RAPID ANALYSIS OF GIRAFFE CONSERVATION IN EAST AFRICA

December 2017

Background

Giraffe (*Giraffa* spp.) are integral to their ecosystems, opening habitat, spurring growth of new forage, acting as watchtowers for multi-species, dispersing seeds and pollinating flowers. Over the past 30 years, giraffe have declined by almost 40%, from >150,000 to <100,000, resulting in the species being classified as 'Vulnerable' to extinction on the IUCN Red List in December 2016 (Muller et al. 2016).

Most recently, the Giraffe Conservation Foundation (GCF) and partners proposed new giraffe taxonomy based on more than fifteen years of research. In particular, East Africa is home to three of the four recently identified giraffe species (Fig. 1; Fennessy et al. 2016), and has lost a large portion of Africa's giraffe population in last three decades: Masai giraffe (*G. tippelskirchi*) have declined by 52%, Nubian giraffe (*G. c. camelopardalis*) by 97%, and reticulated giraffe (*G. reticulata*) by 77% (Muller et al. 2016). Habitat loss and fragmentation, livestock and human population growth, civil unrest, disease, poaching and changes in climatic conditions all contribute to the continued decline of giraffe populations in East Africa (Strauss et al. 2015; Ogutu et al. 2016 ; GCF 2017). Currently, there are an estimated 34,000 Masai, 2,600 Nubian and 8,700 reticulated giraffe remaining in the wild – and these three species constitute <50% of the total wild population of giraffe. For this reason, GCF has undertaken a rapid analysis highlighting the current knowledge gaps on the conservation status of giraffe in East Africa, linking it to the previously developed GCF Africa-wide Giraffe Conservation Strategic Framework (GCF 2016). This analysis is based on an extensive literature review on giraffe ecology and management in East Africa, coupled with a series of interviews and discussions with government and private stakeholders. Importantly, the analysis reviews the strengths, weaknesses, opportunities and threats to the survival of giraffe in the region.

Giraffe population numbers and trends

While the major threats to giraffe in East Africa have been identified (e.g. Owen-Smith et al. 2005; Ogutu et al. 2009, 2016; Strauss et al. 2015; Bolger et al. 2016; GCF 2017), a gap remains on the extent to which giraffe numbers and distribution have been impacted. There is limited information available on historical and current giraffe numbers in the region. One reason for this stems from the fact that recent numbers of wildlife are documented in government reports, which are at times inaccessible to the public and researchers. Additionally, researchers, academic institutions and NGOs also fail to analyse and publish data or submit reports to relevant government institutions and authorities, creating a disconnect between these very important stakeholders and subsequent loss of data. As an example, government reports

indicate that giraffe populations have increased by 50% in the Tsavo ecosystem over a 3-year period (Ngene et al. 2017), yet a recent review highlighted an extreme decline of giraffe populations across the country (-67%) and showed no increase in any county, concluding giraffe populations are at risk of losing their viability in some areas in Kenya (Ogutu et al. 2016).

