

# Rediscovery of the Black-fronted Francolin *Pternistis (castaneicollis) atrifrons* (CONOVER, 1930) (Aves: Galliformes: Phasianidae) with notes on biology, taxonomy and conservation

TILL TÖPFER<sup>1</sup>, LARS PODSIADLOWSKI<sup>2</sup> & KAI GEDEON<sup>3</sup>

<sup>1</sup> Zoologisches Forschungsmuseum Alexander Koenig, Adenauerallee 160, 53113 Bonn, Germany; t.toepfer(at)zfmk.de —

<sup>2</sup> Rheinische Friedrich-Wilhelms-Universität Bonn, Institut für Evolutionsbiologie & Ökologie, An der Immenburg 1, 53121 Bonn, Germany; lars(at)cgae.de — <sup>3</sup> Verein Sächsischer Ornithologen, P.O. Box 1129, 09331 Hohenstein-Ernstthal, Germany; gedeon(at)gmail.com

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## Abstract

In May 2012 and in May 2013 we searched for the Black-fronted Francolin *Pternistis (castaneicollis) atrifrons* in the Mega area in southern Ethiopia. Since most of the scarcely published records date back about seven decades, our objectives were (1) to confirm its presence at the type locality, (2) to explore other potentially suitable areas, (3) to collect information on morphology and field characteristics, behaviour and habitat, (4) to conclude on its taxonomic position, and (5) to make a preliminary assessment of threats to the birds and their habitat. We recorded at least 12 different Black-fronted Francolin individuals on five sites around the town of Mega (04°03'28" N 38°19'16" E). The birds inhabited semi-open woodland between 1,480 and 2,223 m asl, where the original juniper forest has almost vanished because of heavy utilisation pressure, primarily by the expansion of agriculture, grazing and harvesting of firewood and timber. A typical external feature of the males is a clearly visible bald yellow patch behind the eye. While no other *P. castaneicollis* subspecies seems to have this spot, other francolin species have. Additionally, our molecular and bioacoustic data support the separate taxonomic status of *atrifrons*. Taking together all characters, assigning species status for the Black-fronted Francolin is justified. Based on our survey, we estimate the current population to be very small, rendering the Black-fronted Francolin the most endangered galliform bird of Africa. Also, we assume its range to be much smaller and more fragmented than previously thought, making the local populations crucially endangered.

## Kurzfassung

Im Mai 2012 und im Mai 2013 haben wir nach dem Schwarzstirn-Frankolin *Pternistis (castaneicollis) atrifrons* im Raum Mega in Süd-Äthiopien gesucht. Da die meisten der spärlich publizierten Nachweise über sieben Jahrzehnte zurückliegen, waren unsere Ziele, (1) das Vorkommen des Vogels an der Typuslokalität zu bestätigen, (2) andere potentiell geeignete Habitats zu erkunden, (3) Informationen über die Morphologie und Feldmerkmale, Verhalten und Habitat zu sammeln, (4) auf den taxonomischen Status der Form zu schließen und (5) eine vorläufige Abschätzung der Gefährdung der Vögel und ihres Habitats vorzunehmen. Wir konnten mindestens 12 Individuen des Schwarzstirn-Frankolins in fünf Vorkommensgebieten um den Ort Mega (04°03'28" N 38°19'16" E) feststellen. Die Vögel bewohnten halboffenes Waldland zwischen 1.480 und 2.223 m ü. NN, wobei der ursprüngliche Wacholderwald durch die Ausbreitung der Landwirtschaft, Weidewirtschaft und Abholzung fast vollständig verschwunden ist. Ein typisches äußerliches Merkmal der Männchen ist ein deutlich sichtbarer unbefiederter gelber Fleck hinter dem Auge. Während dieser allen anderen *P. castaneicollis*-Unterarten zu fehlen scheint, haben andere Frankolin-Arten einen solchen Fleck. Außerdem unterstützen unsere molekularen und bioakustischen Daten einen separaten taxonomischen Status von *atrifrons*. Bei gemeinsamer Betrachtung aller Merkmale erscheint es gerechtfertigt, das Schwarzstirn-Frankolin als eigene Art zu betrachten. Basierend auf unserer Erfassung schätzen wir die aktuelle Populationsgröße als sehr gering ein, was das Schwarzstirn-Frankolin zu dem am stärksten bedrohten Hühnervogel Afrikas macht. Außerdem schließen wir, dass das sein tatsächliches Areal viel kleiner und stärker fragmentiert ist als ursprünglich angenommen, wodurch die einzelnen lokalen Populationen kritisch gefährdet sind.

## Key words

Ethiopia, *Pternistis*, *Francolinus*, *Juniperus* forest, habitat degradation, conservation.

**Table 1.** Altitudes (m asl) of francolin and quail records in the Mega region (Borana zone).

	min	max	mean	n
<i>Pternistis (c.) atrifrons</i>	1,480	2,223	1,936	12
<i>Pternistis sephaena</i>	1,683	2,055	1,788	6
<i>Pternistis leucoscepus</i>	1,607	1,759	1,659	9
<i>Coturnix delegorguei</i>	1,623	1,703	1,655	3

## Introduction

The South Ethiopian Highlands are of exceptional importance for avian diversity and conservation. Representing one of BirdLife International's Endemic Bird Areas (EBAs), there are no fewer than five endemic bird species confined within a range of just 37,000 km<sup>2</sup>: Prince Ruspoli's Turaco *Tauraco ruspolii*, Nechisar Nightjar *Caprimulgus solala*, Ethiopian Bush-crow *Zavattariornis stresemanni*, White-tailed Swallow *Hirundo megalensis* and Liben Lark *Heteromira fra sidamoensis*. Except for the turaco, none of these species was discovered or described scientifically before the mid-1930s. This is particularly astonishing because at least three expeditions visited the area between 1880 and 1929: the second RUSPOLI expedition in 1893 (which discovered the turaco), the DONALDSON SMITH expedition in 1899 and the WHITE-COATS expedition in 1929 (FIELD MUSEUM OF NATURAL HISTORY, 1930; ASH & ATKINS, 2009). The latter collected 73 bird specimens for the Field Museum Chicago. Among them there was a francolin, collected on 31 May 1929 by C. J. ALBRECHT in the Mega Mountains. Based on this specimen, a new species, the Black-fronted (or Ethiopian) Francolin *Francolinus atrifrons* CONOVER, 1930, was described.

