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SHORT COMMUNICATION

Updated distribution of spotted hyaenas in Gabon reveals resident populations

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Abstract

Spotted hyaena distribution currently widely encompasses sub-Saharan Africa, apart from the Congo Basin. Formerly described as residents of Gabon but considered extinct, vagrant individuals have been recorded since 2003, but no systematic species presence assessment has been made. Based on records of killed individuals, tracks and camera-trap sightings, we show that not only vagrant individuals are roaming in Gabon, but a small resident population occurs in the North-East of the country. The records collated here formed the basis for spotted hyaenas to be listed as protected in Gabon, were included in the IUCN Red List species' range map update and showcased the importance of large-scale by-catch data analysis in updating species distributions.

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Résumé

Actuellement, l'aire de répartition de la hyène tachetée couvre largement l'Afrique subsaharienne, à l'exception du Bassin du Congo. Anciennement décrits comme résidents du Gabon mais considérés comme éteints, des individus vagabonds ont été enregistrés depuis 2003, mais aucune évaluation systématique de la présence de l'espèce n'a été faite. En se basant sur des enregistrements d'individus tués, des traces et des observations par pièges photographiques, nous montrons que non seulement des individus vagabonds errent au Gabon, mais qu'une petite population résidente est présente dans le nord-est du pays. Les données rassemblées ici ont servi de base à l'inscription des hyènes tachetées sur la liste des espèces protégées au Gabon, ont été incluses dans la mise à jour de la carte de l'aire de répartition des espèces de la liste rouge de l'UICN et ont montré l'importance de l'analyse des données sur les prises accessoires à grande échelle pour la mise à jour de la répartition des espèces.

1 | INTRODUCTION

Spotted hyaenas (*Crocuta crocuta*) are considered in both the 2013 encyclopaedic work, The Mammals of Africa (Kingdon & Happold, 2013) and the current IUCN Red List assessment (Bohm & Höner, 2014) to be widely distributed across sub-Saharan Africa, except for the large Congo Basin rainforest block. However, spotted hyaena distribution prior to 1950 was estimated to include the Republic of Congo (Figure 1) and to extend into the Batéké Plateaux and the Nyanga-Ngounié savannahs of Gabon (Du Chaillu, 1861; Malbrant & Maclatchy, 1949; Wilks, 1990). In the last glacial period (18,000 years BP), hyper-arid conditions caused the retraction of the Central African rainforests into a series of refugia (Maley, 2001), and a forest-savannah mosaic dominated by open, grass-rich vegetation covered most of the region (Dupont et al., 2000; Maley, 2001), facilitating its colonisation by savannah species like lion (*Panthera leo*), serval (*Leptailurus serval*), waterbuck (*Kobus ellipsiprymnus*), southern reedbuck (*Redunca arundinum*), common duiker (*Sylvicapra grimmia*) and spotted hyaena. The following hyper-humid phase (9000–4000 BP) then allowed forest expansion, progressively isolating these western populations of savannah species from the larger savannah-dominated landscapes of Africa and retaining them in the emerging Western Congolian forest-savannah mosaic, which is considered a distinct ecoregion (Olson et al., 2001).

The last spotted hyaena sighting published for Gabon was on the eastern edge of the country in the Haut-Ogooué Province, in 1949 (Bout et al., 2010). Spotted hyaena are, with the lion, the historical savannah apex predator in the Western Congolian forest-savannah mosaic (Henschel et al., 2014), but their adaptation to this tropical, humid forest-savannah mosaic, specific behaviour and potential ecological role in this environment remain unknown. Spotted hyaenas were potentially present until the end of the 1980s in the extreme south of Gabon, near the Congo border (Mills & Hofer, 1998; Wilks, 1990), where the establishment of commercial cattle ranches likely furthered their decline, as at the time hyaenas and other large carnivores were systematically persecuted to avoid depredation on the introduced cattle (Henschel, 2006). A survey conducted in 2007 in Odzala-Kokoua National Park (OKNP) in the Congolese part of this historical Central African range confirmed the persistence of a resident hyaena population in the savannah-forest mosaic south of the park (Henschel et al., 2014), making it the only known population remaining within the limits of the Congo Basin.

