

## Research Article

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### Corresponding author:

N. J. Collar;  
Email: [nigel.collar@birdlife.org](mailto:nigel.collar@birdlife.org)

# The conservation status of the Nubian Bustard *Nubotis nuba*: a review and prognosis

N. J. Collar<sup>1,2</sup>  and Tim Wacher<sup>3</sup>

<sup>1</sup>BirdLife International, Pembroke Street, Cambridge CB2 3QZ, UK; <sup>2</sup>IUCN SSC Bustard Specialist Group and <sup>3</sup>Zoological Society of London, London NW1 4RY, UK

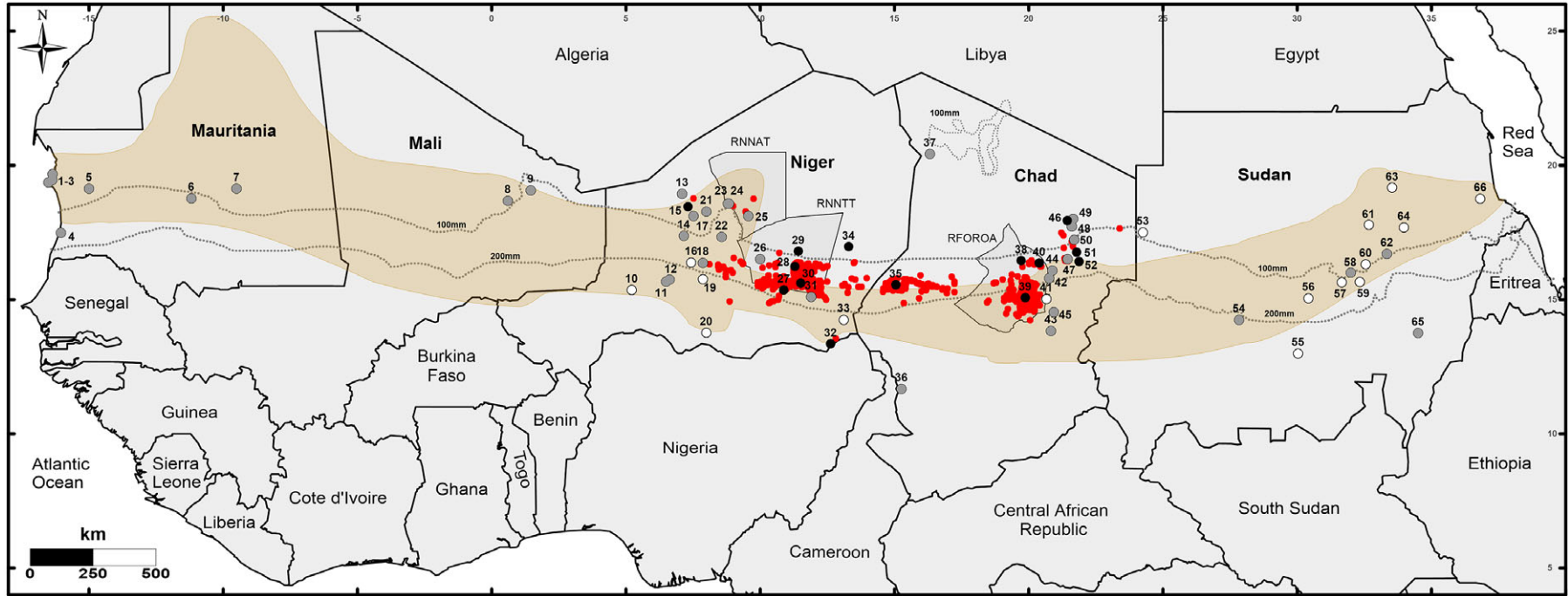
## Summary

Records of the Nubian Bustard *Nubotis nuba* range across the drier northern component of the Sahel zone in Africa from Mauritania through Mali, Niger, and Chad to Sudan. Reports of significant hunting pressure have caused it to be treated as IUCN “Near Threatened” for almost 40 years, but information relating to distribution and population trends remains scattered, anecdotal, and unevaluated. All accessible evidence bearing on its conservation is therefore assembled and reviewed here. The lack of records from Mauritania since 1984, Mali since 1974, and Sudan since 1988 suggests that populations there may now be very small and perhaps entirely extinguished. Records from Niger and Chad remain many, thanks largely to the assiduous reporting of observations on the West African Bird DataBase (WABDaB) by researchers involved in ungulate conservation. The national nature reserves of Air and Ténéré (RNNAT) and Termit and Tin-Toumma (RNNTT) in Niger and the Ouadi Rimé–Ouadi Achim Faunal Reserve (RFOROA) in Chad emerge as vital to the long-term survival of the Nubian Bustard, given the accumulating evidence in both countries of (1) widespread habitat degradation and conversion, as human populations and their livestock expand in numbers and range in the Sahel, and (2) intensifying persecution, as highly mobile and well-armed local poachers plus Gulf state hunters gain increasing vehicular access to the remotest regions, depleting all huntable wildlife (a Sahel-wide bird study, 2011–2019, encountered just 16 bustards of four species – none Nubian – in 487 observation days). Populations of Nubian Bustard must now be greatly fragmented and depleted, with many entirely lost, so targeted programmes to minimise disturbance, persecution, and damage to habitat in the three key reserves (including the exclusion of powerlines) are urgently needed. Ultimately however the survival of this and other endemic Sahelian species can only be secured via a huge programme of ecologically and economically sustainable management practices.

## Introduction

Bustards, Otididae, are mid-sized to large birds of open and semi-open landscapes whose survival depends on high levels of crypsis and vigilance (Collar 1996). The direct and indirect pressures of hunting and habitat conversion have driven populations down in numbers and back in range to the point where 15 (58%) out of the family’s 26 species are now at elevated risk of extinction (BirdLife International 2023). Crypsis and vigilance also combine with the birds’ use of often remote regions to leave many species remarkably little known. The Nubian Bustard *Nubotis nuba*, which ranges (or ranged) some 5,500 km across the African Sahel from the Atlantic coast to near the Red Sea (Collar *et al.* 1986), was described in 1826 but, almost a 100 years later, was still only known to western ornithologists from Sudan (Sclater 1924); moreover, it was only documented in Mauritania and Mali in the 1970s such that these enormous countries were omitted from the first site-based range map of the species in Snow (1978). Its self-advertising display was entirely unrecorded until 2022 (Collar and Wacher 2023), proving so anomalous as to warrant the removal of the species from its long-established position in the genus *Neotis* to a genus of its own, *Nubotis* (Collar and Kirwan 2023). Such evolutionary distinctiveness only increases the importance of identifying and countering the threats the species faces.

