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## ARTICLE

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## Status of Nahan's Partridge *Ptilopachus nahani* (Dubois, 1905) (Aves: Galliformes: Odontophoridae) in Uganda

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**Abstract:** We carried out a survey of Nahan's Partridge *Ptilopachus nahani* in the Ugandan forests of Mabira, Bugoma, and Budongo from December 2016 to December 2017, using a point count method employing a call playback technique. The aim was to establish the population status of this globally threatened species, which was last surveyed in 2003. Separate analyses of the number of groups per point and those involving use of the Distance Program yielded the same density estimates, indicating that either method reliably estimates the density of the species. The density estimates for the three reserves were 31.6, 25.2, and 13.3 groups per km<sup>2</sup> for Bugoma, Budongo, and Mabira forest reserves, respectively. In the last 14 years, it appears that the density of the species for Uganda has increased from 16.3 to 23.4 groups per km<sup>2</sup>, which when extrapolated translates to 16,000 and 23,000 groups, respectively. This represents a 44% increase in density, or a group growth rate of 450 per year. The lowest density and population increment was registered in Mabira and we attribute this to the apparently high incidence of disturbance and degradation of this forest compared to the other two. Since Mabira, Bugoma, and Budongo are the only remaining large tropical rainforest reserves in Uganda, strengthening their conservation or upgrading their conservation status to national parks is required to save the species.

**Keywords:** Conservation, degradation, density, endangered species, ecotourism sites, hunting, nature reserve, playback, vulnerable.

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**Competing interests:** We declare that we have no significant competing financial, professional, or personal interests that might have influenced the performance or presentation of the work described in this manuscript.

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**Authors contribution:** WO as director Nature and Livelihoods and ES (Galliform specialist) conceived the project; ES, SA, and UR collected the data; ES led the writing of the manuscript. All authors contributed critically to the drafts and gave final approval for publication.

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## INTRODUCTION

Nahan's Partridge *Ptilopachus nahani* is categorized as a globally Vulnerable species (BirdLife International 2019a), although between 2000 and 2018 it was categorized as Endangered. It is an enigmatic galliform known from a few localities in the eastern Democratic Republic of the Congo (DRC) from Yangambi eastwards, and in central and western Uganda (Dranzoa et al. 1999; McGowan 1994). Although Budongo, Bugoma, and Mabira forests are recognized as Important Bird Areas in Uganda (Byaruhanga et al. 2001) and are legally protected forest reserves, Mabira is under severe pressure from disturbance including logging and hunting. Nahan's Partridge is a strict forest specialist species (Bennun et al. 1996), inhabiting closed forest up to 1,400m (Dranzoa et al. 1999), but its tolerance of degraded and secondary habitats is not well known. In fact, until a study by Sande (2001), the species was listed as Data Deficient by IUCN (Collar et al. 1994; McGowan et al. 1995). Being one of the main sought-after species in Uganda for avi-tourism, its conservation through tourism would benefit the three forest reserves and their biodiversity. Nahan's Partridge was previously wrongly classified as a francolin. Now it is classified as a partridge, a sister species to another African endemic, the Stone Partridge *Ptilopachus petrosus*. It is most closely related to the New World quails (Odontophoridae) (Crowe et al. 2006; Cohen et al. 2012; BirdLife International 2016). Although the species was downgraded from Endangered to Vulnerable in 2019, its population in some parts of its range remains unknown and its global population size is believed to be decreasing (BirdLife International 2019a).

The population status of Nahan's Partridge is of particular concern because it is a forest specialist species occurring in only three forest reserves in Uganda (Mabira, Bugoma, and Budongo). Fuller et al. (2004) carried out a survey of the species in the three forest reserves in 2003 and estimated the Ugandan population to be 40,000 individuals. They recommended, among other actions, the survey to be repeated every 10 years. This is the first study to follow up those recommendations. Conservationists used the occurrence of this species as one of the arguments to reverse the 2007 government proposal to degazette 7,000ha of Mabira forest reserve for growing sugarcane. Fuller et al. (2004) estimated the density of the species in the naturally forested part of Mabira (204km<sup>2</sup>), Bugoma (300km<sup>2</sup>), and Budongo (428km<sup>2</sup>) forest reserves (hereafter Mabira, Bugoma, and Budongo) as 8.3, 19, and 21 groups km<sup>-2</sup>, respectively (Fuller et al. 2012). They attributed the relatively low

density in Mabira to a high rate of logging and human disturbance compared to the other two forests. In their assessment of recreational values to promote sustainable use of Mabira, Olupot (2015) and Olupot & Isabirye-Basuta (2016) recommended the need for assessment of the status of the species in the entire Mabira to promote tourism and discourage the illegal human activities that threaten it. This study was conducted in part as a response to those recommendations.

The general aim of this study was to assess the population status of Nahan's Partridge in Uganda. Specific objectives were to:

1. Determine the population status of the species in Uganda after 14 years
2. Compare the population status of the species in the existing and proposed ecotourism sites (Olupot & Isabirye-Basuta 2016) in Mabira Forest Reserve.

## METHODS

### Study area

The study was conducted in the Ugandan forest reserves of Mabira, Budongo, and Bugoma (Figure 1).

Mabira Forest Reserve (Figure 2a) is the largest block of moist semi-deciduous forest remaining in central Uganda. It is estimated to be 303km<sup>2</sup> in total area (Howard 1991) but Westman et al. (1989) estimated the least degraded, high forest area to have fallen from 285.4km<sup>2</sup> in 1973 to 204.2km<sup>2</sup> in 1988. As Fuller et al. (2004) used the area estimate of 204.2km<sup>2</sup> for their study, we use the same for this study. The reserve lies in a gently undulating landscape, characterized by numerous flat-topped hills and wide, shallow valleys. The reserve is isolated from other protected areas by settled and agricultural land. The relative closeness of Mabira to Kampala (59km), and the presence of various ecotourism facilities, makes it a potentially popular site for visitors (BirdLife International 2019b).

