Recovery of the Nahan's francolin

Decline of a globally threatened bird in the forests of central Uganda

June - September 2003

Richard Fuller, Perpetra Akite, John Bosco Amuno, Claire Flockhart, John Martin Ofwono, Gil Proaktor & Richard Ssemmanda

WORLD PHEASANT ASSOCIATION

Final project report: Durham, UK, March 2004

Partridge, Quail and Francolin IUCN Specialist Group

BirdLife INTERNATIONAL

WILDLIFE CONSERVATION SOCIETY

bp

CONSERVATION INTERNATIONAL

FAUNA & FLORA International
Conserving wildlife since 1903

the bp conservation programme

Table of contents

Acknowledgements 5

EXECUTIVE SUMMARY 7

1. Background & Introduction 8

1.1 Threatened habitats: African forests 8

1.2 Threatened species: the Nahan's francolin 9

1.3 Background to this project 10

1.4 Current status of the original project objectives 12
1.4.1 To estimate Nahan's francolin population densities in Mabira and Bugoma Forests 13
1.4.2 To design a francolin monitoring programme at Bugoma, Mabira & Budongo Forests, and put in place specific arrangements for future monitoring surveys 13
1.4.3 To determine whether and how hunting is affecting francolin populations, and place this in the context of local bushmeat harvesting 13
1.4.4 To assist in preparing new and existing information on ecology and distribution for publication 14
1.4.5 To collect samples from any trapped birds for future genetic analysis 14
1.4.6 To produce a recovery plan identifying management requirements in key protected areas 14

2. Density and population estimates for the Nahan's francolin in Uganda 15

2.1 Introduction 15

2.1.1 Scope of survey work 15
2.1.2 Playback surveys 16

2.2 Methods 17
2.2.1 Playback surveys 17
2.2.2 Estimating the density of francolin groups 19

2.3 Results 19
2.3.1 Responses by francolins 19
2.3.2 Distances travelled by groups between plays 21
2.3.3 Group size 23
2.3.4 Density analyses 24

2.4 Discussion 26
2.4.1 Population densities in Budongo, Bugoma and Mabira forests 26
2.4.2 Methodological considerations 28
2.4.3 Where next? 29

3. Habitat selection by Nahan's francolin 30

3.1 Introduction 30

3.2 Methods 31
3.2.1 Broad habitat classification 31
3.2.2 Habitat structure 33
3.2.3 Active logging 37
3.2.4 Presence of potential food items 38

3.3 Results 38
3.3.1 Habitat type 38
3.3.1.1 Elevation 39
3.3.1.2 Forest structure 41
3.3.2 Detailed habitat measurements 41
3.3.2.1 Forest structure 42
3.3.2.2 Tree density and size 43
3.3.2.3 Presence of potential food items 43
3.3.2.4 Characteristics of buttressed trees 44
3.3.2.5 Active logging 44
3.3.3 Anecdotal observations of habitat destruction and degradation 45

3.4 Discussion 47

4. Hunting of forest Galliformes 50

4.1 Introduction 50

4.2 Methods 51

4.3 Results 52
4.3.1 Frequency of hunting 53
4.3.2 Time of day 53
4.3.3 Location of hunting and movement while hunting 54
4.3.4 Methods of hunting 55
4.3.5 Use of hunted Galliformes 57
4.3.6 Reliance on hunting 58

4.4 Discussion 59

5. Research and management plan for the Nahan's francolin in Uganda 61

5.1 Introduction 61

5.2 Research priorities 61
5.2.1 Surveys for Nahan's francolin in eastern Democratic Republic of The Congo 62
5.2.2 Surveys in Uganda 63
5.2.3 Conservation-relevant research 64
5.2.4 Saving the Mabira population 65
5.2.5 Monitoring the populations 66

5.3 Management priorities 67
5.3.1 Declare Bugoma forest an Important Bird Area 67
5.3.2 Enforce government forestry policy in Mabira 68
5.3.3 Provide alternative incomes for people illegally taking

forest resources 69
5.3.4 Provide a reliable public viewing station for Nahan's francolin 70

6. Current activities 72

6.1 Surveys in the Democratic Republic of The Congo 72

6.2 Further surveys in Uganda 72

6.3 Scoping of community-based project and research work in Mabira 73
6.3.1 MAFICO concept paper 74

7. Appendix: Project outputs so far 77

7.1 Poster presented at International Galliformes Symposium 78

7.2 Text that appeared in BP Conservation Programme newsletter 79

Acknowledgements

This work was funded by a BP conservation silver award. We would like to warmly thank Marianne Dunn, Kate Stokes and Robyn Dalzen at the BP Conservation Programme secretariat for the friendly and efficient way in which they supported this project. Also to the entire team involved in the training workshop held at the Smithsonian Conservation Research Centre, Virginia, in June 2003.

Philip McGowan was instrumental in facilitating the early stages of this work, and helped decide on Nahan's francolin as a priority species in a global context. He has long been active in galliformes conservation work, and his energy and enthusiasm appear to be boundless! We also thank the World Pheasant Association and John Carroll of the Partridge, Quail and Francolin Specialist Group for their continued support for this project. We are also extremely grateful to Derek Pomeroy and Christine Dranzoa at Makerere University, who made it possible for this work to turn from an idea into reality. They made us feel at home in Uganda, provided invaluable support and advice, and found a first rate group of young Ugandan scientists to work on the project.

Many thanks to Panta Kasoma and the Makerere University Institute for Environmental Resources for allowing us to rent a vehicle for our fieldwork. Our work would have been impossible without this assistance.

During the fieldwork phase of the project, we were supported by countless people, not least those in rural villages around the forest reserves. We are very grateful for the warm welcome we received in all these villages and the many chairmen and local councillors that we met along the way. Fred Babweteera welcomed us to the Budongo Forest Project, and made our stay there very enjoyable. For their help during fieldwork we would particularly like to thank Tinker Israel and Geoffrey Okethuwengu. Tinker was a natural "people person", and had the diplomatic skills necessary to win people's confidence and explain exactly what these strange people were doing with the birds. Geoffrey, the "human GPS", was an accomplished field person, and he got us out of many a scrape in the forest, and always managed to navigate home when the rest of us were completely lost. We wholeheartedly thank Fazira, who cooked us gorgeous meals at Mabira, that even kept us going long after we had left Mukono.

We would also like to thank Robert Kungujje and other members of the MAFICO central steering committee, who warmly welcomed us to Mabira Forest. They took a great deal of time to patiently explain to us the background to forest use in Mabira, and helped us understand the causes of some of the problems there. We look forward to working with MAFICO again in the future.

The British Airways Communities and Conservation programme enabled Richard Fuller to return to Uganda in March 2004, and we are very grateful for their ongoing support for conservation work through the World Pheasant Association. We would like to thank the Uganda Wildlife Authority, the Forest Department, and the Uganda National Council for Science and Technology for granting us permission to work within protected areas in Uganda.

The project team outside the Budongo Forest Project building. From left to right Gil Proaktor, Tinker Israel, John Ofwono, Richard Fuller, Claire Flockhart, Perpetra Akite & Richard Ssemmanda. Left inset, Geoffrey Okethuwengu. Right inset, John Bosco Amuno.

Executive Summary

- We are losing biodiversity at an alarming rate. Habitat change and direct exploitation by man are among the most important reasons for the current extinction crisis. African forest wildlife is particularly affected by these problems.
- We studied one of the jewels in Uganda's biodiversity crown, and world's most threatened birds, the Nahan's francolin *Francolinus nahani*. A forest-specialist ground-dwelling partridge, this bird is now found globally in less than 10 forest fragments in Uganda and DRC, and has recently been identified as a global priority for conservation.
- We estimate that there are approximately 23,000 groups of Nahan's francolin remaining in Uganda. In comparison with previous survey data from the late 1990's, our data suggest that the Budongo population has remained stable, although the Mabira population appears to be heading for extinction in the medium term. We estimate that over 1,200 groups have been lost from Mabira since the mid-1970s because of habitat loss, and only 2,500 groups are left today.
- We found that francolins preferred forested habitat with a tall, dense canopy, full understorey and sparse ground vegetation. Modification of forest structure by logging appears to have already affected the distribution of the francolin, with birds being gradually forced into remaining suitable habitat in the forests. This underlines the urgent need for action to prevent further habitat destruction.
- We interviewed over 200 people that regularly hunt forest birds and other wildlife. Although some could recognise the bird, few caught it on a regular basis. We therefore conclude that hunting does not pose a significant threat to the survival of francolin populations.
- We identify Mabira Forest Reserve as an important priority for the future conservation of Nahan’s francolin. Furthermore, efforts to install a conservation NGO in the communities surrounding the reserve have been hampered by financial shortages. We are currently seeking funding for further conservation work in Mabira Forest.

1. Introduction

1.1 Threatened habitats: African forests

Within the last few thousand years, African forested habitats have declined drastically in area and become heavily fragmented largely as a result of human influence (figure 1.1). The situation is particularly serious in Uganda. In 1900, about 45% of the country was forested, but this had declined to only 4.5% by the end of that century (National Environment Management Authority 1998a). Owing to improved economic and political stability, rates of deforestation appear to have stabilised, and it is now vital that the remaining forest patches are conserved effectively (Howard et al. 1997). The Ugandan Forest Act has just been revised, and there is evidence of substantial political will that must be harnessed for conservation by close collaboration between the scientific community and the Ugandan government (National Environment Management Authority 2001). Because of this severe past forest fragmentation, monitoring of the conservation status of Uganda's forest birds is extremely important in the wider context of understanding the effects of forest loss on natural populations.

The main threat to forested habitats in Uganda is the near-total dependence of rural communities on wood for its energy needs. Demand for fuelwood appears to exceed supply by about 17% (World Bank 1986), so there is continuing intense pressure on forest and woodland habitats. Mabira and Bugoma forest reserves are surrounded by agricultural settlements, industrial development and urban areas (Dranzoa et al. 1999), and removal of wood for charcoal burning is rife.

As well as directly affecting biodiversity, the opening up of habitats through logging and other commercial activites has also allowed an influx of hunters. Central and East Africa are particularly badly hit. For example, the entire Congo basin has been severly affected by the recent rise in bushmeat harvesting. Some indigenous peoples have sustainably hunted this bushmeat for centuries, but the level of hunting has skyrocketed in the past two decades. Today, species ranging from cane rats to elephants are being hunted at unprecedented levels, and recent estimates suggest a bushmeat harvest of between 1 million and 5 million metric tonnes each year (Clarke 2003). This general level of harvesting appears to be unsustainable.

Uganda contains six of the twelve major centres of plant endemism in tropical Africa. Each of these centres comprises a distinctive set of higher plants, and corresponding animal habitats (White 1983). For its size, Uganda is one of the most biodiverse countries in the world. The continued study and protection of these unique habitats is central to the conservation of biodiversity in Uganda, and this project aims to make a contribution to this wider effort.

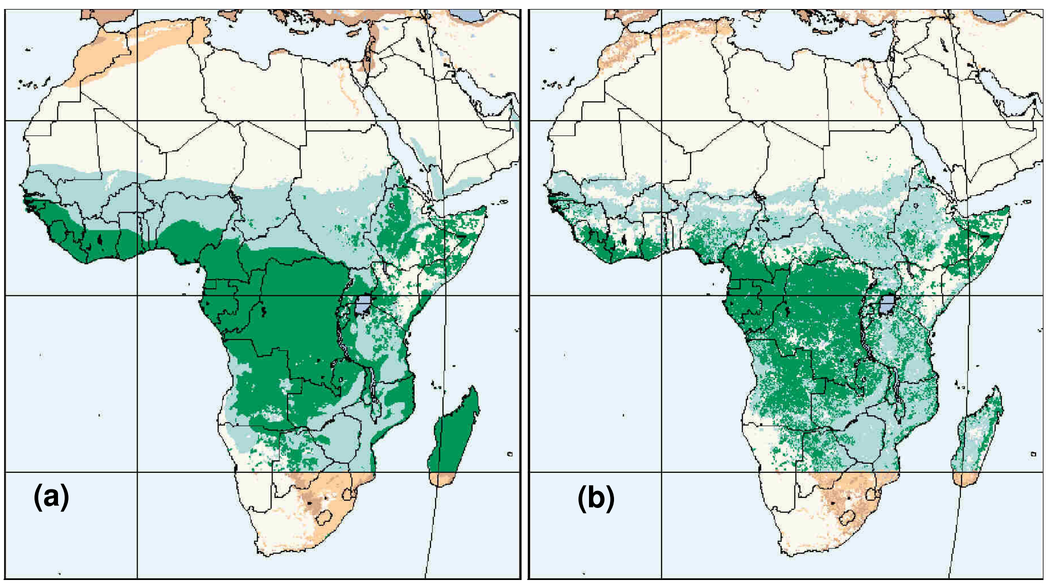


Figure 1.1 Forested habitats in Africa (a) 8000 years ago and (b) currently. There has been a steep decline in total forest area, and a dramatic increase in fragmentation, particularly in eastern Africa in Mozambique, Tanzania, Uganda, Kenya and Ethiopia.

1.2 Threatened species: the Nahan's francolin

The Nahan's francolin is listed as globally Endangered (Hilton-Taylor 2000). This means it faces a high risk of extinction in the near future. Globally it occurs in less than 10 forest fragments in eastern Democratic Republic of The Congo and western Uganda. Restricted to the Guinea-Congo forests biome, it occurs in only two Important Bird Areas (IBAs) in Uganda (Fishpool & Evans 2001). Ugandan sites for the francolin are under severe pressure from disturbance; hunting is known to occur, but its impact on francolin populations is currently unknown. The Nahan's francolin appears to be a strict forest specialist (Bennun et al. 1996), inhabiting closed forest up to 1400m (Dranzoa et al. 1999), but its tolerance of degraded and secondary habitats is poorly known. In fact, until a recent study by Sande (2001), the species was listed as Data Deficient by IUCN (Collar et al. 1994; McGowan et al. 1995).

Working in Budongo Forest reserve in the late 1990s, Eric Sande refined methods for capturing and surveying the species, and using radio-telemetry found that the birds live in groups ranging over about 14 hectares, although they ranged more widely in primary forest than in secondary forest. Groups were larger in unlogged than in logged forest, and breeding success was also affected by logging (Sande 2001). The francolins tended to occur in groups of about 2.2 birds, and bird distributions were strongly affected by habitat. He estimated the total population of Nahan's francolin in Budongo Forest to be about 5000-7,000 groups comprising 10,000-15,000 individuals. The geographic range of Nahan's francolin is continuously declining throughout its current highly fragmented global distribution. This is thought to be largely due to loss of habitat through logging and clearance of forest for charcoal burning. However, a better understanding of the causes of this decline is urgently required for designing effective long-term conservation measures for this species (Fuller et al. 2000).

1.3 Background to this project

Our work is designed to address recently-identified conservation targets for the Nahan's francolin directly (Fuller et al. 2000). These targets have been internationally agreed by experts working on this and other species in the region, and as such represent the most urgent and feasible actions required to prevent further declines in this species. The fieldwork component of the project examines the relationship between francolin population densities and habitat type, disturbance and hunting levels. Ugandan students from Makerere University in Kampala formed the majority of the project team.

Focusing on the clear set of targets laid out in two recent global assessments of the threat status of birds (BirdLife International 2000, Fuller et al. 2000), our work has provided estimates of population densities in all Ugandan sites for this species, determined how hunting is affecting populations, and identifed management requirements in the key sites. Based on methods pioneered by Eric Sande (now based at NatureUganda), who carried out his PhD research at Budongo Forest Reserve, we collected data on population densities in relation to habitat type, disturbance and hunting levels. Monitoring of populations of threatened species is crucial in their long term conservation (Fuller et al. 2003). Because we used a similar methodology to that of Eric Sande, we provide direct monitoring information on how francolin populations have changed in the 5 years since that work took place. We have also put in place specific arrangements for a further cycle of monitoring to take place in 2008. We will eventually build up a very valuable long term dataset, allowing us to detect changes in francolin populations, and assess whether particular conservation strategies are helping to prevent further decline.

