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Assessing the status of Handsome Francolin *Francolinus nobilis* in Bwindi Impenetrable National Park, western Uganda

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The Handsome Francolin is a ground-dwelling partridge occurring in montane forest and the high-altitude bamboo zone within a restricted area along the Albertine Rift Mountains from the Bleus Mountains in eastern Democratic Republic of the Congo (DRC) south to Burundi (Urban *et al.* 1986, Madge & McGowan 2002). It appears to occur over a global range of about 120 000 km^2 (Fuller *et al.* 2000, BirdLife International 2004), although there are very few recent records from most parts of this area.

The small area of the Albertine Rift Mountains supports 41 endemic bird species, 11 of which are globally threatened (BirdLife International 2004, Plumptre *et al.* 2003). Forest covers much of the 56 000 km^2 in the Albertine Rift Endemic Bird Area, and much of it is rugged terrain very difficult to access (Shaw & Shewry 2001). Despite this, there are significant human pressures in the area, stemming mostly from large increases in human population densities as a result of refugee movements (Omari *et al.* 1999, Gatarabirwa *et al.* 2000). Being large, slow-moving, palatable, terrestrial birds, the Galliformes are under particularly direct pressure from humans through hunting and disturbance, and they may provide useful rapid indicators of the amount of human pressure in a particular area.

The area surrounding Bwindi is one of Uganda's most densely populated rural areas with human densities of 160–320 people/km^2. Approximately 10 000 families cultivate the land immediately surrounding the park (Butynski 1984). About 84 % of the forest compartments display signs of human activity, including pit sawing (29 %), hunting (24 %), mining (6 %), livestock (10 %) and footpaths (67 %) (Butynski & Kalina 1993). This suggests that species providing consumable bush meat are at particular risk.

Pairs and small groups of Handsome Francolins have been encountered in southwestern Uganda (Prigogine 1971, Dehn & Christiansen 2001), and it is frequently seen by birdwatchers, though many visitors see the species within a very small area near Ruhiza, in Bwindi Impenetrable National Park (Rossouw & Sacchi 1998). It has been described as locally common within its small global range (Fuller *et al.* 2000), although there has never been any scientific survey to measure its abundance. No research has ever been

conducted on this species; its nest and eggs are undescribed, its diet and breeding season are unknown and, in view of possible threats, research on its ecology is now urgently needed (Dehn & Christiansen 2001).

As an illustration of how difficult this species is to detect in the field, recent extensive bird surveys using circular plot methods in Bwindi Impenetrable National Park, Uganda, detected Handsome Francolins only once (Shaw & Shewry 2001), and intensive fieldwork in Rwenzori Mountains National Park in 1996 found the species at only one location (Dehn & Christiansen 2001). Handsome Francolins are only seen with any frequency when foraging on wide roads that run though the bamboo zone near Ruhiza (Rossouw & Sacchi 1998) and rarely call in natural situations.

Playback surveys have been successfully used to census populations of elusive birds including several species of Galliformes (Glahn 1974, Marion *et al.* 1981, Gibbs & Melvin 1993, Fuller *et al.* 2004). Playback surveys often detect more birds than conventional methods (Sliwa & Sherry 1992) and have been used to study globally threatened species (Njoroge & Bennun 2000, Carroll & Hoogestein 1995). So we set out to design and test a survey method capable of producing a density estimate for the Handsome Francolin. One possible way of sampling the birds is to play a recording of the advertising call and use the distribution of distances between the observer and the responding bird to generate a detection function (Bibby *et al.* 2000, Buckland *et al.* 2001). We adapted a playback technique used to census Nahan's Francolins *Francolinus nahani* in Uganda (Sande 2001, Fuller *et al.* 2004).

In addition to this, we present new data on altitudinal range, broad habitat preferences and the distribution of the species within Bwindi Impenetrable Forest National Park.

Study area and methods

Between January and March 2004 we studied Handsome Francolins in Bwindi Impenetrable Forest National Park, western Uganda (00°03'S, 29°40'E). With an area of 32 092 ha, the park is completely protected on paper, although extractive use is occasionally sanctioned and illegal extraction of forest resources does occur. Steep hills and narrow valleys characterize Bwindi with a general incline from the northern and western areas below 1750 m, to the southwestern corner above 2250 m. Bamboo thickets are restricted to less than 100 ha. The area is broadly classified as medium-altitude moist evergreen and high-altitude forest (Langdale-Brown *et al.* 1964). Bwindi is an important locality for the conservation of Afromontane fauna in particular those endemic to the Albertine Rift Mountains (Plumptre *et al.* 2003). See Howard (1991) for further details of vegetation types and climatic conditions within the park.

