

RESULTS

Population status

During the study period in Dudhwa National Park we observed only 13 males and 3 females of Bengal Florican. During 2011 and 2012 we observed 5 males each year but in 2013 we observed only three males. In unprotected Laukyha grassland (latitude 28.205588° longitude 80.778088°) and Sampurna Nagar range of North Kheri forest division (latitude 28.635790° longitude 80.274095°) we sighted single male Bengal Florican each grasslands. Both are situated along the Sharda River and are unprotected. Assuming the equal sex ratio it seems that 5 pairs still breed in Dudhwa. If we also include sighting from unprotected area it can be said that currently there are about 14 birds in the grasslands of Lakhimpur Kheri district. During our survey we did not encounter any Bengal Florican in Kishanpur Wildlife Sanctuary. Most of the sightings were in *Saccharum* grasslands.

Total 80 grasslands covering 206.85 Km² areas were surveyed. Out of this presence of Bengal Florican was found only in seven large grasslands (12.63 ± 9.12 Km²).

Threats

During the present study it was observed that the grasslands in protected area were fragmented except the grasslands along Suheli and Ull river. Major grasslands (133.19 Km²) were found along the Sharda and Suhali rivers. Anthropological activity was relatively low in protected grasslands however, during April-

Research Article

May collection of wild fruits in grasslands by tribal women and children was very common thereby increasing the level of disturbance in grasslands around the tribal village. During peak fruiting season

Table 1: Sighting of male Bengal Florican (2011-13) in the study area

| Strata | No. of Males, Females | | |
|---------------------------------|-----------------------|------------|------------|
| | 2011 | 2012 | 2013 |
| Protected grassland | | | |
| Pure <i>Imperata</i> grasslands | 0,0 | 0,0 | 0,0 |
| <i>Saccharum</i> grasslands | 4,1 | 5,2 | 2,0 |
| Tall wet grasslands | 1,1 | 0,1 | 1,0 |
| Unprotected grassland | | | |
| Pure <i>Imperata</i> grasslands | 0,0 | 0,0 | 0,0 |
| <i>Saccharum</i> grasslands | 0,0 | 0,0 | 1,0 |
| Tall wet grasslands | 0,0 | 0,0 | 1,0 |
| Total | 5,2 | 5,3 | 5,0 |

about 200 women and children were observed in single grassland in 2011. Cattle population in the district was high which produced high grazing pressure in unprotected grasslands. Grazing activities of cattle were seen in 107.67 Km² grasslands. Only 99.18 Km² grassland was without cattle. During our study we observed 11 *Gaurhis* (cattle settlements) inside the north and south Kheri forest division with total 13268 animals, covering 51.37 km² grasslands. In unprotected grasslands each *Gaurhi* consisted 17.09±22.21 (range 5-82) cattle settlements and 1206.18±1270.26 (range 367-4937) animals and each *Gaurhi* covered 4.67 km² areas for fodder. These *Gaurhis* were mostly situated along the Sharda River in all major grasslands. Villagers around the grasslands also graze their animals in grasslands. There was not a significant difference ($p < 0.05$) in activity of grazers in grasslands during breeding and non-breeding season of Bengal florican. Agricultural fields were the most dominant land use type. Sugarcane (44.95%) and wheat (36.77%) were the most dominant crops of the area. Sugarcane fields were found most dominated man made agro-ecosystem (44.95% of total cultivated land). Harvesting of sugarcane takes place between November and March whereas harvesting of wheat takes place between April and May. Significantly high human activity ($t=3.953$, $p=0.00226$) in agricultural fields was observed during these months. In north and south Kheri forest division most of the thatching material (e.g. *Saccharum* grasses) was sold by auction. Timing of thatching material collection was found between March to June every year coinciding with the breeding season of Bengal Florican.

