Conservation Status of Giraffe: Evaluating Contemporary Distribution and Abundance with Evolving Taxonomic Perspectives

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Abstract

Giraffe are iconic figures across a range of African landscapes but they are currently under considerable conservation threat. Although they are widely distributed throughout 21 different countries, continent-wide populations have declined considerably over the past several decades, highlighted by the International Union for the Conservation of Nature's (IUCN) new categorization of giraffe as a single species as "*Vulnerable.*" Recent genetic studies, however, propose alternative taxonomic categorizations in which giraffe are comprised of four distinct species. These proposed taxonomic classifications have considerable impact on giraffe conservation status, emphasizing the diverse challenges that giraffe face throughout Africa. Here, we describe recent studies on the taxonomic status of giraffe and examine implications for conservations status assessments. We conducted an extensive review of current giraffe abundance throughout all known populations and evaluated these updated abundance trends through the taxonomic perspective of a four species classification. We provide the most recent and comprehensive abundance estimates for wild giraffe in Africa. According to our assessment, there are approximately 117,173 giraffe in the wild. Providing the most current and accurate giraffe abundance estimates within evolving taxonomic perspectives can better guide targeted conservation efforts for these imperiled taxa.

Introduction

Giraffe are widely distributed in fragmented populations across sub-Saharan Africa, with their current range encompassing 21 different countries (O'Connor et al., 2019) (Fig. 1). Given this distribution, giraffe as a singular taxon (Dagg, 1971; Muller et al., 2018) experience a diverse suite of habitat types, land-use practices, wildlife policies, human cultural contexts, and threats. Effectively assessing the conservation status of giraffe requires a multi-scale understanding of abundance and distribution trends across both geographic regions and taxa. In an watershed moment for giraffe conservation, the International Union for the Conservation of Nature (IUCN) recently reclassified giraffe conservation status from "*Least Concern*" to "*Vulnerable*," highlighting substantial population declines occurring in key areas across Africa (Muller et al., 2018). Since this historic review of giraffe conservation status, new studies and data have emerged, providing better abundance estimates and challenging older perspectives of giraffe taxonomic identity across Africa.

Effective conservation assessments require a clear understanding of the distribution and abundance of biological diversity. Therefore, conservation status assessments are rooted in a nuanced understanding of taxonomy, distribution, abundance trends, and threats (Dubois, 2003). Inappropriate taxonomic classification, for example, may mask local (or broader) population declines and threat evaluations by generalizing patterns across improperly grouped taxa. Furthermore, conservation strategies, policy decisions, and wildlife trade agreements are often predicated on taxonomic groupings, so these distinctions are also legally consequential.

The historically disparate approaches for describing giraffe taxonomy present alternative groupings for conservation assessments (Coimbra et al., 2021; Bercovitch, 2020; Fennessy et al., 2016). Based on an interim consensus among the IUCN Species Survival Commission (SSC) Giraffe and Okapi Specialist Group (GOSG), this Red List assessment (Muller et al., 2018) used the taxonomic classification outlined by Dagg (1971), in which *Giraffa camelopardalis* is a single species with nine subspecies. In this way, assessors developed a global conservation assessment for all giraffe, and then created separate subspecies-level assessments (Bercovitch et al., 2018; Bolger et al., 2019; Fennessy and Marais, 2018; Fennessy et al., 2018a,b; Muller et al., 2018; Muneza et al., 2018b; Wube et al., 2018). The evolutionary history of giraffe, which has challenged naturalists, zoologists, and taxonomists for hundreds of years, has also strongly influenced efforts to classify the conservation status of giraffe throughout Africa (Bercovitch, 2020; Seymour, 2012; Winter et al., 2018a,b). Since the initial publication of the giraffe IUCN Red List Assessment (Muller et al., 2018), several studies have proposed alternative taxonomic classifications schemes based on newly available and more widely sampled genetic data (Coimbra et al., 2021; Fennessy et al., 2016; Petzold and Hassanin, 2020; Winter et al., 2018a,b). Evolving taxonomic perspectives therefore indicate the need for new assessments to effectively guide conservation initiatives.

In this paper, we apply the four species giraffe taxonomic scheme to assess the current abundance and distribution trends of each of these species based on the detailed findings from the primary mitochondrial, nuclear, and genomic data analyses (Coimbra et al., 2021; Fennessy et al., 2016; Winter et al., 2018a,b). We describe the historical understandings of giraffe taxonomy in relation to recent conservation assessments and use the latest available information to assess the current conservation status of all recently described giraffe taxa throughout Africa. Using a detailed literature review and drawing from insights in grey literature reports, as well as local wildlife management authority and expert communications, we compiled the most current overview of giraffe abundance in the wild (Table 1).

Taxonomic status of giraffe

Since the earliest taxonomic descriptions of giraffe hundreds of years ago, understandings of giraffe taxonomy have undergone a series of developments reflecting emerging scientific evidence, applications of different species concepts, and alternative interpretations of available data. A variety of taxonomic classifications have been proposed based on characteristics ranging from pelage pattern to geographical distribution, and cranial morphology to molecular genetics (Seymour, 2012). These diverse diagnostic characteristics coupled with different species concepts have resulted in a varied and disparate understanding of giraffe taxonomy. The widespread distribution of giraffe across much of sub-Saharan Africa coupled with the evolutionary forces of biogeography have

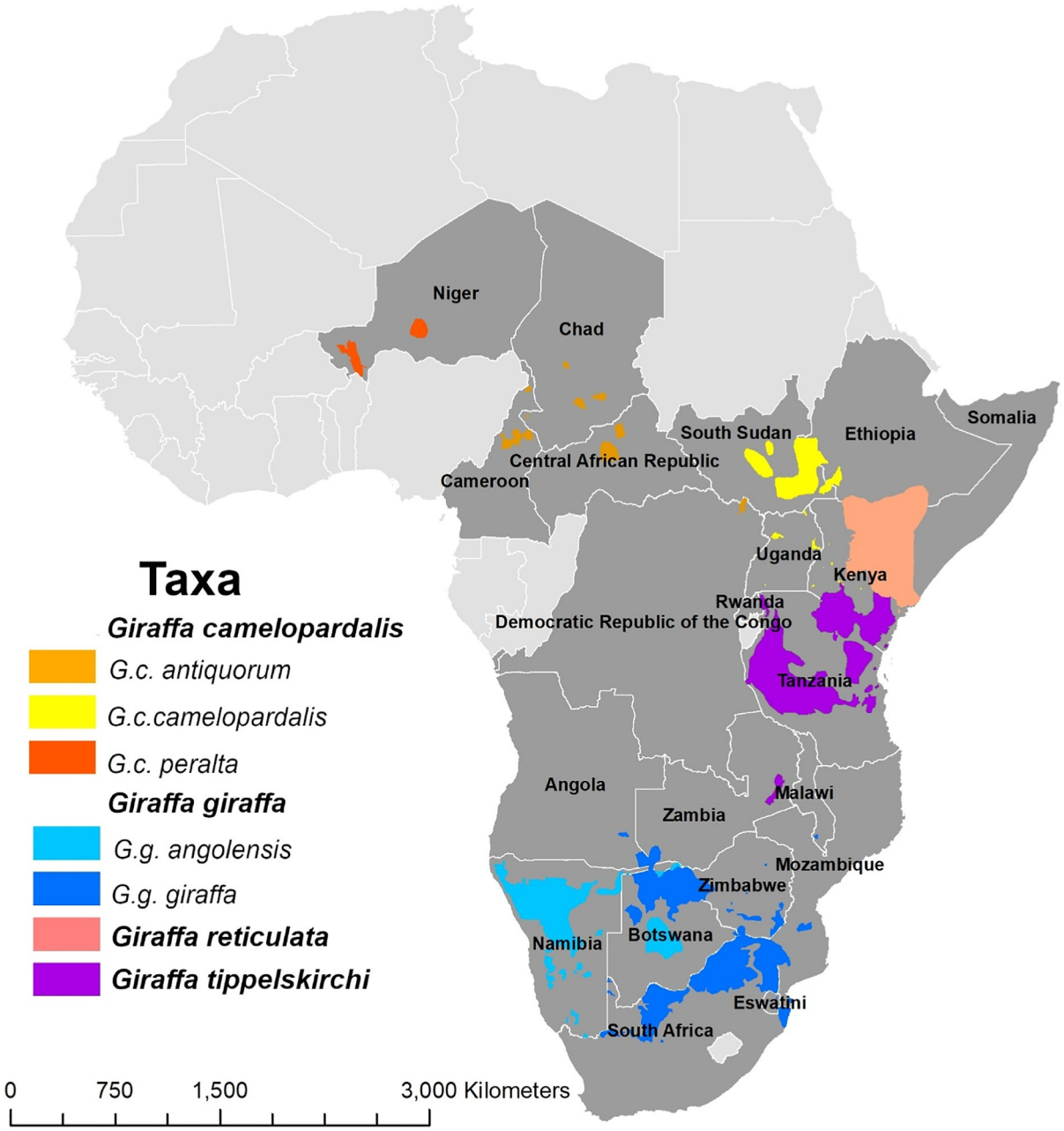

Fig. 1 A distribution map of all four species of giraffe (Fennessy et al., 2016). Range map is derived from data presented in O'Connor D, Stacy-Dawes J, Muneza A, Fennessy J, Gobush K, Chase MJ et al. (2019) Updated geographic range maps for giraffe, Giraffa spp., throughout sub-Saharan Africa, and implications of changing distributions for conservation. *Mammal Review* doi: 10.1111/mam.12165.

led to a polymorphic and genetically diverse taxon (Thomassen et al., 2013). While the complicated evolutionary history of giraffe is widely recognized, some questions around giraffe taxonomic categorization have been raised (Bercovitch et al., 2017; Bercovitch and Deacon, 2015; Fennessy et al., 2016, 2017).

