An observation of Grauer's Long-eared Owl, *Asio graueri*, in Nyungwe Forest, Rwanda

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Summary. On 21 November 2019, the authors observed an owl identifiable as *Asio graueri* on the edge of Uwasenkoko Swamp in Nyungwe NP, Rwanda, first record of *A. graueri* in Nyungwe Forest and first encounter of the taxon anywhere in its range in almost 40 years. There are only seven previous records, all in the mountains of the Albertine Rift. The type was taken in the Itombwe, DRC, in 1910. A dried head was discovered in Kalongi, on the west slopes of the Ruwenzori, DRC, in 1926. Specimens were collected in the DRC on Mt. Kabobo in 1951 and on Mt. Kahuzi in 1959. Sight records were made in Rwanda on Mt. Bisoke in 1979 and 1980, on Mt. Sabyinyo in 1981. Two *Asio* specimens taken on Mt. Kenya in 1947 and 1961, allocated to *A. graueri*, proved not to be that taxon. All records of *A. graueri* are within the environment of afromontane or afrosubalpine forests, situated in two altitudinal ranges, the 2000-2400 m level of upper montane forests for the Itombwe, Kabobo, Kahuzi and Nyungwe records, the 3000-3400 m level of afrosubalpine forests for Volcanoes NP records. A link of the lower altitude localities with pockets of cold microclimates, as found in the basins of peat bogs, and for all records with *Hagenia* stands is probable. *A. graueri* is diagnosable and isolated. We argue for specific rank under the unified species concept (USC) of de Queiroz applied with the phylogenetic species (PSC) criteria proposed by Cracraft. In accordance with IUCN Red List criteria, the species should be given Endangered status. Its Extent of Occurrence (EOO) is small, its Area of Occupancy (AOO) tiny. The species is rare within its range and there was no record in four decades prior to this sighting.
Key words: *Asio graueri, Asio abyssinicus*, Albertine Rift, Nyungwe Forest, Uwasenkoko Swamp, Itombwe, Mt. Kabobo, Mt. Kahuzi, Mt. Bisoke, Mt. Sabyinyo, Ruwenzori, Rwanda, DRC, Mt. Kenya, upper montane forest, afrosubalpine forest, *Hagenia.*

Résumé. Le 21 novembre 2019, les auteurs ont observé un hibou, identifiable comme *Asio graueri*, au bord de la tourbière d'Uwasenkoko dans le PN de Nyungwe, première observation pour la forêt de Nyungwe et première rencontre du taxon, n'importe où dans son aire de distribution, en près de 40 ans. Il n'y a que sept mentions antérieures de ce taxon, toutes dans les montagnes du Rift Albertin. Le type a été pris dans l'Itombwe en 1910. Une tête séchée a été découverte dans le village de Kalongi, sur le versant ouest du Ruwenzori, en 1926. Des spécimens ont été collectés sur le Kabobo en 1951 et sur le Kahuzi en 1959. Des observations ont eu lieu sur le Bisoke en 1979 et 1980, sur le Sabyinyo en 1981. Deux spécimens d'*Asio* obtenus sur le mont Kenya en 1947 et 1961, attribués à *A. graueri*, s'avèrent ne pas être ce taxon. Toutes les observations d'*A. graueri* se placent dans l'environnement des forêts afromontagnardes ou afrosubalpines, réparties en deux zones d'altitude, le niveau supérieur des forêts montagnardes, à 2000-2400 m, dans les massifs de l''Itombwe, du Kabobo, du Kahuzi et de Nyungwe, le niveau des forêts afrosubalpines, 3000-3400 m, dans le PN des Volcans. Un lien des localités de basse altitude avec des poches de microclimats froids, comme on en trouve dans les bassins des tourbières, et de toutes les observations avec des peuplements d'*Hagenia* est probable. *A. graueri* est diagnosable et isolé, et nous argumentons le choix du rang spécifique selon le concept unifié de l'espèce (USC) de de Queiroz appliqué avec les critères de l'espèce phylogénétique (PSC) proposés par Cracraft. Conformément aux critères de la Liste rouge de l'UICN, l'espèce doit être classée En Danger. Sa Zone d'Occurrence (EOO) est petite, sa Zone d'Occupation (AOO), minuscule. En outre, l'espèce est rare dans ses stations et il n'y a eu aucune observation au cours des 40 années qui ont précédé l'observation rapportée ici.
Mots clefs : *Asio graueri, Asio abyssinicus*, Rift Albertin, Forêt de Nyungwe, Uwasenkoko, Itombwe, Mt. Kabobo, Mt. Kahuzi, Mt. Bisoke, Mt. Sabyinyo, Ruwenzori, Rwanda, RDC, Mt. Kenya, forêt afromontagnarde, forêt afrosubalpine, *Hagenia.*

Introduction

On 21 November 2019, during a visit to Nyungwe Forest, Rwanda, the senior author spotted a medium-sized owl sheltering in a small Hagenia (*Hagenia abyssinica*) growing on the edge of Uwasenkoko Swamp. He drew the attention of the other members of the party, the authors and Wendi Craig, and all five observed and photographed the bird for about 20 minutes. Aware of the scarcity of observations of the Albertine representative of the Long-eared Owl complex, *Asio graueri*, we endeavoured to gather as many details and views as possible without disturbing the bird. The observation appears to be the first record of *Asio graueri* in Nyungwe Forest and the first documented record of the taxon, anywhere in its range, in almost 40 years. It is thus appropriate to provide more details on the occurrence and review what is currently known of the bird that is certainly a rare and probably threatened species.

Material and methods

We visited Nyungwe Forest from 21 to 25 November 2019. Our focus was mainly the observation of birds and the examination of flora and habitats. Our observations were conducted from roads and trails. There was no collecting nor trapping. Playback was used occasionally to ascertain presence of species. Standard photographic equipment was used to document records. There was no systematic search for owls, no night transects and no playback of owl calls. Long-eared Owls in particular were not searched for, as the first two authors had never encountered them or recorded any sign of their possible presence during many long periods spent in Nyungwe Forest between 1970 and the present.

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Fig. 1. Uwasenkoko Swamp, Nyungwe Forest, Rwanda, 21 November 2019. Photo J. Devillers-Terschuren.

The Nyungwe observation

Uwasenkoko Swamp (Fig. 1) is a peatland situated at 2400 m asl, within the eastern part of Nyungwe Forest, at about 10 km from the boundary of Nyungwe National Park. The valley-bottom forest adjacent to the swamp is composed of *Hagenia abyssinica, Hypericum revolutum, Erica johnstonii, Erica benguellensis, Cliffortia nitidula*. The surrounding hills are occupied by a more diverse forest where *Hagenia abyssinica, Macaranga capensis, Maesa lanceolata* and *Erica johnstonii* are common (Molau, 2017). The main road that traverses the park from east to west intersects the marsh and it is from that road, at 2°31'43"S and 29°21'27"E, that birds, including the owl, were observed. The owl was spotted at 10:45 a.m. in fair, dry weather with light overcast. It was perched on a thick *Hagenia* branch, mostly hidden by the foliage (Fig. 2a,b). It remained more or less in the same position for about 20 minutes at about 10 m from us, then quietly slipped deeper into the vegetation.

The most striking features of the owl were prominent, somewhat rounded, centrally placed, bicoloured tufts, rufous facial discs and a very dark blackish brown, blotchy mantle (Fig. 2a,b). The tail was boldly barred dark brown and buff. The eyes were orange.