The observer (RS) walked along routes of varying length through the reserve (Figure 1), establishing survey points at least 200 m apart along each

route. Direct distances between points were measured using a handheld GPS receiver rather than distance along the walked route. At each point, the advertising call of the Handsome Francolin (recording taken from Chappuis 2000) was played using a Nakai tape recorder and Sony battery-powered 10 W speaker.

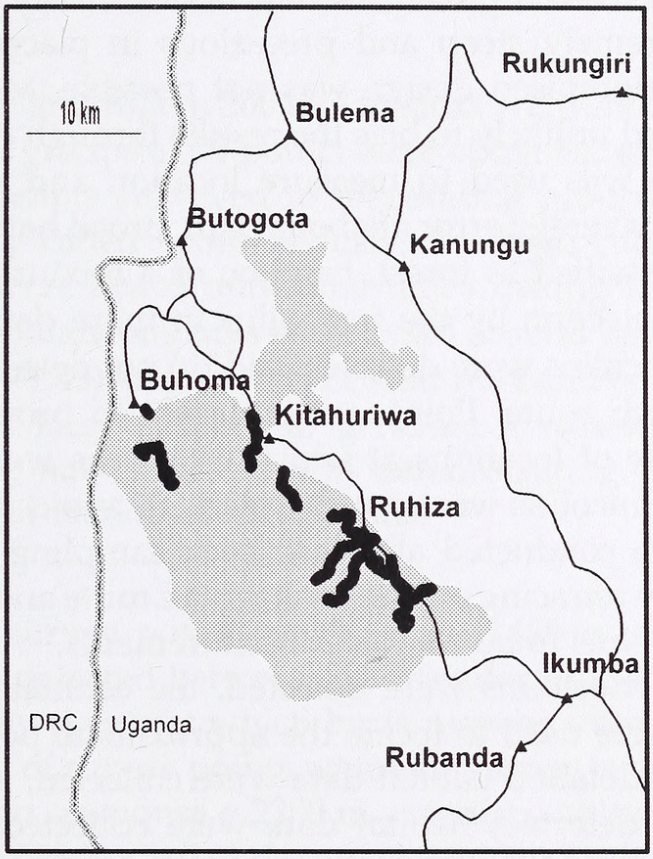

Figure 1. Map showing the location of Bwindi-Impenetrable National Park (shaded grey) in southwest Uganda, together with locations of the survey routes (shown in black).

The Handsome Francolin advertising call was played for 20 s and any response noted in the ensuing 120 s. This process was repeated twice, to give a total of three successive playbacks. The distance to any calling group and the playback episode after which it responded were noted for each responding group. Distances were estimated to the nearest 15 m. The observer had extensive previous experience of estimating distances to calling birds and, prior to commencing fieldwork, checked the accuracy of distance estimation by visually locating calling birds along tracks around Ruhiza and confirming their actual distance.

All playback surveys were conducted between 07:00 and 13:00, as the birds appeared to call more frequently in the morning. In the case of rain (only one day was affected), surveying was suspended until the rainfall had ceased. Routes were walked entirely along existing trails in the forest. The reasons for this were fourfold. 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 and loggers 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 point count area. Thirdly, cutting trails is time-consuming and would have severely reduced our sample sizes and the comprehensiveness of our survey work. Fourthly, the terrain was extremely steep and precarious in places, so for safety reasons a strictly randomised design was not possible. Most of the trails were very narrow and unlikely to bias the results through edge effects.

A handheld GPS was used to measure location and altitude at each survey point with an average error of about 10 m. Broad habitat type at each survey point was classified as forest, bamboo or a mixture of the two. To investigate habitat selection by the francolins in more detail, a sample of points where (a) francolins were detected and (b) not detected, was chosen at random along each route. Points were chosen to provide an approximately equal sample of locations at which francolins were detected and locations 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 route and stopping at the randomly selected points to take habitat measurements.

At points where francolins were detected, the estimated distance and measured bearing were used to locate the approximate position of calling groups, from where detailed habitat data were collected. At points where francolins were not detected, habitat data were collected 30 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 (for example where the terrain was too steep to be crossed safely) or the randomly selected position, detailed habitat data were not collected at that point.

For detailed habitat data, a 5 x 5 m quadrat was estimated around the sample location. The observer stood at the centre of this quadrat and estimated the following habitat variables: (i) height of the canopy, defined as all vegetation above 11 m in height; (ii) percentage canopy cover (iii) height of the understorey, defined as vegetation between 2.5 and 11 m in height; (iv) percentage cover by the understorey; (v) height of the ground vegetation, defined as all vegetation less than 2.5 m in height; (vi) percentage cover of ground vegetation; (vii) circumferences of all live trees within the quadrat with a diameter at breast height (dbh) > 20 cm; (viii) number of trees with dbh < 20 cm; (ix) depth of leaf litter, expressed as the average leaf litter depth at four random points in the quadrat; (x) distance to the nearest buttressed tree (possibly used as nesting or roosting sites, as in other forest-dwelling francolins), defined as a tree with at least one buttress that was distinct from the trunk at > 2 m from the

ground; (xi) circumference at breast height of the nearest buttressed tree; (xii) number of buttresses on the nearest buttressed tree. If a buttressed tree could not be located within 30 m of the centre point, the search was abandoned.