The IUCN Red List Assessment for giraffe (Muller et al., 2018), was based on taxonomic classifications outlined by Dagg (1971), which categorized giraffe as a single species with nine subspecies, largely based on geographic distribution, morphology, and pelage pattern. Several subsequent studies have elaborated on these taxonomic perspectives with the advent of genetic diagnostics. Seymour (2001) described potentially six or seven subspecies based on a combination of pelage patterns, skull morphology, and mitochondrial DNA analysis. Brown et al. (2007) undertook an extensive genetic study and became the first to suggest that most giraffe subspecies formed monophyletic clades on genetic bases. The study investigated wild giraffe populations representing six of the nine recognized taxa at the time: *G. c. angolensis*, *G. c. giraffa*, *G. c. peralta*, *G. c. reticulata*, *G. c. rothschildi*, and *G. c. tippelskirchi*. Brown et al. (2007) proposed six distinct giraffe lineages, but suggested that at least eleven species could exist with five of the accepted lineages containing genetically separate populations.

Table 1 A summary of current abundance estimates and population trends for giraffe taxa across countries.

Species	*Subspecies*	*Country*	*Population Estimate*	*Trend*
Northern giraffe (*Giraffa camelopardalis*)	Kordofan giraffe (*G. c. antiquorum*)	Cameroon	760	Increasing
		Central African Republic	<50	Decreasing
		Chad	1,325	Increasing
		Democratic Republic of Congo	62	Increasing
		South Sudan	100	Unknown
		Total Kordofan	2297	
	Nubian giraffe (*G. c. camelopardalis*)	Ethiopia	<171	Decreasing
		Kenya	709	Increasing
		Uganda	1692	Increasing
		South Sudan	<450	Unknown
		Total Nubian	3022	
	West African giraffe (*G. c. peralta*)	Niger	600	Increasing
		Total West African	600	
		Total Northern	5919	
Masai giraffe (*Giraffa tippelskirchi*)		Kenya	15,807	Increasing
		Tanzania	28,850	Increasing
	Luangwa giraffe	Zambia	650	Increasing
		Rwanda (extralimital)	95	Increasing
		Total Native Masai Giraffe	45,307	
		Total Extralimital Masai Giraffe	95	
		Total Masai Giraffe	45,402	
Reticulated giraffe (*Giraffa reticulata*)		Ethiopia	<100	Decreasing
		Kenya	15,785	Increasing
		Somalia	<100	Decreasing
		Total Reticulated Giraffe	15,985	
Southern Giraffe (*Giraffa giraffa*)	Angolan giraffe (*G. g. angolensis*)	Angola	<100	Increasing
		Botswana	2129	Unknown
		Namibia	14,500	Increasing
		Zimbabwe	1897	Decreasing
		Democratic Republic of Congo (extralimital)	1	Unknown
		Nigeria (extralimital)	30	Increasing
		South Africa (extralimital)	>1500	Unknown
		Zambia (extralimital)	35	Increasing
		Total Native Angolan Giraffe	18,626	
		Total Extralimital Angolan Giraffe	1566	
		Total Angolan Giraffe	20,192	
	South African giraffe (*G. g. giraffa*)	Botswana	>8200	Unknown
		Eswatini	<250	Unknown
		Malawi	30	Increasing
		Mozambique	250	Increasing
		Namibia	250	Increasing
		South Africa	>16,000	Increasing
		Zambia	>350	Unknown
		Zimbabwe	4060	Decreasing
		Angola(extralimital)	<200	Increasing
		Democratic Republic of Congo (extralimital)	<35	Increasing
		Senegal (extralimital)	50	Increasing
		Total Native South African Giraffe	29,390	
		Total Extralimital South African Giraffe	285	
		Total South African Giraffe	29,675	
		Total Southern Giraffe (Native)	48,016	
		Total Southern Giraffe (Extralimital)	1851	
		Total Southern Giraffe	49,867	
		Total Giraffe	117,173	

Fennessy et al. (2016) undertook an extensive analysis of giraffe genetics with the first published research to include data/samples from all of the nine reported subspecies. The analysis of Fennessy et al. (2016) asserted at least four separate and monophyletic groups, which based on the genetic isolation criterion, suggested four distinct giraffe species: *G. camelopardalis* with subspecies *G. c. antiquorum, G. c. camelopardalis, G. c. peralta, and G. c. rothschildi, G. giraffa* with subspecies *G. g. giraffa* and *G. g. angolensis; G. tippelskirchi*; and *G. reticulata*. Two previously recognized subspecies *G. c. thornicrofti* and *G. c. rothschildi* were found to be indistinguishable from *G. c. tippelskirchi* and *camelopardalis* respectively and it is suggested they be subsumed accordingly. Bercovitch et al. (2017) raised concerns that the Fennessy et al. (2016) inferences were suspect and data were limited and lacked explicit gene flow analyses. Winter et al. (2018a,b) subsequently extended the analyses of Fennessy et al. (2016) to include explicit gene flow analyses with an increased dataset. Their analyses identified less than one migrant per generation, thereby supporting the four genetically distinct giraffe taxonomic classification (Winter et al., 2018a,b). As such, Winter et al. (2018a,b) proposed a revision to the IUCN giraffe taxonomy classification as greater conservation effort and support was needed for at least three of the four species that are threatened by extinction. Petzold et al. (2020) conducted an analysis of giraffe taxonomy using the original genetic data from Fennessy et al. (2016) and Winter et al. (2018a,b). Their study concluded that there was more likely a minimum of only three distinct giraffe species: *G. camelopardalis (with reticulata* subsumed into it), *G. giraffa* and *G. tippelskirchi*. Coimbra et al. (2021), subsequently conducted a whole-genome analyses of 50 giraffe from recognized subspecies to further support the delineation of four species of giraffe. Based on these latest whole genome analyses, and the growing body of literature supporting this taxonomic classification, we adopt the four species giraffe categorization for the purposes of this assessment.

Species/subspecies specific assessments

Northern giraffe (*Giraffa camelopardalis*)

2015: 4776 Giraffe, Decreasing.
2020: 5919 Giraffe, Increasing.
IUCN Red List status (as a subspecies): Not Assessed.

*Country occurrence (*Fig. 2*)*

- Native: Cameroon, Central African Republic, Chad, Democratic Republic of Congo, Ethiopia, Kenya, Niger, South Sudan, Uganda.

Overview

Consisting of the Kordofan (*G. c. antiquorum*), Nubian (*G. c. camelopardalis*) and West African (*G. c. peralta*) giraffe subspecies, the northern giraffe is distributed in small, fragmented populations across West, Central, and East Africa. According to recent studies

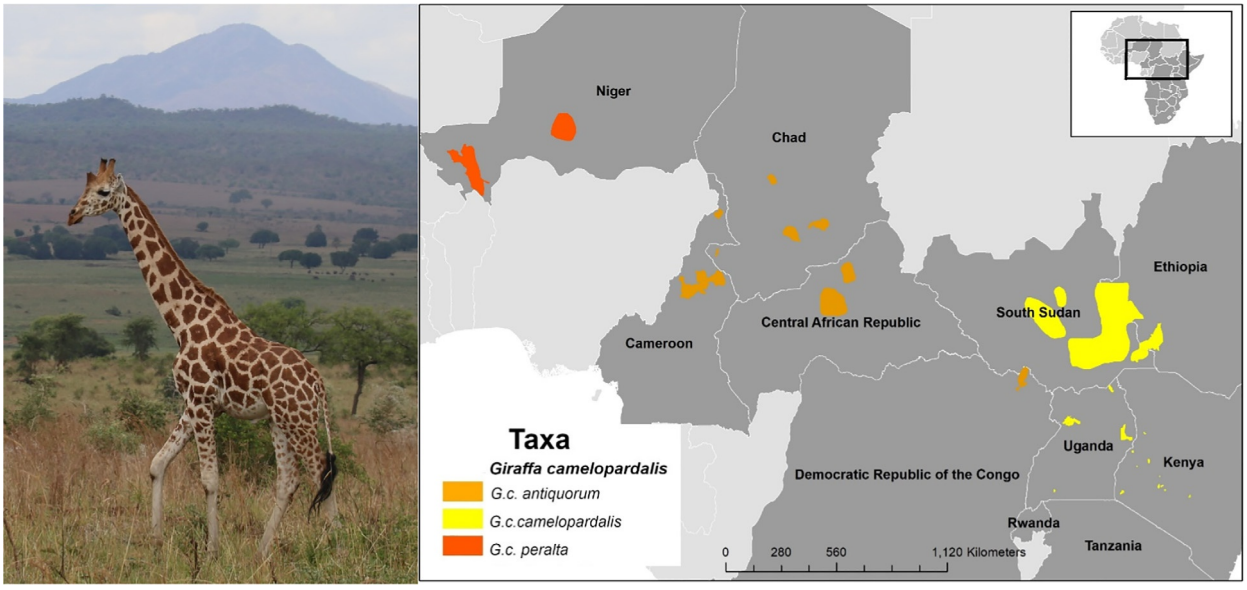

Fig. 2 A distribution map of northern giraffe (Fennessy et al., 2016). Range map is derived from data presented in O'Connor D, Stacy-Dawes J, Muneza A, Fennessy J, Gobush K, Chase MJ et al. (2019) Updated geographic range maps for giraffe, Giraffa spp., throughout sub-Saharan Africa, and implications of changing distributions for conservation. *Mammal Review* doi: 10.1111/mam.12165. Photo credits M. Brown.

(Coimbra et al., 2021; Fennessy et al., 2016; Winter et al., 2018a,b), the formerly recognized Rothschild's giraffe (*G. c. rothschildi*) is genetically indistinguishable from the Nubian giraffe and is therefore subsumed into the nominate *G. c. camelopardalis* under this taxonomic scheme.

Kordofan giraffe (*G. c. antiquorum*)

Status: Critically Endangered (Fennessy and Marais, 2018).
2015: 1942 (Muller et al., 2018).
2020: 2297 (Increasing).

Country occurrence

- Native: Cameroon, Central African Republic, Chad, Democratic Republic of Congo, and South Sudan.

Cameroon

2015: 680 giraffe; Decreasing (Marais et al., 2019a).
2020: 760 giraffe; Increasing (Marais et al., 2019a).

