The status of the Oberländer's Ground-Thrush *Zoothera oberlaenderi* in Uganda

Final Report

Thomas K. Gottschalk
Justus Liebig University
Department of Animal Ecology
Heinrich-Buff-Ring 26-32
D-35392 Giessen
Germany. Phone: +49 (0)641 99 35711
Fax: +49 (0)641 99 35709
Email: Thomas.Gottschalk@allzool.bio.uni-giessen.de

Abstract

For a huge number of rare or threatened bird species, no population estimates are available because they are difficult to detect or live in remote areas. As an example, we show for one of the least studied African birds, the Oberländer's Ground-Thrush *Zoothera oberlaenderi*, how a rapid population estimation can be conducted if a short-term bird census is combined with a predictive species–habitat model. The study aims at analysing habitat preferences and clarifying the status of the Oberländer's Ground-Thrush in Uganda. This was done by conducting intensive field surveys using point counts and mist-netting in Semliki National Park and Bwindi Impenetrable National Park between 9 February and 14 March 2008. While in Semliki the species was not recorded, in Bwindi seven singing Oberländer's Ground-Thrushes were heard. For the first time habitat preferences of the species were analysed. The Oberländer's Ground-Thrush preferred dense forest types especially of *Newtonia* dominant forests in close distance to rivers within an altitude of 1506 m and 1935 m. We predicted 28 km^2 of suitable habitat containing a minimum number of 27 males out of the 331 km^2 of Bwindi Impenetrable National Park. Successively enlarging the park to increase this unique isolated population is recommended in the long-term. The small Ugandan population solely restricted to Bwindi Impenetrable National Park and the ongoing degradation and deforestation of forests within its potential distributional range suggests the need to reconsider Oberländer's Ground-Thrushes' current IUCN Red List category.

Introduction

Population estimates are of fundamental importance to identify species that are sufficiently rare or endangered and are the base of any conservation management strategies. The problem of reliable population estimates arises for a huge number of species which are shy, difficult to detect or which live in remote areas. One of these birds is the Oberländer's Ground Thrush *Zoothera oberlaenderi* which occurs in north-east Democratic Republic of the Congo (DRC) and in western Uganda, and is known solely from a few sites in the former country (Ituri Forest, Bondo- Mabe, Kamituga area, southern Kivu and Semliki Valley) and two in Uganda (Semliki/Bwamba Forest and Bwindi Impenetrable National Park (Clement & Hathway, 2000). The species inhabits primary lowland and transitional forest at 700–1,620 m (Urban *et al.*, 1997), but is unknown from secondary forests (Collar, 2005). In Bwamba (Uganda), this thrush is known from tall stands of ironwood trees, *Cynometra alexandri*, with a fairly open understorey, and avoids areas with dense undergrowth (Urban *et al.* 1997). The species' current status is unclear, e.g., only eight dated records have been published from Uganda since the 1960s (Carswell *et al.*, 2005; Gottschalk & Ampeire, 2008). However, the IUCN / BirdLife International red list (2007) currently treats Oberländer's Ground Thrush as Near Threatened, despite the lack of population estimates or confirmation of old records on sites from which the species has previously been recorded, e.g., from the Semliki Valley or the DRC. Urban *et al.* (1997) suggested that the species may no longer be extant in the Bwamba Forest of the Semliki Valley, owing to habitat degradation. Habitat loss may have also caused its local extinction at Beni and Kamituga (Ituri, DR Congo: Collar & Stuart (1985)) as the species appears sensitive to forest degradation (Plumptre, 1997), which is extensive within its small range (Collar, 2005). Moreover, conservation efforts are impeded by the fact that Oberländer's Ground Thrush remains one of the least-studied African birds, due to its elusive behaviour and tiny range; the species' breeding habits or territory size are largely unknown (Urban *et al.*, 1997; Collar, 2005). Further, a detailed description of habitat conditions of the different sites the species has been recorded is missing. To close some of these knowledge gaps we investigated a study with the aim being to estimate the population size and to study the ecology of the species. Therefore, during February and March 2008 surveys on the Oberländer's Ground-Thrush were conducted mainly in the Bwindi Impenetrable National Park, as this is very likely to be the last remaining area of the species in Uganda. An additional short-time research expedition was conducted in the Semliki National Park which is the main remaining part of the Bwamba Forest, to search for a potential relict population of the species. We did not extend our surveys to the eastern part of the DR Congo due to political unrest. Our study shows how rapid population estimates for a largely unknown bird species can be assessed if efficient bird census methods and modelling approaches are combined.

