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ANTELOPE SPECIALIST GROUP

IUCN Species Survival Commission
Antelope Specialist Group

GNUSLETTER is the biannual newsletter of the IUCN SSC Antelope Specialist Group (ASG). First published in 1982 by the first ASG Chair Richard D. Estes, the intent of *GNUSLETTER*, then and today, is the dissemination of reports and information regarding antelopes and their conservation.

ASG Members are an important network of individuals and experts working across disciplines throughout Africa, Asia and America. Contributions (original articles, field notes, other material relevant to antelope biology, ecology, and conservation) are welcomed and should be sent to the editor. *GNUSLETTER* is published in English in electronic form and distributed widely to members and non-members, and to the IUCN SSC global conservation network. To be added to the distribution list please contact asgpo@marwell.org.uk.

GNUSLETTER **Editorial Board**
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Front Cover. *Silver Dik-dik* Madoqua piacentinii *photographed in the Ogaden region of Ethiopia (© Sven and Catrin Hammer)*

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BREAKING NEWS

Conservation successes: Scimitar-horned Oryx and Saiga upgraded on the IUCN Red List

ASG is delighted to welcome two significant conservation success stories that were announced in the latest update to the IUCN Red List of Threatened Species published on 11 December 2023. The status of the Scimitar-horned Oryx *Oryx dammah* has improved from Extinct in the Wild to Endangered, and Saiga antelope *Saiga tatarica* has moved from Critically Endangered to Near Threatened. Species do not often undergo a positive change in status and it is extremely rare for a two-step and three-step improvement to occur, as here.

Until the mid-20th century, the Scimitar-horned Oryx seemed to remain common in the Sahel, but numbers declined rapidly and the last herds disappeared in the late 1980s or possibly early 1990s and the species became Extinct in the Wild. An ambitious reintroduction project was initiated in 2010-2012, led by Environment Agency Abu Dhabi and the Chadian government agency, and implemented by Sahara Conservation and partners, supported by the ex-situ community. The first oryx were released into the wild in the Ouadi Rimé-Ouadi Achim Wildlife Reserve in Chad in August 2016. The wild population is now established, with at least 140 mature scimitar-horned oryx, and 331 calves born in the reserve there by the end of 2021. The scimitar-horned oryx becomes the second antelope species, after Arabian Oryx *Oryx leucoryx*, to have been reintroduced to the wild after having become Extinct in the Wild.

Historically Saiga may have numbered in the millions. There were still an estimated 1,250,000 Saiga in the mid-1970s but then declined catastrophically from 1989 onwards, when political and economic changes accompanying the break-up of the USSR led to weakening of nature protection systems and severe economic hardship, while at the same time, international borders were opened up, enhancing the opportunities for trading Saiga horn. The species was assessed as Critically Endangered in 2002 due a population reduction of >80%. A wide range of conservation measures was implemented and Saiga numbers increased before disease outbreaks in 2010, 2015 caused mass mortality – an estimated 200,000 died in 2015, representing >60% of the global population.

The population in Kazakhstan has since recovered dramatically, growing by about 1100% between 2015 and 2022, with annual increases of up to 40%. The 2023 aerial census in May 2023 estimated a total of 1,900,000 Saiga in Kazakhstan. This phenomenal population increase is due to concerted investments by national governments in anti-poaching, protected area creation, and other measures, strongly supported by local and NGOs and research scientists, plus Saiga's very high fecundity – females can breed in their first year and most females bear twins.

These two successes rightly deserve to be celebrated, but they should now be followed up with further conservation measures – reintroductions of Scimitar-horned Oryx into other sites within its historic range and actions to bring similar levels of increase to Saiga populations outside Kazakhstan.

IUCN Red List Press Release 11/12/2023

[quotes from : https://www.iucn.org/press-release/202312/freshwater-fish-highlight-escalating-climate-impacts-species-iucn-red-list]

[…] The **Scimitar-horned Oryx** (*Oryx dammah*) has moved from Extinct in the Wild to Endangered on the IUCN Red List, thanks to conservation efforts that have reintroduced the species to Chad. Once common across the Sahel region of Africa, this antelope disappeared from the wild by the end of the 1990s. Increasingly intense poaching with modern firearms and motor vehicles, plus extreme droughts every decade, led to its demise in the twentieth century. Today, poaching levels are rising mainly for subsistence and trade, amidst high levels of poverty and food insecurity. Following a long-term international project, the scimitar-horned oryx is now established in the wild, with at least 140 mature individuals ranging freely in the Ouadi Rimé-Ouadi Achim Faunal Reserve in Chad and 331 calves born there by 2021. The full support of national authorities and local communities has played an essential part in the project's success, and the species' survival depends on continued protection against poaching. Climate change in the Sahel remains a possible threat to the future of the scimitar-horned oryx.

"*The Scimitar-horned Oryx is the fourth large mammal to have been successfully reintroduced to the wild in the past 100 years. The success of this project and the dramatic recovery of the saiga are the results of strategic vision, strong government commitment and investment, technical support from non-governmental organisations and scientific experts, and collaboration with local communities,*" said **Dr David Mallon**, **Co-Chair of the IUCN SSC Antelope Specialist Group**.

The Red List status of the **Saiga antelope** (*Saiga tatarica*), which lives across Kazakhstan, Mongolia, Russia and Uzbekistan, has improved from Critically Endangered to Near Threatened. The population in Kazakhstan, home to 98% of all saigas, increased by 1,100% between 2015 and 2022 and reached 1.3 million in May 2022. The species is very susceptible to disease outbreaks, suffering mass mortality events in 2010, 2011, 2015 and 2016. The high death rate in 2015 is understood to have been triggered by abnormally high temperatures and humidity, conditions expected to become more frequent with climate change. Combined with growing numbers of domestic livestock, which increase the chance of disease transfer, the risk of future disease outbreaks causing significant mortality remains high. Poaching for horns and meat has also caused major saiga declines. The improvement in status is the result of extensive anti-poaching measures, along with education programmes, training of customs and border officials, and action against illegal sale in consumer countries. This situation is entirely dependent on continued enforcement of anti-poaching measures and trade controls. [...]

FROM ASG

CONTACTS FOR THE IUCN SSC ANTELOPE SPECIALIST GROUP (ASG)

ASG Website:
https://antelopesg.org/

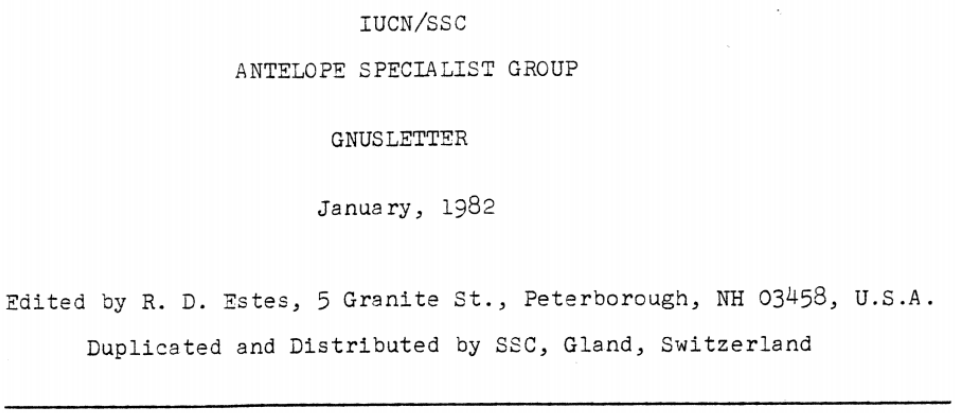
ASG Twitter:
https://twitter.com/AntelopeSG

ASG email address:
asgpo@marwell.org.uk

ASG Programme Office land mail address:
C/o Marwell Wildlife, Thompson's Lane, Colden Common, Winchester SO21 1JH, UK

40 volumes of *Gnusletter*

The first issue of *Gnusletter* appeared in January 1982, produced and edited by the founder Chair of ASG, Dr Richard D. Estes, who continued as editor until 2007. In the early years, each issue was typed by his wife, Runi, then photocopied and paper copies mailed, by SSC. Non-ASG members paid a small subscription and some additional funding support to cover production and mailing costs was provided by WWF and San Diego Zoo. In 2007 Steve Shurter took over as editor, helped by Stephanie Rutan, and supported by White Oak Conservation, where Steve was CEO. Steve produced every issue until 2020. A small ASG editorial team is currently responsible for production. For several years only electronic copies have been produced and *Gnusletter* is freely available to all. Over the last 40 years, a large number of people have contributed articles, notes from the field, updates, reports, summaries of the scientific literature, and photos on all aspects of antelopes and their conservation. These include young and emerging researchers for whom *Gnusletter* provides a useful publication option. Many thanks to all contributors and readers – and looking forward to the next 40 years!



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ASG's Social Media: A Year in Review

In the last year ASG has been tracking our progress and engagement through our social media platforms, namely X (formerly twitter) and Facebook. For our readers not familiar with our accounts we make regular posts with facts about antelope behaviour, morphology, conservation actions, recent papers and more.

Our combined accounts are followed by more than 3,000 people including many of you that engage with our weekly posts, but we are also reaching large numbers that do not follow us. Over the past year our posts have been viewed by almost 100,000 different accounts displaying just how many people can be reached even with just a small amount of text and a nice image or two.

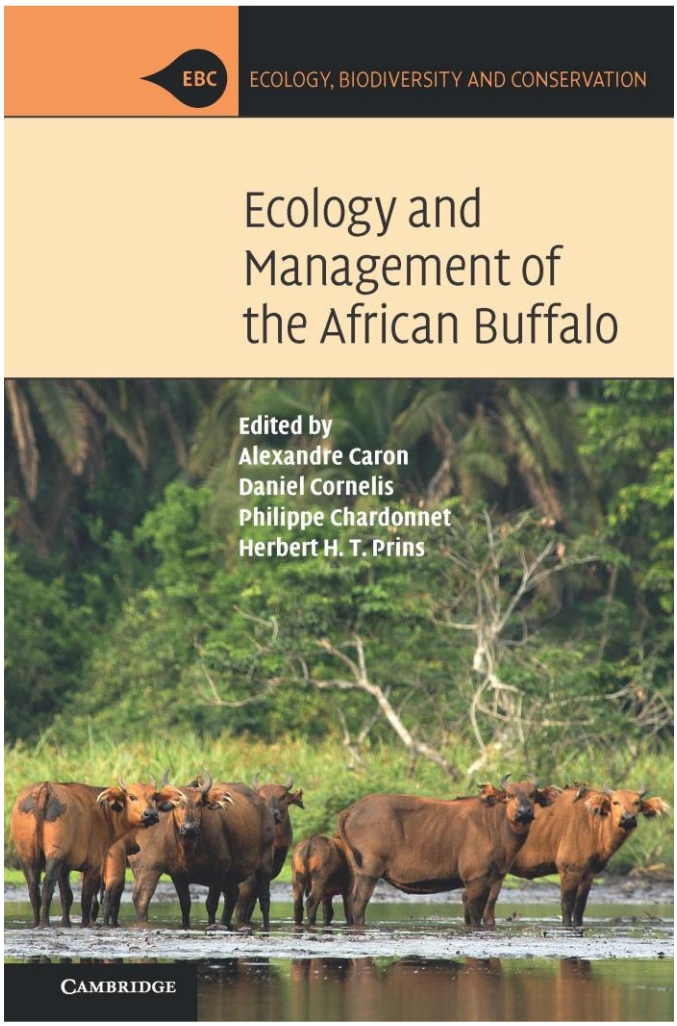
We would love to see more people engaging with our posts and for those not already following us you can find ASG on Facebook at 'IUCN SSC Antelope Specialist group' and on X at '@AntelopeSG'.

Forthcoming meeting

CMS CoP 14

The 14th Conference of the Parties of the Convention on Conservation of Migratory Species of Wild Animals (CMS) takes place in Samarkand, Uzbekistan, on 12-17 February 2024. Among proceedings, programme the countries/Parties will be asked to formally approve the CMS Sahelo-Saharan Megafauna Action Plan developed with the help of ASG and endorsed at the 4th Meeting of the Range States in Agadir, March 2023. The SSMF AP covers seven species of antelopes occurring in the Sahara and Sahel regions, including the critically Endangered addax and dama gazelle. Other relevant items to be covered include the Memorandum of Understanding on the Saiga Antelope and the Central Asian Mammals Initiative

Ecology and Management of the African Buffalo



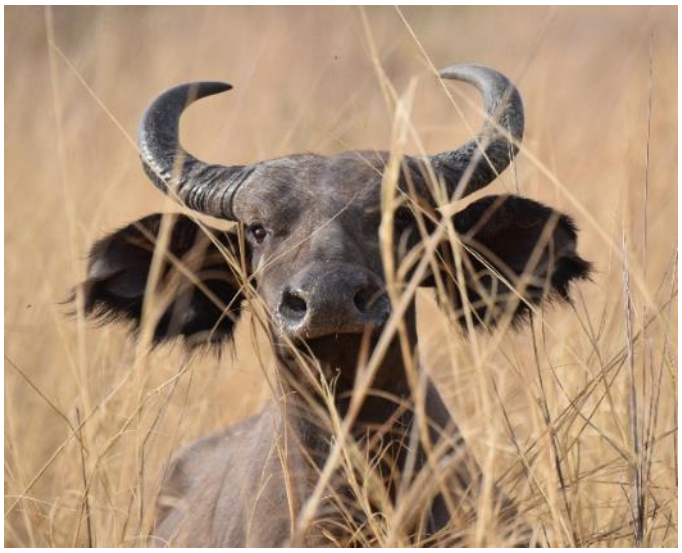
Edited by Alexandre Caron[1], Daniel Cornelis[2], Philippe Chardonnet[3], and Herbert T. Prins[4]

One of iconic Africa's Big Five, the African buffalo is the largest African bovine or antelope that occurs throughout most of sub-Sahara and in a wide range of ecosystems from savanna to rainforest. The African buffalo is also one of the most successful large African mammals in terms of abundance and biomass. This species thus represents a powerful model to enhance our understanding of African biogeography and wildlife conservation, ecology and management.

Edited by four researchers experienced in different aspects of the African buffalo's biology, three of them members of ASG, this volume provides an exhaustive compilation of knowledge on an emblematic species that stands out as an important component of African natural and human ecosystems. It delivers a global view of the African buffalo and all known aspects of its ecology and management.

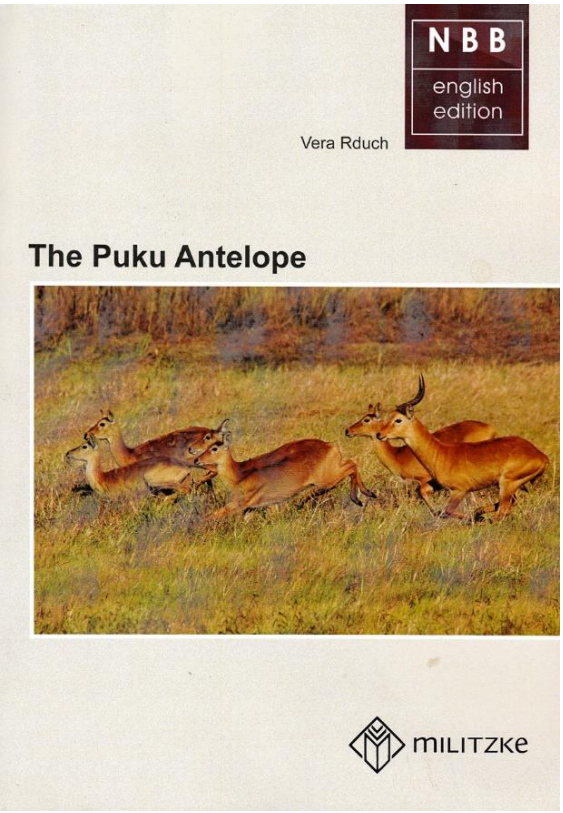
This book will appeal to students, scholars, scientists and wildlife managers as well as those enthusiastic about the charismatic species. This title is also available as **Open Access** on Cambridge Core, available now at **www.cambridge.org/emab-open**

[1]Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), France, [2]Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD) and Foundation François Sommer, France, [3]International Union for Conservation of Nature (IUCN) SSC Antelope Specialist Group, [4]Wageningen Universiteit, The Netherlands



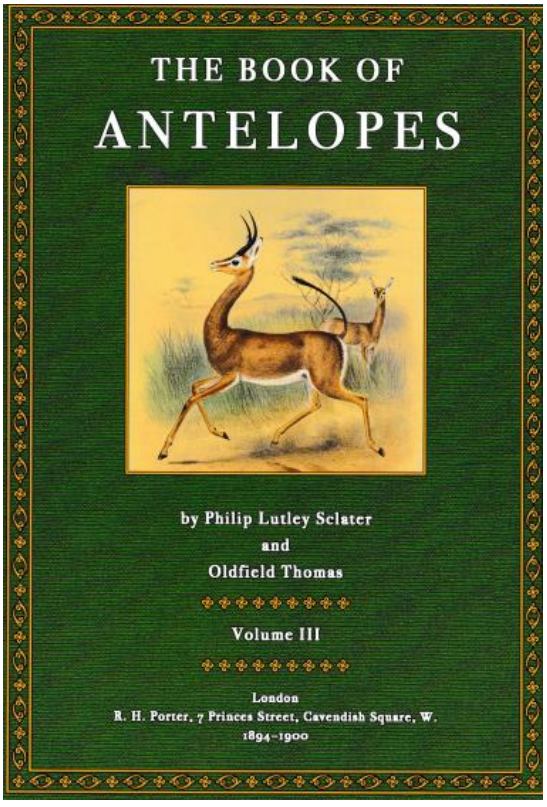
West African savanna buffalo, Benin (© Christophe Morio)

The Puku Antelope



This book written by ASG member Dr Vera Rduch of the Leibniz Institute for the Analysis of Biodiversity Change – Museum Koenig Bonn, is the first monograph published on the puku *Kobus vardoni*. It is based on many months of field work conducted since 2007 and is a comprehensive account of the species biology and ecology. It was first published in German in 2022. This English version was produced in July 2023 by Neue Brehm-Bücherei / Militzke. www.neuebrehm.de
ISBN 978-3-89432-445-2

The Book of Antelopes (1894-1900)



The Book of Antelopes by Philip Sclater and Oldfield Thomas was published in four volumes between 1894 and 1900. It contains an account of all the antelope species described at that time, illustrated by beautiful hand-coloured paintings, and it has become a classic work on these species. First editions of the four-volume set are only rarely available for sale and may cost between 5,000 and 20,000 USD depending on their condition. A facsimile reprint of all four volumes, containing reproductions of the original plates, was produced in 2018 by the publisher Fines Mundi GmbHb, Saarbrucken, Germany. Second-hand copies of this edition are also sometimes available and may cost around 300-500 USD. Readers of *Gnusletter* may be interested to know that a digitized version of the original book is available to download, free of charge, from the Biodiversity Heritage Library at:
https://www.biodiversitylibrary.org/bibliography/65969

RESEARCH AND REPORTS

Silver Dik-dik *Madoqua piacentinii*: Range revision

David Mallon[1], Hassan Kaariye[2], Brooke Kassa[3], Osman Gedow Amir[4], Giuseppe G. Bellani[5], Catrin Hammer[6], Sven Hammer[6], Jens-Ove Heckel[7], Håkan Pohlstrand[8], Ludwig Siege[9], and Friedrich Wilhelmi[10]
[1]Manchester Metropolitan University, UK, [2]Kebre Dehar, Ethiopia, [3]Addis Ababa, Ethiopia, [4]National Museum of Somalia, Mogadishu; [5]Museo Museo di Storia Naturale, Novara, Italy; [6]Zoo Görlitz, Germany; [7]ZGAP, Germany; [8]Strängsnäs, Sweden; [9]Frankfurt, Germany; [10]Mutterstadt, Germany

Introduction
The Silver dik-dik *Madoqua piacentinii* is a poorly known species that is endemic to the Horn of Africa. It is currently assessed as Data Deficient on the IUCN Red List (IUCN SSC Antelope Specialist Group 2016). It has sometimes been listed as a subspecies of *M. saltiana*, but was considered to be a valid species by Yalden (1978), Funaioli and Simonetta (1961, 1966), East (1999), Grubb (2005) and Simonetta (2013).