Kordofan giraffe in Cameroon are found predominantly in the savannahs and woodlands of the northern Sahelian zone (East, 1999). Recent security concerns in the region have made updated abundance estimates uncertain. The most recent aerial surveys were conducted in 2007 (Foguekem et al., 2010; Omondi and Mayienda, 2007). The largest recorded population of Kordofan giraffe in Cameroon is currently found in Waza National Park (NP), although numbers are uncertain (Marais et al., 2019a). Smaller populations of Kordofan giraffe are thought to persist in Bouba Ndjida, Benoue, and Faro NPs, and the neighboring hunting zones (Marais et al., 2019a).

Central African Republic

2015: <170 giraffe; Decreasing (Fennessy and Marais, 2018).
2020: <50 giraffe; Decreasing (Ferguson et al., 2020b).

Historically, Kordofan giraffe occurred in large expanses of northern Central African Republic (CAR) with relatively low human density. However, civil unrest and illegal hunting in the area has led to substantial declines in populations and increasingly restricted ranges (Bouché et al., 2010). Continued insecurity in the region has restricted additional range-wide survey efforts and limited accurate population estimates (Ferguson et al., 2020b; O'Connor et al., 2019). While it is possible that giraffe are now absent from Manovo Gounda St. Floris and Bamingui Bangoran NPs, very small numbers of giraffe may still occur in the Bamingui Bangoran and Boungou Ouadda hunting areas (Ferguson et al., 2020b).

Chad

2015: 947 giraffe; Decreasing (Fennessy and Marais, 2018).
2020: 1325 giraffe; Increasing (Marais et al., 2020b).

Kordofan giraffe were formerly distributed widely throughout central and southern Chad, but numbers and distribution have been greatly reduced through illegal hunting and changes in vegetation associated with drought and development (East, 1999). The population of Zakouma NP has increased in recent years and is currently the largest known population of Kordofan giraffe with approximately 1,200 individuals (Marais et al., 2020b). Smaller populations of Kordofan giraffe still occur in the Sinniaka-Minnai Faunal Reserve, Sena-Ouara NP, the Binder-Lere area in the Mayo Kebbi Region, the Chari Baguirmi Region, and the Yamoussa transboundary area with Cameroon. Recent reports have also confirmed the occurrence of a small population of giraffe east of Lake Fitri in central Chad (Giraffe Conservation Foundation, pers. comm.).

Democratic Republic of Congo

2015: 45 giraffe; Decreasing (Fennessy and Marais, 2018).
2020: 62 giraffe; Increasing (Marais et al., 2019b).

In the Democratic Republic of Congo (DRC), Kordofan giraffe are only thought to occur in the Garamba ecosystem. Historically, giraffe were found widely throughout the southern portions of Garamba NP, although they currently are found largely on the peripheries of the southern sector of the park and areas that extend to the Azande, Mondo Missa and Gangala na Bodio Hunting Reserves. After substantial estimated population declines in the early 2000s, enhanced protections and monitoring of this population has resulted in marginal increases over the past decade (D'haen et al., 2019).

South Sudan

2015: 100 giraffe; Decreasing (Fennessy and Marais, 2018).
2020: 100 giraffe; Stable.

The status of Kordofan giraffe in South Sudan is poorly understood. Both Kordofan and Nubian giraffe are thought to occur in South Sudan, and historically, Kordofan giraffe were thought to be distributed west of the Nile (East, 1999). Populations were previously documented in Shambe and Southern NPs, however, publicly available information on current Kordofan giraffe numbers and range in South Sudan remains limited. Kordofan giraffe in South Sudan are currently thought to be restricted to Shambe NP (Ferguson et al., 2020a).

Nubian giraffe (*G. c. camelopardalis*)

Status: Critically Endangered (Wube et al., 2018).
2015 Population: 2434.
2020 Population: 3022; Increasing.

Country occurrence:

- Native: Ethiopia, Kenya, South Sudan, Uganda.

Nubian giraffe populations in Kenya and Uganda showed steady increases in abundance due to effective conservation strategies and practices. Reliable information on the small and fragmented populations in Ethiopia and South Sudan is difficult to access. These populations may have decreased due to intense poaching in both countries. The majority of Nubian giraffe in Kenya are extralimital, a result of efforts to establish viable populations for conservation purposes (Brenneman et al., 2009). While overall Nubian giraffe numbers remain low, their recent increase is a positive trend considering their significant decline in previous decades. These increases are attributed in part to the inclusion of the formerly recognized Rothschild's giraffe into these estimates.

Ethiopia

2015: <200 giraffe (Wube et al., 2018).
2020: <171 giraffe; Decreasing.

Ethiopia's Nubian giraffe were previously widely distributed across the western lowlands but populations declined significantly due to development and illegal hunting by the latter half of the 20th century (East, 1999). Currently, Ethiopia's largest population of Nubian giraffe is in and around Gambella NP, with a small population recently confirmed in the Tama Wildlife Reserve (Marais et al., 2020c; Elkan, 2018). While Omo and Mago NPs and the Tama Steppe previously supported large populations of giraffe, recent estimates from these areas suggest either local extinction or populations numbering less than 10 individuals (Elkan, 2018).

Kenya

2015: 488 giraffe (Fennessy et al., 2018a,b).
2020: 709 giraffe; Increasing.

Although Nubian giraffe were historically distributed along much of western Kenya, increasing development and habitat fragmentation restricted their natural range predominantly to the area around Eldoret (Brenneman et al., 2009; East, 1999). Currently, most Nubian giraffe in Kenya are extralimital, established through a series of conservation translocations from this source population (Brenneman et al., 2009). Ruma and Lake Nakuru NPs, Soysambu Wildlife Conservancy, and Mwea NR also support viable populations of Nubian giraffe. Smaller populations occur in private conservation areas and captive facilities including Kigio Wildlife Conservancy, Giraffe Center, Sergoit-Kruger farm in Iten, Rimoi NR, Haller Park, Nguuni Sanctuary, Tindress, and Mt. Elgon NP (Muruana et al., 2021). Several giraffe were also re-introduced into Ruko Community Conservancy in Baringo County (Muruana et al., 2021).

Uganda

2015: 1296 giraffe (Fennessy et al., 2018b).
2020: 1692 giraffe; Increasing.

In the early 20th century, Nubian giraffe in Uganda were widely distributed north of the Nile River. However, increasing human development and periods of civil unrest led to the restriction of their range to two small populations in Murchison Falls and Kidepo Valley NPs (Brown et al., 2019). At their respective population nadirs, there were only three giraffe remaining in Kidepo Valley NP and fewer than 100 giraffe in Murchison Falls NP (Brown et al., 2019). These populations have rebounded considerably and Murchison Falls NP, north of the Nile River, currently supports the largest population of Nubian giraffe, containing approximately 50% of the known global population. Through a series of six conservation translocations beginning in 2015, over 100 Nubian giraffe were translocated from Murchison Falls NP to (re)introduce and augment populations of giraffe across Uganda. In addition to Murchison Falls NP (north of the Nile), and Kidepo Valley NP, which was augmented by a translocation from Lake Nakuru NP (Kenya) in 1997 and from Murchison Falls NP in 2018 (Brown et al., 2019; Kalema, 1998), there are growing populations in Lake Mburo NP, Murchison Fall NP (south of the Nile), and Pian Upe Wildlife Reserve (Brown et al., 2019; Fennessy et al., 2013).

South Sudan

2015: <450 giraffe (Wube et al., 2018).
2020: <450 giraffe; (Ferguson et al., 2020a).

South Sudan formerly supported large populations of giraffe estimated to exceed 9000 individuals in and around Boma NP, with a similarly large population reported in Bandingilo Reserve, northern Darfur (Wilson, 1980), southern Darfur (Wilson, 1979), and estimates of over 6000 individuals during the early dry season in Jonglei Canal survey area adjacent to Ez Zeraf Game Reserve. Years of civil unrest throughout these areas have reduced many wildlife populations, especially giraffe. Currently, most Nubian giraffe in South Sudan are thought to be limited to Boma NP and Bandingilo Reserve (Ferguson et al., 2020a). Recent sightings of giraffe were reported from the Old Fangak area in Fangak County (Giraffe Conservation Foundation, pers. comm.). Given the insecurity in the region, there is a lack of publicly available data of giraffe abundance and distribution. In recent years, vagrant giraffe have made forays into South Sudan's Kidepo Game Reserve from Uganda's Kidepo Valley NP (Ferguson et al., 2020a).

West African giraffe (*G. c. peralta*)

2015: 400 giraffe; Increasing (Muller et al., 2018).
2020: >600 giraffe; Increasing (Ferguson et al., 2020b).
Status: Vulnerable (Fennessy et al., 2018a).

Country occurrence

- Native: Niger.

West African giraffe exist predominantly outside of formally protected areas in what is known as the Giraffe Zone in the Kouré and Dallol Bosso areas of Niger. A smaller population has continued to expand into the south-central part of the country, especially in the areas of Illa, Konni, and Doutchi. These areas are dominated largely by cultivated land and small scale agriculture (Le Pendu and Ciofolo, 1999; Suraud et al., 2012). In late 2018, a small population of eight giraffe was translocated from the Giraffe Zone and successfully re-introduced into their former range in the Gadabedji Biosphere Reserve (Ferguson et al., 2021a).

Niger

West African giraffe were once widely distributed across the Sudano-sahelian area from Mauritania, Senegal, the Gambia, Mali, Niger, and Nigeria. By the end of the 20th century, however, West African giraffe were found only in small populations in Niger (Ciofolo, 1995). By 1996, only a small population of approximately 50 individuals remained near the capital city of Niamey. Through concerted conservation efforts, the population has grown considerably in the last two decades (Ciofolo, 1995; Suraud et al., 2012).

Masai giraffe (*Giraffa tippelskirchi*)

2015: 31,611 giraffe; Decreasing (Muller et al., 2018).
2020: 45,402 giraffe; Increasing.
IUCN Red List status (as a subspecies): Endangered (Bolger et al., 2019).