Mabira Forest Reserve is divided into three management zones. The strict nature reserve covers 23% of the forest and no activities are legally permitted there except scientific research and law enforcement. Tourism activities are permitted only in the recreational and buffer zones which covers 22% of the reserve. The production zone which covers 54% of the reserve is allocated to sustainable supply of round wood for Uganda's plywood and veneer industry (Ministry of Water and Environment 2010). Despite having the designated zones, it is difficult to regulate the use of forest resources in the reserve because Mabira has 22





Figure 1. The three study sites: Budongo Forest (1.794°N, 31.582°E), Bugoma Forest (1.287°N, 30.964°E) and Mabira Forest (0.389°N, 33.005°E). These are the only sites for the Nahan's partridge in Uganda (Fuller et al. 2004).

legal enclaves (Howard 1991). The human population living in the forest enclaves was approximately 825,000 with a density of 200–230 people per km<sup>2</sup> in 2001 (Mrema et al. 2001). Mabira is considered an Important Bird and Biodiversity Area (IBA) because of the presence of the Nahan's Partridge (VU) and the Papyrus Gonolek *Laniarius mufumbiri* (NT) (BirdLife International 2019b). The reserve is home to 315 species of birds (Byaruhanga et al. 2001) and 30 species of mammals including the endemic Uganda Mangabey *Lophocebus albigena ugandae*. The survey was conducted in the following compartments: Wantuluntu, Namaganda (Nature Reserve), Namusa Hill, Kiwala, Lugala, Najjembe, Griffin, Bugoma, and Buwola (Mulberry forest) (Figure 2a). Some of these sites (Namaganda, Namusa Hill, Najjembe, and Buwola) were visited during previous studies and are relevant to both objectives of this study. Although not sampled during the early 2000s, we also sampled in Kiwala, Lugala, and Griffin sites with the primary purpose of fulfilling objective 2.

Bugoma Forest Reserve (Figure 2b) is situated on top of an escarpment east of and overlooking Lake Albert on the edge of the Western Rift Valley. It lies, approximately

10km south-west of Hoima and 10km east of Lake Albert. It sits on a gently sloping area, which drains towards lake Albert in the west. It comprises irregular blocks of high forest intersected by large patches of *Hyparrhenia*, *Pennisetum*, and *Cymbopogon* grasslands, which occupy approximately 18% of the reserve. About half of the forested portion is dominated by Iron Wood *Crynometra alexandri* and a further 38% is mixed Forest (BirdLife International (2019c). Bugoma is an IBA because of Nahan's Partridge (VU) and the Grey Parrot *Psittacus erithacus* (EN) (BirdLife International 2019c), and the forested area is 300km<sup>2</sup> (Howard 1991). The reserve is home to 225 species of birds (Byaruhanga et al. 2001) and 23 species of mammals including the globally endangered Chimpanzee *Pan troglodytes* (Humble et al. 2016). The survey was done in the nature reserve (Figure 2b) which is dominated by *Crynometra alexandri*.

Budongo Forest Reserve (Figure 2c), is one of the most important forest reserves in Uganda for biodiversity conservation. It lies on the escarpment north-east of lake Albert and covers 793km<sup>2</sup> of which 428 is forested. It consists of a medium-altitude moist semi-deciduous forest, with areas of savanna and woodland.

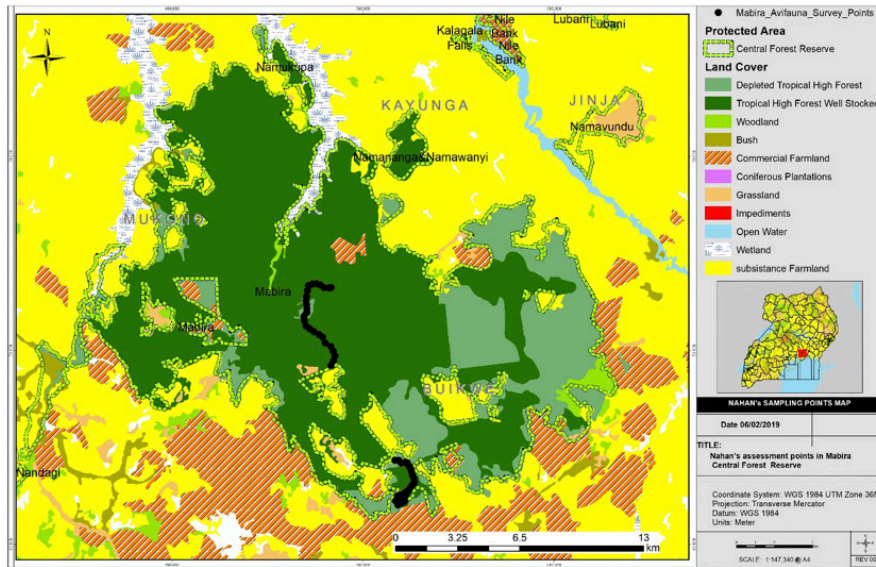


Figure 2a. Mabira Forest Reserve showing where the survey was done.

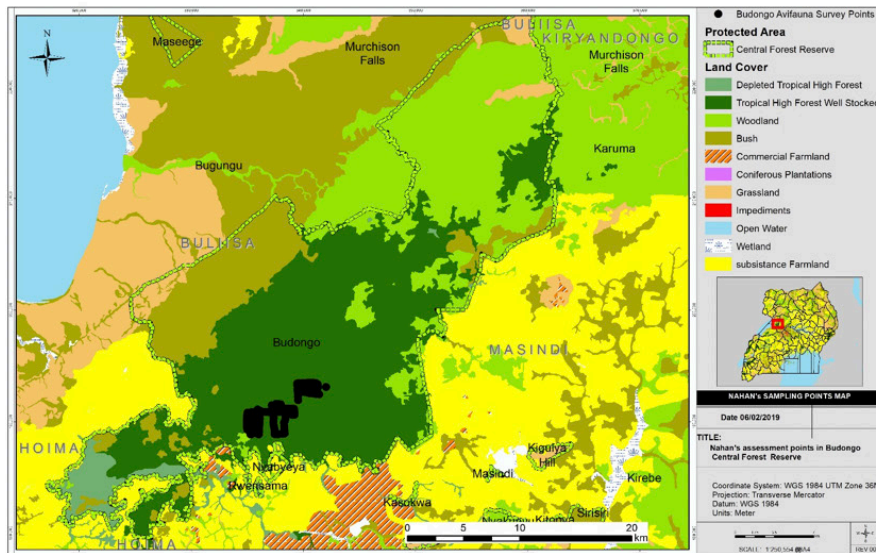


Figure 2b. Budongo Forest Reserve showing where the survey was done.

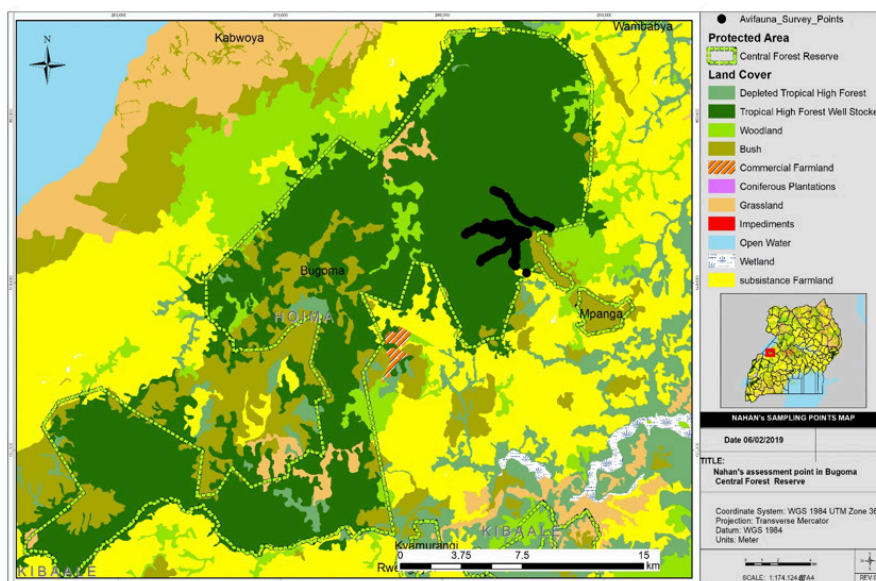


Figure 2c. Bugoma Forest Reserve showing where the survey was done.