The taxon was later treated as a subspecies of the Chestnut-naped Francolin *P. castaneicollis* (HALL, 1963; URBAN & BROWN, 1971; URBAN *et al.*, 1986; JOHNSGARD, 1988; MCGOWAN, 1994; DICKINSON, 2003; CLEMENTS *et al.*, 2013; DICKINSON & REMSEN, 2013), although this is sometimes challenged (MADGE & MCGOWAN, 2002). Relevant molecular genetic studies are still lacking to date; CROWE *et al.* (1992, 2006) do not consider *atrifrons* in their analyses. Using quantitative criteria for species delimitation following TOBIAS *et al.* (2010), DEL HOYO *et al.* (in press) suggest that *atrifrons* should be considered as a species in its own right. Regarding the generic names, CROWE *et al.* (1992) suggest gathering many African francolins in the genus *Pternistis* ("spurfowl"; CROWE & LITTLE, 2004), which is adopted by DICKINSON & REMSEN (2013) and GILL & DONSKER (2014) whom we follow here.

Because the Black-fronted Francolin had apparently only very rarely been observed since the early 1940s, we visited the Mega region in southern Ethiopia in May 2012 and in May 2013. Our objectives were (1) to confirm its contemporary presence, (2) to explore other potentially

suitable areas, (3) to collect information on morphology and field characteristics, behaviour and habitat, (4) to conclude on its taxonomic position, and (5) to make a preliminary assessment of threats to the birds and their habitat.

## Study area and methods

The Borana zone, an administrative unit of the Oromia Regional State, lies in southern Ethiopia, bordering Kenya to the south. The landscape is dominated by savannah vegetation and gently undulates between elevations of 1,000 to 1,600 m asl. At higher altitudes there are remains of juniper forests. The dominant species is the East African Juniper *Juniperus procera* with other common species such as *Barbeya oleoides*, Khat *Catha edulis*, African Olive *Olea europaea africana*, Ethiopian Pistachio *Pistacia aethiopica*, *Pittosporum* spp. and Wing-leaved Wooden Pear *Schrebera alata* (OROMIA REGIONAL STATE, 2001). Botanically, the lower areas are categorized as *Acacia-Commiphora* woodland and bushland (ACB) while the mountains belong to the dry evergreen Afromontane forest and grassland (DAF) vegetation type (FRIIS *et al.*, 2010). The area has a semi-arid climate with annual mean temperatures from 19 to 24 °C. Rainfall delivery is bimodal, 59 % of annual precipitation occurring from March to May and 27 % from September to November (COPPOCK, 1994).

Because the Black-fronted Francolin was attributed to the group of "mountain francolins" by HALL (1963), we supposed its presence to be restricted to higher, well-vegetated locations. According to the few known localities we focussed on the area around the type locality of *Francolinus atrifrons*, the town of Mega (04°03'28" N 38°19'16" E). The place is surrounded by the volcanic Mega mountains that rise well above the surrounding plateau with the highest peak reaching 2,195 m. To the west lies another mountain range that extends from about Gebel Kancharo in the north to Moyale in the south reaching elevations up to 2,495 m. The escarpment drops steeply to the south-west towards an arid volcanic plain. With an annual rainfall of > 900 mm the two ranges are significantly more humid than the surrounding plateau where only 300 to 700 mm of rain are recorded annually (COPPOCK, 1994).

We visited the area from 14 to 24 May 2012 and from 16 to 24 May 2013, including a brief trip to the adjacent Kenyan area on 21 May 2013. We actively searched for francolins in habitats that appeared suitable and recorded calling birds as well as sight records, droppings or moulted feathers. Records of other francolin species were also documented. Localities were registered by GPS made with a Samsung Galaxy S2 using OruxMap application version 4.8.61. A few sound recordings were made using the same equipment and a sonogram of the best recording was generated using Avisoft. We also asked villagers

repeatedly about the occurrence and habits of francolins as well as about methods of gamebird hunting.

After fieldwork we examined 40 specimens of various subspecies of the Chestnut-naped (*F. c. castaneicollis*: BMNH 1900.1.3.394; 1910.4.30.1–3; 1927.12.13.3; 1933.12.15.1; 1946.5.1423–1438; *F. c. kaffanus*: BMNH 1912.10.15.9–11; 1923.8.7.488; 1938.5.18.90–92; 1945.40.15–18; *F. c. ogoensis*: BMNH 1904.6.14.4; 1910.4.13.1–2; 1918.6.6.4; 1923.8.7.484–486) and four specimens of the Black-fronted Francolin (BMNH 1946.5.1939–1942) in the ornithological collection of the Natural History Museum at Tring, UK in order to confirm ageing and sexing of birds in the field. We placed particular emphasis structural features (number and size of spurs) as well as on the colours of bare parts because the latter do not persist in specimens. In order to countercheck our observations of the different phenotypes, we compared our photographs and field notes with aged and sexed voucher specimens. We also performed an internet-based search of francolin photographs (ca. 300) for comparison of colours of plumages, bare parts, bills and legs.