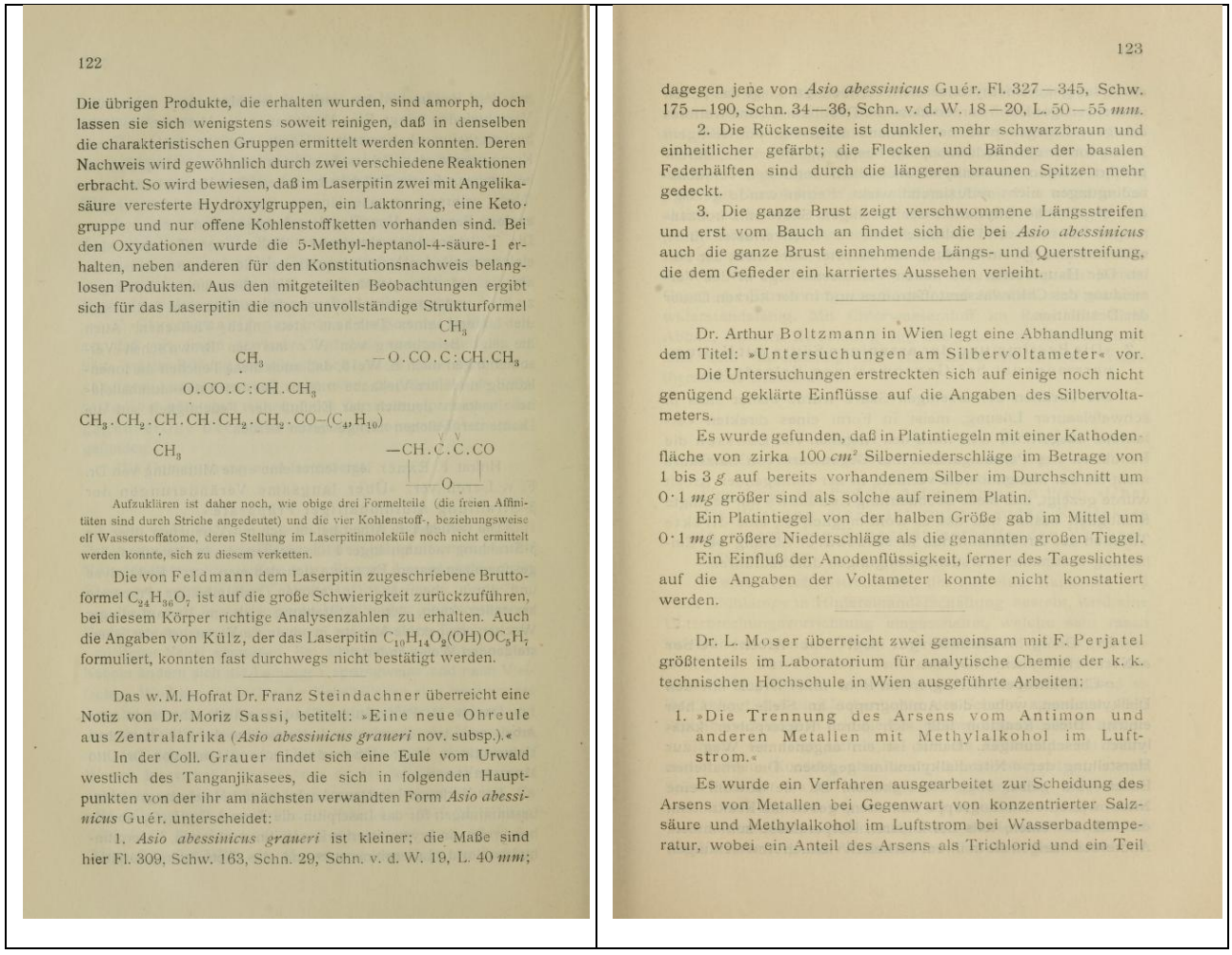
Other birds seen in the swamp or in the fringing woodland vegetation included Plain Martin, *Riparia paludicola*, Ruwenzori Sawwing, *Psalidoprogne holomelas*, Grauer's Swamp-Warbler, *Bradypterus graueri*, Brown Woodland-Warbler, *Phylloscopus umbrovirens*, Kandt's Waxbill, *Estrilda kandti*, Streaky Seedeater, *Crithagra striolata*, and Yellow-crowned Canary, *Serinus flavivertex.*

Fig. 2a. Grauer's Long-eared Owl, *Asio graueri*, Uwasenkoko Swamp, Nyungwe Forest, 21 November 2019. Photo G.R. Vande weghe.

Fig. 2b. Grauer's Long-eared Owl; the same individual, with the head turned. Photo G.R. Vande weghe.

The type and original description of Grauer's Long-eared Owl

The owl was described by Moriz Sassi as a new subspecies of "*Asio abessinicus* Guér." in a short communication (Fig. 3) to the Imperial Academy of Sciences of Vienna in May 1912 (Sassi, 1912a). The description is explicitly based on a specimen collected by Rudolf Grauer in March 1910, in the course of an epic journey that took him from the eastern shore of Lake Victoria to the Western Rift, and back, over a period of 14 months, the Albertine mountains being explored from the north-western shores of Lake Tanganyika, in the south, almost to Lake Albert, in the north (e.g. Sassi, 1912b, 1924; Lorenz v. Liburnau, 1917). The holotype is preserved in the Natural History Museum of Vienna, with the following details (Schifter et al., 2007): Vienna Museum no. NMW 6.557, collected March 1910, Urwald westlich vom Tanganjika-See, Congo, 2000 m asl, leg. Rudolf Grauer, coll. Grauer no. 1710, durch Kauf: 1910/11.



122

Die übrigen Produkte, die erhalten wurden, sind amorph, doch lassen sie sich wenigstens soweit reinigen, daß in denselben die charakteristischen Gruppen ermittelt werden konnten. Deren Nachweis wird gewöhnlich durch zwei verschiedene Reaktionen erbracht. So wird bewiesen, daß im Laserpitin zwei mit Angelikasäure veresterte Hydroxylgruppen, ein Laktonring, eine Ketogruppe und nur offene Kohlenstoffketten vorhanden sind. Bei den Oxydationen wurde die 5-Methyl-heptanol-4-säure-1 erhalten, neben anderen für den Konstitutionsnachweis belanglosen Produkten. Aus den mitgeteilten Beobachtungen ergibt sich für das Laserpitin die noch unvollständige Strukturformel

Aufzuklären ist daher noch, wie obige drei Formelteile (die freien Affinitäten sind durch Striche angedeutet) und die vier Kohlenstoff-, beziehungsweise elf Wasserstoffatome, deren Stellung im Laserpitinmoleküle noch nicht ermittelt werden konnte, sich zu diesem verketten.

Die von Feldmann dem Laserpitin zugeschriebene Bruttoformel $C_{24}H_{36}O_7$ ist auf die große Schwierigkeit zurückzuführen, bei diesem Körper richtige Analysenzahlen zu erhalten. Auch die Angaben von Külz, der das Laserpitin $C_{10}H_{14}O_2(OH)OC_5H_7$ formuliert, konnten fast durchwegs nicht bestätigt werden.

Das w. M. Hofrat Dr. Franz Steindachner überreicht eine Notiz von Dr. Moriz Sassi, betitelt: »Eine neue Ohreule aus Zentralafrika (*Asio abessinicus graueri* nov. subsp.).«

In der Coll. Grauer findet sich eine Eule vom Urwald westlich des Tanganjikasees, die sich in folgenden Hauptpunkten von der ihr am nächsten verwandten Form *Asio abessinicus* Guér. unterscheidet:

1. *Asio abessinicus graueri* ist kleiner; die Maße sind hier Fl. 309, Schw. 163, Schn. 29, Schn. v. d. W. 19, L. 40 *mm*;

123

dagegen jene von *Asio abessinicus* Guér. Fl. 327—345, Schw. 175—190, Schn. 34—36, Schn. v. d. W. 18—20, L. 50—55 *mm*.

2. Die Rückenseite ist dunkler, mehr schwarzbraun und einheitlicher gefärbt; die Flecken und Bänder der basalen Federhälften sind durch die längeren braunen Spitzen mehr gedeckt.

3. Die ganze Brust zeigt verschwommene Längsstreifen und erst vom Bauch an findet sich die bei *Asio abessinicus* auch die ganze Brust einnehmende Längs- und Querstreifung, die dem Gefieder ein karriertes Aussehen verleiht.

Dr. Arthur Boltzmann in Wien legt eine Abhandlung mit dem Titel: »Untersuchungen am Silbervoltameter« vor.

Die Untersuchungen erstreckten sich auf einige noch nicht genügend geklärte Einflüsse auf die Angaben des Silbervoltameters.

Es wurde gefunden, daß in Platintiegeln mit einer Kathodenfläche von zirka 100 cm^2 Silberniederschläge im Betrage von 1 bis 3 g auf bereits vorhandenem Silber im Durchschnitt um 0·1 *mg* größer sind als solche auf reinem Platin.

Ein Platintiegel von der halben Größe gab im Mittel um 0·1 *mg* größere Niederschläge als die genannten großen Tiegel.

Ein Einfluß der Anodenflüssigkeit, ferner des Tageslichtes auf die Angaben der Voltameter konnte nicht konstatiert werden.

