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# A consolidated checklist and new avifaunal records for southern Tigray, Ethiopia

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**SUMMARY.**—We recorded 17 bird taxa new for southern Tigray across a mosaic of habitats. Some of these records document substantial geographical extensions of previously known ranges. Many are *Acacia* woodland and bushland species but were documented in habitats subject to considerable human disturbance. New records for Tigray include White-breasted Cormorant *Phalacrocorax lucidus*, Pygmy Falcon *Polihierax semitorquatus*, Three-banded Courser *Rhinoptilus cinctus mayaudi*, Orange-breasted Bushshrike *Chlorophoneus sulfureopectus*, House Sparrow *Passer domesticus indicus* and White-headed Buffalo Weaver *Dinemellia dinemelli*. In addition, the endemic subspecies *erlangeri* of Blanford's Lark *Calandrella blanfordi*, previously known only from the central highlands of Ethiopia, was recorded for the first time in southern Tigray. Focusing on Hugumbirda and Gra-Kahsu State Forest and human-dominated landscapes in southern Tigray, we found key drivers of habitat modification in the area to be the expansion of settlements, farmland and bare land.

Birds are key indicators of biological diversity (Gregory *et al.* 2003, Fraixedas *et al.* 2020) and habitat conditions (Smetzer *et al.* 2014, Whelan *et al.* 2015, BirdLife International 2018, Morelli *et al.* 2021). In mainland Africa, >2,000 bird species occur (Burgess *et al.* 2004), of which c.1,600 are endemic to sub-Saharan Africa (Jetz & Rahbek 2001). The largest number of these endemics is in the Albertine Rift, followed by the East African and Ethiopian Highlands (de Klerk *et al.* 2002). In Ethiopia, the region of Tigray has four Important Bird and Biodiversity Areas (IBAs), Lake Hashenge (sometimes incorrectly spelled Ashenge), Dessa'a forest, Hugumbirda and Gra-Kahsu (Hugumburda and Grat-Kahsu) forests, and Shire lowlands in the Tekeze Valley (Tilahun *et al.* 1996, Fishpool & Evans 2001, Ash & Atkins 2009, BirdLife International 2023a). Both Lake Hashenge and Hugumbirda and Gra-Kahsu forests are in southern Tigray, which region is characterised by a complex of mountains, a highland lake and plains, interspersed with a heterogeneous farmland mosaic that varies from relatively intact to substantially human-dominated. These characteristics also provide considerable potential to develop ecotourism in the region (Deribew *et al.* 2022).

Recently, both Hugumbirda and, especially, Gra-Kahsu forest have become increasingly fragmented and transformed into human-dominated landscapes. Raya Valley, though human dominated, remains a unique lowland habitat in Tigray, including agricultural fields, mixed plantations (coffee *Coffea arabica*, khat *Catha edulis* and fruits), Cactus pear *Opuntia ficus-indica* dominated habitat, *Acacia* woodland and wetlands. Lake Hashenge is also affected by farming, grazing, sedimentation and other human impacts (Yazew *et al.* 2013), yet is a unique aquatic habitat for resident and migratory bird species in the region (Alemayehu *et al.* 2017).

The avifauna of Tigray is sparsely known, although data from this region were included in the two benchmark publications on Ethiopian and Eritrean birds (Urban & Brown 1971, Ash & Atkins 2009). Taking data from Ash & Atkins (2009), we found the avifauna of Tigray and southern Tigray (i.e. the study area) to comprise 473 and 283 bird species, respectively.

Recent publications (Hering *et al.* 2015, Rannestad 2016, Dove *et al.* 2017, Gedeon *et al.* 2017, Buechley *et al.* 2019, 2022) have detailed new species and other notable records, as well as providing annotated checklists for poorly known parts of the Horn of Africa. Nevertheless, these studies were all the product of relatively short visits by a small number of researchers. Ongoing habitat change and human population growth have prompted us to document the avian diversity of Tigray. Here, we document new bird records for southern Tigray made during 2018–20. We also include information on habitat preferences and spatiotemporal patterns. Furthermore, we assessed land use and land cover (LULC) change using GIS and remote-sensing tools between 1985, 2000 and 2020, to examine trends in habitat modification due to anthropogenic activity.

## Study area and Methods

**Study area.**—Located *c.* 600 km north of Addis Ababa and 160 km south of Mekelle, capital of Tigray National Regional State, between 12°14'50"–12°52'11"N and 39°20'59"–39°52'30"E, at 949–3,699 m, the total area of southern Tigray is 10,139.3 km<sup>2</sup> and that of the study area is 2,328.24 km<sup>2</sup>. With reference to Ash & Atkins (2009: 63) map squares, the study area lies mostly in half-degree squares 31b and 31d, with very small extensions into 31a and 31c (Figs. 1–2).