Methods

Study site

Bwindi Impenetrable National Park is located in south-western Uganda (0°53'–1°08'N and 29°35'–29°50'E). It covers 331 km^2, characterized by steep hills and narrow valleys with continuous forest vegetation throughout. The elevation of Bwindi Impenetrable National Park ranges from 1160 to 2607 m. Although classified as moist lower montane forest, the vegetation composition is complex and greatly affected by altitude, topography and soil depth (Hamilton, 1969). The park is known because it has one of the last and the second largest populations of Mountain Gorillas *Gorilla beringei beringei* (McNeilage *et al.*, 2006). Bwindi Impenetrable National Park was visited between 9 and 15 February 2008 and between 28

February and 14 March 2008. This period of time was selected as nesting of the species has been reported on 1 March (Gottschalk & Ampeire, 2008).

Semliki National Park, named after the Semliki river, is located in Western Uganda, bordering the DRC. It covers 219 km^2 on a gently undulating landform ranging between 670 to 760 m. The forest is classified as moist semi-deciduous and is much dominated by a single tree species *Cynometra alexandrii* (Howard, 1991). Bird surveys in Semliki National Park were conducted between 17 and 23 February 2008.

Bird census

In Bwindi Impenetrable National Park bird species were recorded at 99 sampling locations using ten-minute Point Counts (Bibby *et al.*, 2000). Points were located randomly and were at a distance of at least 500m from each other. However, some of those points located in remote areas were hardly reachable or only by a time-consuming hike through dense forest structure. Therefore, alternative points were sampled by leaving the tracks or path and walking between 10-100 m in the direction of the sampling location (Shaw & Shewry, 2001). The analysis was restricted to birds recorded within a maximum distance of 200 m from the survey locations. Playback techniques were used to record Oberländer's Ground Thrush. In the course of the field work, habitats suggested as suitable for the Oberländer's Ground Thrush were searched intensively to record the species. Point counts accompanied by mist-netting have often been used to census forest birds in the tropics (Terborgh, 1990; Whitman *et al.*, 1997; Derlindati & Caziani, 2005). Therefore, mist-netting was conducted in areas where the species has been recorded in the last four years to detect this shy forest species. 22 nets of 6m, one net of 15m and one of 18m length were used with about two days of catching effort at each site. Based on the knowledge about the habitat conditions extracted from previous records, the mist-nets were set in similar habitats at different locations within the study area.

In Semliki National Park we conducted surveys to find the Oberländer's Ground Thrush in the east (Red Monkey trail) and central part (Kirumia trail) of the National Park between an altitude of 662 and 726 m. Besides walking along these trails, we surveyed several kilometres to the west of the Red Monkey trail.

Modelling species distribution and estimating population size

To create a species habitat map we used (a) a digitized vegetation map of Bwindi Impenetrable National Park (UNESCO, 2005), which vegetation classes were aggregated to the eight principal forest types classified by (Howard, 1991) (b) a digital elevation model (50 x 50 m)(MUIENR, 1991), and (c) a map of distances to rivers derived from the habitat map. A second order polynomial of the altitude was included in the model to account for a non-linear response. The species presence-absence data were complemented by a number of "pseudo-absence" points (Osborne, 2001; Engler *et al.*, 2004). Pseudo-absence data were obtained through generating random points within the border of the whole National Park. The distance between pseudo-absence points and observed presence points was controlled not to fall below 250 m. The combination of presence data and pseudo-absence data allowed for calculating a resource selection function by means of a Generalized Linear Model (GLM) analysis. A logit link function and a binominal error distribution were applied to account for the binary nature of the data (logistic regression). The corrected Akaike Information Criterion (AICc, (Akaike, 1973; Burnham & Anderson, 2002), was used to separate meaningful from information-less predictor variables amongst all the habitat-, distance- and topography-related parameters described above. The quality of the resulting model was checked with the area