Dr. L. Moser überreicht zwei gemeinsam mit F. Perjatel größtenteils im Laboratorium für analytische Chemie der k. k. technischen Hochschule in Wien ausgeführte Arbeiten:

1. »Die Trennung des Arsens vom Antimon und anderen Metallen mit Methylalkohol im Luftstrom.«

Es wurde ein Verfahren ausgearbeitet zur Scheidung des Arsens von Metallen bei Gegenwart von konzentrierter Salzsäure und Methylalkohol im Luftstrom bei Wasserbadtemperatur, wobei ein Anteil des Arsens als Trichlorid und ein Teil

Fig. 3. Original description of *Asio abessinicus graueri* Sassi.

The exact geographical position of the recorded collecting locality, "primeval forest west of Lake Tanganyika, 2000 m asl" cannot be established, but it is certain from examination of Grauer's itinerary and dates that it is within the Itombwe Range (Sassi, 1912b: 347, 1924: 20; Lorenz von Liburnau, 1917: 171; Schaller, 1964: 86; Prigogine, 1971: 8-9, 86). Grauer had already worked in the Itombwe for three months in 1908 but, although his efforts resulted in the collection of the type of the Eastern Lowland Gorilla, *Gorilla beringei graueri*, and of a large number of birds, including the types of Grauer's Swamp Warbler, *Bradypterus graueri*, and Neumann's Bush Warbler, *Hemitesia neumanni*, he did not encounter the owl.

The original description (Sassi, 1912a) is brief but it spells out very clearly the diagnostic characters that distinguish the taxon from *Asio abyssinicus*:
-- smaller size, with a wing of 309 mm vs. 327-345 mm for *abyssinicus;*
-- darker, more blackish brown and uniformly coloured dorsal aspect, the pale flecks and bars of feather bases more covered by longer dark tips;
-- the entire breast marked by diffuse brown streaks, with a cross-bar pattern limited to the belly, while it covers the whole breast in *abyssinicus*.

In his detailed analysis of the material collected during Grauer's 1909-1911 expedition, Sassi (1912b: 360-361) gives a more elaborate account of the specimen. It adds precision to the terms used in the original diagnosis without modifying its content. The main diagnostic characters are again summarised by Snow (1978).

Records and distribution of Grauer's Long-eared Owl

Standard references, checklists, faunistic surveys, conservation status assessments and field guides agree on limiting the distribution of *Asio graueri* to the Albertine Rift mountains and Mount Kenya (Lippens & Wille, 1976; Snow, 1978; Fry et al., 1988; Marcot, 1995; Zimmerman et al., 1996; Holt et al., 1999; König et al., 1999; Bennun & Nioroge, 2000; Demey & Louette, 2001; Stevenson & Fanshawe, 2004; Vande weghe & Vande weghe, 2011; BirdLife International, 2016a; Vande weghe, 2018). The range states listed are the Democratic Republic of the Congo (DRC), Uganda, Rwanda and Kenya, though one or another of them is omitted in many of the accounts. A number of range maps have been published, displaying similar discrepancies, some of them even omitting the type locality.

Documented records attributed to Grauer's Long-eared Owl are very few. We have been able to trace only 7 of them prior to our Nyungwe observation, 4 in the DRC and 3 in Rwanda. They are, in chronological order:

-- 1. Itombwe range, DRC, March 1910, female, specimen collected by Rudolf Grauer, at about 2000 m asl. Holotype conserved in the collections of the Natural History Museum in Vienna, NMW 6.557 (Schifter et al., 2007). Photographs of the specimen, taken by Alice Schuchmacher, were provided to us by Hans-Martin Berg.

-- 2. Ruwenzori Mountains, DRC, November 1926, dried head discovered by James Chapin in the rafters of a hut in Kalongi (or Kalonge) village, at 2100 m asl on the west side of the range (Chapin, 1939: 402-403; see also Chapin, 1932: 23; Prigogine, 1971: 86). There is no indication in the publications of James Chapin or Alexandre Prigogine that the head was acquired or preserved. However, in the course of investigations undertaken in support of the present analysis, Paul Sweet established that the Ruwenzori head, although not entered in the catalogue of the museum, was indeed deposited in the collection of the American Museum of Natural History. It has now been given the catalogue number SKIN 844257 (Paul R. Sweet, in litt.). A photograph of the specimen was provided to us by Paul Sweet. The coordinates of Kalongi are given by Chapin (1954) as 0°20'N, 29°49'E.

-- 3. Mount Kabobo, DRC, 1 January 1951, specimen collected by Raymond F. Laurent, herpetologist, in the valley of the High Kabumbe at 2300-2400 m asl (Schouteden, 1952: 302, 1954: 344-345; Prigogine, 1960: 12, 1971), conserved in the collections of the Royal Museum for Central Africa in Tervuren (MRAC 55415). The specimen has been examined, photographed and measured by us. The information "Haute Kabumbe" is provided by Alexandre Prigogine (Prigogine, 1960: 12) who had had personal contact with Raymond Laurent. He describes the headwaters of the river "*à peu près à mi-chemin entre Sangwa et le Mont Kabobo*" (ibid., footnote 1). Combined with the altitude recorded for the specimen, this would place the collecting locality at about 5°10'12"52S and 29°03'18"E, in an area where montane forest and open spaces appear, from examination of Google Maps, to persist today. The area was intensively explored by Prigogine's collectors between 1953 and 1957, in a specific effort to find the bird (ibid.).

-- 4. Mount Kahuzi, DRC, plantation Van der Borght, 2300 m asl, 3 and 4 June 1959, 2 males collected by J. Tyskens, conserved in the collections of the American Museum of Natural History (SKIN 789173 and SKIN 789172, immature)[2]. Photographs of the specimens and their labels were provided to us by Paul Sweet. The original labels

[2]These specimens are those that appear or have appeared in international data bases, such as those of the GBIF, as collected at "Kohnm, Mbara", DRC, 6 March 1961 and 6 April 1951, the locality and dates resulting from errors of transcription of the specimen labels.

include an "official" label of IRSAC (Institut pour la Recherche scientifique en Afrique centrale), the major and highly performant research institution of the colonial and post-colonial Congo. Thanks to the kind cooperation of Dr. Peter Kunkel, honorary Director General of IRSAC, we have been able to precisely identify the collecting locality. The "Van der Borght plantation" of the 1950s-1960s was located along the Bukavu-Kisangani road on the southern slope of Mount Kahuzi, at about 2° 16' 49'' S and 28° 41' 19'' E (Appendix 1: Fig. 6). Altitudes within the site are near 2300 m asl. The area is still covered by open montane forest and a very large peat bog is nearby (Muzizi Swamp).

-- 5. Mount Bisoke, Volcanoes NP, Rwanda, 9 June 1979, single bird observed at length by J.P. Vande weghe in tall *Erica* thickets at 3400 m asl on the eastern slope of the mountain (Vande weghe & Vande weghe, 2011: 154; Bizuru et al., 2015). Jean Pierre Vande weghe's account is as follows: "I was walking along the trail coming down from the crater rim to Lake Ngezi in the late afternoon. The bird was perched at most at 10 m from me in large tree heaths, probably *Erica johnstoni*, mixed with *Hagenia* and with a dense undergrowth of *Hypericum revolutum* and *Vernonia*. The trees were no more than 8m tall and the canopy was very open. The bird did not move. It was looking down at me, and only once moved its ear tufts. After about five minutes I had to leave it in order to be out of the park before dark."

-- 6. Mount Bisoke, Volcanoes NP, Rwanda, 1980, "pair" encountered, perched in a tree, by John Fowler about halfway between Dian Fossey's Karisoke research centre and the summit of the mountain (Fowler, 2018: 342). The location would thus be at about or just above 3300 m asl, on the southern slopes of the volcano. The south-western flank of Mount Bisoke is covered with stands of widely spaced very old *Hagenia*, 10-15 m high, heavily loaded with epiphytes (mosses, orchids, and lichens) and with a very dense undergrowth of *Hypericum revolutum* and *Vernonia*, 2-3 m high.

-- 7. Mount Sabyinyo, Volcanoes NP, Rwanda, 18 July 1981, single bird briefly seen by J.P. Vande weghe at about 3000 m asl (Vande weghe & Vande weghe, 2011: 154; Bizuru et al., 2015). The bird was seen in the morning, perched in very open ridge thickets with large tree heaths, *Erica sp*., and abundant *Cornus volkensi*, draped in large lichens of the genus *Usnea*. It stayed only for a few seconds and then flew away, down into a deep gulley. Its size, ear tufts and overall dark plumage were characteristic.