We sequenced almost 90% of the complete length of the mitochondrial cytochrome-*b* gene (*cyt-b*). DNA was obtained from a feather using the QIAamp DNA micro kit (Qiagen, Hilden, Germany) with extended proteinase K digestion of 16 h. Three PCR primer pairs were designed from an alignment of 123 *cyt-b* sequences representing all 40 currently recognized species of francolins (*Francolinus* 5 spp., *Pternistis* 23 spp., *Peliperdix* 4 spp., *Scleroptila* 7 spp., *Dendroperdix* 1 sp.) available from NCBI's nucleotide database. Primers were purchased from Metabion (München, Germany), primer sequences were as follows (all in 5'-3' direction):

—  
 Fra\_cyt-*b*\_1F: CCCAACATTTCGAAAATCAC;  
 Fra\_cyt-*b*\_1R: GCCAAATATCATTCTGAGG;  
 Fra\_cyt-*b*\_2F: CTCCTCCTCACATTAATAGC;  
 Fra\_cyt-*b*\_2R: GTGAAGTTTTCTGGGTCC;  
 Fra\_cyt-*b*\_3F: TAACACTAGCCCTGTTCTCC;  
 Fra\_cyt-*b*\_3R: GTATTTTGTCTTCTAGTGTTCCG.  
 —

These primers allowed PCR amplification of three overlapping fragments (1F/R: 371bp, 2F/R: 416 bp, 3F/R: 411 bp). PCR was performed using the TAKARA Ex Taq Kit (Takara Bio, Japan) according to the manufacturer's protocol with initial denaturation (1min, 94°C), 40 cycles of denaturation (30 sec, 94°C), primer annealing (30 sec, 49°C), primer extension (1min, 72°C) and final elongation (1min, 72°C). Fragments were sequenced from both sides and assembled with Bioedit ver. 7.09 (HALL, 1999) to a contig of 1014 bp length. The final contig is submitted to GenBank (accession no. KJ934714).

To analyse the position of the Black-fronted Francolin to its nearest neighbours we obtained all available complete and fragmentary *cyt-b* sequences of Francolins (114) from NCBI nucleotide database. An alignment of these and the new sequence was produced with MAFFT ver.7 (KATO & STANDLEY, 2013). Phylogenetic analysis

was done using the Maximum Likelihood method with RAxML ver.7.2.8 (STAMATAKIS, 2006). Model parameters were: GTR + CAT (=categories model instead of gamma distributed), partitioned for 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> codon position; 100 bootstrap replicates plus final optimization of best tree.

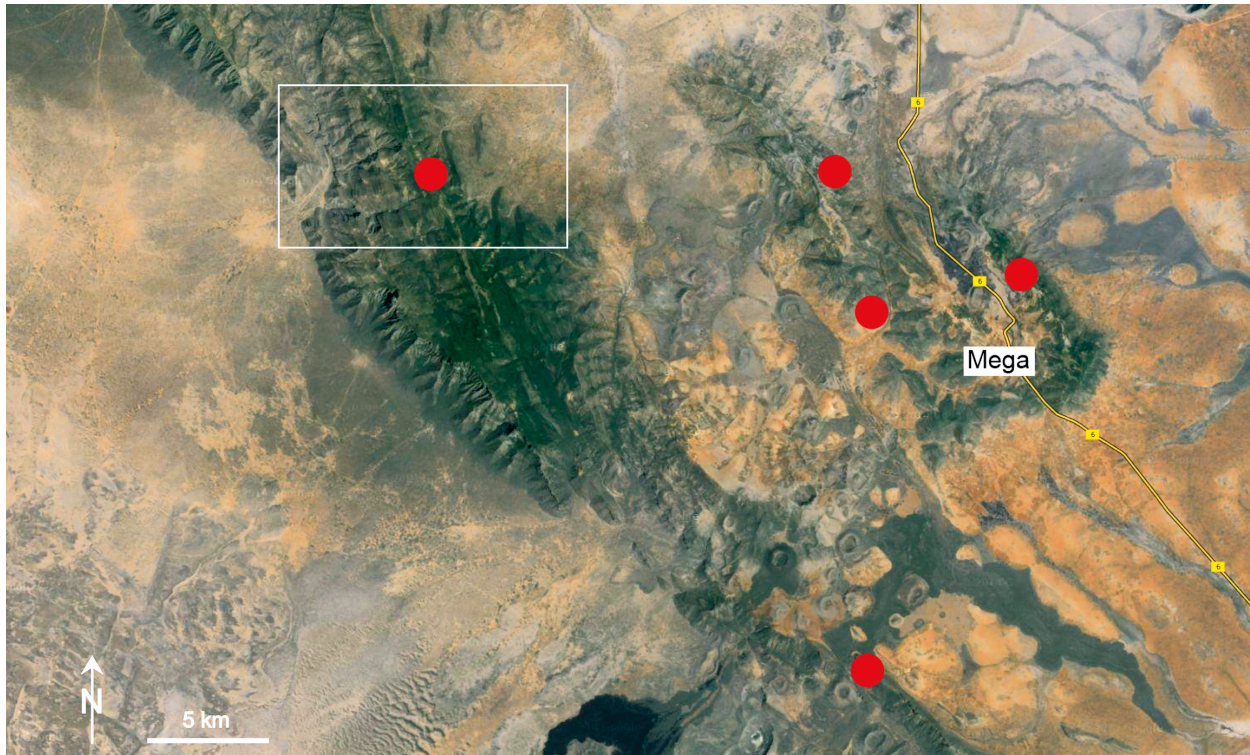
## Results

We recorded at least 12 different Black-fronted Francolin individuals at five sites within a radius of about 25 km around Mega (Fig. 1) where we could distinguish up to five individuals at one location. However, we could neither document Black-fronted Francolins nor could we receive reliable information on its former presence from the locals in the remaining mountain chain that runs south-west from Mega to Moyale. We mostly noticed single birds and usually not more than two individuals together. Only once, on 19 May 2013, we saw two adult birds along with a half-grown juvenile. The records were confined to altitudes between 1,480 and 2,223 m asl. Of all the francolins and quails found in the study area (Black-fronted Francolin, Crested Francolin *P. sephaena*, Yellow-necked Francolin *P. leucoscepus* and Harlequin Quail *Coturnix delegorguei*), the Black-fronted Francolin occupied the highest elevations (Tab. 1, Fig. 2). Partially overlapping ranges were found between Black-fronted and Crested Francolin and between Crested Francolin, Yellow-necked Francolin and Harlequin Quail, respectively. Where Crested and Black-fronted Francolin occurred together, the former preferred more open and drier areas. However, we did not record any francolin on the sprawling agricultural land or on the dense grassy pastures in the Mega area.