under the receiver operating characteristic (ROC) curve (AUC) (Fielding & Bell, 1997; Pearce & Ferrier, 2000). As the records of the Oberländer's Ground Thrush were limited we did not split up the data set for using one part for model building and one for model validation. Instead we used a 1st order jack-knife permutation to systematically quantify prediction accuracy in unknown plots (Verbyla & Litvaitis, 1989). Each plot was temporarily removed from the calibration data, the model refitted, and the error of this new model in predicting the removed plot was recorded. Finally, the absolute values of the resulting errors were averaged. All model calculations were performed using the GEPARD-tool (Gottschalk *et al.*, 2006), which provides an integration of the R statistics software (R Development Core Team 2006) into the working environment of the ArcInfo 9 GIS package (ESRI, Redlands Ca., USA).
The habitat suitability map was used to calculate the occurrence probability of the species for each pixel of the map. An overestimation of available habitat was avoided by post-processing the resulting suitable habitat map using a defined probability threshold of 0.5. The total population size of the Oberländer's Ground-Thrush was estimated by calculating the density of the species. This was done by dividing the number of Oberländer's Ground-Thrushes recorded in 2008 by the area of predicted suitable habitat surveyed in 2008. This density was multiplied with the total area of the predicted suitable habitat and by the mean habitat suitability value of this area.

Results and Discussion

In total 1,152 birds of 133 species were recorded in Bwindi Impenetrable National Park using point counts and 224 birds of 45 species were caught using mist-nets (Bwindi Impenetrable National Park: 152 birds of 27 species, Semliki National Park: 72 birds of 24 species). Despite intensive field work we did not record an Oberländer's Ground Thrush in Semliki National Park. Two reasons for this absence can be suggested. (1) Since all of the six historical records from the 1960s are of birds caught in July (Carswell *et al.*, 2005) we suggest that the species is only a seasonal visitor of this forest. This assumption is supported by the fact that the vegetation, dominated by almost pure ironwood *Cynometra alexandri*, is completely different compared to the dense mountain forest structure of Bwindi Impenetrable National Park. These possibly suboptimal habitat conditions prevent the birds to breed in Semliki National Park. (2) Large parts of the intermediate-altitude forest which is suggested to be more similar to the forest structure in Bwindi Impenetrable National Park have been lost or severely degraded (Howard, 1991). Additional surveys in different parts of Semliki National Park throughout the year can improve the knowledge concerning possible seasonal distribution patterns of the Oberländer's Ground-Thrush.

In Bwindi Impenetrable National Park we were able to record two individuals of the Oberländer's Ground Thrush by using point counts. Additionally, five singing males were recorded by conducting intensive surveys within the vicinity of rivers, in those areas we expected to be most suitable for the species. In addition to these seven records, three other sightings of Oberländer's Ground Thrush were made: on 6 March 2005, in June 2006 (Robert Byarugaba and Saul Ampeire in lit.) and on 1 March 2007 (Gottschalk & Ampeire, 2008) and these were also used to analyse the species' habitat preferences and to predict species distribution.

The Oberländer's Ground Thrush was recorded within an elevational range from 1506 to 1935 m and in the vicinity to rivers 25 m to 125 m away. The univariate analyses revealed significant preferences for the species at lower altitudes and closer to rivers (U-test, $p < 0.05$) compared to absent points (Tab. 1). Average distance to park borders was not a significant

driver of habitat selection. Moreover, individuals selected forest types different from random points (Chi-square test, $p < 0.05$). Mature mixed forest, especially the *Newtonia*-dominant forest type proved the strongest predictor of Oberländer's Ground Thrush occurrence (Table 2, last column), while *Chrysophyllum*-dominant forest, altitude and distance to rivers were also retained in the model by the AICc information criterion. Negative predictors were an increasing distance to rivers and hill forest. Besides the identification of preference to specific forest types we identified a significant preference for forests in the vicinity to rivers, which has not been reported before. Furthermore, the species was recorded at a mean altitude of 1643 m and up to 1935 m, at highest, both values exceeding the elevational range of 700 m to 1620 m previously known for this species (Urban *et al.*, 1997).