In declassified map of British Indian Army, 21 records of *Gaurhis* and 23 villages were shown between Dudhwa National park and Kishanpur Wildlife Sanctuary, during 1914 to 1923. Out of these 21 *Gaurhis*, 11 have been vanished in protected area and rest 10 *Gaurhis* which were outside of protected area, have now been converted (47.61 %) in agricultural lands covering an area of 46.7 Km² and 98 new villages were settled during this period which cover 165.29 Km² area. As per declassified map of British Indian Army 38.87 Km² area was occupied by villages and 98.07 Km² area of grasslands was covered by *Gaurhis* during 1914-23. It indicates that 165.29 Km² area, which was then available to wildlife, is now converted to agriculture, out of this about 46.7 Km² area was covered with grasslands. This unprotected habitat was the only corridor for movement of animals between Dudhwa National Park and Kishanpur Wildlife Sanctuary.

Research Article

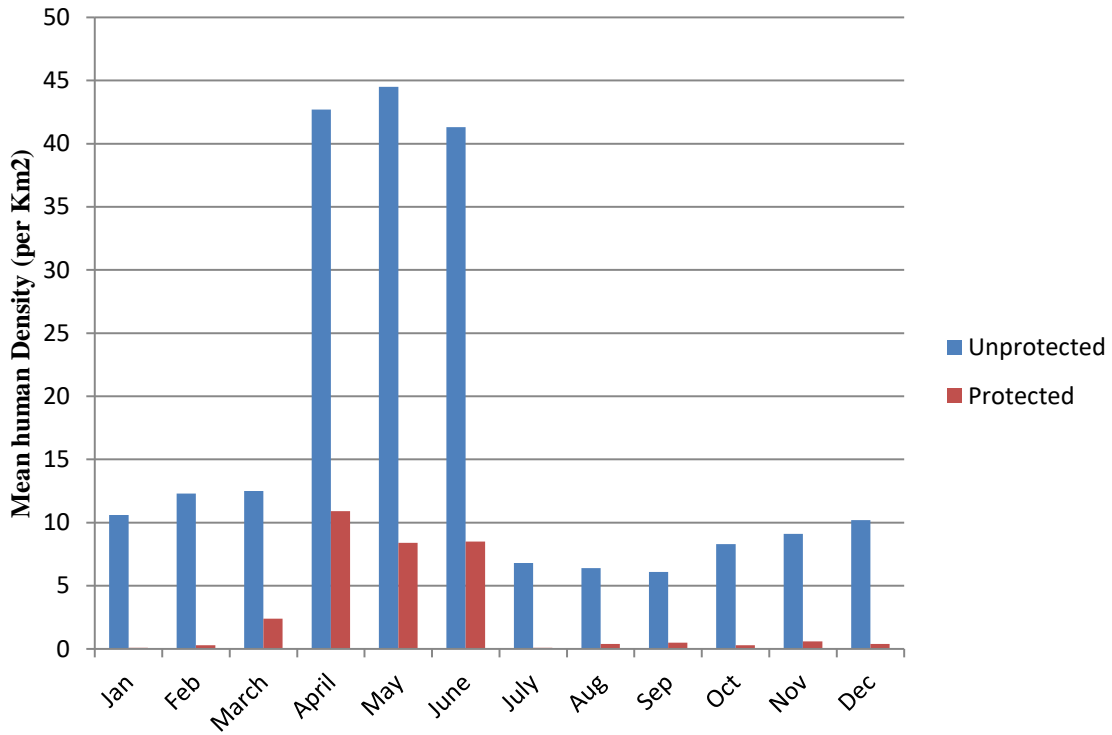


Figure 1: Seasonal variation in the disturbance level (Density) in the grasslands of the study area