Two more specimens of "*Asio abyssinicus graueri"* are widely reported in literature and databases, both taken on Mount Kenya:

-- Mount Kenya, Kenya, 3 January 1947, male, specimen collected at Lake Ellis [3200 m asl], conserved in the collections of the Natural History Museum at Tring, acquired as a gift from the Coryndon Museum, Nairobi (Natural History Museum Data Portal, Zoology, Aves https//data.nhm.ac.uk).

-- Mount Kenya, Kenya, 10 September 1961, adult female, specimen collected by J.R.M. Tennent above Naro Moru at 3350 m asl in *Hagenia* woodland, conserved in the collections of the National Museum of Kenya, Nairobi (Lewis & Pomeroy, 1989; Zimmerman et al., 1996; Don Turner in litt., 2020).

Photographs and measurements of the two Kenya specimens were provided to us by Mark Adams (Natural History Museum at Tring) and by Don Turner and Peter Njoroge (Nairobi). Comparison of these photographs and measurements with those of the four complete Albertine specimens clearly shows that neither Kenyan specimen matches *graueri*, either in plumage or in measurements. Both Kenyan specimens are very close to Ethiopian *Asio abyssinicus*, an observation also made by Don Turner (in litt.).

Possible additional encounters of *Asio abyssinicus* have also been described for Mount Kenya, and attributed to *graueri*, in particular, in 1975 and 1992 (Zimmerman et al., 1996), and again, in 2015-2017 (Ogada & Muriithi, 2017). None can be substantiated (Don Turner, pers. comm., Darcy Ogada, pers. com.).

Mann (1976: 8) reports that "M.P.L. Fogden (in litt. to G.C. Backhurst) records ["*Asio otus"*] from the Uganda side of the Ruwenzori". This second-hand unsubstantiated record appears to be the only basis for the frequent listing of Uganda among the range states of *graueri*. Keith et al. (1969) explicitly mention the absence of the species in the Impenetrable Forest. Two, widely used, frequently updated, international references, Avibase (Lepage, 2021) and

Wikipedia, do not list the owl on their current Uganda country checklists, following Carswell et al. (2005). The IUCN Red Data List, however, still includes Uganda among the range states in its 2016 assessment.

We could not find any substantiated observation of Grauer's Long-eared Owl outside of Rwanda after 1961 or anywhere after 1981. The Nyungwe record is the first after an absence of almost 40 years.

The characters of *Asio graueri*

Grauer's Long-eared Owl is a little known bird. Of the 8 records known, one (no. 4, above) is of specimens that were never reported in a publication. One (no. 2) is a dried head seen in a hut, of which James Chapin summarily described the little that could be seen. Two (nos. 5 and 7) are observations by one of us (J.P. Vande weghe), included in an avifaunal compilation the format of which did not allow for details. One (no. 6) is an incidental anecdote in a literary account of life in the Virunga Mountains, with little description of the birds except for "golden eyes". Only two records (nos. 1 and 3), are accompanied by a description of the bird. Henri Schouteden's description (Schouteden, 1954: 345) of the Mount Kabobo specimen (no. 3) is closely similar to Moriz Sassi's description of the type specimen (no. 1). In addition to our field encounters, we have had the opportunity to examine one specimen, the 1951 Kabobo bird, and to see photographs of the three other specimens attributed to *graueri*, kindly provided by the staff and collaborators of the institutions in which they are housed. We have also obtained wing measurements of all four specimens.

The birds seen in the field and the four Albertine Rift specimens (Fig. 4) correspond closely to Sassi's description. The specimens presumed to be adults show a dark brown mantle with few scattered large buff blotches. The specimen labelled "immature" is similar but with an admixture of buff marks on the nape and upper mantle. The facial discs are prominent, strongly rufous coloured. The Mount Kabobo specimen displays a conspicuous white extension of the facial ruff. In all four specimens, the breast is marked by broad brown stripes, flared sub-distally, sometimes blurred or coalescing, with no or little cross-barring. A coarse pattern of stripes and cross-bars occupy a limited part of the abdomen. There is a clear contrast, both of pattern and colour, between the breast and the abdomen. The ventral pattern of the Kabobo bird is not well shown in the photograph but examination of the specimen itself showed it to be similar to that of the others. Compared to Ethiopian *Asio abyssinicus* (Fig. 5), *A. graueri* has a darker mantle, quite uniform or marked with large buff blotches, but with much less buff flecking. A larger area of the upper breast is marked by coarse stripes while the pattern of fine stripes and cross-bars is more restricted. These are the diagnostic characters selected by Sassi. In addition, the pattern of the central tail feathers may be slightly different, the pale bars tending to be broader than the dark ones instead of narrower. *A. graueri* is substantially smaller than *A. abyssinicus*, a difference readily seen in comparison of specimens (Fig. 5) and confirmed by wing length measurements (Table 1). The characters of the Nyungwe individual that we were able to observe in the field (cf. also Fig. 2a,b) correspond well to those of the specimens. The mantle is very dark with scattered blotches and the pale bars of the tail are broad. There is also a conspicuous pale corona formed around the facial disk by diverse tracts of feathers similar in part to those visible on the Kabobo specimen, a condition not seen in specimens or live photographs of *A. abyssinicus.*

The two Mount Kenya specimens attributed to *Asio graueri* are more similar to Ethiopian *A. abyssinicus* than to Albertine *graueri*, an observation as noted by Don Turner (in litt.). The dorsal plumage shows the buff flecking of *abyssinicus*. On the underparts, the striped pattern is limited to a narrow band on the upper chest, while lower breast and belly carry an extensive pattern of thick, strongly defined stripes and cross-bars. The pale barring of the tail is very narrow. Wing measurements (Table 1), provided to us by Mark Adams (Natural History Museum at Tring) and Peter Njoroge (National Museum, Nairobi), are well within, or just above, the range of published *abyssinicus* measurements and very far from the range of *graueri* data. Whether the Kenyan birds fully fit within the range of variation of the Ethiopian population cannot be decided with the small sample available. There are no data on the birds of Mount Kenya beyond the two specimens. Affiliation of the Mount Kenya bird with *A. abyssinicus* rather than with *A. graueri* is biogeographically coherent. The southernmost part of the known range of *A. abyssinicus* in Ethiopia is in the mountains that form the eastern rim of the Eastern Rift Valley, in particular, the Bale Mountains. It is that chain that continues through Kenya on the eastern side of the valley, to the Aberdares. Mount Kenya is situated 80 km to the east of the Aberdares.

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Fig 4. Dorsal and ventral views of the four known complete specimens of *Asio graueri*. First from left, the type, Itombwe range, 1910 (Vienna, NMW 6.557; photos A. Schuchmacher). Second from left, Mt. Kabobo, 1951 (Tervuren, MRAC 55415; photos P. Devillers). Third from left, Mt. Kahuzi, 3 June 1959 (New York, AMNH, SKIN 789173; photos P. Sweet). Fourth from left, Mt. Kahuzi, 4 June 1959, labelled immature (New York, AMNH, SKIN 789172; photos P. Sweet).

Taxon	Locality	Specimen	sex	Wing	Reference
A graueri	Itombwe	NMW 6557	?	309	Sassi (1912a)
A graueri	Mt Kabobo	MRAC 55415	?	306	Schouteden (1954)
A graueri	Mt Kabobo	MRAC 55415	?	300	Pierre Devillers
A graueri	Mt Kahuzi	AMNH SKIN 789172	M	295	Paul R. Sweet
A graueri	Mt Kahuzi	AMNH SKIN 789173	M	290	Paul R. Sweet
A abyssinicus	Ethiopia	NMW	M&F	327-345 (N ?)	Sassi (1912a)
A abyssinicus	Ethiopia	NHMUK, ZFMK	M&F	330-365 (N ?)	Roselaar (1985)
A abyssinicus	Ethiopia		?, F, F	347, 357, 360	Kemp (1988)
A abyssinicus	Ethiopia	MRAC	F, M	335, 340	Pierre Devillers
A cf. abyssinicus	Mt Kenya	NHMUK 1961.21.8	M	350	Mark Adams
A cf. abyssinicus	Mt Kenya	NMK 5667	F	372	Peter Njoroge

Table 1. Wing measurements of the four *Asio graueri* specimens, a sample of *A. abyssinicus* specimens from Ethiopia and the two *Asio* specimens from Mount Kenya.