Hugumbirda and Gra-Kahsu State Forest is spread across Raya Azebo, Endamekoni, Ofla and Raya Alamata districts. The state forest is at 1,500–3,000 m and is part of the dry evergreen Afromontane forest and grassland complex (hereafter DAF). Dominant trees are African juniper *Juniperus procera* and African olive *Olea europaea cuspidata* (Woldemichael

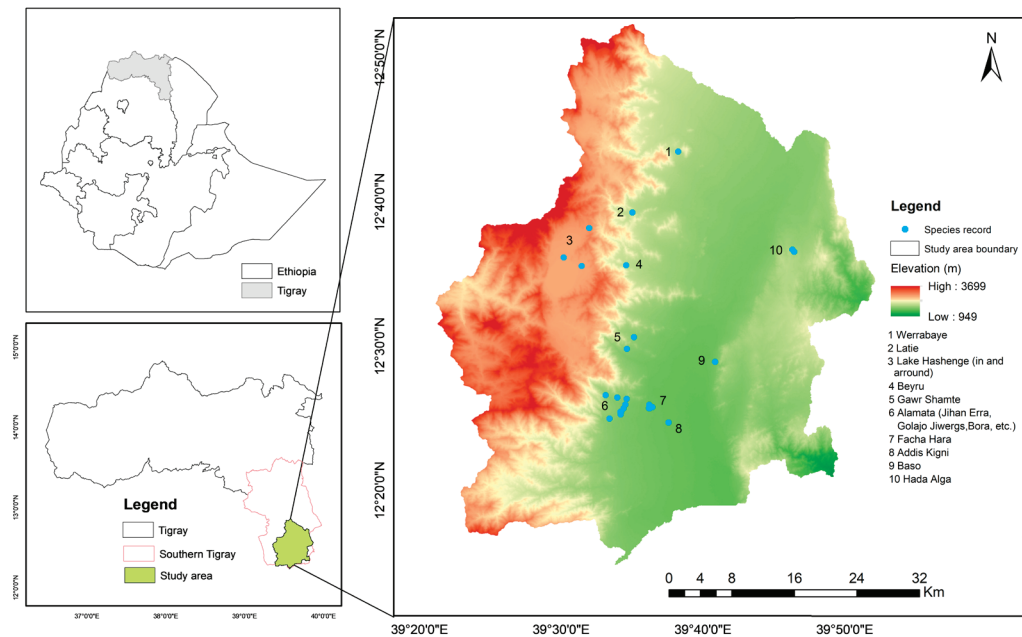


Figure 1. Location of the study area in Ethiopia and of bird records in southern Tigray.

*et al.* 2010). The lowland area (Raya Valley) is at 949–1,600 m. The valley's vegetation comprises *Acacia-Commiphora* woodland and bushland (hereafter ACB) (Friis *et al.* 2010).

Due to human disturbance (including infrastructure development), the Raya Valley is currently characterised by fragmented *Acacia* woodland, settlements, farmland with scattered trees and mixed plantations (Table 1, Fig. 2), and is also affected by overgrazing and invasive plant species (e.g. *Parthenium hysterophorus*, *Prosopis juliflora*, *Coleus* sp.). The major land use land cover (LULC) categories in the study area are bare land, farmland, forest, grassland, settlements and water (Fig. 2). As the area covers both lowlands and highlands, mean annual min. temperature varies from 14–30°C in the lowlands (Raya Alamata and Raya Azebo districts) to 8–25°C in the highlands (Ofla district), respectively (Yemane *et al.* 2020).

**Methods.**—The study was conducted between 2018 and 2020. We used point counts ( $n = 134$ ) to census birds along elevational gradients in Hugumbirda and Gra-Kahsu State Forest (relatively intact natural habitat). Other sites were surveyed using line transects ( $n = 22$ ) in the human-dominated landscape at Raya Valley, and at Lake Hashenge and the

TABLE 1

Description of habitat types at various localities, mostly human-dominated ecosystems, in southern Tigray, Ethiopia. Abbreviations: DAF = Dry evergreen Afromontane forest and grassland complex, and ACB = *Acacia-Commiphora* woodland and bushland proper (Friis *et al.* 2010).