Examination of the original specimens and descriptions by Yalden (1978) and of specimens in the La Specola Museum, University of Florence, and the Faraggiana-Ferrandi Natural History Museum in Novara, and Parma Museum, Italy by Bellani (2013; Fig. 1-2) show that *M. piacentinii* is distinguished by smaller size, a narrower skull, length of the upper tooth row, uniform silvery coat colour with no rufous flares, the colour banding of individual hairs, a reddish tuft on the crown separated by grey fur from a reddish patch on the nose, a narrow black edge to the ear, and the white circle around the eye being less prominent than in *M. saltiana*.

Figure 1. *Pair of Silver Dik-dik in Natural History Museum "Faraggiana-Ferrandi" in Novara, Italy (© G.G. Bellani).*

Figure 2. *Mounted specimen of a Silver Dik-dik in Natural History Museum "Faraggiana-Ferrandi" in Novara, Italy (© G.G. Bellani).*

The range of *M. piacentinii* has been described as a narrow strip along the east coast of Somalia, but in the late 1990s its presence was confirmed in the southern part of the Ogaden (Somali Region of Ethiopia), and more recently in the northern Ogaden, indicating that the range is much more extensive than previously described.

Historical records

M. piacentinii was first named by Drake-Brockman (1910) based on two male skins obtained by his collectors near Gharabwein, located "about 12 miles [19 km] inland from Obbia where they were plentiful and the only dikdik seen, though at Eil Hur not more than 10 miles [16 km] distant, *M. phillipsi* abounded and this species, resembling *M. swaynei,* was absent". Obbia is now known as Hobyo, 5.3505 N, 88.5211 E. Gharabwein lies to the NNW.

Funaioli and Simonetta (1966) said the range of the silver dik-dik was limited to the central coastal strip of eastern Somalia "from about Adaleh to somewhat north of Obbia and extending hardly 30 miles [48 km] inland". Their map showed a narrow band along the coast. A similar range is mapped by Yalden (1978), Simonetta (1988), and East (1999).

In the *Mammals of Africa,* Simonetta (2013) mapped the same distribution along the coast, but said the range extended only 10 km inland, and also added several pieces of new information: (i) Specimens in the Florence Natural History Museum were obtained from local hunters at Balcad, north of Mogadishu, or from skin dealers in the city; (ii) on one occasion Simonetta had himself obtained specimens 16 km west of Mahadda Wein, c. 100 km north of Mogadishu; (iii) on other visits to the areas inland and north of Mogadishu between 1969 and 1982, he found no *M. piacentinii*, only *M. s. lawrencei*; (iv) he visited the Hobyo coastal zone in 1982,

describing it as ‘low coastal steppe’, but he saw no dik-diks of any species, although Speke’s gazelle *Gazella spekei* was quite common. Balcad and Mahadda Wayn are situated on the eastern bank of the Web Shebelle valley, about 35 km and 105 km north-north-east of Mogadishu, respectively. Mahadda Wayn is located at 02.9717N, 45.5280E at an elevation of 120 m asl. These two sites were not included on the map in Simonetta (2013) and Mahadda Wayn lies a long way from the range shown along the coast.

Recent records

During field surveys conducted by FW and HK in the southern Ogaden in the Somali Region of Ethiopia in the late 1990s, two species of dik-dik, *Madoqua [saltiana] hararensis* and *M. guentheri* were frequently recorded. A local hunter described a third, smaller species, that was later photographed and identified on subsequent field missions as *M. piacentinii* (Wilhelmi 1997, Wilhelmi *et al*. 2006; cover photo). Its distribution in this area was reported to extend from about 60 km south of Kebri Dehar southwards to the Shebelle river and possibly as far as the Somali border to the east, though the border area was subject to heavy poaching (Wilhelmi *et al*. 2006).

HK continued to monitor the situation in the region and facilitated a reconnaissance mission by HP in March 2016 to Aware, around 200 km north of the location reported by Wilhelmi *et al*. (2006). Silver Dik-dik was observed and photographed on this and on subsequent field visits in March 2017 and November 2018 (Siege & Pohlstrand 2017). The sightings were made 35-40 km east of Aware, around the village of Gurdumi (08.0174 N, 44.3413 E) and some way to the south (Fig. 3).

Figure 3. *Silver Dik-dik near Gurdumi northern Ogaden (© Ludwig Siege)*

The only recent record from Somalia is a live Silver Dikdik offered for sale in Wadajir market in the southern part of Mogadishu city in July 2021 (Fig. 4). This animal was reportedly obtained in Km50 village (1.5851N 45.0025), south of Mogadishu. This village lies on the road between Mogadishu and Mark district in the Lower Shebelle region. This locality is on the western side of the river Shebelle and its origin needs more investigation.

Figure 4. *Silver Dik-dik in Wadajir Market, Mogadishu, 2021 (© Osman Gedow Amir)*

Habitat and ecology

The specimens from Gharabwein were obtained in "…thick aloe scrub country in a locality some little distance from water; they were very local and appeared to be surrounded by *M. phillipsi*" (Drake-Brockman 1911). Specimens from west of Mahadda Wain were obtained in "low bush with wide open spaces, a habitat also commonly used by *M. s. lawrencei* and occasionally *M. guentheri*, both seen within a few miles" (Simonetta 2013).

The Hobyo coastal strip is biogeographically distinctive. It is recognised by WWF as a separate ecoregion, the Hobyo Grasslands and Shrublands. The ecoregion consists of dunes, sandy steppe, and low, dense thickets including *Aerva javanica, Indigofera sparteola, Jatropha pelargoniifolia, Tephrosia filiflora*, and *Solanum arundo*. Simonetta (2013) visited Hobyo in 1982, describing it as 'low coastal steppe' but he saw no dik-diks of any species, though Speke's Gazelle *Gazella spekei* was quite common.

In the Kebri Dehar area, Silver Dik-dik occurred in dense to semi-dense *Acacia-Commiphora* bushland with *Acacia bussei, A. mellifera, A. ziziphuspina, Commiphora hodei*, and *Boswellia neglecta.* Here it was sympatric with *M. saltiana* and *M. guentheri* and all three species could be observed simultaneously in an area of less than 2,000 m² (Wilhelmi *et al*. 2006). In the northern Ogaden (Aware-Gurdumi area) silver dik-dik inhabited the same type of *Acacia-Commiphora* bush, preferring denser patches of vegetation, especially where the branches of *Combretrum* bushes extended to the ground, forming low thickets. Here too they lived sympatrically with *M. guentheri* and *M. [saltiana] hararensis*. The local Somali names in the Ogaden for these species are: *guyu* (*M. piacentinii*), *sagaro* (*M. saltiana*) and *ghussli* (*M. guentheri*). Elevations range from sea level at Hobyo to around 1100 m at Gurdumi.

Population

East 1999 estimated a total population of 30,000, assuming a density of 2/km^2, similar to *M. saltiana*, and an area of occupancy 15,000 km^2, but he said this may be an overestimate due to hunting pressure and disturbance. Time-point-counts around Kebre Dehar indicated a density

of 1-2 /km² (Wilhelmi *et al*. 2006). Silver Dik-dik is much less numerous than Salt's and Guenther's Dik-diks in the Ogaden and appears to be much more locally or patchily distributed.

Threats

From 1951-1963, 350,000 dik-dik skins of all species were exported each year on average, harvested by local hunters using nets and other methods and "the one that suffered most is dik-dik argente [silver dik-dik]" (Funaioli and Simonetta 1961; Simonetta and Simonetta 1988). Simonetta (2013) said the abundance of skins on the market, with Silver Dik-dik being particularly appreciated for handicraft products, may indicate that it is subject to excessive hunting pressure. A survey of wildlife trade in Somalia reported that high volumes of animals were killed or caught and traded, including dik-diks with both meat and live animals exported to the Gulf region.

In 2010, dik-dik skins were confiscated by customs authorities at Dubai airport. Live animals were also exported to the UAE and one Silver Dik-dik was photographed at this time in the Sharjah animal market (Fig. 5). This trade was short-lived and was halted by the UAE authorities. A small number of Silver Dik-dik were obtained by Moscow Zoo around 2012-2013, but there are no details of their geographical origin (Bellani 2013).

Figure 5. *Silver Dik-dik in Sharjah animal souk, UAE, in 2010 (© Roland Wirth/ZGAP)*

Conservation

Silver Dik-dik does not occur in any formally protected area anywhere within its range. There are few domestic dogs in the Ogaden region of Ethiopia which is likely to be a positive factor for this, and all other *Madoqua* species.

Summary

It is clear that the range of *M. piacentinii* is much more extensive than hitherto reported, but several questions remain. Occurrence has been confirmed by specimens or photos in only five localities that are widely spaced geographically and recorded from different time periods.

In Somalia, two specimens were obtained near Gharabwein in the first decade of the 20th century. Specimens in Italian museums were obtained between 1966-1982 from Balcad and unspecified localities from skin dealers, plus from Mahadda Wayn. No later records have been reported. The species is reported to occur in the Hobyo coastal zone, but no specimens or photographs have been produced from this area and when Simonetta (2013) visited Hobyo in 1982 he did not see any species of dik-dik. Furthermore, ;large parts of the Hobyo ecoregion are covered with sand dunes and sandy steppe which lacks the dense cover required by Silver Dik-dik and would appear to be unsuitable habitat for the species. The current status of the species in Somalia is therefore uncertain.

In Ethiopia, *M. piacentinii* has been seen and photographed since the late 1990s at two localities 300 km apart in the Ogaden area. Based on surveys and local information, there are good reasons to assume that silver dik-dik occurs throughout the Somali Region, east of Tug Farfan (seasonal river valley) and the Web Shebelle, but this requires further confirmation. We suspect that this species has always been present in the Ogaden, and has been overlooked. Figure 6 shows the known and possible distribution of the species.

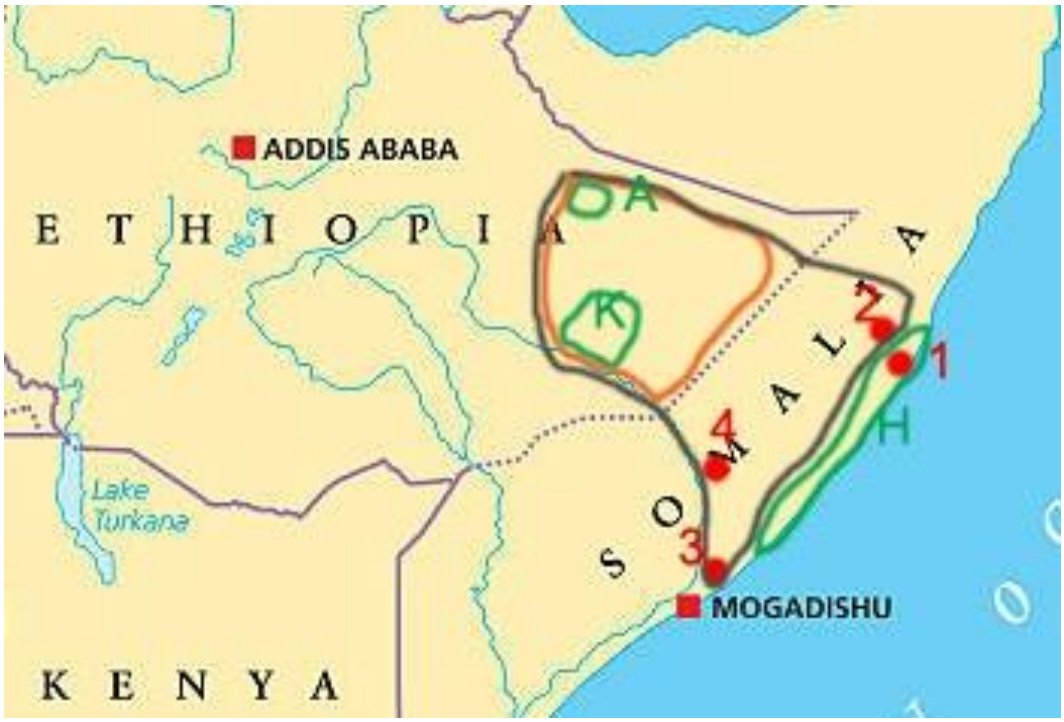


Figure 6. *Map of the known and possible range of M. piacentinii. 1 = Hobyo, 2 = Gharabwein, 3 = Balcad, 4 = Mahadda Wayn. Green polygons: H = Hobyo, A = Aware-Gurdumi, K = Kebri Dehar area.*
Orange polygon: Estimated range in eastern Ogaden. Grey polygon: Potential Aea of Habitat.

The very sparse information on distribution makes it difficult to estimate the size of the historic and current range. The mapped range in the Hobyo ecoregion covers 13,500 km^2. The Extent of Occurrence (a minimum convex polygon drawn around all known points, as used by the IUCN Red List) is about 132,000 km^2, but the small number of data points means that some areas of potential range are omitted. The Area of Habitat (total area of available habitat within the range) could in theory be as high as 185,000 km^2 but will likely be much smaller once the open plains and other unsuitable habitats have been subtracted.

The Area of Occupancy (the area actually occupied by the species) is even more difficult to calculate because of the lack of field data. Drawing two polygons around the known distribution in the Kebri Dehar (13,000 km^2) and Aware (3000 km^2) areas indicates a minimum range size of 16,000 km^2. A larger single polygon encompassing both these areas would cover ca. 40,000 km^2, while the whole of the eastern Ogaden range described above would cover about 67,000 km^2. No field observations on the species in Somalia has been reported since 1982 so no firm conclusions can be drawn on current status there. The recent export of animals to Moscow Zoo and reports of poaching of dik-diks for meat and skins suggest that exploitation is continuing, though at an unknown rate.

Silver Dik-dik prefers dense cover and all reports indicate that it is locally distributed and scarcer than other *Madoqua* species. In all sites it is sympatric with *M. guentheri* and one of the *M. saltiana / phillipsi / hararensis / lawrencei* complex.

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Note on Salt's Dik-dik from Somalia

Osman Gedow Amir
Director, National Museum of Somalia, Mogadishu.

Salt's Dik-dik *Madoqua saltiana* is endemic to the Horn of Africa. It is very variable in colour and five subspecies are recognized based on pelage features, notably the extent and intensity of rufous coloration (Yalden 1978; 2013). Phillips Dik-dik *M. s. phillipsi* is distributed along the coast of northern Somalia from Bossasso in the east to the border with Djibouti south to the Goolis escarpment and *M. s. lawrencei* in central and eastern Somalia (Yalden 2013). On 5 June 2022, a report and photograph circulated on Facebook showing a young dik-dik matching the description of *M. s. phillipsi* that was caught on the outskirts of Guriceel city (5.303435N, 45.880207E) in Central Somalia (Fig. 1). Later I observed several individuals between Eyl and the village of Qarxis, however I was only able to take a picture of one animal, when entering the coastal areas of Eyl in the lower Nugaal Valley, at 8.0411N, 49.4945E (Fig. 2). Guriceel and Qarxis lie 400-500 km from the nearest mapped localities for *M. s. phillipsi* and both localities lie in a region where *M. s. lawrencei* might be expected, according to Yalden (1978) (Fig. 3). This indicates the urgent need for more accurate data on distribution to establish the pattern of Salt's Dik-dik distribution and the status of the various forms of this species complex within Somalia.