The reserve occupies gently undulating terrain, with a general slope north-north-west towards the Rift Valley. Budongo has five main forest-types: colonizing, mixed, *Cynometra*, *Cynometra*-mixed and swamp-forest. The vegetation has also changed considerably following 60 years of selective logging and silvicultural treatment which favored the growth of valuable timber species, especially mahoganies. Today, the forest is the richest in Uganda for native timber production. The Budongo Conservation Field Station (BCFS) based at Sonso carries out research throughout the forest, mainly on primates and birds (BirdLife International 2019d). Budongo is an IBA because of the presence of the Nahan's Partridge (VU) and the Brown-cheeked Hornbill *Bycanistes cylindricus* (VU) (BirdLife International 2019d) with a forested area of 428km<sup>2</sup> (Howard 1991). The reserve is home to 360 species of birds (Byaruhanga et al. 2001) and 24 species of mammals including the globally endangered Chimpanzee *Pan troglodytes* (Humble et al. 2016). The survey was carried out in three compartments namely: N15 (66.7km<sup>2</sup>; Nature Reserve), N3, (384.4km<sup>2</sup>; logged in 1947–52) and W21 (24.5km<sup>2</sup>; logged in 1963–64 and 1996–97) (Figure 2c).

### Survey techniques

The field survey was conducted on the following dates: 14–23 December 2016, 7–8 January 2017 and 2–3 December 2017 in Mabira; 11–19 November 2017 in Bugoma, and 15–24 December 2017 in Budongo. The point count method was used to survey the birds. At each point, locations of the birds were determined using a call playback technique at the points spaced evenly along line transects of varying lengths at distances of approximately 200m. Playback is the only method currently available for surveying the presence, absence, density and relative abundance of the species. Playback surveys have been used in the past to survey the species (Sande 2001; Sande et al. 2001; Fuller et al. 2004, 2012). In their verification of the methods used by Sande (2001), Fuller et al. (2012) noted that the playback method is now well developed, and recommended the use of the method for future surveys of the species. Elsewhere, playback surveys have been widely used to determine the presence of elusive birds (Glahn 1974; Marion et al. 1981; Gibbs & Melvin 1993).

The survey effort was 162, 231 and 397 points (covering 32.6, 46.4 and 79.6km) in Bugoma, Budongo, and Mabira forest reserves, respectively. The 200m interval between survey points was used because the investigator can hear the call within a radius of 100m (Sande et al. 2001; Fuller et al. 2004, 2012). At every

point, we played the call for 20 seconds, three times at an interval of one minute. Fuller et al. (2004) on the other hand played for 10 seconds, waited for any ensuing response in 60 seconds and did this for two more playbacks. They, thus, estimated density from responses after three and a half minutes (70 seconds x3). Fuller et al. (2004) recommended that future surveys use a playback period of 20 seconds, play a total of three times, with a one-minute gap between each playback.

Fuller et al. (2012) demonstrate that movement of birds toward the sound stimulus during playback surveys can lead to significant overestimation of bird densities. They further showed that a higher number of groups responded to the third playback than the first two. This exacerbates the problem of overestimation, because some birds delayed several minutes before responding and were therefore likely to move a substantial distance toward the observer before being detected.

Sande (2001) found that 77% (n=525) of Nahan's Partridge responded to the playback within one minute and used only these records to estimate density in Budongo Forest in 1997–1999. Also for this study, only responses within one minute were used in the estimation of density. This minimized the risk of overestimating density arising from birds moving towards the observer before being detected as the response within the one minute meant that the birds would not have moved a substantial distance before they responded. This is confirmed by the fact that the population estimate by Sande (2001) for Budongo Forest reserve (6000–7000 groups) (using the responses within one minute) was comparable with the estimate by Fuller et al. (2012) (8000 groups) in 2003 using the adjusted response distance (based on the responses from three call backs taking into account the distance they could have moved before responding). Thus, either the population estimate based on only the responses within one minute of the playback (Sande 2001) or that based on adjusted response distance (Fuller et al. 2012) can be used to avoid overestimation of density.

For every survey point we recorded the GPS coordinates, and wherever we got a positive response we estimated the distance from the researcher to the responding birds (sighting distance) and the number of individuals in case they were seen. Playback surveys were conducted from around 07.30h to around 15.00h.

### Data analysis

Two methods were used: the number of groups per point, and distance analysis. A requirement of the latter is at least 60–80 sightings for fitting the detection

function (Buckland et al. 1993). Since this may not always be possible for rare or globally threatened species, there is need to test and recommend other methods that can be used to analyse data sets with fewer observations. This is important in conservation terms since threatened bird species require regular assessment to feed data into the Global Bird Species Program that is updated every four years.

Using the number of groups per point method, we obtained the mean response distance  $r$  from which the birds responded to the observer (which ranged from 10–200 m), the area of each point surveyed ( $\pi r^2$  m<sup>2</sup>), the number of points surveyed in each forest reserve ( $n$ ) and the total area surveyed in the reserve ( $n\pi r^2$  m<sup>2</sup>). Thus, using the total number of groups ( $g$ ) recorded in each forest reserve, the density of groups per m<sup>2</sup> was  $g/n\pi r^2$  and the number of groups per km<sup>2</sup> was calculated.

The Program DISTANCE as described by Buckland et al. (1993) and Laake et al. (1993) was used. For point counts, this program calculates the density of animals using the sighting/radial distances. According to Bibby et al. (1998), each point surveyed is regarded as a sample and the effort is the number of times the point was surveyed. Buckland et al. (1993) stated that often when distances are estimated, the observer tends to round to convenient values (heaping) and recommended that the analysis of such data can be improved by grouping the distance data taking the midpoints as the distance measurements for each observation. Following Buckland et al. (1993), we used midpoint distances as these also remove the zero distance in the unlikely event that a bird was observed on the point. The six bands (groupings) used were: 0–5, 6–15, 16–30, 31–50, 51–100, 101–200 m. Distance analysis using point count data requires sighting distance and the number of individuals for every group recorded. For groups whose individuals were not seen during our surveys, the mean group size for the forest in question was used. This technique (and the groupings) was used by Sande (2001).