Table 1: Parameters analysed of Oberländer's Ground Thrush habitat in Bwindi Impenetrable National Park, Uganda, 2008. "Rejected" means that the specific variable was not included in the set of variables with the most relevant contribution to model fit based on AICc values. The univariate comparison between parameters recorded at places the Oberländer's Ground Thrush was present and at random sites. All values are means ±standard deviations (SD).

		Univariate comparison				Logistic regression	
	Unit	Presence Sites		Absence Sites		coeff.	ß
		Mean	SD	Mean	SD		
Intercept						-4.897	-22.9995
Altitude	m a.s.l.	1643	156	1997	288 [a]	rejected	
Altitude^2						-3.27E-06	1.4444 *
Distance to rivers	m	75	33	179	124 [a]	-0.028	-2.1169 *
Distance to park border	m	1532	821	2400	1548	rejected	
Forest types							
Chrysophyllum -dominant, mixed						2.824	2.6522
Hill forest						-6.649	-1.9402
Mature mixed forest						16.930	19.7709
Newtonia -dominant, mixed						19.890	22.0822

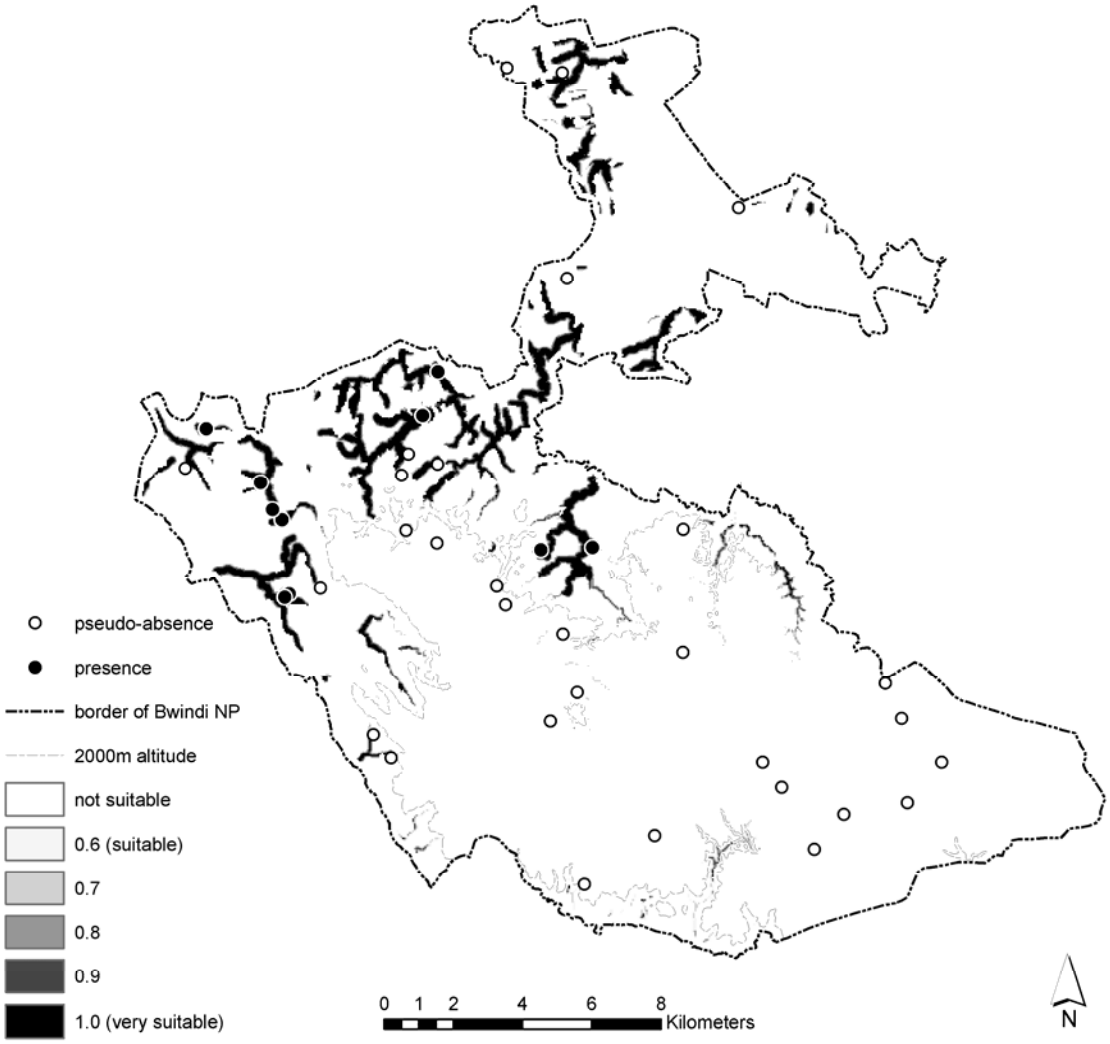
[a]Significant after sequential Bonferroni correction, Mann-Whitney U-test