Results

Playback surveys

Between January and March 2004, playbacks were conducted at 244 points. Responses by 25 groups at 21 points were obtained, giving a ratio between the number of points surveyed to responding groups of 10:1. Handsome Francolins rarely called spontaneously; francolin calls not stimulated by tape playback were heard only nine times during the fieldwork period. Most of these spontaneous calls were heard around dawn and dusk, (05:00–06:30 and 19:00–19:45) and were in or near the bamboo zone at Ruhiza. Our dataset was not large enough to generate a robust population density estimate, but we have succeeded in demonstrating that playback can be used to survey for Handsome Francolins.

Elevation

The altitude of survey points ranged from 1468 m to 2541 m. Handsome Francolins were detected between the altitudes of 1541 m and 2541 m. The altitude of survey points at which birds responded to the tape was higher than the altitude of survey points where no response was detected (median altitude with no response = 2200 m, median altitude with response = 2399 m; $U_{223,21}$ = 553.5, p = 0 011), suggesting that birds were selecting higher-altitude regions of the study area.

Broad habitat type

The broad habitat types surveyed were altitudinally distinct. Forest occurred from the lowest parts of the reserve at 1500 m up to 2200 m, and the bamboo zone from about 2400 m upwards. The vegetation between these two zones was mixed.

Francolins were detected far more frequently in bamboo habitat than in forest habitat (G_{adj} = 13.018, $p < 0.001$). Birds responded at over 30 % of survey locations in bamboo and about 6 % of the locations in forest, whilst there were no responses in any of the mixed habitat survey points (Table 1).

Habitat structure

A total of 50 habitat plots was assessed, comprising 31 plots at randomly chosen points where francolins were not heard, and 19 at points where francolins were heard.

Canopy cover or height did not differ between random and francolin survey points (canopy cover: t = 0.01, d.f. = 48, p = 0.992; canopy height: t = 0.82, d.f. = 48, p = 0.416). However, variables relating to the structure of

Table 1. The number of survey points in each of the six broad habitat types where francolin groups responded to playback. Because no birds responded in mixed forest, data were analysed using a G-test with Williams correction on a 2 x 2 contingency table to compare the frequency of detections in bamboo and forest habitat types.

	Bamboo	Forest	Mixed	Total
Francolins not detected	19	183	21	223
Francolins detected	9 (32%)	12 (6%)	0 (0%)	21 (9%)
Total	28	195	21	244

the understorey and ground vegetation were strong predictors of francolin presence. Understorey was denser at locations where francolins were found than at random points (t = 2.1, d.f. = 48, p = 0.044), and percentage cover of ground flora was much lower (t = 2.68, d.f. = 48, p = 0.010), suggesting that birds preferred areas with more bare ground, but denser understorey cover. Tree density was much higher at locations where francolins were detected than at random points (francolin points = 35 trees per quadrat; random points = 19 trees per quadrat; t = 3.66, d.f. = 48, $p < 0.001$). Furthermore, the girth of large trees (those with a dbh < 20 cm) was significantly higher at francolin points than at random points (francolin points = 1.55 m; random points = 2.08 m; t = 2.67, d.f. = 48, p = 0.010).

Distance to the nearest buttressed tree and the number of buttresses on the nearest buttressed tree did not differ between random and francolin survey points (distance: $U_{21,15}$ = 121.0, p = 0.252; number of buttresses: $U_{23,17}$ = 194.5, p = 0.978). The circumference of the nearest buttressed tree was significantly larger at locations where francolins were found than at random points ($U_{21,15}$ = 76.0, p = 0.008), although this probably simply reflects the general association with forest comprising large trees described above.

Discussion

Our work has demonstrated that playback surveys can be used effectively for surveying Handsome Francolin. Surveyors can expect responses at about 9 % of survey points. Owing to the long delay between stimulus and response, the surveyor should play back the recording and wait for responses for at least 5 min at each survey point. This information allows improved planning of future surveys for the species. Such survey work could incorporate detailed ecological research without compromising its efficiency.

Our data suggest that the species occurs at relatively low densities, and we therefore consider that a quantitative understanding of the conservation status of this species is urgently required so it can be evaluated properly against IUCN threat criteria. In view of its strong preference for bamboo, a rare and patchy habitat, there is a possibility that its global population size is rather low.