Figure 1. *Salt's Dik-Dik* Madoqua saltiana phillipsi *near Guriceel, Central Somalia*

Figure 2. *Salt's Dik-dik* M. s. phillipsi *near Eyl, Somalia (© O.A. Amir)*

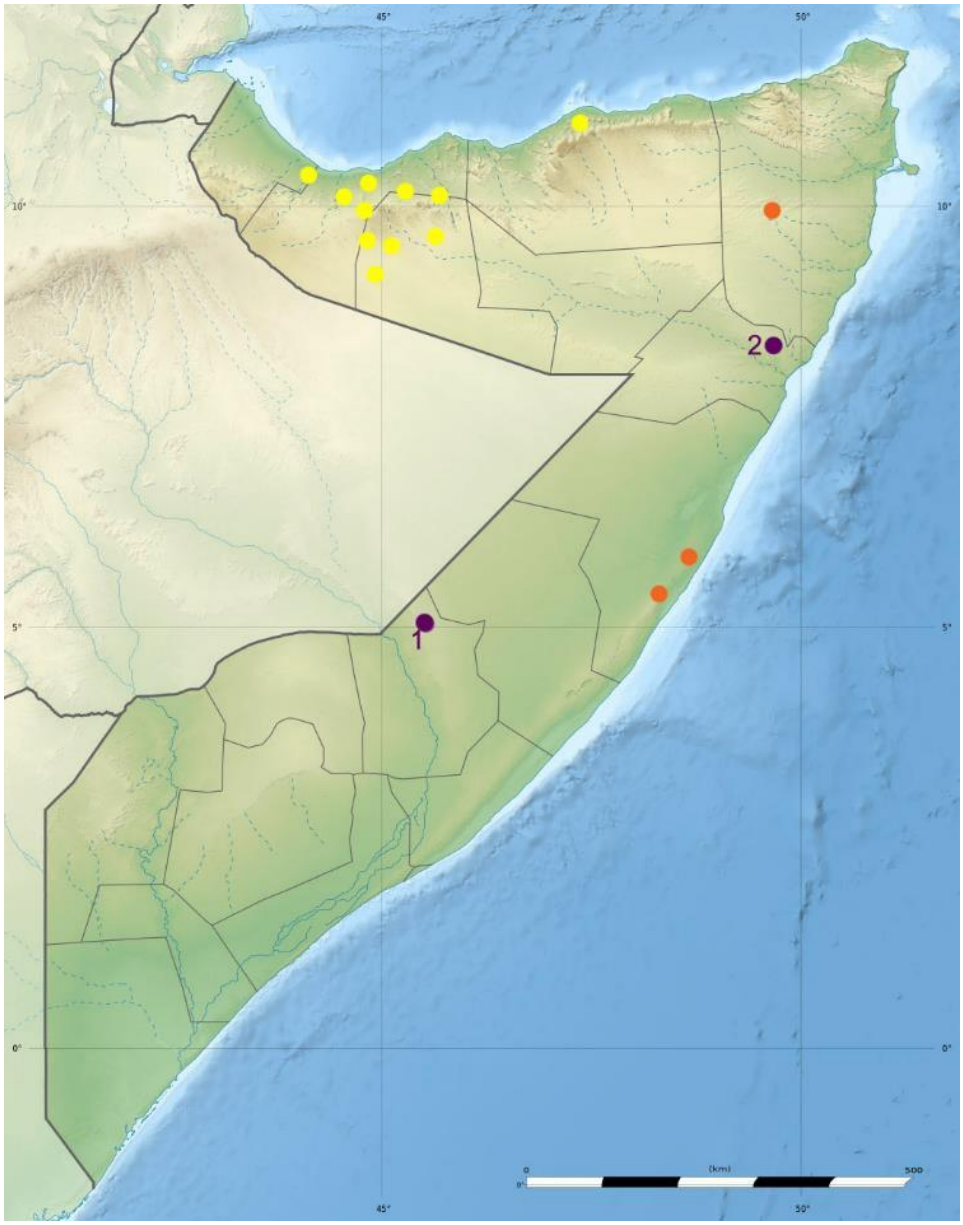

Figure 3. *Somalia. Yellow dots* - M. s. phillipsi *localities, orange dots* M. s. lawrencei *(Yalden 1978). Purple dots - recent records: 1 = Guriceel, 2 = Eyl.*

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Lesser Kudu documented in Djibouti

Houssein Rayaleh[1,2,3] and Faysal Daher Djama[1]
[1] Association Djibouti Nature, Immeuble Nasser Ali Othman Apt no 2, Heron/Marabou, Djibouti, Republic of Djibouti. naturedjibouti@gmail.com
[2] Horn of Africa Regional Environment Centre & Network (HoA-REC/N), Addis Ababa University, Addis Ababa, Ethiopia
[3] Ministry of Environment and Sustainable Development, Djibouti, Republic of Djibouti

We document for the first time the confirmed presence of Lesser Kudu *Tragelaphus imberbis* in Djibouti. A disoriented and tired adult male Lesser Kudu was hit and killed by an automobile on 18 May 2023 almost inside the town of Ali-Sabieh (Figure 1). Ali Sabieh (11°9'13.79"N, 42°42'44"E) is the capital of the Ali-Sabieh region in southern Djibouti (Figure 2).

Figure 1. *The first photographic evidence of Lesser Kudu in Djibouti, taken on 18 May 2023 at Ali Sabieh town, Ali Sabieh Region, Djibouti (© Association Djibouti Nature)*

The Lesser Kudu is native to semi-arid areas of north-east Africa, extending from the Awash Valley through south-eastern Ethiopia and most of Somalia, parts of Kenya, south-east South Sudan, extreme north-eastern Uganda to central Tanzania; the region coincides with the "Somali-Masai Arid Zone" (Leuthold 2013, Tilahun 2019). Djibouti lies within the ranges of

both Lesser Kudu and Greater Kudu *T. strepsiceros* but prior to this sighting these species were only known from a few verbal and anecdotal reports, and confirmed evidence of presence was lacking (East 1988, 1999) Laurent and Laurent (2002) cited some historical reports of "kudu" (species not defined) and mentioned a single observation lf Lesser Kudu made in 1999 by a visiting ornithologist. Lesser Kudu are classified as Near Threatened and considered possibly extinct in Djibouti on the IUCN Red List (IUCN SSC Antelope Specialist Group 2016).

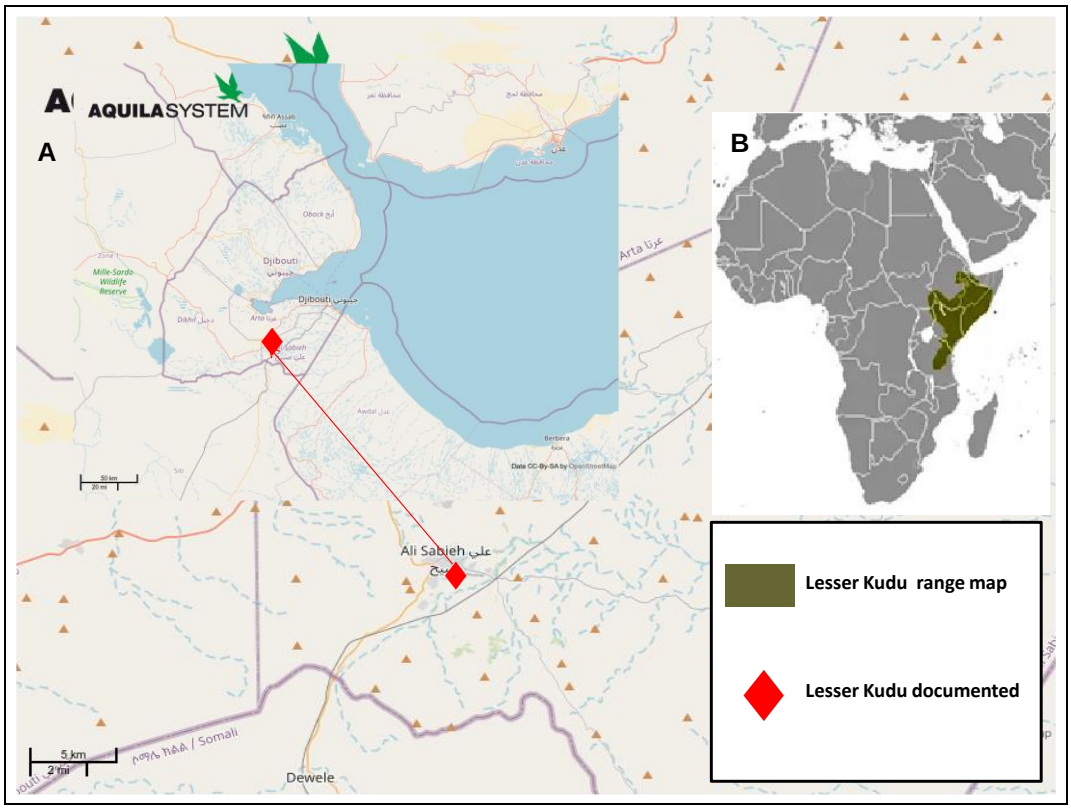

***Figure 2**. Location of the 2023 Djibouti record and Lesser Kudu global range*

This record from 18 May 2023, even if it is sad news because the observed individual was killed, presents the first hard evidence of the presence of Lesser Kudu in Djibouti, and reinforces the annals of the country's biological heritage, which we greatly value. It is not known how this individual arrived in the city of Ali-Sabieh and why it was disorientated and tired. The Ali-Sabieh region borders the neighbouring countries of Ethiopia and Somalia, and it is possible that the animal may have travelled a large distance in search of abundant forage, following the recent and unusual rains in this region. Alternatively, it could be from a population still inhabiting the rugged mountainous terrain within this region. Either way, this sighting is an important story that sheds light on Djibouti's biodiversity hotspots, showing that there are opportunities for new scientific research.

Having spent over 34 years conducting field work in Djibouti, I always suspected that this species could survive in the country because many remote areas of Djibouti are sparsely populated and largely inaccessible to humans due to rugged geological features. We therefore speculate that other individuals of Lesser Kudu, or other large mammals, are still living undetected in Djibouti.

The Republic of Djibouti, a former French colony, has had limited natural history research or international interest. Negative historical descriptions of the country's flora and fauna have

portrayed it as an inhospitable country, even for wildlife, and valuable only for mining. However, recent field work has shown the survival of unrecorded species is in Djibouti home to many hidden and as yet unrecorded marine and terrestrial species. For example, the Somali Sengi *Galegeeska revoilii* was thought to be endemic to Somalia and had not been seen since the 1970s. In 2019 the species was trapped and photographed at several localities in Djibouti, demonstrating both that the species is still extant and a significant range extension (Heritage *et al*. 2020).Then in In 2022 an adult Cheetah *Acinonyx jubatus*, was photographed on the Digri plateau, the first photographic evidence of the species in the country (Murgatroyd *et al*. 2023). The Digri plateau in fact lies only about 30 km from Ali Sabieh, where the Lesser Kudu was found.

These rediscoveries could be a first step in achieving conservation efforts for the species and underscore the need for further wildlife research in Djibouti. Publication of discoveries such as this may help to generate interest and additional funds for conservation (Ladle *et al*. 2011). Further studies are desperately needed in this pocket of Africa which has suddenly become a point of strategic military interest and subject to rapid development of power infrastructure and renewable energy. We recommend that field surveys be undertaken quickly in the area of this sighting, as well as in other potential natural habitats in the country, to determine whether there is a resident population of Lesser Kudu and indeed other antelope species. We are therefore appealing to the generosity of the philanthropic and international conservation communities to help us in this endeavour.

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The Somali National Museum

Osman Gedow Amir
Director, National Museum of Somalia, Mogadishu. Email: osmangedow@snm.gov.so

The Somali National Museum (SNM) is an independent, non-profit making, professional institution dedicated to the research, preservation, study, documentation, and safeguarding of Somali history and culture. The museum was first established in 1933 and a new Museum building was opened in 1987. However, during the civil war which started in 1991 the museum was ransacked, artifacts were looted, and the building remained idle for three decades. In 2020, Somalia ratified the Convention Concerning the Protection of the World Cultural and Natural Heritage (1972) and the Convention for Safeguarding of the Intangible Cultural Heritage (2003), and started to develop strategies for the conservation of its cultural and natural heritage. The Somali National Museum was renovated from 2019 to 2020 and reopened on 1 July 2020 by Mohamed Abdullahi Mohamed (Farmaajo).

Somali National Museum on opening day, 1 July 2020 (© UNESCO)

The museum has established four departments to assemble collections and prepare exhibitions to educate youth and the public at large. The Department of Natural History has set up a database on the flora of Somalia and is digitizing 10,000 images of plants. The museum is also conducting research on presence/absence of key species of mammals and birds in Somalia in cooperation with Colorado State University. This project will record information on 6 carnivores, 29 prey species including antelopes, elephant, ostrich, and vultures in Somalia in each one-degree square. Questionnaires will be administered in 20 villages. The data will be analysed and distribution maps published. This will allow us to analyse the status of threatened antelopes in Somalia and to develop a conservation strategy for them.

The Museum welcomes collaboration – please contact the author.

A New Community-Led Organisation for Conservation of Beisa Oryx & Small Antelopes in Northern Kenya

Paul Edonga Ekwam
Founder & Executive Director, Save Beisa Oryx & Community Resilience (SBOC)
Edonga2000@gmail.com, edonga2000@gmail.com

The IUCN SOS African Wildlife Initiative funded a Beisa Oryx conservation project in Nakuprat-Gotu Community Conservancy (NGCC) from 2019 to June 2021. A new organization, Save Beisa Oryx Community Trust (SBOC) was then established to continue conservation work on Beisa Oryx. SBOC was designed as a community-led, and inclusive recovery action plan framework for conservation of the endangered Beisa Oryx and threatened small antelopes. The SBOC approach emphasizes community ownership, and commitment and accountability through building alliances at grassroots level - the community-based networks. The SBOC delivery framework is formed of a network of 24 community-based Self-help Groups consisting of 326 members working in partnership with Nakuprat-Gotu Community Conservancy (NGCC).

SBOC's goal and purpose is to advance recovery action and conservation of Beisa Oryx through enhanced community policing, Community Stewardship, Resilient habitat Management, Building Resilience and thriving enterprises, Community Conservation, and stakeholder collaboration as tenants for successful delivery and empowering community livelihoods. SBOC looks at maintaining economic opportunities for conservancy communities, lasting peace, reduced wildlife trafficking across the conservancy and enhanced resilience in the ability of people and landscapes to withstand climate variability.

SBOC Vision; Thriving Beisa Oryx and other Antelopes, and Nature, Coexisting with local Prosperous Communities

SBOC Mission**;** To create a self-sustaining, community-led conservation initiative for the protection of endangered Beisa Oryx and dependent small antelopes through community led, inclusive recovery actions.

The delivery framework is formed of a network of 24 community-based Self-help Groups composed of 326 volunteers. SBOC envisions a new recovery action and conservation of Beisa Oryx that underlines optimization of population recovery of Beisa Oryx through enhanced community policing, Community Stewardship, Resilient habitat Management, Building Resilience and thriving enterprises, Community Conservation and stakeholders' collaboration as tenants for a successful recovery action delivery and empowering community livelihoods. SBOC also aims to maintain economic opportunities for conservancy communities anchored in biodiversity, reduce wildlife trafficking across the conservancy and enhance resilience in the ability of people and landscapes to withstand climate variability and shocks.

SBOC Conservation landscapes span Isiolo and Samburu Counties of Northern Kenya which are the historical habitats of Beisa Oryx, Kirk's Dik-Dik and Gerenuk, SBOC works in partnership with local communities in Community Conservancies that co-share the landscape alongside national reserves.

Figure 1. *Beisa Oryx in Nakuprat Gotu Conservancy (© SBOC)*

In 2020-2022 the long and short rains all under-performed, leading to the most severe and prolonged drought ever experienced in northern Kenya. Combined with the effects of the COVID 19 pandemic, the situation left the conservancy deprived of vital operational funding and led to new technical challenges. Encroachment of livestock into conservation areas in high densities degraded pastures, while poaching and charcoal burning spiked. Beisa Oryx in particular faced intensified threats and increased resource competition. More than 116 Oryx succumbed to starvation and water scarcity while more than 2500 other wildlife and 50,000 livestock also died.

A rapid response programme was developed to alleviate the dire situation, in collaboration with Northen Rangelands Trust, Kenya Wildlife Service, Wildlife Conservation Network, Grevy's Zebra Trust, and Ewaso Lions. Between September 2022 and March 2023, measures implemented included: intensive supplementary feeding and water management, enhanced Conservancy Ranger monitoring and anti-poaching patrols, and increased drought relief. The programme area focused on Nakuprat Gotu Community Conservancy, with some outreach monitoring activities in neighbouring Community Conservancies and the Isiolo and Samburu National Reserves.

Beisa Oryx Recovery Populations were identified at 10 sites for supplementary feeding and watering. The SBOC Beisa Rangers and Conservancy Rangers conduct weekly profiling of each site. Joint patrols and landscape mapping were conducted with GZT and Ewaso Lions at Funan, Chafa, Boji Dera, Kashuru, Magado plains, Argoti plains and Joys' camp. Key habitats and grazing areas were identified in Kashuru plains, Argoti plains and lower parts of Magado. Key water points were identified at Funan springs, Chafa Gavarsa swamps and Boji Dera springs. Tree planting exercises involved all community members. During the 6 months, 1000 hay bales (628 for Beisa Oryx) and 90,000 litres of water were provided, and 18 poachers were apprehended.

Figure 2. *Beisa Oryx in Nakuprat-Gotu Conservancy (© SBOC)*

Wildlife Conservation Network is thanked for their continued financial support to SBOC.