However, in 2003, a single-spotted hyaena was captured by camera traps in the dense rainforest area of Ivindo National Park, Gabon (Henschel & Ray, 2003). In 2008 and 2009, hyaena tracks were confirmed west of Batéké Plateaux National Park (Bout et al., 2010). Vagrant hyaenas were therefore known to occasionally enter Gabon from Congo, but there was no recent evidence of a resident population (Bohm, 2015; Henschel et al., 2014).

The present study reassesses hyaena status in Gabon in terms of population size and distribution using a large collection of camera trap by-catch data and incidental records of tracks and animals killed. Camera-trapping is one of the most powerful tools currently available to estimate the size and distribution of large wildlife species populations, including hyaenas (Davis et al., 2022; Dheer et al., 2022). We used by-catch data from Gabon from twenty different existing camera trap studies covering 49,000 km^2, combined with opportunistic sightings, to investigate the presence of hyaenas in Gabon and specifically in the densely forested northeastern part of the country, which lies closest to the sole confirmed remaining resident population in OKNP in the neighbouring Congo. The study was not a systematic survey of the whole country, but nonetheless reveals important insights about hyaena populations in Gabon.

2 | METHODS

As part of a nationwide project to assess connectivity for large mammals between protected areas in Gabon, we compiled all confirmed