The Black-fronted Francolins inhabited semi-open woodland with extensive areas of low shrubs (Fig. 3), interspersed by higher vegetation (trees, bushes) and open spaces (rocks, grazed patches). The ground of the woodland was covered with sparse grasses and other herbaceous vegetation. The original juniper forest has almost completely disappeared and even virtually inaccessible slopes were grazed by cattle, goats and sheep. The few remaining forest remnants were severely damaged, obviously by recent forest fires and ongoing timber harvesting (Fig. 3d). In contrast, the foothills south of Moyale in Kenya are much denser forested than the mountain ranges on the Ethiopian side.

In one of the villages near Mega we were shown three just-captured live Black-fronted Francolins of which two were obviously adult males (Figs. 4a,b) and one a sub-adult bird, most likely a female (Fig. 4c). The plumage of the males was a combination of bold black-and-buff marked upperparts (giving a scaly appearance) and a nearly plain off-white throat, breast and underparts. The characteristic head pattern consisted of a black forehead and supercilium that was separated by an ill-defined





**Fig. 1.** Sites occupied by the Black-fronted Francolin *Pternistis (c.) atrifrons* in the Mega region (Borana zone, Ethiopia) in May 2012/13. Mega town: 4°03'28" N 38°19'16" E, 1,700 m asl. The white rectangle defines the area shown in figure 2. Map generated from GoogleEarth.

white line from the greyish-brown crown. The bills were coral-red and the legs orange-red with two equal-sized spurs (Fig. 4f). The males had yellowish eye-rings and a single bald yellow skin-patch just above the ear. The body feathers on the upperparts were basically bicoloured, with blackish shaft-streaks from their base to their centre, surrounded by a buff to off-white V-shaped streak bordering a broad brownish-black subterminal band and buff to light brownish fringes. Although some of the body feathers showed a few brown freckles, there was no chestnut colouration. The remiges were predominantly brownish, the primaries monochrome, while the outer portions of the secondaries were partially mottled brownish and fringed light brownish to off-white. The respective greater coverts showed a similar colour pattern. While the Black-fronted Francolin's plumage generally looks mostly greyish-black, flying birds appeared quite brown due to the predominantly brownish primaries.

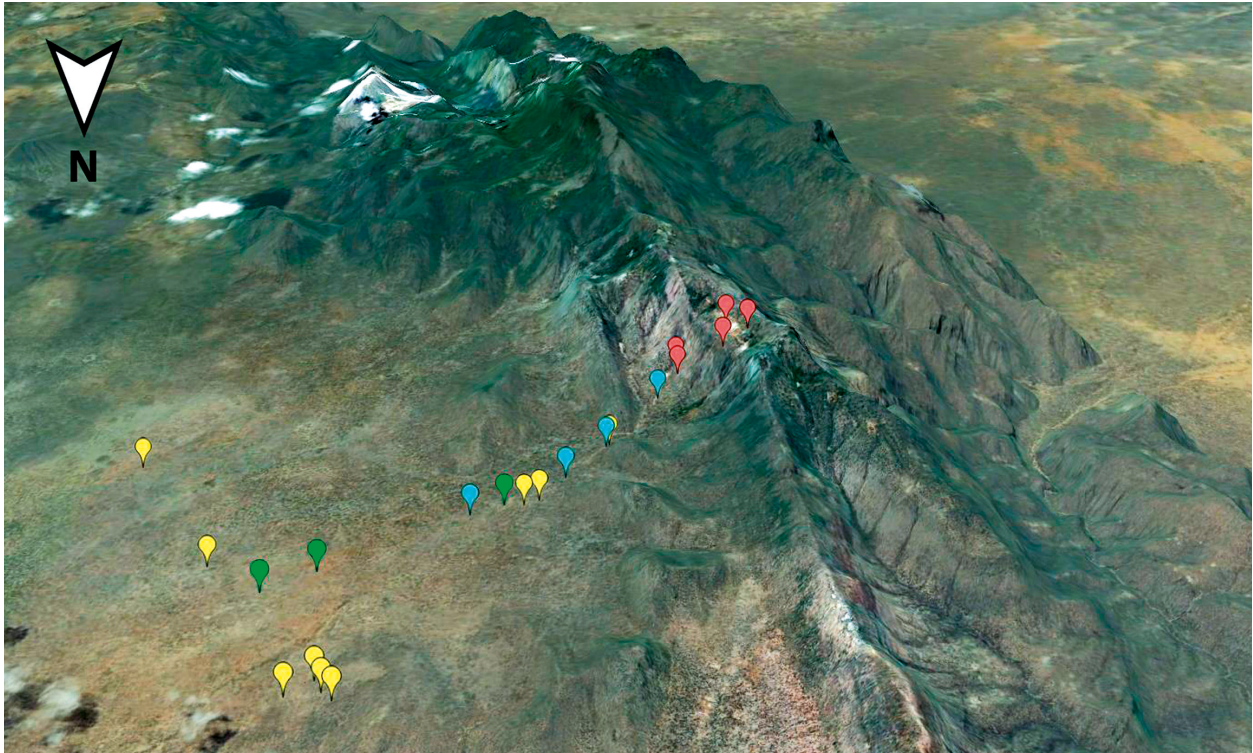
We inferred the third individual to be subadult because the bill was only incompletely red, the upper mandible being largely brownish-black (Fig. 4c), and we concluded it to be a female because it lacked spurs, a point confirmed in BMNH specimens. It was slightly smaller than the males, with a weaker bill and a less massive head shape (Fig. 4e). The head was similar in colour to the two males but appeared more brownish and with a much reduced black forehead and without a pronounced black supercilium. It had a bluish skin-patch above the ear, a bluish eye-ring and orange-red legs. The body plumage