The Nubian Bustard is adapted to the arid and semi-arid conditions of the Sahara–Sahel contact zone, in areas of short ephemeral grassland, desert scrub, thorn scrub savanna, and sparse acacia woodland interspersed with grassy steppe (Wettstein 1917, Bowen 1925, Cave and Macdonald 1955, Salvan 1968, Nikolaus 1987, Isenmann undated [2006]); the majority of records are located in the 100–200 mm rainfall zone (Figure 1). It penetrates further north into the Sahara than other bustard species (Salvan 1968), and in the Manga region of Chad it associates more with broken tussock grasslands than with continuous swards (Monfort *et al.* 2001). It even enters unstable dune regions (Dragesco-Joffé 1993, Poilecot 1996), but is not “a true desert bustard” (*contra* Mackworth-Praed and Grant 1952); indeed, Poilecot (1996) judged that the species prefers areas richest in vegetation (although these are still probably tussock grassland: TW pers. obs.).



**Figure 1.** The distribution of records of Nubian Bustards *Nubotis nubis*. Circles with numbers are records itemised in **bold** in the main text; white indicates records (16 in number) before 1950, grey (36) 1950–1999, and black (14) 2000–2020. Red unnumbered circles represent squares in which records have been registered in WABDaB, 1982–2022. Thin-bordered polygons outline the areas of RNNAT, RNNTT (outline shows original 2012 area; degazetted area not precisely known), and RFOROA. Pale brown indicates the Nubian Bustard range as mapped in BirdLife International (2023). The dotted lines delineate the 100–200 mm annual rainfall zone. RFOROA = Ouadi Rimé–Ouadi Achim Faunal Reserve, Chad; RNNAT = National Nature Reserve of Air and Ténéré, Niger; RNNTT = National Nature Reserve of Termit and Tin-Toumma, Niger; WABDaB = West African Bird DataBase.

Its apparent association with elevated ground, e.g. Adrar des Iforhas in Mali, Air in Niger, and Ennedi in Chad (Dragesco-Joffé 1993), Haraza Mountains (see above) and Nuba Hills rather than the southern Kordofan steppe (Wettstein 1917), may reflect a preference for “intermontane habitats..., particularly areas of diffuse drainage, i.e. major wadis and their associated floodplains, wadis with dunes, low plateaus and rocky hills” (Poilecot 1996).

Although said to be “the most sedentary of [the biome’s] bustards” (Newby 1979) and “resident” in Sudan (Cave and Macdonald 1955) and the Air, Niger (Newby *et al.* 1987), the species shows seasonal variations in densities, e.g. a significant increase in dry-season encounters in the Ouadi Rimé–Ouadi Achim Faunal Reserve (RFOROA) (peak in January–February) with many birds disappearing in the wet season, July–October, when it breeds (Newby 1979, Wachter *et al.* 2011a, b, Wachter and Newby 2012). It feeds on seasonally available plant shoots, leaves, seeds and berries (including *Salvadora*), beetles, grasshoppers, bugs, and ants (Hartert 1924, Fairon 1975, Dragesco-Joffé 1993). In Mauritania, Mali, and Niger birds tend(ed) to move south in winter and north with rains (Gee 1984, Lamarche 1988, Thiollay 2006); to the north-west of N’guigmi, Niger, birds disappeared in the dry season (P. J. Jones in Giraudoux *et al.* 1988). Predators include Cheetahs *Acinonyx jubatus* and Sand Cat *Felis margarita* (Dragesco-Joffé 1993), but these felids and foxes live at low density and pose no threat (Poilecot 1996); however, Caracals *Caracal caracal* and African Wild Cats *Felis lybica* live at high densities in RFOROA, both species posing a risk to young bustards and the former also to adults (TW). One flying bird was killed by a Golden Eagle *Aquila chrysaetos* (Wachter and Newby 2010).

More dangerous to the species, however, are human hunters, both local and foreign. As the ecological equivalent of the African Houbara *Chlamydotis undulata* on the southern periphery of the Sahara (Collar and Stuart 1985, Dragesco-Joffé 1993), the Nubian Bustard is especially attractive as a quarry for Gulf state falconers. For 50 years these hunters have been using the oil wealth of their home countries to further their pursuit of both the African and Asian Houbara *C. macqueenii*, with devastating consequences for the conservation status of both species, now globally Red Listed with the IUCN category “Vulnerable” (BirdLife International 2023). From his experience in Niger in 1974, Fairon (1975) already considered the Nubian Bustard “particularly threatened by hunting”, although he did not identify the hunters; but a decade later P. D. Goriup (in Collar and Stuart 1985) reported that “hunting of bustards by Arab dignitaries” was “believed to be widespread in the Sahelian subdesert zone”, as a consequence of which the Nubian Bustard was judged “likely to be suffering seriously”. In another five years Newby (1990) produced first-hand evidence of such persecution, captioning a photograph of a Nubian Bustard as “a threatened species which is being slaughtered in large numbers by hunters from Saudi Arabia”. Other fragments of testimony followed (cited below), implying immense damage being done to the species. However, local hunters have also been identified as inflicting such damage, alongside (in the sparsest outline) indirect factors such as overgrazing, improved veterinary care of cattle, locust control, rising human populations, drought, and global heating.

With this expanding list of threats, in line with Brito *et al.* (2014) who considered the documentation and mapping of endangered species in the Sahel a priority, the conservation status of the Nubian Bustard, since 1985 treated in the IUCN Red List category “Near Threatened” (Collar and Stuart 1985, BirdLife International 2023), needs detailed review, in order to make informed decisions over its long-term management and survival. For this we assembled and

scrutinised all relevant literature concerning its distribution, abundance, ecology, and threats; consulted museums (initials in text, full names in Acknowledgements), online photographs, archives, and personal contacts; traced and mapped localities through mainly online searches (Wikipedia, Google Maps, [mapcarta.com](http://mapcarta.com), [maplandia.com](http://maplandia.com), [mindat.org](http://mindat.org)), during which eBird (2023) and especially the West African Bird DataBase (WABDaB) (2023) emerged as key sources of additional distributional data.