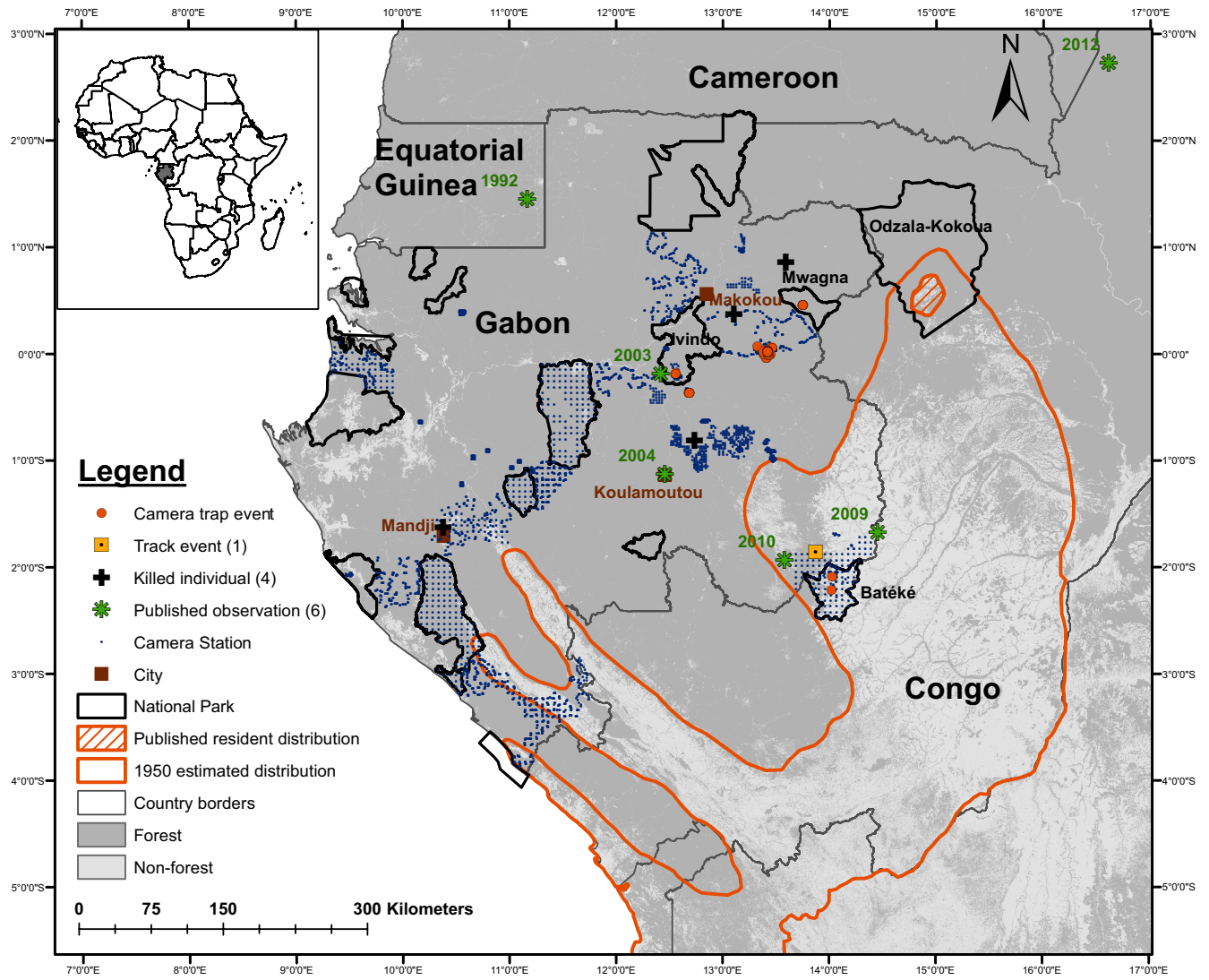

FIGURE 1 Published and new sightings (since 2015) of spotted hyaena (*Crocuta crocuta*) in Gabon and neighbouring countries. The 1950 estimated distribution is based on descriptions from Malbrant & Maclatchy (1949) (redrawn from Henschel, 2009).

locations of killed hyaena individuals, tracks and camera trap detections available for Gabon between 2015 and mid-2023, using the following methods of data collection and collation.

2.1 | Killed individuals

Having a hyaena killed by a hunter or through a vehicle collision is an extremely rare and unexpected event that, today, is often documented on social media, shared with local conservationists on different messaging groups and often ends up being published in local newspapers. Such datapoints were collected via the respective social networks of the different co-authors, representing multiple wildlife research and management institutions across Gabon. We confirmed species identification from pictures taken at the scene. The exact location was not always available, and in those cases, the location of the closest settlement was provided (Table 1).

2.2 | Tracks

Potential hyaena track pictures, if complete with scale and GPS position, were collected via an open email and social media call to field workers, park rangers and other wildlife professionals across Gabon to collate suspected hyaena track sightings. Species identification from track records was confirmed by one of the authors.

2.3 | Camera-trap data

None of the surveys included in this study were designed specifically to detect and study hyaenas. The camera-trap surveys for which data were collated here had various objectives, including inventorying wildlife populations, assessing connectivity for wildlife between protected areas, monitoring forest clearings, assessing hunting impacts and recording lion presence in different areas. Therefore,

TABLE 1 Confirmed locations of different hyaena sign types.