*Country occurrence (*Fig. 3*)*

- Native: Kenya, Tanzania, Zambia.
- Introduced: Rwanda.

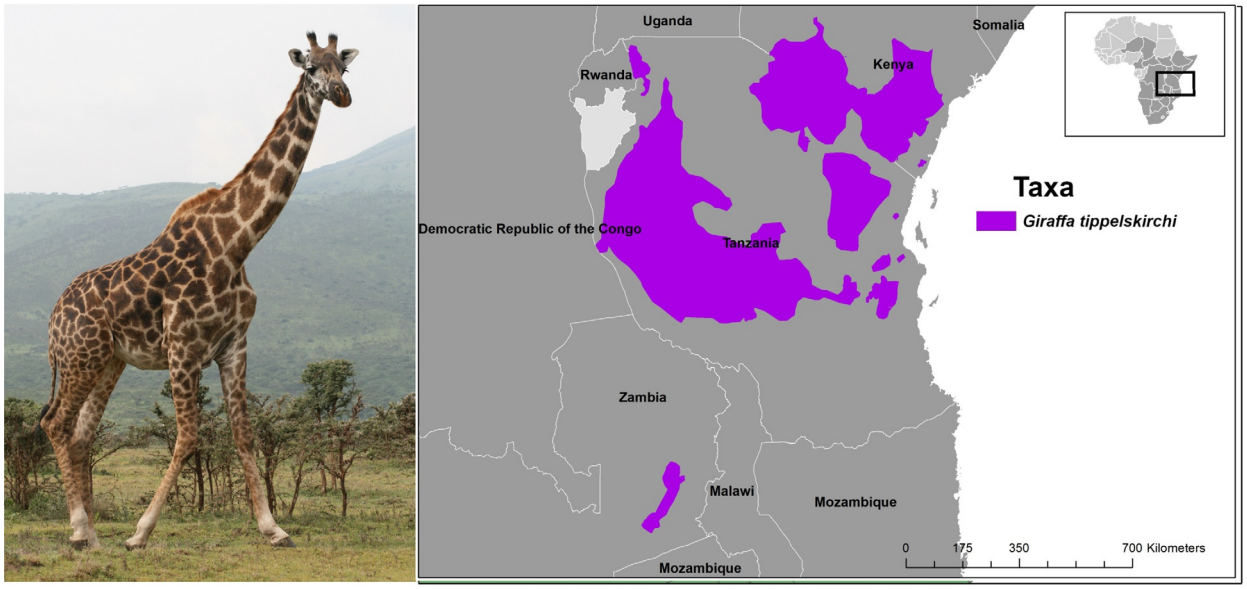

Fig. 3 A distribution map of Masai giraffe (Fennessy et al., 2016). Range map is derived from data presented in O'Connor D, Stacy-Dawes J, Muneza A, Fennessy J, Gobush K, Chase MJ et al. (2019) Updated geographic range maps for giraffe, Giraffa spp., throughout sub-Saharan Africa, and implications of changing distributions for conservation. *Mammal Review* doi: 10.1111/mam.12165. Photo credits M. Brown.

Overview

Historically, Masai giraffe were among the most populous giraffe taxa with widespread distribution across large swaths of East Africa. Currently, their range encompasses much of southern Kenya and central and northern Tanzania (O'Connor et al., 2019). In 1986, there was an extralimital introduction of six individuals from a Kenyan founder populations into Akagera NP in Rwanda (East, 1999). Recent genetic studies indicate that the formerly recognized Thornicroft's giraffe is closely related to Masai giraffe and should be subsumed as the Luangwa giraffe (*G. t. thornicrofti*)—the preferred local Zambian common name—thereby extending Masai giraffe range into the South Luangwa Valley of northern Zambia (Fennessy et al., 2016; Winter et al., 2018a,b). Despite the relatively large population estimates, the most recent IUCN subspecies assessment for Masai giraffe in 2018 listed them as '*Endangered*' because population estimates—derived largely from aerial survey data—indicated substantial declines of approximately 49–51% over the span of 30 years (Bolger et al., 2019).

Kenya

2015: 11,548 giraffe; Decreasing (Bolger et al., 2019).

2020: 15,807 giraffe; Increasing.

Historically, Masai giraffe in Kenya were distributed across ranch lands and protected areas throughout southern and eastern Kenya (East, 1999). Currently, they are found predominantly in four major ecosystems across southern Kenya: the Tsavo-Mkomazi, Amboseli, Maasai Mara, and Namanga-Magadi ecosystems (Bolger et al., 2018). Smaller populations are found in the Naivasha-Nakuru ecosystem, the Maanzoni-Malinda ecosystems, and the Athi-Kapiti and Machakos Ranches. Additionally, Nairobi and Shimba Hills NPs support small populations of Masai giraffe. The Tsavo-Mkomazi and Masai Mara ecosystems currently host the largest numbers of giraffe in Kenya and these landscapes, comprised of both public and communal areas, provide critical habitat for giraffe. In the Naivasha-Nakuru ecosystem, Masai giraffe occur throughout public, private, and communal land. Maintaining connectivity between different landscapes and land uses is key to the long-term future of Masai giraffe in Kenya (Bolger et al., 2019; Muruana et al., 2021).

Rwanda

2015: 79 giraffe; Increasing (African Parks pers. comm.).

2020: 95 giraffe; Increasing (African Parks pers. comm.).

Rwanda's sole population of giraffe occurs in the savannahs of Akagera NP. This population was established with an introduction of six giraffe from Kenya in 1986 and has continued to increase steadily with current estimates of 95–100 individuals (East, 1999, African Parks pers. comm.).

Tanzania

2015: 22,986 giraffe; Decreasing (Bolger et al., 2018).

2020: 28,850 giraffe; Increasing.

Relative to other range states, Tanzania supports one of the largest known populations of giraffe. Despite these large overall abundance estimates, habitat fragmentation and increasing human pressures on key ecosystems have led to substantial range restrictions and population declines across the country (Bolger et al., 2019). Large Masai giraffe populations in Tanzania still occur in the Serengeti, Ruaha-Rungwa, Selous-Mikumi, Tarangire-Manyara and Katavi-Rukwa ecosystems. In addition, smaller populations can be found in the Burigi-Biharamulo, Mkomazi, Malagarasi-Mwoyovosi and Sadaani ecosystems (Muneza et al., 2018a). Small populations also persist in Arusha NP (Mahenya et al., 2016), West Kilimanjaro region, Lake Natron, and Magadi/Namanga (Okello et al., 2015).

Zambia

2015: 600 giraffe; Stable (Bercovitch et al., 2018).

2020: 650 giraffe; Increasing.

IUCN Red List status (as a subspecies): Endangered.

Zambia's Luangwa giraffe (also known as Thornicroft's giraffe) have historically occurred in smaller numbers along the Luangwa River in the Petauke District and the narrow corridor between the Luangwa Valley and the Mwembezi Hills (Berry and Bercovitch, 2016). Their stronghold remains throughout the South Luangwa Valley NP and the adjacent Lupanda Game Management Area. However, their range appears to be expanding further throughout the Munyamadzi and Sandwe Game Management Areas and surrounding hunting blocks, with vagrant individuals reportedly venturing as far as the North Luangwa NP (Ferguson et al., 2021a).

Reticulated giraffe (*Giraffa reticulata*)

2015: 8661 giraffe; Decreasing (Muller et al., 2018).

2020: 15,985 giraffe; Increasing.

IUCN Red List status (as a subspecies): Endangered (Muneza et al., 2018b).

*Country occurrence (*Fig. 4*)*

- Native: Ethiopia, Kenya, Somalia.

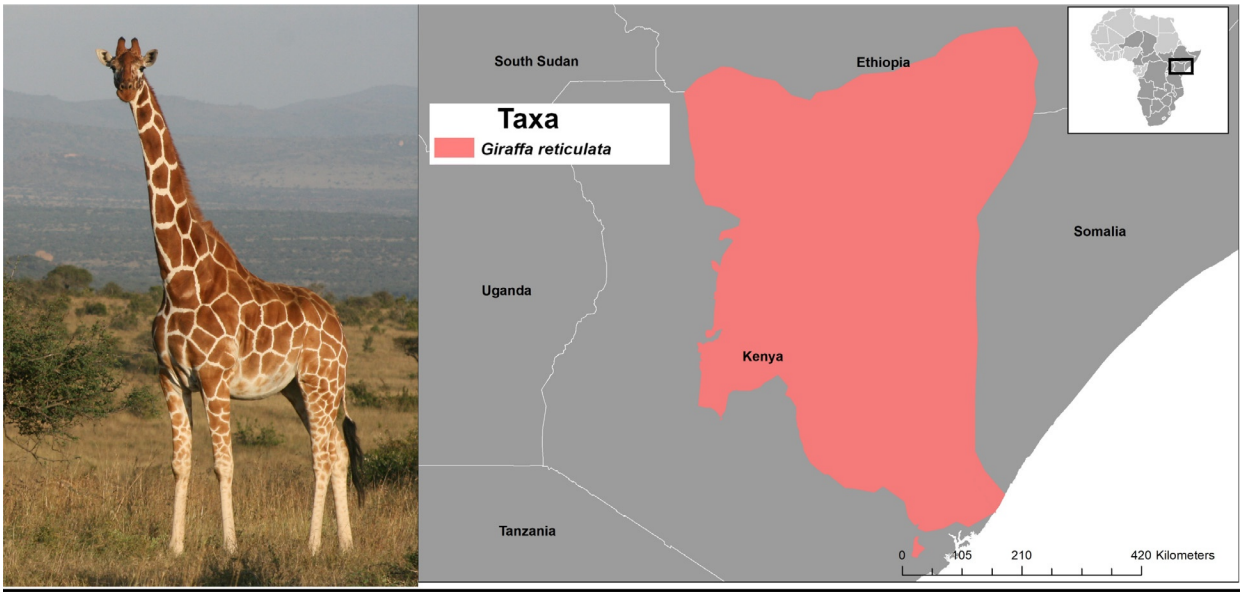

Fig. 4 A distribution map of reticulated giraffe (Fennessy et al., 2016). Range map is derived from data presented in O'Connor D, Stacy-Dawes J, Muneza A, Fennessy J, Gobush K, Chase MJ et al. (2019) Updated geographic range maps for giraffe, *Giraffa* spp., throughout sub-Saharan Africa, and implications of changing distributions for conservation. *Mammal Review* doi: 10.1111/mam.12165. Photo credits M. Brown.