Locality	Elevation (m)	Habitat type	Habitat features
Facha Hara, Addis Kigni, Golajo Jiwerge, Kabri Silam and Werrabbaye	1,400–1,550	ACB	Dominated by <i>Acacia</i> . Threatened by human pressure except at churchyards and Muslim tombs.
Hada Alga and Baso	1,500–1,700	ACB	Dense <i>Acacia-Commiphora</i> stands, and succulent vegetation mixed with small- to medium-sized perennial woody plants.
Addibbo Mosa and Menkere	2,200–2,450	Aquatic	Lake Hashenge (sometimes incorrectly spelled Ashenge) is one of Ethiopia's highland lakes; it harbours resident and migratory birds, and breeding and non-breeding visitors.
Chekon, Facha Gama and Kukufto	1,400–1,650	Cactus pear	Dominated by cactus pear <i>Opuntia ficus-indica</i> with sparse <i>Acacia</i> and shrub tree species. In southern Tigray the recently introduced invasive cochineal bug <i>Dactylopius coccus</i> infests cactus pear.
Jihan Erra, Harksa, Bora, Kukufto, Hayyalo and Hashenge	1,500–1,650 and 2,200–2,500	Farmland	Suitable land for cultivation in southern Tigray is located in the Raya Valley (lowlands), where sampling sites included Jihan Erra, Harksa, Bora, and Kukufto, and highland areas of Lake Hashenge and Hayyalo. Main three cereals are teff <i>Eragrostis tef</i> , sorghum and maize varieties.
Hugumbirda and Gra-Kahsu (Hugumburda and Grat-Kahsu) State Forest	1,500–3,000	DAF	Dominant African juniper <i>Juniperus procera</i> and African olive <i>Olea europaea cuspidata</i> .
Silakunie and Ela Bu'eye	1,400–1,500	Wetland and farmland	Grazing land; typical grass species are <i>Pennisetum</i> sp. and <i>Hyparrhenia</i> sp.
Latie, Beyru, Gra Asmerom Tikuye, Gawr Shamte, Raya Grand Resort Hotel	1,500–1,700	Plantation	Mixed plantation, including coffee <i>Coffea arabica</i> , khat <i>Catha edulis</i> , and fruits mainly in Latie and Beyru, whereas Gra Asmerom Tikuye, Gawr Shamte, and Raya Grand Resort Hotel grow mainly fruits.
Hayyalo and Hashenge grazing land	2,200–2,500	Wetland and farmland	Previously dominated by Cattail <i>Typha latifolia</i> but now replaced by papyrus, weed, grass and other plant species.

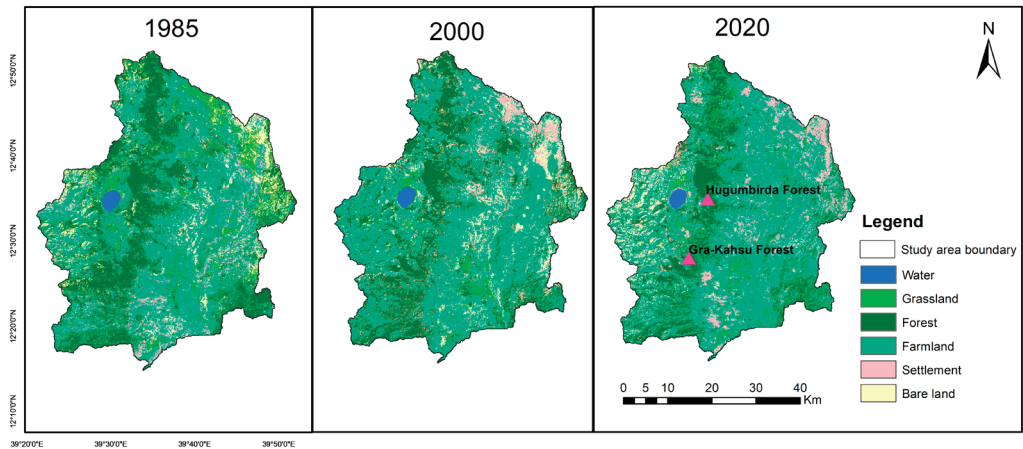


Figure 2. Land use land cover (LULC) change maps of the study area in southern Tigray from 1985 to 2020.



Figure 3. Habitat types in southern Tigray from left to right: (top) farmland at Facha Hara and *Acacia* woodland at Sera Addi Ebo; (middle) *Acacia-Commiphora* woodland and bushland at Hada Alga and cactus pear *Opuntia ficus-indica* between Chekon and Facha Gama; and (bottom) Lake Hashenge and dry evergreen Afromontane forest and grassland complex at Hugumbirda, all December 2018 (Mulugeta Kiros)

surrounding grazing land and farmland (Fig. 3). Field visits were generally conducted 2–4 times a month in the morning (06.00–09.00 h) and evening (16.00–18.00 h) in the dry season (October–June). Birds were identified using the field guide by Redman *et al.* (2011).

We compared our new records with previously documented occurrence based on tetrad coverage by Ash & Atkins (2009). For inclusion herein, the criteria for new bird records were: (1) major range extension; (2) minor range extension, first report in Tigray; (3) discrepancy between distributions in different sources (Ash & Atkins 2009, Redman *et al.* 2011, BirdLife International 2023a, Gill *et al.* 2023); and (4) taxonomic questions. Some species met more than one criterion. A major extension is defined as previous occurrence only in remote tetrads, whereas a minor extension involves species previously recorded in directly adjoining tetrad/s but not those we surveyed. For taxonomy, we follow Gill *et al.* (2023).