Sign type	Latitude	Longitude	Date	Individual	Flank
Camera trap	0.033819	13.402252	02/08/2015	A	Left
Killed	−1.62673	10.38484	10/03/2016	unk	NA
Killed	0.37198	13.10274	21/10/2016	unk	NA
Camera trap	−0.186638	12.558089	30/11/2016	unk	Right
Camera trap	−0.186638	12.558089	06/08/2017	unk	Right
Camera trap	−2.09437	14.02361	25/10/2017	unk	Left
Camera trap	−2.21819	14.01646	19/11/2017	unk	Right
Track	−1.86506	13.86726	24/02/2018	unk	NA
CT video	−0.186638	12.558089	12/12/2018	B	Right
CT video	−0.186638	12.558089	13/01/2019	unk	Right
Camera trap	−0.003957	13.422343	08/08/2019	A	Right
Camera trap	0.01216	13.428278	08/08/2019	A	Right
Camera trap	−0.001947	13.384	09/08/2019	A	Left
Camera trap	0.013356	13.415456	09/08/2019	A	Right
Camera trap	0.025416	13.376422	10/08/2019	A	Left
Camera trap	0.070955	13.32363	11/08/2019	A	Right
Camera trap	0.058631	13.461174	16/08/2019	unk	Right
Camera trap	−0.037842	13.406797	20/08/2019	B	Right
Camera trap	−0.012081	13.429007	22/08/2019	B	Right
Camera trap	0.032614	13.420017	24/08/2019	B	Both
Camera trap	0.022603	13.418747	25/08/2019	B	Left
Camera trap	−0.006012	13.446845	25/08/2019	B	Right
Camera trap	0.032614	13.420017	25/08/2019	B	Left
Camera trap	−0.001947	13.384	27/08/2019	A	Left
Camera trap	0.013356	13.415456	27/08/2019	A	Right
Camera trap	−0.037842	13.406797	28/08/2019	B	Right
Camera trap	−0.001947	13.384	28/08/2019	B	Left
Camera trap	0.46052	13.74945	20/12/2020	unk	Left
Camera trap	0.46052	13.74945	30/12/2020	unk	Left
Camera trap	0.46052	13.74945	31/12/2020	unk	Left
Camera trap	0.46052	13.74945	12/01/2021	2 unk	Left
Camera trap	0.46052	13.74945	13/01/2021	unk	Right
Camera trap	0.46052	13.74945	08/02/2021	unk	Left
Camera trap	0.0233	13.41909	06/04/2021	A	Right
Camera trap	0.0233	13.41909	23/04/2021	A	Left
Camera trap	−0.36597	12.68585	10/05/2021	B	Left
Camera trap	−0.36736	12.68122	11/05/2021	unk	Right
Camera trap	−0.36597	12.68585	14/05/2021	unk	Right
Camera trap	0.0233	13.41909	28/08/2021	B	Both
Killed	−0.812325	12.7336	06/10/2021	unk	NA
Camera trap	0.078074	13.3206	18/08/2022	D	Both
Camera trap	0.022528	13.425506	12/09/2022	D	Left
Camera trap	0.022528	13.425506	08/10/2022	D	Right
Camera trap	0.027381	13.424969	15/10/2022	C	Both
Camera trap	0.022528	13.425506	17/10/2022	C	Right

TABLE 1 (Continued)

Sign type	Latitude	Longitude	Date	Individual	Flank
Camera trap	0.026067	13.374948	11/11/2022	C	Both
Camera trap	0.024864	13.294889	21/01/2023	D	Right
Camera trap	0.026981	13.424933	26/01/2023	D	Both
Camera trap	0.078074	13.3206	05/02/2023	C	Right
Camera trap	0.026981	13.424933	11/03/2023	D	Right
Camera trap	0.078074	13.3206	11/03/2023	C	Right
Camera trap	0.029046	13.422584	23/03/2023	D	Right
Camera trap	0.026067	13.374948	09/04/2023	C	Left
Camera trap	0.024496	13.457192	17/04/2023	C	Both
Camera trap	0.026981	13.424933	28/04/2023	D	Left
Camera trap	0.029046	13.422584	25/05/2023	unk	Left
Camera trap	0.02444	13.421667	07/06/2023	unk	Right
Killed	0.864006	13.588409	25/10/2023	unk	NA

Note: Multiple camera-trap pictures of the same individual on the same day are collated into a single event. The two individuals killed in 2016, the four recognisable individuals and the two other fatalities, one set of tracks and sixteen other camera trap events represent a minimum of 9 and a maximum of 13 hyaena individuals recorded in the country during the 8 years of the study.

different grid designs, placement types, camera trap models and brands were used (including Browning, Bolyguard, Bushnell or PantheraCam (Olliff et al., 2014)), all of which can influence detection probabilities (Apps & McNutt, 2018a, 2018b; Geyle et al., 2020; Kolowski & Forrester, 2017; Mann et al., 2014). We do not, therefore, attempt to infer abundances or densities.