Overview

Reticulated giraffe historically had a relatively limited distribution across northern Kenya, southern Somalia, and southern Ethiopia (East, 1999). Although population estimates in Ethiopia and Somalia are currently data deficient, most evidence suggests that Kenya remains the stronghold for this species with much of their current range outside of formerly protected areas in the northern Kenyan rangelands and the Laikipia Plateau (Crego et al., 2020; East, 1999). In the first-ever IUCN Red List assessment for giraffe in 2016, reticulated giraffe were estimated to number 8661 individuals (Muller et al., 2018). However, a subsequent update enumerated 15,785 reticulated giraffe (Muneza et al., 2018b). This discrepancy—and the increased current estimates—are attributed largely to the availability of more accurate data on giraffe abundance as opposed to substantial population growth.

Ethiopia

2015: <100 giraffe; Unknown (Muller et al., 2018; Muneza et al., 2018b).

2020: <100 giraffe; Possibly stable (unknown).

The status of the reticulated giraffe in Ethiopia is uncertain since no new publicly available population surveys have been conducted in the last five years. The population is assumed to be largely restricted to southwestern parts of the country, along its borders with Kenya and Somalia, with populations thought to persist in the Borana and Ogaden regions (Muneza et al., 2018b).

Kenya

2015: 8561 giraffe; Decreasing (Muneza et al., 2018b).

2020: 15,785 giraffe; Increasing.

Kenya is home to almost all remaining wild reticulated giraffe. Their range extends from the Rift Valley in central Kenya northwards to the borders with Ethiopia and Somalia and southeast to the Tana River. More specifically, the Greater Ewaso ecosystem, Laikipia District, and the northern rangelands are strongholds for reticulated giraffe across the diverse public-private-communal landscapes (Crego et al., 2020; Muneza et al., 2018b; O'Connor et al., 2019). In northeastern Kenya, reticulated giraffe range across Ijara and parts of Fafi in Garissa County, Lamu, Wajir and Mandera Counties (Muneza et al., 2018b; O'Connor et al., 2019).

Somalia

2015: <100 giraffe; Unknown.

2020: <100 giraffe; Possibly stable.

No reliable updated data exist for reticulated giraffe in Somalia. As such, it remains uncertain if any viable populations persist in the country. The last known populations of reticulated giraffe in Somalia were reported from the former Bushbush (Lag Badana) NP and surrounding areas in the Lower Juba Region in the far southern corner of the country bordering with Kenya (Marais et al., 2013b; O'Connor et al., 2019). Reticulated giraffe in Somalia are likely to occur only in low numbers and/or as vagrants (Muneza et al., 2018b).

Southern giraffe (*Giraffa giraffa*)

2015: 51,969 giraffe (Muller et al., 2018).
2020: 48,016 giraffe; Increasing.
2020: 1851 extra-limital giraffe.
2020: 1534 hybrid giraffe, not included in overall estimates (Angolan/South African).
IUCN Red List status (as a species): Not Assessed.

*Country occurrence (*Fig. 5*)*

- Native: Angola, Botswana, Eswatini, Malawi, Mozambique, Namibia, South Africa, Zambia, Zimbabwe.
- Extralimital: Democratic Republic of Congo, Nigeria, Senegal.

Overview

The southern giraffe consists of two subspecies: the Angolan giraffe (*G. g. angolensis*) and the South African giraffe (*G. g. giraffa)* (Fennessy et al., 2016; Winter et al., 2018a,b). Distributed across much of southern Africa and more widely through extralimital introductions, the southern giraffe is the most abundant giraffe species. Although anthropogenic development and intensive hunting led to reduced giraffe population during the first half of the 20th century, southern giraffe have increased dramatically in abundance over the past 30 years. This increase in abundance across their range is attributed to increased availability of habitat in formal protected areas and a large network of privately managed ranches, game farms, and reserves (Deacon and Tutchings, 2019; Marais et al., 2018). Given the intensive management of southern giraffe in key range states and the relatively frequent translocation of giraffe through networks of protected areas, private ranches, game farms, and conservancies, hybridization of these recognized subspecies may threaten their genetic distinctness (Deacon and Tutchings, 2019; Marais et al., 2018).

Angolan giraffe (*G. g. angolensis*)

2015: 14,748 giraffe; Increasing (Marais et al., 2018).
2020: 18,626 giraffe; Increasing.
Extralimital—1,566 giraffe.
IUCN Red List status (as a subspecies): Least Concern (Marais et al., 2018).

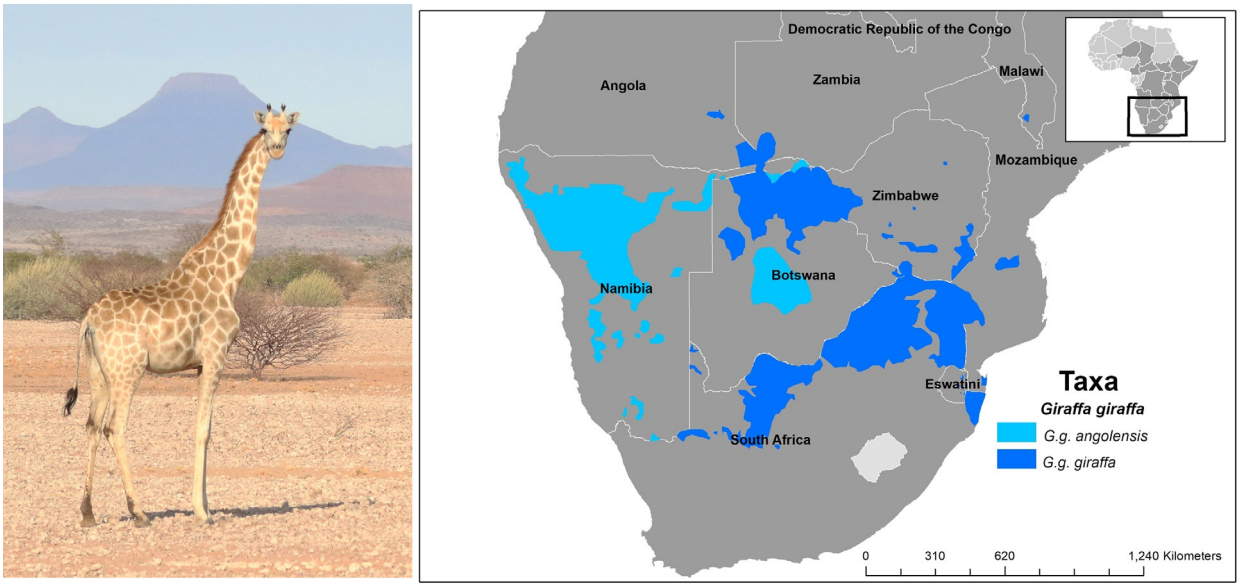

Fig. 5 A distribution map of southern giraffe (Fennessy et al., 2016). Range map is derived from data presented in O'Connor D, Stacy-Dawes J, Muneza A, Fennessy J, Gobush K, Chase MJ et al. (2019) Updated geographic range maps for giraffe, Giraffa spp., throughout sub-Saharan Africa, and implications of changing distributions for conservation. *Mammal Review* doi: 10.1111/mam.12165. Photo credits M. Brown.

Country occurrence

- Native: Angola, Botswana, Namibia, Zimbabwe.
- Extralimital: Democratic Republic of Congo, Nigeria, South Africa, Zambia.

The Angolan giraffe is widely distributed across several southern African range states and has been introduced extralimitally in several countries. Central and northern Namibia is the current stronghold for the Angolan giraffe. They extend in isolated properties throughout southern Namibia and eastwards into Botswana's Central Kalahari Game Reserve and Khutse Game Reserve and further east into some properties across southern Zimbabwe including Bubye Valley Conservancy. Northwards, Angolan giraffe have been introduced into the eastern Zambezi Region in Namibia and across the border into southwestern Zambia.

The exact range of Angolan giraffe across southern Africa is yet to be fully quantified with numerous translocations of Angolan giraffe from Namibia and South African giraffe from South Africa occurring across southern Africa. Additionally, extralimital introductions were undertaken recently to DRC, Nigeria, South Africa and Zambia.

Angola

2015: <50 giraffe; Increasing.
2020: <100 giraffe; Increasing.

Angolan giraffe were historically distributed across the savannahs of southern Angola and in the 1960s several hundred were reported in Mupa NP—Cafima area and the Mucoso area (East, 1999). East (1996) suggests that they were extirpated from these areas by the late 1980s, and few, if any, naturally persisted anywhere in Angola. Angolan giraffe have subsequently been re-introduced from Namibia to several private game farms in Angola. The small number of populations on private game farms across southern Angola range from near Bicuar NP in the west across to just north of Cuito Cuanavale (Marais et al., 2020a). The population has increased marginally, though precise numbers are unknown. Anecdotal reports suggest that Angolan giraffe may still survive in the eastern part of Mupa NP, although these animals are potentially the result of re-introductions rather than population range expansion (Marais et al., 2020a).

Botswana

2015: 1,450 giraffe; Increasing (Marais et al., 2018).
2020: 2,129 giraffe; Unknown.

The current distribution of Angolan giraffe in Botswana is mostly relegated to a large population in Central Kalahari Game Reserve, extending south into Khutse Game Reserve. Some uncertainty remains whether Angolan, South African, or both giraffe subspecies were introduced to small private farmland/ranges in western and southern Botswana.

Namibia

2015: 12,000 giraffe; Increasing (Marais et al., 2018).
2020: 14,500 giraffe; Unknown.