**Remote sensing data.**—Land use and land cover (LULC) change maps were produced using Landsat Thematic mapper (TM 1985), Landsat Enhanced Thematic Mapper plus (ETM+ 2000) and Landsat Operational Land Imager (OLI 2020) captured in January and February during the dry season. Landsat images (<https://earthexplorer.usgs.gov>), including TM, ETM+ and OLI were acquired for 2 January 1985, 5 February 2000 and 19 January 2020, respectively. We used bands 1–5 and 7 of TM and ETM+ and bands 1–7 of OLI for image analysis and classification. These Landsat images cover path 168 and rows 51–52 of TM and ETM+ and 51 of OLI. All bands used had 30 m resolution. Standard supervised classification was performed using ERDAS IMAGINE software and max. likelihood algorithm was applied. Overall accuracy and kappa coefficient were checked to assess the accuracy of the classified images.

## Results

**Species accounts.**—We recorded 287 bird species in the study area during the period (2018–20) of which 55 were new for southern Tigray (Supplementary Information). Thirteen of the records were new for Tigray, of which eight involved major range extensions. Based on the criteria above, 13 new taxa for Tigray and four taxa new for southern Tigray are described below.

### WHITE-BREASTED CORMORANT *Phalacrocorax lucidus*

First records for Tigray. Commonly encountered at Lake Hashenge (12°36'09"N, 39°30'14"E; 2,442 m) in association with other waterbirds in December 2018 and April 2019, including a non-breeding adult and a juvenile there on 17 April 2019 (Fig. 4).



Figure 4. Non-breeding adult (left) and juvenile White-breasted Cormorants *Phalacrocorax lucidus* with Egyptian Geese *Alopochen aegyptiaca*, a Great White Pelican *Pelecanus onocrotalus*, African Sacred Ibis *Threskiornis aethiopicus* and Northern Shoveler *Spatula clypeata*, Lake Hashenge, Ofla, Ethiopia, April 2019 (Abadi Mehari Abrha)

**PYGMY FALCON** *Polihierax semitorquatus*

First records for Tigray. Three on 16 January 2019 and two on 22 January 2020 at Hada Alga (12°36'30"N, 39°46'31"E; 1,672 m) in *Acacia-Commiphora* woodland.

**AFRICAN HOBBY** *Falco cuvierii*

First record for southern Tigray. On 2 March 2018, an adult perched on Christ's thorn jujube *Ziziphus spina-christi* and umbrella thorn *Vachellia tortilis* trees at Facha Hara (12°25'40"N, 39°36'14"E; 1,461 m).

**THREE-BANDED COURSER** *Rhinoptilus cinctus mayaudi*

First record for Tigray. On 26 January 2019, two were in St George churchyard (Golajo Jiweres; 12°25'56"N, 39°34'34"E; 1,523 m) in an area of wooded grassland with planted and natural *Acacia* trees.

**GREATER HONEYGUIDE** *Indicator indicator*

First records for southern Tigray. During our three-year study, we repeatedly recorded the species at Facha Hara (12°25'54"N, 39°36'15"E; 1,457 m) *Acacia* woodland, singing sporadically between 10.00 and 14.00 h. Local people also know the value of this species to locate natural bee hives in hollow trees including *Acacia* and *Ficus*.

**EASTERN GREY WOODPECKER** *Dendropicos spodocephalus*

First records for Tigray. A pair was constructing a nest cavity on 17 March 2018 at Facha Hara (12°25'44"N, 39°36'17"E; 1,457 m). A total of eight was recorded in *Acacia* woodland at St Rufael churchyard (Werrabbaye; 12°43'29"N, 39°38'20"E; 1,752 m) and Facha Hara on 26 May 2019 (Fig. 5). We also recorded a male and female at Alamata (12°24'57"N, 39°33'26"E; 1,563 m) on 28 May 2019, and a pair was found nesting in wooded grassland at Dess'a Forest Reserve on 29 December 2019 (13°40'02"N, 39°46'25"E; 2,363 m). Another individual was seen feeding on the bark of the bamboo *Yushania alpina* in the Choke Mountains in Amhara National Regional State in 2019 (10°37'23"N, 37°46'42"E; 3,100 m). Ash & Atkins (2009) stated that the species is recorded only to 1,820 m in Ethiopia.