## RESULTS

### Use of the number of groups per point and distance sampling analyses methods

The mean distance from the observer at which the birds responded was 73.14, 73.43 and 62.90m in Bugoma, Mabira, and Budongo, respectively. The density estimates using the number of groups per point and that using Distance sampling in each of the three forest reserves didn't differ ( $Z < 1.96$ ,  $P > 0.05$ , Table 1).

This shows that either method can be used to estimate density for the species and thus the number of groups per point method can be reliably be used to estimate density when the number of observation or sightings is less than 60. Therefore, the results presented in Tables 2, 3 and 4 were based on distance analysis method since the number of observations were more than 60. Results presented in Tables 5 and 6 however (comparisons among Mabira forest reserve's compartments) were based on the number of groups per point analysis method since the number of observations in study compartments were less than 60.

### Density and relative abundance of Nahan's Partridge

The density estimates using Distance analysis for the three reserves were 31.6, 25.2 and 13.3 groups per km<sup>2</sup> for Bugoma, Budongo, and Mabira, respectively (Table 2). Results show an increase of density in Uganda from 16.3 in 2003 to 23.4 groups per km<sup>2</sup> in 2017. The mean group size in the three reserves was not significantly different ( $F = 1.52$ ,  $df = 2, 124$ ,  $P = 0.21$ , One-way ANOVA). From 2002 to 2017, a period of 14 years, the total number of individuals of Nahan's Partridge in Uganda increased by 50% from about 40,000 to 60,000 (Table 3). Sande (2001) found that although the Nahan's Partridge breed throughout the year, the peaks of breeding were January to March, and then August to November. The survey by Fuller et al. (2004) was done from July to September while that for this study was done from November to January during the peak of the breeding season. Since our study was done in the breeding months, it is a good time to survey these birds. Call playback surveys are recommended as the most efficient survey method during the breeding season, especially for those species that are known to respond to call playback, occupy relatively large home ranges and/or are otherwise difficult to detect (Ministry of Environment, Lands & Parks (1999). The time when our study was done is therefore the best to get a good population estimate, and hence our results are reliable and not an over or under estimate.

Intra-reserve status analyses are required for monitoring of population changes within each reserve. Comparisons were done only for Budongo and Mabira where there was data from compartments with different management histories. In Budongo, the three compartments with different management histories (N15-Nature Reserve, N3-logged in logged 1947–52 and W21-logged in logged in 1963–64 and 1996–97) were surveyed in 1997 and 2017. In 2017, the mean group size from the three compartments was not



**Table 1. Density estimation (95%CI) for Bugoma, Budongo, and Mabira using Distance sampling and groups per point analyses.**

Forested area (km <sup>2</sup> )	Effort	n	MRD (+SE)	Grps/km <sup>2</sup>		Z value	Significance
				GPM	DSM		
Bugoma (300)	162	79	73.14 ±5.12	29.1 (20.6–33.6)	31.6 (19.3–51.7)	0.321	0.749
Budongo (428)	231	82	62.90±3.91	28.6 (25.3–32.5)	25.2 (13.4–47.5)	0.463	0.643
Mabira (204)	397	96	73.43 ±4.24	14.3 (12.9–16.3)	13.3 8.13–21.68)	0.190	0.849

MRD—Mean response Distance | GPM—Groups per point | DSM—Distance Sampling method.

**Table 2. Density estimates for Bugoma, Budongo, and Mabira.**

Forested area (km <sup>2</sup> )	Effort	n	Grps/ km <sup>2</sup> (95%CI) (2017)	Grps/ km <sup>2</sup> (2002)	Z value	Significance
Bugoma (300)	162	79	31.6 (19.3–51.7)	21.5	1.386	0.166
Budongo (428)	231	82	25.2 (13.4–47.5)	19.0	0.933	0.351
Mabira (204)	397	96	13.3 (8.13–21.68)	8.3	1.076	0.282
All the 3 reserves (Ugandan population)			23.4	16.3	1.127	0.260

**Table 3. Total no. of groups of Nahan's Partridge (95%CI) in Bugoma, Budongo, and Mabira for 2002 and 2017.**

Forested Area (km <sup>2</sup> )	Total no. of groups	Total no. of groups		Mean group size	Total no. of individuals	Total number of individuals	
		2002*	2017			2017	2002*
Bugoma (300)	9,480 (5790–15,510)	6,458	9,480	2.58±0.19	24,458 (14,938–40,015)	24,458	18,400
Budongo (428)	10,785 (5,735–20,330)	8,112	10,785	2.71±0.20	29,228 (15,541–55,094)	29,228	18,658
Mabira (204)	2,713 (1,658–4,422)	1,695	2,713	2.54±0.12	6,891 (4,211–11,231)	6,891	2,610
Total no. of groups in Uganda		16,265	22,978	Total no. of individuals in Uganda		60,577	39,668

\* Fuller et al. 2012

significantly different ( $F=1.64$ ,  $df=2$ ,  $17$ ,  $P=0.43$ , One-way ANOVA). The density was, however, significantly higher between N15 and N3 ( $Z=2.74$ ,  $P=0.006$ ) and also significantly higher between W21 and N3 ( $Z=3.25$ ,  $P=0.001$ ). The density in N15 and W21 was the similar ( $Z=0.53$ ,  $P=0.593$ ) (Table 4). With the current estimate of 10,000 groups and 30,000 individuals for Budongo, (Tables 3), the population of Nahan's Partridge in the reserve increased by 33% groups and by 57% individuals within 20 years. In two decades, (1997 to 2017), the density did not change significantly in N3 ( $Z=0.195$ ) but it doubled in N15 ( $Z=2.676$ ) and almost doubled in W21 ( $Z=2.284$ ) (Table 4).

Olupot & Isabirye-Basuta (2016) recommended among other things the assessment of the status of the Nahan's Partridge in the entire Mabira Forest Reserve and setting up of new tourism camps. We conducted our surveys in nine sites (Table 6). Using the number of groups per point method, the highest densities of Nahan's

Partridge were recorded in Wantuluntu (39.3 groups/km<sup>2</sup>) and lowest in the forest adjacent to the Buwoola enclave (2.0 groups/km<sup>2</sup>), which is predominantly a Mulberry forest (Table 5). The density was significantly higher in Wantuluntu compared to other sites ( $Z>2.58$ ,  $P<0.01$ ). There were no significant difference in the densities between the existing and proposed ecotourism sites and between proposed ecotourism sites and the nature reserve ( $Z<1.96$ ,  $P>0.05$ ) (Table 6).