Angolan giraffe are distributed across a range of national parks, private farms, and communal land mostly in northern Namibia from the Kunene Region in the northwest to Khaudum and Mahango NPs. Angolan giraffe can be found in several protected areas in Namibia including: Etosha, Daan Viljoen, Hardap, Naute, Von Bach, and Waterberg Plateau National/Game Parks and the Palmwag, Etendeka and Hobatere Concession areas. They also currently occur across several communal conservancies in northwestern, north central, and northeastern Namibia, as well as commercial conservancies in central Namibia, largely due to reintroduction efforts. In the Erongo and Khomas Regions, large numbers of Angolan giraffe occur on private lands. Additionally, Angolan giraffe were introduced extralimitally into the Zambezi Region. The apparent increase in giraffe abundance relative to the 2015 estimates is likely a combination of more reliable population estimates and actual population growth.

Zimbabwe

2015: 3000 giraffe; Decreasing.
2020: 1897 giraffe; Decreasing.

Although Angolan giraffe were not thought to historically occur in Zimbabwe, recent genetic studies indicate that they occur naturally in Bubye Valley Conservancy and preliminary reports suggest the presence of hybrids (*G. g. angolensis* / *G. g. giraffa*) in the Save Valley Conservancy (Winter et al., 2018b). As such, the current estimate for Angolan giraffe suggests a minimum of 1897 individuals on Bubye Valley, and potentially 1534 hybrids on Save Valley Conservancy (GCF pers. comm). Given these recent taxonomic findings, it is possible that other populations in Zimbabwe are not South African giraffe as previously assumed.

Extralimital populations

Democratic Republic of Congo

2015: 0 giraffe.

2020: 1 giraffe; Unknown (extralimital).

Extralimital populations of Angolan giraffe were recently introduced into several wildlife reserves in the DRC. Between 2017 and 2019, 21 Angolan giraffe were introduced to Parc de la Vallee de la Nsele (Marais et al., 2019b). Another four giraffe were introduced to Mateba Island, close to the southern border with Angola (Marais et al., 2019b). Unfortunately, most giraffe have not survived.

Nigeria

2015: 10 giraffe; Increasing.

2020: 30 giraffe; Increasing (extralimital).

Historically, giraffe were distributed across Nigeria (likely *G. c. peralta*). By the 1960s, however, only infrequent accounts of giraffe were reported, likely vagrants from both Niger and Cameroon, with no natural resident populations remaining (Dagg and Foster, 1982). In 2006, the Namibian government donated Angolan giraffe as an extra-limital introduction to the Nigerian government. Angolan giraffe are currently restricted to Sumu Wildlife Park, located within the Lame Burra Reserve in Bauchi State, Nigeria and are now estimated to number 30 individuals (Ferguson et al., 2021a). Internal translocations in the country are currently occurring with small populations being established in various captive facilities in the south of the country (Giraffe Conservation Foundation pers. comm.).

South Africa

2015: Unknown.

2020: >1,500; Unknown.

Historically, Angolan giraffe were not thought to occur naturally in South Africa. Recent findings suggest that their taxonomic status is less certain than previously thought, and throughout the Free State Province—where uncertainty around their historical distribution exists—introductions have resulted in a mix of South African, Angolan and hybrid populations (Van Niekerk et al., 2019). Throughout South Africa, >17,500 giraffe reside in a combination of national protected areas and private land, but their taxonomic identify is unresolved. The majority of these giraffe are likely South African giraffe, although obtaining accurate figures is difficult (Deacon and Tutchings, 2019). Extra-limital introductions of Angolan giraffe continue throughout South Africa, resulting in increased extralimital abundance and range.

Zambia

2015: 17 giraffe.

2020: 35 giraffe; Increasing.

Historically, Angolan giraffe were not thought to naturally occur in Zambia. Recent studies indicate that their taxonomic status is less certain than previously thought (Bock et al., 2014). In recent years, a small population of Angolan giraffe was introduced and subsequently augmented from Namibia to Simalaha Community Conservancy (Du Raan et al., 2014). This small population has increased and is now estimated at 35 individuals (GCF pers. comm.).

South African giraffe (*G. g. giraffa*)

2015: 21,387; Increasing (Muller et al., 2018).

2020: 29,390 giraffe; Increasing.

Extra-limital—285 giraffe.

IUCN Red List status (as a subspecies): Not Assessed.

Country occurrence

- Native: Botswana, Eswatini, Malawi, Mozambique, Namibia, South Africa, Zambia, Zimbabwe.
- Extralimital: Angola, Democratic Republic of Congo, Senegal.

The South African giraffe is natively distributed across southeastern Angola through northern South Africa, Zambia, Eswatini and Zimbabwe. Additionally, South African giraffe were extralimitally introduced to several countries through a series of translocations. Large numbers of South African giraffe are managed on privately held property, challenging efforts for effective population estimates. Like their Angolan giraffe counterparts, populations of South African giraffe are generally through to be stable or increasing, but the potential impacts of hybridization with Angolan giraffe as a result of translocations is unknown.

Botswana

2015: 8000 giraffe (Ferguson et al., 2021b).

2020: >8200 giraffe; Likely increasing.

Formerly, Botswana supported large populations of giraffe across much of the central and northern regions of the country (East, 1999). Botswana remains home to important populations of South African giraffe, although no new systematic surveys have been undertaken in the last 5 years. The majority of giraffe across the western, northern, and eastern districts are thought to be South African giraffe, although this distinction remains unsubstantiated with genetic data. Re-introductions of giraffe into private areas have occurred over the past decades, resulting in increased numbers and range.

Eswatini

2015: <250 giraffe.
2020: <250 giraffe; Unknown.

Giraffe in Eswatini were thought to historically occur north of the Nkomati River, although these giraffe have all likely been extirpated (East, 1999). Several translocations from Namibia and South Africa reintroduced giraffe to Eswatini, resulting in today's estimated population of <250 individuals. The giraffe occur in two protected areas: Hlane Royal NP and Mkhaya Game Reserve, as well as on private establishments: Mbuluzi Game Reserve, Mhlosinga Nature Reserve, Nisela Ranch, Oberland, Inyoni Yami Swaziland Irrigation Scheme, Panata River Lodge, Canterbury Estates, and Royal Jozini Private Estate (East, 1999). Given the uncertain taxonomic origin of these reintroduced founder populations, the possibility of hybridization in these populations remains high (Marais et al., 2013b).

Malawi

2015: 10 giraffe (Marias et al., 2020d)).
2020: 30 giraffe; Increasing.

The historic status and distribution of giraffe in Malawi is unclear, with some studies suggesting that giraffe did not occur there in recent history. Through a series of translocations, small populations of South African giraffe were established in Kuti Game Reserve, Nyala Park, and Game Haven Park (Marais et al., 2020d). Additionally, in 2018, 13 giraffe were introduced to Majete Wildlife Reserve from a private game park in South Africa (O'Connor et al., 2019).

Mozambique

2015: <150 giraffe (Ferguson et al., 2020a).
2020: 250 giraffe; Increasing (Ferguson et al., 2020a).

It is believed that giraffe historically occurred in Mozambique only south of the Save River (East, 1999), however, recent evidence seems to suggest their historical occurrence north of the Save River (Giraffe Conservation Foundation pers. comm.). Years of conflict led to the extirpation of giraffe throughout the country (East, 1999). Recently, giraffe were reintroduced to several areas of Mozambique through a series of translocations to Limpopo and Zinave NPs, and Maputo Special Reserve. Additionally, the Greater Lebombo Conservancy supports a small population of giraffe which may have naturally existed and or been recolonized naturally from South Africa (Ferguson et al., 2020a,b,c,d).

Namibia

2015: 100 Giraffe (Craig and Gibson, 2013).
2020: 250 Giraffe; Increasing.

Historically, South African giraffe were not thought to naturally occur in Namibia. Recent genetic studies suggest that giraffe in Bwabwata NP, Zambezi Region, are South African giraffe (Bock et al., 2014). The population of 250 individuals appears to have increased markedly in the last 5 years and is potentially a result of immigration from Angola and Botswana.

South Africa

2015: >17,272 giraffe.
2020: >16,000 giraffe; Unknown.

South Africa likely remains the stronghold of the South African giraffe, although numerous introductions over the last four decades from Namibia have resulted in extralimital and hybrid populations with Angolan giraffe. Recent findings suggest that their taxonomic status is less certain than previously thought. As an example, the Free State Province appears to be a mix of both southern giraffe species—and hybrids (Van Niekerk et al., 2019).

The majority of giraffe across northern South Africa and south into Kwa Zulu Natal and throughout the Cape, are assumed to be South African giraffe. Re-introductions of giraffe back into a number of private and communal conservation areas have continued in South Africa over the past 5 years, likely increasing numbers and range.

Zambia

2015: <260 giraffe.

2020: >350 (private) giraffe; Increasing (unknown).

Historically, South African giraffe occurred throughout southwest Zambia, however, recent genetic studies cast doubt on the taxonomic identity of giraffe in Zambia's private lands (Bock et al., 2014). The South Africa giraffe on Zambia's private game farms and properties are largely descended from individuals imported in the late 1980s and 1990s from the Lowveld of Zimbabwe, and consequently their taxonomic identity is unresolved. Analysis of giraffe in Sioma Ngwezi National Park, Mosi-oa-Tunya National Park, and several nearby properties indicate they are all South African giraffe, and their numbers continue to increase (Fennessy et al., 2016).

Zimbabwe

2015: 4985 giraffe.

2020: 4060 giraffe; Decreasing (Fennessy et al., 2020).

South African giraffe have occurred widely throughout much of western and southern Zimbabwe, and they are still present in protected areas, private conservancies, and game ranches across their traditional range (East, 1999). South African giraffe currently occur in Gonarezhou NP, including Malapati Safari Area in the Southeast, and potentially in southern private conservation areas, the Tuli Safari Area in southwestern Zimbabwe, and Matabeleland (including Hwange, Zambesi P, and Kazuma Pan NPs, and the Matetsi and Denka Safari Areas) (Fennessy et al., 2020). Many smaller private ranches and properties in central Zimbabwe also support small numbers of South African giraffe. Assumed to occur throughout Zimbabwe, recent findings show that South African giraffe do not naturally inhabit the Bubye Valley Conservancy and preliminary reports suggest hybrids with Angolan giraffe exist in the Save Valley Conservancy (Winter et al., 2018b).