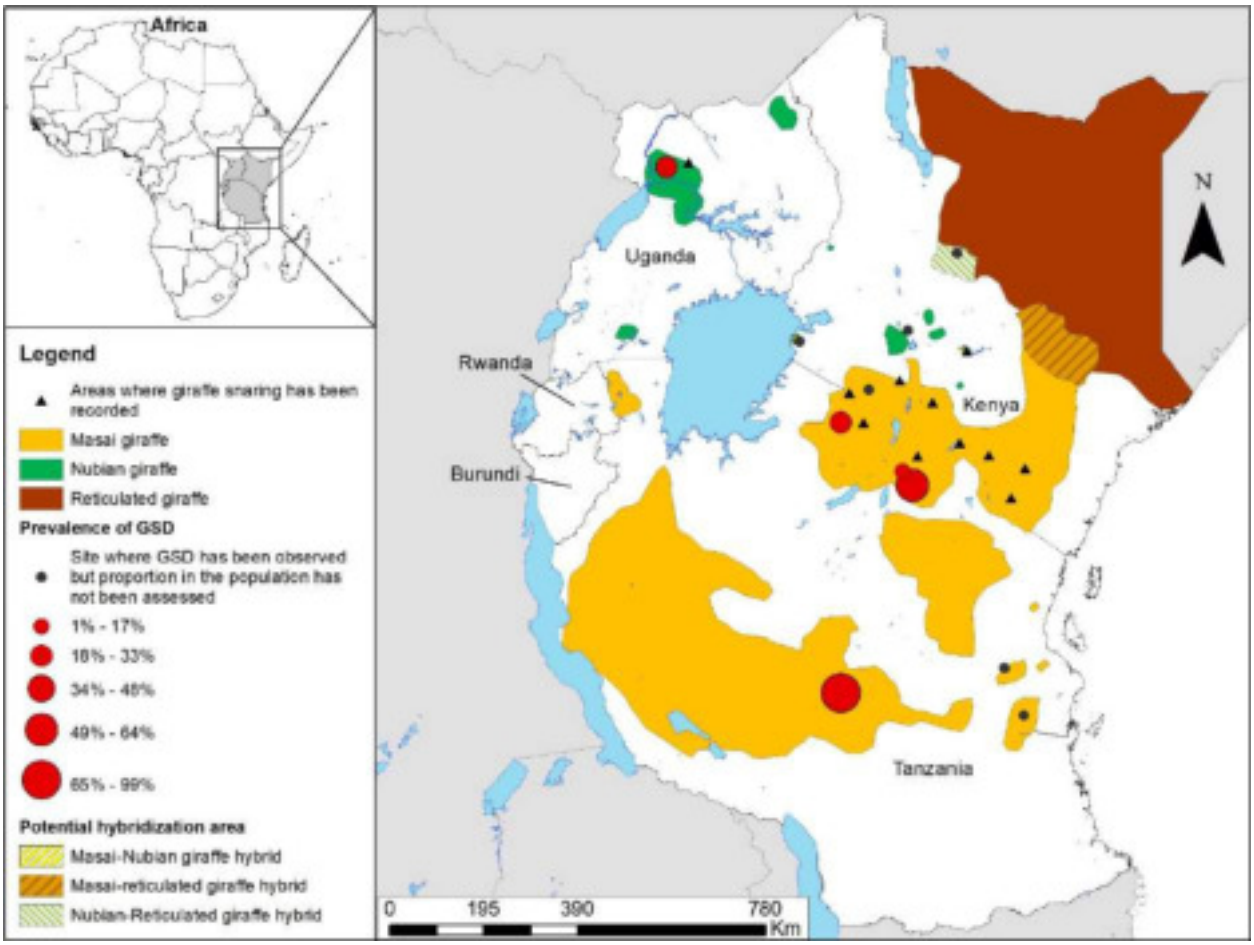

Fig 1: Distribution of giraffe species in East Africa and potential hybridization areas. Prevalence of giraffe skin disease (GSD) is adapted from Muneza et al. 2016 and includes additional data obtained from communications with conservation managers, researchers and personal observations (GCF 2017).

There are different methods for counting giraffe, all dependent on the goals of the study/project/survey. The Kenya Wildlife Service (KWS) and Tanzania Wildlife Research Institute (TAWIRI) have long used systematic reconnaissance flights (SRF) for surveying wildlife, including giraffe. The surveys are not conducted on a yearly basis as they require extensive logistical planning and resources to cover large areas. The main source of bias with regards to SRF is visibility of target species. For giraffe specifically, other methods have been shown to be more effective and these include line transect methodology, indexing techniques and individual recognition (Jachmann 2001; Lee & Bond 2016). More recently, a combination of line transect surveys, pattern recognition software and population modelling have

increased accuracy for population estimation and other wildlife parameters estimation (Bolger et al. 2012; Muneza et al. 2017). These efforts should be reviewed and considered appropriately for future accurate population assessments.