Figure 5. Female (left) and male Eastern Grey Woodpecker *Dendropicos spodocephalus* with a nest cavity in a snag of umbrella thorn *Vachellia tortilis*, Facha Hara, Raya Alamata, Ethiopia, March 2018 (Abadi Mehari Abrha)

**BLANFORD'S LARK** *Calandrella blanfordi erlangeri*

First records for Tigray. *C. b. erlangeri* is endemic to the central highlands of Ethiopia (Ash & Atkins 2009). It was found over large areas of Tigray, but especially in highland habitats of southern Tigray (Hashenge; 12°35'33"N, 39°31'30"E; 2,453 m; Fig. 6). The first record

was on 28 February 2018. The species was also identified at Alula Abba Nega International Airport (13°28'30"N, 39°31'56"E; 2,231 m, tetrad 23d) and at Mekelle University Endayesus campus (13°28'37"N, 39°29'06"E; 2,197 m, tetrad 23d). We also encountered *C. b. blanfordi* in the Atsbi highlands (13°38'37"N, 39°46'30"E; 2,727 m, tetrad 23d) and in Dessa'a Forest Reserve (13°56'51"N, 39°43'46"E; 2,430 m, tetrad 23d). In our study area, *C. b. erlangeri* is a farmland and grassland specialist. Breeding males in December 2018 climbed c.40–60 m above ground, singing for 2–5 minutes while circling.



Figure 6. Blanford's Lark *Calandrella blanfordi erlangeri*, around Lake Hashenge, Ofla, Ethiopia, February 2018 (Abadi Mehari Abrha)

#### HORSFIELD'S BUSH LARK *Mirafra javanica marginata*

First record for Tigray. One was recorded on 7 January 2019 on unploughed farmland at Jihan Erra (12°25'39"N, 39°34'26"E; 1,523 m), feeding in carrot grass *Parthenium hysterophorus*, an invasive weed species (Fig. 7). The subspecies *marginata*, previously



Figure 7. Horsfield's Bush Lark *Mirafra javanica marginata* in harvested *Eragrostis tef*; the green weed is the invasive carrot grass *Parthenium hysterophorus*, Jihan Erra, Raya Alamata, Ethiopia, January 2019 (Abadi Mehari Abrha)



treated in Singing Bush Lark *M. cantillans*, is now considered part of Horsfield's Bush Lark *M. javanica* (Gill et al. 2023).

**AFRICAN STONECHAT** *Saxicola torquatus albofasciatus*

First records for Tigray. *S. t. albofasciatus* is nearly endemic to Ethiopia, reaching marginally into South Sudan and Uganda (Gill et al. 2023). An adult male and female were recorded on the highland plateau of Endodo (12°38'11"N, 39°32'02"E; 2,556 m), near Lake Hashenge on 18 November 2018 and 10 March 2019 (Fig. 8). Two were also recorded on 24 May 2017 in the Atsbi highlands in eastern Tigray (13°53'19"N, 39°43'38"E; 2,705 m). Only Siberian Stonechat *S. maurus variegatus*, a Palearctic winter visitor, has previously been recorded in much of northern and eastern Tigray (Ash & Atkins 2009).



Figure 8. Male (above) and female African Stonechat *Saxicola torquatus albofasciatus*, Addibbo Mosa (Tabiya Hashenge), Ofla, Ethiopia, November 2018 (Abadi Mehari Abrha)

**ORANGE-BREASTED BUSHSHRIKE** *Chlorophoneus sulfureopectus*

First record for Tigray. On 16 April 2018, four were observed in *Acacia* at Latie (12°35'36"N, 39°34'38"E; 1,796 m) and Addis Kigni (12°24'34"N, 39°37'39"E; 1,429 m). On 19 March 2019, we recorded it again at the same location.

**RÜPPELL'S STARLING** *Lamprotornis p. purpuroptera*

First records for Tigray. Throughout the study period, *L. p. purpuroptera* was very common in *Acacia* woodland at Facha Hara (12°25'40"N, 39°36'17"E; 1,462 m) and Addis Kigni (12°24'46"N, 39°37'8"E; 1,441 m). Moreover, we encountered several adults with juveniles around the villages of Bora (12°26'30"N, 39°33'52"E; 1,606 m) and Harsa (12°26'04"N, 39°33'32"E; 1,584 m) at the foot of Mt. Gra-Kahsu in December 2018 and January 2019 (Fig. 9). The longer-tailed *L. p. aeneocephalus* has previously been recorded in north and



Figure 9. Rüppell's Starling *Lamprolornis p. purpuroptera*, Addis Kigni, Raya Alamata, Ethiopia, December 2018 and January 2019 (Abadi Mehari Abrha)

west Tigray and in a small part of western Ethiopia bordering Sudan (Ash & Atkins 2009). Recently, *L. p. aeneocephalus* was also confirmed to occur in Kafta Shirao National Park (Buechley *et al.* 2022; AMA, KG & TT pers. obs.).