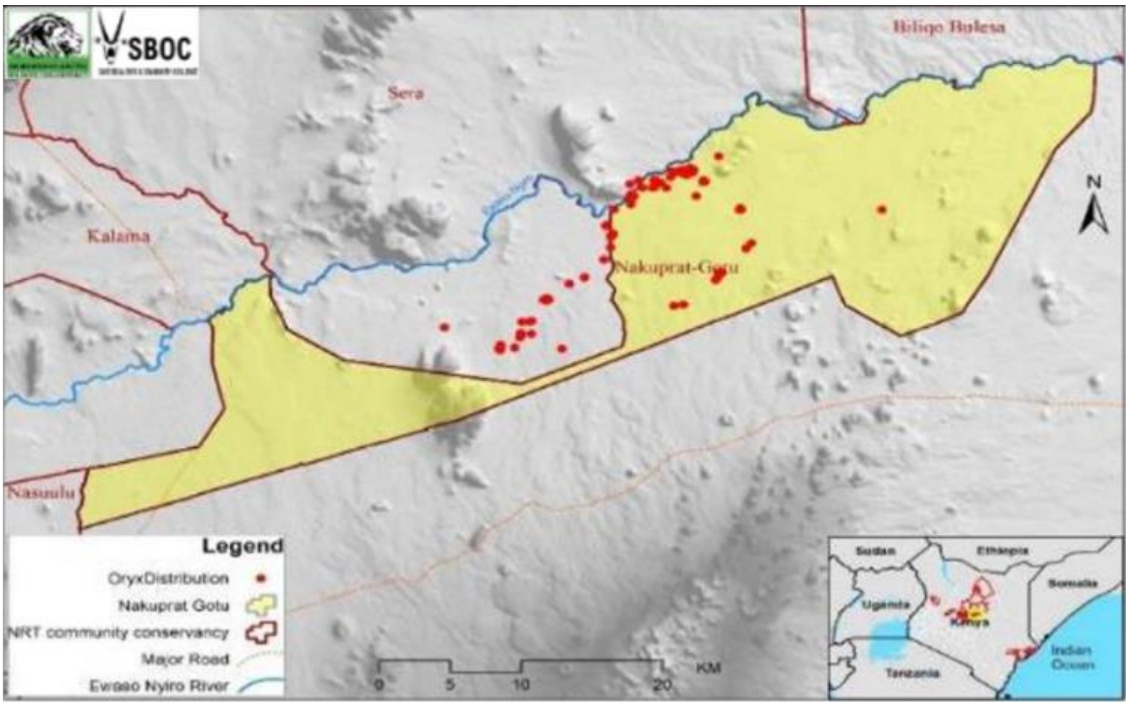

Figure 3. *Beisa Oryx distribution between October.2022 & March 2023 in Nakuprat Gotu Conservancy (© SBOC)*

Presumption confirmed in Koundjourou area, Chad: presence of Tiang & Greater Kudu

Thomas Rabeil[1*], Jaime Dias[2], Wachoum Abacar[3], Habib Hamit[4] & Julian Fennessy[5]
[1] Wildlife Africa Conservation, [2] Wings for Conservation, [3] Direction de la Faune et des Aires Protégées, République du Tchad, [4] Sahara Conservation & [5] Giraffe Conservation Foundation
** Corresponding author:* t.rabeil@wac-niger.org

A second wildlife aerial survey was conducted in Koundjourou area, Batha and Guera Provinces, central Chad at the end of the wet season (02-07/10/2023) after the first survey in this area during the dry season (see Rabeil *et al*., 2022 in *Gnusletter* (40)1). Funded by 'Giraffe Conservation Foundation' and 'Wings for Conservation', the survey was undertaken by 'Wings for Conservation' in support to the *Direction de la Faune et des Aires Protégées du Tchad* (Chad Department of Wildlife and Protected Areas).

As a reminder, the first survey (March 2022) in this unprotected communal landscape revealed the presence of a formerly poorly known - even unnoticed - assemblage of wildlife species, notably: Kordofan giraffe (*Giraffa camelopardalis antiquorum*) (34 individuals identified), red-fronted gazelle (*Eudorcas rufifrons*), common duiker (*Sylvicapra grimmia*), common warthog (*Phacochoerus africanus*), striped hyena (*Hyaena hyaena*), spotted hyena (*Crocuta crocuta*), common jackal (*Canis aureus*), North African ostrich (*Struthio camelus camelus*), Arabian bustard (*Ardeotis arabs*) and lappet-faced vulture (*Torgos tracheliotus*) (nine active nests with chicks). The area was also presumed to seasonally host tiang (*Damaliscus lunatus tiang*) ranging south from the Zakouma Great Ecosystem and, according to local communities, central African greater kudu (*Tragelaphus strepsiceros burlacei)*.

The second survey (October 2023) covered a transect of 4400 km in 30 hours. The results of this survey confirmed the importance of this area for the red-fronted gazelle with 32 individuals sighted, and the permanent presence of an isolated population of the northernmost Critically Endangered Kordofan giraffe with 51 individuals observed. Interestingly, the presumptions raised by local communities during the first survey were confirmed: tiang and greater kudu occurs there during the wet season. One tiang, north-east of Abu Telfan Reserve and two greater kudu in thick bushes were spotted. The seasonal presence of tiang in this area had been documented previously by African Parks through analysis of GPS satellite collaring data from individuals initially tagged in Zakouma National Park. However, the last record was in 2015. Regarding the Central African greater kudu, this is the most recent north-western-most observation, not far from the Batha River which had been mentioned in the 1950's by Malbrant (1952) then in the 1960's by Gillet (1964), both highlighting the seasonal presence of this species along the riverine forest of Batha River. The aerial survey also recorded a very high number of livestock with thousands of cattle, small ruminants and dromedaries in this area, a well-known wet season transhumance corridor.

These results confirm the importance of this area for the conservation of a diverse antelope assemblage including red-fronted gazelle, tiang, and central African greater kudu and common duiker at least, as well as of the Critically Endangered Kordofan giraffe. More than ever, there is a critical need to rapidly develop a Protected Area under the category '*Réserve de faune*' (Faunal Reserve or Wildlife Reserve) in Kondjourou landscape, central Chad, before it becomes too late.

Greater kudu in Koundjourou area, October 2023 (© Jaime Dias/Wings for Conservation)

Tiang in Koundjourou area, October 2023 (© Jaime Dias/Wings for Conservation)

Acknowledgments

We would like to thank the Chad authorities ("*Direction de la Faune et des Aires Protégées*") for supporting and facilitating this mission by involving two agents, Mr. Wachoum Saley Abacar and Mr. Djousou Kaimalamda, as well as the decentralized service of the DFAP in Guera and Abdramane Chaibo, Director of Wildlife Authorities. Our sincere thanks also to the international NGOs Giraffe Conservation Foundation and Wings for Conservation for having made possible to carry out this inventory thanks to their funding and technical support.

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Status of antelopes and African buffalo in Mpem and Djim National Park, Cameroon

Ngouh Amadou[1], Doumbé Osiris[1], Kamgang Serge[2], Bissek Jean-Pierre[3], Brugière David[1]

[1] *Technical Assistance team, BRLi Consulting Company, Ntui, Cameroon*

[2] *Ecole de faune de Garoua, PO Box 271, Garoua, Cameroon*

[3] *Ministère des Forêts et de la Faune (MINFOF), Ntui, Yaoundé, Cameroon*

Figure 1: *A group of West African kobs in Mpem and Djim National Park (© J-P. Mbamba)*

Abstract

Mpem and Djim National Park is located in the savannah-woodland of Cameroon, a zone characterised by a rich biodiversity due to a great variety of habitats from dense forest to open savannah. Since its creation in 2004, very few studies have been conducted in this protected area. As part of the elaboration of the Management Plan of the park, a medium-large terrestrial mammal survey took place in 2020-2021 using camera-traps and line transect surveys. A total of 12 bovid species were recorded including five duikers, three *Tragelaphus* spp., two *Kobus* spp. along with the African buffalo (*Syncerus caffer*) and the water chevrotain (*Hyemoschus aquaticus*). The most abundant taxonomic group is the medium-sized duikers (16.97 individuals/km²), followed by the blue duiker (10.11 individuals/km²) and the yellow-backed duiker (3.36 individuals/km²). Poaching is likely to have had a negative impact on the bovid community in Mpem and Djim NP, especially on the Vulnerable West African kob (*Kobus kob kob*) and Near-Threatened Defassa waterbuck (*Kobus ellipsiprymnus defassa*). An improved management of the protected area thanks to the financial and technical support from partners would make Mpem and Djim National Park a safe haven for the bovids of the savannah-woodland of Cameroon.

Résumé
Le Parc National du Mpem et Djim est localisé dans la mosaïque forêt-savane du Cameroun, une zone caractérisée par sa riche biodiversité qui est due à une grande variété d'habitats, allant de la forêt dense à la savane ouverte. Depuis sa création en 2004, très peu d'études ont été conduites dans cette aire protégée. Dans le cadre de l'élaboration du plan d'aménagement du parc, un inventaire des grands et moyens mammifères a été réalisé en 2020-2021. Les résultats montrent que 12 espèces de bovidés ont été observées, incluant cinq céphalophes, trois *Tragelaphus* spp., deux *Kobus* spp. ainsi que le buffle d'Afrique (*Syncerus caffer*) et le chevrotain aquatique (*Hyemoschus aquaticus*). Le groupe taxonomique le plus important est celui des céphalophes de taille moyenne (16,97 individus/km²), suivi du céphalophe bleu (10,11 individus/km²) et du céphalophe à dos jaune (3,36 individus/km²). Le braconnage a probablement eu un impact négatif sur la communauté de bovidés du PN du Mpem et Djim, notamment sur le cobe d'Afrique de l'Ouest (*Kobus kob kob*), Vulnérable et le cobe defassa (*Kobus ellipsiprymnus defassa*), Quasi-Menacé. Une meilleure gestion de l'aire protégée grâce au soutien financier et technique de partenaires pourrait faire du Parc National du Mpem et Djim un véritable sanctuaire pour les bovidés de la mosaïque forêt-savane du Cameroun.

Introduction
Mpem and Djim National Park (MpDNP) is a protected area covering 97,480ha, located in the Centre Region of Cameroon (08°21'-09°00' N and 14°25'-14°55' E (Figure 2). It was created in 2004 as part of the Cameroonian Government's will to increase the protected area network in the savannah-woodland mosaic (ecotone). Until 2020, very few studies had been conducted in MpDNP. Thanks to non-systematic surveys of Simo *et al.* (2019, 2021), a non-extensive list of terrestrial mammals was compiled. Threatened species such as the Endangered (EN) giant ground pangolin (*Smutsia gigantea*), the Vulnerable (VU) African golden cat (*Caracal aurata*), as well as several species of antelopes were recorded in the park.

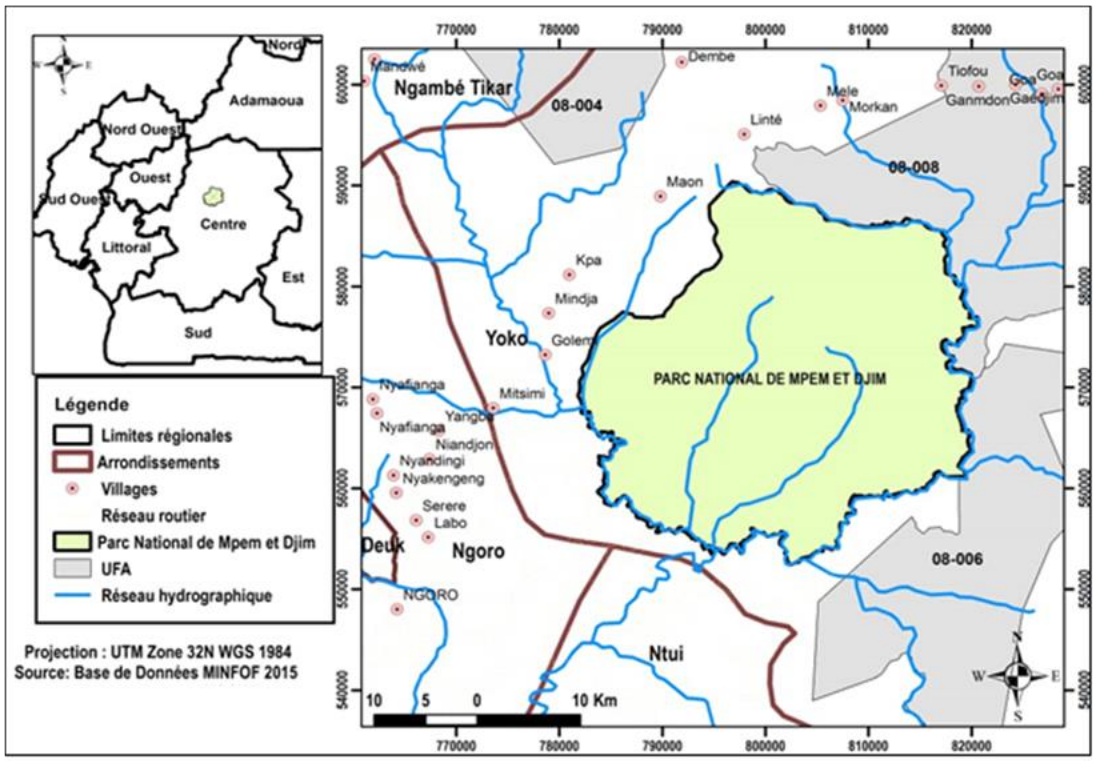

Figure 2. *Location of Mpem and Djim National Park,* Cameroon.

Since its creation, MpDNP suffered greatly from a lack of infrastructure and financial support, until the implementation of the Memorandum of Understanding (MoU) signed between the Ministry of Forests and Wildlife of Cameroon (MINFOF) and Nachtigal HydroPower Company (NHPC) in 2018. This MoU recognises MpDNP as an offset of NHPC's dam construction on the Sanaga River and puts in place a Technical Assistance (TA) framework financed by NHPC to assist MINFOF in the elaboration and the implementation of a Management Plan (MP). Prior to the creation of MpDNP's MP (validated by the Government of Cameroon in 2022), socio-economic and ecological studies were conducted to identify the resources of the park and its surroundings. As part of these studies, a medium-large terrestrial mammal survey was conducted. This paper presents the results of this mammal survey, focusing on bovids.

Study site

Located in the savannah-woodlands of Cameroon, MpDNP is characterized by four seasons: a long dry season (November-March), a short rainy season (March-June), a short dry season (July-August) and a long rainy season (August-November). The rainfall is about 1,500mm/year and the park's dense hydrography, composed of small tributaries of the Djim River and the Mpem River, is part of the Sanaga Basin, the largest river network of Cameroon. Eight types of habitat have been identified in the park: primary forest, secondary forest, gallery forest, *Raphia* sp. swamps, forested savannah, open savannah, and inselberg. About 20,000 inhabitants live in the direct periphery of MpDNP (Nzie 2021) composed of native Vouté and Baveuck as well as newcomers (Eton, Manguissa, Kumbo, Bamoun, etc.) who have arrived in the region since the end of the 1990s, attracted by the high potential for cocoa plantations (Nzie 2021).

Methods

A total of 51 camera-traps were placed in the park in three types of habitats (Figure 3). They were active from September to December 2020 over 84 days of operation yielding a total of 4,284 camera-days. A total of 85 x 2-km-long transects totaling 170 km were mapped over the whole protected area (Figure 3) and surveyed in January and February 2021. The presence of mammals was confirmed from both direct (visual) or indirect observations (feces, footprints). Footprint identification can be challenging for similar-sized species, notably the medium-sized duikers. Therefore, all *Cephalophus* spp. (except for the yellow-backed duiker *Cephalophus silvicultor*) were recorded under a single group named "medium-sized duikers".

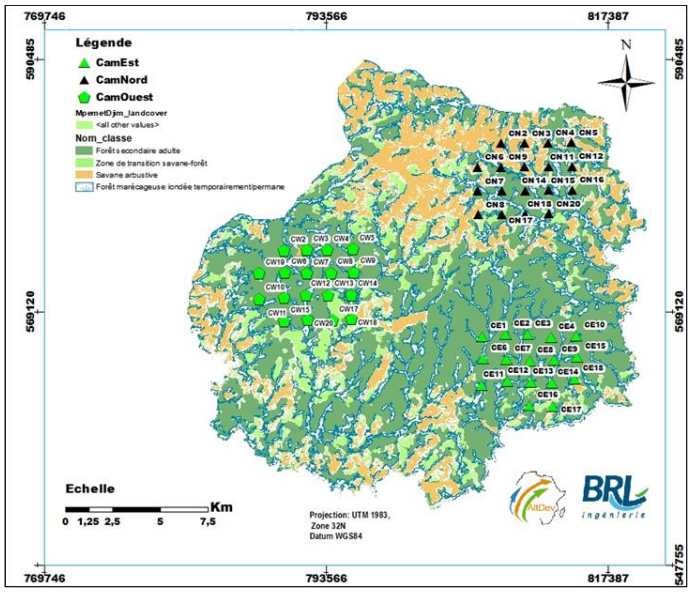

Figure 3. *Location of 51 camera traps in the Mpem and Djim National Park.*

Population densities were calculated for taxa for which at least 60 pellet groups were observed on transects, using DISTANCE software (Thomas et al. 2014) and a 95% confidence interval. The model used while running DISTANCE was the default mode: Half-normal, Cosine adjustments. For each species, a Kilometric Index of Abundance (KIA) was calculated (total number of observations divided by the total distance walked).

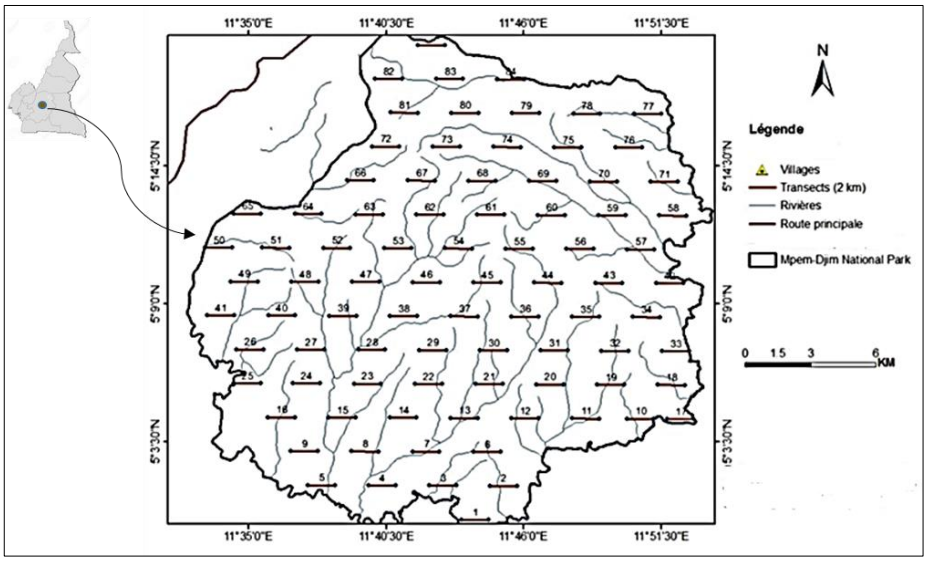

Figure 4*. Location of the transects walked during the survey in Mpem and Djim.*

Results

Seven antelope species and the water chevrotain were recorded on camera-traps including five duiker (Table 1). The blue duiker *Philantomba monticola* and Peter's duiker *Cephalophus callipygus* were the most frequently recorded species.

