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**...TURNING THE TIDE ON THE SILENT EXTINCTION...**

**GIRAFFE CONSERVATION SCIENCE SYMPOSIUM**

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SCBI, Front Royal, Virginia, USA

Populations of giraffe, one of the most charismatic species on earth, have declined dramatically over the past few decades. Now considered 'Vulnerable' to extinction by the IUCN Red List of Threatened Species, there are estimated to be <100,000 giraffe remaining. The causes of population declines are multi-fold, with habitat loss and fragmentation, competition with livestock, and illegal poaching for bushmeat/parts trade all major factors.

Conserving giraffe, as with any wildlife species in Africa, is complex and requires both scientific understanding and action from multiple stakeholders. Given this complexity and the diverse suite of conservation measures required to conserve and protect them, a partnership between the Giraffe Conservation Foundation (GCF), Smithsonian Conservation Biology Institute (SCBI), San Diego Zoo Global (SDZG), and the Senckenberg Biodiversity and Climate Research Centre convened a network of international experts who work directly on giraffe or in thematic areas relevant to long-term species conservation-based decision-making. This first-ever giraffe conservation science symposium, held in May 2018, included stakeholders from NGOs, academia, and African governments. Participants of the symposium identified key gaps for further assessment and developed partnerships to work collaboratively across Africa to produce a unifying Giraffe Conservation Management Strategy (Framework).

Specifically, the symposium:

- Developed and prioritised mechanisms by which all giraffe populations in Africa would be offered the recognition, protection and support needed to ensure their future survival;
- Recognised the seriousness of the threats facing giraffe, including habitat loss and fragmentation, climate chaos, illegal killing for meat and other products,

disease, illegal domestic and potential international trade, lack of conservation knowledge and attention, and lack of institutional and enforcement capacity;

- Highlighted measures to prevent any further localised extinction of giraffe in any part of their range;
- Identified the needs of those individuals mandated with protecting giraffe, and of those coexisting and interacting with giraffe;
- Demonstrated value to conservation partners and supporters through a commitment to transparency, accountability, coordination, and common purpose by African giraffe range states, NGOs, research institutions and other stakeholders; and,
- Identified mechanisms for channelling support to giraffe conservation programmes through a process which has been developed, owned, approved and managed in the future by the African giraffe range States and in collaboration with key partners.

This Framework Strategy was developed to guide giraffe conservation science activities across Africa. It summarizes shared experience and collective thoughts of those at the symposium, including the perceived gaps in current giraffe conservation and management, in terms of current knowledge in giraffe status, taxonomy, ecology, health, and human dimensions. Lastly, this Framework Strategy outlines conservation priority areas and suggested activities to address long-term threats and prevent the silent extinction of the species.

### **Conservation Status**

More than a century ago, giraffe were reportedly widespread across Africa, with a population estimate of more than one million individuals. By the mid-1980s, there were estimated to be only 155,000 giraffe (East 1999; Fennessy & Brown 2010; GCF 2016). By 2016, the population had further declined to <100,000 individuals, with a fragmented range (Muller et al. 2016) (Figure 1). Due to these declines, the conservation status of the species was uplisted to 'Vulnerable' in December 2016. Recent genetic evidence also shows four distinct species of giraffe (Fennessy *et al.* 2016; Winter *et al.* 2018) (Table 1).

A few (sub)species and populations are increasing or remain stable. The southern giraffe species, which includes two subspecies (Angolan and South African), have exhibited considerable population growth in the last 30 years. West African giraffe, estimated to be 49 individuals in the mid-1990s (Ciofolo *et al.* 2000), have increased to more than 600 individuals by 2017 (Niger Ministry of Environment, *pers. comm.*). Nubian giraffe in the Murchison Falls Conservation Area (MFCA), in north-western

Uganda, has grown from 150-200 individuals in the 2000s (Rwetsiba 2006; NEMA 2009; Rwetsiba et al. 2012), to over 1,300 individuals (M. Brown, unpublished data) but across the rest of their range have declined by >90%. However, other subspecies, such as the Kordofan, Masai and reticulated giraffe have all experienced widespread declines and require appropriate IUCN Red Listing. Population dependent, these declines vary from 50% to as large as 97% decline. As such, their conservation status as (sub)species requires urgent attention and some are scheduled to be evaluated by the IUCN Red List of Threatened Species in late 2018. Ongoing efforts to better estimate and monitor the continent's giraffe populations will allow a more accurate assessment of the conservation status of each of these (sub)species, which is currently often limited by lack of resources, capacity, political will and accessibility.