Habitat and altitude

We have confirmed the presence of Handsome Francolins at 1541 m above sea level. This extends downward the known altitudinal range of the species, and interviews with local bird guides suggest that it occurs regularly at this altitude. However, overall the species shows a marked preference for higher-altitude areas in Bwindi, and in particular, bamboo habitat. This habitat occurs in isolated patches near mountaintops in Uganda and along the Albertine Rift. There are less than 100 ha of bamboo in Bwindi (UNEP-WCMC 2004), and bamboo is regularly removed from the park (Butynski 1984). The extreme rarity of this habitat may have serious implications for the conservation status of the Handsome Francolin, particularly where forest connections between bamboo 'islands' have been cleared for agriculture and may prevent effective movement among suitable habitat patches. Further study of seasonal use of different habitat types would be worthwhile, to help us understand if and how birds move among patches of high altitude bamboo.

Bwindi has comparatively dense forest and a diverse tree flora (Eilu *et al.* 2004), suggesting that it may form prime habitat for Handsome Francolins, which selected areas of high tree density within the Park. Our data indicate that the francolins selected sites with a high density of large trees with dense understorey but sparse ground cover typically associated with undisturbed forest. This suggests that the species may be adversely affected by selective logging and other forms of forest degradation.

Hunting pressure

Discussions with local people, nature guides and park staff indicated that hunting of francolins in Bwindi was still widespread. Seven francolin traps were found during the survey work, mostly in the bamboo zone near to the human settlements around Ruhiza. These traps require a great deal of maintenance and regular checking, so there are at least some local people in the Ruhiza area who concentrate on trapping Galliformes (presumably both Scaly *F. squamatus* and Handsome Francolins) for food. Indeed, the Handsome Francolin became locally extinct in the Ruhiza area after the birds were hunted for food (A. Twinomujuni pers. comm.), so there is evidence that they are vulnerable to human persecution. The larger scale impact of hunting on francolin populations remains difficult to assess, and a much larger study in the future would be required to understand this issue. Given the apparently low density of Handsome Francolins in Bwindi, any direct persecution of the birds could translate into a profound population-level effect.

Interviews with local people also indicated that, during hunting expeditions, eggs of Galliformes such as the Scaly Francolin, Crested Guineafowl *Guttera pucherani* and the Handsome Francolin are an extra source of protein while camping in the forest. Working with these people

could be a good opportunity to locate nests and eggs of the Handsome Francolin, which have never been described. Traditional healers also exploit these species, which are collected through their clients.

The Handsome Francolin is currently listed as Lower Risk (least concern) by BirdLife International (2004), because of its relatively large global extent of occurrence and the fact that no evidence of a population decline has been found. In fact, no systematic surveys allowing robust estimates of population trajectories have ever been published for this species, so it is difficult to make an evaluation against IUCN criteria. Given that the more widespread Nahan's Francolin is listed as Endangered, the status of Handsome Francolin must be urgently investigated, particularly because it is rarely encountered by birdwatchers away from Bwindi (Uganda) and Nyungwe Forest (Rwanda), and therefore may be uncommon in parts of its range.

Research priorities

Our knowledge of this species is in its infancy, but at least we now have a reliable method for surveying it. We suggest the following research priorities:

1. Extensive surveys are urgently required to generate a global picture of the distribution and status of this species. Data are required from Kibira National Park (DRC), forests west of Lake Edward (DRC), Itombwe Mountains (DRC), Kahuzi-Biéga National Park (DRC), Lendu Plateau (DRC), Virunga National Park (DRC), Nyungwe Forest (Rwanda), Parc National des Volcans (Rwanda), Bwindi Impenetrable National Park (Uganda), Echuya Forest Reserve (Uganda), Mgahinga Gorilla National Park (Uganda) and Rwenzori Mountains National Park (Uganda).
2. Once surveys are completed, a thorough evaluation of the species against IUCN threat criteria is required.
3. Given the anecdotal evidence, an understanding of the effects of hunting on the species is required. This could be achieved by comparing francolin densities in areas with different levels of hunting pressure.
4. Information on the dispersal capabilities of Handsome Francolins will help us understand how and if they move between isolated bamboo patches. This might also include an investigation into the genetic structure of the population, given that it appears to exist in isolated fragments rather than show a continuous distribution. This may help to identify populations that are at particular risk and not able to colonise new areas.
5. Nothing is currently known about the breeding biology of Handsome Francolin and even the nest and eggs remain undescribed. Bwindi is a good place to investigate this, perhaps in collaboration with local hunters.
6. Detailed ecological study of Handsome Francolins will help describe seasonal patterns in movement and breeding of the species. Ideally, all members of one or more groups should be radio-tagged and followed for as

long as possible. Given that birds are frequently seen in a very local area near Ruhiza, there is some evidence that radio-tracking is likely to work effectively, but the difficulty of traversing the terrain must be taken into account when choosing a location for radio-tracking work.

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