Fig 5. Direct comparison of a specimen of *Asio graueri* (MRAC 88415, left in both views) with two MRAC specimens of *Asio abyssinicus*. The size difference is striking, regardless of the vagaries of preparation. More subtle differences in pattern, described in the text contribute to diagnosability. Photos P. Devillers.

Several characterisations of *A. graueri* in standard references depart substantially from the original description, although, as far as we could ascertain, no new description of the type or of any other specimen has ever been published. Thus, the *Handbook of the birds of the world* (Holt et al., 1999) characterises *graueri* as "greyer overall" (p. 241) than *abyssinicus* and Plate 20 (Lewington, 1999) shows a bird with greyish upperparts, whitish underparts with no contrast between breast and belly and pale grey facial discs. The drawing resembles neither *A. graueri* nor *A. abyssinicus* and the identity of the model is not clear. *Owls, a guide to the owls of the world* (König et al., 1999) describes *graueri* as "greyer" than *abyssinicus* (p. 427) and depicts *abyssinicus* and *graueri* with a similar pattern, *abyssinicus* more warmly coloured, *graueri* paler and greyer (Plate 63), but both within the range of variation of *A. abyssinicus* as displayed by photographs from Ethiopia. A bracket of wing measurements is offered, the lowest value (309 mm) ostensibly borrowed from Sassi, the highest (342 mm) much larger and within the range of *abyssinicus* measurements. Although no source is given, the bracket is identical to that proposed by *The Birds of Africa* (Kemp, 1988), and the high value is probably provided by an *Asio abyssinicus* from Mt Kenya, probably the Tring specimen. This specimen may also have been the model for Martin Woodcock's Plate 7 in *The Birds of Africa* (Fry et al., 1988), which gives very similar portraits of *abyssinicus* and *graueri*. A similar bracket, 309-340 mm, is offered by Mackworth-Praed and Grant (1957: 646). The higher measurement certainly corresponds to the Tring specimen as it is the only one, with Sassi's type, to have been collected before 1952, the date of publication of the first edition of *Birds of Eastern and North Eastern Africa*. Mackworth-Praed and Grant's brief characterisation of *graueri* appears directly inspired by Sassi's diagnosis. Zimmerman's more detailed description in *Birds of Kenya* (Zimmerman et al., 1996: 446) conforms closely to the original description. It may have benefitted from examination of the specimens of the American Museum of Natural History (collected in the DRC), the only museum holding *graueri* that is listed among the institutions that provided the bulk of the material used for *Birds of Kenya* (Zimmerman et al., 1996: 10).

Taxonomy

Long-eared owls occur in North America, the Palaearctic, eastern Africa and Madagascar. They constitute six discrete, allopatric, named taxa, *otus* on the Eurasian continent and north-western Africa, *wilsonianus* (including *tuftsi*) in North America, *canariensis* in Macaronesia, *abyssinicus* in north-eastern Africa and the Eastern Rift, *graueri* in the Albertine Rift and *madagascariensis* on Madagascar. All have been at times considered subspecies of a widespread polytypic species, *Asio otus*, as a result of the mid-20th century application of a Biological Species Concept (BSC) that strove to relegate any allopatric taxa to subspecies status. At present, under a less all-inclusive implementation of the BSC, they are most often distributed between three species, *Asio otus*, *A. madagascariensis*, and *A. abyssinicus* (Vaurie, 1965; Snow, 1978; Roselaar, 1985; Fry et al., 1988; Zimmerman et al., 1996; Holt et al., 1999; König et al., 1999; Stevenson & Fanshawe, 2004; Collar & Boesman, 2019). The first comprises all Holarctic entities, the second is monotypic, the third includes *A. graueri*.

Taxonomic treatment of allopatric populations depends largely on the species definition adopted and on the criteria used to evaluate whether or not a given taxon fits that definition. We subscribe to the analysis of de Queiroz (2005a, 2005b) and Groves (2017), who argue that most modern species "concepts" proceed from a common species definition as "a lineage (an ancestral-descendant sequence of populations) evolving separately from others and with its own unitary evolutionary role and tendencies" in the words of Simpson (1961). Among the criteria proposed to decide the status of a taxon, we prefer those attached to the Phylogenetic Species Concept (PSC), as proposed by Cracraft (1983, 1987, 1989), genetic independence and diagnosability, rather than those that guide the Biological Species Concept (BSC), essentially, potential for interbreeding. We have previously explained (e.g. Devillers & Devillers-Terschuren, 1994, 2004, 2012, 2013; Vande weghe & Vande weghe, 2011) reasons for this choice. They are eloquently expressed by Colin Groves in the introduction to *Ungulate Taxonomy* (Groves & Grubb, 2011: 1-4; see also Groves, 2017). Making the species coincide with the evolutionary unit, the phylogenetic definition is the most appropriate both for the construction of phylogenies and for the orientation of efforts aimed at the preservation of biological diversity. Application of the PSC criteria only requires taking into account the past and present evolutionary pathway of populations, while the BSC imposes, in the case of allopatric taxa, hypotheses on future events that are impossible to falsify. Hailed as a "considerable simplification of the classification" of organisms (Mayr, 1969: 38), residing mostly in a drastic reduction of the number of species recognised, the BSC can "obfuscate patterns of species diversity in its classifications, which lump evolutionarily-distinct lineages into imprecisely diagnosed taxa" (Cotteril, 2006) and lead "to forget that a distinct population exists, after it has been classified as a subspecies, synonym or race in a polytypic species" (Cotteril, ibid.).

Among the components of the *Asio otus* assembly, genetic independence and diagnosability are of course obvious for the three widely recognised taxa, *A. otus, A. madascariensis* and *A. abyssinicus*, but also for *A. wilsonianus* vs. *A. otus* (cf. e.g. Robb, 2015) and for *A. graueri* vs *A. abyssinicus*. The range of *A. graueri* is widely separated from that of *A. abyssinicus* with no indication of contacts, and its diagnosability has long been reported (Sassi, 1912a, 1912b; Snow, 1978). It is confirmed by our consideration of additional individuals, the similarity of which, over time and space, compared to the range of variation of *A. abyssinicus*, also dispels any suggestion of occasional visitors from Ethiopia. We thus refer to the Albertine taxon as *Asio graueri*.

Habitat

Precise data on habitat are available for only three of the eight known records of *Asio graueri*, but altitude provides some information for the others. The Nyungwe sight record and the collecting localities of the three Kahuzi and Kabobo specimens are situated within a narrow altitudinal range of 2300 to 2400 m. The other two specimens were probably collected at similar altitudes. The label of Grauer's type-specimen indicates 2000 m. However, as noted by Prigogine (1971: 9), all of the very numerous specimens collected by Grauer during his February to April 1910 Itombwe transect, many of them montane forest specialists, bear the same locality characterisation "*Urwald westlich vom Tanganjika-See, 2000 m*" (Sassi, 1912b, 1916, 1924) so that the expression must be understood as describing the whole area, not any particular collecting spot. The itinerary sketched by Sassi (1924: 20), as interpreted by Prigogine (1971: 9), would have taken Grauer on a roughly 50 km crossing of the Itombwe plateau, from the crest line of the range, at about 28°55'E west to about Kisale at 28°32'E. On such a line he would indeed have encountered the limit of the continuous dense montane forest at 2000 m, but before that he would have crossed several forest outposts between 2500 and 2000 m (cf. Curry-Lindahl, 1956: fig. 13). The Ruwenzori specimen was found in a Kalonge hut, at 2100 m. It is likely to have been collected in or on the edge of the neighbouring forest, which extends from the village to altitudes of 2300-2400 m.