#### **HOUSE SPARROW** *Passer domesticus indicus*

First records for Tigray. Recorded from arid and semi-arid areas of Afar and southern Ethiopia (*P. d. indicus*) (Gedeon *et al.* 2015) and western Tigray (*P. d. rufidorsalis*) (Gedeon *et al.* 2015, Buechley *et al.* 2022). An adult *indicus* was recorded on 25 January 2019 together with Swainson's Sparrows *P. swainsonii* at Jihan Erra (12°25'25"N, 39°34'13"E; 1,532 m). Several *rufidorsalis* were breeding at Setit Humara (14°17'22"N, 36°36'34"E; 580 m) in northern Ethiopia on 29 November 2018 (AMA, KG & TT pers. obs.).

#### **CHESTNUT SPARROW** *Passer eminibey*

First records for Tigray. Fairly common in *Acacia* woodland at Facha Hara (12°25'45"N, 39°36'28"E; 1,451 m), Jihan Erra (12°25'14"N, 39°34'7"E; 1,537 m), Gawr Shamite (12°30'43"N, 39°34'50"E; 1,622 m) and Serra Addi Ebo (adjacent to Silakunie wetland; 12°26'18"N, 39°37'7"E; 1,430 m) and in farmland. It was encountered continuously in both the wet and dry seasons in 2018–19 and observed in urban and peri-urban habitats.

#### **CHESTNUT-CROWNED SPARROW-WEAVER** *Plocepasser superciliosus*

First records for southern Tigray. Common in lowland *Acacia* woodland from Harksa (12°26'35"N, 39°33'10"E; 1,627 m), near Alamata, to Kukufto (12°37'13"N, 39°38'29"E;



Figure 10. Chestnut-crowned Sparrow-Weaver *Plocepasser superciliosus* collecting carrot grass *Parthenium hysterophorus* (a), a grass stalk (b), bird inside the nest chamber (c) and perched on *Vachellia xanthophloea* (d), Bora, Raya Alamata, Ethiopia, January 2019 (Abadi Mehari Abrha)

1,646 m), at the foot of Hugumbirda and Gra-Kahsu forests. A male and female were recorded nestbuilding in the lower branches of a *Vachellia xanthophloea* on 25 January 2019 (Fig. 10). The most important nest materials were *Eragrostis tef*, *Parthenium hysterophorus* and other dry herbaceous species. The nest typically differs from other weavers because the dried plant material is interleaved into a complex structure without intertwining. Unlike the next species, individual nests are not in contact and the upper part of the structure includes non-thorny twigs and sticks (Fig. 10c).

#### WHITE-HEADED BUFFALO WEAVER *Dinemellia dinemelli*

First records for Tigray. The hilly dryland areas of Hada Alga (12°36'39"N, 39°46'23"E; 1,665 m) and Baso (12°28'53"N, 39°40'55"E; 1,460 m) are preferred by the species including areas dominated by bush, shrub woodland, scattered *Acacia* trees and succulent vegetation. A total of 12 was found nesting on *Vachellia tortilis* and *V. etbaica* on 12 December 2018, sited between 2 and 6 m above ground, along the road and amid *Acacia-Commiphora* woodland and bushland, with the lowest nests away from settlements (Fig. 11).

#### RED-BILLED BUFFALO WEAVER *Bubalornis niger*

First record for Tigray. Fifteen observed nestbuilding on the lower branches of umbrella thorn trees on 2 March 2019 in *Acacia* woodland at Facha Hara (12°25'25"N, 39°34'16"E; 1,458 m). Nests were sited between 12 and 17 m (mean 14.3 m) above ground.