The fieldwork component of this project concentrated on the three remaining known localities for the Nahan's francolin in Uganda, namely Budongo, Bugoma and Mabira Forest Reserves (Fuller et al. 2000). The locations of the study sites together with co-ordinates are given in figure 1.2. These reserves contain medium to high altitude moist semi-deciduous forest affected in many parts by selective logging, and in Mabira Forest Reserve by intense human disturbance. The six main forests types are colonising, mixed, *Cynometra*, *Cynometra*-mixed, Maesopsis mixed and swamp-forest (Fishpool & Evans 2001). Budongo forest reserve has been sustainably managed using a forest compartment system (some compartments are logged and others are maintained as nature reserves) since the 1930s (Plumptre et al. 1997). A detailed description of the logging history of the whole forest has been published (Plumptre 1996), complete with the area of each compartment, date logged, volume of timber removed per hectare, and volume of mahogany wood removed per hectare. As the forest compartments are fully mapped, we will eventually be able to investigate long term effects of habitat change on population densities and other population properties of Nahan's francolin, as well as investigate recolonisation of recovering compartments.

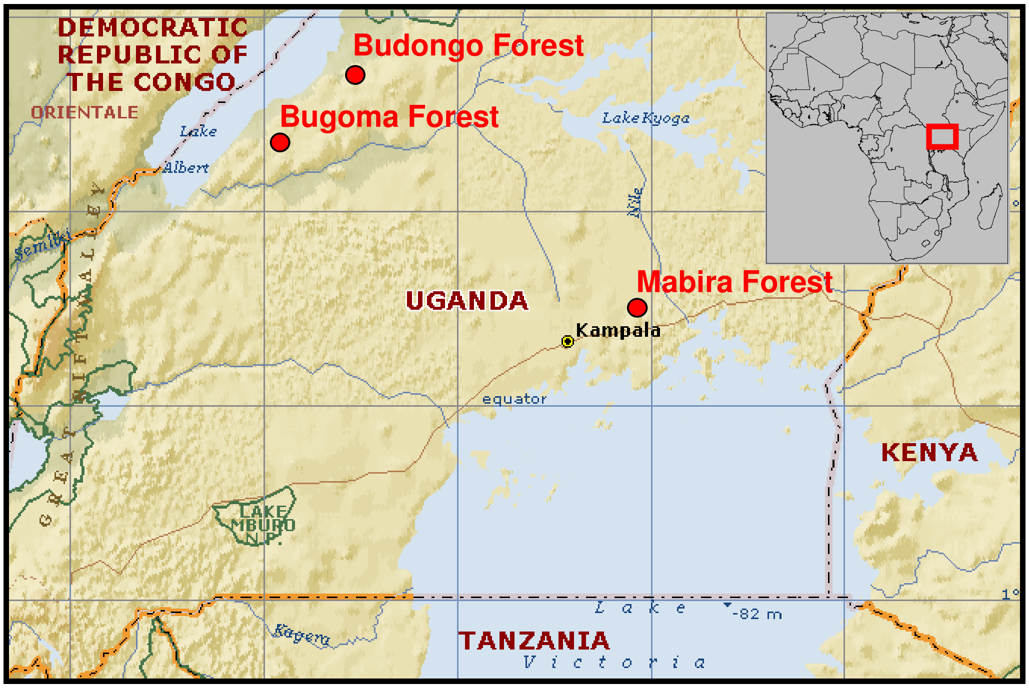


Figure 1.2 Locations of the three study sites: Budongo Forest (1°47'N, 31°35'E), Bugoma Forest (1°20'N, 31°05'E) and Mabira Forest (0°30'N, 32°57'E). These are the only sites for the Nahan's francolin in Uganda. The handful of other sites in the world are in neighbouring Democratic Republic of The Congo.

1.4 Current status of the original project objectives

This project began with six specific objectives. The purpose of this report is to show how each of these objectives has been addressed by our work, and in some cases to outline current and ongoing activities designed to ensure that they are all eventually fully achieved. Some of the project objectives were designed to answer specific biological questions, and these have all been fully achieved through the fieldwork phase of the project. Others are longer term objectives, and this document provides evidence of current progress of each of them.

1.4.1. To estimate Nahan's francolin population densities in Mabira and Bugoma Forests

See chapter 2 for a detailed discussion of the current population status of Nahan's francolin in Mabira and Bugoma Forests. The chapter also provides new information essential for refining the methodology associated with using playback surveys for this and other galliforme birds. We will be developing this analysis further and submitting the results to a scientific journal for publication. Chapter 3 gives the results of detailed studies on habitat use by the francolins within each of the forests we studied.

1.4.2. To design a francolin monitoring programme at Bugoma, Mabira & Budongo Forests, and put in place specific arrangements for future monitoring surveys

We conducted extensive surveys in Budongo Forest (see chapter 2), which for the first time provides monitoring data for this species. Budongo was surveyed in the late 1990s, and chapter 2 gives a comparison of these earlier population estimates with those obtained by this project. Specific arrangements are now in place for continued monitoring of this species across its global range, and we anticipate monitoring the population every 10 years (chapter 5).

1.4.3. To determine whether and how hunting is affecting francolin populations, and place this in the context of local bushmeat harvesting

We interviewed over 200 people who regularly hunt birds in the three forests we visited. Some preliminary results of this work in relation to general patterns of bushmeat harvesting are reported in chapter 4. We will be developing this analysis further and submitting the results to a scientific journal for publication.

1.4.4 To assist in preparing new and existing information on ecology and distribution for publication

A follow-up visit to Uganda has resulted in concrete plans for publication of further material about this species, and key players will be meeting at the Pan-African Ornithological Congress in November 2004 to progress this further. Results from the current project will be presented by Richard Ssemmanda, Richard Fuller & Claire Flockhart at the 8th International Galliformes Symposium in India in April 2004. See Appendix for a copy of the poster.

1.4.5 To collect samples from any trapped birds for future genetic analysis

No birds were trapped during the study, so samples could not be taken. However, samples collected as part of a previous study are currently being sent from Uganda to South Africa to be used for phylogenetic analysis. This analysis hopes to clarify the taxonomic position of the Nahan's francolin, which may turn out to be only distantly related to other African galliformes, and hence of even greater conservation value than is currently realised.

1.4.6 To produce a recovery plan identifying management requirements in key protected areas

Combined with previous work, we have used the results of this study to suggest a research and recovery plan with five major components. This has been sent to all interested parties and will form the basis of work on this species for the next 10 years. See chapter 5 for a draft copy of the plan, and information on key players.

2. Density and population estimates for the Nahan's francolin in Uganda

2.1 Introduction

Surveys to estimate the population size and density are of crucial importance in the conservation of threatened species, and surveys are among the first actions required to understand the likelihood of any given species' extinction (IUCN 1994, Fuller et al. 2000). Because, by definition, globally threatened birds are rare, there are relatively few comprehensive surveys concentrating on threatened species; most information on distribution and abundance come from well-known species in Europe and North America. There are even fewer examples of long term monitoring data involving threatened tropical forest birds. We present current population density data on the Nahan's francolin in Uganda that includes a comparison with surveys conducted five years ago.

An intensive study in five compartments of Budongo Forest Reserve conducted during 1998-1999 estimated that the average density of Nahan's francolin groups was 15.37 ± 1.70 per km^2 and the average density of individuals as 32.12 ± 3.59 per km^2 (Sande 2001). This translated into a population estimate for the entire protected area of 6,578 groups, and Sande suggested that the overall population of Budongo Forest Reserve lay somewhere between 5,000 and 7,000 groups comprising 10,000-15,000 individuals. Given that habitat destruction is continuing apace in many Ugandan forests (Flüshöh 2002), it is essential to monitor populations to allow any changes to be identified and appropriate action taken before populations are lost completely.

2.1.1 Scope of survey work

The Nahan's francolin is confirmed from only three sites in Uganda, namely Budongo, Bugoma and Mabira forests (Fuller et al. 2000). There are persistent reports by competent birdwatchers of the bird from Kibale Forest

(Byaruhanga pers comm.), although playback surveys in a fairly limited area of the reserve have failed to locate the species there (Dranzoa et al. 1999). Further playback surveys in Kibale that will cover the whole forest are currently being planned (see chapter 6). Given that we already have a robust population estimate for Budongo Forest, the aim of this study was to provide the first piece of monitoring information on Nahan's francolin in that reserve. Bugoma forest has never been systematically surveyed for the species, so here we provide completely new information. Only in the last few years has it become safe to work in Bugoma, as, being close to the border with the Democratic Republic of Congo, the area has been subject to rebel activity in recent years.

While Budongo and Bugoma forests are relatively well protected, Mabira forest is under intense pressure from human populations living in and around the forest (Naidoo 2004; Naidoo in press), and there is some evidence that the population densities of Nahan's francolin in Mabira are lower than in the other forests (Dranzoa et al. 1999), although the forest has not yet been surveyed extensively. Given that Mabira forest could harbour the most threatened Ugandan population of Nahan's francolin, extensive surveys across the entire reserve are urgently required to provide an assessment of the relative size of that population and to provide a baseline for monitoring. Without specific data pointing to decline, conservationists will have difficulty in demonstrating to decision-makers that action is required.

2.1.2 Playback surveys

Nahan's francolins rarely call in natural situations, and birdwatchers have long known that the only reliable way to observe the bird is play a recording of its call, and attempt to attract the birds out of thick forest vegetation (Rossouw & Sacchi 1998). Playback surveys have been widely used to determine the presence of elusive birds (Glahn 1974, Marion et al. 1981, Gibbs & Melvin 1993). Although playack surveys often detect more birds than conventional surveys (Sliwa & Sherry 1992) and have been used to study globally threatened species (Njoroge & Bennun 2000, Carroll & Hoogestein 1995), there are significant methodological problems associated with using the technique to estimate population densities (Legare et al. 1999, Sliwa & Sherry 1992). The proportion of birds that respond to the stimulus must be known to allow the results to be calibrated, and movement toward the stimulus is a common feature of many playback surveys, potentially resulting in overestimation of animal densities (Lefare et al. 1999). It is especially important that overestimation is avoided when we are dealing with globally threatened species, so this study aimed to investigate movement toward the stimulus by Nahan's francolin during playback surveys and factor this into the density estimates.

Playback surveys have been used several times to survey for Nahan's francolins (Plumptre 1996, Dranzoa et al. 1997, Sande 2001), and Sande (2001) indicated that Nahan's francolin groups did indeed move toward the observer during playback surveys. However, no study on this species has yet investigated or corrected for possible biases generated by this movement. Here, we use repeated playbacks to estimate the rate of movement of birds towards the stimulus to at least partly address this question.

This chapter provides density estimates of Nahan's francolin in Budongo, Bugoma and Mabira forests, and translates these into population estimates covering the entire Ugandan range of the species. It also provides new information on methological problems associated with surveying forest birds using the playback technique.

2.2 Methods

2.2.1 Playback surveys

We walked transects of varying length through the forest reserves. Following Sande (2001), we conducted playback surveys at points spaced at least 200 m apart along the transects. Direct distances between points were measured using a handheld GPS receiver rather than distance along the walked transect. At each point, the advertising call of the Nahan's francolin was played using a Marantz PD222 tape recorder and Sony battery-powered 10W speakers. The tape of the advertising calls was complied using a combination of recordings 51908 and 51909 recorded by E Sande and A Plumptre/I Owiunji respectively and held by the British Library of Wildlife Sounds (96 Euston Road, London, NW1 2DB, UK). The call was played for 10 seconds, and any response noted in the ensuing 60 seconds. This process was repeated twice, to give a total of three successive playbacks. The distance to calling group, the playback after which it responded, and the delay between the playback and the response were noted for each group. Distances were estimated to the nearest 10 m in the field. If a response was elicited by any one of the first three playbacks, a further two playbacks were conducted to facilitate modelling of the movement of birds toward the stimulus. Data from these additional playbacks were not used in density estimation.

All playback surveys were conducted between 0700 h and 1300 h, as Nahan's francolin calling activity appears to be stronger during this period than in the afternoon (Sande 2001). In the case of rain, we stopped surveying and waited until the rainfall had ceased. In Budongo and Mabira Forests, transects were walked entirely along existing trails in the forest. The reasons for this were threefold. Firstly, we wanted to minimise the impact of our work, and opening up new trails through the forest would have caused environmental damage as well as opened up the areas for hunters, loggers etc to enter the forest. Secondly, cutting our own path through the forest would have made a lot of noise, and probably seriously affected the results of the survey if birds were repelled from the transect area. Thirdly, cutting trails is time-consuming and would have severely reduced our sample sizes and the comprehensiveness of our survey work.

In Bugoma Forest, we used a combination of existing trails and trails cut by a research group that had been in the forest several weeks before we arrived. We termed these "random trails". These trails were straight and cut along predetermined compass directions into the forest, thereby providing a much more randomised sample of the forest than existing trails. This also gave us the opportunity to compare the density of francolins around random trails with that around existing trails, allowing us to estimate the amount of bias caused by using existing trails through the forest.

2.2.2 Estimating the density of francolin groups

Data were analysed using the DISTANCE computer software. Because francolin groups responding to playbacks along random trails were significantly closer to the stimulus than existing trail responses ($t = 2.405$, $df = 46.197$, $p = 0.020$), trail type was included as a covariate in the density estimate. This necessitated the use of the Multiple Covariates Distance Sampling method with the DISTANCE program.

Observations were truncated at 200m, and following inspection of the frequency distribution of the distances, observations were grouped into 10 intervals each of 20 m width. This eliminated all signs of heaping in the dataset, producing a smooth distance histogram. Detection function models using half-normal and hazard-rate key functions were compared using Akaike's Information Criterion, and the results of goodness-of-fit, with particular attention paid to the tests near zero values, which have a large influence on resulting density estimates.

2.3 Results

2.3.1 Responses by francolins

Between 9th July and 24th September 2003, we conducted a total of 1104 playback surveys in Budongo, Bugoma and Mabira forests (see table 2.1). There was one or more responses by francolin groups at 239 of the sampling points, representing a response rate of 22%.

Table 2.1 Dates of surveys in the three forests studied as part of this project. The total number of playback surveys is given, together with the number of survey points at which one or more francolin groups responded to the playback. The total number of responding groups is given in the final column.

	Dates	Surveys	Points with at least one response	Total responses
Mabira	9 Jul - 31 Jul	363	77	107
Budongo	6 Aug - 29 Aug	387	81	93
Bugoma	4 Sep - 24 Sep	354	81	103
Total		**1104**	**239**	**303**

A total of 303 responses was elicited from francolin groups, 94.3% of these from the first three playbacks. Only 23.1% of francolin groups responded to the first playback, and the proportion of first responses by francolin groups increased from the first to the third playback (figure 2.1). Just over 5% of groups first responded after the fourth and fifth playbacks that were played in order to model response times and movement of birds that responded during the first three playbacks. These birds were excluded from density analyses, as only three playbacks were used as part of the regular sampling protocol.

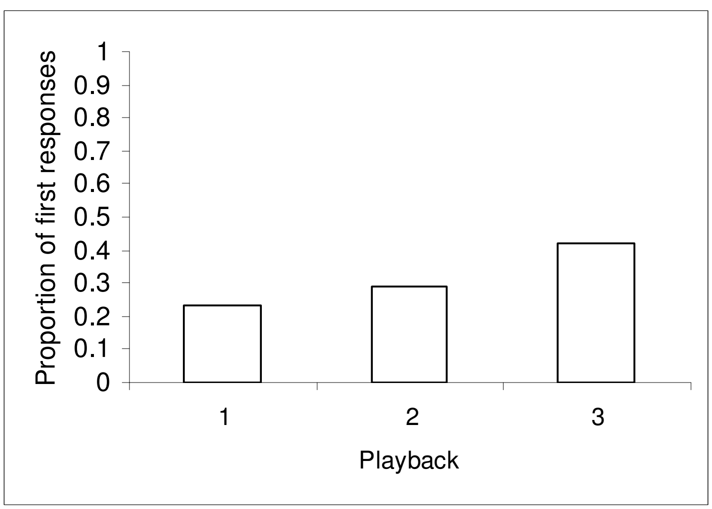


Figure 2.1 The proportion of first responses by francolin groups increased between the first and third playbacks.