The three sightings in the Virunga Mountains form a very different cluster. The 1979 and 1980 records, on Mount Bisoke, were at 3300-3400 m, thus a 1000 metres higher than the Nyungwe, Kahuzi and Kabobo records. The 1981 brief encounter, on Mount Sabyinyo, was at a similar altitude, of about 3000 m. Altogether, the eight records outline two altitudinal zones, the 2000-2400 m zone in Nyungwe, the Itombwe, the Kabobo and Kahuzi ranges, and perhaps the west slope of the Ruwenzori, the 3000-3400 m zone in the Virunga Mountains. A similar range of altitudinal occurrence at these localities is displayed by a more often observed Albertine endemic, the Stripe-breasted Tit, *Melaniparus fasciiventer*. The tit is recorded at 2000-2800 m in the Itombwe, at 2080-2480 on Mt Kabobo, at 2100-2800 m in Nyungwe, at 2200-3000 m on the west slopes of the Ruwenzori, and at 2100-2300 m in the Kahuzi range (e-Bird), but is common at 3355 m in the Virunga Mountains (Harrap & Quinn, 1996: 343). This pattern may reflect differential deforestation (Jean-Pierre Vande weghe, pers. obs.) as well as accessibility.

The altitudinal zonation of vegetation in the Albertine Rift mountain ranges has been described by many authors (e.g. Lebrun, 1957, 1958, 1960a, 1960b; Misonne, 1963; Curry-Lindhal & Lamotte, 1964; Pierlot, 1966; Schlichte, 1975; Prigogine, 1978; White, 1983; Delvingt et al., 1990; Doumenge, 1990, 1998; Dowsett-Lemaire, 1990a; Vedder, 1992; Fischer, 1996, 2013; Doumenge & Schilter, 1997; Vande weghe, 2004; Owiunji et al., 2005, Bussman, 2006; Linder & Gehrke, 2006; Languy & de Mérode, 2006; Fischer and Killmann, 2008; White & Vande weghe, 2008; Eggermont et al., 2009; Guillaumet, 2009; Kabonyi Nzabandora, 2012, 2016; Happold & Lock, 2013; Seburanga et al., 2014; Kabonyi Nzabandora & Roche, 2015; Roche et al., 2015; Bizuru et al., 2015; Carbutt & Edwards, 2015; Imani et al., 2016; Mangambu Mokoso, 2016; Carbutt, 2020). The elevation of the boundaries between the zones differs somewhat between the ranges and depends in part on the parameters emphasized for their characterization. Nevertheless, a fairly constant overall picture emerges. In the western piedmont of the ranges, the lowland rain forests of the Congo basin ascend to about 1200-1300 m. Afromontane rain forests replace them at higher altitudes, from 1500-1700 m to 2600-3000 m. Altitudes comprised between the upper limit of fully expressed lowland forest and the lower limit of montane forests were occupied by a belt of drier submontane or transition forests which have, for the most part, been cleared. Above the afromontane forest belt, from 2600-3000 m to 3200-3900 m a mostly ericaceous, afrosubalpine heath forest develops, followed, on the highest mountains, by afroalpine formations, characterized in particular by spectacular giant *Lobelia* and *Senecio*, and shrubby *Alchemilla* and *Helichrysum*.

The afromontane forest belt includes several physiognomically distinct facies. The bulk of it is constituted by a tall, mixed forest, closed-canopied and highly multispecific. Near the upper limit of the belt, the tall forest is

progressively replaced by a lower-canopied, less dense, more xerophytic upper montane forest, called by Pierlot (1966) "*forêt de haute montagne*", by White (1983) "undifferentiated montane forest". In this forest, the trees rarely reach more than 10-12 m and form an open, single-stratum, canopy dominating a very dense undergrowth. Epiphytes, especially *Usnea* lichens and mosses, are very abundant. Tree diversity is reduced so that a tendency to mono- or pauci-dominance appears (Vande weghe, 2004) and distinctive facies form, according to edaphic and microclimatic conditions. One of these facies is the particularly striking *Hagenia-Hypericum* forest, woodland or parkland which covers significant surfaces on many of the Albertine mountain ranges. An equally distinct facies is formed by bamboo thickets which may on some ranges constitute a continuous belt, mapped by some authors as "bamboo belt" or "bamboo zone".

The distribution, abundance and genesis of *Hagenia*-dominated formations has been a matter of controversy. They are often considered as a distinct biome, such as the *Hagenia* woodland of Lind and Morrisson (1974: 48-50), the *Hagenia abyssinica* forest of White (1983: 166), the *Hagenia abyssinica*-Sekundärwald of Fischer (1996: 71), the *Hagenia-Hypericum*-zone of Linder and Gehrke (2006), or the *Hagenia-Hypericum* woodland of Seburanga et al. (2014). Most authors regard *Hagenia* formations as a seral stage established after disturbances (Lebrun, 1960a; White, 1983; Habiyaremye & Roche, 2003; Bloesch et al., 2009; Kindt et al., 2011; Ayingweu, 2016), such as fires (eg. Bussman & Lange, 1999; Bussman, 2001, 2006), landslides (Vedder, 1992) or anthropic degradation (Guillaumet, 2009). However, edaphic or microclimatic conditions that favour the abundance or dominance of *Hagenia* in undisturbed forests clearly exist (e.g. Ublig, 1988; Bloesch et al., 2009). Lind and Morrison (1974) had suggested that *Hagenia* formations could, in particular, be climax forests where cold night temperatures prevent the growth of less frost-tolerant tree species, a hypothesis expressed again by Kabonyi Nzabandora (2012, 2016) for Mount Kahuzi and by Roche et al. (2015) and Molau (2017) for Nyungwe.

In the Albertine mountains, *Hagenia* woodland appears in two distinct situations. Stands form near the upper limit of the mixed upper montane forests, at about 2000-2500 m, below the bamboo belt or intermixed with it, on Mount Kahuzi (Curry-Lindahl, 1956: 60, fig. 19; Fischer, 1996; Wagner, 2007: 809; Kabonyi Nzabandora, 2012, 2016; Kabonyi Nzabandora & Roche, 2015; Imani et al., 2016; Mangambu Mokoso, 2016), in Nyungwe (Curry-Lindahl, 1956: figs. 3 & 4; Dowsett-Lemaire, 1990a; Vedder, 1992; Vande weghe, 2004; Wagner, 2007: 809; Fischer, 2013; Roche et al., 2015; Molau, 2017) and on the Itombwe plateau (Curry-Lindahl, 1956: 17, 64, fig. 14; Curry-Lindalh, 1961; Leleup, 1962; Laurent, 1964; Doumenge & Schilter, 1997; White & Vande weghe, 2008; Plumptre et al., 2009; Berzaghi et al., 2018). In all these massifs, links to disturbances have been noted but occurrence in cold pockets, particularly in the basins of peat bogs, has also been documented. We have not found documentation of such montane *Hagenia* stands or similar woods in the Kabobo massif, but we have been unable to find any detailed information on the vegetation of the area. Topographic features that lead to cold-pocket upper-montane forests on other ranges also occur on Mt. Kabobo and the occurrence of montane wetlands and their fringes is confirmed by the amphibian record (e.g. Laurent, 1952; Greenbaum et al., 2013). Likewise, montane *Hagenia* stands, below the bamboo belt, do not seem to have been reported on the Ruwenzori, but boggy valleys and depressions exist in the 2100-2300 range, in particular within 1 km of Kalonge, with recent records of *Melaniparus fasciiventer* (Macaulay Library). Misonne (1963) found *Hagenia* prominent below 2300 m on Mount Tshiaberimu, the high relief situated to the south of the Ruwenzori range and to the north of Mount Kahuzi, along the west shore of Lake Edward. The *Hagenia* stands were associated to a bamboo belt that was very extensive at the time of his visit in 1958. *Asio graueri* was never recorded in the Mount Tshiaberimu massif. However, surveys were rare, apparently limited to fairly intensive efforts by Prigogine and his collectors in 1948-1952 (Prigogine, 1953), and surveys in 1996 and 2008 (Kyungu et al., 2009; Kyungu Kasolene & Sikubwabo Kiyengo, 2020). There may no longer be habitat suitable for the owl on Mount Tshiaberimu as the total surface of the forested area has been reduced from 450 km² in the 1950s to 60 km² in the 1990s (Butynski & Sarmiento, 1995) and 53 km² today (Kyungu Kasolene & Sikubwabo Kiyengo, 2020). The bamboo belt was considerably reduced after 1960 (Verschuren et al., 2006) and the *Hagenia* stands had entirely disappeared, at least by the 1990s (Butynski & Sarmiento, 1995).