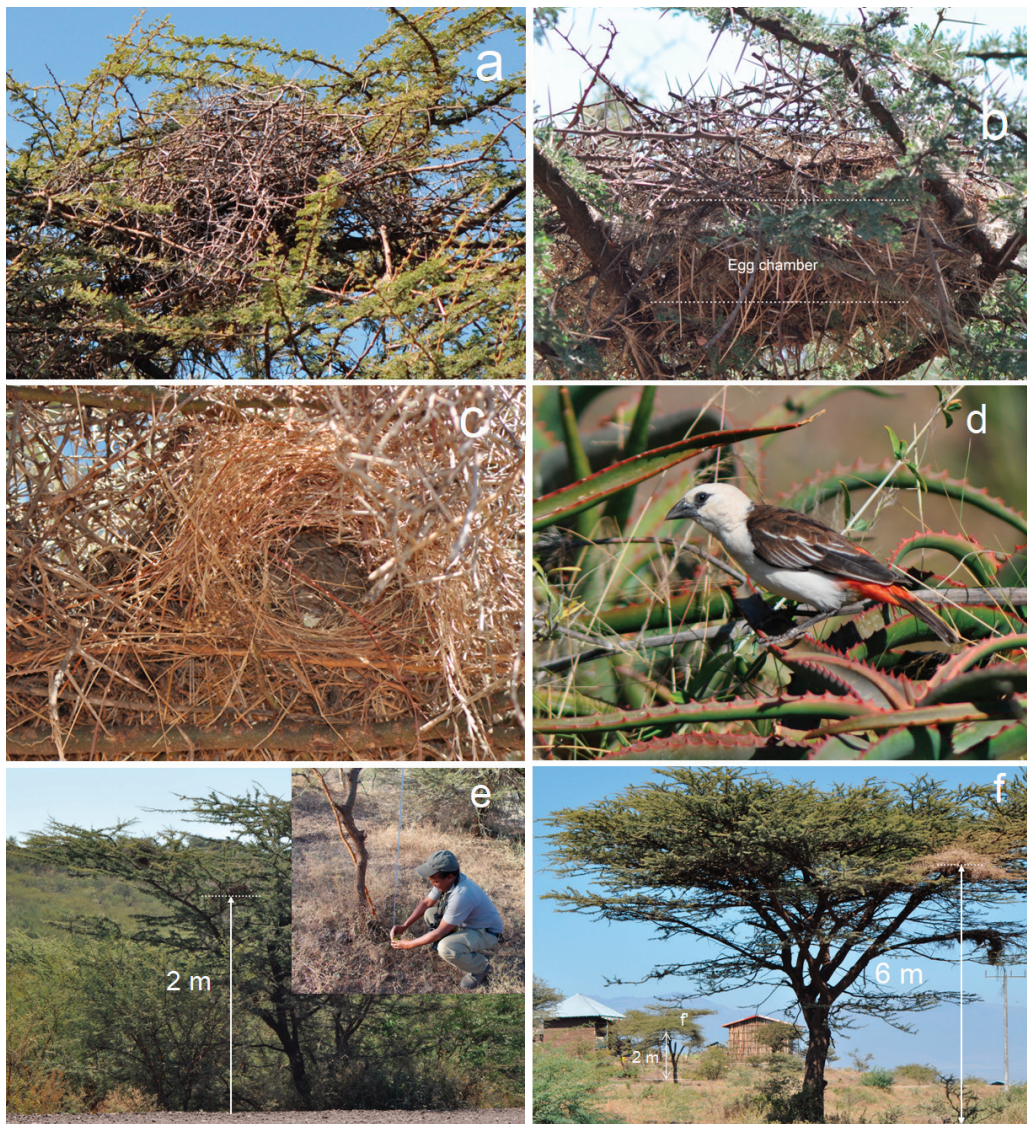


Figure 11. Nests of White-headed Buffalo Weaver *Dinemellia dinemelli* showing (a) nest exterior largely constructed of thorny sticks, (b) egg chamber, (c) entrance, (d) a breeding bird, (e) nest in comparatively undisturbed *Acacia-Commiphora* woodland and bushland, and (f) nest close to a settlement, although note that there are no nests in the low *Acacia* trees nearest to the building (f'), Hada Alga, Raya Azebo, Ethiopia, January 2019 (Abadi Mehari Abrha)

### BRONZE MANNIKIN *Spermestes cucullata*

First records for southern Tigray. On 24 November 2018 and 3 January 2019 several were found in coffee and khat plantations and farmland at Latie and Beyru ( $12^{\circ}39'15''\text{N}$ ,  $39^{\circ}35'5''\text{E}$ ; 1,772 m). At Latie, the birds were using abandoned nests of Baglafaecht Weaver *Ploceus baglafaecht* to breed. We also observed a Bronze Mannikin nest being raided by a Baglafaecht Weaver with the nestling being thrown out (Fig. 12). Elsewhere at Latie, an adult was observed feeding a fledged juvenile (Fig. 12).



Figure 12. Bronze Mannikins *Spermestes cucullata* used deserted nests of Baglafaecht Weaver *Ploceus baglafaecht*, but the latter did not always accept the new occupants: (a) a female weaver enters a nest, (b), throws out a nestling mannikin, which (c) survived the c.4 m fall to the ground, and (d), an adult mannikin returned to the nest to feed the newly evicted young; (e) adult Bronze Mannikin feeding a fledged juvenile, Latie, Raya Azebo, Ethiopia, November 2018 and January 2019 (Abadi Mehari Abrha)

**Land use and land cover (LULC) change.**—Farmland cover in the study area increased from 51.0% (1,188.2 km<sup>2</sup>) in 1985 to 57.5% (1,339.1 km<sup>2</sup>) and 62.6% (1,458.5 km<sup>2</sup>) in 2000 and 2020, respectively. During 1985–2000, there was a decrease in forest cover from 26.5% (616.7 km<sup>2</sup>) to 22.4% (521.1 km<sup>2</sup>) and then to 16.9% (392.7 km<sup>2</sup>) in 2020. Similarly, bare land decreased from 9.6% (223.4 km<sup>2</sup>) to 9.3% (216.4 km<sup>2</sup>) during 1985–2000, reaching 5.5%