Extralimital

Angola

2015: <100 giraffe.

2020: <200 giraffe; Increasing.

Angola's South African giraffe population declined significantly until the end of the civil war in the early 2000s (East, 1999). Following re-introduction of giraffe in the early 2000s from South Africa's Madikwe NP to Kissama NP, numbers have increased to almost 50 individuals (Marais et al., 2020a). South African giraffe have since slowly started to naturally repopulate Luengue-Luiana and Mavinga NPs from Namibia's Bwabwata NP (Marais et al., 2020a).

Democratic Republic of Congo

2015: <10 giraffe.

2020: <35 giraffe; Increasing.

Extralimital populations of South African giraffe have been introduced to several private wildlife reserves and properties in the DRC. Both Mikembo Sanctuary and Society Virginia, the governor's property in Lubumbashi, have small but increasing giraffe populations, all originally introduced from Zambia. Additionally, a small number of giraffe were introduced to "Ferme Espoir" (Hope Farm), near Lubumbashi, from Zimbabwe. The largest number of giraffe occur in Muyambo Park (Marais et al., 2019b).

Senegal

2015: <10 giraffe.

2020: 50 giraffe; Increasing.

Historically, giraffe in Senegal were likely *G. c. peralta*, distributed across the Sahelian savannahs of the central and eastern regions (East, 1999). By 1954, illegal hunting led to their extirpation from their remaining stronghold in Niokolo Koba NP, thus signaling the extirpation of giraffe in Senegal (Malyjurkova et al., 2014). By 1971, seven Kordofan giraffe were introduced to Niokolo Koba NP, but they did not reproduce and all individuals died soon thereafter (Malyjurkova et al., 2014). In 1997, four South African giraffe were translocated to Bandia Reserve. Subsequent translocations introduced giraffe to Fathala Reserve in 2003 (Malyjurkova et al., 2014). Both populations continue to grow.

References

Bercovitch FB (2020) Giraffe taxonomy, geographic distribution and conservation. *African Journal of Ecology* 58(2): 150–158. https://doi.org/10.1111/aje.12741.

Bercovitch FB and Deacon F (2015) Gazing at a giraffe gyroscope: Where are we going? *African Journal of Ecology* 53(iv): 135–146.

Bercovitch FB, Berry PSM, Dagg A, Deacon F, Doherty JB, Lee DE, et al. (2017) How many species of giraffe are there? *Current Biology* 27(4): R136–R137. https://doi.org/10.1016/j.cub.2016.12.039.

Bercovitch F, Carter K, Fennessy J and Tutchings A (2018) *Giraffa camelopardalis* ssp. *thornicrofti*, The IUCN Red List of Threatened Species 2018.

Berry PSM and Bercovitch FB (2016) Population census of Thornicroft's giraffe Giraffa camelopardalis thornicrofti in Zambia, 1973-2003: Conservation reassessment required. *Oryx* 50(4): 721–723. https://doi.org/10.1017/S003060531500126X.

Bock F, Fennessy JT, Bidon T, Tutchings A, Marais A, Deacon F, and Janke A (2014) Mitochondrial sequences reveal a clear separation between Angolan and south African giraffe along a cryptic rift valley. *BMC Evolutionary Biology* 14(1): 219. https://doi.org/10.1186/s12862-014-0219-7.

Bolger D, Ogutu J, Strauss M, Lee D, Muneza A, Fennessy J and Brown D (2019). *Giraffa camelopardalis* ssp. tippelskirchi. *The IUCN Red List of Threatened Species* 2019: 8235. doi: 10.2305/IUCN.UK.2019-1.RLTS.T88421036A88421121.en.

Bouché P, Renaud PC, Lejeune P, Vermeulen C, Froment JM, Bangara A, et al. (2010) Has the final countdown to wildlife extinction in northern Central African Republic begun? *African Journal of Ecology* 48(4): 994–1003. https://doi.org/10.1111/j.1365-2028.2009.01202.x.

Brenneman RA, Bagine RK, Brown DM, Ndetei R, and Lousi EE (2009) Implications of closed ecosystem conservation management: The decline of Rothschild's giraffe (Giraffa camelopardalis rothschildi) in Lake Nakuru National Park, Kenya. *African Journal of Ecology* 47: 711–719.

Brown DM, Brenneman RA, Koepfli KP, Pollinger JP, Milá B, Georgiadis NJ, et al. (2007) Extensive population genetic structure in the giraffe. *BMC Biology* 5: 1–13. https://doi.org/10.1186/1741-7007-5-57.

Brown MB, Bolger DT, and Fennessy J (2019) All the eggs in one basket: A countrywide assessment of current and historical giraffe population distribution in Uganda. *Global Ecology and Conservation* 19: e00612. https://doi.org/10.1016/j.gecco.2019.e00612.

Ciofolo I (1995) West Africa's last giraffes: The conflict between development and conservation. *Journal of Tropical Ecology* 11(4): 577–588.

Coimbra RTF, Winter S, Kuma V, Koepfli K, Gooely RM, Dobrynin P, Fennessy J, and Janke A (2021) Whole-genome analysis of giraffe supports four distinct species. *Current Biology* 31: 2929–2938.

Craig GC and Gibson DStC (2013) Aerial survey of elephants & other wildlife in the Caprivi. In: *Ministry of Environment and Tourism (MET) and World Wildlife Fund (WWF)*. Namibia: Windhoek.

Crego RD, Ogutu JO, Wells HBM, Ojwang GO, Martins DJ, Leimgruber P, and Stabach JA (2020) Spatiotemporal dynamics of wild herbivore species richness and occupancy across a savannah rangeland: Implications for conservation. *Biological Conservation* 242: 108436.

D'haen M, Fennessy J, Stabach JA, and Brandlová K (2019) Population structure and spatial ecology of Kordofan giraffe in Garamba National Park, Democratic Republic of Congo. *Ecology and Evolution* 9(19): 11395–11405. https://doi.org/10.1002/ece3.5640.

Dagg AI (1971) Giraffa camelopardalis. *Mammalian Species* 5: 1. https://doi.org/10.2307/3503830.

Dagg AL and Foster JB (1982) *The Giraffe: Its Biology, Behavior, and Ecology*. Malabar, FL: Kreiger Publishing Company.

Deacon F and Tutchings A (2019) The south African giraffe Giraffa camelopardalis giraffa: A conservation success story. *Oryx* 53(1): 45–48. https://doi.org/10.1017/S0030605317001612.

Du Raan R, Marais AJ, Fennessy S, Bercovitch FB and Fennessy JT (2014) *Country profile: A rapid assessment of the giraffe conservation status in the Republic of Zambia*. Giraffe Conservation Foundation, Windhoek, Namibia, 2, September, 0–64. Retrieved from https://zambia.unfpa.org/sites/default/files/pub-pdf/Final.7NDP.Implementation.Plan.9.April_2018.pdf.

Dubois A (2003) The relationships between taxonomy and conservation biology in the century of extinctions. *Comptes Rendus Biologies* 326(supplement 1): 9–21. https://doi.org/10.1016/s1631-0691(03)00022-2.

East R (1999) African antelope database 1998. In: *IUCN/SSC Antelope Specialist Group*. Retrieved from: http://books.google.com/books?hl=en&lr=&id=59Ci3C8BCmEC&oi=fnd&pg=PR7&dq=African+Antelope+Database+1998&ots=AGpWPs6cAZ&sig=GjowMasjvNknLoC4VlaD4IrnNnY

Elkan P (2018) *WCS Aerial and Terrestrial Reconnaissance Survey Gambella-Omo-Tana-Mago November 2018*. WCS Unpublished Data.

Fennessy J and Marais A (2018) *Giraffa camelopardalis* ssp. antiquorum. *The IUCN Red List of Threatened Species* 2018: e.T8842074. https://doi.org/10.2305/IUCN.UK.2018- 2.RLTS.T88420742A88420817.

Fennessy JT, Marais AJ and Fennessy S (2013) *Country Profile: A Rapid Assessment of the Giraffe Conservation Status in the Republic of Uganda*. Windhoek, Namibia.

Fennessy J, Bidon T, Reuss F, Kumar V, Elkan P, Nilsson MA, et al. (2016) Multi-locus analyses reveal four giraffe species instead of one. *Current Biology* 26(18): 2543–2549. https://doi.org/10.1016/j.cub.2016.07.036.

Fennessy J, Winter S, Reuss F, Kumar V, Nilsson MA, Vamberger M, Fritz U, and Janke A (2017) Response to "How many species of giraffe are there?" *Current Biology* 27(4): R137–R138. https://doi.org/10.1016/j.cub.2016.12.045.

Fennessy J, Marais A and Tutchings A (2018a) *Giraffa camelopardalis* ssp. peralta,. *The IUCN Red List of Threatened Species* 2018: e.T136913A. doi: 10.2305/IUCN.UK.2018-2.RLTS.T136913A51140803.en%0ACopyright.

Fennessy S, Fennessy J, Muller Z, Brown M and Marais A (2018b) *Giraffa camelopardalis* ssp. rothschildi. *The IUCN Red List of Threatened Species* 2018. doi: 10.2305/IUCN.UK.2018-2.RLTS.T174469A51140829.en%0ACopyright.

Fennessy JT, Ferguson S, and Fennessy S (2020) *Republic of Country Profile: A Rapid Assessment of the Giraffe Conservation Status in the Republic of Zimbabwe*. Windhoek, Namibia: Giraffe Conservation Foundation.

Ferguson S, Almeida J, Fennessy S, Marais AJ, and Fennessy JT (2020a) *Country Profile: A Rapid Assessment of the Giraffe Conservation Status in the Republic of Mozambique*. Windhoek, Namibia: Giraffe Conservation Foundation. https://doi.org/10.5089/9781513542515.002.