appeared more brownish, particularly on the lower back. Overall, the bird gave a more streaked impression than the males because of the thin brownish fringes and the distinctly pointed V-shaped buff streaks of the feather-centres. Another individual we observed in the field (Fig. 4d) showed an even more streaky appearance due to prominent light buff to whitish shaft-streaks of its upper side. This plumage characteristic was also found in three study skins of immature Chestnut-naped Francolins (BMNH 1910.4.13.1; 1910.4.13.2; 1923.8.7.486), which is why we concluded that the bird seen in the field also was an immature individual.

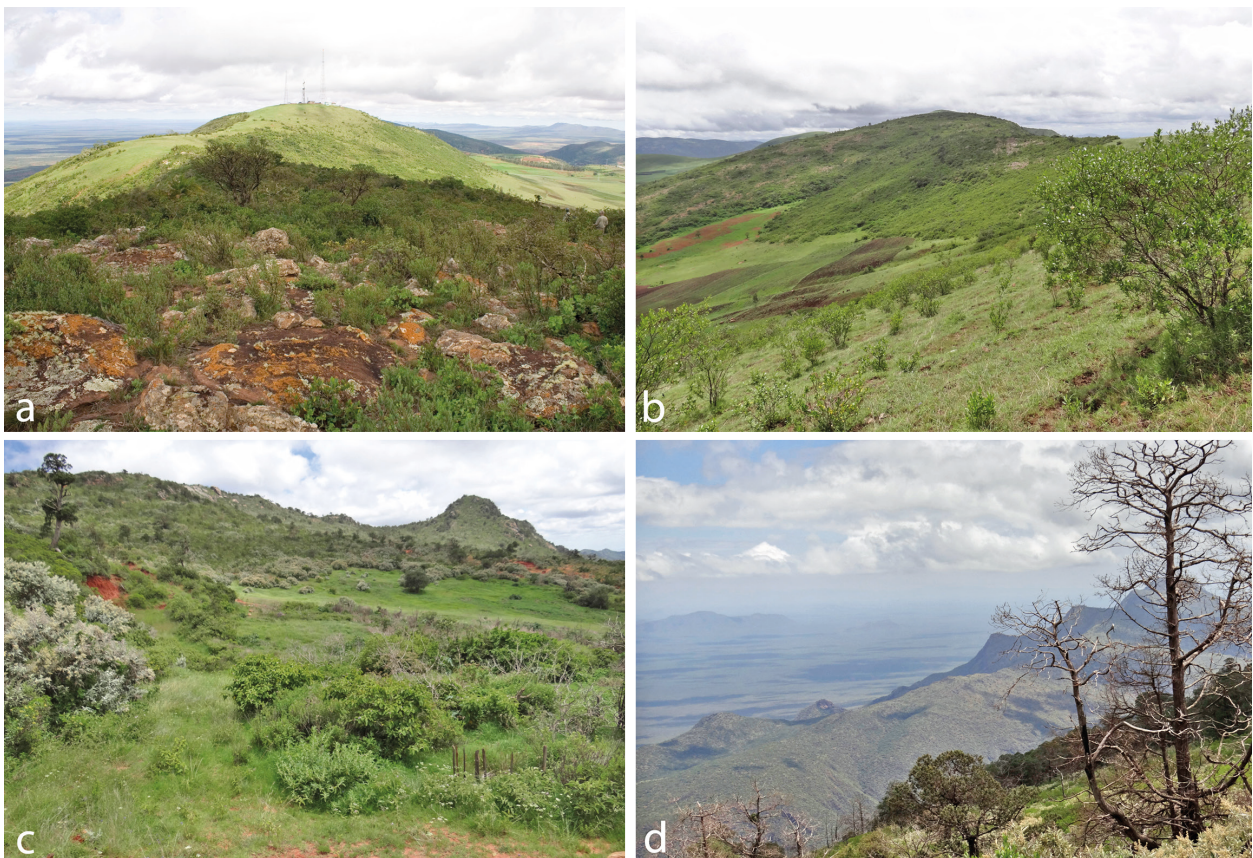
The molecular results show that the Black-fronted Francolin indeed is closely related to the different subspecies of the Chestnut-naped Francolin. Together they form the sister group to a clade comprising Erckel's Francolin *P. erckelii* and Djibouti Francolin *P. ochropectus* (Fig. 5). The molecular distance between Black-fronted and the three published sequences of Chestnut-naped Francolins is 1.2 – 1.3 %, about half of the distance between Erckel's and Djibouti Francolin (2.4 – 2.6 %).

The vocalisations uttered from the ground were harshly grating and fairly noisy cackles. According to our recordings, such an advertisement lasted about 3 seconds and consisted of four elements with interjacent pauses of equal length (0.2 s). While the first element has no component, each subsequent element gained one additional component. The last four-component element contributes to a 'cackle-trill' (Fig. 6). The birds did not only call in the early morning, but also later during the day.





**Fig. 2.** Occurrence of francolins and quails at different altitudes along a transect 18 km northwest of Mega. Red: Black-fronted Francolin *Pternistis (c.) atrifrons*; yellow: Yellow-necked Francolin *P. leucoscepus*; blue: Crested Francolin *P. sephaena*; green: Harlequin Quail *Coturnix delegorguei*. Map generated from GoogleEarth.