## DISCUSSION

### Status of Nahan's Partridge population in Uganda

The study has established that the density of the globally Vulnerable Nahan's Partridge in Uganda increased from 16.3 to 23.4 groups per km<sup>2</sup> in 14 years. Over the years, the total number of groups of Nahan's Partridge in Uganda grew from 16,000 to 23,000 (44%).

Table 4. Density (95%CI) and number of groups (abundance) (95%CI) of Nahan's Partridge in Budongo in 2017 compared to 1997.

	N15	N3	W21
Mean response Distance	59.1±5.9	67.5±10.4	62.3±5.6
No. of responses	32.0	16.0	34.0
Sampling Effort	84.0	73.0	71.0
Density (Gps/km <sup>2</sup> ) (2017)	34.7 (28.7–42.9)	15.3 (21.4–11.5)	39.3 (33.1–47.4)
Density (Gps/km <sup>2</sup> ) (1997)	15.7	16.4	22.1
Z Value (2017 Vs 1997 density)	2.676 (P=0.007)	0.195 (P=0.845)	2.284 (P=0.022)
Total No. of groups (2017)	2,316 (1,915–2,859)	5,337 (4,007–7,458)	962 (810–1,162)
Total No. of groups (1997)*	751	6,051	450
Population change based on No. of groups	Tripled	No change	Doubled

\*Sande (2001)

Table 5. Status of Nahans Partridge in the existing and proposed ecotourism sites of Mabira.

	Points surveyed	No. of groups	Groups/km <sup>2</sup>
Wantuluntu	6	5	39.3
Nature Reserve (Namaganda)	113	44	18.4
Namusa Hill**	15	5	15.7
Kiwala Hill**	17	5	13.9
Lugala**	9	2	10.5
Najjembe*	85	19	10.5
Griffin*	46	9	9.2
Bugoma	38	7	8.7
Buwola (Mulberry)	23	1	2.0

\*—existing eco-tourism site | \*\*—proposed eco-tourism site

The population growth is attributed to the fact that the species inhabits only three remaining largest forest reserves (Mabira, Budongo, and Bugoma) which are protected by law. There is sustainable utilization of forest resources in the three forest reserves and the other 503 central forest reserves in Uganda. Human activities in the species habitat are allowed but fairly regulated by the Uganda National Forestry Authority (NFA).

Mabira, Budongo, and Bugoma, the three major forest reserves in Uganda, happen to be the only reserves in the country that harbor Nahan's Partridge. They have been zoned into nature reserves (20% of the forest is strictly protected), protection /buffer zone where low-impact uses are permitted (30%) and the production zone for controlled production of timber and other forest products (50%). Although these zones occur in theory, the situation on the ground is very different

because the communities utilize the zones the way they want in some reserves due to ineffective enforcement by NFA. Current forest destruction within and outside protected areas in Uganda is alarming. According to NFA (2018), forest cover across the country declined sharply from 24% (4,933,271ha) of land area in 1990 to less than 9% (1,956,664ha) in 2018 (<https://www.nfa.org.ug/index.php/12-nfa-news>).

The lowest density in Mabira can be explained by less favourable management forest practices compared to the other reserves. Our study observed that at the time of the survey, logging was very severe in Mabira Forest Reserve in particular, although the intensity was not quantified. It often involves use of tools such as power saws to cut or damage large mature trees and trees with prominent buttresses such as *Ficus exasperata* and *Alstonia boonei* (Image 1a,b), which are vital for nesting and roosting of Nahan's Partridge. Loss of such trees reduces the breeding and roosting micro-habitats of the species. Sande (2001) found that 91% (n=58) of breeding females nested in buttresses. Another tree species that is intensively being harvested in Mabira forest reserve is the wild rubber tree *Funtumia elastic* (Image 2a,b). We were reliably informed by locals that this tree is highly desired for making face-boards in house construction and sofa set chairs. Other than the timber harvesting, we encountered many charcoal burning spots in Mabira Forest Reserve; some with stumps being collected for burning, some covered with soil ready for burning, and others after burning and charcoal taken (Image 3a–c). The fact that Mabira Forest Reserve has up to 22 enclaves (villages) legally settled within the reserve makes it a fertile ground for forest encroachers compared to Budongo and Bugoma, which do not



Image 1. a—Logged *Ficus exasperata* (Mabira) | b—Logged *Alstonia boonei* (Bugoma). © Eric Sande

Table 6. Pair-wise comparison of density between the different compartments.

Pairs	Value 1	Value 2	Z-Value	P-Value
Wantuluntu vs Nature Reserve	39.3	18.4	2.751	0.006
Wantuluntu vs Namusa	39.3	15.7	3.182	0.001
Wantuluntu vs Kiwala	39.3	13.9	3.482	0.000
Wantuluntu vs Lugala	39.3	10.5	4.081	0.000
Wantuluntu vs Bugoma	39.3	8.7	4.416	0.000
Wantuluntu vs Najjembe*	39.3	10.5	4.081	0.000
Wantuluntu vs Griffin	39.3	9.2	4.322	0.000
Nature Reserve vs Namusa	18.4	15.7	0.462	0.644
Nature Reserve vs Kiwala**	18.4	13.9	0.791	0.429
Nature Reserve vs Lugala**	18.4	10.5	1.469	0.142
Nature Reserve vs Bugoma	18.4	8.7	1.863	0.062
Nature Reserve vs Najjembe*	18.4	10.5	1.469	0.142
Nature Reserve vs Griffin	18.4	9.2	1.751	0.080
Nature Reserve vs Namusa**	15.7	18.4	-0.462	0.644
Namusa** vs Kiwala**	15.7	13.9	0.330	0.741
Namusa** vs Lugala**	15.7	10.5	1.015	0.310
Namusa** vs Bugoma	15.7	8.7	1.417	0.156
Namusa** vs Najjembe*	15.7	10.5	1.015	0.310
Namusa** vs Griffin*	15.7	9.2	1.302	0.193
Kiwala** vs Bugoma	13.9	8.7	1.093	0.274
Lugala** vs Bugoma	10.5	8.7	0.410	0.681
Lugala** vs Najjembe*	10.5	10.5	0	1.000
Lugala** vs Griffin*	10.5	9.2	0.292	0.770
Kiwala** vs Lugala**	13.9	10.5	0.688	0.491
Kiwala** vs Najjembe*	13.9	10.5	0.688	0.491
Kiwala** vs Griffin*	13.9	9.2	0.977	0.328
Bugoma vs Najjembe*	8.7	10.5	-0.410	0.682
Bugoma vs Griffin*	8.7	9.2	-0.118	0.906
Najjembe vs Griffin*	10.5	9.2	0.292	0.770

have such settlements within the reserves. According to BirdLife International (2019a), Nahan's partridge is currently categorized as globally Vulnerable because its very small, severely fragmented global range is declining in the area of occupancy and in the extent and quality owing to deforestation and forest degradation. The high forest destruction of Mabira forest reserve is a significant contribution to this global decline of the species area of occupancy.