Recently, citizen science techniques are increasingly used for ecological research and provide robust data at the species, population, community and even ecosystem level (Dickinson et al. 2010; Dickinson et al. 2012). For instance, Zooniverse, an online platform where volunteers register and collect data for projects of their choosing currently has more than 1.5 million users and has generated 158 scientific publications. More research efforts are required to better understand the conservation status of giraffe populations across their range but there are limited resources available to researchers and ecologists. Hence, to increase data collection efforts and raise awareness on the plight of giraffe populations, GCF has partnered with San Diego Zoo Global and WildMe to develop an online pattern identification software called GiraffeSpotter that can use pictures and videos from researcher, managers and the public to detect individual giraffe and capture their encounter history. This is particularly important in photographic mark-recapture surveys and using GiraffeSpotter, researchers and conservation area managers can acquire and use citizen science data from the consolidated database to make informed decisions on the conservation and management of giraffe populations.

Creating a dedicated repository where summary giraffe data and resources could be accessible to the public can create a platform for data sharing to collate pertinent information and to raise more conservation awareness to the plight of giraffe. As an example, the Rhino Resource Center (RRC) (http://www.rhinoresourcecenter.com/), contains more than 22,000 notes, scientific papers, grey literature and images on rhino conservation and management, of which 21,773 are downloadable PDF files (Rookmaaker 2017). Through the RRC, information and research becomes easily accessible to interested stakeholders in the conservation of rhino. Following this model, GCF has initiated the first steps towards establishing the first-ever dedicated Giraffe Resource Centre (GRC) (https://www.girafferesourcecentre.org/) that will help collate literature on all giraffe species, something largely ignored by the scientific community to date (GCF 2017). For East Africa specifically, the GRC will hopefully bridge the gap between government and private stakeholders, and create a platform to share data and information as identified in the draft National Giraffe Conservation Strategies and Action Plans for both Kenya and Uganda. While the Strategies and Action Plan provide frameworks through which all giraffe conservation and management activities can be assessed and measured (National Committees and Working Groups), they also provide priority actions that should be implemented to ensure the survival of giraffe in East Africa.

The precipitous decline of giraffe populations has largely gone unnoticed leading researchers to proclaim that giraffe are at risk of a silent extinction. Campaigns of raising awareness on the plight of giraffe are crucial in the fight to save these iconic species of the African savannah before it is too late by providing the most recent and updated information to the public and stakeholders. For instance, GCF runs the Khomas Environmental Education Programme (KEEP) in Namibia, which incorporates practical aspects of science, the environment and wildlife conservation in the curriculum of school-going children, using giraffe as a model species. Additionally, posters have proven to be useful tools in disseminating information to the public. In collaboration with conservation partners, GCF has developed environmental

education workbooks and posters for the East African region, which help raise awareness on the plight of giraffe populations.

One of the most crucial objectives of the National Strategies and Action Plans, as well as the IUCN, is updating the conservation status, population numbers and distribution of giraffe, and both GiraffeSpotter and the GRC lays the foundation for interactive communication channels and forums between government and NGO giraffe conservation stakeholders. Specific outcomes from collating data and literature on giraffe conservation and management include:

- Regular updated numbers, distributions and conservation status across East Africa, including use of GiraffeSpotter;
- Increased monitoring on giraffe conservation status and identifying cost-efficient, standardised giraffe population surveys for use by government and NGO giraffe conservation partners;
- On-going giraffe research and surveys leading to publicly accessible reports and peer-reviewed publications, and subsequently uploaded online in the GRC;
- Open access to giraffe distribution papers, maps, posters and reports on trends to educate public and decision makers on giraffe conservation and management;
- Development of Regional, National and species-specific Giraffe Conservation Strategies and Action Plans for the three giraffe species that occur in East Africa, as well as associated Working Groups and National Committees to monitor their implementation; and
- Increased collaborations between government and NGO giraffe conservation stakeholders across all areas of field research, monitoring, surveys and analysis.