Groups that responded to the first playback were on average 54.7 m from the observer (range: 6 - 180 m; SD = 45.71), while groups that first responded to the second or third playback were on average 44.6 m from the observer (range: 3 - 210 m; SD = 42.18). Groups that first responded to the second and third playbacks were significantly closer to the observers than groups that responded to the first playback ($t = 2.19$, $df = 284$, $p < 0.03$), suggesting that they had moved toward the stimulus after the first playback before responding. The fact that francolin groups spent up to three minutes moving towards the stimulus before responding made it necessary to model the movement to avoid overestimating the density of the birds.

2.3.2 Distances travelled by groups between plays

To investigate the movement toward the stimulus by birds before they responded to a playback, we compared the mean distance from the observer of francolin groups that first responded to each playback (see table 2.2). In all but one case, this distance declined, and in most cases the decline was statistically significant, suggesting that groups were moving towards the observer before calling. Considering all forests together, birds that first responded to the third playback were an average of 13.5 m closer to the observer than birds that responded to the first playback (one-way ANOVA: $F_{2,374} = 4.521$, $p = 0.011$). Movement towards the stimulus source was strongly affected by site. Francolin groups in Budongo moved toward the observers by an average of 28 m, a rate of 14 m per minute. In Mabira and Bugoma, the movement was less pronounced, although with the exception of cut trails in Bugoma, was always in the direction of the observer.

This movement has the potential to seriously bias any estimate of density, because by the time groups call, they will be closer to the observer than when the tape was first played. By modelling this movement, however, it is possible to correct for this effect. We calculated the rates of movement between each playback for each site in table 2.2, and combined this information with the time delay until response after each playback by the birds. We then calculated the estimated position of each calling group at the time of initiating the first play. This calculation assumes that movement by non-calling groups occurs at a similar rate to movement by calling groups. Although this seems a reasonable assumption, it is very difficult to test, as it requires tracking the location of groups before they have called for the first time.

Table 2.2 Average distance from the observer of calling francolin groups that first responded after the 1st, 2nd and 3rd playbacks.

	Average distance at 1st play (m)	Average distance at 2nd play (m)	Average distance at 3rd play (m)	p (ANOVA)
Budongo	54.0	27.0	26.2	0.006
Bugoma (existing trails)	39.4	32.3	30.9	0.270
Bugoma (cut trails)	22.3	17.8	23.8	0.882
Mabira	68.5	67.4	63.6	0.639
Global	54.7	44.5	41.2	0.011

As well as movement toward the observers, table 2.2 reveals a strong difference between distances of detected francolin groups from the observer on existing and cut trails in Bugoma forest. Francolin groups were closer to the observer on first detection in cut trails than in existing trails (mean 37.6 m in existing trails, 21.4 m in cut trails; $t = 3.324$, $df = 98$, $p = 0.001$). This suggests a higher density of francolin groups in areas traversed by cut trails than in areas traversed by existing trails.

Predicted distance of birds from the observer at the time of the first play varied with the playback to which the birds first responded (one-way ANOVA: $F_{4,298} = 5.65$, $p < 0.001$). This was because predicted distances at first play for groups first detected on the fourth and fifth plays were significantly higher than predicted distances at first play for groups first detected on the first to third plays (Tukey post-hoc tests, $p < 0.05$). There were no significant differences in predicted distance at first play for francolin groups detected on the first to third plays (Tukey post-hoc tests: all $p > 0,05$). These results suggest that movement of the birds towards the stimulus and the likelihood of the group calling were limited if the group was a long distance away from the observer. Because birds that first responded to fourth and fifth plays were generally a long distance from the observer, and appeared to respond to the stimulus in a qualitatively different way to groups that responded after the first, second or third playback, those groups were excluded from all further analyses. The predicted distances at first play were recalculated using only information from the first three plays using the method described above.

To check the results of this process, we compared mean predicted distance at first play with mean actual distance at first play. Although mean predicted distance at first play was slightly higher than mean actual distance at first play (predicted = 59.3 m; actual = 54.7 m), this difference was not statistically significant despite the large power of the test ($t = 1.76$, $df = 101.7$, $p = 0.081$). It also makes biological sense, that groups that did not respond to the first playback were initially further from the observer than groups that did respond to the first playback.

The resulting dataset contained 290 records of responding francolin groups, together with their predicted distance from the observer at the time of the first playback. The predicted distance was therefore different from the recorded distance except where the group responded immediately to the first playback.

2.3.3 Group size

Of the 303 francolin groups that responded to playback, only 41 were seen. No systematic special effort was made to lure birds into the open to record group size, as this would have taken too long and compromised the other objectives of the study. A much lower frequency of groups was seen in Mabira (5%) than in the other two forests (Budongo = 18%, Bugoma = 27%; $G_{adj} = 13.92$, $df = 2$, $p < 0.001$).

Observed group size ranged from 2 - 8 birds, and the mean group size for all groups seen was 2.73 (SD = 1.25). Mean group sizes were: Mabira (1.54, SD = 0.68), Bugoma (2.85, SD = 1.35), Budongo (2.30, SD = 1.02). Group size varied among the three forests (one-way ANOVA: F2,153, $p < 0.001$), being significantly lower in Mabira than in the other two forests (Tukey post-hoc tests, $p < 0.001$). Group sizes were lower in primary forests than secondary forests, although the difference was not significant (mean group size in primary forest = 2.2, secondary forest = 1.86; $t = 0.74$, $df = 148$, $p = 0.463$).

2.3.4 Density analyses

Models using half-normal key functions produced much better results than models using hazard-rate key functions. Despite having a slightly lower AIC, the models using half-normal key functions produced strong goodness of fit results, particularly near zero. The results were relatively insensitive to selection of different intervals for grouping data, and alternative truncation options, suggesting that the final detection function chosen was giving robust results. Choosing alternative series expansion terms did not alter the results at all.

Table 2.3 gives the resulting density estimates for francolin groups in the three forests surveyed, and table 2.4 multiplies up these density estimates into population estimates for the Ugandan range of the Nahan's francolin. Owing to wide confidence intervals, these data must be treated with caution, and we urge that the confidence intervals are always reported when these figures are quoted. These data are not corrected for differing densities in different habitats, for example primary versus secondary forest. Firstly, the only patches of true primary forest anywhere within our study areas were small blocks around the research station at the Budongo Forest Project, and at the ecotourism site at Kaniyo Pabidi. Even these areas are considered effectively secondary because they are so small. Secondly, our surveys covered a very large proportion of each of the forests, and there was no obvious bias in our sampling of different habitat types. Thirdly, extrapolation may introduce further error because high quality data on habitat distributions are simply not available in the forests we studied.

The forested area of Mabira is usually quoted as about 303 km^2 based on Howard (1991), but rapid habitat destruction particularly from the edge of the reserve has reduced the forested area of the reserve, which Westman et al. (1989) estimated on the basis of satellite imagery to have fallen from 285.4 km^2 in 1973 to 204.2 km^2 in 1988. Given that 204.2 km^2 is the most recent justified estimate of the forest area within Mabira forest, this is the value we use here. This is likely to be a conservative approach, as the area of forest is likely to have fallen considerably in the last 16 years. However, perusal of BIOMASS maps produced for the area in the mid 1990s indicate about 210 km^2 of forest remaining in Mabira, so the situation may have stabilised since the late 1980s. Given the protection status of Budongo Forest, and the fact that Bugoma Forest is under much less pressure from human populations, we use the figures of 428 km^2 and 300 km^2 given in Howard (1991) for these sites.

Table 2.3 Estimated densities of Nahan's francolins in Budongo, Bugoma and Mabira Forests.

Forest	Density (groups per km^2)	Lower 95% CI	Upper 95% CI
Budongo	16.88	12.56	22.68
Bugoma	33.87	25.31	45.32
Mabira	12.46	9.23	16.81

Table 2.4 Population estimates for Nahan's francolin in three Uganda forests extrapolated from density data based on the total forested area of each reserve. These areas were Budongo (428 km^2), Bugoma (300 km^2), Mabira (204.2 km^2). See text for sources of forest cover estimates.

Forest	Total number of groups	Lower 95% CI	Upper 95% CI
Budongo	7,223	5,376	9,705
Bugoma	10,160	7,592	13,595
Mabira	2,543	1,885	3,432
Total	19,926	14,853	26,732

Using the density figures in table 2.3, and the figure of 98.8 km^2 of forest lost from Mabira (based on Westman et al. 1989), we estimate that 1231 (95% CI: 912 - 1660) groups of Nahan's francolins have been lost from Mabira since 1973. The figures in table 2.4 are based on the number of groups of francolins. Given that these birds remain in groups during the breeding season (Sande 2001), number of groups is probably the most important indicator of the population status of the species. However, given that the average size of Nahan's francolin groups is 2.21 (Sande 2001), the figures given in table 2.4 can be multiplied up to produce a total current population estimate for Uganda of 44,038 individuals (95% CI: 32827 - 59079).

2.4 Discussion

2.4.1 Population densities in Budongo, Bugoma and Mabira forests

The density of Nahan's francolin in Bugoma was much higher than in the other two forests. Bugoma is a patchy forest, with irregular forest blocks intersected by grasslands composed of *Hyparrhenia*, *Pennisetum* and *Cymbopogon* spp (Howard 1991). Our data therefore suggest that fragmentation *alone* does not adversely affect Nahan's francolin. Francolins were found in natural small forest patches in Bugoma (see chapter 3), so it appears that the species can disperse across non-forest habitat, and can indeed thrive in highly fragmented habitats.

Bugoma Forest is generally regarded as a relatively poor forest in comparison with Budongo and Kibale (Langdale-Brown et al. 1964, Howard 1991), but this work has shown that it supports the largest population of Nahan's francolin so far discovered. A relatively small proportion of the forest has been logged in the past, the human population around the forest is relatively low, and there has been almost no agricultural encroachment into the reserve (Howard 1991). Given that the reverse of each of these statements applies to Mabira Forest, and that the population estimate for that forest is far lower (2,543 groups, 95% CI: 1,885 - 3,432), it seems possible that logging and human disturbance have adversely affected the species in Mabira. Like Bugoma, parts of Mabira have become highly fragmented. For example, the edge to area ratio rose from 2.97 to 3.84 between 1973 and 1988 (Westman et al. 1989). Mabira is one of most encroached Forest Reserves in Uganda (National Environment Management Authority 1998b). However, the causes of fragmentation are different in Bugoma and Mabira. In the former, the reserve is a natural mosaic of forest and grassland, whereas human influence has been the sole cause of fragmentation in Mabira. This suggests that habitat changes associated with fragmentation, rather than fragmentation *per se* have been the main factor affecting Nahan's francolin populations.

The estimate for Budongo (7,223 groups, 95% CI: 5,376 - 9,705) corresponds very well with Sande (2001) who estimated there to be 6,578 groups in the forest (95% CI: 5,850 - 7,305). This suggests that the population in Budongo Forest has remained reasonably stable over the past five years. It further suggests that the playback method to survey for this species has produced consistent results over two different studies conducted using different personnel, opening up the possibility of a consistent monitoring programme to be developed in the long term. Furthermore, the high response rate obtained in this study (22%) suggests that the playback method is an efficient way to study Nahan's francolin and enables specific planning of survey effort in relation to likely sample sizes for future surveys.

2.4.2 Methodological considerations

Our data show that francolins strongly moved towards the tape during playback surveys, and that this must be taken into account when using playback to estimate population densities of elusive or secretive animals. To address the remaining possible biases of playback surveys for Nahan's francolin, future studies should try to estimate the proportion of groups that respond to the call stimulus, and measure the distance moved by birds towards the tape before they begin calling, including information on whether groups split up before reaching the observer. Both of these would involve using playback surveys on radio-tagged birds whose precise location was known before the tape was played. This has been done by Lefare et al. (1999), using radio-tagged black rails *Laterallus jamaicensis* in Jamaica.

Our result that an increasing proportion of francolin groups responded to successive playbacks is in contrast to the work by Sande (2001, who found that 77% of birds responded within one minute to playback. This may result from a slight difference in methodology, in that Sande used 20 seconds for each playback, whereas we used 10 seconds (to allow us to model movement by birds more accurately). We therefore recommend that, now that the method is well-developed, future surveys use a playback period of 20 seconds, played a total of three times, with a one-minute gap between each playback. This seems to be the best way to maximise data return for a given level of time in the field.

2.4.3 Where next?

Building on earlier work (Plumptre 1996, Dranzoa et al. 1997, Dranzoa et al. 1999, Sande 2001, Sande et al. 2001), our work has provided a complete census of the known populations of Nahan's francolin in Uganda.

- Firstly, we recommend that surveys using comparable methods to those used here and in Sande (2001) are repeated before 2015, preferably sooner (particularly in Mabira, where the population may be declining rapidly), to identify any changes in Nahan's francolin populations in these three sites. Raw data on species declines are crucial if decision-makers are to be influenced.

- Secondly, Nahan's francolin has been reported from Kibale Forest, and we found it in some forest patches in Bugoma south of the main reserve. Given that there is almost a continuous distribution of patchy forest all the way from Bugoma to Kibale, these patches should be intensively surveyed, so we have presence / absence data for as many patches as possible. Some northern parts of Kibale have been surveyed (Dranzoa et al. 1997, 1999), but there is a need for further surveys in the southern part of the forest to confirm whether Nahan's francolin occurs in Kibale.

- Thirdly, the current status of the species in eastern Democratic Republic of The Congo is currently unknown. It is reported from several sites, but systematic surveys are now urgent. Surveys have recently become feasible in many areas because of the easing security situation. It is now possible for Congolese (but not foreign) researchers to conduct extensive survey work safely in several of the candidate forests and we recommend that these are undertaken as soon as possible. This will complete the global survey of the conservation status of Nahan's francolin.

3. Habitat selection by Nahan's francolin

3.1 Introduction

The Nahan's francolin has long been recognised as a forest specialist species (Bennun et al. 1996), and was once thought to be restricted to dense primary forest (Urban et al. 1986). We now know that this is not true, and that the species can tolerate a reasonably high degree of habitat degradation, and can persist in relatively high densities in secondary forest, providing the forest structure and species composition has not been radically altered. Sande (2001) studied Nahan's francolin ranging behaviour in five compartments (two unlogged, three logged) of Budongo Forest, Uganda. He found that radio-tagged birds in heavily logged forest with a relatively open canopy had much smaller home ranges than birds in lightly logged and unlogged forest, probably because they also occurred in smaller groups in heavily logged habitat. During the day, birds preferred to spend time in area of high understorey density, but moved to more open areas containing very large forest trees where they roosted between the buttresses of trees such as *Cynometra alexandrii* and *Broussonetia papyrifera*. The birds also used large buttressed trees for breeding, particularly of *Cynometra*, *Alstonia*, and *Celtis*. Most trees used for breeding were over 100 cm diameter at breast height.