Table 1. List of species recorded on camera-traps

Common name	Scientific Name	Number of camera traps where the species was recorded (n=51)
Waterbuck	*Kobus ellipsiprymnus*	3
Sitatunga	*Tragelaphus spekii*	7
Yellow-backed Duiker	*Cephalophus silvicultor*	14
Peter's Duiker	*Cephalophus callipygus*	28
Red-flanked Duiker	*Cephalophus rufilatus*	1
Bay Duiker	*Cephalophus dorsalis*	24
Blue Duiker	*Philantomba monticola*	37
Water Chevrotain	*Hyemoschus aquaticus*	1

A total of 170 km of transect and 157.95 km of recce were surveyed. Table 2 presents observations made during data collection: in addition to African buffalo and water chevrotain, ten species of antelope were identified during the transect survey: *Cephalophus* (n=4), *Tragelaphus* (n=3), *Kob* (n=2), and *Philantomba* (n=1). In addition to these 12 species, the

presence of other ungulates was confirmed in the park, including Critically Endangered (CR) African forest elephant and VU common hippopotamus (*Hippopotamus amphibius*).

The medium-sized duikers were the most common bovids with a total of 1028 observations including 690 on transects, and three direct encounters. Whereas signs of Peter's duikers and Bay duikers were mainly found in closed-canopy habitats, red-flanked duikers were restricted to the savannahs (both forested and open). A large number of pellet groups were observed on transects (n=614) at a maximum distance of 4.30m. The density of medium-sized duiker pellet groups is estimated at 1567.8/km² (CV=13.38%, DOF=111.54, SE=209.7). Using the daily production rate (4.4 dung/day) and decomposition rate (21 days) of duikers in the Democratic Republic of Congo (Koster and Hart 1988), the density of individuals is estimated at 16.97[13.03-22.09]/km².

A total of 411 observations of blue duiker were made, with 218 pellet groups found on transects at a maximum distance of 4.68m. The density of blue duiker pellets is estimated at 555.03/km² (CV=13.75%, df=105.12, SE=76.321). With a production rate of 4.9 dung/day and a decomposition rate of 11.06 days (Viquerat *et al*. 2012), the blue duiker density is estimated at 10.11[7.71-13.26] individuals/km². The presence of yellow-backed duiker was confirmed by 260 signs in total, including 142 pellet groups on transects at a maximum distance of 3.98m. The estimated density of pellets is 310.08/km² (CV=12.95, df=171.68, SE=40.168). Using the decomposition and daily production rates of dung from Koster and Hart (1988), yellow-backed duiker density is estimated at 3.36[2.6-4.33] individuals per km². The density of non-duiker bovids was not calculated due to the small number of pellet observations on transects (n<60).

Table 2. Numbers of observations of each species on transects and recce, and the KIA

Species	IUCN Red List status	Transect direct visual obs.	Transect indirect: dung	Transect indirect: footprint	Recce total observations	KIA (transect + recce)
Syncerus caffer	NT	0	27	25	28	0.244
Tragelaphus euryceros	NT	0	7	0	1	0.024
T. spekii	LC	1	24	26	21	
T. scriptus	LC	0	21	1	16	0.116
Kobus e. defassa	NT	0	3	1	6	0.030
K. k. kob	VU	0	0	2	5	0.021
Cephalophus silvicultor	NT	0	142	36	82	0.793
C. callipygus	LC	3	614	73	338	3.135
C. dorsalis	NT					
C. rufilatus	LC					
Philantomba monticola	LC	2	218	23	168	1.253
Hyemoschus aquaticus	LC	0	12	27	3	0.128

The composition of the bovid community of the park includes species with very different habitat preferences. Peter's duiker, Bay duiker, blue duiker are mostly forest specialists, whereas red-flanked duiker, West African kob, and to a lesser extent the bushbuck, prefer savannah habitats (Frost 2015). Some other species are more generalist and can be found in the forests as well as savannahs of the park: yellow-backed duiker and African buffalo. Three species are riverine specialists: the water chevrotain, sitatunga and Defassa waterbuck (Frost 2015).

The taxonomy of the African buffalo is not well accepted, with some authors recognizing one, two, or even four subspecies (IUCN SSC Antelope Specialist Group 2019). The forest form (smaller with a red-orange coat) and the savannah form (larger with a brown-black coat) of buffalo in Cameroon are potentially a single subspecies (Smitz et al. 2013) with different phenotypes. The rare footage of buffalo captured by camera-traps (set prior to the current survey) have shown bulky, brownish individuals resembling the savannah form. Moreover, signs or *S. caffer* were more often found in open than in forested habitats.

Figure 5. *Sitatunga in Mpem and Djim National Park (© J-P. Mbamba)*

The most abundant species are the medium-size duikers (16.97 individuals/km²). All three species (Red-flanked, Bay and Peter's duikers) occupy the same ecological niche and are distributed in most of the protected area. Fresh and smoked carcasses of medium-size duikers are regularly confiscated by the eco-guards of MpDNP making them one of the most targeted taxa by poachers (MINFOF 2021). All three species are partially protected by the national law. The number of droppings collected on transects for the other bovids was too low to estimate their densities. The population size of some antelopes is likely to be quite small because of the very low number of signs observed during the data collection, especially the West African kob (n=7, one direct observation on recce) and the Defassa waterbuck (n=10). The low encounters of *Kobus* spp. is likely to be due to past overhunting. There are no baseline data on the population size of these species at the creation of the protected area, but it is said that groups of West African kob and Defassa waterbucks were easy to spot in the 1990s (Vivien, pers. obs) and even 10 years ago. The number of bongo signs (n=8, no direct observation) is so low that a specific survey on the species is needed to confirm the presence of a viable population. As part of a landscape including several forest timber units, MpDNP plays a key role in the preservation of the bovids of the savannah-woodland of Cameroon and their habitats. MpDNP currently faces two main threats: poaching for wild meat trade and seasonal encroachment into

the northern parts of the park by pastoralists in search of grazing land. To improve the protection of antelopes and African buffalo and to observe a positive population trend in the near future, it is urgent for the managers of MpDNP and their partners to maintain and reinforce eco-guard patrols.

Acknowledgement
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Facial and body markings of Arabian Oryx as potential indicators of genetic diversity

Mark Keegan
College of Forestry, Department of Forest Ecosystems and Society, Oregon State University, Corvallis, OR, USA 97331. Email: keeganm@oregonstate.edu

Introduction

The Arabian Oryx (*Oryx leucoryx*) recovery effort is well-known, and now the search is on for more sites for releases. Another goal is to maintain or increase genetic diversity of each herd. Diversity happens naturally with wide-ranging, unfragmented species, as males (especially) disperse far from home. But in the age of fences and highways, gene flow must be helped by human effort (Reed and Frankham 2003; Leus 2011). Translocation can benefit populations (Ochoa et al. 20pose serious acute and chronic stresses to animals (Dickens *et al.* 2010). It is currently prohibitive to analyse each individual's genotype in a wild or even semi-managed herd. Considering the cost, and the stress on wild animals of obtaining their DNA, ways to assess diversity from the phenotype are needed (Croose *et al.* 2019). Therefore, I propose an inexpensive and hazard-free way of identifying some degree of genetic diversity in the Arabian oryx by rating six facial and body marking characters.

Materials and Methods

The facial and body markings protocol. A *Gnusletter* report on a Body Condition Score method for Arabian oryx (El Alqamy 2013) got me thinking what else could be done with close-up views of Arabian oryx. Stanley Price (1989) remarked on a "flank stripe" difference among the "uniformly white" oryx, and I saw this on pictures from the internet. But looking closer, other differences emerged, which I felt could have genetic causes. We know hormones can modify pigmentation to a degree (Slominski *et al.* 2005) but the presence (or absence) of one or more genes could also causing (or not) hair follicles to produce pigment.

Several possible oryx pelage features were examined and discarded for being the same on nearly every oryx: intrahorn patch, muzzle patch, supraorbital patch, foreleg color peak, pasterns (just above the hoof -- always white). But six Arabian oryx markings showed marked variation, so I developed a draft protocol for scoring each of these markings on a scale of 0 to 4 (Table 1).

***Sampling sites*.** The dataset consisted of 239 Arabian oryx photographed in four sites in three countries on the Arabian Peninsula in January and February 2023. The main site was the Dubai Desert Conservation Reserve in the United Arab Emirates, where 159 oryx were photographed. Nineteen oryx were photographed at the nearby Al Marmoom Conservation Reserve, 25 out of 26 oryx at the tiny Al Samriya Oryx Reserve in Qatar (the 26th was hidden by vegetation), and 36 of the, 36 of its estimated 120 oryx at Shaumari Wildlife Reserve in northeastern Jordan.

***Data collection*.** Nearly all photographs were taken while standing on the desert floor, not sitting in a vehicle. The main goal was to not alarm the oryx, and so the approach was always slow, quiet, and not too close; the result was always "Comfort Zone", with oryx unstressed and not fleeing. Photographs were taqken with a handheld Nikon D7500 DSLR camera with a Nikkor 200-500 mm lens.

Table 1. Scoring scheme for Arabian Oryx facial and body marking features.

metric	0	1	2	3	4
JAPA Jaw Patch extent and shape	absent	indistinct, not U-shape	U-arm(s) not to eye level	U-shape to eye level only	U-shape to eye and above
CHST Chest Stripe extent and distinctiveness	absent	very faint	incomplete or scanty	semi-complete, semi-distinct	complete jaw to torso, distinct
LATS Lateral Stripe extent and distinctiveness	absent	very faint	incomplete or scanty	semi-complete, semi-distinct	complete elbow to hind, distinct
FOCO Foreleg Color most of lower leg	white	light brown	medium brown	dark brown	black
HICO Hindleg Color most of lower leg	white	light brown	medium brown	dark brown	black
HIPK Hindleg Color Peak	absent	below hock	at hock	below mid-thigh	even or above mid-thigh

Results

Figure 1a-f show subtle or not-so-subtle differences in the six Arabian oryx markings, with their ratings (on a scale of 0 to 4) shown above each example. Figure 2 shows the distribution of scores for each of the six Arabian oryx markings, for the entire dataset of 239 oryx.

Discussion

Though present-day Arabian oryx are descendants of small founder populations, the markings suggest a moderate degree of diversity in their underlying genomes. We can feel confident the markings are genetically related, for they stabilize in the oryx's second year and remain fairly stable through the seasons. Also, if the markings were mainly the result of pigmentation-stimulating hormone action, the different markings would likely be strongly correlated, i.e. darker and more prominent together, or not. However, analysis of the correlation between markings suggested that they occur to a greater or lesser degree independently of the others.

Determining to what extent these phenotypic differences reflect overall levels of genetic diversity, or even different lineages, or whether the apparent genetic differences have important implications for fitness, would require detailed genetic analysis. It is possible that some markings are related to age (such as colour) or breeding status of the animal. For example, it was noted that the boldest oryx in a group often had a bold chest stripe. However, there remains the intriguing possibility that in the shorter term, these facial and body markings may provide a rough guide to genetic differences that could be used by managers to select animals for breeding or for transfer between groups or sites in order to increase diversity within individual herds, without the time, expense and stress of genetic sampling.

Al Rawahi et al. (2022) lament that still "no breeding strategies accounting for genetic diversity have been implemented". Maybe paying close attention to the facial and body markings of oryx can be part of such a strategy.

Acknowledgements
For their interest and encouragement, I would like to thank: Basil Roy, Gerhard Erasmus, and Aline Witte de la Torre of the Dubai Desert Conservation Reserve; Hassan Shishani of the Shaumari Wildlife Reserve; Oregon State University professors Joan Hagar, Luke Painter, Nicole Duplaix, Susie Dunham, and Clint Epps; and, at the start of it all, Husam El Alqamy now of the King Salman Bin Abdelaziz Royal Reserve in Saudi Arabia.

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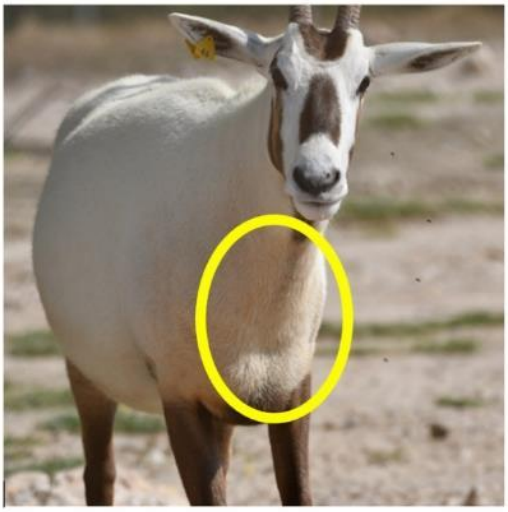
Jaw Patch