## Distribution and population

The Nubian Bustard has a historical range which extends from the Atlantic seaboard of Mauritania in the west through the Sahelian zone (mainly between 13° and 17°N) in Mali, Niger, and Chad to Sudan in the east (Snow 1978, Collar *et al.* 1986, Collar 1996). The species has been described as “uncommon to rare” (Borrow and Demey 2014), and records of it, other than those associated with project work in Niger and Chad by the NGO Sahara Conservation (almost all logged on WABDaB), are very patchy in space and time. However, it seems wholly likely that its populations are or until recently were continuous (Bannerman 1931, Collar 1996). Dowsett and Forbes-Watson (1993) mentioned “no firm breeding record” for Chad or Sudan – Nikolaus (1987) said the same for the latter – but there are specimens of growing young from both countries that pre-date these statements (see below).

Place names in bold roman below are mapped, their superscript numbers corresponding to those on Figure 1; all site records in WABDaB are mapped as small red dots but not treated in the text or identified by numbers. Three key reserves are placed in bold italic and mapped in outline. If records do not indicate the number of birds seen it is because they lack this information. All translations from French and German are ours. Pending fuller investigation, we follow Friedmann (1962) and many subsequent authors in declining to recognise the subspecies *agaze* (Vaurie 1961), which was based on a tiny sample size.

## Mauritania

The first record of the species – unpublicised, despite the enormous range extension – only occurred in the early 1970s (see records below), with the centre of abundance being judged to lie north of that of the Arabian Bustard *Ardeotis arabs* (Gee 1984), and generally north of 18°N (Isenmann *et al.* 2011). However, in consideration of Dowsett-Lemaire and Dowsett (2005) four published localities – Azeffal, Aftout de Faye, Nouakchott, and Awana Sud (Lamarche 1988) – and nine Important Bird Areas (IBAs) – Amreikat, El Mréiti, Kediet ej Jill, El Ghallâouïya, Ibi (Graret el Frass), Arâguib el Jahfa, Wagchogda, Tinigart, and Wad Initi – all associated with the testimony of B. Lamarche (Fishpool and Evans 2001), are here considered unreliable; the IBAs are responsible for the anomalous northward extension in Mauritania mapped in BirdLife International (2023) (see also Figure 1).

## Specific records

Near **Nouamghar**<sup>1</sup>, Banc d’Arguin National Park (PNBA), three, 22 November 1973 (Knight 1975); **Baie de Saint Jean**<sup>2</sup>, PNBA, one, 27 November 1973 (Knight 1975); Serini (=Serenni<sup>3</sup>), opposite Tidra island, PNBA, 1–2 birds, 10–15 November 1973 (Knight 1975); **62 km south of Nouakchott**<sup>4</sup> (between Nimjat and Tamxat), four, 4 January 1974 (J. P. Gee diary held by P. W. P. Browne *in litt.* 2023); **160 km north-east from Nouakchott**<sup>5</sup> on Akjoujt road,



15–20 birds, 9 December 1972 (Collar *in press*); desert north(-east) of **Tidjikja**<sup>6</sup>, six, 19–20 August 1972, and 70 km north of **Tichit**<sup>7</sup>, singleton, 3 February 1974 (Gee 1984; position of sightings and number of birds from J. P. Gee diary held by P. W. P. Browne *in litt.* 2023). There are records from the PNBA also in December 1984 and January–February of both 1983 and 1984 (Isenmann undated [2006]), plus a recent possible occurrence (feathers found) in January 2005 between El Beyyed and Atar/Adrar (H. Dufourny in Crochet 2007).

### Abundance

In the 1970s the Nubian Bustard was judged “rather common” in the country, and was reportedly the common bustard in desert north of Tidjikja and Tichit in February and August (Gee 1984). However, by the early 2000s the situation had changed: a guide in Diawling National Park reported all bustards to have become rare owing to hunting, and in 2003 some 30 wildlife surveyors, operating in various groups, spent weeks and months at multiple sites across the country (Nouakchott, Iwik [PNBA], Chinguetti, Akmakou oasis, Ouadane, Tichit), recording no bustards except a single Denham’s *Neotis denhami* (V. Salewski *in litt.* 2003 to L. D. C. Fishpool in BirdLife International archives). Few nomads questioned in the Adrar (central–north) knew the species, one mentioning birds north of Adrar, all others indicating them south of Adrar or in the Tagant region; the northern Adrar had recently become drier, with fewer locusts, so that “the species must be at best very rare” (Crochet 2007). A contributor to the IUCN Red List assessment in 2012 wrote that “several hundred kilometres of vehicle-based transects have been conducted recently in Mauritania in search of *N. nuba* without success by January 2012” (BirdLife International 2023); these searches, which took place south and east of the border with Western Sahara from Bon Lanuar east to Choum and north to Fderik, began in 2009 (K. Du Rose *in litt.* 2023). Around the same time an Emirati falconer reported to NJC that bustard hunting in Mauritania was “finished”, as the birds have been completely hunted out (A. bin Ablan al Mazrouei verbally 2010).

### Mali

At a time when the Nubian Bustard was unreported from the country Simon (1965) mapped it as far as the northernmost curve of the Niger River. The species was subsequently said to occur across the country to the Niger border region called “Azaouak” or “l’Azzawak”, i.e. Azawagh Basin, roughly synonymous with the Iullemeden Basin (Lamarche 1980), centred around 17.40°N 4°E. However, more precise records are remarkably few.

### Specific records

**Tilemsi Valley**<sup>8</sup>, eight, September–November 1971 and/or 1973, but none, January–February 2004 (Thiollay 2006); **Adrar des Ifoghas**<sup>9</sup> (Iforhas), nine, September–November 1971 and/or 1973, but none, January–February 2004 (Thiollay 2006).

### Abundance

The species was considered “common in the Sahel and the Sahara as far as 20°N in the cold season” (Lamarche 1980), but in the light of Dowsett-Lemaire and Dowsett (2005), this testimony must be considered un dependable. Moreover, Thiollay (2006) viewed his failure to record the species in 2004 as “indicative of a dramatic decline”, but the two areas in question are relatively far north (18.5–19°N) (see Figure 1), and in the early new year (start of the dry

season), the birds may well have moved south (based on evidence from long-term monitoring of the species in Chad: TW).