Fuller et al. (2004) indicated that around Mabira, Bugoma, and Budongo forest reserves, 54% and 30% of the respondents said that they hunt galliformes by hand and using nets, respectively. Netting is probably by far the more destructive of these two hunting techniques. Hunters string out nets and then drive ground animals towards them using dogs and by shouting and beating objects. During our survey on Bugoma Hill (Compartment 192 of Mabira), the informant (our local guide who himself also occasionally participates in hunting) informed us that forest management authorizes hunting in that compartment three days a week (Tuesdays, Thursdays and Saturdays), however, this is contradicted by NFA managers who insist that hunting is not authorized. Hunters can kill up to 30 duikers and six Nahan's Partridges in a single expedition. If this is true, extrapolating from the figures provided by the informant it would appear that one team of hunters can kill up to 18 Nahan's Partridge in a week. Such a level of off-take likely explains why the abundance of Nahan's Partridge in Mabira lower than in other reserves. Further detailed studies on the impact of hunting on the species need to be carried out in the three reserves.

#### Density and relative abundance of Nahan's Partridge in Budongo from 1997 to 2017

Sande (2001) and this study provide a good baseline assessment of the population status of the species after two decades and a prediction of the population of the species in the next 50 years if the conservation efforts currently being undertaken are maintained or improved. The tripling of the groups in 20 years in the Nature Reserve (N15) can be explained by two factors. Firstly, the relatively rapid population growth in the nature reserve is explained by the healthy breeding environment there. Our study has observed that Budongo's Nature Reserve (N15) still remains relatively intact. It is an Ironwood *Cynometra* forest which Eggeling (1947) suggested that this represents the climatic climax and a species poor forest type with *Cynometra alexandrii* dominating and forming 75% of the cover. *C. alexandrii* usually has extensive thin buttresses near the base that can be up

to 8m long and several metres high. Sande (2001) found that 91% of the Nahan's Partridge nested in buttresses and nest survival and nest success were higher in the unlogged Nature reserve than in the logged habitat with *C. alexandrii* being the most commonly used tree species for nesting. So a microhabitat with many large buttresses provides a good breeding environment for the species.

The second factor could be that fewer researchers and research assistants spend less time in the nature reserve compared N3. There is therefore a high human-Nahan's Partridge encounter rate in N3 compared to N15 and W21. This is because most of the research in Budongo is done on primates, especially Chimpanzees. The habituated groups of Chimpanzees spend most of the time in N3 (where Sonso, the Budongo Conservation Field Station is located) because fruiting trees, especially figs, are abundant there. The number of researchers and field assistants, and the amount of time they generally spend, are much less in N15 and W21 than in N3. Nahan's Partridges being very shy birds, their daily activity patterns particularly nesting are affected by human disturbance. According to Sande (2001), the survey from March 1998 to January 2000 reported that 43% of the nests ( $n=58$ ) were located 2m or less from the trail and 76% of these did not succeed probably due to disturbance. It is therefore probable that the relatively low research activity in N15 and W21 provides better nesting conditions for the birds. Thus the tripling of the number of groups in N15 can be explained by the buttress-rich environment provided by *C. alexandrii* and the less human-Nahan's encounter while only the latter explains the doubling of the population in W21. The high human-Nahan's encounter in N3 probably explains the no change over the years. The impact of researcher's activities on Nahan's Partridge's nest success and nest survival needs to however be further investigated.

#### Density of Nahan's Partridge in the proposed ecotourism sites

The highest density in Wantuluntu (39.3 groups per  $\text{km}^2$ ) should be interpreted with caution because of the small sample size (five sightings). When this site is excluded, the density of Nahan's Partridge was generally the same in all the sites (11 groups per  $\text{km}^2$ ). This was probably because of the high and increased incidence of human activities generally in all the sampling sites including what we noted in the strict nature reserve. Although sustainable utilization of natural resources is allowed in forest management in Uganda, areas gazzeted as strict nature reserves should be managed for





Image 2. Logged *Funtumia elastica* for face boards at Namaganda | a—and stumps freshly cut for making sofa sets at Kiwala | b—both from Mabira. © Eric Sande



Image 3. Charcoal burning: a—before covering with soil (Wantuluntu) | b—after covering with soil (Wantuluntu) | c—after burning (Kiwala) all from Mabira. © Eric Sande



Image 4. a—Good birding trails stretch in Kiwala near Nagojje ranger post (Mabira) | b—the Royal Mile (Budongo). © Eric Sande

the purpose they are set aside for particularly in Mabira. This will allow better assessments and predictions of the impact of forest disturbance and utilization on biodiversity.

Compared to Watuluntu and Namaganda areas,

Kiwala and Lugala (sites that Olupot & Isabirye-Basuta 2016 recommended for ecotourism development) did not do well in terms of Nahan's Partridge abundance. This was probably because of the high and increased incidence of human activities noted there, particularly





Image 5. Good birding trails along Namusa Hill: a—forest-grassland interface | b—swamp on Namusa Hill top. © Eric Sande



Image 6. a—Paper Mulberry forest in Mabira FR | b—understorey growth in the *Cynometra* (Bugoma). © Eric Sande

tree cutting for charcoal and fire wood. The two recommended sites are nonetheless good potential ecotourism sites that could be developed. Kiwala Hill Area was recommended because of a good landscape and camp site. In addition, it has an excellent hiking route (Image 4a) from the valley near Nagojje Ranger post to the sugarcane plantation that looks like the famous Royal mile of Budongo (Image 4b) which is believed to be one of the best places for forest bird watching in Uganda according to Rossouw & Sacchi (1998). Lugala on the other hand has a good forest and high potential for hiking route and camp site. Our survey in Lugala found that in addition, an excellent 2–3 km long birding trail along the forest boundary where the visitors would enjoy watching the forest edge birds, e.g., turacos and hornbills.

Namusa Hill is the third potential ecotourism site which could be developed. Our study found that because it has a good landscape appeal, good birding

trail of up to 5km, the hill top has a grassland meadow with a transitional grassland-forest interface (Image 5a) and a swamp at the top of the hill (Image 5b). The hill is therefore an excellent bird watching site where forest specialists, forest generalists, grassland birds and water birds can be seen.