Given that logging preferentially removes large trees and that current levels of forest use appear to unsustainable in many of Uganda's forests (Singer 2002), there is severe pressure on habitat suitable for Nahan's francolin, even within forest reserves. However, Sande (2001) found that francolins occurred in high densities in lightly logged forest, and it appears that the birds are able to tolerate quite a high degree of habitat degradation. Birds appeared to favour areas with high understorey vegetation density for foraging during the day. In tropical forests, such areas are often associated with gaps created in the forest by tree-fall, after which the growth of shrubs and tree saplings leads to the formation of a dense understorey (Whitmore 1978). Brokaw (1985) found that understorey density was elevated for up to six years following gap formation. Indeed, natural tropical forests are highly dynamic environments, characterised by a continuous process of gap formation and closure, resulting in a heterogeneous mosaic forest structure (Christensen & Franklin 1987, Lorimer 1989, Whitmore 1989).

Light selective logging could, at least temporarily, increase heterogeneity in forest structure, and lead to an increase in favourable foraging areas for Nahan's francolin, providing that enough trees with large buttresses are left in the system for roosting and breeding. We wanted to investigate in detail whether the francolins preferred heterogeneity in forest structure i.e. areas of thick, dense understorey, that also contained large buttressed trees nearby for breeding and roosting. This could have profound management implications for Nahan's francolin, and allow us to design realistic and practical recommendations for management policies in Ugandan forests that will always be subject to a certain level of timber offtake. We collected extensive habitat data from across the Ugandan range of the Nahan's francolin to examine its tolerance of logged habitats, and whether densities appeared to be influenced by habitat heterogeneity.

Because our survey also included non-forest habitat, we also present data on broad habitat use by the birds. Given that some parts of the forests in which the francolin occurs are naturally patchy, we wanted to know whether the species can colonise and survive in natural forest patches surrounded by non-forest habitat. If so, this demonstrates that the species can disperse across non-forest habitats, again with significant implications for management.

3.2 Methods

3.2.1 Broad habitat classification

To provide information on the broad habitat types used by Nahan's francolin in Uganda, the habitat at each of 1104 playback points described in chapter 2 was categorised into habitat form, structure and degee of human disturbance. See table 3.1 for details of the qualitative observations recorded. These data were written down while playback surveys were conducted by another team member. It must be noted that these details related to the habitat at the sampling point, rather than at the exact locations from which any francolins may have responded. The intention was to provide a rapid description of the general habitat type at each sampling point, allowing broad habitat choices by the francolins to be identified by comparing habitat descriptors at points where francolins were detected with the habitat at points where francolins were not detected.

Habitat types were forest (figure 3.1; about 50 species reaching the canopy including *Cynometra*, mahogany *Khaya*, *Entandrophragma*, *Chrysophyllum*, *Alstonia*, *Celtis*, *Funtumia*, *Trichilia*), woodland (dry woody species including Terminalia, Combretum, Bauhinia, Albizia, Acacia), scrub (dense thickets e.g. *Lantana camara*), cultivation (plantations of bananas *Musa*, cassava *Manihot*, tea *Camillia*), grassland (tall savanna grasses including *Setaria*, *Brachiaria*, *Pennisetum*, *Panicum*).

Figure 3.1 Left (a), mature forest with emergent trees and natural gaps in Bugoma Forest, September 2003. Right (b), degraded forest being invaded by paper mulberry *Broussonetia papyrifera* after severe logging, Mabira Forest, July 2003.

Table 3.1 Habitat variables recorded at all sampling points.

Variable	Categories / units
Elevation	in metres above sea level. Collected using a Garmin eTrex 12 channel GPS receiver
Habitat type	Forest; Woodland; Scrub; Cultivation; Grassland
Habitat status	Primary; Secondary
Canopy height	Low (below c 15 m); Medium (c 15 - 20 m); High (above c 20 m)
Understorey density	Open; Medium; Dense (purely arbitrary)
Proximity to edge of habitat patch	Habitat patch edge within 200 m of point; Habitat patch edge beyond 200 m from point
Active disturbance	Active signs of human forest use; No active signs of human forest use

3.2.2 Habitat structure

To investigate habitat selection by the francolins in detail, sampling points were chosen at random along each transect. Points were chosen to provide an approximately equal sample of points at which francolins were detected and points at which francolins were not detected. To avoid disturbing birds, habitat surveys were conducted after playback sampling was completed each day, typically by retracing our steps along the transect route and stopping at the randomly-selected points to take habitat measurements. Points were relocated using a handheld GPS receiver.

At points where francolins were detected, distance and bearing measures were used to locate the exact position of calling groups, where the detailed habitat data were collected. At points where francolins were not detected, habitat data were collected 50 m from the survey point in a random direction (chosen using random number tables). Where it was physically impossible to reach the position of a calling francolin group, or the randomly-selected position, detailed habitat data were not collected at that point. This only occurred in about five instances.

From the centre point (the exact location of each calling group), understorey and ground vegetation density was estimated by recording the distance in metres at which a piece of white A4 paper ceased to be visible (a) at head height and (b) at 20 cm height from the ground along each of the four cardinal compass directions. The longer the distance, the more open the vegetation structure. Next, quadrats of 2 m * 2 m were established at a distance of 5 m along the four cardinal compass directions from the centre point. Within these quadrats, the following were recorded: leaf litter depth, density of fruits, density of termites / ants, cover and height of ground flora, and proportion of bare ground within the quadrat. Then, the observer looked directly upwards and estimated the cover of understorey vegetation and canopy within an imaginary 2 m * 2 m square directly above the observer. Understorey and canopy heights were also estimated at this point. The number of small trees (diameter at breast height (dbh) < 20 cm) and the number and dbh of large trees (dbh > 20 cm) within the 10 m * 10 m square enclosed by the four observers was recorded.

Finally, the observers searched for the nearest buttressed tree to the centre point. A buttressed tree was defined as a tree with at least one buttress that began no less than 2 m from the ground (see figure 3.2). Our definition was therefore based on the structure of the buttresses themselves rather than the size of the tree. The circumference at breast height of the buttressed tree was measured around the buttresses (allowing calculation of dbh), and the number of buttresses was counted (figure 3.2). The horizontal extension of each buttress from the trunk to the point at which the buttress had a vertical height of 20 cm from the ground was measured. Finally, the gaps between the buttresses were inspected, and the number of "protected areas" was recorded. A protected area was defined as a cleft between buttresses that extended below ground level, therefore providing a potential roosting or breeding site for francolins. Nests of the species are usually located in such protected areas (Sande 2001, pers obs). If a buttressed tree could not be located within 50 m of the centre point, the search was abandoned.

Figure 3.2 Measuring the circumference of a buttressed tree. The buttress on the left hand side of the picture can clearly be distinguished from the trunk above a height of 2 m from the ground. Photo by Claire Flockhart.

See table 3.2 for a complete list of habitat variables measured. Measures were grouped into those relating to (i) forest structure, (ii) feeding behaviour, (iii) availability of roosting and breeding sites.

Table 3.2 Habitat variables

Variable	Measurement
(i) Forest structure	
canopy cover	mean of proportions estimated in four 2 m * 2 m quadrats
canopy height	mean of heights estimated in four 2 m * 2 m quadrats
understorey cover	mean of proportions estimated in four 2 m * 2 m quadrats
understorey height	mean of heights estimated in four 2 m * 2 m quadrats
ground flora cover	mean of proportions estimated in four 2 m * 2 m quadrats
ground flora height	mean of heights estimated in four 2 m * 2 m quadrats
vegetation density at 1.3 m height	mean of four distances at which A4 white paper was no longer visible
number of large trees	counted within 10 m * 10 m quadrat
dbh of large trees	mean of all large trees within 10 m * 10 m quadrat
(ii) Ground characteristics	
bare ground cover	mean of proportions estimated in four 2 m * 2 m quadrats
leaf litter depth	mean of depths estimated in four 2 m * 2 m quadrats
vegetation density at 20 cm height	mean of four distances at which A4 white paper was no longer visible
density of fruits	in four 2 m * 2 m quadrates: none; few; many
density of termites / ants	in four 2 m * 2 m quadrates: total number of trails and mounds
(iii) Roosting / breeding sites	
distance to nearest butressed tree	in m, direct distance from centre point
dbh of nearest buttressed tree	measured around buttresses
number of buttresses	count
average size of buttresses	mean of horizontal extension of each buttress from the trunk to the point at which the buttress had a vertical height of 20 cm from the ground

3.2.3 Active logging

Given that very little forest in Uganda can be classified as primary, we were specifically interested in determining whether recent habiat destruction has affected francolin distributions. For this purpose, active logging was defined as evidence around each survey point suggesting that one or more trees had been removed within the past two years. Usually, this was cut stumps or the remains of pits used for sawing up the wood. Occasionally we found evidence of pits dug for charcoal burning with cleared areas surrounding them (figure 3.3). We made a note of signs of active habitat disturbance at each francolin survey point.

Figure 3.3 Part of the team investigates an illegal charcoal-burning pit. Saplings are removed from the surrounding forest, often following the logging of a large forest tree. A pit is then dug, the saplings covered with earth and left to smoulder for several days. Growth of dense shrubs can be seen in the area surrounding the pit, and a large gap in the forest canopy has been created in this area. Photo by Claire Flockhart.

3.2.4 Presence of potential food items

Nahan's francolins are known to eat termites and ants as well as fruits of forest plants (Sande 2001), so we scored the availability of each of these food types in the four 2m * 2m quadrats during each of the detailed habitat surveys. For each food type, we used a three level qualitative classification of none, few and many, and assigned the numeric values 0, 1, 2 to each of the levels respectively. This gave a total possible "food score" of six to each quadrat, and hence 24 to each survey point.

3.3 Results

3.3.1 Habitat type

Data on general habitat type were collected at the 1104 survey points. Table 3.3 shows the frequency at which francolin groups were detected in the six broad habitat types.

Table 3.3 The number of survey points in each of the six broad habitat types where francolin groups responded to playback.

	Primary forest	Secondary forest	Woodland	Scrub	Cultivation	Grassland
Response	22	210	0	6	1	0
No response	75	630	43	67	45	5
% responses	22.7	25.0	0	8.2	2.2	0

The Nahan's francolins overwhelmingly preferred forested habitats, but were sometimes found in adjacent scrub and cultivation. From a total of 239 survey points from which at least one groups of Nahan's francolins was detected, only 7 (3%) were in non-forest habitat. This difference in frequency was highly significant ($G_{adj} = 29.18$, df = 1, $p < 0.001$). However, there was no difference in the frequency of detecting Nahan's francolins in primary and secondary forests ($G_{adj} = 0.25$, df = 1, $p = 0.615$).

The few birds detected in non-forest habitats were generally in thicket scrub, often dominated by flowering *Lantana camara* bushes. *Lantana camara* is a native of South America, but also an aggressive alien producing a proliferous seed-set now widely naturalised in the tropics. These groups were up to 500 m from forest habitat, suggesting that they were not engaged simply in short excursions from forest. The group recorded in cultivation was in a banana plantation very close to the forest edge.

If the birds recorded in non-forest habitats were taking advantage of opportunities to feed in edge habitat, for example with abundant seeds, we might expect francolins to prefer locations near to the forest edge. However, we found no evidence that francolins in forest habitats preferentially used habitat near the forest edge. There was no difference in the frequency of responses from survey points within 200 m of the forest edge and survey points more than 200 m from the forest edge ($G_{adj} = 0.18$, df = 2, $p = 0.668$). These data suggest that birds recorded in non-forest habitats may have been dispersing.

3.3.1.1 Elevation

Altitude was recorded for 1099 of the 1104 survey points. Five could not be recorded because no GPS reception could be obtained at those locations. Mean altitude of all survey points varied markedly among the three forests (figure 3.4; one-way ANOVA: $F_{2,1096} = 614.2$, $p < 0.001$), and was generally slightly lower at points from which francolin responses were elicited. Figure 3.5 shows the actual distribution of altitudes from which we observed francolin groups. A multiple logistic regression model using site as a factor and altitude as a covariate was constructed to investigate the altitudinal distribution of the francolins. Altitude was a significant predictor of francolin responses only in Mabira, where more responses were made at lower altitudes (Wald statistic = 9.38, $p = 0.002$). There was no detectable effect of altitude in Budongo or Bugoma ($p > 0.3$). These data indicate that, in general, Nahan's francolin occurred throughout the altitudinal range of the forests studied, with the exception of Mabira, which was the highest forest. This suggests that some parts of Mabira are nearing the upper altitudinal range of the Nahan's francolin.

Figure 3.4 Mean altitude of survey points where a response was not elicited (black bars) in comparison to points where a response was elicited (grey bars). Error bars are 95% confidence intervals. The mean altitude ± 95%CI of all survey points in the three forests was: Budongo = 1055 ± 4.7, Bugoma = 1125 ± 3.4, Mabira = 1172 ± 5.7.

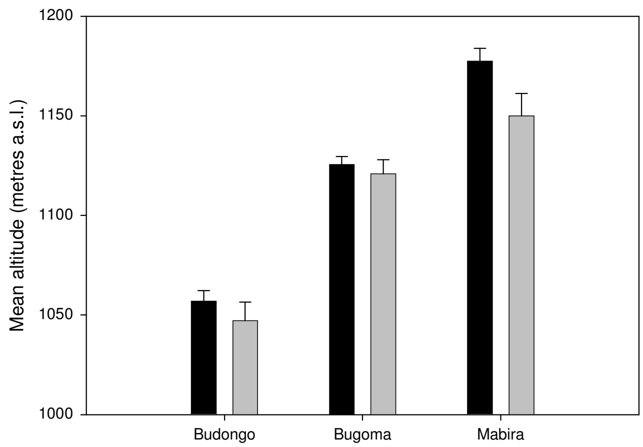
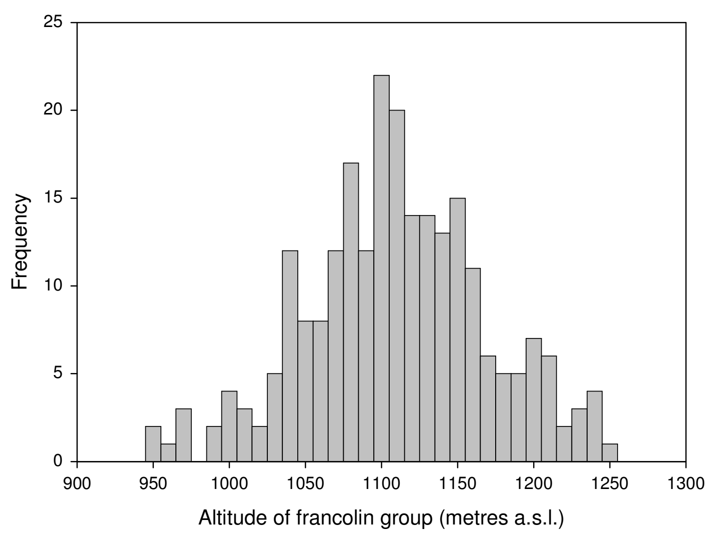


Figure 3.5 Altitudinal distribution of all 239 survey locations from which francolin groups were detected. Mean altitude of all francolin locations was 1105 m (range 948 m - 1242 m).



3.3.1.2 Forest structure

The frequency of response by francolins did not change with habitat density (table 3.4; $G_{adj} = 2.62$, df = 4, $p = 0.269$), but it was strongly affected by canopy height, with significantly fewer responses in low canopy forest than in medium and tall forest (table 3.4; $G_{adj} = 24.24$, df = 4, $p < 0.001$). Because canopy height and understorey density for these analyses were measured qualitatively, we checked whether the detailed habitat data collected at a subset of the sampling locations supported our classification of the habitats "by eye". Indeed, both canopy height and understorey density (visibility at 1.3 m height) as measured in the detailed habitat surveys increased significantly among the three qualitative categories used in these analyses (one-way ANOVA: canopy height $F_{2,390} = 10.26$, $p < 0.001$; understorey density $F_{2,399} = 4.91$, $p = 0.008$), suggesting that they represent well the overall picture of habitat use by the francolins at all of the points surveyed.

Table 3.4 The frequency of Nahan's francolin responses in relation to canopy height and density.