### Niger

Studies in the 1980s established that the Nubian Bustard occurs in Niger between 14° and 20°N (exceptionally 21°N) (Dragesco-Joffé 1993). Given these latitudes an eBird (2023) record of a singleton at Say (13.1°N), south-east of Niamey, 14 July 1975, is noted but not mapped here.

### Specific records

Near **Taza**<sup>10</sup> well (Tazza; north of Tahoua), almost certainly this species, May–June 1931 (Bates 1934); **31 km north-east of Abalak**<sup>11</sup>, two, 5 December 1988 (eBird 2023); **48 km north-east of Abalak**<sup>12</sup>, one, 5 December 1988 (eBird 2023); **250 km north of Agadez**<sup>13</sup> (here taken to be Oubandawaki Makiani), 30 January 1954 (female in ZFMK); **Aguéliough**<sup>14</sup>, 15 km east of Arlit, 3–5 birds seen from a helicopter at a Desert Locust *Schistocerca gregaria* outbreak, late October–early November 2015 (W. C. Mullié *in litt.* 2020); **Plaine de l’Ighazer**<sup>15</sup> (Irhazer), November 1983 (Dragesco-Joffé 1993); **Marandet**<sup>16</sup>, southern Air, nest with eggs, 17 August 1922 (Hartert 1924); **150 km north of Agadez**<sup>17</sup>, 30 January 1954 (female in ZFMK); **65 km south of Agadez**<sup>18</sup>, four, 5 June 1975 (eBird 2023); “Taberghi” (type-locality of subspecies *agaze*; untraced, but apparently **Toumbelaga**<sup>19</sup>), 6–7 days north of Tanout (and south of Agadez *vide* Vaurie 1961), 4 July 1922 (Hartert 1924), not 24 July as in Bannerman (1931); near **Tessawa**<sup>20</sup>, west of Zinder, undated (but from context 1922) (Hartert 1924); **Air Mountains**<sup>21</sup>, undated (Newby *et al.* 1987); **70 km north-east of Agadez**<sup>22</sup>, 22 February 1970 (eBird 2023); **Tchintoulous**<sup>23</sup> (Tin Telloust, Tin Tolloust), Air, 29 June 1974 (female in RBINS), and 15 June 1983 (eBird 2023); (Kori) **Zilalet**<sup>24</sup> (virtually the same as Tchintoulous), Air, 29 June 1974 (female in RBINS), evidently the same as “Tanou Samed” (Anou Samed), 1 July 1983 (eBird 2023); **Tafidet**<sup>25</sup>, 15 December 1983 (eBird 2023); **Air and Ténéré National Nature Reserve** (RNNAT) (Figure 1 includes the three preceding sites), 77,360 km<sup>2</sup>, created in 1991 but with records in the area, other than those above, June 1983 to March 1984 (eBird 2023) and 1987–1991 (Poilecot 1996); **150 km south of Ténéré tree**<sup>26</sup>, undated (Dragesco-Joffé 1993); **Dilia Achetinamou**<sup>27</sup>, 13 September 2011 (<https://www.naturepl.com/stock-photo-nubian-bustard-nature-image01347415.html>); 25 km north-east of **Dangoumi**<sup>28</sup> (Dongoumi), February 2010 (as mapped in Rabeil *et al.* 2010); **Gosso Lolom Bo**<sup>29</sup>, south of Fachi, 23 June 1984 (Dragesco-Joffé 1993), and February–March 2002 (Wacher *et al.* 2004); near **Termit-Kaoboul**<sup>30</sup>, several, 12 November 1978 (Giraudoux *et al.* 1988), and (within a radius of 35 km) to the west, south-west, and north, February 2010 (as mapped in Rabeil *et al.* 2010); in the **Dilia de Lagane**<sup>31</sup> 130–167 km north-west of N’guigmi, several observations plus three nests (each with two eggs) 150 km north-west of N’guigmi, all on 19 August 1975 (P. J. Jones in Giraudoux *et al.* 1988); **Termit and Tin Toumma National Nature Reserve** (RNNNT) (Figure 1 includes the six preceding sites), initially (2012) 97,000 km<sup>2</sup> but later (2019) reduced by 50,000 km<sup>2</sup> (Chardonnet *et al.* 2022); near **Diffa**<sup>32</sup>, pair, 24 September 2002 and 26 September 2003 (Jensen *et al.* 2008); near **N’guigmi**<sup>33</sup> at the north-west corner of Lake Chad, three (two shot), but also seen (by implication more than once, as far west as Tessawa: see above) on a journey lasting January–April 1925 (Lavauden 1926); **Agadem**<sup>34</sup> area, February–March 2002 (Wacher *et al.* 2004).

### Abundance

In 1974 the species was observed throughout the kori Zilalet (see above) and kori Tchinn-Tajet (a watercourse), with footprints indicating it was commoner than implied by the sighting of 10 during an 80-km drive; nevertheless, a threat from hunting was then apparent (Fairon 1975). In the years 1979–1986 birds were judged “frequent” in the northern Air (Newby *et al.* 1987). In May 1983 the highest “density” was a maximum of 20 birds in 10 km, in the east around 15°N (Dragesco-Joffé 1993). Between June 1989 and May 1990 surveys in RNNAT yielded an estimated 700–800 birds, but numbers in annual surveys 1987–1991 showed an unexplained sharp drop in 1990 and recovery in 1991 (Poilecot 1996). Having counted 17 in the Southern Air, 24 in the Central Air, and six in the Northern Air, September–November 1971 and/or 1973, Thiollay (2006) found none in the same locations, January–February 2004, but this may have been due to seasonal emigration (see above). A survey in mid-2010 in the Gadafaoua and Taguedoufat region immediately south of the Southern Air encountered Nubian Bustards only every 100 km on average (Wacher 2010).