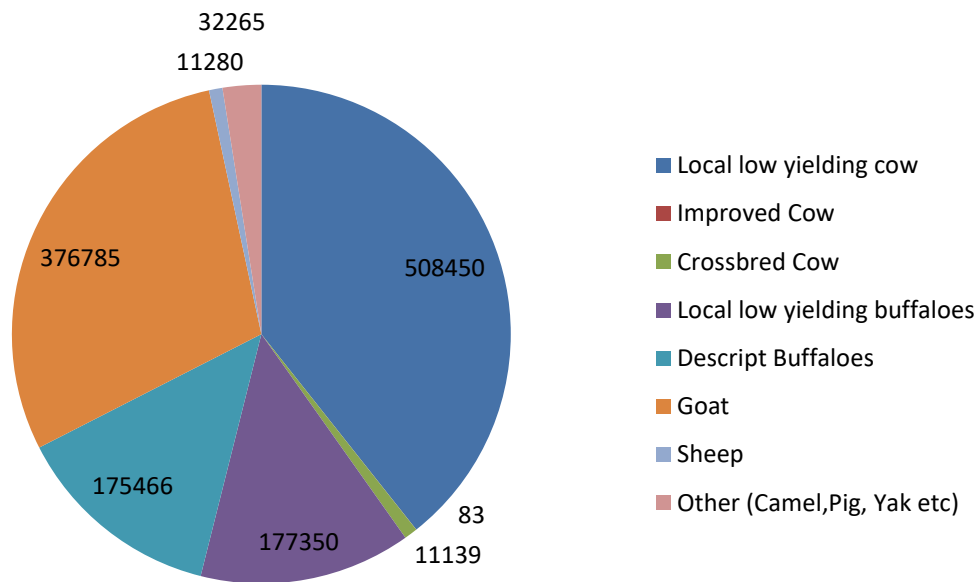


Figure 2: Showing cattle population in the study area (based on 2007 cattle census) (Source: Dept. of Animal Husbandry, Govt. of Uttar Pradesh)

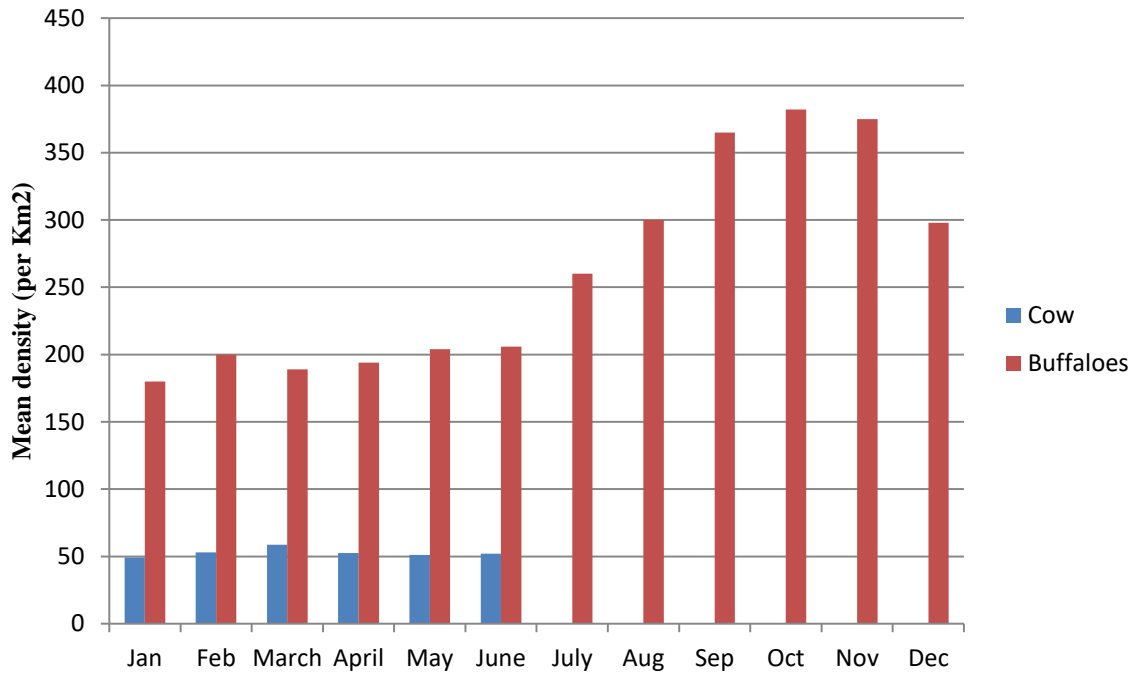


Figure 3: Cattle distribution level (density) in unprotected Pure *Imperata* grasslands