Anthropogenic factors affecting giraffe population declines

As highlighted, IUCN, GCF and others have identified many threats to giraffe survival, however, one factor that is common to all these threats is that they are all directly (illegal hunting and civil wars) or indirectly (habitat loss and ecological changes) linked to human pressure on community lands and protected areas where giraffe occur. In East Africa, the gradual reduction of accessible grazing land for pastoralists and land-use change from pastoral to sedentary lifestyle in core wildlife landscapes presents a major challenge for sustainable ecosystem management (Kimiti et al. 2016). Further, human population growth and increased pressure on conservation areas fuels human-wildlife conflict whereby both human and animal lives are lost in addition to crop damage. It is important to document these instances to help make informed conservation and management policies.

While preliminary data from ongoing attitudinal surveys by the Amboseli Conservation Program (ACP) indicate that giraffe are the least threatening to human communities among surveyed wildlife (ACP pers. comm.), the socio-economic and cultural importance of giraffe remains poorly understood and documented. These knowledge gaps and lack of incentives for wildlife conservation deter local communities in contributing towards preservation of wildlife and wild spaces, and further fuels demand for wildlife products. There is a crucial need to understand the perceptions and attitudes towards giraffe, especially by communities living with wildlife and/or adjacent to protected areas. Recently, a prolonged drought in northern Kenya pushed pastoralists to invade private conservancies in order to access pasture,

and this led to increased poaching of wildlife, including giraffe. In northern Tanzania, giraffe products are used in traditional medicine, whereby giraffe bone marrow and brains are incorrectly believed to cure AIDS (Arusha Times 2004; Nkwame 2007).

Giraffe are predominantly poached for bushmeat, using wire snares hung in tree canopies or bushes (Fig. 2; Strauss et al. 2015) and incidences have been observed across all East Africa. As giraffe are curious animals, poison arrows (Fig. 3) and rifles are also used to quickly bring them down from a relatively close distance, after which poachers can quickly remove and transport giraffe meat. In Kenya, the suspected major markets that have been identified include Rongai, Naivasha, Nakuru, Machakos, Makueni, Taita Taveta and Voi (KWS pers. comm.). Nonetheless, it is important to note that it is still not clear as to whether giraffe are a preferred source of meat in these areas.

Fig 2: Cache of snares, blades and torches used by poachers to kill giraffe and butcher. Poacher in case (from Machakos, Kenya) was caught with giraffe heads, skin and meat, along with parts of other small game © Stephen Tankard

Whilst they are often snared, in some cases they are not the intended target species. Snares are often set in and around protected areas by poachers intending to trap smaller game for subsistence. In cases where giraffe meat and parts are targeted and sold on the 'black' market, one poacher would be able to purchase one '*boda boda*' (a motorbike commonly used to transport people and goods) after selling a whole giraffe. On average, a *boda boda* retails at $1,000 (Tsavo Conservancies Network pers. comm.). In the Serengeti, annual giraffe poaching results in a 2-10% decline of the population (Rentsch et al. 2015). Poaching of Masai giraffe appears to be also widespread in the Katavi-Rukwa ecosystem (Caro 2008) and the West Kilimanjaro corridor (Nkwame 2007). In Uganda, poaching is limited to Murchison Falls NP (M. Brown per. comm.).

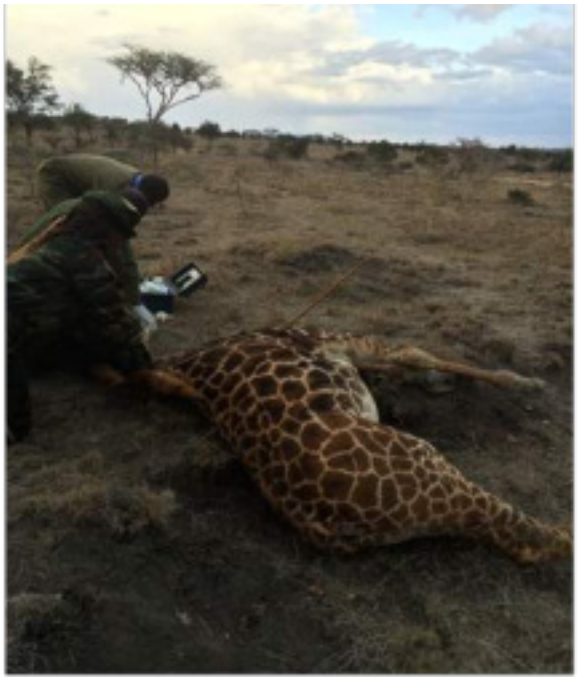

Fig. 3: KWS vets tend to a giraffe shot by a poisoned arrow in Athi Kapiti Plains, Kenya. Fortunately, the KWS vets were able to act in time to prevent the giraffe from succumbing to the poison. © Stephen Tankard