### Chad

Records extend across the centre of the country. Malbrant (1954, 1957) listed the species for the three northerly areas of Tibesti, Borkou, and Ennedi, but he earlier mentioned the adjacent areas Kanem and Batha to the south (Malbrant 1952). In July–October of 1957 and 1958 Gillet (1960) found “a few everywhere” (hence localities unspecified) throughout the Ennedi Plateau; one specific site (West Ennedi, see below) is mapped here. Salván (1968) cited “Anna” as indicating the species does not occur south of 13°N, but omitted this source from his bibliography. The record from Zouarké (site 37) in the Tibesti Massif is some 500 km distant from other records and appears anomalous (Snow [1978] did not map it and the reported specimen is yet to be traced), but it is consistent with the information from Malbrant (1952) above and the observer was regarded as wholly reliable (P. Devillers *in litt.* 2023); moreover, the site is close to an outlying area of the 100–200 mm annual rainfall zone that holds most Nubian Bustard records (see Figure 1). Nevertheless, no bustard of any species was seen on an ornithological expedition from N'Djamena to the Tibesti Massif (including Zouarké) in May 2023 (J. Hering *in litt.* 2023).

### Specific records

**Manga area**<sup>35</sup>, multiple encounters, August 2010 (Wacher and Newby 2010); **20 km east of Zimado**<sup>36</sup> (Zimado itself is in Cameroon), one, April 1992 (Scholte *et al.* 1999); **Zouarké**<sup>37</sup>, Tibesti Mountains, specimen taken, 22 June 1961 and numerous tracks found in the area (Simon 1965); **Ouadi Rimé–Ouadi Achim Faunal Reserve** (RFOROA) (Figure 1), 77,950 km<sup>2</sup>, birds widespread over all more arid areas between 15° and 17°N (Figure 1 suggests 14.25–16.5°N), the area including Wadi Fira (Newby 1979, eBird 2023, WABDaB; for profile see also Wacher *et al.* 2023), and providing a dry-season feeding range and wet-season breeding range for the species (Wacher *et al.* 2011b, Wacher *in prep.*); **Chad Mission Quad 166**<sup>38</sup>, 21 September 2014 (eBird 2023); **Chad Mission Quad 129**<sup>39</sup>, 15 and 24 September 2014 (eBird 2023); **Chad Mission Quad 167**<sup>40</sup>, 17–20 September 2014 (eBird 2023); **Arada**<sup>41</sup>, 27 February 1937 (Berlioz 1938, also Malbrant 1952; female in MNHN); **Oum Chalouba**<sup>42</sup>, undated (Malbrant 1952); **Ouaddai**<sup>43</sup>, in years 1963–1964 (Salván 1968); **160 miles east of Koro Toro**<sup>44</sup>, “fairly common”, 22 January 1960 (Friedmann 1962); **Biltine**<sup>45</sup>, undated (Malbrant 1952); **Mourdi Depression**<sup>46</sup>, one, November

2012 (L. Nemeth in African Bird Club image database); on road from Fada to Oum Chalouba (half-way point on mapped curved road being roughly at **Ouadi Ketemechi**<sup>47</sup>), two, 9 October 1957 (Kollmannsperger 1959); **Agai**<sup>48</sup> (Agay) well, one, 26 September 1957 (Kollmannsperger 1959); **Ouadi Nkaola**<sup>49</sup> (Wadi N'Kaola), two, 23 September 1957 (Kollmannsperger 1959); **Ouadi Torba**<sup>50</sup> (Tourba), Ennedi, half-grown female, 8 October 1959 (specimen in MNHN); **West Ennedi**<sup>51</sup>, three, 25 February 2022 (eBird 2023); **Ouadi Negoka**<sup>52</sup>, Ennedi Ouest, pair, January 2016 (A. Zboray photograph in <https://uk.inaturalist.org/observations/7467200>).

### Abundance

In the mid-twentieth century Malbrant (1952) reported the species as common in subdivisions Kanem, northern Batha, and northern Ouaddai, and claimed “numerous individuals in the area from Oum Chalouba south through Arada to Biltine”, but he also indicated that “the species seems commonest” in the “north-east” of the country. In the Ennedi Massif it was “rather common” in the early 1950s (Malbrant 1954), and it was the most frequent of the three large bustards there (“much commoner than Arabian”) in the late 1950s (Gillet 1960). In the mid-1960s it was overall “rather rare in the south of the sahelian zone” (Salván 1968). In September 2010 extensive distance sampling from transects in the Manga area generated a population estimate of 600 birds in some 4,000 km<sup>2</sup> of semi-desert; however, comparison with data generated in August 2001 showed a 50% drop in encounter rate, with lower rates also for gazelles (Wacher and Newby 2010). At RFOROA, where in the 1970s the Nubian Bustard was judged “not at all common” (Newby 1979), five wet-season and seven dry-season surveys of a c.3,000 km<sup>2</sup> block between 2011 and 2023 recorded an average wet-season density of 0.2/km<sup>2</sup> and an average dry-season density of 0.62/km<sup>2</sup>; associated population estimates range from c.200 (dry-season minimum) to c.2,000 (wet-season maximum) birds (TW unpublished data).

### Sudan

The Nubian Bustard takes its English and scientific generic and specific names from Nubia, the land encompassing the Nile River from south of Aswan in Egypt to north of Khartoum in Sudan (Appiah and Gates 2005), but the Nuba Mountains or Nuba Hills, also indicated as occupied by the species (see habitat below), are in south-east Kordofan, 400 km south-west of Khartoum. Reference in the literature to Abu Hamed (Cave and Macdonald 1955), Port Sudan (Cave and Macdonald 1955), and Berber Province, i.e. the area between Berber and Port Sudan north to the Egypt border (Bowen 1925), some of them repeated in later publications, appear to be overly broad generalisations, unsupported by museum specimens or published evidence. This also seems to be the case with von Heuglin's (1873) mention of Sennar (Senar, Senaar), which would extend the range into south-western Sudan, abutting the Ethiopia border, although a record below from the Rahad canal, just east of the current Sennar state, is accepted here. The map in Bowen (1925) almost exactly mirrors the map showing the “arid zone” in Nikolaus (1987), suggesting that Bowen may simply have relied on habitat data to delineate the range of the species. The sites marked by Snow (1978) and the squares marked by Nikolaus (1987) do not fully match each other or our own evidence; we investigated these mismatches and prefer to present only our own findings in Figure 1. Jebel Marra is reportedly a site for Nubian Bustard (Fishpool and Evans 2001), wholly plausibly given its intermediate position

between sites 43 and 54 on Figure 1, but no record of the species has been traced.