3 | RESULTS

3.1 | Killed individuals

Our investigation revealed that four individuals had been found killed since 2015. An individual was killed by a local hunter in March 2016 because it was preying on the local livestock in a village near Mandji, in the western part of the country (Figure 1). A second individual was shot near Lastourville in October 2021, but the exact site and the context were not documented. In October 2016 and October 2023, two individuals were killed by cars in the northeast of the country (Table 1). The two individuals killed in 2016 must clearly have been different individuals from those recorded afterwards in the camera traps; however, the fatalities in 2021 and 2023 could have been animals recorded earlier by the camera trap.

3.2 | Tracks

In February 2018, a set of tracks was discovered north of Batéké Plateaux National Park (Figure 1). We do not know if these were made by an individual and also recorded by camera trap in the same landscape.

3.3 | Camera-trap data

Despite extensive camera-trapping efforts across the country, hyaena have only been documented by camera-trapping in two regions. In these two areas, four individuals were clearly identified, and we further recorded sixteen events involving unknown hyaena individuals. The different flanks recorded and the image quality of some pictures prevent an exact determination of the total number of different animals; however, the presence of a minimum of 9 and a maximum of 13 different individuals is likely from this dataset.

In the southeast of the country, a lone hyaena was photographed twice in the Batéké Plateaux National Park, in October and November 2017. Although the individuals captured looked similar in size, the respective photos show different flanks, making it impossible ascertain of those two records represent one or two individuals. No more hyaenas have been captured on camera-traps in this area since then, despite continued camera trapping effort.

In the northeast of the country, through the compilation of images from multiple studies, 85 images of hyaenas have been collated. Four different individuals have been identified from this dataset and have been recaptured multiple times. In August 2015, an adult female (Figure 2a) was captured by a camera trap near Momba baï, between Ivindo and Mwagna National Parks. The same individual was recaptured in a 10-km radius around Momba baï eight times in August 2019 and twice in April 2021.

A second female (Figure 2b) was first captured in December 2018 in Langoue baï, Ivindo National Park. She was then recaptured on multiple occasions and on multiple camera stations near Momba baï between the 20th and the 28th of August 2019, almost 100 km northeast of her first position (Figure 3). She then appeared in one of the Milole clearings southeast of Ivindo National Park in May 2021, and again in Momba baï in August 2021. Monitoring at Momba baï

FIGURE 2 Right flanks of the four individuals identified in the Momba area. The green boxes superimposed on images (a) and (b) show the different spot patterns seen in these two individuals.

had been ongoing throughout and thus her absence from August 2019 to 2021 was confirmed and not due to a gap in survey work at the site.

The two other identified individuals (Figure 2c,d) were captured near Momba baï in 2022 and were recaptured multiple times in 2023. The individual shown in Figure 2c was recaptured four times in 2023, near Momba baï, but also near another baï fourteen kilometres to the west.