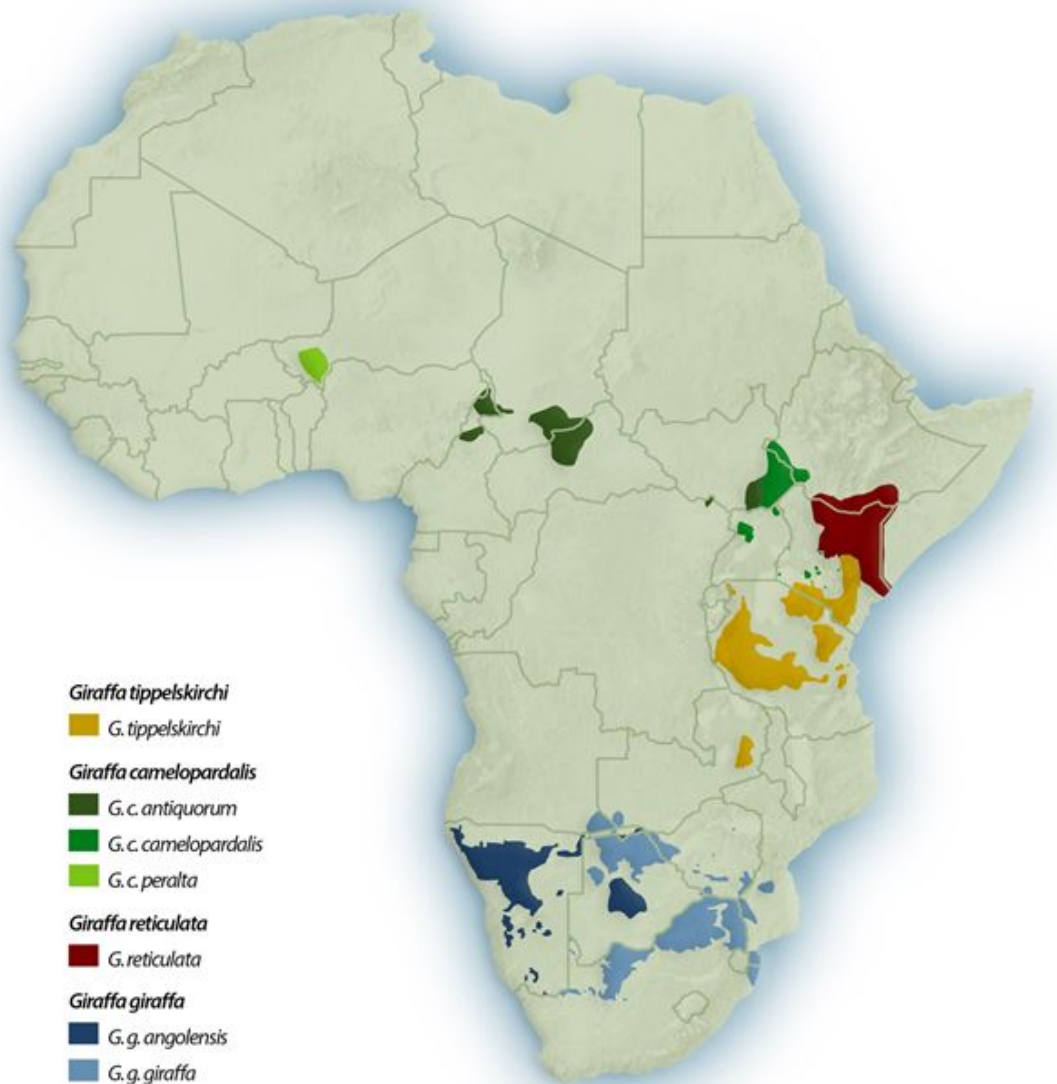


Figure 1. Current range map for proposed giraffe species and subspecies (Source: GCF)

Table 1. Current population estimates for the four giraffe species and subspecies.