#### Possible causes for the low abundance of Nahan's Partridge in *Broussonetia papyrifera* forest

Paper mulberry *Broussonetia papyrifera* is an exotic tree that has colonised a large degraded area in the eastern part of the forest. This is where the population of Nahan's Partridge was minimum. Fuller et al. (2004) also did not report occurrence of Nahan's Partridge in this habitat. As this is a monodominant *B. papyrifera* - dominated forest (Image 6a), the diversity of arthropods that are known to be one of the major food items for the species is low. The trees also do not have large buttresses that can provide nesting and roosting sites,

probably reducing breeding success. We suspect these are the likely reasons why the population in that particular forest type is low because we know that the species prefers forest types that have trees with large buttresses and a lot of undergrowth (Image 6b) that presumably has lots of arthropods and insect larvae.

## CONCLUSIONS

Results from this study show that the density of Nahan's Partridge (Image 7) increased by seven groups per km<sup>2</sup> in Uganda, while the total number of groups and total number of individuals increased by 44 and 50% respectively in the period of 14 years. The lowest density was noted in Mabira, where the level of forest disturbance and degradation was notably higher as the forest lies in the vicinity of highly-industrialized and populous Kampala City, Jinja, Lugazi, and Mukono municipalities, which are in dire need of forest products including bushmeat. The rampant exploitation is exacerbated by the apparent weak and limited law enforcement by NFA. There is, therefore, an urgent need to hasten conservation action in these only remaining forest reserves in Uganda that will save the 315, 225, 360 bird species and 30, 23, 24 mammal species in Mabira, Bugoma, and Budongo forests, respectively, many of which will undoubtedly disappear if the forests themselves disappear.

## RECOMMENDATIONS

1. Carry out a detailed study on impacts and mechanisms through which forest, use including hunting, affect Nahan's Partridge populations in Uganda
2. Stop or at least discourage hunting, particularly with nets as they over exploit and do not discriminate forest floor fauna according to target and non-target species and age groups
3. Assess the impact of research intensity on the nesting success of Nahan's Partridge in Budongo Forest Reserve.
4. NFA should ensure that the strict nature reserves within these forests are better managed to ensure that they are visited strictly for research and law enforcement.
5. As threatened primates and other biodiversity occur in the three forest reserves, including globally endangered chimpanzee in Budongo and Bugoma and the endemic Uganda Mangabey *Lophocebus albigena*



**Image 7. A pair of Nahan's Partridge roosting between buttresses of a large Cynometra tree stand in Budongo Forest. © Eric Sande**

*ugandae*, every effort should be made to strengthen conservation of the three reserves, including the possibility of having them gazetted as national parks.

## REFERENCES

- Bennun, L., C. Dranzoa & D. Pomeroy (1996). The forest birds of Kenya and Uganda. *Journal of the East African Natural History Society* 85(1): 23–48. [https://doi.org/10.2982/0012-8317\(1996\)85\[23:TFBOKA\]2.0.CO;2](https://doi.org/10.2982/0012-8317(1996)85[23:TFBOKA]2.0.CO;2)
- Bibby, C., M. Jones & S. Marsden (1998). *Expedition Field techniques. Bird Surveys*. Royal Geographical Society, 139pp.
- BirdLife International (2016). *Ptilopachus nahani*. The IUCN Red List of Threatened Species. . Downloaded on 29 December 2016.
- BirdLife International (2019a). Species factsheet: *Ptilopachus nahani*. Downloaded from <http://www.birdlife.org> on 02 January 2019.
- BirdLife International (2019b). Important Bird Areas factsheet: Mabira Forest Reserve. Downloaded from <http://www.birdlife.org> on 02 January 2019.
- BirdLife International (2019c). Important Bird Areas factsheet: Bugoma Central Forest Reserve. Downloaded from <http://www.birdlife.org> on 02 January 2019.
- BirdLife International (2019d). Important Bird Areas factsheet: Budongo Forest Reserve. Downloaded from <http://www.birdlife.org> on 02 January 2019.
- Buckland, S.T, D.R. Anderson, K.P. Burnham & J.L. Laake (1993). *Distance Sampling: Estimating Abundance of Biological Populations*. Chapman and Hall, London, 446pp. (available for free at <http://www.ruwpa.st-and.ac.uk/distance/>)
- Byaruhanga, A., P. Kasoma & D.E. Pomeroy (2001). *The Important Bird Areas in Uganda*. Nature Uganda, Kampala Uganda.
- Cohen, C., J.I. Wakeling, T.G. Mandiwana-Neudani, E. Sande, C. Dranzoa, T.M. Crowe & R.C.K. Bowie (2012). Phylogenetic affinities of evolutionarily enigmatic African Galliforms: the Stone Partridge *Ptilopachus Petrosus* and Nahan's Francolin *Francolinus Nahani*, and support for their sister relationship with new World quails. *Ibis* 154: 768–780.
- Collar, N.J., M.J. Crosby & A.J. Stattersfield (1994). *Birds to Watch 2: The World List of Threatened Birds*. Cambridge, UK: BirdLife International, 407pp.
- Crowe, T.M., R.C.K. Bowie, P. Bloomer, T.G. Mandiwana, T.A.J. Hedderson, E. Randi, S.L. Pereira & J. Wakeling (2006). Phylogenetics, biogeography and classification of, and character