JAPA 1
indistinct,
not U-shaped

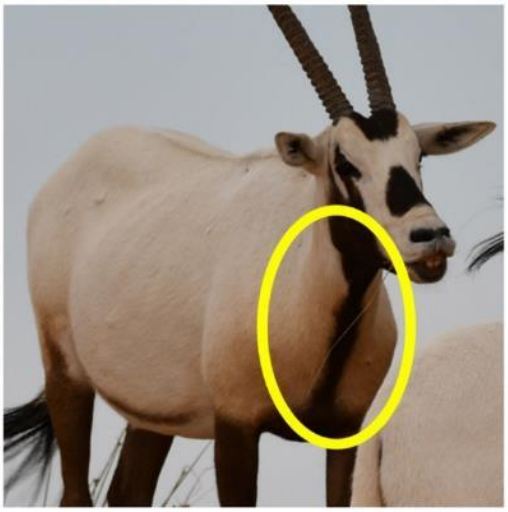
JAPA 4
'U' shape to
eye and above

Chest Stripe

CHST 0
absent



CHST 4
complete, distinct



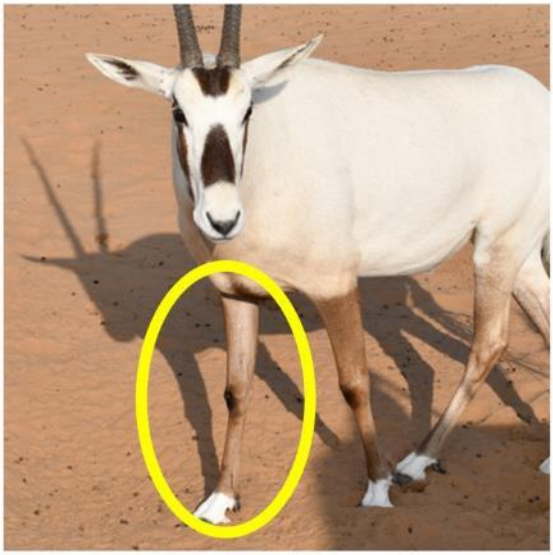
Lateral Stripe

LATS 0
absent

LATS 4
complete, distinct

Foreleg Color

FOCO 1
light brown



FOCO 4
black

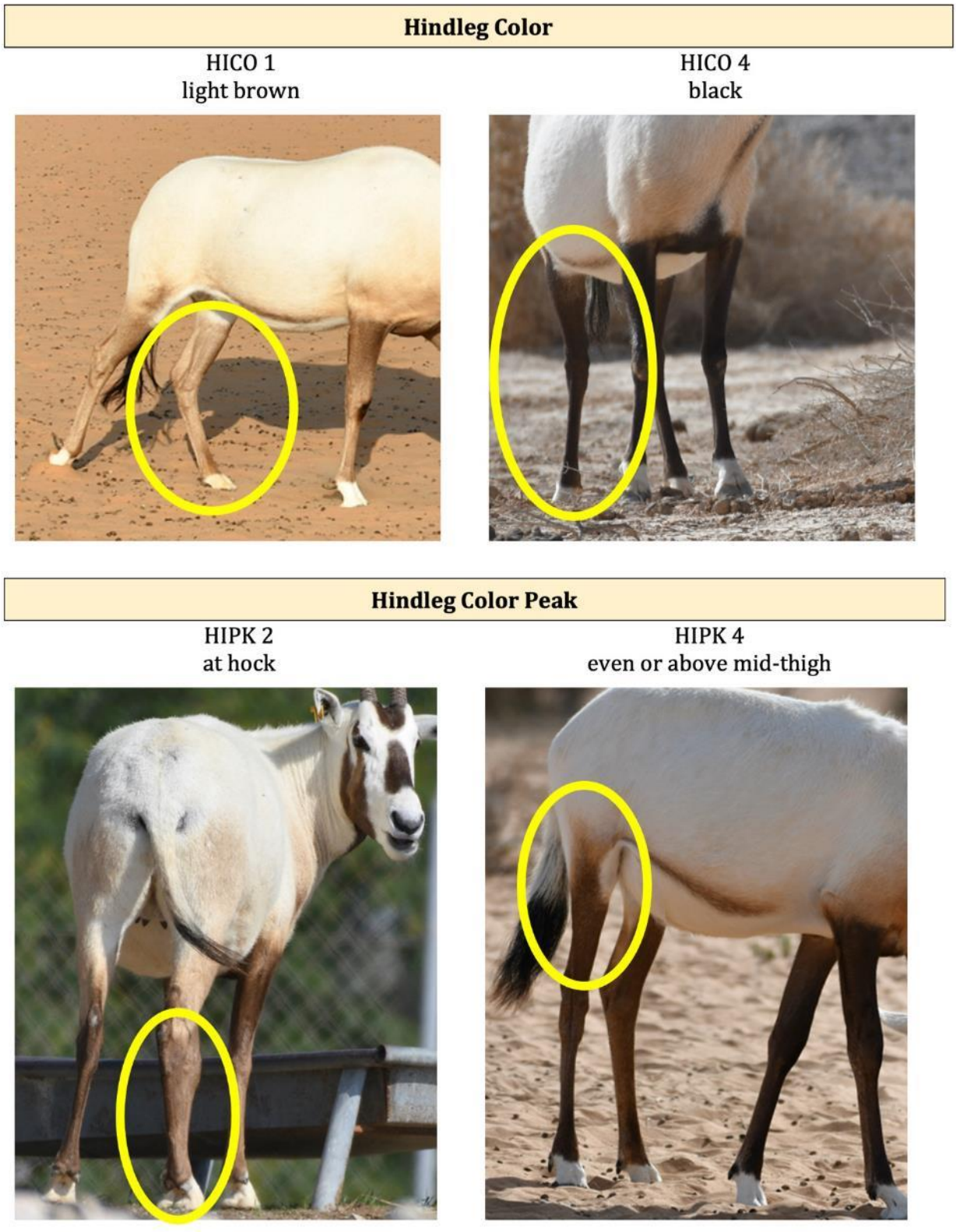


Figure 1a-f. *Examples of low and high scores on metrics (© the author)*

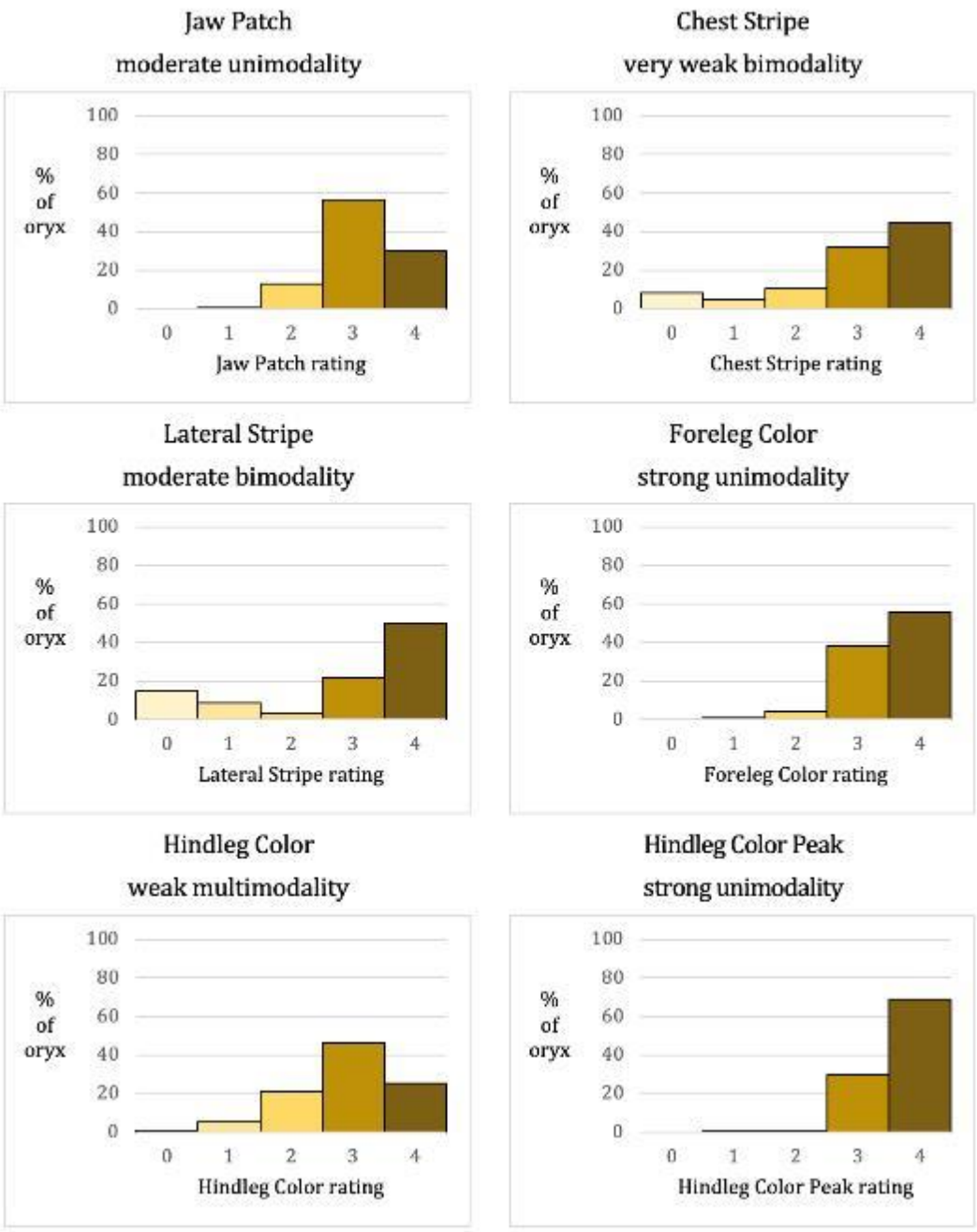


Figure 2. *Distribution of the ratings for each Arabian Oryx pelage feature (n = 239).*

Partially melanistic Four-horned Antelope in Mudumalai Tiger Reserve, India

Arockianathan Samson[1*], Palanisamy Santhoshkumar[2], Magendran Palanisamy[2], Jesudass Beulahbah[3] & Jabamalainathan Leona Princy[3]
[1]Bombay Natural History Society-Vulture Conservation Breeding Centre, Bhopal, Madhya Pradesh, India.
[2]Biologist, Mudumalai Tiger Reserve, Nilgiris, Tamil Nadu, India.
[3]Department of Zoology and Wildlife Biology, Government Arts College, Udhagamandala 643 002, The Nilgiris, Tamil Nadu, India.
**Email: kingvulture1786@gmail.com*

The Four-horned Antelope or Chowsingha (*Tetracerus quadricornis*) is endemic to the Indian subcontinent, being found only in India and a few pockets of Nepal. It is widely distributed in India but found nowhere in high abundance. It has always been known as a shy and elusive creature (Prater 1971; Gurang and Singh 1996; Menon, 2014) and inhabits dry deciduous forests, well-wooded, open grasslands, and well-watered undulating or hilly terrain (Prater 1971; Krishna et al. 2009; Sharma & Rahmani 2005). Historically, the Four-horned Antelope was distributed from the Terai region of Nepal in the north, to the Nilgiri Hills in the south and Bengal region in the east of India to Sind province in the west (Blanford 1888; Jerdon 1867; Murray 1884) but are extirpated from Pakistan (Roberts 1997). Four-horned Antelope is a small species, weighing about 20-22 kg (Prater 1971; Menon 2014). Its coat is coarse and uniformly light or slightly reddish-brown brown in colour, with a paler neck and whitish underparts. (Prater 1971; Menon, 2014). The coat may darken to some extent during the monsoon (August-January). This note reports an observation of an unusually dark-coloured, partially melanistic, Four-horned Antelope.

On 12 October 2022 at 11:30 AM, while carrying out fieldwork on the Sigur Plateau in Mudumalai Tiger Reserve, Tamil Nadu, India, we observed and photographed a solitary Four-horned Antelope with an abnormal colour pattern. The body and legs were dark brown with a contrasting golden-brown neck and head, while the underparts were light brown in colour instead of the usual white (Fig.1). The sex of the animal could not be determined because as soon as we spotted this individual, it rushed back into the thick understorey away from our vehicle.

The coat on this Four-horned Antelope was also quite long which may indicate seasonal moult. However, even allowing for this, the pelage is atypically dark brown in colour and likely represents a case of partial melanism. Melanism is caused by a buildup of melanin pigment, producing an abnormal black or dark brown coloration of the outer layers, such as skin and hair (Kettlewell 1973). Such colour aberration is quite common in mammals (Caro 2005). In India, only two records in antelopes have been reported. Ramanju of Surguja (1932) recorded a melanistic female Four-horned Antelope accompanying a normally colored male in Ambikapur (23.118 N, 83.195 E), Surguja State, Central Province (now Chattisgarh state). Smith (1905) observed a melanistic Blackbuck (*Antilope cervicapra*), which was dark colored throughout the body without the usual white belly and legs in Bhopal (23.261 N, 77.4120 E), Madhya Pradesh on 6 September 1904.

A few examples of colour aberrations in other Indian species have been reported from Tamil Nadu, including: a melanistic Tufted Grey Langur (*Semnopithecus priam*) (Samson *et al*. 2021a); a melanistic Indian Giant Flying Squirrel (*Petaurista philippensis*) (Ramakrishnan *et*

al. 2016), an albino Wild Boar (*Sus scrofa*) (Samson *et al*. 2021b), a leucistic Bonnet Macaque (Deepan et al., 2019) and a leucistic Three-striped Palm Squirrel (*Funambulus palmarum*) (Samson *et al*. 2017; Cleamant Kiran Kumar *et al*. 2021).

Figure 1. *Four-horned Antelope (*Tetracerus quadricornis*) showing an unusually dark coat, on Sigur Plateau, Mudumalai Tiger Reserve, India (© Arockianathan Samson)*

The population of Four-horned Antelope in Mudumalai Tiger Reserve is very small in number and distributed in small pockets. Ramakrishnan *et al*. (2016) reported that habitat fragmentation, stress, and inbreeding could be possible elements in the occurrence of melanism. In conclusion, further studies should be encouraged to report the records of colour aberrations in wildlife to better understand the frequency of this phenomenon and the ecological and physiological effects of this condition on animal survival (Samson *et al*. 2017; 2021a,b).

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ANTELOPE NEWS

ASIA AND MIDDLE EAST

Saiga populations in Kazakhstan continue to increase

Analysis of the aerial census results from spring 2023 have shown another large annual increase in the size of the Saiga population in Kazakhstan. Total numbers this year are estimated to be 1,915,000, representing a 472% increase since 2019. The annual estimates for each of the three Saiga populations, and the totals for the country, are shown in the table. The census is conducted during spring, before the birth season, so the number of Saiga currently present (October 2023) in Kazakhstan is almost certainly well in excess of 2 million animals. This spectacular increase – following on from a mass mortality event from disease in 2015 – marks a welcome conservation success. However, the very high numbers in some populations, which may be unprecedented in recent times, are also leading to problems – see the next item, below.

Year	Betpakdala	Ustyurt	Ural	Total
2019	115,000	5,900	217,000	**334,000**
2020	Not counted			
2021	285,000	12,000	545,000	**842,000**
2022	489,000	28,000	801,000	**1,318,000**
2023	745,300	39,700	1,130,000	**1,915,000**

Strategy for the conservation and management of saiga in Kazakhstan

The rapid growth in the Saiga population in recent years in Kazakhstan, and the highest number ever recorded in the Ural population, have caused increasing concern among agricultural land users and local communities. In 2022, the Government of Kazakhstan requested the assistance of CMS in addressing this human-wildlife conflict. The CMS Secretariat organized multi-stakeholder consultations online from 28 February to March 2023 and 25-27 May 2023 in Astana, Kazakhstan. A group of international experts were invited jointly by the CMS Secretariat and the Forestry and Wildlife Committee of the Government of Kazakhstan to provide advice along with a range of national experts, local community representatives, government officials and other stakeholders. The resulting Strategy for the Conservation and Management of Saiga in Kazakhstan was endorsed by all participants and consists of a logical framework, setting out the main activities required for the conservation and sustainable management of Saiga populations over the coming years and considering the needs of local communities living in Saiga range.

The strategy is available in English and Russian versions from: https://www.cms.int/cami/en/meeting/consultative-meeting-%E2%80%9Cidentifying-solutions-human-wildlife-conflict-involving-saiga

Reintroduction of Goitered Gazelle to Kyrgyzstan

The Goitered or Black-tailed Gazelle *Gazella subgutturosa* has entirely disappeared from the wild in Kyrgyzstan. A reintroduction project has now been launched, implemented by two local NGOs, the Argali Foundation and the Ilbirs Foundation, working together with NABU (Nature and Biodiversity Conservation Union), one of the oldest and largest environmental associations in Germany. In the October 2021, 15 juvenile gazelles were brought from the Jeyran breeding centre in Uzbekistan to an enclosure in the Tom region of Issyk Kul district. This pilot phase

was financed by a 50,000 USD grant from the GEF Small Grants Programme in Kyrgyzstan and some private funding. In 2022, NABU funded the expansion of the enclosure from 0.25 ha to approximately 12 ha and more juvenile gazelles were brought from Uzbekistan to establish a stable and genetically diverse population.

Kazakhstan's Altyn-Emel National Park has a large Goitered Gazelle population and gazelles used to move between the grasslands of the two countries. Argali Foundation Director and Project Leader, Askar Davletbakov, hopes to sign an agreement with Kazakhstan to bring some gazelles from Altyn-Emel National Park to boost genetic diversity of the breeding herd ahead of the reintroduction. Six release areas in Issyk-Kul region have been identified and the project partners plan to release the first gazelles into the wild in 2026. The project also includes environmental education measures to combat poaching and illegal trade.
Sources: https://eurasianet.org/kyrgyzstans-goitered-gazelles-are-back-but-still-vulnerable
https://en.nabu.de/topics/species/goitered-gazelle-project/index.html

Reintroduced Goitered Gazelles thriving in Georgia

WWF-Caucasus's Gazelle Reintroduction Programme has been operating since 2013, with the generous support of the Ministry of Ecology and Natural Resources of Azerbaijan. Over 80 gazelles have been translocated from healthy populations in Shirvan National Park, Azerbaijan, on the coast of the Caspian Sea, to the Samukh Steppe, bordering Vashlovani Protected Area, in southeastern Georgia. Since the start of the project, nine new generations of Gazelles have been born in the reintroduction site up to 2023 and the number of gazelles in Georgia is currently estimated at around 250 individuals. Local rangers monitor the release areas The Gazelle Reintroduction Programme is implemented by WWF in close cooperation with the governments of Azerbaijan and Georgia, with financial support provided by the German Government (BMZ / KfW) and WWF Deutschland. The promising results of this collaboration have led to more introductions being planned.
Sources: https://report.az/en/region/azerbaijan-to-send-goitered-gazelles-to-georgia/
https://www.wwfcaucasus.org/our_work/all_initiatives/gazelle_reintroduction_programmme/

Steppe fire kills over 230 Mongolian Gazelles

In eastern Mongolia, dry and windy conditions in spring make the steppes vulnerable to wildfires. On April 8, 2023, a steppe fire broke out in Erdenetsagaan district of Sukhbaatar province and spread to neighbouring Dornod province, destroying 2.2 million ha of steppe grassland. Over 98% of the Numrug Strictly Protected Area (3,112 km²) was burnt. The fire was brought under control after 3 days. According to a preliminary study by Department of Environment and Tourism of Dornod aimag, 230 Mongolian Gazelles *Procapra gutturosa* were killed, some of them trapped against the border fence with China. WWF-Mongolia has provided 17.2 million tugriks (5000 USD) to help the Environmental Agency and Protected area administrations in the provinces affected to tackle the consequences and undertake post-fire assessments. Training and technical support on fire prevention and protection will now be provided to the stakeholders in the eastern provinces.
Source: https://www.wwf.or.th/en/?379095/Steppe-fire-kills-over-230-Mongolian-gazelle-in-eastern-Mongolia

Arabian Oryx born in King Salman bin Abdul Aziz Royal Natural Reserve

King Salman bin Abdul Aziz Royal Natural Reserve (KSRNR) was created in 2018 and is the largest nature reserve in Saudi Arabia, covering 130,700 km^2. The reserve lies in the northern part of the Kingdom and contains three main conservation sites: Khunfah, bordering the west

of the Great Nafud desert, Al-Tubaiq sedimentary plateau near the border with Jordan, and Harrat Al-Harra. The terrain includes mountains, plateaus, sandy desert, and basalt plains. The reserve also contains several UNESCO-listed historical sites dating back 8000 years. On 30 March 2023, 50 Arabian Oryx (*Oryx leucoryx*), 100 Arabian sand gazelles (*Gazella marica*) and 20 Nubian Ibex (*Capra nubiana*) were released into one of the three primary wildlife reserves, in a collaborative project between the KSRNR Development Authority and the National Center for Wildlife. The first oryx calves were born in September 2023, ninety years after species became extinct in that region.
Source: https://www.arabnews.com/node/2098591/saudi-arabia

'Uruq Bani Ma'arid gains World Heritage status

UNESCO has announced that 'Uruq Bani Ma'arid has been granted World Heritage status. 'Uruq Bani Ma'arid protected area (UBM) in southern Saudi Arabia encompasses the western part of the Rub' al-Khali (Empty Quarter), one of the largest expanses of windblown sand on Earth, as well as the southern end if the 1000-km long Tuwayq escarpment. UBM covers 12,765 km^2 with an additional 806-km^2 buffer zone. Since 1995, 174 Arabian Oryx have been released into the site and are fully free-ranging. Arabian Sand Gazelle (*Gazella marica*) and Arabian gazelles have also been reintroduced. Estimated numbers in 2020-2021 are 125-150 oryx, 150 Mountain Gazelle, and 300-400 Arabian Sand Gazelle.
Source: https://whc.unesco.org/en/list/1699/

Arabian Oryx in 'Uruq Bani Ma'arid (© National Center for Wildlife)

RECENTLY PUBLISHED ARTICLES

Africa

Combined effects of clime, vegetation, human-related land use and livestock on the distribution of the three indigenous species of gazelle in Eritrea

Futsum Hagos, Tecle Yemane, Kamal M. Ibrahim, Marco Mangiacotti, Roberto Sacchi (2023) *Animals* 13(9) 1490; https://doi.org/10.3390/ani13091490 (open access)

Abstract

The status and habitat selection of the three species of gazelle indigenous to Eritrea, i.e., Nanger soemmerringii, Gazella dorcas and Eudorcas tilonura, are not well known. In this study, we analyzed the present distribution of the three species in the country in order to identify preferred habitats and assess the effect of human disturbance (land use for agricultural purposes and livestock) on species occurrence. These data represent baseline information for evidence-based strategies for conservation of the three species in Eritrea. Presence/absence data of the three species in each of the 67 administrative subregions (Sub- Zoba) composing the country were collected using direct (field surveys) and indirect methods (questionnaires). For each sampling unit, we collected fifteen environmental variables, of which three are associated with climatic features, eight with vegetation structure and four with human disturbance (human-related land use and livestock). The occurrence probability of each species was modeled through Generalized Linear Models (GLM). The analyses showed that Dorcas gazelle occurred more frequently in warmer conditions and in a wide range of natural vegetation types. Heuglin's gazelle occurred in warmer regions with higher seasonality in both temperature and precipitation with a preference for closed woody and open grassland areas. In the case of Soemmerring's gazelle, the GLM with climatic variables predicted a preference for warmer conditions but with lower seasonality of temperature and precipitation. The species also seemed to prefer arid and semi-arid open vegetation. Human disturbance is the variable with the strongest, negative, effect on the species occurrence. Indeed, the occurrence probability of each species decreased with increasing livestock density and agricultural land use. Most of these gazelles occurred in unprotected areas, thus the human-related activities are undoubtedly the most important threat for the three species of gazelle in Eritrea. Therefore, the establishment of protected areas that preserve the potential optimal habitats for gazelle and reduce the impact of livestock ranching are essential to ensure a future for these gazelles in Eritrea.