* $P < 0.05$

The habitat variables used explained 45% of the variance in the presence/absence data. The area under the ROC function revealed a high performance of the model with an AUC of 0.98 ($p < 0.0001$), indicating that the model discriminated correctly between presence and absence of the Oberländer's Ground Thrush in 98% of cases. Prediction accuracy, as calculated by jack-knife permutation, amounted to ± 0.157, which corresponded to a mean relative error of 10% of the predicted occurrence probability of the Oberländer's Ground Thrush. A total of 28 km^2 (8.6%) of Bwindi Impenetrable National Park was predicted to provide suitable habitat for the species (Fig. 1 and Tab. 2), in the western and northern parts of Bwindi Impenetrable National Park. Within the areas of suitable habitat we estimated a density of about one singing male per km^2, and thus, the total population of Oberländer's Ground Thrush was predicted to be about 27 males. This number could correspond to the number of breeding pairs, but we are not aware on the sex ratio of this species (cf Donald, 2007). To avoid false conclusions, we see this population estimate as the minimum size. A species-specific detectability function would be needed to calculate more robust population estimates

(Buckland *et al.*, 2001). However, we do not believe that this will be possible in the near future due to many difficulties in sampling this species. Its cryptic behaviour and its low density prohibit receiving enough records to calculate a detectability function. Furthermore, repeated surveys in Bwindi Impenetrable National Park, which are required in order to estimate detection probabilities, are much hampered by the rugged terrain, particularly the steep valleys and the dense forest structure.

Figure 1: Habitat suitability of Bwindi Impenetrable National Park, Uganda for the Oberländer's Ground Thrush. The map clearly shows suitable habitat in the vicinity of rivers.



We neither caught an Oberländer's Ground Thrush in Semliki National Park nor in Bwindi Impenetrable National Park. The individuals heard in Bwindi Impenetrable National Park were singing from trees in the mid-stratum and flew notably higher than the 2.5 m tall mist nets erected in the vicinity of the song places. This finding is congruent to the reported habit of the species singing on trees at mid-height (7-10m) (Keith, 1968; Clement & Hathway, 2000). Mid-story nets would be necessary (Derlindati & Caziani, 2005) but they are less efficient in studies which are aimed to estimate population size within a relatively large study site (Whitman *et al.*, 1997).

Table 2. The predicted suitable habitat classes and the proportion of suitable habitat for the Oberländer's Ground Thrush, as guided by probability of species occurrence using a 0.5 threshold.

Predicted suitable habitat / estimated population	
Area of a 0.6 habitat suitability (km^2)	3.1
Area of a 0.7 habitat suitability (km^2)	3.1
Area of a 0.8 habitat suitability (km^2)	3.7
Area of a 0.9 habitat suitability (km^2)	5.0
Area of a 1.0 habitat suitability (km^2)	13.3
Total area predicted as suitable habitat (area in km^2)	28.3
Percentage of the total area predicted as suitable habitat	8.6 %
Percentage of suitable habitat which was surveyed	22 %
Density within the suitable area (singing males/km^2)	1
Estimated population size (number of males)	27

The study shows that intensive field surveys within a relative short time period and predictive species-habitat modelling can help to get a rapid estimate of population size and habitat preferences of a rare and shy forest species living hidden in the vegetation. However, such a modelling approach used to predict the distribution and to estimate the population is highly dependent on the availability of digital maps, especially of vegetation types and altitude. A further prerequisite to obtain reliable results are extensive field surveys conducted during the most suitable season when the chance of detecting the species is high.