**Fig. 3.** Habitat of the Black-fronted Francolin *Pternistis (c.) atrifrons*. Extended areas of low shrubs are interrupted by higher vegetation (trees, bushes) and open areas (rocks, grazed patches). **a, b** – habitats of the mountains close to the town of Mega; **c, d** – habitats of the mountain ridge north-west of Mega (= large image in figure 1).



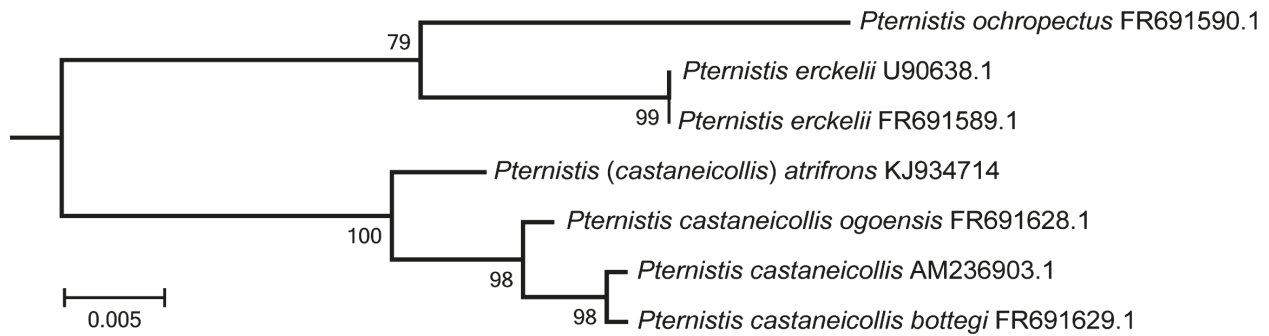


**Fig. 4.** Morphological characteristics of the Black-fronted Francolin *Pternistis (c.) atrifrons*. **a, b** – portrait of two males, note extension of black on the forehead, the coral-red bill, the yellowish eye-ring and the yellow skin-patch behind the eye; **c** – portrait of an immature female, note the lesser extent of black on the forehead, the blackish-red bill, the bluish eye-ring and the blue skin-patch behind the eye; **d** – portrait of an immature, possibly a male because of the head patterns, note the streaking typical of immatures; **e** – comparison between the immature female (left) and a male (right), note the more brownish appearance of the female; **f** – spurs of equal length of a male.

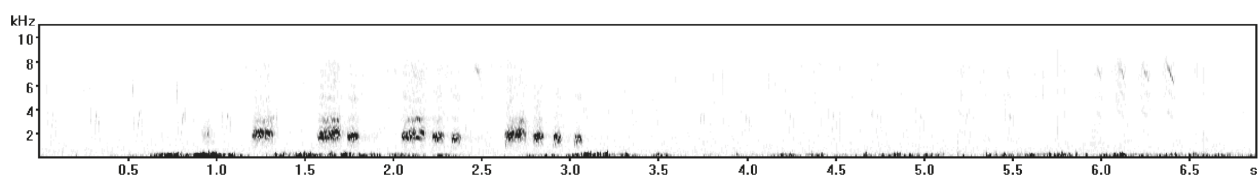
Black-fronted Francolins were shy towards humans and always tried to hide in the ground vegetation when approached. They preferred to escape on foot and flew only relatively short distances before landing on the ground (but not in trees or bushes). The local Borana people were familiar with the different francolin species. When comparing illustrations in a field guide (REDMAN *et*

*al.* 2011), they distinguished reliably between the three species found. Confronted with pictures of the different subspecies of the Chestnut-naped Francolin including *atrifrons*, they pointed unerringly at the Black-fronted Francolin. Young boys showed us string nooses used for catching francolins. They reported that trapping is usually very easy and a popular pastime while tending cattle.





**Fig. 5.** The phylogenetic position of the Black-fronted Francolin *Pternistis (c.) atrifrons* among its closest relatives. Partial tree from ML analysis of a 1140bp alignment of mitochondrial cytochrome-b sequences of 123 individual sequences of all 40 currently recognized francolin species. Numbers close to nodes reflect bootstrap percentages, branch lengths reflect estimated substitution rate (substitutions per site according to scale bar). Numbers next to species names are NCBI accession numbers.



**Fig. 6.** Sonogram of an advertisement call of the Black-fronted Francolin *Pternistis (c.) atrifrons* (Mega mountains, south Ethiopia, 04°06'00" N 38°19'13" E, 15 May 2012).

## Discussion

According to ASH & ATKINS (2009) the Black-fronted Francolin, treated there as *P. castaneicollis atrifrons*, is only distributed in Ethiopia's extreme south below 5°N. The isolated record of *P. castaneicollis* in a single tetrad at Lake Chew Bahir remains unclear, as is the sub-specific status of this local population. The respective map documents four one-degree tetrads occupied by the Black-fronted Francolin of which one represents the Mega mountain population. The records in the northernmost tetrad, however, refer to nominate Chestnut-naped Francolin, not to *atrifrons* (cf. BENSON, 1945), as confirmed by BENSON's specimens in the Natural History Museum at Tring. For the southernmost tetrad there is only a single sight record on the Kenyan side south of Moyale on 21 June 1975 (BRITTON & BACKHURST, 1980) while there is no further information on the record from the adjacent Ethiopian tetrad to the north. Our own survey among locals of the mountainous area south-east of Mega revealed only ambiguous information on the former presence of francolins on the mountain tops between Mega and Moyale.