More extensive, sometimes pure, *Hagenia* forests form above the bamboo zone, and just below, or within, the heather zone, at 3000-3600 m, on the Ruwenzori, on the Virunga volcanoes and on Mount Kahuzi, as they do on many high East African mountains, from Ethiopia to Malawi (McKinnon & McKinnon, 1986). On the Virunga volcanoes, *Hagenia* forests form an extensive and in part continuous belt at 2800-3200 on Mount Karisimbi, Mount Mikeno and Mount Bisoke, with a more restricted surface on Mount Sabinyo (Lebrun, 1960a, 1960b; Curry-Lindalh, 1961; Curry-Lindhal & Lamotte, 1964; Delvingt et al., 1990: 54; Vedder, 1992; Dondeyne et al., 1993; McNeilage, 1995; Vande weghe, 2004; Owiunji et al., 2005, Bussman, 2006; Languy & de Mérode, 2006; Verschuren et al.,

2006; White & Vande weghe, 2008; Williamson & Fawcett, 2008; Bloesch et al., 2009; Roelke & Smith, 2010; Tuyifingize, 2010; Kabonyi Nzabandora, 2012, 2016; Fischer, 2013; Tuyifingize et al., 2013; Seburanga et al., 2014; Roche et al., 2015; Derhé et al., 2019; van der Hoek et al., 2019). In the 1960s, these forests were often described as park-woodland. They were very open, with sparse undergrowth, as a result of grazing pressure. After the removal of domestic cattle in the late 1970s, the vegetation began regenerating and today a dense undergrowth of *Vernonia*, *Dendrosenecio* and giant lobelias has formed under the large hagenias. On the Ruwenzori, high altitude *Hagenia* formations are of much more local occurrence then on the Virunga volcanoes. Isolated stands are found between 3100 and 3300 m (Demaret, 1958; Curry-Lindalh, 1961; Misonne, 1963; Linder & Gehrke, 2006; Montserrat et al., 2013), and trees may be scattered throughout the ericaceous zone, from 2600 to 3900 m (Inforcongo, 1958: 277; Eggermont et al., 2009). On Mount Kahuzi, similar stands are found above the bamboo belt, between 2600 and 3000 m (Schlichte, 1975; Kabonyi Nzabandora, 2012; Maldonado et al., 2012). There may not be a clear break between these subalpine formations and the montane stands.

It is in *Hagenia* woodland, within an environment of upper montane forest, that the Nyungwe sighting was made (cf. Fig. 1 and Appendix 2: Figs. 7 & 8). Uwasenkoko Swamp was the object of a detailed bio-climatic study by Molau (2017). The peat bog is surrounded by a valley-bottom, low-canopied, open *Hagenia abyssinica* forest. The hillsides are occupied by taller, denser, more multi-specific forests, the tallest, richest stands being found on the hilltops. This inverted zonation is the result of cold air trapped in the valley bottom, forming cold-air lakes. Temperatures at Uwasenkoko may fall below freezing on clear nights of the dry season. The site is the only one in Rwanda that still harbours *Cliffortia nitidula,* a dominant shrub during the Last Glacial Maximum (Vande weghe, 2004). It is probable that comparable conditions prevailed in the upper reaches of the Kabumbe River, where Raymond Laurent collected the Kabobo specimen (Prigogine, 1960) at a similar altitude. Laurent collected at the same location several upper montane amphibians (Laurent, 1952; Greenbaum et al., 2013) and a chameleon, *Trioceros schoutedeni*, that he describes as a member of a group found "*dans les forêts ombrophiles ou dans les étages des Bambous, des Hagenias et des Bruyères*" (Laurent, 1952: 21). The two Kahuzi *Asio* specimens were collected on slopes situated just above the Muzizi Swamp, a peat bog very similar to the Uwasenkoko Swamp. These slopes are now occupied by open upper montane forest. A photograph taken by Kai Curry-Lindahl on 17 March 1952 (Curry-Lindahl, 1956: fig. 18), probably from very near the 1959 record and a few years prior to it, shows a similar habitat. Kabonyi Nzabandora (2012: 28) notes the intrusion of *Hagenia* in the valleys of the Kahuzi massif under the influence of a local cold and humid microclimate, and Roelke et al. (2011: 344) describe the habitat as "secondary *Hagenia abyssinica* forest" near the Mugaba Ranger Station, located, at 2300 m, a few kilometres to the west of the Muzizi Swamp, between the Cinya and Mubara swamps (Kerbis Peterhans et al., 2010; Ngera et al., 2019).

The exact collection locality of the two oldest specimens is not known. It is certain, however, that Grauer's specimen was taken on the Itombwe plateau, at or somewhat above 2000 m, and in, or on the edge or outliers of, montane rain forests. Laurent (1964) notes the abundance of swampy areas rimmed by "hagenits" and tree-like heathers between 2000 and 3000 m in the Itombwe highlands. The upper edge of the mixed montane forest, with associated swamps can also be found quite close to Kalonge, where the dried head acquired by Chapin was found. It is thus highly likely that all four specimen records were obtained, like the Nyungwe sight record, in open woodland of the upper limit of the montane mixed forest, in particular in *Hagenia* stands or similar formations.

The three Virunga sightings took place at much higher altitudes, 3000-3400 m, but in forest formations physiognomically similar to the Uwasenkoko site. All were in the afrosubalpine *Hagenia-Erica* belt. The 1979 and 1980 Mount Bisoke observations were in *Hagenia-Hypericum* open woodland. The 1981 Mount Sabyinyo observation was in a very open *Erica* thicket (Appendix 2: Fig. 9). In the 1950s, Kai Curry-Lindhal (in Curry-Lindhal & Lamotte, 1964: 158-159) evaluated on Mount Karisimbi the species richness of small vertebrates in the various subalpine formations and found it much higher in *Hagenia* woodland than in all other formations. Similarly, in a 2009 study of small mammals, Tuyisingize et al. (2013) found a higher richness in *Hagenia* woodland than in all other habitat types, montane, subalpine and alpine. These findings may, in part, explain the attractiveness of *Hagenia* formations for Grauer's Long-eared Owl both in the subalpine belt and at the upper montane level.

Overall, montane and subalpine *Hagenia*, *Hagenia-Erica* and similar forests cover only small areas in the ranges where *Asio graueri* has been recorded. The largest surfaces are in Rwanda's Volcanoes National Park where the continuous belt of old *Hagenia-Hypericum* forests occupies about 7000 ha. A few thousand hectares of these woods are also found in Nyungwe Forest, scattered around swamps and on high summits above 2600 m. The total surface of

the Hagenia stands that occur around upper montane bogs of the Itombwe, Kahuzi and Kabobo ranges and in the subalpine heath belt of Ruwenzori are no larger, and perhaps nowadays much smaller, than in Nyungwe.

Conservation

The IUCN Red List 2016 evaluation (BirdLife International, 2016a) lists *Asio abyssinicus s.l.* (including *A. graueri*), as "Least Concern", a status clearly inappropriate for *A. graueri*. This misrepresentation proceeds in part from the treatment of *A. graueri* as a subspecies of *A. abyssinicus* and the absence of separate assessments for the two constituents of the resulting polytypic species. It illustrates how, in practice, and in spite of claims to the contrary, subsuming distinctive forms into polytypic species obscures their need for conservation concern and conservation measures (e.g. Cotteril, 2006; Groves, 2017). The greatly overoptimistic treatment results also from a misleading interpretation of the distribution and population parameters of both of the two taxa, *A. abyssinicus* and *A. graueri*. Their combined range is described as "very large", a characterisation that seems to only take into account the "extent of occurrence" (EOO), the envelope of the areas of known occurrence, evaluated at 1 470 000 km^2. The IUCN criteria require, however, for the evaluation of the range to be based on both the EOO and the "area of occupancy" (AOO), a scaled metric representing the area of suitable habitat currently occupied by the taxon (Gaston & Fuller, 2009; IUCN, 2012, 2019). The EOO is particularly taxonomy-dependent when allopatric, widely separated taxa are being dealt with. An EOO for *A. graueri*, when not combined with *A. abyssinicus*, amounts at most to 60 000 km^2, 4% of the EOO of the "polytypic species". The AOO of *A. graueri*, measured in terms of 2 x 2 km grid cells as imposed by the IUCN guidelines (IUCN, 2019: 52), is 32 km^2, if one uses all the records to indicate the "current" occupation in spite of the fact that the DRC records are all more than 50 years old and one more than 100 years old, while three of the four Rwandan records are almost 40 years old. A more generous way to calculate the area of occupancy than the strict application of the IUCN guidelines, the extent of the suitable habitat still extant in the mountain ranges where the species has been recorded (Gaston & Fuller, 2009), would still yield an AOO of less than 500 km^2. In addition, the AOO is highly fragmented, with vast areas of unsuitable country separating the surviving patches (e.g. Plumptre et al., 2007; Ochanda et al., 2012).