The restriction of Oberländer's Ground Thrush to only one forest in Uganda and the identified low abundance in this forest justify the need of conservation initiatives to increase its population size. Although human influence affected Bwindi Impenetrable National Park seriously until 1991 (Babaasa *et al.*, 2004), we do not see any urgent management needs within the boundaries of the National Park. However, we recommend successively enlarging the forest especially along rivers to increase this unique isolated population in the long-term. The small Ugandan population restricted to Bwindi Impenetrable National Park and the ongoing degradation and deforestation of forests in the eastern part of the DR Congo suggests the need of reconsidering the current IUCN Red List Category of Oberländer's Ground Thrush.

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Appendix, Table 3: Bird species caught in Bwindi and Semliki National Park between 9 February and 15 March 2008

Common Name	Scientific Name	Bwindi	Semliki	total
Yellow-whiskered Greenbul	*Andropadus latirostris*	24	1	25
Red-throated Alethe	*Alethe poliophrys*	24	0	24
Olive Sunbird	*Nectarinia olivacea*	14	6	20
Equatorial Akalat	*Sheppardia aequatorialis*	19	0	19
Xavier's Greenbul	*Phyllastrephus xavieri*	0	13	13
Red-bellied Paradise Flycatcher	*Terpsiphone rufiventer*	0	12	12
White-bellied Robin-Chat	*Cossyphicula roberti*	9	0	9
Little Greenbul	*Andropadus virens*	6	1	7
Shelley's Greenbul	*Andropadus masukuensis*	6	0	6
Red-tailed Bristlebill	*Bleda syndactyla*	5	1	6
Mountain Greenbul	*Andropadus nigriceps*	5	0	5
Pale-breasted Illadopsis	*Illadopsis rufipennis*	5	0	5
Short-tailed Warbler	*Hemitesia neumanni*	5	0	5
Olive-green Camaroptera	*Camaroptera chloronota*	4	0	4
Fire-crested Alethe	*Alethe castanea*	0	4	4
Forest Robin	*Stiphrornis erythrothorax*	0	4	4
Rufous Flycatcher-Thrush	*Stizorhina fraseri*	0	4	4
Black-faced Rufous Warbler	*Bathmocercus rufus*	3	0	3
Red-faced Woodland Warbler	*Phylloscopus laetus*	3	0	3
Toro Olive Greenbul	*Phyllastrephus hypochloris*	3	0	3
White-tailed Ant-Thrush	*Neocossyphus poensis*	3	0	3
Red-tailed Greenbul	*Criniger calurus*	2	1	3
Woodhouse's Antpecker	*Parmoptila woodhousei*	1	2	3
African Dwarf Kingfisher	*Ispidina picta*	0	3	3
Brown-chested Alethe	*Alethe poliocephala*	0	3	3
Grey-headed Sunbird	*Anthreptes axillaris*	0	3	3
Green-tailed Bristlebill	*Bleda eximia*	0	3	3
Mountain Illadopsis	*Illadopsis pyrrhopter*	2	0	2
African Paradise Flycatcher	*Terpsiphone viridis*	2	0	2
Blue-headed Crested Flycatcher	*Trochocercus nitens*	0	2	2
Tambourine Dove	*Turtur tympanistria*	0	2	2
African Broadbill	*Smithornis capensis*	1	0	1
Blue-headed Sunbird	*Cyanomitra alinae*	1	0	1
Grey-chested Illadopsis	*Kakamega poliothorax*	1	0	1
Olive Thrush	*Turdus olivaceus*	1	0	1
Red-headed Bluebill	*Spermophaga ruficapilla*	1	0	1
White-bellied crested Flycatcher	*Trochocercus albiventris*	1	0	1
Kivu Ground Thrush	*Zoothera tanganjicae*	1	0	1
Green Hylia	*Hylia prasina*	0	1	1
Green-backed Twinspot	*Mandingoa nitidula*	0	1	1
Grey-throated Flycatcher	*Myioparus griseigularis*	0	1	1
Spotted Honeyguide	*Indicator maculatus*	0	1	1
Western Nicator	*Nicator chloris*	0	1	1
Grey-backed Camaroptera	*Camaroptera brachyura*	0	1	1
Scaly-breasted Illadopsis	*Illadopsis albipectus*	0	1	1
Number of birds		152	72	224
Number of bird species		27	24	45