4 | DISCUSSION

Our findings confirm the presence of a small, resident population of spotted hyaenas in Gabon, with one individual recorded as present over the course of 5 years, and another over 3 years. Even though hyaenas are known to be able to travel over long distances, the only study in a similar ecosystem highlighted that individuals using clearings only 50 km away from the main population in OKNP, were not linked to any of the identified clans (Bohm, 2015), therefore our repeated detection in the Momba area, over 150 km away, should belong to a specific clan. In addition, the individual shown in Figure 2d appeared to be juvenile, of an age that can be assumed to be too young for a long-distance dispersal from the nearby OKNP population, which leads us to suspect that the small resident population in the Momba area may also be breeding. Our findings were made possible by the collation of data from multiple camera-trap projects on different topics. As date- and location-stamped photographs were available, we could identify individuals by their spots, estimate their sex and age, and track their movements over time and space (Figure 3). The extensive camera trap study in the Momba baï area permitted multiple recaptures across time and revealed the repeated use of the baï clearing by an adult female (individual in Figure 2a) between 2015 and 2021. The use of forest clearings by hyaenas has been documented in OKNP, Congo, with track events and direct observation (VanLeeuwe et al., 1998) and via camera-trap pictures (Bohm, 2008). By monitoring elephant trails leading to forest clearings, the baï monitoring project led by Gabon's National Park Agency ANPN at Momba and Langoué facilitated the recapture of another individual (shown in Figure 2b) across a large, forested landscape between 2018 and 2021. This demonstrates the ability of some individuals to navigate