Common Name	Scientific Name	Estimated Remaining	Prior Subspecies Included
<b>Southern giraffe</b>	<b><i>Giraffa giraffa</i></b>	<b>52,050</b>	
Angolan	<i>G. g. angolensis</i>	13,050	
South African	<i>G. g. giraffa</i>	39,000	
<b>Northern giraffe</b>	<b><i>Giraffa camelopardalis</i></b>	<b>5,195</b>	
Nubian	<i>G. c. camelopardalis</i>	2,645	Rothschild's ( <i>G. c. rothschildi</i> )
Kordofan	<i>G. c. antiquorum</i>	2,000	
West African	<i>G. c. peralta</i>	550	
<b>Reticulated giraffe</b>	<b><i>Giraffa reticulata</i></b>	<b>15,785</b>	
<b>Masai giraffe</b>	<b><i>Giraffa tippelskirchi</i></b>	<b>32,500</b>	Thornicroft's ( <i>G.c. thornicrofti</i> )

## Conservation Science Priorities

### 1. ECOLOGY

Understanding the spatial aspects of giraffe ecology are integral to evaluating distributional changes and population trends, the evolution of genetics, the spread of disease and the dynamics of human dimensions, as well as to inform more precise applied management and conservation efforts.

#### *A) Population Trends*

One of the major questions surrounding current giraffe research is evaluating their population numbers, distribution and status across the African continent. Along with an increased ability to assess population trends, repetitive and accurate monitoring will advance our understanding of the factors that led to genetic speciation. Combining historic data with existing knowledge, we will create accurate range maps of each of the (sub)species to assist with field conservation efforts and provide the foundation for further spatial analyses and distribution modeling.

#### *B) Distribution*

Spatial analyses, such as (sub)species distribution or environmental niche models, are useful to identify suitable habitat necessary for (sub)species to thrive. These models help inform conservation decisions on known populations,

but also provide insight into the needs of giraffe in areas that are difficult to study. This type of modeling has the potential to be incredibly useful to identify relocation potential of available habitat. We will assemble a suite of covariates, relying on previous studies and relevant experience, to determine the environmental factors that influence the distribution of giraffe.

#### *C) Species Monitoring*

Standardized monitoring protocols and data collection techniques will aid in providing databases for analyses that are consistent and integrable across the continent. These efforts will lead directly into further development of spatial ecology efforts, such as the Twiga Tracker Initiative (see below), with aims towards using state-of-the-art technology (e.g. solar-powered GPS tracking units, high-resolution drone surveys) to better understand the (sub)species' movements and habitat requirements.

#### *D) Animal Movements*

One of the more publicized aspects of giraffe research is the evolving tracking efforts that now use solar-powered ossicone-mounted tracking devices and trialling other technologies. Twiga Tracker, a continental-scale initiative, aims to deploy >250 tracking units on giraffe across all (sub)species populations. This collaborative initiative, which includes several institutes and organizations, will provide insight into the movement patterns of individuals, providing a more detailed understanding into resource utilization, response to human impacts and infrastructure, and inter- and intraspecies interactions. These data also reveal a need for a standardized land-cover analysis, providing insight into the dynamic habitat that giraffe occupy. Further, foraging ecology analyses will provide fine-scale assessments of the habitats necessary for survival and yield valuable information regarding the relationship between giraffe and their environment.

#### *E) Conservation Action*

We also realize that the effectiveness of the data we collect is only as good as our efforts to inform conservation action. This initiative will assemble deliverables that are pertinent to the communities surrounding giraffe and to policymakers. These include standardized protocols detailing steps for successful translocation, the importance of giraffe on ecosystem services, and sustainable use models that evaluate giraffe meat production and trade in relevant areas.

## 2. TAXONOMY

### A) *Taxonomic Review*

Allocation or division of giraffe into species or subspecies has marked conservation implications with respect to listing, protection, funding, prioritisation and management action. To best determine the most appropriate and meaningful taxonomic groupings, a comprehensive review has been proposed, that includes the following components and builds on current efforts, which will culminate in final recommendations to IUCN on giraffe taxonomy.