### Specific records

**Unnamed site 1**<sup>53</sup> (very close to Ouadi Keidi over the Chad border), 30 October 1932 (Moreau 1934); **Um Badr lake**<sup>54</sup>, scarce, 1955 (Mackenzie 1955); south of **Um Ramad**<sup>55</sup>, near Sheikan and south of El Obeid, Kordofan, two, 16 March 1914 (Wettstein 1917); near **Jebel Haraza**<sup>56</sup> (Haraza Mountains), western Kordofan, reportedly common, November 1902 (Butler 1905) (specimen in NHMUK); **unnamed site 2**<sup>57</sup>, (arbitrarily mapped at 75 km) west of Omdurman inside north-east Kordofan, pair collected alive, 7 October 1912, male collected alive, 19 December 1912, male collected alive, 13 May 1913 (specimens in AMNH); **30 miles north-west of Omdurman**<sup>58</sup>, one, February 1961 (Dare undated); **Fatasha**<sup>59</sup>, just west of Omdurman, 29 January 1933 (specimen in NHMUK); **Wadi Bishara**<sup>60</sup> (position mapped in Martin 1942), two, 6 June 1850 (Baldamus 1856) – one of these or another bird being glimpsed by Brehm (1856); Djebel-el-Djilif (evidently **Gilif Jebels**<sup>61</sup>, indicated in Wilson [1886] as between Korti and “Matammeh”, now Al Matamma, close to Shendi), undated (specimen in ZMB; also Hartmann 1863); near **Al Matamma**<sup>62</sup> (“Metamma”), one, February 1961 (Dare undated); above **Kurgos**<sup>63</sup> (also Kurgus; type-locality of the species), reportedly near Shendi (Peters 1934), but in fact >300 km further north on the Nile, undated but in or before 1826 (Cretzschmar 1826); **Fifth Cataract of the Nile**<sup>64</sup>, undated, but specimen registered in 1844 (Sharpe 1894) (three-quarters-grown juvenile in NHMUK); **Rahad canal**<sup>65</sup> near Abu Rakhham camp, west of Al Qadarif (Gedaref), one bird seen at least once, unspecified time in late 1980s (J. E. Miskell *in litt.* 2023); **summit of Red Sea Railway**<sup>66</sup> (stated as 89 miles from Port Sudan [Anon. 1906] and in fact shown on Google Maps less than 10 km south of Sinkat), undated (A. L. Butler in Sclater and Mackworth-Praed 1920), hence doubtless “Red Sea hills” and “Red Sea coast” in various published range summaries.

### Abundance

The historical evidence suggests a generally scarce but locally frequent species. This was the view of von Heuglin (1873), who called it “not very rare in suitable places, but shy”. The repeated capture of birds at “unnamed site 2” above in 1912–1913 suggests a good population west of Omdurman, and in the Haraza Mountains the species was “common” (Butler 1905) and “very common” (specimen label in NHMUK), hence the generalised “not uncommon in western Kordofan” (Mackworth-Praed and Grant 1952). However, Bowen (1925), extrapolating to the entire country, remarked that “judging from the scarcity of records, it seems to be rather uncommon”, adding that Admiral Lynes did not encounter it during extensive fieldwork in Kordofan and Darfur. Cave and Macdonald (1955) called it “not common” and Nikolaus (1987) described it as “rare” and “very little known”. For Khartoum province Macleay (1960) reported it an “uncommon resident east of the Nile”. Records since 1950 are from 1955, 1961, and some time during 1985–1988, suggesting a very serious decline in either numbers or observers or both.

### Other countries

There are very few records of Nubian Bustards in other countries and these presumably involve vagrants or mistaken assumptions. The list here is alphabetical.

### Burkina Faso

A record from the Sylvo-Pastoral and Partial Faunal Reserve of the Sahel, 20 June 2008, is based on a report on Global Biodiversity Information Facility (GBIF) (Boano *et al.* 2022), where the observation is currently still mentioned (<https://www.gbif.org/species/2474878>) but not mapped, suggesting its withdrawal. Two dead birds in a Ouagadougou fetish market on 4 May 2007 – a one-off encounter in 22 years of visiting West African markets (G. Nikolaus *in litt.* 2022) – could have been traded from outside the country (Boano *et al.* 2022).

### Cameroon

The species is a vagrant (Borrow and Demey 2001), this evidently based on a male in Waza National Park, early May 1998 (Scholte *et al.* 1999). An earlier mention of the country (Mackworth-Praed and Grant 1970) was judged mistaken (Scholte *et al.* 1999).

### Central African Republic

The species was mentioned by Mackworth-Praed and Grant 1970 but not listed by Dowsett and Forbes-Watson (1993).

### Ethiopia

A specimen in the collections of T. Lefebvre made during his expedition to Abyssinia in 1839–1843 was found “without note or drawing” (des Murs *et al.* 1845), so there can be no certainty as to its provenance.

### Libya

Simon (1965) mapped the range in the southernmost corner (20°N), and his study area (Tibesti) straddles the Chad/Libya frontier, but there is no record.

### Nigeria

A record of a pair between Udubo and Gadau, 20 May 1959 (Elgood *et al.* 1973, Elgood 1982) was treated not as reflecting vagrancy but as a claim of occurrence for which “confirmation [is] needed” (Dowsett and Forbes-Watson 1993); but it was repeated in Elgood *et al.* (1994).

### South Sudan

Some birds were seen near the entrance to the Bahr el Zeraf from the White Nile (here taken to be Tondiak), 7 February 1911 (Staples-Browne 1912). This record is anomalously far south and treated as provisional here, but gains credence if the species’s occurrence in Sennar, in adjacent south-west Sudan (see above), can be established.