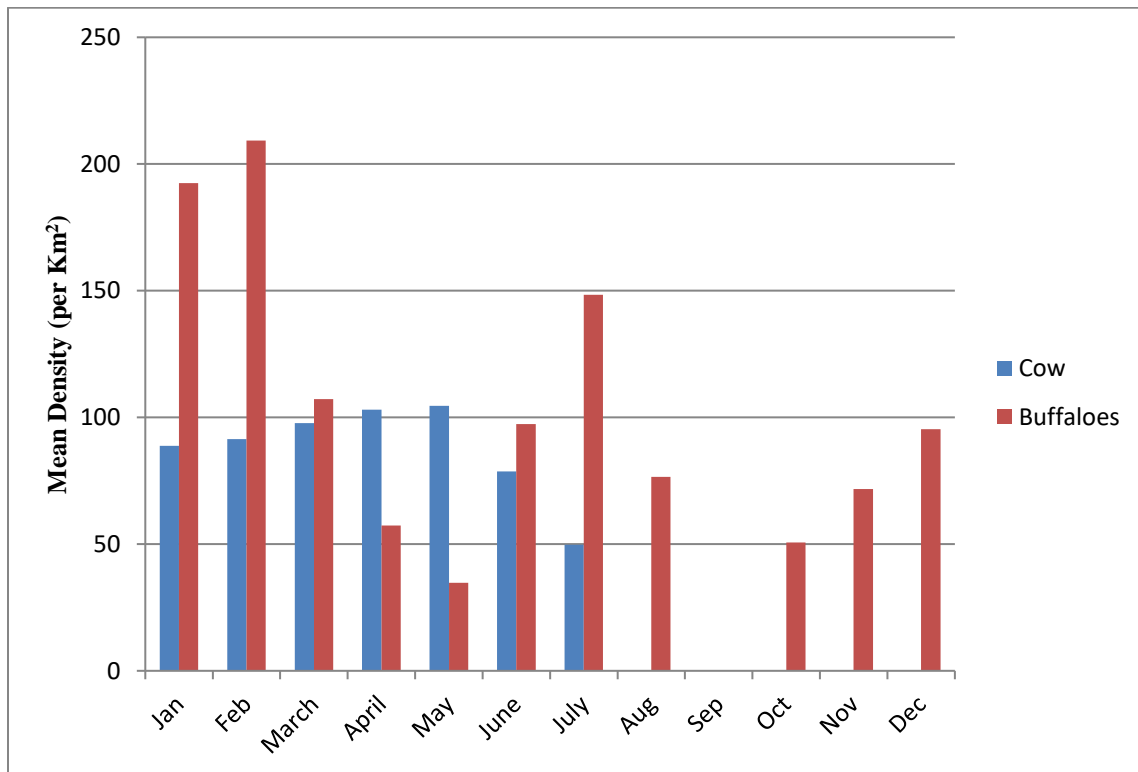


Figure 4: Cattle disturbance in unprotected *Saccharum* grasslands showing monthly variations

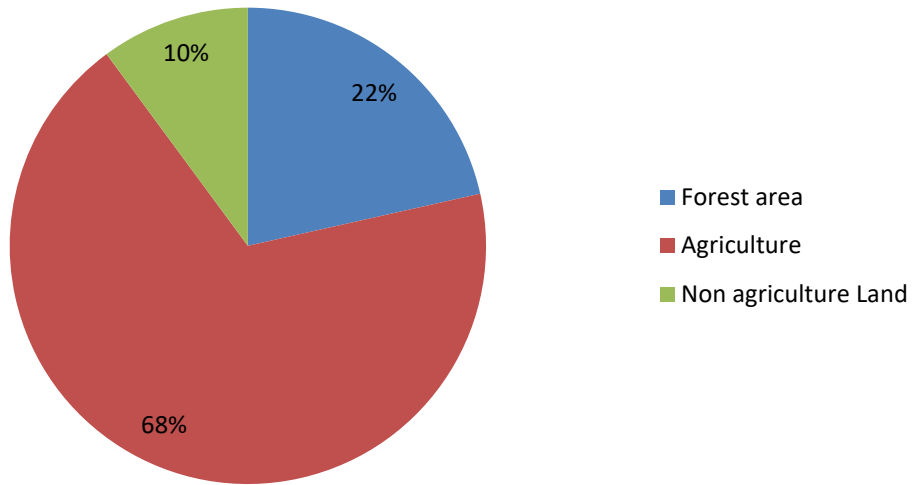


Figure 5: Land use pattern of Lakhimpur Kheri recorded during 2011 (Source: Ministry of Micro Small and Medium Enterprise, Govt. of India)