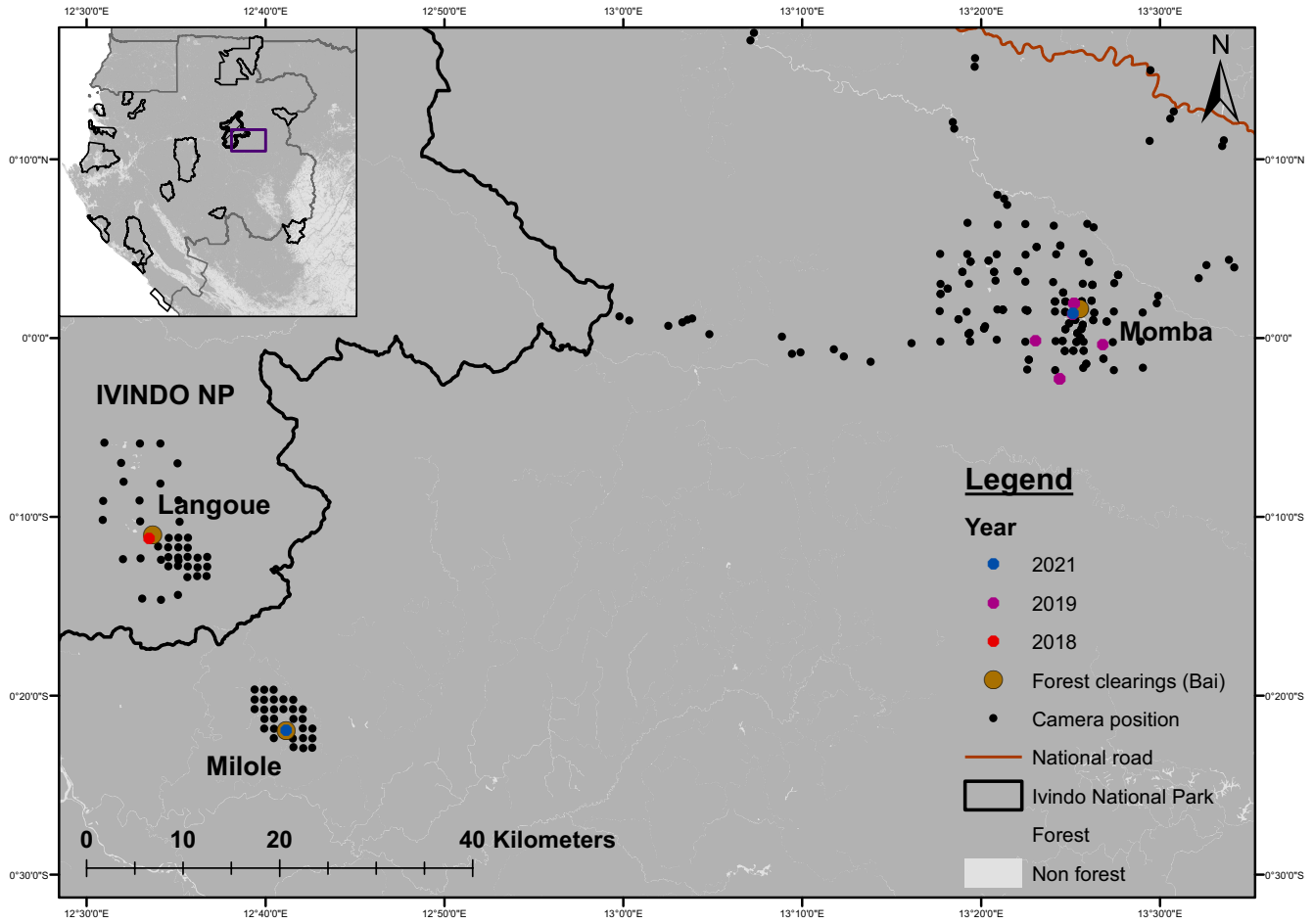

FIGURE 3 Camera trap detections of the individual shown in Figure 2b between 2018 and 2021, with camera-position in the area.

across hundreds of kilometres to reach different clearings. Former published sightings (Bout et al., 2010; Gessner et al., 2014; Henschel & Ray, 2003; Juste & Castroviejo, 1992), and recorded instances of fatalities among hyaenas in Gabon indicate that although the hyaena population in OKNP seems geographically isolated due to the presence of the rainforest surrounding the savannah mosaic, in fact, vagrant individuals can travel large distances across this dense forest habitat (Figure 1), meaning that the OKNP population could still be genetically connected to other populations. A comparative genetic study of the OKNP population and adjacent populations, like in northern Cameroon (Bauer et al., 2016; Breuer, 2005; Kirsten et al., 2018), could inform on former and potentially current gene flow in this Congo Basin population.

These valuable new results highlight the value of collating by-catch data from different projects, especially for less studied species, to update information on their distribution relative abundance and to learn more about the species' adaptations to their environment (Tarugara & Clegg, 2022). A closer look at other new technological tools, such as acoustic and eDNA, could also help us identify other areas where rare and elusive species, like hyaenas in rainforests, are present.

Very little is known about hyaena behaviour in a forested landscape like the northeast of Gabon (Wilkinson et al., 2024), but Bohm (2008) showed hyaena scats from the Maya Nord forest clearing in OKNP to contain remains of different duikers (*Cephalophus* spp.), red river hog (*Potamochoerus porcus*), forest buffalo (*Syncerus caffer nanus*), different pangolin species, putty-nose monkey (*Cercopithecus nictitans*) and sitatunga antelope (*Tragelaphus spekii*). This, combined with the description of hyaena predator activity in the same forest clearing (VanLeeuwe et al., 1998), demonstrates the potential role of hyaena as an important predator at baïs, which are known to attract multiple medium and large mammal species (Gessner et al., 2014). A further evaluation of hyaena presence and use of the network of baïs in the northeast of Gabon would help us to understand the role of baïs as 'stepping stone' sites facilitating hyaena movement through a forested habitat and would further confirm the presence of a small, breeding population in Gabon. Hyaena population recovery in Gabon may be slowed by human-induced mortality, as evidenced by our records of killed individuals, highlighting a potentially strong anthropogenic impact on their movement and restrictions on connectivity on a larger scale.

Although an update of the 2015 IUCN range map for the species has not yet been published, a future version should include Gabon as a range state and extend the known range into the parts of the country where regular records have been made (Wilkinson et al., 2024). A new decree on species' protection for Gabon (Décret n°0040bis_PR_MEFPECCHF_2023, 2023), passed

in November 2023, now includes spotted hyaena as a fully protected species, showcasing the value of a closer look at by-catch data and the impact this can have on wildlife management policies and practices.

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CONFLICT OF INTEREST STATEMENT

No conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available in the supplementary material of this article.

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