- i. Morphology: This component will involve application of 21<sup>st</sup> century morphometric assessments from all key giraffe (sub)species across Africa.
- ii. Pelage: A pelage analysis has already been completed as part of a MSc project at ZSL in collaboration with GCF. Results will be reviewed in 2018 to determine if further research is required.
- iii. Ecology: Particularly in the case of sympatric giraffe, ecological niche modeling will assist with providing a better understanding of why and how different giraffe remain genetically and ecologically distinct.
- iv. Phylogeography: To better understand how giraffe vary genetically across their range and amongst populations, increased sampling and analysis is required from key areas, including hybrid zones. Gaps will be identified to prioritize strategic collection of additional samples. These will be analyzed in addition to the ~300 samples collected across Kenya, where three of the four proposed giraffe species are found (Fennessy *et al.* 2016; Winter *et al.* 2018).

### B) *Genomics*

Genomic analysis of giraffe can help to evaluate gene flow and population structure. This will begin with a low-coverage analysis, sampling 10 individuals per (sub)species. Potential applications include estimation of effective ancestral population sizes, susceptibility to disease and physiological differences.

### C) *Giraffe Biodiversity*

- i. *In situ*: Related to the phylogeography work discussed above, further analysis will allow a better understanding of genetic diversity within and among giraffe. This will provide improved information for taxonomic purposes, help to identify important populations and assist in forensic analyses. Having an established baseline will also help to monitor and assess loss of diversity and population declines in the future, with the goal

of establishing a recurring conservation genetics monitoring program (e.g. every ten years); and.

- ii. *Ex situ*: Some giraffe populations in Africa are at a higher risk of extinction when compared to others, especially from potential stochastic events. An “assurance” or satellite population already established elsewhere may be beneficial. In addition, it is possible that these individuals retain genetic diversity no longer found in the wild, particularly if descended from wild populations that have been extirpated or undergone severe declines. The first step to better evaluate these possibilities (and to identify potential founders for the proposed satellite population) is to assess current biodiversity amongst captive giraffe, with a focus on AZA and EAZA institutions, as well as select private collections.

#### *D) Giraffe Biorepository*

To facilitate coordinated giraffe research, a biobank of biological samples from giraffe is proposed to be established. A standardized protocol will be created for future collections, allowing for standardized contributions. Discussions with all interested and relevant partners over the potential location that samples will be stored will be initiated in 2018-19.

### **3. HEALTH**

Giraffe face a variety of health threats in the wild, including emerging diseases such as “giraffe skin disease”. These names hint at how little is known about the disease(s) and highlight a need to understand their cause, effect and management. In addition, many giraffe are anesthetized each year as part of research and management activities.

Giraffe are more difficult to manipulate than other species, with a higher risk of associated complications, and require systematic assessment to minimize adverse effects. Four priority areas have been identified to both better understand and respond to health issues in wild giraffe and improve the safety and efficacy of field operations.

#### *A) Epidemiology of giraffe skin disease*

Determining the cause(s) and consequences of giraffe skin disease, as well as investigating potential management options (if appropriate), will require a holistic approach across the continent. In the short-term, current efforts will continue to evaluate skin samples to determine the etiology of the disease. Samples collected in Uganda will be complemented by a new sampling initiative in Tanzania. In Kenya, inquiries and surveillance will be conducted to better understand the presence of the disease, which is yet to be verified. We will also utilize the network described below to better understand the occurrence of the

disease across the continent. To determine potential consequences of the disease, the presence of the disease will be incorporated into models to predict its occurrence and potential effect on population dynamics. A Fellow or PhD student will be engaged to conduct a more in-depth study of its progression and effects, in particular in Tanzania. A pharmacokinetics study on potential treatments will also be carried out in zoological facilities in the USA.

### *B) Anesthesia*

There is a need to better understand variation in anesthetic outcomes based on drug protocols or other veterinary interventions (e.g. provision of supplemental oxygen), type of giraffe (sub)species and procedure (e.g. collaring, translocation, snare removal). Regional veterinary teams will be supported to identify gaps that may prevent implementation of desired practices. Short-term goals include:

- i. Determining the state of knowledge about giraffe anesthesia - using the network discussed below to gain records and experiences of current practitioners on anesthetic protocols, procedures and outcomes. In some cases, this may include digitization of prior paper records. Additionally, electronic records will be established for giraffe capture, ideally through common platforms that can be shared between organizations (e.g. ZIMS for captive facilities);
- ii. Acquiring istat machines (and cartridges) for giraffe veterinary teams in Kenya, Tanzania and Uganda as a pilot - several recent anesthetic deaths were associated with exertional myopathy, a condition associated with reduced oxygenation. Field use of istat machines will allow real-time assessment of blood gas values and determination of which animals may be more at risk, informing the extent of procedures conducted on an individual basis - and then which can be applied more broadly Africa-wide; and
- iii. Assessing the impact of field oxygenation - a pilot study in Kenya will use an istat to assess the need for, efficacy of, and practicality of field oxygenation (via insufflation) of giraffe during anesthesia - and then which can be applied more broadly Africa-wide.