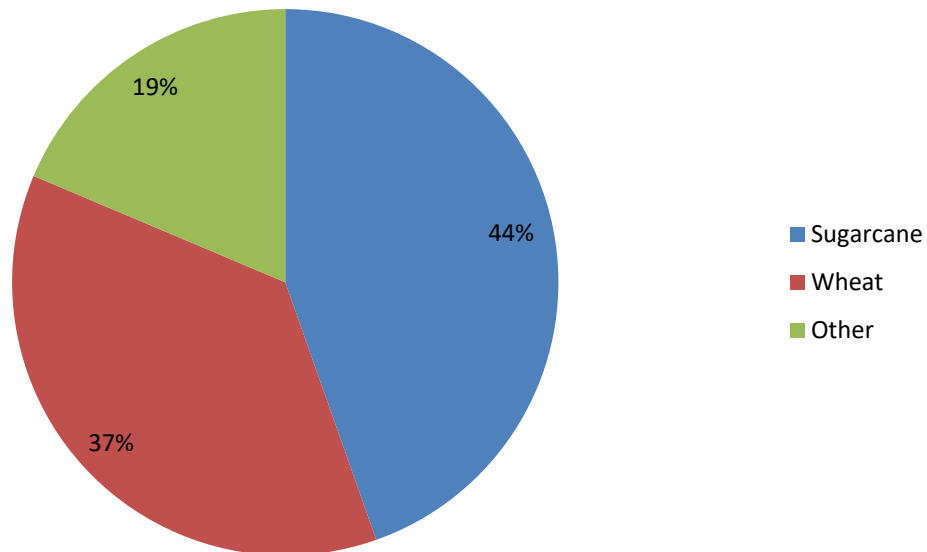


Figure 6: Cropland areas as recorded in April 2012 (Source: Krishi Vigyan Kendra, Jamunabad, Lakhimpur Kheri)

Research Article

DISCUSSION

Tall grassland of Terai, surrounded by woodland and other habitats show an island effect as also found in some other mainland ecosystems (Bawa *et al.*, 2011). Islands generally have a high incidence of endemic species because of their isolation. A relationship between area of an island and the number of species it contain is synthesized as the island biogeography model (Mac Arthur and Wilson 1967). Island biogeography model indicates that large island will have a greater number of species than small Island. Species-area relationship has been used to predict the number and percentage of those species that would become extinct if habitats destroy (Michalski and Peres 2005). Model predicts that when 50% of an island is destroyed, approximately 10% of the total species occurring on the habitat will be eliminated. Predictions of extinction rates based on habitat loss have been used in several studies to predict the extinction rate on terrestrial ecosystems (Koopowitz *et al.*, 1994). This model has great utility in Terai grassland ecosystem because most of the Terai grasslands are shrinking either by succession or by land use change in to agriculture. In long term higher rate of loss was seen among large ground birds due to decreasing the area of Habitat Island. In this study we found somewhat similar patterns in Terai grasslands due to habitat degradation and modification. The Population of Bengal Florican is restricted and surviving only in large grasslands. Studies based on island biogeography model explain why large sized grasslands area still supporting a population of Bengal Florican. Shrinkage of grassland has adverse effect on Bengal Florican due to its large body size. The quality and quantity of grasslands in protected areas are still decreasing due to *Eucalyptus spp.* plantation, encroachment by Invasive species such as *Lantana camara* and ecological succession. The condition of grassland outside the protected area is more severe due to high anthropogenic as well as grazing pressure. Most of these grasslands are surrounded by human settlements.

People live in or near the protected area depend upon goods and services from such ecosystem (Bawa *et al.*, 2011). For whole India number of people who rely on non-timber forest products (NTFP) for their livelihood may exceed 275 million (Bajaj 2001). Extraction of wide range of natural products is an important source of food and income for locals. Even in core area of national park locals sometime collect wide variety of NTFP such as fuel, food and fodder.