	Canopy height			Canopy density		
	Low	Medium	Tall	Open	Medium	Dense
Response	262	393	175	406	326	110
No response	37	139	57	108	103	24
% responses	12.4	26.1	24.6	21.0	24.0	17.9

3.3.2 Detailed habitat measurements

A total of 406 habitat surveys was conducted, comprising 186 surveys at randomly chosen sampling points where francolins were not heard, and 220 at randomly chosen sampling points where francolins were heard (see table 3.5).

Table 3.5 Detailed habitat surveys conducted in the three forests.

Site	Surveys at francolin points	Surveys at random points	Total
Budongo	74	67	141
Bugoma	65	49	114
Mabira	81	70	151
Total	220	186	406

3.3.2.1 Forest structure

Variables describing forest structure (percentage canopy cover, canopy height, percentage understorey cover, understorey height, percentage ground flora cover, and ground flora height) were entered into a factor analysis. Three factors were identified, explaining 74% of variation in the data. A logistic regression model was then constructed to investigate selection of forest structure by the francolins. The second factor was a good predictor of the presence and absence of francolins (Wald statistic = 6.409, df = 1, p = 0.011). This factor was associated with tall, dense canopy, full understorey and sparse ground vegetation, indicating that francolins were more likely to be detected in such habitat (see table 3.6).

Table 3.6 Forest structural variables significantly predicting the presence of francolins at survey points

Variable	Correlation with factor 2	Prediction for francolins
canopy cover	0.60***	prefer dense canopy
canopy height	0.63***	prefer tall canopy
understorey cover	0.32***	prefer dense understorey
understorey height	0.19***	prefer tall understorey
ground flora cover	-0.60***	prefer sparse ground flora
ground flora height	-0.33***	prefer short ground flora

*** correlation significant at p < 0.001 level

The fact that francolins preferred both dense canopy cover and dense understorey was interesting, given that a dense canopy cover would normally be associated with lower light levels penetrating through to the understorey, and hence result in more open understorey. Indeed, our data showed that canopy cover and understorey cover were negatively correlated ($r = -0.23$, $n = 403$, $p < 0.001$), suggesting that these habitats rarely coincide exactly. This suggests that the francolins were responding to heterogeneity in the habitat, being found at some locations where dense canopy cover reflected mature forest containing suitable breeding and roosting sites, and at other locations where dense understorey reflected the presence of preferred feeding habitat.

3.3.2.2 Tree density and size

There was no difference between points with and without francolin responses in the density of large trees ($t = 1.28$, $df = 404$, $p = 0.203$), or the density of small trees ($t = 0.73$, $df = 401$, $p = 0.464$). However, the average dbh of the large trees was significantly greater in points where francolins were detected (mean dbh in francolin points ± 95%CI = 46 cm ± 4.9, mean dbh in non-francolin points = 39 cm ± 2.5; $t = 2.91$, $df = 356.4$, $p = 0.004$). This suggests that tree density did not strongly affect francolin distributions, but that the francolins preferred forest comprising larger trees.

3.3.2.3 Presence of potential food items

Food score was significantly higher in francolin points than in random points (figure 3.6; $t = 5.66$, $df = 399.7$, $p < 0.001$). There was a weak positive correlation between food availability score and understorey cover ($r = 0.14$, $n = 403$, $p = 0.007$), while there was no relationship at all between canopy cover and food availability ($r = 0.024$, $n = 403$, $p = 0.632$). These results suggest that high food availability was associated with a dense understorey, but was not affected by canopy cover.

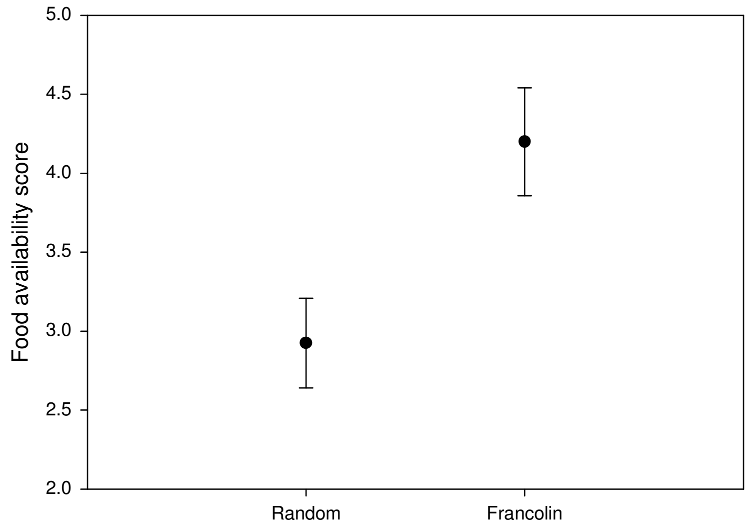


Figure 3.6 Food availability score at survey points where francolins were and were not detected. The food availability score could vary between 0 and 24, and included fruits, termites and ants.

3.3.2.4 Characteristics of buttressed trees

Points from which francolins where detected were closer to buttressed trees than were random points (mean distance ± 95%CI to buttressed tree in francolin points = 8.7 m ± 1.6, random points = 11.9 m ± 2.7). Although this difference was only marginally significant ($t = 1.99$, $df = 299.7$, $p = 0.047$), it does suggest that in general, francolins used habitat in close proximity to buttressed trees. Buttressed trees at francolin sites did not differ in any structural characteristics from buttressed trees at random sites (dbh, number of buttresses, buttress size, or number of protected areas).

3.3.2.5 Active logging

Active logging was defined as evidence around each survey point suggesting that one or more trees had been removed within the past two years. Usually, this was cut stumps or the remains of pits used for sawing up the wood. Occasionally, we disturbed people actively removing timber or sawing trees; in all cases they ran away into the forest, suggesting that their activity was illegal. Although most logging was done manually, using pitsawing, we heard chainsaws in the forest around Namukupa (Mabira). That this was during the night again suggests that this activity was illegal.

Table 3.7 shows the frequency at which francolin groups were detected at points with signs of active logging versus points with no sign of active logging.

Table 3.7 The number of survey points in each of the disturbance types where francolin groups responded to playback.

	No active logging	Active logging
Response	207	28
No response	745	95
% responses	21.7	22.7

There was no significant differences in the frequency of detection of francolin groups in forest that was being actively logged and forest that showed no signs of active disturbance (G_{adj} = 1.24, df = 2, p = 0.537).

3.3.3 Anecdotal observations of habitat destruction and degradation

Rather than present a catalogue of all illegal activity seen in the forests visited, this section provides three anecdotes describing illegal activity seen during our field work as examples of the kind of activity that is currently threatening the forest reserves.

On one day in July 2003, we saw over 110 recently logged trees along a 3 km transect from Wantuluntu through part of the strict reserve zone in Mabira forest. There were several hundred timber planks that had been stood up to dry. Many were marked with initials, and they were clearly ready for transport out of the forest.

While conducting habitat surveys near Busingiro in Budongo forest, we heard the sounds of pitsawyers. Because we had a forest ranger with us, we decided to follow up the sound, and crept up on the pitsawyers. They had, however, posted a guard in the forest who spotted us when we were about 50 m from the logging site. He raised the alarm and all the loggers ran off into the forest. Despite chasing them we could not catch them as they were clearly skilled at "evaporating" at any sign of being caught. According to the ranger with us, about 80% of arrest attempts fail because the loggers are so skilled at evading capture. They were working on a huge trunk recently cut (figure 3.7), and had already cut down two other trees and created a very large clearing in the forest.

Figure 3.7 Pitsawyers' handywork in Budongo forest, minutes after we had disturbed a group of men illegally logging near Busingiro in August 2004. The trunks are sawn into planks by teams of people using hand saws, often singing to keep in rhythm. The planks are then carried out of the forest, often by women who work for less than 1US$ per day.

Charcoal burning was also quite frequent in Mabira forest. In one case, we caught two people digging a charcoal pit red-handed. They were clearly terrified, but we explained that we were just researchers and not representing the authorities. They were clearing forest edge habitat next to a sugar-cane plantation, and the evidence was that this activity had been going on for many years, gradually encroaching on the forest from the edge.

We also saw active encroachment by agricultural plantations into the forest near Wakisi in the northern part of Mabira forest. Where the edge of the forest reserve had been marked with red paint rings around the trees, we saw evidence that the border was being re-marked further in, as areas were clear-felled to make way for plantations of pineapple and other crops. As we approached the area, the alarm was raised, and people were shouting (in Luganda) warnings of our approach to others in the forest. Together with our evidence of boundary remarking, this suggests that the clearance we observed was illegal. We found Nahan's francolins in forest right up to the edge of the cleared areas, indicating that habitat had been removed that had once supported the birds.

3.4 Discussion

The fact that habitat structural variables emerged as predictors of the presence of Nahan's francolins suggests that forest disturbance has already made its mark on the distribution of the bird. Nahan's francolins avoided forest with the open canopy, characteristic of heavily logged areas. However, the fact that birds favoured dense canopy *and* dense understorey suggests that heterogeneity of forest structure is important to them. Areas with an open canopy formed, for example, by tree fall give rise to luxuriant growth of understorey plants and saplings of canopy species (Barden 1980, Runkle 1981, Brokaw 1985, Canham 1989). Natural forests are highly dynamic environments (Chokkalingam et al. 2001), and it is easy to see how a continuous cycle of natural treefall will provide the necessary heterogeneity. Gaps created by treefall will dense up quite quickly and there is some evidence that these are preferred foraging areas for Nahan's francolins (Sande 2001). This may also explain why Nahan's francolins still thrive in areas that have been lightly logged. However, our data also suggest that it is important for logged areas to retain enough large trees for breeding and roosting, because the francolins preferred areas that contained larger trees. If logging removes too many large trees, we might predict (a) low productivity and (b) increased predation risk for Nahan's francolins.

We found that sites with active logging did not support a different density of birds than sites with no signs of active logging (presumably these latter sites are "old-logged", with evidence of logging long since disappeared). Sites with active logging may be higher quality than old-logged sites as they represent areas that still have large forest trees that attract illegal activity. That these areas were no better or worse suggests that the levels of logging so far observed have not seriously affected the Nahan's francolin, rather that extent of habitat has been a more serious problem. For example, forest area is lost in Mabira at a rate of 2.2% per year (Westman et al. 1989), clearly an unsustainable rate of destruction. However, it must be noted that the density of francolins was far lower in Mabira and Budongo than in Bugoma, and that Mabira and Budongo have been subject to far higher timber offtake than Bugoma (Howard 1991). So we are probably looking at a combination of habitat degradation and active disturbance / hunting (see chapter 4 for data on direct exploitation).

We detected Nahan's francolins in over 8% of the playback survey points made in scrub habitat. These were generally thickets of the introduced alien species *Lantana camara*. Because in general, francolins did not appear to prefer edge habitats, we believe that these birds were probably dispersing rather than making foraging trips into the scrub areas. Goth & Vogel (2003) found that thickets of *Lantana camara* promoted dispersal of Australian brush-turkeys. Furthermore, they recommended that these habitats, despite being composed of non-native species, were an important component of dispersal behaviour, promoting population spread, recolonisation and gene flow.

One of the world's most aggressive alien invaders, *Lantana camara* is a native of North and South America, now introduced across most of tropics, and common in Uganda (Holm et al. 1997). Our results do not suggest that

Lantana thicket is a good habitat for Nahan's francolins, but only that they do use the thickets, perhaps for dispersal. We do not know whether native scrub species that have been outcompeted by *Lantana* might be better habitat for dispersing Nahan's francolins. *Lantana* does have a prolific seed set (Binggelli 1998), so the possibility of the birds taking advantage of good feeding opportunities cannot be entirely ruled out. Further study using radio-tracking of birds caught in *Lantana* thicket will help throw light on this question.

4. Hunting of forest Galliformes

4.1 Introduction

Galliformes and humans have been closely associated throughout much of history. Chiefly terrestrial birds, they are easily trapped, and their meat and eggs provide rich sources of protein (Fuller et al. 2000). Almost all wild Galliformes have been, or still are being, extensively hunted for subsistence, sport, or trade (Aebischer 1997). It can be very difficult to distinguish between the effects of direct exploitation and more general threats to habitats (Fuller et al. 2000). Hunting of forest galliformes, including francolins, is still widespread in Uganda (Sande 2001). According to Dranzoa et al. (2001), 29% of people interviewed around Budongo Forest Reserve said they had eaten the meat of Nahan's francolin. Clearly, hunting may pose a threat to Nahan's francolin. This activity frequently accompanies long pitsawing trips into the forest, where groups of people may camp for several weeks, relying on bushmeat as a food source (Sande 2001).

This section presents some preliminary data that we collected on hunting patterns of galliformes in general, and the relative hunting pressure on forests and surrounding agricultural and savanna populations of galliformes. There are three common forest and forest edge francolins in Uganda, scaly francolin *Francolinus squamatus*, Nahan's francolin and forest francolin *Francolinus lathami* (Urban et al. 1986). However, these are all small-bodied birds compared to the abundant helmeted guineafowl *Numida meleagris* and crested guineafowl *Guttera pucherani* that inhabit semi-open and forest habitats respectively. We were interested in finding out the relative use of these different species and habitats.

4.2 Methods

We used quesionnaire surveys to gain information on hunting areas and methods used to catch birds. For the data analysed here, we used the general questions shown in table 4.1.

Table 4.1 Questions asked to hunters.

Question	Possible responses
1. How frequently do you go hunting?	less than once a month; less than once a week; once a week; twice a week; more than twice per week; daily
2. At which time of day do you hunt?	*any of:* dawn; noon; evening; night
3. Where do you hunt?	forest; agricultural areas; savanna
4. How do you move during hunting?	tracks only; mainly tracks; occasionally tracks; always cut my own way
5. How do you hunt?	*any of:* gun; bow; hand; net; traps; panga; dogs
6. How do you use hunted galliformes?	*any of:* food, feather; sell at market; decoration; culture
7. What are your main sources of food?	*any of:* crops; bushmeat; fish; livestock

To determine how precisely the hunters were able to distinguish the species of interest, we showed each interviewee a set of plates of galliformes scanned from Stevenson & Fanshawe (2001) of the following species: Nahan's francolin, crested guineafowl, helmeted guineafowl, forest francolin (male), Orange River francolin *Francolinus levaillantoides* and scaly francolin. They were presented in no particular order, and no hints were made that we were interested in Nahan's francolin in particular. Orange River francolin was included as a control species, being relatively well-marked but not occurring in Uganda. Many interviewees could not name or did not especially recognise several of the species. Conversely, many thought they recognised Orange River francolin. We therefore exercised extreme caution in interpreting any data attributed by the hunter to individual species. Most people knew the difference between guineafowls and francolins, but did not take it any further than that. This is reflected in the local names used by Luganda speakers around Mabira forest: nkwale (francolins) and nkofu (guineafowls). Although Nahan's francolin does have a name in Luganda (nkojjo), this was rarely used and seemed to be known by only a few hunters.

Because many people were unable to distinguish pictures of several francolins and the two species of guineafowl, we estimated relative use of forest versus non-forest species by asking people to tell us the habitats they regularly visited for hunting. Given that the galliformes species are habitat species, we assumed hunters using forest to be catching crested guineafowl, Nahan's francolin and forest francolin, and hunters using gardens and savanna to be catching scaly francolin and helmeted guineafowl. This interpretation was supported by the relatively few hunters who appeared to be able to distinguish all species accurately.

Interviews were conducted in a sensitive and non-judgmental way without making any reference to conservation or illegal forest use. We used a native speaker of the local village language wherever possible to make sure that interviewees felt relaxed and gave truthful answers. Small token payments were made strictly to village chairmen (not directly to interviewees) at the end of an interviewing session at a particular village. No mention of payment was made until after the questionnaires had been completed.