Ferguson S, Fennessy S, Marais AJ, Pourchier C, Zabeirou RM, and Fennessy JT (2020b) *Country Profile: A Rapid Assessment of the Giraffe Conservation Status in the Republic of Niger*. Windhoek, Namibia: Giraffe Conservation Foundation1–10.

Ferguson S, Marais AJ, Fennessy S, and Fennessy J (2020c) *Country Profile: A Rapid Assessment of the Giraffe Conservation Status in South Sudan*. Windhoek, Namibia: Giraffe Conservation Foundation. https://doi.org/10.5089/9781513561356.002.

Ferguson S, Marais AJ, Fennessy S, and Fennessy JT (2020d) *Country Profile: A Rapid Assessment of the Giraffe Conservation Status in the Central African Republic*. Windhoek, Namibia: Giraffe Conservation Foundation. https://doi.org/10.1163/9789004430013_023.

Ferguson S, Happold DCD, Fennessy S, and Fennessy JT (2021a) *Country Profile: A Rapid Assessment of the Giraffe Conservation Status in Nigeria*. Windhoek, Namibia: Giraffe Conservation Foundation. https://doi.org/10.1007/978-3-030-42088-8_19.

Ferguson S, Fennessy S, van Mourik EM, and Fennessy J (2021b) Country Profile: A rapid assessment of the giraffe conservation status in Botswana. In: *Giraffe Conservation Foundation*. Namibia: Windhoek.

Foguekem D, Tchamba MN, and Omondi P (2010) Aerial survey of elephants (Loxodonta africana africana), other large mammals and human activities in Waza National Park, Cameroon. *African Journal of Environmental Science and Technology* 4(6): 401–411. https://doi.org/10.5897/ajest09.158.

Kalema G (1998) Translocation of Rothschild's giraffes Giraffa camelopardalis rothschildi from Kenya to Uganda. *Re-Introduction News* 15: 8–10.

Le Pendu Y and Ciofolo I (1999) Seasonal movements of giraffes in Niger. *Journal of Tropical Ecology* 15: 341–353.

Mahenya O, Mathisen KM, Andreassen HP, and Skarpe C (2016) Hierarchical foraging by giraffe in a heterogeneous savannah, Tanzania. *African Journal of Ecology* 54: 136–145.

Malyjurkova L, Hejzlarova M, Vymyslicka PJ, and Brandlova K (2014) Social preferences of translocated giraffes (Giraffa camelopardalis giraffa) in Senegal: Evidence for friendship among females? *Agricultura Tropica et Subtropica* 47(1): 5–13. https://doi.org/10.2478/ats-2014-0001.

Marais AJ, Fennessy S, and Fennessy JT (2013a) *Country Profile: A Rapid Assessment of the Giraffe Conservation Status in the Federal Republic of Somalia*. Windhoek, Namibia: Giraffe Conservation Foundation. Retrieved from: https://en.wikipedia.org/wiki/Somalia.

Marais AJ, Fennessy S, and Fennessy JT (2013b) *Country Profile: A Rapid Assessment of the Giraffe Conservation Status in the Kingdom of Swaziland*. Windhoek, Namibia: Giraffe Conservation Foundation. https://doi.org/10.5089/9781484318607.002.

Marais AJ, Fennessy JT, Fennessy S, Brand R, and Carter KD (2018) *Giraffa camelopardalis* ssp. angolensis. *The IUCN Red List of Threatened Species* 2018: e.T8842072.

Marais AJ, Fennessy S, Ferguson S, and Fennessy JT (2019a) *Country Profile: A Rapid Assessment of the Giraffe Conservation Status in Cameroon*. Windhoek, Namibia: Giraffe Conservation Foundation. https://doi.org/10.1596/24697.

Marais AJ, Fennessy S, Ferguson S, and Fennessy JT (2019b) *Country Profile: A Rapid Assessment of the Giraffe Conservation Status in the Democratic Republic of the Congo*. Windhoek, Namibia: Giraffe Conservation Foundation. https://doi.org/10.1163/9789004430013_026.

Marais AJ, Dennessy S, Ferguson S, Russo V, and Fennessy J (2020a) *Country Profile: A Rapid Assessment of the Giraffe Conservation Status in the Republic of Angola*. Windhoek, Namibia: Giraffe Conservation Foundation.

Marais AJ, Fennessy S, Ferguson S, and Fennessy JT (2020b) *Country Profile: A Rapid Assessment of the Giraffe Conservation Status in Chad*. Windhoek, Namibia: Giraffe Conservation Foundation. https://doi.org/10.1596/24586.

Marais AJ, Fennessy S, Ferguson S, and Fennessy JT (2020c) *Country Profile: A Rapid Assessment of the Giraffe Conservation Status in Ethiopia*. Windhoek, Namibia: Giraffe Conservation Foundation.

Marais AJ, Fennessy S, Ferguson S, and Fennessy JT (2020d) *Country Profile: A Rapid Assessment of the Giraffe Conservation Status in the Republic of Malawi*. Windhoek, Namibia: Giraffe Conservation Foundation.

Muller Z, Bercovitch F, Brand R, Brown D, Brown M, Bolger D, et al. (2018) Giraffa camelopardalis (amended version of 2016 assessment). *The IUCN Red List of Threatened Species* 8235: e.T9194A136266699. https://doi.org/10.2305/IUCN.UK.2016-3.RLTS.T9194A136266699.en.

Muneza AB, Fennessy S, Keyyu J, Lyimo EH, Marealle W, Wachira MM, and Fennessy JT (2018a) *Country Profile: A Rapid Assessment of the Giraffe Conservation Status in Tanzania*. Windhoek, Namibia: Giraffe Conservation Foundation1–6. https://doi.org/10.1007/978-1-349-07782-3_161.

Muneza A, Doherty JB, Hussein Ali A, Fennessy J, Marais A, O'Connor D, and Wube T (2018b) *Giraffa camelopardalis* ssp. reticulata. *The IUCN the Red List of Threatened Species* 8235: e.T88420717A88420720. 11. https://doi.org/10.2305/IUCN.UK.2018-2.RLTS.T88420717A88420720.en.

Muruana M, Muneza AB, Ferguson S, and Fennessy JT (2021) *Country Profile: A Rapid Assessment of the Giraffe Conservation Status in Kenya*. Windhoek, Namibia: Giraffe Conservation Foundationhttps://doi.org/10.5089/9781513543284.002.

O'Connor D, Stacy-Dawes J, Muneza A, Fennessy J, Gobush K, Chase MJ, et al. (2019) Updated geographic range maps for giraffe, *Giraffa* spp., throughout sub-Saharan Africa, and implications of changing distributions for conservation. *Mammal Review*. https://doi.org/10.1111/mam.12165.

Okello MM, Kenana L, Maliti H, Kiringe JW, Kanga E, Warinwa F, et al. (2015) Population status and trend of the Maasai giraffe in the mid Kenya-Tanzania borderland. *Natural Resources* 6: 159–173.

Omondi P and Mayienda R (2007) Total Aerial Count of Elephants, Giraffes, Roan Antelopes and Other Wildlife Species and Ostrich in Waza National Park, Cameroon.

Petzold A and Hassanin A (2020) A comparative approach for species delimitation based on multiple methods of multi-locus DNA sequence analysis: A case study of the genus Giraffa (Mammalia, Cetartiodactyla). *PLoS One* 15(2): 1–28. https://doi.org/10.1371/journal.pone.0217956.

Petzold A, Magnant AS, Edderai D, Chardonnet B, Rigoulet J, Saint-Jalme M, and Hassanin A (2020) First insights into past biodiversity of giraffes based on mitochondrial sequences from museum specimens. *European Journal of Taxonomy* 2020(703): 1–33. https://doi.org/10.5852/ejt.2020.703.

Seymour R (2001) *Patterns of Subspecies Diversity in the Giraffe, Giraffa Camelopardalis (L.1758): Comparison of Systematic Methods and Their Implications for Conservation Policy*. University of Kent.

Seymour R (2012) The taxonomic history of giraffe. *Giraffa* 6(1): 10.

Suraud J-P, Fennessy JT, Bonnaud E, Issa AM, Fritz H, and Gaillard J-M (2012) Higher than expected growth rate of the endangered west African giraffe Giraffa camelopardalis peralta: A successful human–wildlife cohabitation. *Oryx* 46(4): 577–583. https://doi.org/10.1017/S0030605311000639.

Thomassen HA, Freedman AH, Brown DM, Buermann W, and Jacobs DK (2013) Regional differences in seasonal timing of rainfall discriminate between genetically distinct east African giraffe taxa. *PLoS One* 8(10). https://doi.org/10.1371/journal.pone.0077191.

Van Niekerk ME, Deacon F, and Grobler PJ (2019) The genetic status of the introduced giraffe population in Central South Africa. *Koedoe - African Protected Area Conservation and Science* 61(1): a1570. https://doi.org/10.4102/koedoe.

Wilson TW (1979) Wildlife in southern Darfur, Sudan: Distribution and status at present and in the recent past. *Mammalia* 43(3): 323–338. https://doi.org/10.1515/mamm.1979.43.3.323.

Wilson RT (1980) Wildlife in northern Darfur, Sudan: A review of its distribution and status in the recent past and at present. *Biological Conservation* 17(2): 85–101. https://doi.org/10.1016/0006-3207(80)90039-7.

Winter S, Fennessy J, and Janke A (2018a) Limited introgression supports division of giraffe into four species. *Ecology and Evolution* 1–11. https://doi.org/10.1002/ece3.4490.

Winter S, Fennessy JT, Fennessy S, and Janke A (2018b) Matrilineal population structure and distribution of the Angolan giraffe in the Namib desert and beyond. *Ecological Genetics and Genomics* 7–8: 1–5.

Wube T, Doherty JB, Fennessy J, and Marais A (2018) *Giraffa camelopardalis* ssp. camelopardalis. *The IUCN Red List of Threatened Species* 2018: e.T8842070. https://doi.org/10.2305/IUCN.UK.2018-2.RLTS.T88420707A88420710.en%0ACopyright.