Direct human disturbance increased rapidly in recent years throughout the range of distribution of Bengal Florican (Narayan 1992, Choudhury 1996). In Dudhwa National Park wild grassland fruits such as phalsa (*Grewia sapida*) and wild dates (*Phoenix spp.*) are important resource for both local Tharu tribes and Bengal Florican. Tribes use these fruits to make beverages. Selling of these fruits is not so common but sometimes it also occurs. I observed seeds of Phalsa (*Grewia sapida*) in the stool of Bengal Florican. Collection of wild grassland fruits by Tharu tribes is a severe problem for surviving population of Bengal florican. Fruits become available during the nesting season of the Bengal Florican. At the peak time of availability of fruits I observed 200 women and children per square kilometer. Intensive collection of wild fruits produce direct human disturbance in habitat which can damage eggs and chicks of ground nesting birds and also produce competition for food and decrees the quality of grassland. Collection of eggs by these tribes is common which decrease recruitment rate of the species. In buffer Zone of Dudhwa Tiger Reserve collection of thatching material (e.g. *Saccharum* grasses) produce a sever effect on habitat. Summer is the best time for collection of thatching material. It is also the time of breeding of Bengal florican. In buffer zone it is a prominent reason of human disturbance causing habitat degradation. Sometimes collection of NTFP is also associated with poaching i.e. locals comes inside the park to collect NTFP and set traps at evening next morning they collect the trapped animal. Generally traps are made by fishing cord or metal wire and are applied near the water source. The traps made by fishing cord are commonly used to capture birds. Extraction of non-timber forest products is so much important for their livelihood that whenever wildlife management agencies try to control, they always produce conflicts with wildlife management agencies. Situation becomes more adverse when local political leader start to help locals and stand against wildlife managers for their political profits. Additionally, at Stoung-Chikraeng

Research Article

BFCA it is located close to an important lek and is predicted to significantly increase adult male mortality (Mahood *et al.*, 2016)

In buffer zone of Dudhwa Tiger Reserve grasslands are surrounded by cattle settlements (*Gaurhis*). All cattle depend on these grasslands for fodder. In some areas such as at the road side range of north Kheri and Gola range of south Kheri forest division, numerous feral cows are also present which produce high grazing pressure on grasslands and make these grasslands less suitable for Bengal florican. In peak summer (May- June) grasses become hard and less favorable to grazers. For insuring the availability of fodder cattle owner burn the grasslands in April to increase sprouting in grasses. This action destroys the eggs of ground nesting summer breeding birds including Bengal florican.

Breeding success among grassland birds typically ranges between 25% and 55%, (Wray *et al.*, 1979) although it can exceed 90% or be as low as 10% (Best, 1978). Packman (2011) in his study on Bengal florican indicated low breeding success in Cambodia, probably due to non-targeted incidental predation. Non-targeted incidental predation is a primary cause of nest failure and it seriously affects reproductive success of rare and sparsely distributed species (Vickery *et al.*, 1992). Non-targeted incidental predation among grassland birds was well (Nolan, 1963 and Ricklefs, 1969). In grassland birds non-targeted mammalian predator account for most predation which mostly visit between sunset and sunrise (Maxson and Oring 1978) (Sanders and Maloney 2002). However, a wide variety of predators, including birds, snakes and mammals generally cause nest losses among grassland birds (Gottfried and Thompson 1978, Maxson and Oring 1978, Wray and Whitmore, 1979). Because of their broad, less selective diets, generalist consumers, especially omnivores (Clark, 1981) and some herbivores (Sinclair 1995) are more likely to consume a rare species than specialist consumers. Non-targeted predation could have important consequences for many prey species because it may limit the utility of certain anti-predator adaptation (Vickery *et al.*, 1992). Some anti-predator activities, such as specialized microsite nest placement, may be less effective when predation is incidental rather than directed specifically at avian nests (Vickery *et al.*, 1992).