### *C) Standardized protocols*

Using common protocols can help ensure that desired standards are maintained. These standards can be beneficial for giraffe and also help to maximize our understanding of the issues they face by making samples and diagnostics comparable across the continent. In the coming months, recommended protocols for sampling, diagnostics and common giraffe procedures (e.g. wound



management, necropsy) will be finalized and made available. Additionally, a manual of known conditions encountered in giraffe (e.g. snares, lumpy skin disease) will be created, including photographs and recommendations for diagnostics and management.

#### *D) Field practitioner network*

There are numerous veterinarians working across Africa and internationally with extensive experience and knowledge of giraffe medicine. However, no mechanism currently exists to foster information exchange and collegiality across different regions. This deficiency will be addressed potentially by:

- i. Establishing a private online group for veterinarians who work with giraffe to share their experiences and ask for advice, as well as to connect and discuss potential collaborations; and
- ii. Supporting African wildlife veterinarians to attend the Zimbabwe Chemical and Physical Restraint of Wild Animals held annually in Malilangwe Wildlife Reserve.
- iii. Organizing a giraffe medicine workshop, or similar, with participants from countries across the giraffe range. This will serve as a forum for in-person knowledge exchange and discussion and offer training opportunities in key components of giraffe capture and medicine (e.g. necropsy).

## **4. HUMAN DIMENSIONS**

Community support and participation is critical to any conservation initiative, and their perceptions, values, and actions must be better understood to enable appropriate sustainable conservation initiatives. Four main issues were identified as priorities:

#### *A) Cultural Values and Beliefs*

In order to design conservation messaging, a better understanding of the traditional beliefs, lore and perceptions of various African communities is required. A Masters-level student will be recruited to focus on this component.

#### *B) Giraffe Use and Trade*

While giraffe are used and traded throughout Africa, the scale, extent and purpose is not well understood. A gap analysis will be conducted to assess current trends in giraffe use and trade, including potential future vulnerabilities. This analysis will be followed up with case studies, focused on specific communities/regions, to better understand the drivers, scale, and potential trade

routes. Once identified, potential peaceful intervention strategies will be tested (e.g. conflict transformation) to address these findings.

### *C) Translocations*

Translocations are a major tool in giraffe conservation and management. Their success, however, depends upon receptivity and readiness of governments and communities. Guidelines and principles will be developed to assess the current social conditions in communities, advise on preferred translocation locations and proactively build receptivity with all stakeholders to meet desired results. We will also conduct post-release monitoring to retrospectively learn and improve future translocations.

### *D) Risk Perceptions and Wildlife Disease*

With the potential for shared pathogens between giraffe, domestic animals (especially livestock) and people, there is interest in how communities view the risk of transmission from giraffe to themselves or their animals. Pilot studies are being conducted in Kenya to better understand local perceptions to wildlife disease, with questions framed as part of a broader study around disease risks.

## **Moving Forward**

Over the past decade and a half we have made significant strides in better understanding giraffe numbers, distribution, threats, wildlife health and their ecology, whilst the same time implementing various actions to better conserve and manage them across the African continent - all undertaken on a case-by-case depending on the population and range state.

It is critical that we evaluate giraffe conservation status ongoing, and by combining this with the best science at hand we can better proactively manage giraffe long-term. Whilst giraffe numbers have declined markedly over the last three decades, it is as important to focus on the various conservation success stories, highlighting what has been done and what needs to be done to help turn the tide in those areas that need more support.

We propose that regular meetings of the key coordinating partners of this initiative coupled with biennial meeting of all stakeholders will aid to regularly assess and update actions, whilst bringing together new relevant scientific findings for application in direct conservation efforts.

Together we can make a difference for giraffe before it is too late!

## Appendix 1: Attendees

### **Ecology**

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