(127.6 km<sup>2</sup>) in 2020. Human settlements increased in area from 7.0% (163.3 km<sup>2</sup>) to 8.9% (207.0 km<sup>2</sup>) between 1985 and 2000, and to 11.7% (271.8 km<sup>2</sup>) in 2020. Grassland cover abruptly decreased from 5.3% (123.2 km<sup>2</sup>) in 1985 to 1.3% (31.4 km<sup>2</sup>) in 2000, but increased to 2.8% (64.1 km<sup>2</sup>) in 2020. The relative size of water cover, mostly Lake Hashenge, has been similar since 1985 (Fig. 2). Overall, LULC changes from 1985 to 2020 demonstrated that settlement and farmland increased by 66.5% and 22.7% respectively. Contrastingly, grassland showed a 47.9% reduction, while bare land declined by 42.9% and forest cover by 36.3%.

## Discussion

We documented range extensions for 55 bird taxa in the region, 13 (23.6%) of them first records for Tigray, suggesting that the geographic ranges of some species are broader than previously thought. For example, our House Sparrow records must be considered in the context of its recent expansion into the north-east and north-west, together with small pockets in central and southern Ethiopia (Gedeon *et al.* 2015, 2017, Buechley *et al.* 2022). Pygmy Falcon, Three-banded Courser, Eastern Grey Woodpecker, Horsfield's Bush Lark, African Stonechat, Rüppell's Starling, Chestnut Sparrow, and White-headed and Red-billed Buffalo Weavers were previously recorded in eastern Ethiopia and the Rift Valley (Ash & Atkins 2009, Redman *et al.* 2011, BirdLife International 2023), but hitherto not from Tigray.

White-breasted Cormorant was the only new record for Tigray at the highland lake. In contrast to Alemayehu *et al.* (2017), we detected no other congeners there. Importantly, two endemics, Rouget's Rail *Rougetius rougetii* and Blue-winged Goose *Cyanochen cyanoptera*, previously recorded in the area (Tilahun *et al.* 1996, Ash & Atkins 2009) are now locally extinct, having been neither reported by Alemayehu *et al.* (2017) nor during our study in 2018–20. Grazing pressure (Alemayehu *et al.* 2017) could be a factor in their disappearance.

We confirmed that the Ethiopian endemic *Calandrella blanfordi erlangeri* is widely distributed from Hintalo and Enderata highlands to the southern Tigray highlands abutting the DAF plateaux belt of Hugumbirda and Gra-Kahsu State Forest and Lake Hashenge. Hitherto nominate *C. b. blanfordi* had been tentatively assumed to occur in the highlands of our study area (tetrad 31b), whilst tetrads 31a and 31c were thought to be occupied by *erlangeri* (Ash & Atkins 2009). However, we encountered *C. b. erlangeri* only in grazing land and farmland around Hashenge in tetrad 31b. According to our observations in 2017–18, *C. b. erlangeri* also occurs in plateau grassland of Dessa'a Forest Reserve, Atsbi (Kal Amin, Golgol Naele and Ruba Feleg) and Dera highlands, c.240 km north of our study area, in agreement with Ash & Atkins (2009). However, we did not investigate the potential co-occurrence of the taxa in Tigray.

In our three-year study, of the 17 newly recorded taxa, 14 (82.4%) were in the lowlands, three (17.6%) in highland areas. All of the new records were made in disturbed habitats, suggesting a degree of tolerance of at least some anthropogenic disturbance. Our results are thus in accord with other reports (Wang *et al.* 2022) that suggest human-dominated landscapes support high avifaunal diversity (Aerts *et al.* 2008), especially in structurally complex farmland (Otieno *et al.* 2011, Gove *et al.* 2013, Marcacci *et al.* 2022). As found by Gove *et al.* (2008) and Buechley *et al.* (2015) small-scale mixed plantations of coffee and khat also harbour high species diversity in our study area.

Based on LULC dynamics, key drivers of habitat modification at the expense of native grassland and intact forest habitats are settlements, farmland and bare land (79.8%). Moreover, the increase in grassland cover during 2000–20 may be due to replacement of native grass species with invasive weeds (e.g. *Parthenium hysterophorus*). Such changes could

have a profound impact on the area's biodiversity. Thus, without serious conservation interventions, human-induced habitat modifications could gradually affect species diversity. The development of ecotourism in the region relies on speciose wildlife.

**Recommendations for future studies.**— We provide baseline data from an ornithologically poorly known area of Ethiopia. Our extended monitoring underscores the value of such work, as most of our 'new' species records were multiple, suggesting that they were not one-off sightings of 'vagrants' or 'rarities'. Moreover, spatiotemporal documentation of bird species should avoid both false negatives as well as false positives, but does necessitate robust effort in terms of time, budget, field equipment and expertise, including trained field assistants.

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#### Supplementary Information. Bird taxa recorded from southern Tigray.