### Threats

#### Accelerating environmental degradation

Many changes, all anthropogenic in origin or degree of intensity, are steadily compromising the ecological resilience of the Sahel. Two late twentieth-century reviews independently pointed to catastrophic desertification across the region owing in large part to the steady growth in and settlement of the previously migratory human population and the resulting pressure placed on natural vegetation, mainly by concomitantly increasing livestock and the sinking of ecologically unsustainable boreholes (Sinclair and Fryxell 1985, Le Houérou 1992). Already 40 years ago White (1983) expressed the need to keep livestock numbers within carrying capacity, yet rangeland degradation through grazing



intensity persists (Miehe *et al.* 2010). Indeed, Sahelian grasslands have been entirely colonised by livestock (150 million cattle, 300 million sheep and goats (Zwarts *et al.* 2009), and boreholes continue to proliferate, even inside RFOROA (Wacher *et al.* 2023). “Beyond the parks it is cattle, sheep, goats, dromedaries, and donkeys galore – and people of course” (R. G. Bijlsma *in litt.* 2023). Apart from sinking new wells, regional support for farming inevitably involves improved veterinary care and the suppression of locusts (Thiollay 2006), the latter being blamed for declines in Nubian Bustards in Mauritania (B. Lamarche in Crochet 2007). Meanwhile, rangeland is rapidly being converted to farmland (which in Zimbabwe is associated with a decline in Kori Bustards *Ardeotis kori*: Pringle *et al.* 2019), particularly in the southern Sahel; in the north, only 4% of the land has been converted in the 100–200 mm rainfall zone, where the Nubian Bustard appears mainly to occur, but that figure rises to 22% in the adjacent 200–300 mm zone (Zwarts *et al.* 2023). A collateral impact of this land-use change is acacia cutting for fuel, which promotes soil erosion (Thiollay 2006, J. Brouwer *in litt.* 1999 in BirdLife International 2023).

The human population of the Sahel is on course for a 10-fold increase in the century 1950–2050, from >30 million through 100 million in 2010 to >300 million (Potts *et al.* 2013), reflecting what 30 years ago was already considered a “demographic explosion” that “can only drive [Arabian and Nubian Bustards] from their favoured areas” (Dragesco-Joffé 1993). Also by 2050 Sahelian temperatures are set to rise 3–5°C, which is likely to be intolerable for many species including bustards (see, e.g. Silva *et al.* 2015), increasing drought in an already drought-prone region (Potts *et al.* 2013, Brito *et al.* 2014), although RFOROA has shown a greening trend in the south as well as a desiccating trend in the north (Fremantle *et al.* 2013). These phenomena will combine to fuel greater societal pressures and environmental change, resulting in further exploitation of wildlife and a concomitant inability to protect it.

## Hunting

Hunting of wildlife in the Sahel over the past century appears to have taken place on a scale that is astonishing not only for its size but also for its almost complete neglect as a conservation issue.

### Local hunting

The advent of the rifle and then of motorised transport over the last century greatly increased native capacity to hunt wildlife, partly for subsistence and partly to eliminate competitors for livestock pasture (Newby 1980, Zwarts *et al.* 2009). This can only have been detrimental to bustards. Moreover, wars, rebellions, and insurgencies have affected all five Nubian Bustard range states since the 1960s, placing firearms in the hands of thousands of people (Fletcher *et al.* 2022; numerous correspondents *in litt.* 2023). This pressure compounds other “local” hunting activities by nomads and villagers, who may use dogs (Dragesco-Joffé 1993) or falcons (W. C. Mullié *in litt.* 2020), wealthy officials in 4x4s that can pursue animals to exhaustion, security guards protecting energy and mineral exploration staff, the energy and mineral exploration staff themselves, and lorry-drivers (who all carry rifles for self-protection but use them opportunistically for obtaining bushmeat: P. Hall verbally 2023), such that “heavy, relentless hunting pressure is likely to be the main reason for the dramatic decline or near-extinction of all large terrestrial birds” in Niger and Chad (Thiollay 2006). The

combination of these interests has in places produced “an ongoing wildlife massacre” (Brito *et al.* 2018), resulting in such traumas as the almost complete elimination of 1,600 Common Ostriches *Struthio camelus* from RNNAT within a decade (Ostrowski *et al.* 2001). Poachers on motorbikes indiscriminately killing wildlife remain a challenge in RNNAT and the adjacent Gadafaoua and Taguedoufat regions (Wacher 2010, A. Harouna *in litt.* 2023) and in eastern RFOROA (TW).

### Gulf state hunting

Every range state of Nubian Bustard has been involved: “Mauritania, Mali, Niger, Chad and Sudan..., [with] mostly Nubian, Arabian and White-bellied Bustards [*Eupodotis senegalensis*] being the prey species” (Michler 2009). Anecdotally, a visit to the abandoned camp of an Arab prince in Mali revealed the damage a single hunting party could inflict, with “bustard feathers scattered over an area of several hundred square metres” and “a pit into which bustard remains [including Nubian] had been thrown” (Newby 1990). In another incident, a Saudi prince reportedly killed “1660 dorcas gazelles and 3000 bustard [our italic]... from Omdurman to western Darfur”, Sudan, in early 1989 (Cloudsley-Thompson 1992). During such hunting parties “hundreds (some say thousands) of bustards are slaughtered”; moreover, “with bustard populations wiped out [our italic], wealthy Arabs are being forced further afield in search of quarry” (Newby 1990). A government ban in Niger on “industrial poaching” by Saudi falconers in 1992 was judged to have stabilised the Nubian Bustard population (Poilecot 1996), but this evidently did not last: fieldwork early this century in both Niger and Chad revealed that “the organized hunting parties of wealthy Arabs have recently had a devastating effect” (Thiollay 2006), while, as noted, one falconer has conceded that his kinsmen killed so many Nubian Bustards in Mauritania that visiting it became pointless.

For perspective, one informed source has put the number of members of the Saudi royal family (i.e. princes) who are also multi-millionaires (i.e. can afford the huge cost of sorties to the Sahel) at 2,000 (Milmo 2012); if only 1% of these – setting aside the Emiratis, Bahrainis, Qataris, and Kuwaitis, who just as readily hunt bustards (Weaver 1992, Oufkir 2019) – have regularly visited the Sahel, each time killing “hundreds” of bustards, Nubian Bustard populations are likely to have suffered extreme damage. The scale and scope of Gulf state hunting parties in North Africa were outlined by Collar (2022), who emphasised the improbability of any populations of African Houbaras having escaped their attention. The same consideration applies to the Nubian Bustard, and it is therefore hardly surprising that Gulf state hunting in the Sahel has seemingly much diminished since the start of the present century. Multiple correspondents identify three factors behind this decline: greater sensitivity in some host countries to the damage hunting does both to wildlife and to local community relations; increasing security risks to hunting parties from radical insurgent groups; and, surely foremost, the hunters’ almost total elimination of their quarry.