Snare injuries often lead to giraffe mortalities due to difficulty in mobility or permanent injuries in cases where affected animals are maimed – and as such more prone to predation. To date, only one study in Murchison Falls NP, Uganda has attempted to quantify the proportion of the giraffe population with snare injuries, observing that giraffe with snare injuries had a poorer body condition (Brown & Fennessy 2014). More generally, snaring incidences of giraffe have been recorded across East Africa (Fig. 1). The transboundary region of northern Tanzania and southern Kenya appears to be a hotspot area for giraffe poaching, despite being one the last strongholds for Masai giraffe. Thus, there is a crucial need to understand and document the socio-economic and cultural importance of giraffe in the region, as well as monitor poaching incidences and increase anti-poaching efforts. These findings will identify incentives that can be used to involve local communities in giraffe conservation to stop their decline in the region. Specifically, the outcomes will be:

- Identification and mapping of current and potential future trouble areas for giraffe so that anti-poaching and monitoring efforts can be efficiently and precisely targeted;
- Determining prevalence and proportion of giraffe populations affected by snaring;
- Study of indirect effects of snaring on affected giraffe;
- Creation of community-based giraffe monitoring and anti-poaching programmes;
- Wildlife rangers are adequately equipped to carry out de-snaring and anti-poaching measures;
- Development and distribution of giraffe conservation education materials and implementation of targeted education programs; and
- Assessment of recent and current status of regional and international trade of giraffe parts.

Spatial ecology and taxonomy of giraffe

The direct and indirect causes of habitat loss and fragmentation of giraffe populations are by far the most critical threat to giraffe survival in the wild. However, East Africa has one of the youngest and fastest-growing human demography in Africa, with increasing demand for arable land and pressure on wildlife habitat. Giraffe populations in East Africa have undergone a severe decline in the past 40 years (Muller et al. 2016), yet we know very little about their movements, variation in seasonal occupancy, home ranges and habitat utilisation. Ongoing changes in land-use practices in giraffe ranges and habitats, especially with pastoral communities becoming increasingly sedentary (Kimiti et al. 2016), is resulting in fragmented movement corridors, reduced access to seasonal browsing areas and destruction of core habitat.

Fig. 4: Panel A: Motorist flouts traffic laws, thereby knocking down a zebra on Mombasa Highway; Panel B: Giraffe that was killed after being hit by a speeding vehicle on Mombasa Highway. © Stephen Tankard

Spatial ecology of giraffe is poorly understood. To date, there are few studies that have examined the extent of the home range of giraffe. Home range and habitat utilisation analyses give an indication of the resources required to maintain a population. Many countries are undertaking important infrastructural development projects, and unfortunately development of tarmacked roads through giraffe habitat have resulted in an increase in the number of wildlife killed by vehicles (Big Life, pers. comm.; Fig. 4). Perhaps paradoxically, the proposed solution of using fences to cordon off roads and demarcate human settlement areas also poses a lethal threat to giraffe populations, notably in southern Kenya (Fig. 5). Giraffe are known to entangle themselves when attempting to climb over fences to access resources in search of forage and mates, depending on availability and climatic conditions. As an example, following a prolonged drought, there was a notable decline in the giraffe populations in Tsavo West NP, while there was an increase in the Chyulu-Amboseli ecosystem and even more pronounced in the surrounding community conservancies. Researchers hypothesised that the giraffe in Tsavo West NP could have migrated to Chyulu-Amboseli ecosystem and surrounding community lands (Amboseli Conservation Program, pers. comm.). While the extent of giraffe home ranges and habitat utilisation has not been well studied, there is a crucial need to better understand these factors for the efficient management and conservation of giraffe populations, and identify crucial wildlife corridors.