The total range of the Chestnut-naped Francolin has been estimated at 270,000 (FULLER *et al.* 2000) and 312,000 km<sup>2</sup> (BIRDLIFE INTERNATIONAL, 2012). It extends broadly along the mountain ranges of central and south Ethiopia on both sides of the Rift Valley to Somalia (Somaliland) in the extreme north-west and to the Kenyan border in the extreme south (URBAN *et al.*, 1986; JOHNSGARD, 1988; ASH & MISKELL, 1998; ASH & ATKINS,

2009; MADGE & MCGOWAN, 2002). Consequently, the Chestnut-naped Francolin is regarded at lower risk in the IUCN species action plans (FULLER *et al.*, 2000) and currently assigned to the "Least Concern" category of the IUCN Red List (IUCN, 2012). However, these estimations do not consider the population of the Black-fronted Francolin as an independent unit of conservation interest. Irrespective of its taxonomic status, *atrifrons* actually has a very small range and is probably highly vulnerable to various threats. The existing maps (e.g. BIRDLIFE INTERNATIONAL, 2012) very likely overestimate the actual range sizes. Instead, we assume that the current range of the Black-fronted Francolin is indeed limited to the small mountainous area around Mega, perhaps not larger than 300 km<sup>2</sup> according to preliminary habitat modelling data (PAUL DONALD, pers. comm.). Its conservation status is masked by that of the common and fairly widespread Chestnut-naped Francolin when the taxa are not regarded as discrete entities.

The specific habitat requirements of the Black-fronted Francolin need further study. In the 1940s, BENSON (1945) recorded juniper woods with dense evergreen undergrowth as the original habitat. They might have resembled the arid juniper forests inhabited by the Somalian Chestnut-naped Francolin populations today (MADGE & MCGOWAN, 2002). URBAN & BROWN (1971) assign four different forest habitats (*Hagenia* forests, Highland bamboo *Arundinaria*, Juniper-*Podocarpus* forest, and Olive-*Podocarpus*-Juniper forest) to the Black-fronted Francolin without further reference. Meanwhile, the conifer stocks in the southernmost regions of the Borana zone have disappeared almost completely. Instead, we



have found the Black-fronted Francolin in scrubby woodland where juniper trees are largely missing (Fig. 3). Moreover, it is unclear to what extent the birds also use the now rapidly expanding farmland (Fig. 3b). Although agriculture often extended right up to the territories of the francolins, we could not detect any birds calling from the fields themselves. The farmland appeared to be unattractive, at least when freshly ploughed during the rainy season. However, NEUMANN (1904) mentions that the Chestnut-naped Francolin in the Ethiopian highland also inhabits fields at the edge of bamboo forests. Moreover, further investigations around Moyale in Kenya are necessary because the current habitat structure matches the descriptions of the original wooded habitats quite well. While we could not confirm its presence during our excursion, the area although at lower elevation, appears suitable for the Black-fronted Francolin (pers. obs.).

There is a pronounced bimodal rainfall in the south and east of Ethiopia with the main rain season from March to May and a smaller rain season from September to November (COPPOCK, 1994; ASH & ATKINS, 2009). Our observations and literature data indicate a correlation between the reproductive period of the Black-fronted Francolin and the main rain season: we observed a juvenile on 19 May 2013 and BENSON (1945) records a juvenile on 14 March 1942. Although the onset of breeding might be heavily influenced by temporal weather conditions, the growth of vegetation and of invertebrates during the rain season provides ample food for the francolin offspring. However, there is no record of reproductive activity of the Black-fronted Francolin during the period of small rains.

In general, hitherto published descriptive notes on sexing and ageing of Black-fronted Francolins are few and do not differ substantially from those of Chestnut-naped Francolins. There appears to be no pronounced sexual dimorphism except for the lack of spurs in females and their slightly smaller size. Juveniles and immatures are often said to be of undefined “duller” colouration. Our findings (cf. Fig. 4) support the description of sex differences, while we found that immatures are comparatively easily to distinguish from adults by the prominent whitish shaft streaks on the feathers of the lower neck and upper back (“mantle”). This character is also present in the BMNH’s immature specimens of Chestnut-naped Francolins while the same plumage portions are mostly V-patterned in adults. Although these characters are fairly good features for field identification, they are only mentioned explicitly by FRIEDMANN (1930) and TOSCHI (1959). The fine barring on the rump and tail given by many authors is, however, not a good criterion for age determination under field conditions. Moreover, in all the photographs found on the internet, males and females of the Chestnut-naped Francolin were virtually the same plumage colour. Hence, we suppose that the morphological differences in the individuals we studied (Figs. 4a–d) are due to age differences. As reported for other red-billed francolins (e.g. JOHNSGARD, 1988), the bill colours of Black-fronted Francolins very likely also change under

hormonal control from drab reddish or sepia in immatures to coral red in adults. This would explain the dark culmen in the immature individuals (Figs. 4c, d).

The bald yellow or bluish skin-patch above the ear has not previously been described in the Black-fronted Francolin. We did not find this character in our own photographs of Chestnut-naped Francolins from the Bale Mountains or in photographs on the Internet. This feature is a further indication of the separate taxonomic status of the Black-fronted compared to the various subspecies of the Chestnut-naped Francolin. Interestingly, such a yellow patch occurs in some other francolin species as well (Table 2).

Habitat preferences and distributional patterns usually also provide important clues for species identification (MADGE & MCGOWAN, 2002). However, in the case of the Black-fronted Francolin the lack of biological information complicates taxonomic judgements. Its isolated range without contact zones to its closest relative, the Chestnut-naped Francolin, hampers the inference of actual reproductive isolation as requested by the Biological Species Concept (MAYR, 2001). Hence, an assessment of overall differentiation relative to other francolin species is necessary to conclude on the taxonomic status of *atrifrons*.