- evolution in, gamebirds (Aves: Galliformes): effects of character exclusion, data partitioning and missing data. *Cladistics* 22: 495–532.
- Dranzoa, C., E. Sande, I. Owiunji & A.J. Plumptre (1999).** A survey of (Data Deficient - DD) Nahan's Francolin *Francolinus nahani* Dubois in two tropical rain forests in Uganda. *Bulletin of the African Bird Club* 2: 90–92.
- Eggeling, W. (1947).** Observations of the ecology of the Budongo rainforest, *Journal of Ecology* 34: 20–87.
- Fuller, R., P. Akite, J.B. Amuno, C. Flockhart, J.M. Ofwono, G. Proaktor & R. Ssemmanda (2004).** Recovery of the Nahan's francolin: decline of a globally threatened bird in the forests of central Uganda. Final Project Report, Durham, UK, 84pp.
- Fuller, R., P. Akite, J.B. Amuno, C. Flockhart, J.M. Ofwono, G. Proaktor & R. Ssemmanda (2012).** Using playback of vocalisations to survey the Nahan's francolin, a threatened African forest galliform. *OSTRICH* 83(1): 1–6.
- Gibbs, J.P. & S.M. Melvin (1993).** Call-response surveys for monitoring breeding waterbirds. *Journal of Wildlife Management* 57: 27–34.
- Glahn, J.F. (1974).** Studies of breeding rails with recorded calls in northcentral Colorado. *Wilson Bulletin* 86: 206–214.
- Howard, P.C. (1991).** *Nature conservation in Uganda's tropical forest reserves*. IUCN, Gland, Switzerland & Cambridge, UK, 330pp.
- Humle, T., F. Maisels, J.F. Oates, A. Plumptre & E.A. Williamson (2016).** *Pan troglodytes* (errata version published in 2018). *The IUCN Red List of Threatened Species* 2016: e.T15933A129038584. Downloaded on 05 August 2019. <https://doi.org/10.2305/IUCN.UK.2016-2.RLTS.T15933A17964454.en>
- Laake, J.L., S.T. Buckland, D.R. Anderson & K.P. Burnham (1993).** *DISTANCE user's Guide*. Colorado Co-operative Fish and Wildlife Research Unit, Colorado State University, Fort Collins, USA, 72pp.
- Marion, W. R., T.E. O'Meara & D.S. Maehr (1981).** Use of playback recordings in sampling elusive or secretive birds, pp 81–85. In: Ralph, C.J. & J.M. Scott (eds.). *Estimating numbers of terrestrial birds*. Studies in Avian Biology No. 6, 630pp.
- McGowan, P.J.K. (1994).** Phasianidae (Pheasants and Partridges), pp. 434–552. In: del Hoyo, J., A. Elliott & J. Sargatal (ed.) *Handbook of the Birds of the World*. Lynx Edicions, Barcelona, Spain.
- McGowan, P.J.K., S.D. Dowell, J.P. Carroll & N.J. Aebischer (1995).** Partridges, Quails, Francolins, Snowcocks and Guineafowl: Status Survey and Conservation Action Plan 1995–1999. Gland, Switzerland, 100pp.
- Ministry of Environment, Lands & Parks (1999).** Inventory Methods for Woodpeckers. Standards for Components of British Columbia's Biodiversity No. 19. The Province of British Columbia Resources Inventory Committee, 63pp. Available on: <http://www.for.gov.bc.ca/ric>
- Ministry of Water and Environment (2010).** Forest Management plan for Mabira Central Forest Reserves (Mabira, Nadagi, Namakupa, Namawanyii/Namananga & Kalagala Falls Central Forest Reserves) for the period 1st July 2009–30th June 2019, Ministry of Water and Environment, Kampala.
- Mrema, M., D. Wafula & H. Agaba (2001).** Livelihood strategies and the use of forest and tree products in Mabira buffer zone. Kabale: Agroforestry Programme FORRI/ICRAF Collaborative project, 2001.
- Olupot, W. (2015).** Mapping tourism values of Mabira Central Forest Reserve: an activity report of the project on “Strengthening the conservation of Mabira Central Forest Reserve” funded by the MacArthur Foundation. Nature and Livelihoods Technical Report, Kampala.
- Olupot, W. & G. Isabirye-Basuta (2016).** Influencing SEPLS governance policy through action research: an assessment of recreational values to promote sustainable use of the Mabira Central Forest Reserve, Uganda, pp. 59–70. In: Chapter 6, UNU-IAS and IGES (eds.) 2016, Mainstreaming concepts and approaches of socio-ecological production landscapes and seascapes into policy and decision-making (Satoyama Initiative Thematic Review vol. 2), United Nations University Institute for the Advanced Study of Sustainability, Tokyo, 95pp.
- Rossouw, J. & M. Sacchi (1998).** *Where to watch birds in Uganda*. Uganda Tourist Board, Kampala, 110pp.
- Sande, E. (2001).** The ecology of the Nahan's Francolin *Francolinus nahani* in Budongo Forest Reserve, Uganda. PhD Thesis. Makerere University, Kampala, 168pp.
- Sande E, C. Dranzoa & P. Wegge (2001).** Population density of the Nahan's Francolin *Francolinus nahani* in Budongo Forest Reserve, Uganda. *Ostrich* 15: 33–37.
- Westman, W.E., L.L. Strong & B.A. Wilcox (1989).** Tropical deforestation and species endangerment: the role of remote sensing. *Landscape Ecology* 3: 97–109.

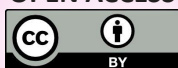






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## Articles

**Status of Nahan's Partridge *Ptilopachus nahani* (Dubois, 1905) (Aves: Galliformes: Odontophoridae) in Uganda**

– Eric Sande, Sisiria Akoth, Ubaldo Rutazaana & William Olupot, Pp. 17063–17076

**Fish diversity in streams/rivers of Kalakad-Mundanthurai Tiger Reserve, Tamil Nadu, India**

– K. Kannan & J.A. Johnson, Pp. 17077–17092

**Gastrointestinal helminth and protozoan infections of wild mammals in four major national parks in Sri Lanka**

– Chandima Sarani Sepalage & Rupika Subashini Rajakaruna, Pp. 17093–17104

## Review

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

– Muntasir Akash & Tania Zakir, Pp. 17105–17120

## Communications

**Diversity of scorpions (Arachnida: Scorpiones) in Polonnaruwa Archaeological Reserve, Sri Lanka**

– Kumudu B. Wijesooriya, Lakshani S. Weerasekara & Kithsiri B. Ranawana, Pp. 17121–17128

**A faunistic survey of tiger beetles (Coleoptera: Carabidae: Cicindelinae) in Chakrashila Wildlife Sanctuary and adjoining riverine ecosystem in Assam, India**

– Kushal Choudhury, Chandan Das & Amar Deep Soren, Pp. 17129–17137

**Occurrence of the *Aporrectodea caliginosa caliginosa* (Savigny, 1826) (Annelida: Clitellata: Haplotaxida) from Kashmir Valley, Jammu & Kashmir, India**

– Ishtiyag Ahmed Najjar, Anisa B. Khan & Abdul Hai, Pp. 17138–17146

## Short Communications

**Avian congregation sites in the Gulf of Kachchh, Gujarat, India**

– Jigar D. Joshi, Sandeep B. Munjpara, Kinjal Joshi, Harshad Salvi & R.D. Kamboj, Pp. 17147–17152

**Checklist of brachyuran mangrove crabs of Kerala, India**

– Kurian Mathew Abraham & Apreshgi Kolothuthara Prakasan, Pp. 17153–17160

## Notes

**A new country record of Smooth-backed Gliding Gecko *Gekko lionotum* (Annandale, 1905) (Squamata: Gekkonidae) from Bangladesh**

– M. Rashedul Kabir Bhuiyan, M. Fazle Rabbe, Mohammad Firoj Jaman, Ananda Kumar Das & Samiul Mohsanin, Pp. 17161–17164

***Amblyomma gervaisi* (Ixodida: Ixodidae: Amblyomma) infestation in a Rat Snake from northwestern Himalayan region: a case study**

– Aman D. Moudgil, Ankur Sharma, Adarsh Kumar, Amit Singla & Surender Bansal, Pp. 17165–17167

**Parasitic enteritis in the free-ranging Common Myna *Acridotheres tristis* (Aves: Passeriformes: Sturnidae)**

– Rakesh Kumar, Aman Dev Moudgil, Sameeksha Koundal, Rajendra Damu Patil & Rajesh Kumar Asrani, Pp. 17168–17170

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