Rapid development of individual identification and presence systems for a critically endangered antelope, the Mountain bongo

Sandri, T., Bunge, D., Omengo, F., Cain, B., Jones, M., & Harris, W. E. (2023). *African Journal of Ecology* https://doi.org/10.1111/aje.13201

Abstract

Monitoring of species, particularly remnant populations requiring urgent conservation is often hampered by the lack of reliable tools for individual identification (using images or their spoor). Here, we develop rapid monitoring tools for individual animals of the Mountain bongo (*Tragelaphus eurycerus isaaci*), a critically endangered subspecies of the bongo only found in Kenya. We developed and tested an individual identification system using camera trap footage, as well as a quantitative tool to identify bongo spoor in the field, both useable by naïve observers. We implemented an information content approach to assess the importance of different visual elements in 61 individual bongos to optimise our identification system. We

tested the reliability of the system with 15 naïve observers. We conclude that an optimal identification system should rely on three main visual features (stripe pattern, facial markings and horns appearance). We show that reliability amongst observers is high ($\kappa = 0.64$). We also developed a field scheme to identify footprint and spoor sign. Measurements of bongo footprints were compared with those of waterbuck (*Kobus ellypsiprimnus*), a syntopic antelope. Confusion occurs between spoor and footprints of both species. We find that differences in the aspect ratio of bongo and waterbuck footprints can identify the two species, 1.22 (±0.08) for bongo and 1.49 (±0.10) for waterbuck. The acquisition of reliable tools ensures monitoring activities are less dependent on individual expertise, which will allow consistent monitoring of bongo remnant populations in the future. The methods we used to develop these monitoring tools can help managers and field workers in the study of this and similar rare species where monitoring is a challenge.

Population monitoring of a Critically Endangered antelope, the mountain bongo, using camera traps and a novel identification scheme

Sandri, T., Prettejohn, M., Omengo, F., Cain, B., Jones, M., & Harris, W.E. (2023). *Oryx*,1-8.

Abstract

Conservation monitoring is paramount for the gathering of information on species and populations in need of conservation actions. However, monitoring of the mountain bongo *Tragelaphus eurycerus isaaci*, a Critically Endangered antelope endemic to Kenya, has hitherto been limited to surveillance (i.e. focused on persistence of the species in particular areas), thus limiting the information that could be retrieved on the status and trends of these populations. Using a newly developed identification system, we implemented robust design mark–recapture using existing camera-trap records of four wild subpopulations of the bongo. We provide data on sex and age structure and the first estimates of population size in the wild. Males and calves seem to be suffering higher mortality than females, and only two of the four monitored populations include adults of both sexes and calves. The combined size of these two breeding populations is estimated to be 29–50. Our findings confirm the critical situation of the mountain bongo in the wild and highlight the need for conservation actions to reinforce the wild populations for the long-term conservation of this antelope.

Motives, other meat sources and socioeconomic status predict number of consumers with preference for two antelope species served in Enugu-Nigeria

Andong, F. A., Ossai, N. I., Echude, D., Okoye, C. O., & Igwe, E. E. (2023). *Global Ecology and Conservation 42*, e02387.

Abstract

Conservationists are raising concerns about escalating rates of illegal hunting and trading of wildlife resource for food (meat). Hunting of wild animals is associated with complex motivations and drivers that include the high demand for high-value luxury products or a preference for a particular wild animal that consumers consider nutritious over other commercial meat products. Despite the fact that the preference for animal meat from the wild could be a contributory factor hampering most conservation efforts, more studies are still focusing more on habitat destruction rather than bushmeat trade. We investigated the factors influencing preference for antelopes compared with other forms of meat (commercial and non-antelope bushmeat) sold at bushmeat retail centers of Enugu-Nigeria. Data was collected from retailers and a face-to-face interview of respondents at four different centers (selected by cluster probability sampling method) of the three rural areas over a 12-month period. A total of 283 bushbucks (*Tragelaphus sylvaticus*) and 211 common duikers (*Sylvicapra grimmia*) were provided by hunters to the retail centers. Data from 1884 semi-structured questionnaires

(administered by simple random sampling) indicate most respondents preferred to consume antelope meat because it is readily availability. The duiker was consumed for its morphology and resemblance to goat. In the absence of antelope, the non-antelope bushmeat (guinea fowl) and commercial meat (pork) were consumed due to affordability. Generalized linear mixed model (GLMMs) analyses indicated that respondent age, occupation and motives were significantly related to the number of consumers of antelopes and other sources of meat at the retail centers. The younger consumers of age range 18–35 years consumed antelope and other forms of meat at the retail centers due to health benefits, while businessmen, due to availability. The selection of antelopes by the younger consumers could be an indication of a push to healthier living which may be motivated by status-seeking attitude that could in turn affect future conservation of wildlife resources.

Home range and habitat use of roan antelope *Hippotragus equinus* in Northern Botswana

C.P. Havemann, T.A. Retief, K. Collins, R.W.S. Fynn, C.A. Tosh, P.J.N. de Bruyn (2022). Home range and habitat use of roan antelope *Hippotragus equinus* in Northern Botswana, *Journal of Arid Environments* 196, 104648

Abstract

Studies investigating animal movement and habitat use are essential for wildlife management and conservation. Northern Botswana represents some of the least modified landscapes in Africa. Studying the seasonal habitat use of herbivores in these landscapes provides important baseline information with which to compare the behavioural responses of similar species occurring in anthropogenically modified landscapes. We report on the home range extent and habitat use of roan antelope (*Hippotragus equinus*) in a region of northern Botswana unaffected by artificial water and fences. We deployed Global Positioning System (GPS) collars on individuals in four roan antelope herds in northern Botswana, three herds in the drier northern section of Botswana and one herd in the wetter Okavango Delta. Herds in the drier northern section occupied larger home ranges (>50 km^2) than did herds in the wetter Okavango Delta (<50 km^2). All herds preferred specific core areas (all smaller than 20 km^2) within their home ranges. All herds had similar location and size of home range between the wet and dry season (non-migratory). All herds occurred in back-country sandveld areas dominated by either Kalahari apple-leaf (*Philenoptera nelsii*) or silver cluster-leaf (*Terminalia sericea*) woodlands with low densities of competitors and predators. In Botswana, the long-term persistence of free-roaming roan antelope herds likely depends on the preservation of these unmodified back-country habitats away from permanent water.

Allometry of behavior and niche differentiation among congeneric African antelopes

Joshua H. Daskin, Justine A. Becker, Tyler R. Kartzinel, Arjun B. Potter, Reena H. Walker, Fredrik A. A. Eriksson, Courtney, Buoncore, Alexander Getraer, Ryan A. Long, Robert M. Pringle (2023). *Ecological Monographs* 93(1), e1549. https://doi.org/10.1002/ecm.1549

Abstract

Size-structured differences in resource use stabilize species coexistence in ani-mal communities, but what behavioral mechanisms underpin these niche differences? Behavior is constrained by morphological and physiological traits that scale allometrically with body size, yet the degree to which behaviors exhibit allometric scaling remains unclear; empirical datasets often encompass broad variation in environmental context and phylogenetic history, which complicates the detection and interpretation of scaling relationships between size and behavior. We studied the movement and foraging behaviors of three sympatric, congeneric spiral-horned

antelope species (*Tragelaphus* spp.) that differ in body mass—bushbuck (26–40 kg), nyala (57–83 kg), and kudu (80–142 kg)—in an African savanna ecosystem where (i) food was patchily dis-tributed due to ecosystem engineering by fungus-farming termites and(ii) predation risk was low due to the extirpation of several large carnivores. Because foraging behavior is directly linked to traits that scale allometrically with size (e.g., metabolic rate, locomotion), we hypothesized that habitat use and diet selection would likewise exhibit nonlinear scaling relationships. All three antelope species selected habitat near termitaria, which are hotspots of abundant, high-quality forage. Experimental removal of forage from termite mounds sharply reduced use of those mounds by bushbuck, confirming that habitat selection was resource driven. Strength of selection for termite mounds scaled negatively and nonlinearly with body mass, as did recursion (frequency with which individuals revisited locations), whereas home-range area and mean step length scaled positively and nonlinearly with body mass. All species disproportionately ate mound-associated plant taxa; nonetheless, forage selectivity and dietary composition, richness, and quality all differed among species, reflecting the partitioning of shared food resources. Dietary protein exhibited the theoretically predicted negative allometric relationship with body mass, whereas digestible-energy content scaled positively. Our results demonstrate cryptic size-based separation along spatial and dietary niche axes—despite superficial similarities among species—consistent with the idea that body-size differentiation is driven by selection for divergent resource-acquisition strategies, which in turn underpin coexistence. Foraging and space-use behaviors were nonlinearly related to body mass, supporting the hypothesis that behavior scales allometrically with size. However, explaining the variable functional forms of these relationships is a challenge for future research.

Keeping cool on hot days: activity responses of African antelope to heat extremes

Paul E. Berry, Melanie Dammhahn, Niels Blaum (2023).
Frontiers in Ecology and Evolution 11, 1172303.| https://doi.org/10.3389/fevo.2023.1172303

Abstract

Long-lived organisms are likely to respond to a rapidly changing climate with behavioral flexibility. Animals inhabiting the arid parts of southern Africa face a particularly rapid rise in temperature which in combination with food and water scarcity places substantial constraints on the ability of animals to tolerate heat. We investigated how three species of African antelope - springbok *Antidorcas marsupialis*, kudu *Tragelaphus strepsiceros* and eland *T. oryx* - differing in body size, habitat preference and movement ecology, change their activity in response to extreme heat in an arid savanna. Serving as a proxy for activity, dynamic body acceleration data recorded every five minutes were analyzed for seven to eight individuals per species for the three hottest months of the year. Activity responses to heat during the hottest time of day (the afternoons) were investigated and diel activity patterns were compared between hot and cool days. Springbok, which prefer open habitat, are highly mobile and the smallest of the species studied, showed the greatest decrease in activity with rising temperature. Furthermore, springbok showed reduced mean activity over the 24 h cycle on hot days compared to cool days. Large-bodied eland seemed less affected by afternoon heat than springbok. While eland also reduced diurnal activity on hot days compared to cool days, they compensated for this by increasing nocturnal activity, possibly because their predation risk is lower. Kudu, which are comparatively sedentary and typically occupy shady habitat, seemed least affected during the hottest time of day, and showed no appreciable difference in diel activity patterns between hot and cool days. The interplay between habitat preference, body size, movement patterns, and other factors seems complex and even sub-lethal levels of heat stress have been shown to impact an animal's long-term survival and reproduction. Thus, differing heat tolerances among species could result in a shift in the composition of African herbivore communities as

temperatures continue to rise, with significant implications for economically important wildlife-based land use and conservation.

Asia and Middle East

Activity behavior of goitered gazelles in an arid environment

D.A. Blank (2023). *Behavioral Processes* 204, 104804. doi: 10.1016/j.beproc.2022.104804

Abstract

The daily activity pattern in ruminants consists mainly of alternating foraging with bouts of resting, while other behaviors usually play a minor role in the daily activity budgets of ungulates most of the year. Interactions of both intrinsic and extrinsic factors force animals to adopt compromises to form optimal time proportions for foraging and resting to satisfy their daily energy demands. This paper considers the impact of ambient temperature, pasture conditions, body-size, and the effects of lactation and animal growth on the daily activities of goitered gazelles (Gazella subgutturosa). My study found: 1) temperature was the most significant factor leading to the greatest daily hour-to-hour variations in activity, as well as significant monthly changes in activity fluctuations; 2) seasonal improvement of forage conditions did not have a distinctive effect on daily activity; 3) the effect of body size, lactation and fawn growth also did not noticeably change activity fluctuations; but 4) factors related to hiding behavior had a significant impact on goitered gazelle activity. Though goitered gazelles are a sexually dimorphic species, they did not demonstrate any significant deviation between males and females in their daily activities in contrast to typical dimorphic ruminants. The goitered gazelles' hiding behavior may provide a possible explanation for this distinction, as other previously observed dimorphic ungulates were mainly species where fawns followed their mothers from birth. Among other influences, ambient temperature and features of their hiding behavior were the most significant factors influencing diurnal activity of goitered gazelles, while age and sex had a weaker impact on daily behavior.

Goitered Gazelle *Gazella subgutturosa* responded to human disturbance by increasing vigilance rather than changing the group size

Wenxuan Xu, Muyang Wang, David Blank, António Alves da Silva, Weikang Yang, Kathreen E. Ruckstuhl, and Joana Alves (2022).

Biology 11(8), 1236. https://doi.org/10.3390/biology11081236

Abstract

Nonlethal human disturbances have been confirmed to have a negative effect on wildlife in a variety of ways, including on behaviors. In many studies, the impact of human disturbances on gregarious species of wildlife is assessed through changes in their social organization and vigilance. In our study in the Kalamaili Nature Reserve, China, we wanted to estimate the impacts of differing levels of human disturbances on two different group types (mixed-sex and all-male) of goitered gazelle, *Gazella subgutturosa*, living in three functional zones (experimental, buffer, and core zones), which represent high, medium, and low human disturbance levels, respectively. In addition, we studied the time spent vigilant as a function of group size with different levels of human disturbances in the three zones. In general, mixed-sex gazelle groups were of similar sizes in the three different zones, while all-male groups slightly differed in their sizes between the experimental and buffer zones. This may indicate that human disturbances have varying effects on the different group types, with smaller-sized, single-sex groups being more significantly affected by human disturbances than larger-sized, mixed-sex groups. Goitered gazelle showed higher vigilance levels in the experimental zone

than in the two other zones. A trend of decreasing vigilance varying linearly with group size was also found in the three zones, and the rate of decrease was higher in the experimental zone. Increased habitat fragmentation and human activities brought goitered gazelle and humans closer together in the core zone. Therefore, stopping mining activities and returning the reserve to a continuous habitat with fewer environmental disturbances is the best way to establish and protect a stable population of this endangered species of gazelle.

Antelope adaptations to counteract overheating and water deficit in arid environments

David Blank & Yaoming Li (2022).
Journal of Arid Land 14(10), 1069–1085. https://doi.org/10.1007/s40333-022-0076

Abstract

Many arid areas have very severe climates with extremely high summer temperatures, strong solar radiation, and a lack of drinking water during the driest season. Therefore, antelopes living in arid areas are forced to solve two main problems: avoiding overheating and maintaining water balance. Generally, there are physiological, morphological, and behavioral mechanisms for antelope adaptations to arid environments. Among the mechanisms, behavioral adjustments have a minimal cost and are activated first, while physiological mechanisms are the most energetically costly and involve adaptations to high temperatures when other mechanisms are insufficient. In previous publications, some examples of the antelope behavioral adaptations have been described only rarely, while in this review, we try to clarify all available information on the adaptations of antelopes living in arid areas to their native environments, paying particular attention to behavioral adjustments. Behavioral mechanisms, especially daily activity, diet and microclimate selection, and migrations, are so important and commonly used by antelopes in natural conditions, in which physiological mechanisms are usually not involved. Antelopes adjust their behaviors according to environmental changes so successfully that purely physiological mechanisms are discovered under laboratory conditions; for example, adaptive heterothermia or selective brain cooling phenomenon is difficult to observe in their natural habitats. This review provides a better understanding of the main behavioral mechanisms of antelope adaptations to arid environments and allows for the identification of the key factors for successful conservation of antelopes in their natural habitats.

Was the Asiatic cheetah an obligate gazelle hunter?

M.S. Farhadinia, B. Nezami, A. Ranjbaran, R. Valdez (2023).
PLoS ONE 18(4), e0284593. https://doi.org/10.1371/journal.pone.0284593 (open access)

Abstract

Understanding key ecological adaptations, such as foraging, when a predator is almost extinct is complex. Nonetheless, that information is vital for the recovery of the persisting individuals. Therefore, reviewing historical, ethnobiological and recent records can assist in exploring the species behavioral ecology. We applied this approach to Asiatic cheetahs (*Acinonyx jubatus venaticus*), which once roamed most west and central Asian countries but now is confined to a few dozens in Iran, at historical (pre-1970) and recent (post-1970) scales. We addressed a widely popular perception that Asiatic cheetahs were subjected to prey shifts from gazelles (*Gazella* spp.) in open plains areas to urial (*Ovis vignei*) in mountains because of gazelle populations declines due to anthropogenic influences. We also quantified recent prey choice of Asiatic cheetahs and their behavioral plasticity in foraging different prey species types. Although ethnobiological and historical records suggested that gazelle species were the main prey for cheetahs across their Asian range. However, urial were also commonly reported to be

hunted by cheetahs across their historical Asian range, showing that the predation on mountain ungulates is not an emerging hunting behavior in Asiatic cheetahs. We found spatiotemporal plasticity in recent hunting behavior of cheetahs with selective predation on adult urial males. There was temporal overlap in hunting times for plains dwelling versus mountain ungulates, albeit with some minor differences with morning mostly for gazelles while the predation on mountain ungulates was predominantly post-midday. We provided three management implications for the recovery and restoration of cheetahs in Asia. Our work highlighted the importance of historical studies in informing the behavioral ecology of rare species.