Still, the Black-fronted Francolins’ current distribution matches the moist belt along the southern mountain ranges with precipitations over 900 mm very well (cf. fig. 2.4. in COPPOCK 1994) which further underlines their ecological ties to mountainous and wooded habitats. Regarding their general behaviour, Black-fronted do not seem to differ substantially from Chestnut-naped Francolins. Although the latter are less shy, the two are apparently quite similar in their habit of fleeing on foot into dense vegetation cover (URBAN *et al.*, 1986; MADGE & MCGOWAN, 2002). BENSON (1945) does not comment on their behaviour, but mentions the similarity of the „environment“ in which he observed *atrifrons* and *castaneicollis*. That is why HALL (1963) also considers the Black-fronted a subspecies of the Chestnut-naped Francolin.

The molecular data corroborates the earlier-assumed relationship of *atrifrons* with the *P. castaneicollis* subspecies (Fig. 5), among which the former is a distinct lineage with a genetic distance of 1.2–1.3 %. While these values are higher than distances among the other Chestnut-naped Francolin subspecies (0.2–0.7 %), they are still lower than the hitherto known interspecific *cyt-b* distances of 2.5–13.6 % between other francolin species (BLOOMER & CROWE, 1998). However, even though the *cyt-b* distance between their closest relatives Erckel’s and Djibouti Francolin is 2.4–2.6, the relatively low molecular distance between Black-fronted and Chestnut-naped Francolin does not necessarily indicate solely subspecies level: For example, even between undisputed falcon species cytochrome-*b* distances might greatly overlap with those of acknowledged subspecies (BELL *et al.*, 2014).

BENSON (1945) notes the voices of Chestnut-naped and Black-fronted Francolin to be very similar, which is

**Table 2.** African francolins with bald yellow ear-patches based on examinations of photographs (Internet search 27 October 2012, n – number of pictures examined). Without noticeable coloured patch are *Pternistis erckelii*, *P. ochropectus*, *P. castaneicollis*, *P. capensis*, *P. harwoodi*, *P. clappertoni*, *P. icterorhynchos*, *P. hartlaubi* and *P. bicalcaratus*. There were no photographs of *P. camerunensis* available.

species	ear-patch	eye-ring male	eye-ring female	n
<i>Pternistis (c.) atrifrons</i>	yellow	yellowish	bluish (imm.)	3
<i>Pternistis jacksoni</i>	yellow-orange	red	red	17
<i>Pternistis nobilis</i>	yellow-orange	red	red	10
<i>Pternistis swiестrai</i>	yellow	yellow	bluish (imm.?)	3
<i>Pternistis natalensis</i>	yellowish	yellow	yellow	17
<i>Pternistis hildebrandti</i>	yellow	yellow	yellow	37
<i>Pternistis adspersus</i>	yellow	yellow	yellow	28

in accordance to our findings: the advertisement call recorded by us (Fig. 6) is structurally and temporally similar to those of the Chestnut-naped Francolin analysed by MANDIWANA-NEUDANI *et al.* (2014; cf. appendix 3 therein). The latter's calls consist of six elements vs. four in the Black-fronted Francolin and differs in the number of individual elements. However, in both taxa the number of elements increases with time and the whole strophe ends with a “cackle-trill” as part of a last four-element component. Although our acoustic data set does not allow an assessment of individual variation, we can confirm the affiliation of the Black-fronted Francolin with the “montane squelching group” (which also includes the Chestnut-naped Francolin) as defined by VAN NIEKERK (2014) on grounds of structural song characteristics. Nonetheless, this resemblance may be of limited value for species delimitation because many francolin species either may have very similar calls (HALL, 1963) or because apparently closely related species like Erckel's and Djibouti Francolin may have structurally very different calls (MANDIWANA-NEUDANI *et al.*, 2014).

Taken together, its morphological and molecular distinctness as well as smaller differences in vocalisations and behaviour would justify the taxonomic treatment of the Black-fronted Francolin as a species separate from the Chestnut-naped Francolin. This appears also reasonable considering the respective differentiation between its closest relatives, the undisputed species Erckel's and Djibouti Francolin.

Currently, hunting appears to be the biggest direct threat to these isolated francolin populations. BROWN *et al.* (1986) also refer to string nooses for trapping Chestnut-naped Francolins, and MUIRURI & MAUNDU (2010) mention francolins being hunted for their meat and their eggs in neighbouring Kenya. However, hunting and consumption of birds other than ostriches is not customary in the traditional society of the Borana, although this rule is no longer strictly followed and chickens are quite often kept in Borana villages. Nevertheless, hunting francolins and other birds appears not primarily intended for food acquisition rather than as a pastime of the young people. Therefore, specific educational work at local schools could help to reduce hunting pressure.

Based on their research in Arero and Mankubsa, BORGHESIO *et al.* (2004) conclude that the present conservation status of the juniper forests of the South Ethiopian Endemic Bird Area is critical. They found that forests have decreased by 8.7–39.4% within only 16 years (1986–2002) in the two areas, resulting mainly from grazing pressure, agricultural expansion, commercial firewood and timber exploitation. Obviously, the forests around Mega are affected in much the same way and perhaps to an even greater extent. In 2001, the size of the Mega Regional Forest was only 113.8 km<sup>2</sup> (OROMIA REGIONAL STATE, 2001) and the area is still not officially demarcated or gazetted by the relevant authorities (CHEMERE ZEWDIE, pers. comm.). The dimension of habitat destruction appears so high and protection efforts so low that it is unlikely that the remaining juniper forest plots will persist for long. Even the secondary forests are subject to strong exploitation pressure, with unforeseeable consequences for the survival of the francolin population.

Further detailed studies on the Black-fronted Francolin's current distribution and population size as well as on habitat requirements and potential threats are urgently needed in order to initiate appropriate protective measures. If treated as a separate species, its inclusion in the IUCN Red List of threatened species is unavoidable, considering the small number of individuals recorded by us. As a consequence, the Black-fronted Francolin would become another extremely endangered range-restricted species just like the Djibouti Francolin (FISHER *et al.*, 2009).

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