4.3 Results

In total, 245 questionnaires were completed. Sixty-eight of these were written in Luganda and are currently being translated. We therefore report preliminary results based on the remaining 177 questionnaires that were written in English.

4.3.1 Frequency of hunting

Only 13% of respondents went hunting more than once per week, suggesting that hunting did not form a major occupation for many of the people we spoke to. A significant number of people went hunting less than once per month, and only 5.6% went hunting on a daily basis. Our data suggest that hunting is not an important part of village life, with very few career hunters among the people we spoke to. We rarely saw bushmeat being brought into villages, and there appeared to be no deep cultural association with hunting. People that hunted daily tended to be very old men who had specialised in hunting for most of their lives.

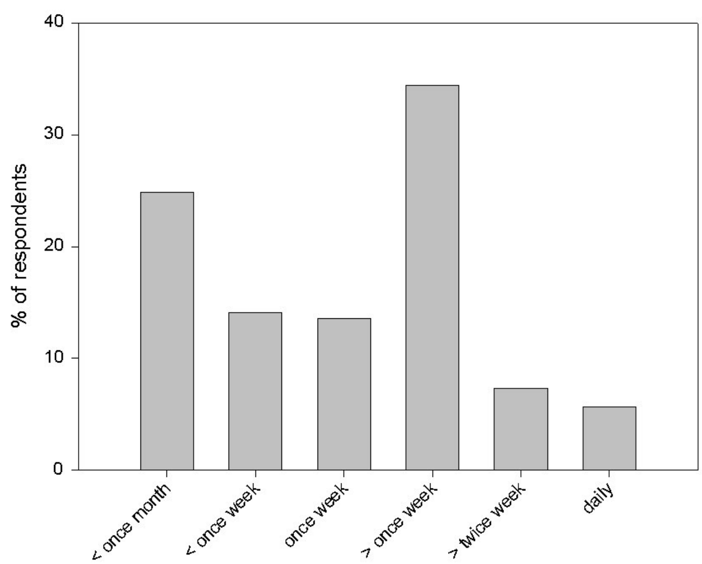


Figure 4.1 Frequency of hunting trips by respondents.

4.3.2 Time of day

The most frequent type of hunting trip (38%) took an entire day to complete. Other people hunted mainly either just in the morning (22%) or just during the middle of the day (26%). A significant proportion of people (5%) hunted during the night, capturing francolins and guineafowls often by hand as they roosted between buttresses of forest trees. Several respondents reported that they walked up to 20 km into the forest to hunt. Clearly such an expedition would require an entire day, and several hunters said that they camp in the forest overnight.

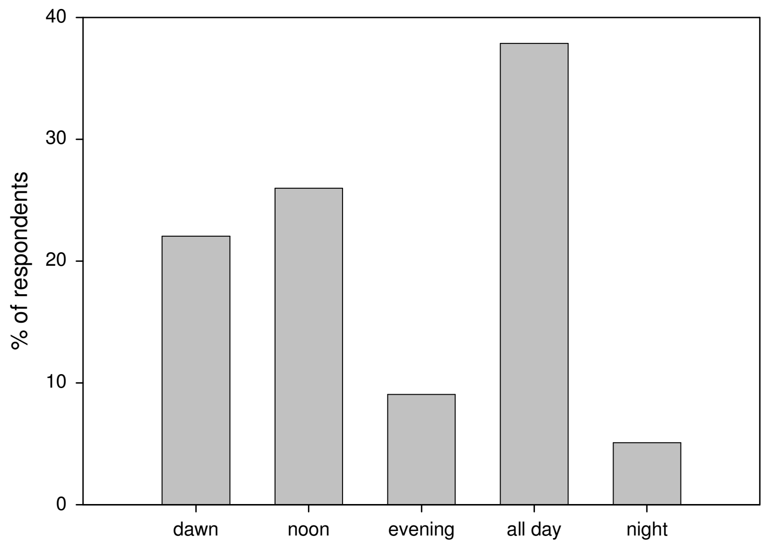


Figure 4.2 Timing of hunting trips

4.3.3 Location of hunting and movement while hunting

Over 60% of respondents said that they hunted within the nearby forest reserve (figure 4.3). This suggests that many people were hunting the two species of francolins (Nahan's and forest) and crested guineafowl while in the forests. They also took part in group trapping events for mammals such as duikers and bush pigs. However, 44% of respondents said they hunted in agricultural areas surrounding their homes, and their activities were portrayed as pest control in the belief that galliformes, particularly guineafowls, were eating their crops.

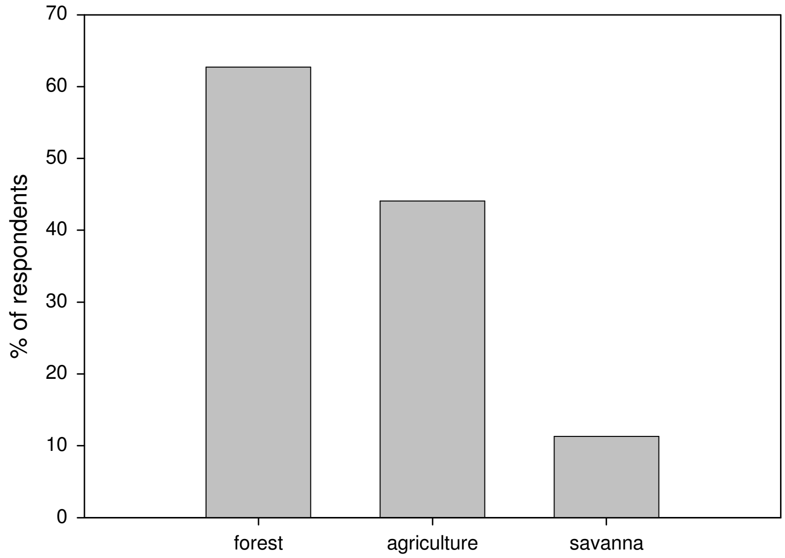


Figure 4.3 Location of hunting trips.

4.3.4 Methods of hunting

By far the commonest way to catch galliformes was by hand (54% of respondents; figure 4.4). Usually this involved throwing stones or branches at the birds, or using a catapult or makeshift spear. This suggests that most hunting was opportunistic and not part of an organised effort. However, nets were used by over 30% of respondents. Typically, these were long nets strung out in the forest. Packs of dogs, and people shouting or beating objects would then move through the forest, scaring birds and other animals into the nets. Other people, concealed near the nets would then kill the animals as they became temporarily entangled.

About a third of respondents (29%) used traps set out in the forest and in agricultural areas to catch galliformes. Typically, these were dome-shaped rings of sticks baited with seeds. These traps were specifically targeted at francolins, which would walk into the traps and allow a person to close up the entrance before they had a chance to escape. See figure 4.5 for a photograph of a francolin trap set up in the forest. We encountered these traps on a regular basis in the forest. In some areas, very many traps had been set out, but usually they were near a settlement at the edge of the forest, presumably because they had to be regularly checked by the owner.

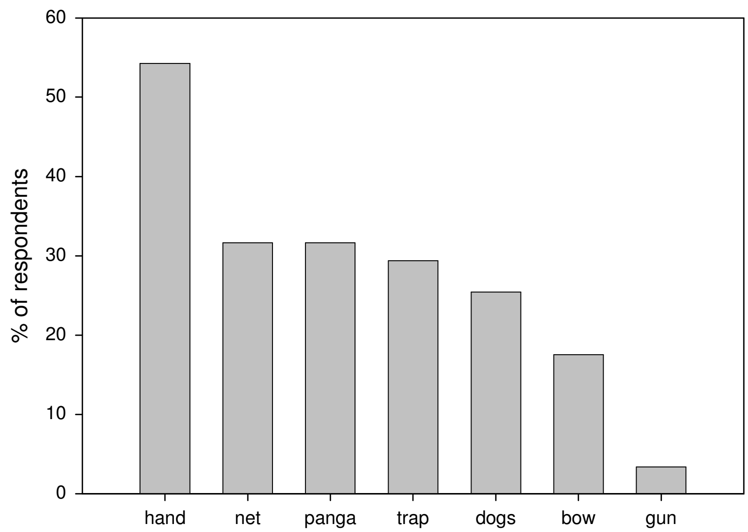


Figure 4.4 Methods used to catch galliformes.

Figure 4.5 A francolin trap in Budongo Forest Reserve. The trap is baited with seeds and fruits, attracting the birds to squeeze through the narrow gap into the centre of the trap. As the hunter approaches, the birds panic and cannot quickly get back out again. They are then collected by the hunter.

4.3.5 Use of hunted Galliformes

The vast majority of respondents (86%; figure 4.6) said that they used hunted galliformes for food. Several people said that Nahan's francolin was considered a real delicacy by local people, and was always greatly appreciated when it could be obtained. About 12% of respondents said they sold meat to other villagers, indicating that hunting to make a living was not particularly common in the areas we surveyed. Other uses of galliformes, such as using the feathers for decoration etc, were not at all common.

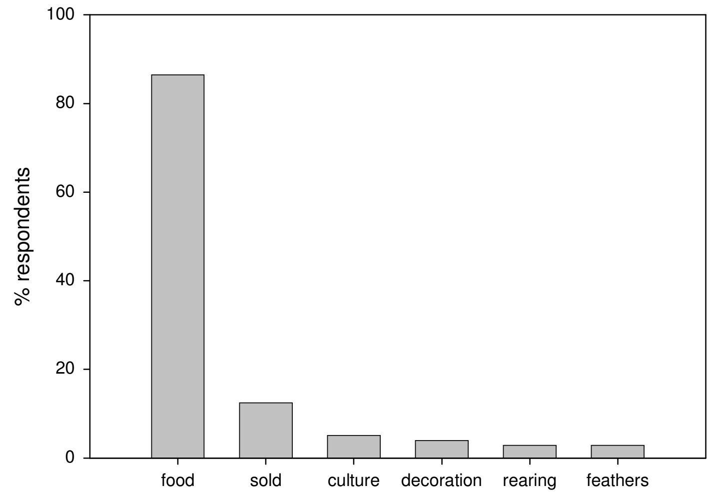


Figure 4.6 Uses of hunted galliformes.

4.3.6. Reliance on hunting

All but one respondent said that his family relied on crops as one of their main sources of food (figure 4.7). Villages surrounding the forest reserves are almost entirely subsistence communities, and all households had an area of gardens around them, in which crops such as cassava, bananas, pineapples etc were grown on a small scale. Perhaps most interesting from a conservation points of view was that 68% of respondents indicated that their families ate bushmeat on a regular basis. Although much of this bushmeat was in the form of guineafowls hunted relatively close to people's homes, most hunters also visited the forest on a regular basis, and most respondents said they regularly ate forest species. These data suggest that there is a significant minority of people who regularly eat bushmeat.

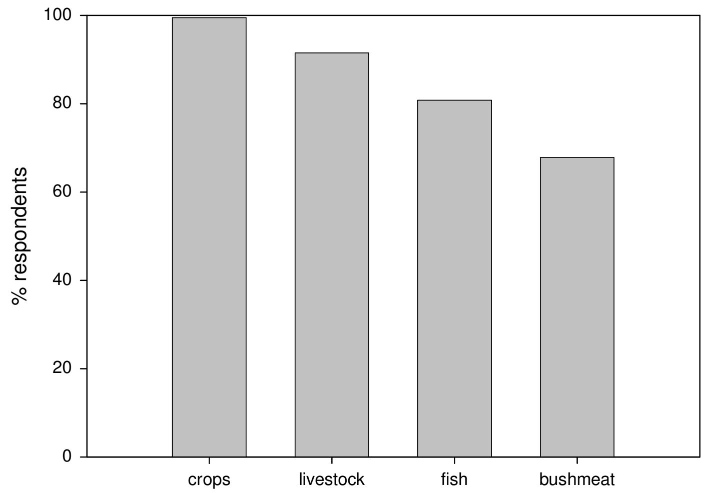


Figure 4.7 Main sources of food for families of hunters.

4.4 Discussion

Sande (2001) suggested that hunting for galliformes and other forest animals is becoming unfashionable. Our data support this opinion, with very few career hunters among the people we spoke to. People that hunted daily tended to be very old men who had specialised in hunting for most of their lives.

In many ways, hunting in agricultural areas could be encouraged in preference to entering forests. In agricultural areas, people can only catch helmeted guineafowls and scaly francolins, both of which are abundant species of no immediate conservation concern. Perhaps ways could be sought of encouraging hunters to switch from using the forest to using the areas closer to their homes. In this way, they will not affect Nahan's francolins, a globally threatened species. Furthermore, other forest-dwelling galliformes such as forest francolin, are generally rare and although not globally threatened, deserve some special conservation attention because of their extreme habitat specialisation.

Using nets for hunting is particularly worrying from a conservation point of view because it appeared to be completely indiscriminate with respect to the quarry. Small francolins were just as likely as larger forest mammals to get caught - anything that was between the beaters and the nets was likely to be caught.

The fact that most hunted galliformes were used for food, and relatively few were sold at market suggests that there may be scope for domestication projects for guineafowl, which may help alleviate the shortage of meat in these poor rural areas. Alternatively, projects such as the goat husbandry programme suggested in chapter 5 of this volume may help boost the quality and quantity of meat that villagers with small-scale livestock holdings can produce.

Our results suggest that hunting is probably a dying trade, and that fewer and fewer young people are taking up hunting in a serious way. This opens up opportunities for conservation awareness programmes, and perhaps income generating and small-scale food production projects that can be linked to removing the need to enter the forest and hunt for bushmeat. These programmes should initially be targeted at the minority of people that still regularly hunt forest galliformes.

5 Research and management plan for the Nahan's francolin in Uganda

5.1 Introduction

Given the fairly substantial amount of work on Nahan's francolin in the past decade (Plumptre 1996, Dranzoa et al. 1997, Dranzoa et al. 1999, Sande 2001, Sande et al. 2001, this report), we are now in a position to think strategically about future priorities for research and management. A series of meetings was held in Uganda in March 2004, and recommendations arising from those meetings are presented here. These are not yet fully agreed priorities, rather they represent the first step in a process that will feed into the next red-listing exercise to be conducted by the IUCN/WPA/BirdLife International Partridge Quail and Francolin Specialist Group in late 2004.

The authors of this report would be very glad to hear from anyone wishing to undertake or fund any of the work listed below. Please email any comments to Richard Fuller at r.a.fuller@dunelm.org.uk.

5.2 Research priorities

The following list of research priorities has been distributed to 14 interested parties for comment. The parties represent Makerere University, NatureUganda, the Percy FitzPatrick Institute of African Ornithology, the IUCN/WPA BirdLife International Partridge Quail and Francolin Specialist Group, the Okapi Project, the World Conservation Society, and the World Pheasant Association. It will be redrafted for final agreement at the Pan-African Ornithological Congress in Tunisia in November 2004.

The aim of this list of research priorities is to ensure that all interested researchers approach work on this globally threatened species in a strategic way, so that each piece of work addresses an agreed priority in a global context. Priorities are listed in decreasing order of urgency. This should eventually enable the first full global assessment of its status within a few years' time, perhaps best accomplished as a workshop held in Uganda or DRC in 2006/7.

5.2.1 Surveys for Nahan's francolin in eastern Democratic Republic of The Congo

The current status of the species in eastern DRC is currently unknown. It is reported from several sites, but systematic surveys are now urgent. Surveys have recently become feasible in many areas because of the easing security situation. It is now possible for Congolese (but not foreign) researchers to conduct extensive survey work safely in several of the candidate forests. It is vital that the surveys cover as large a proportion of each target forest as possible, as the francolins may occur in only part of any given forest. There are seven forests (five currently accessible), so there is a lot of work to be done. Some pilot work looking at hunting pressure should accompany these surveys if possible, as there is some evidence that hunting is a far greater problem in DRC than in Uganda.