Even within favourable habitat, *Asio graueri* is certainly a very rare species, present at low densities. Although all owls are discrete and can be easily overlooked, the rate of encounter of the species in the areas where it has been detected is extremely low. The Itombwe range was intensively combed by Prigogine and his collectors specifically searching for the owl and they could never repeat Grauer's discovery. A five-month comprehensive survey of the range was conducted in 1996 (Omari et al., 1999), with particular attention to owls (Butynski et al., 1997). *Phodilus prigoginei* was rediscovered but there was no encounter of *Asio graueri*. Prigogine's collectors also explored the Kabobo range for a total of about eight months in 1953-1957 (Prigogine, 1960: 12). They visited in particular the area of Laurent's capture and the owl was one of their targets. A new survey was conducted between 28 January and 26 February 2007 (Plumptre et al., 2008). None of these efforts produced a record. The number of naturalists that have visited and visit Volcanoes NP is very high and yet only three encounters have been reported, none in recent years. A team from the Dian Fossey Gorilla Fund International surveyed birds in the park for seven years, 2013-2019 (Derhé et al., 2019; van der Hoek et al., 2019). They established 30 transects between the altitudes of 2400 m and 4300 m, traversing all habitats in which Grauer's Long-eared Owl could have been expected, including *Hagenia-Hypericum* forests, subalpine formations and swamp edges. Most of the transects encompassed altitudes at which the 1979 to 1981 observations were made. Each transect was conducted twice a year. As a result of this intensive effort they recorded 119 bird species, some of which had not been detected by previous surveys. No sign of Grauer's Long-eared Owl was found. The Ruwenzori Mountains and the Kahuzi range have also been the focus of many visits, surveys and field studies by naturalists in recent decades, resulting in discovery or rediscovery of a number of species. The area of Kalongi, on the west side of the Ruwenzori range and the rim of the Muzizi Swamp, in the Kahuzi range, in particular, has been frequented by scientific expeditions and highly motivated birding tours. Yet, no record of *A. graueri* has followed those of Chapin and Tyskens. Two of us, Jean-Pierre and Gael Vande weghe, have spent a considerable time in Nyungwe Forest (over 365 days), from 1970 to the present, yet the observation reported here is their first. Other ornithologists have resided in the forest for prolonged periods, some of them focusing on owls. Françoise Dowsett-Lemaire and Robert Dowsett conducted an 18-week survey of birds in Nyungwe in 1989-1990 (Dowsett et al., 1990; Dowsett-Lemaire, 1990b) and Wildlife Conservation Society researchers organised a new two-month survey from 22 June to 26 August, 1999 (Plumptre et al., 2002), all without recording *A. graueri*. For the past 10 years, Claver Ntoyinkima (pers. comm.) has intensively studied the avifauna of Nyungwe Forest. He found several very rare species, including *Cinnyris rockefelleri* and *Stiphrornis xanthogaster*, both of which were of

uncertain status in Rwanda (Vande weghe & Vande weghe, 2011). He was specifically searching for owls. He never encountered *Asio graueri*. His most thorough efforts were focused on the western parts of Nyungwe, between Mount Bigugu and Gisakura, so that his failure to find Grauer's Long-eared Owl may suggest that the bird is not only rare, but confined to the plateaux and peat bogs of the eastern sector, where we saw it.

The IUCN assessment characterises the "Current Population Trend" as "stable", with as justification "the population is suspected to be stable in the absence of evidence for any declines or substantial threats". A precautionary principle should not have allowed this suspicion at least when *A. graueri* is concerned, with no more records since 1981 in any of the known areas of occurrence nor since 1961 in most of the known range. On the contrary, the distribution in time of the records, mostly when compared to the evolution of the observation intensity, and the failure of recent surveys of major parts of the range to record the species, suggests a possible decline of Grauer's Owl, an eventuality that has been expressed for *A. abyssinicus* on Mount Kenya (Ogada & Muriithi, 2017). Numerous serious threats bearing on the montane forests of the Albertine Rift have been identified (e.g. Redmond, 2001; Kabonyi Nzabandora, 2011; Ochanda et al., 2012; Plumptre et al., 2013, 2021) and they appear particularly at risk under the probable scenarios of climate change (Carr et al., 2013; Ayebare et al., 2013, 2018a, 2018b; Menegon, 2015).

The 2016 IUCN assessment of the Congo Bay Owl, *Phodilus prigoginei*, (BirdLife International, 2016b), another Albertine endemic, states that "This poorly-known species is undoubtedly very rare and has a very small known range. It appears to have very specific habitat requirements and, while a large area of its habitat remains, forest clearance and degradation are likely to be causing declines in range and numbers. It therefore qualifies as Endangered". This evaluation undoubtedly applies to *Asio graueri* in terms of abundance, range, habitat requirements and threats. The species thus also qualifies as Endangered, perhaps, unfortunately, as Critically Endangered.

The reappearance of Grauer's Long-eared Owl, after almost 40 years without an observation, is one more event that underscores the unique importance of Nyungwe Forest, the largest patch of montane forest surviving in the Albertine Rift (Dowsett-Lemaire & Dowsett, 1990), and the absolute necessity to guarantee its perennity. Detailed investigations will undoubtedly be needed to also insure that the habitat characteristics -- still insufficiently known -- that sustain the presence of the owl are maintained and even promoted.

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Appendix 1. Localisation of the Mt Kahuzi record

Fig. 6. Map of the Kahuzi range, showing the location of the "Van der Borght plantation" of the 1950s-1960s. The road that crosses the map from east to west is the Bukavu-Kisangani road. The eastern entrance and visitor centre of the Kahuzi-Biega National Park, at Tshivanga, is in the lower right corner. The red circle indicates the plantation. The white cloud due north of the plantation marks the position of the summit of Mt. Kahuzi. The elongated pale area due south of the plantation is the northern part of the large Muzizi Swamp. Other similar depressions are scattered in the landscape. Forest is visible all around the Muzizi Swamp and on the ridge extending north-eastwards from the road, in the area of the plantation.

Establishing the exact location at which the two *Asio graueri* specimens housed in the American Museum of Natural History had been collected proved to be an arduous endeavour. At first it was because the information recorded on the collector's labels had been widely misquoted in internationally available databases. Joel Cracraft and Paul Sweet kindly provided us with the original label information, establishing that the place of collection was a "Van der Borght plantation". However, we could find no trace of this plantation in current place names, in scientific literature, in administrative texts, in museum and herbarium catalogues or in existing gazetteers. Finally, we had the good fortune of receiving from our friend and colleague, Peter Kunkel, one of the few remaining witnesses of the 1960s in what is now the Kahuzi-Biega National Park, a first-hand account of the "Van der Borght plantation", which he oversaw during absences of the owner. Peter pinpointed for us the exact location of the former plantation. As this information is not available anywhere else, we thought it useful to present it in the map above.

Appendix 2. Habitats of *Asio graueri*

Fig. 7. Uwasenkoko Swamp, site of the 2019 Nyungwe sighting of *Asio graueri*. Above, overview of the swamp and its surrounding hills. Below, valley-bottom forest adjacent to the swamp. Photos G.R. Vande weghe, 14.6.2012.

Fig. 8. Uwasenkoko Swamp. Above: *Hagenia abyssinica* forest near the sighting. Photo P. Devillers, 21.11.2019. Below: bryophyte draperies festooning branches of *Hagenia*. Photo J. DevillersTerschuren, 21.11.2019.

Fig. 9. Volcanoes NP, Rwanda. Above: east, south and south-west slopes of Mt. Bisoke, site of the 1979 and 1980 records; to the left of Mt. Bisoke, in the background, Mt. Karisimbi and Mt. Mikeno, and, in the foreground, the extensive *Hagenia* forest of the saddle between Mt. Bisoke and Mt. Karisimbi (Photo P. Nyinimihigo, 8.4.2017). Below: south-west slopes of Mt. Sabyinyo, 3000-3300 m, heath forest level, site of the 1981 record (Photo G.R. Vande weghe, 13.3.2019).