In the study area sugarcane (*Saccharum officinarum*) is the main annual cash crop, which dominates most of the agriculture landscape. Most of the dominant grasses found in florican habitat also belong to *Saccharum* genus. Although sugarcane fields are not suitable for florican but it supports wide variety of omnivorous mammals such as Golden jackal (*Canis aureus*), jungle cat (*Felis chaus*), Asian palm civet (*Paradoxurus hermaphroditus*) and Indian fox (*Vulpes bengalensis*) etc. Harvesting of sugarcane starts in November and continues till March. After harvesting farmers start tilling the soil of sugarcane field to control weeds. In April wheat harvesting also take place. After harvesting season agricultural land become bare resulting in low food availability for wild animals in agricultural fields. Most of these wild animals move towards grasslands and remain there till sugarcanes start to grow and become suitable for them. Unfortunately, movement of these omnivorous to grasslands coincides with the breeding season of Bengal florican and cause disturbance and predation to Bengal Florican and its young ones during its breeding season.

During whole breeding time Bengal florican share habitat with these animals. Also, some other endemic grassland birds like Swamp francolin (*Francolinus gularis*), bristled grassbird (*Chaetornis striata*), and Indian grassbird (*Graminicola bengalensis*) breed at the same time in the same habitat. They are also threatened species. Thus, presence of the above-mentioned opportunistic omnivores is a serious threat for these birds too.

Due to flooding and problem in accessibility the land was not suitable for agricultural purpose. Most of the land was uncultivated and dominated by grassland and other associated habitats with scattered trees. Dairy was the only agricultural industry which was flourished in the period of Zamindari system. In these grasslands shifting of *Gaurhi* occurred with flooding. Zamindar used to collect tax from *Gaurhis* on cattle grazing lands. Some of these *Gaurhis* are still present in the study area. The population of wild animals was high during this period.

Research Article

The human population was further increased after the abolition of the Zamindari system in 1952, when land held by Zamindars was distributed to landless people. Asian country other than North Korea most people are poor and depend on natural resources (Asadullah & Savoia, 2018). The grassland was the most affected ecosystem by these human settlements. Our results revealed that there is a sharp decline (47.61%) in the grassland area from 1952 to 2013 due to the change in land use pattern. Land use change causes the habitat destruction and is the major threat to the biodiversity (Bawa *et al.*, 2011).

Although, unprotected grasslands have high disturbance in comparison to protected grasslands mainly due to high cattle population but our study indicates that Bengal Florican also depends to some extent on grazers as they maintain a suitable habitat structure for flight display during breeding. However, overgrazing of the habitat will deprive the Bengal Florican and other species from cover/shelter to hide them during emergency. There is a need to control grazing in buffer zone. If controlled grazing is allowed, few unprotected grasslands have strong chance to sustain a population. There are strong possibilities to sustain a population in grasslands along the Sharda river.

REFERENCES

Asadullah MN & Savoia A (2018). 'Poverty reduction during 1990–2013: Did millennium development goals adoption and state capacity matter?' *World development*, **105**, 70-82.

Bajaj M (2001). The impact of globalization on the forestry sector in India with special reference to women's employment'. Pap. Comm. Study Group Women Work. Child Labour National Communication Labour New Delhi Gov. India. Available at: www.cwds.ac.in/library/library.htm

Bawa KS, Primack RB and Oommen MA (2011). Conservation biology: a primer for South Asia (Universities Press, Hyderabad, India). Universities Press (India) Pvt. Ltd.

Best LB (1978). Field Sparrow reproductive success and nesting ecology. *The Auk*. 95, 9, 22.

Bird Life International (2018). Species factsheet: *Houbaropsis bengalensis*. Available at: www.birdlife.org/datazone

Choudhury A (1996). Survey of White-winged Ducks and Bengal Florican in north-east India. *Orient. Bird Club Bull* **23**, 14-17.

Clark DA (1981). Foraging patterns of black rats across a desert- montane forest gradient in the Galapagos Islands. *Biotropica*. **13**, 3, 182–194.