Forests that should be surveyed:

- Maiko (lowland sector). Currently possibly unsafe, but the situation may be improving, and surveys may be possible in a few years' time.
- Kahuzi-Biega (lowland sector). Currently unsafe, although Irangi, a forest patch about 100km from the boundary is safe and should be investigated.
- Virunga (lowland sector). Currently safe and should be surveyed as soon as possible.
- Ituri Forest (eastern side). Currently safe and easily accessed from Okapi Project base. Should be surveyed as soon as possible.
- Ituri Forest (western side). Currently safe and easily accessed using the University at Kisangani as a base. This is at the westernmost limit

of the known range of Nahan's francolin. Should be surveyed as soon as possible.

- Itombwe (lowland sector). Currently unsafe, never been a protected area, and cannot be surveyed in the foreseeable future, although it almost certainly holds the francolin.
- Tayna Forest (most of the forest is within the known altitudinal range of Nahan's francolin). Currently safe and should be surveyed as soon as possible.

Using the now well-developed method, large areas can be surveyed relatively easily, although the surveyors need private transport to ensure comprehensive coverage.

Figure 5.1 Kahuzi-Biega National Park. One the immediate priorities for surveys of the Nahan's francolin in the Democratic Republic of The Congo.

5.2.2 Surveys in Uganda

Due to substantial effort since 1997, we now have good estimates of the population status in Mabira, Budongo and Bugoma Forests, and the beginnings of a monitoring programme for Uganda. However, we feel that some further surveys are required to complete this picture, in particular to make sure that no Ugandan populations have been overlooked.

- Forest patches between Bugoma and Kibale. There is almost a continuous distribution of patchy forest all the way from Bugoma to Kibale. These should be intensively surveyed, so we have presence / absence data for as many patches as possible.
- Kibale. CD and ES have surveyed some northern parts of the forest, but much of the National Park remains unsurveyed, and there are persistent claims that Nahan's occurs in Kibale.

5.2.3 Conservation-relevant research

Surveys in Budongo and Bugoma have shown that Nahan's francolin can be found in very small forest patches, down to isolated patches only a few hundred metres across. These are unlikely to be just relict populations, because many of the Bugoma patches are of natural origin, and therefore likely to be relatively old. This implies that birds can disperse across nonforest habitat to colonise new areas, and recent surveys (see chapter 3) have found birds in scrub habitats (*Lantana camara*) hundreds of metres away from forest. Understanding how the species responds to fragmentation is crucial given the kind of habitat change underway in many of the sites. We propose therefore, that the next tranche of ecological research should include:

- dispersal between patches
- effects of patch size
- effects of patch isolation
- can empty patches be recolonised?
- can we use metapopulation models to estimate the importance of particular patches?
- genetic variability within and between patches - implications for corridors etc
- comparison of genetic variability among populations from different parts of the range - e.g. Mabira population is now an isolated outlier
- how does group membership change over time?

- data on survival (nb these birds are relatively easy to catch)

Such work is probably best tackled as a PhD project, although Masters projects could concentrate on some specific aspects.

5.2.4 Saving the Mabira population

Our surveys (chapter 2) have indicated that the Mabira population is probably not much above 2000 groups, and that it supports the lowest density of francolins of any known site (12 groups per km^2). Mabira is also under intense pressure from habitat destruction. Given that the other currently known populations are relatively well protected, we suggest that current "crisis-orientated" action should focus on Mabira and comprise the following components:

- Community-conservation projects. Interviews have suggested that income-generating projects will help reduce illegal forest use. We have contacts with MAFICO (see figure 5.2), a small NGO wishing to implement a goat husbandry programme to improve the value of villagers' livestock and the provision of *Aloe vera* seedlings and training in how to grow and harvest them. Both projects to be explicitly linked with the need to reduce forest use. Any other ideas for community conservation projects?
- Continuous monitoring of the francolin. We need hard data to demonstrate declines caused by habitat loss, so monitoring is essential in documenting population changes.
- Paper mulberry, an exotic tree has colonised a large area in the eastern part of the forest. There are no Nahan's francolins (and very little of anything else) in this habitat. Further research on how this invasive tree species spreads and how it might be controlled is urgently required.

Figure 5.2 Meeting with the Steering Committee of the Mabira Forest Integrated Community Organisation (MAFICO) in April 2004. These people are committed to conservation through development.

5.2.5 Monitoring the populations

Long term monitoring of the species can be carried out reasonably cheaply. One month's survey work can provide enough data for a forest of about $400km^2$. Work purely concentrating on surveys only requires one researcher plus guides etc. Therefore, with 3 researchers working as independent groups together with associated field assistants etc, the global range of the bird could be covered in about 4 months. We recommend that surveys of known forests are conducted at 10 year intervals. Assuming the DRC surveys are conducted within the next few years, the next round should be scheduled for 2015, and timely funding applications put in place to ensure that it happens.

5.3 Management priorities

As well as research priorities, the data presented in this report suggest a number of management recommendations to help conserve Nahan's francolin. Note that, because we know nothing of the species' status in DRC, these recommendations relate only to the three Ugandan sites.

The following management points are a synthesis of recommendations made by Sande (2001) and conclusions arising out of the work presented in this report. Our knowledge of Nahan's francolin biology is still relatively poor, so these recommendations should be refined as new information comes in.

5.3.1 Declare Bugoma forest an Important Bird Area

The data presented in this report show that Bugoma forest contains the highest density of Nahan's francolin of any site so far surveyed. Despite the fact that only one globally threatened species is confirmed for Bugoma, the population of Nahan's francolins on present knowledge appears crucial to the long term survival of the species. This suggests that Bugoma deserves recognition as an Important Bird Area for this reason alone. On top of this, Bugoma supports several Guinea-Congo biome-restricted species (Sande 2001). IBA status would help support arguments for more on-the-ground protection for Bugoma forest, which may be subject to more intense human pressure in the future as the security situation improves.

Figure 5.3 Bugoma forest contains the largest known population of Nahan's francolins

5.3.2 Enforce government forestry policy in Mabira

We have collected strong evidence suggesting that severe logging destroys populations of Nahan's francolin, and monitoring data collected over the next few years at Mabira should demonstrate this conclusively. Furthermore, forest clearance around the edge of Mabira forest has by definition resulted in loss of Nahan's francolins. The Mabira population of Nahan's francolin is now very low, and further action to restrict habitat loss and damage is crucial in preventing the extinction of the population. We observed rampant illegal logging, as well as illegal clear-felling of some northern parts of the forest (chapter 3). Existing Forestry Authority policy is undoubtedly sufficient to prevent this decline, but without strict enforcement of the rules, extinction of the Mabira population seems possible in the medium term.

Figure 5.4 Illegal logging continues apace in many Ugandan forests.

5.3.3 Provide alternative incomes for people illegally taking forest resources

As mentioned above (section 5.2.4), community-conservation projects in Mabira may help provide alternative incomes and more attractive livelihoods for people currently engaged in illegal forest use. Such projects could include microfinance projects, goat husbandry programmes to improve the value of villagers' livestock, the provision of Aloe vera seedlings and training in how to grow and harvest them, provision of forest tree seedlings for small-scale agroforestry projects etc.

Additionally, a more explicit link between ecotourism revenue and benefits for local people may help deter illegal forest use, although current tourism revenue is very low. A recent economic study in Mabira by Naidoo (in press) found that current ecotourism facilities there are "severely underpriced, compared to what tourists appear willing to pay". Privatisation of ecotourism facilities at Mabira is due within a few years, and this may help to boost tourist revenue.

Figure 5.5 Ecotourist facilities at Mabira are thought to be underpriced, and could generate far greater income than is currently the case

5.3.4 Provide a reliable public viewing station for Nahan's francolin

As recommended by Sande (2001), the Nahan's francolin itself could be used to generate tourist revenue directly related to conservation of forest animals. It should be possible to set up a permanent bird hide in suitable habitat, and perhaps provide supplementary food for the francolins in a way that would guarantee high quality sightings of the bird for visiting birdwatchers and other nature tourists. Nahan's francolin is one of the main target species of many birdwatchers that visit Uganda, and lucrative deals with the many specialist tour operators may be possible if Nahan's francolin sightings could be more or less guaranteed. This might also help reduce pressure on the species in other parts of its range, where it is repeatedly subject to tape-luring by successive groups of visiting birdwatchers. This type of project should be owned and implemented by a local community group, and the income used to provide local amenities.

Figure 5.6 For many birdwatchers visiting Uganda, a sighting of the elusive Nahan's francolin is a priority. There are very few photographs in existence of this threatened species in the wild. Photo © Eric Sande.

6. Current activities

Thanks to support from the British Airways Communities and Conservation programme, Richard Fuller visited Uganda in April 2003. During this visit, meetings were held with several interested parties about future plans for Nahan's francolin conservation and related research work (see chapter 5 for a summary of recommendations). This chapter provides current information on the status of current research and conservation activities.

6.1 Surveys in the Democratic Republic of The Congo

A likely source for funding Nahan's francolin survey work in eastern Democratic Republic of The Congo has been identified, and work should commence sometime in 2004. As part of an MSc project, a young Congolese researcher will generate baseline data on Nahan's francolin from Kahuzi Biega and Iringi forests in DRC. Nothing is known about the status of Nahan's francolin in these forests. They will also survey some parts of Kibale National Park in Uganda, where Nahan's francolin may occur, but has not yet been detected in formal survey work. This project will train young Congolese graduates in techniques for surveying Galliformes, and as such help to build capacity for future research on African forest Galliformes.

6.2 Further surveys in Uganda

We are currently trying to identify people interested in conducting surveys in remaining parts of Uganda that have not yet been surveyed for Nahan's francolin (see chapter 5). Several students at the University of Durham, UK, have expressed an interest in putting together an expedition to Uganda in summer 2005 for this purpose. This will be timed to ensure that undergraduates from Makerere University can take part in the expedition as their field attachment, a requirement of their degree courses.

6.3 Scoping of community-based project and research work in Mabira

Richard Fuller had extensive discussions with the central steering committee of MAFICO, a fledgling conservation NGO spontaneously formed by local village chiefs around Mabira Forest (see concept paper below). The members of the NGO have an exciting vision for transforming agricultural practices in the Reserve and trying to live in closer harmony with forest wildlife for the benefit of both conservation and local people. The Nahan's francolin project team is eager to support them, and we have developed costed proposals for a project aimed at replacing illegal forest use with local agricultural projects that will allow people to generate their own income without further encroaching upon the forest.

MAFICO currently rents basic office space in Najjembe (figure 6.1), but has few facilities and no permanent members of staff. This hampers their ability to implement their well-developed ideas for local community conservation projects (see concept paper below). At present, all committee members are volunteers, a testament to their dedication to community-based conservation in and around Mabira. The Nahan's francolin project team considers that working through MAFICO is the best way to ensure that local people design and implement solutions to local problems of illegal forest use in Mabira. Only local solutions will last into the long term.

As well as community conservation work, a programme of ongoing monitoring and research is required in Mabira to collect data on changes in the population of Nahan's francolin there. In addition, further work is needed on the invasion of paper mulberry, an exotic tree species, into the eastern part of the forest. Such work will be carried out independently of the activities of MAFICO, but the two strands of work complement each other in the research work will identify problems and the community work help build solutions.

Projected costs are in the region of US$ 35,000, and we expect to submit a BP follow-up bid in October 2004.

Figure 6.1 Left: Robert Kungujje, the secretary of MAFICO, outside the office currently rented by the small community-based NGO. Right: owing to lack of funds, office facilities are basic at present. One of the aims of the proposed project is to provide core funding to allow MAFICO to employ a permanent member of staff in an office equipped with electricity, a computer and a telephone connection.

6.3.1 MAFICO concept paper

CONCEPT PAPER

MABIRA FOREST INTEGRATED COMMUNITY ORGANISATION (MAFICO)
P.O. BOX 142, LUGAZI, UGANDA. Tel: 077594000
Email: mafico2003@yahoo.com

Mabira Forest Integrated Community Organisation (MAFICO) is a non-governmental organisation (Registration No. 5.5914/4330) and is operating in and around Mabira Forest Reserve in Najjembe Sub County, Mukono District. Eleven (11) members of the central steering committee that were elected during a delegate conference manage MAFICO. The delegate conference consists of two members for each community interest group (CIG). The management team is headed by an executive secretary and with some technical staff, they manage the day to day activities of the NGO.

VISION

The mission of MAFICO is to improve the livelihood and welfare of the local communities by conserving the environment through development.

OBJECTIVES

The following are the major objectives of MAFICO:-

- To encourage the conservation of natural resources in and around the communities through awareness, education and carrying out demonstrations.
- To encourage within the communities socio-economic and environmental benefits through sustainable development programmes.
- To promote networking with other community interest groups (CIGs, community-based organisations (CBOs), non-governmental organisations (NGOs) and government organisations (GOs), involved in integrated resource management programmes.
- To carry out training in fields that support conservation and improve on the standards of living of local people.
- To identify markets for products produced by the members and develop strategies needed in strengthening the markets.
- To identify and solicit funds for the organisation in order to strengthen the organisation's management capability and that of its members in natural resource management, provision of social services and poverty alleviation.
- To promote social services in the areas of health, gender, community development, culture, education and agriculture, to mention but a few areas.
- To promote savings and credit schemes among the local communities and within the CIGs.
- To do anything possible and necessary for the attainment of the vision of MAFICO.

MEMBERSHIP

The membership of MAFICO shall be open to the following persons:-

- Ordinary members. Here one may belong to more than one CIG, but may only represent one CIG at the delegates conference (DC).
- Honorary members: This shall be given to any person who has made an outstanding contribution to MAFICO. Such a member shall be exempted from all membership fees and subscriptions. He or she shall be proposed by the central steering committee (CSC) and approved by the DC.
- Associate members. Membership shall be for any person interested in resource management and social and economic community development who does not belong to and CIG or local NGO affiliated to MAFICO.

- Corporate members. Members shall include any firms, institutions, associations or bodies interested in the promotion of the aims and objectives of MAFICO through the payment of corporate subscription fees from time to time.

Membership shall be effective only after payment of fees. The name of every member shall be entered in a register to be maintained at the headquarters of MAFICO. A member shall be of sound mind and above the age of eighteen, except students and pupils of schools and institutions affiliated to MAFICO.

INTENDED ACTIVITES

Forest resource conservation through use of alternative outside forest resources. The activities involve:-

- Agroforestry of firewood, timber, fielding tree species
- Commercial cultivation of medicinal plants, Moringa, Kigagi and others.
- Income generation with activities that are forest friendly.
- Capacity building for staff, CIG members and infrastructure.
- Promote and encourage use of fuel-efficient earth stoves using the community volunteerism extension approach.

ACHIEVEMENTS

- Baseline survey needs assessment conducted in MAFICO areas of operation (Najjembe Sub-County). A report has been compiled and forms a basis for project privatisation.
- Constitution writing and its promulgation, August 27th, 2002.
- Collaboration with forest department as a partner in integrated resource management and conservation.
- Study tours to local NGOs involved in integrated forest resource conservation, particularly Budongo Forest Community Development Organisation.
- Mobilisation of sixty (60) CIGs involved in activities such as agriculture, conservation of forest resources, health, education etc within and around Mabira Forest.
- Registration of the organisation with the NGO board, Ministry of Internal Affairs, Gender and Community Development, Mukono District, and Najjembe Urban Authority.

FUTURE PLANS

- Purchase of land (10 hectares) to accommodate organisation premises and land for agricultural demonstration purposes.

7. Appendix

This section lists outputs generated from the project so far. We will be writing up the density, habitat and exploitation results for submission to scientific journals. In the meantime, please do not hesitate to contact Richard Fuller (r.a.fuller@dunelm.org.uk) for further information on any of the material presented anywhere in this report, or for access to any of the sources cited, photographs used etc.