Gulf state hunting nevertheless continues. RNNAT is surrounded by concessions to Gulf state citizens, who freely enter the reserve and hunt there (T. Böhm *in litt.* 2023, A. Harouna *in litt.* 2023). As witness, eight live Nubian Bustards and 150 Arabian Bustards (the numerical difference partly explained by the distribution of the former in the interior, the latter more at the periphery of the reserve) were confiscated from hunters in the years 2020–2022 (A. Harouna *in litt.* 2023).

### Conclusion: protected areas and ecological sustainability

The Sahel is so wide – 5,500 km – and in its northern reaches seemingly so void of people that it is difficult to conceive that a cryptic, well-dispersed species like the Nubian Bustard might be at serious risk. However, this is the case with the African Houbara (IUCN status “Vulnerable”) with a range width of 4,000 km (Collar 2022, BirdLife International 2023), and Great Bustard *Otis tarda* (IUCN status “Vulnerable”), with a range width of 10,000 km (see Kessler and Collar 2022). Thiollay (2006) remarked that “the large bustards (*Neotis*, *Ardeotis*) have been severely overhunted and *may have become extinct over huge areas*” [our italic], a distinct possibility which on the sum of evidence accumulated here resembles a compelling probability. Ornithologists conducting intensive research across the full span of the Sahel over nine years, 2011–2019, within the winter period 20 November–10 March at 1,901 sites (2,022 ha) outside reserves (see *Ardea* 111 (1) [2023] “Sahel Special”), recorded only five Black-bellied *Lissotis melanogaster* and two Arabian Bustards; while travelling between these sites they encountered one Savile’s *Lophotis savilei*, four White-bellied, two Black-bellied, and two Arabian Bustards, producing a total of just 16 individual bustards during 487 observation days (R. G. Bijlsma and L. Zwarts *in litt.* 2023). Our evidence indicates that there have been no records of Nubian Bustard in Mauritania, Mali, or Sudan this century, so that it may now be very rare in these countries, and possibly even extinct. Niger and Chad thus share the responsibility for maintaining the species, and this appears to be only achievable now through existing protected areas.

This in itself will plainly be an enormous challenge. Thiollay (2006) pointed out that in the northern Sahel there are only two theoretically protected areas, RNNAT in Niger (77,000 km<sup>2</sup>) and RFOROA in Chad (77,950 km<sup>2</sup>), but that both were then “totally devoid of any management or law enforcement”. Indeed, RNNAT is one of 55 “properties” listed by the World Heritage Convention as currently in danger (<https://whc.unesco.org/en/soc/4006>); its conservation outlook is “Critical” and the threat from poaching, with Nubian and Arabian Bustards specified as targets, “very high” (<https://worldheritageoutlook.iucn.org/explore-sites/wdpaid/67727>). RFOROA has recently benefited from the recruitment of new rangers and the production of a management plan (TW), but the proliferation of wells and agriculture is a major concern, encouraging stocking rates to reach or surpass the sustainable maximum; consequently a cap on further water development and human settlement within the reserve’s newly defined core conservation zone is needed (Wacher *et al.* 2023).

In 2012 a third major protected area, RNNTT in Niger, covering an area larger than Hungary, was declared, but just seven years later 50,000 km<sup>2</sup> of its eastern sector were degazetted to meet the terms of a pre-existing Chinese oil concession (Chardonnet *et al.* 2022, J. E. Newby *in litt.* 2023). The oil concession will clearly have various negative impacts, but the remaining reserve, under the management of NGO Noé, needs detailed study to establish its current and potential value to the Nubian Bustard. Improved local policing and stewardship of all three key reserves is a cardinal necessity. In this respect, recent conservation initiatives at the RFOROA undertaken by the Government of Chad in collaboration with the Environment Agency of Abu Dhabi and Sahara Conservation (operator of the Scimitar-horned Oryx *Oryx dammah* reintroduction programme and candidate to take delegated management of the reserve), although not directed explicitly at the Nubian Bustard, underscore the immense potential to improve the conservation prospects of all Sahelian species under positive leadership; the

extension of such collaboration to other key reserves in the Sahel is warmly commended.

Nevertheless, other sites also need to be developed as reserves for this and other threatened Sahelian species. Thiollay (2006) called for a large reserve in northern Mali, presumably in Adrar des Ifoghas, to complement RNNAT and RFOROA, but in recent years insurgencies, terrorism, and organised crime have destabilised the country to the point where – unless there is deep-seated popular support (see Canney 2019) – the creation of new protected areas and indeed the practice of nature conservation itself appear unfeasible (Strydom 2019). In Niger the Gadafaoua and Taguedoufat regions hold (or until recently held) gazelles, hares, and Nubian Bustards in small numbers (Wacher 2010), and ideally require evaluation for long-term protection (part of this area is now covered by the re-arranged boundaries of RNNTT: J. E. Newby *in litt.* 2023). In Chad the Manga area holds (or until recently held) significant populations of Dorcas Gazelle *Gazella dorcas* and Nubian Bustards, and has been judged “a very significant wildlife area” worthy of protection (Wacher and Newby 2010), although in recent years it has been badly affected by increasing transport- and security-related activities (TW). The modern status of the Nubian Bustard in Chad’s Ennedi Plateau (a World Heritage Site now part-protected as the Ennedi Natural and Cultural Reserve: <https://www.africanparks.org/the-parks/ennedi>) and adjacent Mourdi Depression also merits investigation, as it does in the very isolated and regrettably still unprotected Tibesti Massif.

Unlike the threatened antelopes for which the existing Sahelian reserves were primarily created, there are no (or no known significant) populations of Nubian Bustard in captivity, and in any case captive breeding for reintroduction is an onerous, expensive, and unrewarding conservation intervention for bustards (Dolman *et al.* 2015, 2018, 2021). The only secure measure must therefore be *in situ* management in which disturbance and persecution are completely minimised and landscapes maintained in as pristine a form as possible, including the zealous prevention of powerlines passing through them (for reasons for which see Silva *et al.* 2023). This is naturally also a prescription applying to the two other large bustards of the Sahel, Arabian and Denham’s, which however have populations elsewhere. Nevertheless, such reserves will be overwhelmed and eventually obliterated if human and livestock populations continue to rise alongside global temperatures, so that ultimately the only means to prevent a slow-building environmental and humanitarian “mega-catastrophe” (Potts *et al.* 2013) must lie with the rapid and full adoption of policies and programmes that deliver genuine ecological stability and economic sustainability to the people of the Sahel.

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