Intention to participate in saiga antelope conservation among young Chinese: Based on an extended theory of planned behavior

Tingyu, Y., Zhongyi, Z., Yuxuan, H., & Yi, X. (2023). *Journal of Beijing Forestry University (Social Science)* 22(1), 43-53.

Abstract

Promoting public participation is a practical move to strengthen wildlife conservation, while exploring public's intention to participate is a common practice when the participation behavior cannot be observed. This study focused on the saiga antelope (*Saiga tatarica*, saiga hereafter), an endangered species which is highly concerned by the international community. Based on the survey data from 536 young Chinese aged 16 ~ 40 years old and an extended theory of planned behavior (TPB), we applied descriptive statistics and structural equation modeling (SEM) to explore the intention to participate in the conservation of saiga and its influencing factors among young Chinese by attitude, norm, perceived behavioral control, conservation knowledge and sociodemographic characteristics. The results showed that: ① Respondents had a positive attitude towards saiga conservation, perceived the responsibility and social pressure to participate in the conservation, and their intention to participate was high, but had limited understanding of saiga and regarded it difficult to participate. ② Norm, perceived behavioral control, attitude, conservation knowledge and educational background positively and successively affected the intention, from strong to weak. ③ Reliability and validity of the scale and the model fit were good, showing that the extended TPB was verified and could effectively explain the intention to participate in saiga conservation. To promote public participation in saiga conservation, it is suggested to strengthen science popularization and broaden the channels of participation.

Predictors of the behavioral intention to participate in saiga antelope conservation among Chinese young residents

Yang, T., Druică, E., Zhang, Z., Hu, Y., Cirella, G. T., & Xie, Y. (2022). *Diversity* 14(5), 411.

Abstract

Promoting public participation is a practical move to strengthen wildlife conservation. This study focuses on saiga antelope (*Saiga tatarica*), an endangered species which has received international concern. Based on an extended version of the Theory of Planned Behavior and a sample of 536 Chinese residents aged 16–40 collected through an online survey, we applied Partial Least Squares Structural Equation Modeling to explore the predictors of the behavioral intention to participate in saiga antelope conservation. The results show that perceived behavioral control is the most influential predictor that contributes to the value of the behavioral intention, followed by injunctive norm, attitude to participation, knowledge of saiga antelope, experience of wildlife conservation, and attitude to saiga antelope, altogether explaining 48.4% of the variance of the behavioral intention. To promote public participation in saiga antelope conservation, strengthening science popularization and broadening the channels of participation are suggested.

Habitats change of Tibetan antelope and its influencing factors on the North Tibetan Plateau from 2020 to 2050

Wei, Z., Xu, Z., Qiao, T., Wang, S., Ishwaran, N., & Yang, M. (2023). *Global Ecology and Conservation* 43, e02462.

Abstract

As an alpine environment sensitive to global climate change and human activities, habitats of Tibetan antelope are exposed to a variety of challenges. Wintering and calving habitats of Tibetan antelopes in 2020 and 2050 on the North Tibetan Plateau (NTP), China were simulated with Maxent model using data of sites where Tibetan antelopes were present; contribution of environmental variables to the habitats distribution in current and future scenarios was analyzed via jackknife test; and current levels of human disturbances were quantified with InVEST model. Conclusions were: 1) in 2020, wintering habitats of Tibetan antelope concentrated in the central and southern parts of the NTP, covered an area of 216,000 km^2. The calving habitats, scattered extensively in the NTP, covered an area of 348,768 km^2. Mean precipitation of the warmest quarter, land cover and NPP were predicted to be large contributors to habitats. 2) During 2020–2050, the wintering habitats coverage was projected to increase 5.93 %, 12.87 % and 4.52 %, and the calving habitats to increase 5.20 %, 8.77 % and 21.23 %, under the Representative Concentration Pathway (RCP)2.6, RCP 4.5, and RCP 8.5 scenarios, respectively. The wintering habitats was predicted to expand by roughly 27,000 km^2 and the calving habitats by 30,500 km^2 in 2050. Mean temperature of the warmest quarter, land cover, NPP, and distance from water sources were predicted to be large contributors to habitats. 3) In 2020, human activities in the middle and southern parts of the NTP were more intense compared to those in the northern parts. Disturbed areas accounted for 48 % of the total wintering habitats, and 1/3 of the total calving habitats, respectively. In the future, human activities in the middle and southern parts of the NTP may intensify, concurrent with the predicted expansion of antelope habitats, resulting in exacerbation of conflicts between community development and wildlife conservation. In the northern parts of NTP, human disturbance may decrease. For better understanding habitats scenarios, we need to gather more data on distribution patterns and behavioral ecology of Tibetan antelope within the wintering and calving seasons. We recommend setting up systems for monitoring habitats changes of Tibetan antelope that could help in defining the national park area to cover critical antelope habitats and manage herdsmen and livestock uses of the areas within the carrying capacity of grasslands, particularly through diversification of livelihoods and support to green development of local communities.

Conservation of the Goitered gazelle (*Gazella subgutturosa*) under climate changes in Iraq

Kaky, E., Nolan, V., Khalil, M. I., Mohammed, A. M. A., Jaf, A. A. A., Mohammed-Amin, S. M., ... & Gilbert, F. (2023). *Heliyon* 9(2).

Abstract

Climate is a vital factor that shapes habitat suitability for many species across space and time. *Gazella subgutturosa* (Goitered gazelle) is a globally vulnerable mammal already extinct in some areas of Armenia and Georgia and is highly threatened in other areas of its distribution. In this study, new data were gathered for 33 locations in north-eastern Iraq, and then together with literature data, Species Distribution Models (SDMs) were used to explore the geographical distribution of the gazelle under current and future climate change scenarios. We studied the relationship between seven climate variables and 43 occurrence records to predict habitat suitability of the gazelle under the current climate, and also under four future climate scenarios

(RCP2.6 and RCP8.5 for both 2050 and 2080). Annual precipitation and isothermality had the most influence on the distribution of *Gazella subgutturosa*. The most suitable habitat in both the current and future scenarios was located in north-eastern Iraq close to the Iranian border near the Zagros Mountains. There was no difference in habitat suitability for the gazelle inside Iraqi Protected Areas (PAs) compared to outside the PAs. Using the occurrence records and IUCN Red List national assessments, we found Iraqi Goitered gazelle populations to be classified as Endangered (EN). Our results suggest urgent conservation planning is needed to save this species, including the establishment of new PAs. These results contribute new baseline information, which was currently missing Goitered gazelle in about Iraq, to the IUCN SSC Antelope Specialist Group, which will hopefully aid with future global assessments and conservation.

Gazelles (Mammalia: Bovidae) from the early Pleistocene Tianzhen area, Shanxi Province, China

Weipeng Bai, Xiaomin Wang & Wei Dong (2023).
Historical Biology DOI: 10.1080/08912963.2023.2222131

Abstract

Fossil gazelles have been discovered from the late Miocene to the late Pleistocene in China, but the Neogene gazelles were much more documented. The gazelle specimens unearthed from the early Pleistocene at Tianzhen are described and classified into three species: *Gazella sinensis, G. blacki* and *Procapra* cf. *przewalskii*. Based on the observation of extant *Gazella subgutturosa* and *Procapra*, we summarised the differential morphological characters of these species. Meanwhile, we reviewed and revised two diagnostic characters, morphology of p4 and size of horn cores, and we suggest that these should be used carefully in classification. Based on the new diagnostic characters, the *Gazella* cf. *subgutturosa* identified by Teilhard de Chardin and Piveteau in 1930 should be reassigned to *G. sinensis*. Partial materials of *G. paragutturosa* described by Bohlin in 1938 may be moved from *Gazella* to *Procapra* as *P. gutturosa*. We infer that the lectotype of *G. blacki* and other materials described by Chen in 1997 belong to the juvenile individuals based on the internal morphology of their horn cores. The different characters of the early Pleistocene *G. sinensis* and *G. blacki* are summarised after reviewing all materials classified into these two species in the previous works.

Ancient DNA from a 2700-year-old goitered gazelle (*Gazella subgutturosa*) supports gazelle hunting in Iron Age Central Asia

Rodrigues Soares A.E., N. Boroffka N, O. Schröder, L. Sverchkov, N. Benecke, T.R. Günther (2022). *Royal Society Open Science* 9(6), 220104. doi: 10.1098/rsos.220104

Abstract

Central Asia has been an important region connecting the different parts of Eurasia throughout history and prehistory, with large states developing in this region during the Iron Age. Archaeogenomics is a powerful addition to the zooarchaeological toolkit for understanding the relation of these societies to animals. Here, we present the genetic identification of a goitered gazelle specimen (*Gazella subgutturosa*) at the site Gazimulla-Tepa, in modern-day Uzbekistan, supporting hunting of the species in the region during the Iron Age. The sample was directly radiocarbon dated to 2724–2439 calBP. A phylogenetic analysis of the mitochondrial genome places the individual into the modern variation of *G. subgutturosa*. Our data do represent both the first ancient DNA and the first nuclear DNA sequences of this species. The lack of genomic resources available for this gazelle and related species prevented us from performing a more in-depth analysis of the nuclear sequences generated. Therefore, we are making our sequence data available to the research community to facilitate other

research of this nowadays threatened species which has been subject to human hunting for several millennia across its entire range on the Asian continent.

African buffalo

Conservation status of the African buffalo: a continent-wide assessment

Cornélis Daniel, Renaud Pierre Cyril, Melletti Mario, Fonteyn Davy, Bonhotal H., Hauptfleisch M., Asefa A., Breuer Thomas, Korte Lisa, Scholte Paul, Elkan P., Kohi E., Mwiu S., Ngene S., Omondi P., Tadjo S.P., Prin Thomas, Caron Alexandre, Prins Herbert & Chardonnet Philippe (2023). In : *Ecology and management of the African buffalo*. Caron Alexandre (ed.), Cornélis Daniel (ed.), Chardonnet Philippe (ed.), Prins Herbert H.T. (ed.). Cambridge : Cambridge University Press, 66-115. (Ecology, Biodiversity and Conservation) ISBN 978-1-316-51874-8 https://doi.org/10.1017/9781009006828.007

Abstract

This chapter presents the distribution, abundance patterns and trends of African buffalo in the 38 countries of its distribution area based on recent aerial and ground census data and feedback from field experts. For the period 2001–2021, we collected abundance data from 163 protected areas or complexes of protected areas and presence data from 711 localities. The savanna buffalo population is estimated in 2022 at over 564,000 individuals, after deduction of the 75,000 buffalo under intensive private management in South Africa. Its abundance is roughly equivalent to that estimated 25 years ago (625,000). The subspecies conservation status is highly unbalanced. The Cape buffalo is by far the most abundant, representing 90 per cent of the total estimated population (510,000 individuals). The West and Central subspecies respectively represent 4 and 6 per cent (>20,000 individuals and >34,000 individuals). The conservation status of the Central African savanna buffalo, whose abundance has been nearly halved over the last 25 years, is worrisome, with exception of the steadily increasing populations of Zakouma NP (Chad) and Garamba NP (DRC). Estimating the abundance of forest buffalo is challenging, as is establishing a trend. Our investigations showed that the forest buffalo is still well represented in Central Africa in areas with low human density. The forest buffalo's most important stronghold in Central Africa is probably the Greater TRIDOM/TNS (Tri-National Dja-Odzala-Minkébé / Trinational Sangha), a vast contiguous block of mainly pristine moist forest covering 250,000 km2 and straddling Cameroon, Congo, Gabon and Central African Republic (11 per cent of the Central African forest block). In West Africa, we obtained very little information on the presence of the forest buffalo in the residual forest block, suggesting that the conservation status of the forest buffalo in this region is very worrisome.

Continent-wide genomic analysis of the African buffalo (*Syncerus caffer*)

Andrea Talenti, Toby Wilkinson, Elizabeth A. Cook, Johanneke D. Hemmink, Edith Paxton, Matthew Mutinda, Stephen D. Ngulu, Siddharth Jayaraman, Richard P. Bishop, Isaiah Obara, Thibaut Hourlier, Carlos Garcia Giron, Fergal J. Martin, Michel Labuschagne, Patrick Atimnedi, Anne Nanteza, Julius D. Keyyu, Furaha Mramba, Alexandre Caron, Daniel Cornelis, Philippe Chardonnet, Robert Fyumagwa, Tiziana Lembo, Harriet K. Auty, Johan Michaux, Nathalie Smitz, Philip Toye, Christelle Robert, James G.D. Prendergast & Liam J. Morrison (2023). *bioRxiv*, 2023-11.

Abstract

The African buffalo (*Syncerus caffer*) is a wild bovid with a historical distribution across much of sub-Saharan Africa. Genomic analysis can provide insights into the evolutionary history of the species, and the key selective pressures shaping populations, including assessment of

population level differentiation, population fragmentation, and population genetic structure. In this study we generated the highest quality *de novo* genome assembly (2.65 Gb, scaffold N50 69.17 Mb) of African buffalo to date, and sequenced a further 195 genomes from across the species distribution. Principal component and admixture analyses provided surprisingly little support for the currently described four subspecies, but indicated three main lineages, in Western/Central, Eastern and Southern Africa, respectively. Estimating Effective Migration Surfaces analysis suggested that geographical barriers have played a significant role in shaping gene flow and the population structure. Estimated effective population sizes indicated a substantial drop occurring in all populations 5-10,000 years ago, coinciding with the increase in human populations. Finally, signatures of selection were enriched for key genes associated with the immune response, suggesting infectious disease exert a substantial selective pressure upon the African buffalo. These findings have important implications for understanding bovid evolution, buffalo conservation and population management.

Futures of the African buffalo

Caron Alexandre, Bourgeois Robin, Chardonnet Philippe, Cornélis Daniel, Prins Herbert (2023). In : *Ecology and management of the African buffalo*. Caron Alexandre (ed.), Cornélis Daniel (ed.), Chardonnet Philippe (ed.), Prins Herbert H.T. (ed.). Cambridge : Cambridge University Press, 517-548. (Ecology, Biodiversity and Conservation) ISBN 978-1-316-51874-8 https://doi.org/10.1017/9781009006828.025

Abstract

In this chapter we envision the possible futures of the African buffalo populations in Africa by reflecting on the regional and international factors and their relationships that could positively or negatively impact the healthiness of the buffalo species in the next 30 years. Using the expertise of the authors of this book, we drafted and validated a list of factors of change that could impact the futures of African buffalo populations on the continent and use a set of prospective methods, i.e. structural analysis, critical uncertainty matrix and morphological analysis to develop seven synopses which provided caricatural African contexts within which the consequences for African buffalo populations could be imagined. In 2050, the futures of the African buffalo will vary according to each country specific social, technical, economic, environmental, political and value contexts. In a context of climate change that will impact increasingly the environmental contexts in Africa, good futures for buffalo were often associated with political stability and good governance. The proportion of African living in cities will also be important. The ratio of urban versus rural African will not only determine the intensity of the agricultural pressure on land but also the African worldviews towards nature and its conservation. The influence of non-African states will also be determinant, especially in extractive industries and their request for land. A pivotal factor is the conservation models that will prevail in 2050: to what extent they are still influenced and constrained by part of the Western opinion; to what extent they are funded by them; and to what extent African worldviews push for the design of new conservation models based on different relationship between people and nature. Probably, landscapes associating land-sparing (e.g. national parks) and land-sharing management options, based on the sustainable use of natural resources will provide the best futures for buffalo to thrive on the continent.

Movement ecology and evolutionary history of forest buffalo

Korte, L., Melletti, M., & Smitz, N. (2023). In *Movement Ecology of Afrotropical Forest Mammals* (pp. 79-97). Cham: Springer International Publishing.

Abstract

Movement ecology framework is particularly insightful for forest buffalo (*Syncerus caffer nanus*) because we can examine it in the context of buffalo movement across Africa at different

spatial and temporal scales. Despite being mainly a sedentary species, buffalo are distributed widely throughout Africa. They occur throughout the Congo Basin forest region of Central Africa and in the residual blocks of forest in West Africa. Unlike for the well-studied savanna buffalo (*S.c. caffer*, *S.c. brachyceros*, *S.c. aequinoctialis*), few data exist on movement ecology of forest buffalo. Although limited, these data are sufficient to elaborate optimal plans for forest buffalo conservation. Relative to savanna buffalo, forest buffalo have smaller home ranges, shorter daily movement, no seasonal movement, and smaller group sizes. While movement ecology is often based on real-time tracking data, genetic studies allow for the understanding of demographic changes shaping the pattern of divergence and distribution on an evolutionary timescale. Genetic information is an important parameter to take into consideration when developing management practices in a conservation context. First, it evaluates the genetic health of a species (especially in the present context of land and climatic changes and overexploitation, resulting in a mosaic of isolated populations) but respects the genetic integrity of the species populations, which can display local genetic adaptations. Over the last decades, the investigation of the phylogeography and evolutionary history of the African buffalo revealed the existence of only two main lineages within the species (incongruency with the accepted taxonomy), one encompassing the buffalo from West and Central (WC) Africa (*S.c. nanus*, *S.c. brachyceros*, *S.c. aequinoctialis*) and another one including all savanna buffalo from eastern and southern (ES) Africa (*S.c. caffer*). Nowadays, despite the lack of contemporary barriers to gene flow, lineages appear conserved, and they should therefore be ascribed to evolutionarily significant units. Additionally, it is important to recognize that the forest buffalo subspecies is more vulnerable compared to its savanna counterparts. To assure the species' long-term survival, sustainable management to maintain the species' resilience to environmental changes and diseases is of prime importance, via, for example, the establishment of protected corridors allowing gene flow between isolated populations.