CURRENT CONSERVATION STATUS OF THE NAHAN'S FRANCOLIN IN UGANDA

Richard A. Fuller[1*], Perpetra Akite[2], John B. Amuno[2], Claire L. Flockhart[1] John M. Ofwono[2], Gil Proaktor[3] & Richard Ssemmanda[2]

At a glance – PROJECT SUMMARY

The Nahan's francolin is listed as globally **ENDANGERED** by IUCN. Being a strict forest specialist, the few remaining populations are highly isolated. We estimate that there are approximately 23,000 groups of birds remaining in the three known Ugandan sites. Numbers appear to have been stable since the late 1990s. We found that habitat preferred by the francolin has already been lost in Uganda, and Mabira Forest in particular is under severe pressure from habitat destruction. Although the bird is hunted, our data suggest that direct exploitation has not contributed greatly to the bird's current plight.

We are seeking funds urgently for surveys in Democratic Republic of Congo, where the status of Nahan's francolin is completely unknown and are ready to implement community conservation projects through a local NGO in Mabira Forest as soon as funding becomes available.

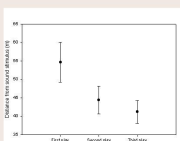
2. What we did

(a) To estimate population densities, we made playback surveys at 1104 points spaced at least 200 m apart: 387 in Budongo, 354 in Bugoma and 363 in Mabira.

(b) To examine habitat preferences, we took habitat descriptions at 406 of the survey points, 220 at points where francolins were detected, and 186 at randomly-selected points.

(c) To assess hunting pressure, we talked to over 200 people who regularly hunt birds in the forests.

Right: Repeated playback surveys revealed that francolins moved towards the tape at about 7 metres per minute. Surveys for Galliformes using playback should always consider this potential bias.



Below: Estimated densities of Nahan's francolin in all known Ugandan sites, together with population estimates. In the late 1990s, Sande (2001) estimated the Budongo population at 6,578 groups (5,850 - 7,305).

	Density (groups/km^2 & 95%CI)	Population (number of groups & 95%CI)
Budongo	16.88 (12.56 - 22.68)	7,223 (5,376 - 9,705)
Bugoma	33.87 (25.31 - 45.32)	10,160 (7,592 - 13,595)
Mabira	12.46 (9.23 - 16.81)	2,543 (1,885 - 3,432
Total		**19,926 (14,853 - 26,732)**

References

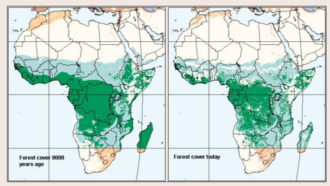
[1]Fuller, R. A., Carroll, J. P., & McGowan, P. J. K. (eds.). 2000. *Partridges, quails and francolins - Status survey and conservation action plan 2000–2004*. IUCN, Gland, Switzerland and Cambridge, UK; [2]Dranzoa, C., J. Nkwasire & E. Sande. 1999. Additional surveys of Nahan's Francolin, *Francolinus nahani*, in the tropical rainforests of Uganda. *Bulletin of the African Bird Club* 6: 52-55; [3]Sande, E. 2001. *The ecology of the Nahan's francolin* Francolinus nahani *in Budongo Forest Reserve*, Uganda. PhD thesis, Makerere University, Uganda

Addresses

[1]University of Durham, South Road, Durham DH1 3LE, UK; [2]Faculty of Veterinary Medicine, Makerere University, P.O. Box 10066, Kampala, Uganda; [3]Imperial College, South Kensington, London SW7 2AZ; [*]Corresponding author. Email: r.a.fuller@durham.ac.uk

1. The Nahan's francolin

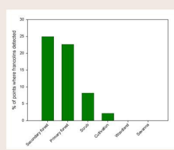
- It occurs globally in less than 10 forest fragments in Uganda and eastern Democratic Republic of Congo[1].
- Because of declines in range area, it faces a high risk of extinction in the near future[1].
- It appears to be a forest specialist, using closed forest up to 1400m[2], but its tolerance of degraded and secondary habitats is poorly known.
- It lives in groups that range over c 14 hectares. Groups are larger in unlogged than in logged forest. Productivity is affected by logging[3].



Above: Forest loss and fragmentation in Africa. Uganda has been particularly badly hit by forest loss, and many of its forest-specialist plants and animals are globally threatened.

Below: Habitat preferences of Nahan's francolins. We included forest structural variables in a factor analysis and then used multiple logistic regression to find significant predictors of francolin presence.

Variable	Correlation with factor	Prediction for francolins
canopy cover	0.60***	prefer dense canopy
canopy height	0.63***	prefer tall canopy
understorey cover	0.32***	prefer dense understorey
understorey height	0.19***	prefer tall understorey
ground flora cover	-0.60***	prefer sparse ground flora
ground flora height	-0.33***	prefer short ground flora



Left: Secondary forest held good numbers of Nahan's francolins. We think the birds in scrub habitat (mainly thickets of the introduced *Lantana camara*) were dispersing between forest patches.

Left: Illegally cut timber being sawn up by pitsawyers in Budongo. The sawyers ran from the scene when we disturbed them. Illegal logging is sadly rife in Ugandan forests.

Above: A rare photo of a group of Nahan's francolins roosting in the buttresses of a forest tree in Budongo Forest Reserve. Photo by Eric Sande.

Above: Locations of the three study sites in Uganda. Note the close proximity of Mabira forest to Kampala, the capital city. This results in severe pressure on the forest for logs and saplings for charcoal production.

Above: Children often hunted Galliformes during school holidays. Here, team member John Ofwono is skilfully interviewing the children about the hunting without being judgmental. Our results suggest that hunting has not badly affected Nahan's francolin – although tasty, they are too difficult to catch!

Above: An illegal charcoal-burning pit in Mabira. Saplings are cut, buried and left to smoulder for several days. Dense shrubs have colonised this area, where a large gap in the canopy has been created.

This work was funded by a BP conservation silver award. We are also grateful to Makerere University, the World Pheasant Association and private donors for additional advice and support. Grateful thanks to Philip McGowan, Christine Dranzoa, Derek Pomeroy, Eric Sande, Panta Kasoma, Fred Babweteera, Robyn Dalzyn, Marianne Dunn, Nigel Dunstone, Tinker Israel, Robert Kungujje, Geoffrey Okethuwengu and Kate Stokes.

the bp conservation programme

University of Durham

7.1 Poster presented by Richard Ssemmanda, Richard Fuller & Claire Flockhart at the 8th International Galliformes Symposium held in Dehra Dun, India on 4th - 11th April 2004.

Recovery of the Nahan's Francolin (Silver Award 2003)

The team has now finished the fieldwork stage of their project on the Nahan's francolin. They spent three months studying the bird in three forests in Uganda where it still occurs, and, offering significant hope for the future, the team found healthy populations.

The team also found that the bird is able to tolerate some degree of habitat degradation, but severe logging of mahogany trees is forcing these birds and much of the other wildlife out. The team saw rampant illegal habitat destruction, including within protected areas. While Budongo and Bugoma Forests appear relatively well protected, urgent action will be required to prevent the extinction of the francolin population in Mabira Forest. The team found that a large proportion of the reserve has been invaded by an exotic tree species, forming habitat in which the francolin and other species cannot survive. Being an isolated forest patch close to the capital city, there is heavy use of forest resources by people living in and around the reserve, and the forest is being cleared from the edges and converted to agricultural plantations. The team talked to over 200 people, many of them children, who regularly hunt forest birds and mammals. Most of them said that the Nahan's francolin tastes very nice, but is a very cunning bird and extremely difficult to catch! The main way they are caught is by setting up very large nets across the forest floor and then chasing birds and other wildlife into them with packs of dogs. On balance, it appears that hunting does not pose an immediate problem to the survival of the Nahan's francolin.

The project team forged close links with MAFICO, a fledgling conservation NGO spontaneously formed by local village chiefs around Mabira Forest. The members of the NGO have an exciting vision for transforming agricultural practices in the Reserve and trying to live in closer harmony with forest wildlife for the benefit of both conservation and local people. The team is eager to support them, and the team leader is returning to Uganda in March 2004 to discuss ways to work with MAFICO in the future. The team will also be presenting work from their project at the 8th International Galliformes Symposium, which will be held in India in April. The conference is run by the World Pheasant Association in collaboration with several IUCN Specialist Groups. The website is http://www.pheasant.org.uk/india2004.asp.

7.2 Text that appeared in the March 2004 issue of the BP Conservation Programme newsletter. It can be downloaded from the BP Conservation website at http://conservation.bp.com/.

References

Aebischer, N. J. 1997. Fowl-like birds (Galliformes). *In*: Roth, H. H. and Merz, G. (eds.). *Wildlife resources: a global account of economic use*, pp. 143-154. Springer-Verlag, Berlin.

Barden, L. S. 1980. Tree replacement in small canopy gaps of a cove hardwood forest of the southern Appalachian mountains. *Oikos* 37: 205-209.

Bennun, L., Dranzoa, C. & Pomeroy, D. 1996. The forest birds of Kenya and Uganda. *Journal of the East African Natural History Society*. Special issue.

Binggelli, P. 1998. *An overview of invasive woody plants in the tropics*. School of Agricultural and Forest Sciences Publication Number 13. Bangor: University of Wales.

BirdLife International, 2000. *Threatened birds of the world*. BirdLife International, Cambridge, UK.

Brokaw, N. V. L. 1985. Gap-phase regeneration in a tropical forest. *Ecology* 66: 682-687.

Canham, C. D. 1989. Different responses to gaps among shade-tolerant tree species. *Ecology* 70: 548-550.

Carroll, J. P. & A. Hoogesteijn. 1995. Observation of the Venezuelan wood-quail at Rancho Grande, Henri Pittier National Park, Venezuela. *Annual Review of the World Pheasant Association*, 1993/4: 67-72.

Christensen, N. L. J. F. Franklin. 1987. Small-scale disturbance in forest ecosystems. *Bulletin of the Ecological Society of America* 68: 51-53.

Clarke, P. 2003. The bushmeat crisis is emptying Africa's forests. *Environmental Magazine*, 18th April 2003.

Collar, N. J., M. J. Crosby & A. J. Stattersfield. 1994. *Birds to Watch 2: The World List of Threatened Birds*. Cambridge, UK: BirdLife International.

Dranzoa, C., E. Sande, I. Owiunji & A. J. Plumptre. 1997 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.

Dranzoa, C., J. Nkwasire & E. Sande. 1999. Additional surveys of Nahan's Francolin, *Francolinus nahani*, in the tropical rainforests of Uganda. *Bulletin of the African Bird Club* 6: 52-55.

Fishpool, L. D. C. & Evans., M. I. 2001. *Important Bird Areas in Africa and Associated Islands*. BirdLife Conservation Series No. 11.

Flüshöh, F. 2002. *The regeneration potential of Podocarpus in mountain forests of East Africa*. I-TOO Working Paper No. 5, pp. 89. Freiburg, Germany.

Fuller, R. A., Carroll, J. P., & McGowan, P. J. K. (eds.). 2000. *Partridges, quails and francolins - Status survey and conservation action plan 2000–2004*. IUCN, Gland, Switzerland and Cambridge, UK.

Fuller, R. A., P. J. K. McGowan, J. P. Carroll, R. W. R. J. Dekker & P. J. Garson. 2003. What does IUCN species action planning contribute to the conservation process? *Biological Conservation* 112: 343-349.

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.

Goth, A & U. Vogel. 2003. Juvenile dispersal and habitat selectivity in the megapode *Alectura lathami* (Australian brush-turkey). *Wildlife Research* 30: 69-74.

Hilton-Taylor, C. 2000. *2000 IUCN Red List of Threatened Species*. IUCN, Gland, Switzerland and Cambridge, UK.

Holm, L., J. Doll, E. Holm, J. Pancho & J. Herberger. 1997. *World weeds: Natural histories and distribution*. New York: John Wiley & Sons.

Howard, P. C. 1991. *Nature conservation in Uganda's tropical forest reserves*. Gland, Switzerland & Cambridge, UK: IUCN.

Howard, P., T. Davenport & F. Kigenyi. 1997. Planning conservation areas in Uganda's natural forests. *Oryx* 31: 253-264.

IUCN. 1994. *IUCN Red List Categories*. IUCN, Gland, Switzerland.

Langdale-Brown, I., H. A. Osmasten, H. A. & J. G. Wilson. 1964. *The vegetation of Uganda and its bearing on land use*. Government Printer, Entebbe.

Legare, M., W. R. Eddleman, P.A. Buckley & C. Kelly. 1999. The effectiveness of tape playbacks in estimating Black Rail densities. *Journal of Wildlife Management* 63: 116-125.

Lorimer, C. G. 1989. Relative effects of small and large disturbances on temperate hardwood forest structure. *Ecology* 70: 565-567.

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.

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: IUCN.

Naidoo, R. 2004 Species richness and community composition of songbirds in a tropical forest-agricultural landscape. *Animal Conservation* 7, 93-105.

Naidoo, R. in press. Biodiversity and Nature -based Tourism: The Potential for Sustainable Development in Uganda. *Environment & Development Economics*.

National Environment Management Authority. 1998a. *First national report on the conservation of biodiversity in Uganda*. NEMA, Kampala, Uganda.

National Environment Management Authority. 1998b. *Mukono District environment profile, 1998*. NEMA, Kampala, Uganda.

National Environment Management Authority. 2001. *Second national report on the conservation of biodiversity in Uganda*. NEMA, Kampala, Uganda.

Njoroge, P. & L. Bennun. 2000. Status and conservation of Hinde's Babbler *Turdoides hindei*, a threatened species in an agricultural landscape. *Ostrich* 71: 69-72.

Plumptre, A. J. 1996. Changes following 60 years of selective timber harvesting in BFR, Uganda. *Forest Ecology & Management* 89: 101-113.

Plumptre, A. J., Reynolds, V. & Bakuneeta, C. 1997. *The effects of selective logging in monodominant forest on biodiversity*. Final report of ODA project number R6057.

Rossouw, J. & Sacchi, M. 1998. *Where to Watch Birds in Uganda*. Kampala, Uganda: Uganda Tourist Board.

Runkle, J. R. 1981. Gap regeneration in some old-growth forests of the eastern United States. *Ecology* 62: 1041-1051.

Sande, E. 2001 *The ecology of the Nahan's francolin* Francolinus nahani *in Budongo Forest Reserve, Uganda*. PhD thesis. Kampala: Makerere University.

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.

Singer, B. 2002. *The road to sustainable mahogany trade in Uganda*. MSc thesis, University College London.

Sliwa, A. & T. W. Sherry. 1992 Surveying wintering warbler populations in Jamaica: Point counts with and without broadcast vocalizations. *Condor* 94: 924-936.

Stevenson, T. & Fanshawe, J. 2001. *Field guide to the birds of East Africa: Kenya, Tanzania, Uganda, Rwanda, Burundi*. Calton, UK: Poyser.

Urban, E. K., C. H. Fry & S. Keith. 1986. *The Birds of Africa, Volume 2. Gamebirds to pigeons*. London: Academic Press.

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.

White, F. 1983. *The vegetation of Africa, a descriptive memoir to accompany the UNESCO/AETFAT/UNSO Vegetation Map of Africa (3 Plates,* *Northwestern Africa, Northeastern Africa, and Southern Africa, 1:5,000,000)*. UNESCO, Paris.

Whitmore, T. C. 1978. Gaps in the forest canopy. pp. 639-655 *in*: Tomlinson, P. B. & M. H. Zimmerman (eds) Tropical trees as living systems. Cambridge: Cambridge University Press.

Whitmore, T. C. 1989. Canopy gaps and the two major groups of forest trees. *Ecology* 70: 536-538.

World Bank. 1986. *Joint UNDP/World Bank Energy Sector Managment Assistance Programme*. Activity Completion Report No. 053/86: Fuelwood/Forestry Project feasibility report. World Bank, Washington, DC.