Collar NJ, Barsal HS, Batbayer N, Bhardwaj GS, Brahma N, Burnside RJ, Chaudhary AV, Combreau O, Dolman PM, Donald PF, Dutta S, Gadhavi D, Gore K, Goroshko OA, Hong C, Jather GA, Jha RRS, Jhala YV, Koshkin MA, Lakhar BP, Lier G, Mahood SP, Morales MB, Narwade SS, Nastsagdorj T, Nefrdov AA, Silva JP, Thakuri JJ, Wang M, Zhng Y and Kessler AE (2017). Averting the extinction of busturds in Asia. *Forktail*. **33**, 1-26.

Gottfried BM and Thompson CF (1978). Experimental analysis of nest predation in an old-field habitat. *The Auk*. **95**, 304–312.

Koopowitz H, Thornhill AD and Andersen M (1994). A general stochastic model for the prediction of biodiversity losses based on habitat conversion. *Conserve. Biol*. **8**, 425–438.

Mac Arthur RH and Wilson E (1967). The theory of island biogeography (Princeton University Press) Wilson Publication.

Mahood SP, Silva JP, Dolman PM and Burnside RJ (2016). Proposed power transmission lines in Cambodia constitute a significant new threat to the largest population of the Critically Endangered Bengal florican *Houbaropsis bengalensis*. *Oryx* **52**, 147–155

Maxson SJ and Oring LW (1978). Mice as a source of egg loss among ground-nesting birds. *The Auk*. **95**, 582–584.

Michalski F and Peres CA (2005). Anthropogenic determinants of primate and carnivore local extinctions in a fragmented forest landscape of southern Amazonia. *Biol. Conserv*. **124**, 383–396.

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

Research Article

Nolan V (1963). Reproductive success of birds in a deciduous scrub habitat. *Ecology* **44**, 305–313.

Packman CE (2011). Seasonal landscape use and conservation of a critically endangered bustard: Bengal florican in Cambodia. Dissertation, University of East Anglia, Norwich, United Kingdom. Available at: <https://ueaeprints.uea.ac.uk/id/eprint/38824>

Rahmani AR (2001). Status of the Bengal Florican *Houbaropsis bengalensis* in Uttar Pradesh, India. *Bombay Natural History Society*. **88**, 1, 350-375.

Rahmani AR, Narayan G, Rosalind L, Sankaran R and Ganguli U (1991). Status of the Bengal Florican (*Houbaropsis bengalensis*) in India. *Journal of the Bombay Natural Historical Society*, **88**, 349-375.

Ricklefs RE (1969). Preliminary models for growth rates in altricial birds. *Ecology* 1031–1039. Available at: <https://doi.org/10.2307/1936894>.

Sanders MD and Maloney RF (2002). Causes of mortality at nests of ground-nesting birds in the Upper Waitaki Basin, South Island, New Zealand: a 5-year video study. *Biol. Conserv.* **106**, 225–236.

Sinclair ARE (1995). Serengeti: dynamics of an ecosystem (University of Chicago Press) 1427 E. 60th Street Chicago, IL 60637 USA.

Sutherland WJ (2000). The Conservation Handbook: Research, Management and Policy Blackwell Science (Oxford, England) Blackwell Science, Oxford. Available at: <https://doi.org/10.1002/9780470999356>.

Vickery PD, Hunter Jr ML and Wells JV (1992). Evidence of incidental nest predation and its effects on nests of threatened grassland birds. *Oikos*. **63**, 2, 281–288.

Welsh DA (1975). Savannah Sparrow breeding and territoriality on a Nova Scotia dune beach. *The Auk* **92**, 235–251.

Wilkinson NI, Langston RH, Gregory RD, Gibbons DW and Marquiss M (2002). Capercaillie Tetrao urogallus abundance and habitat use in Scotland, in winter. *Bird Study* **49**, 177–185.

Wotton SR, Carter I, Cross AV, Etheridge B, Snell N, Duffy K, Thorpe R, and Gregory RD (2002). Breeding status of the Red Kite *Milvus milvus* in Britain in 2000. *Bird Study* **49**, 278–286.

Wray IIT and Whitmore RC (1979). Effects of vegetation on nesting success of Vesper Sparrows. *The Auk*. **1**, 802–805.