Determining the extent of giraffe home ranges and their core habitats are crucial to their management, especially in such highly biologically diverse country such as Kenya. Unconfirmed reports over the decades have proposed that different giraffe species may have interbred in the wild. These reports stem from the fact that the ranges of different giraffe species potentially overlap and could result in the formation of important hybridisation areas (Fig. 1). As an example, there is ongoing debate whether some of the giraffe in Tsavo East NP and South Kitui National Reserve are 'pure' Masai giraffe and potentially the northern area might be a hybrid zone (KWS, pers. comm.). Some experts have proposed that the Mombasa Highway and newly-built standard gage railway that connects the port city of Mombasa to the rest of East Africa are artificial barriers that separate the two "species". However, this is only a recent phenomenon and with Masai giraffe living on both sides the old wildlife corridors still allow populations to migrate back and forth between the two areas. Giraffe have been observed across the region with skin patterns that do not match the 'traditional' pelage patterns of giraffe that form the basis of the giraffe (sub)species classification by the IUCN. This is however true in many giraffe populations across the continent and not a good indicator of (sub)speciation.

Fig. 5: A subadult male giraffe that died trying to disentangle from the fence that trapped his hindleg. © Stephen Tankard

New technologies will play a crucial role in better understanding the taxonomy and spatial ecology of the giraffe species. By studying their genetics and distribution movement patterns, we can better inform their varied management in East Africa, critical when considering the conservation translocations that have and will continue to take place in the region. GCF has been working with Savannah Tracking, a Kenyan-based company, to develop new solar-powered GPS satellite tags called 'ossi-units' (Fig. 6). These units are fitted

on the ossicone of targeted individuals – hence the name 'ossi-units', and are a significant improvement on welfare of giraffe compared to the head harness and neck designs (Fennessy 2009; Flanagan et al. 2016). These ossi-units will be crucial in providing data on movement patterns, extent of home range and core habitat of giraffe, which will form a strong baseline for post-translocation monitoring of giraffe. Over recent years, KWS and the Uganda Wildlife Authority (UWA) have used translocations as a conservation tool to reintroduce giraffe in their historical range where they had become locally extinct. For instance, Nubian giraffe were almost extinct in Kenya in the 1970s due to poaching and habitat loss, however, successful translocations into Ruma NP, Mwea NR and Lake Baringo NR have helped the country's population recover. Similarly, UWA has reintroduced giraffe into Kidepo Valley NP, Lake Mburo NP and the southern bank of Murchison Falls NP. Not only have these translocations extended the range of these endangered giraffe, but also increased the genetic diversity of these critical populations.

Fig. 6: Female reticulated giraffe with ossi-unit in Loisaba Wildlife Conservancy, northern Kenya. © Ken Bohn, San Diego Zoo Global.

Additionally, GCF has partnered with KWS to collect and with the Senckenberg Museum in Frankfurt, Germany to analyse tissue samples across all major giraffe populations in Kenya to better understand their taxonomy and inform conservation decision making. This is a valuable partnership between all partners and will provide the first detailed assessment of giraffe speciation throughout the country, and help assess if any areas of hybridisation occur. These concerted efforts will generate crucial data that will inform management and conservation policy of giraffe at the national and regional level. Expected outcomes from these efforts include:

- Determining the genetic architecture of all major giraffe populations in Kenya and extent of giraffe species range overlap;
- Development of distribution maps of giraffe and updating existing ones based on giraffe speciation and movement studies;
- Reports on habitat preference and suitability based on data from GPS satellite tagged giraffe to inform decision-making on potential areas for giraffe translocation;
- Increased capacity to monitor (any) changes in behaviour and diet of translocated giraffe;
- Identification of poaching hotspot areas and wildlife corridors, and generation of valuable information for protected area and wildlife conservancies planning;
- Determining extent of transboundary movement of giraffe; and
- Use of habitat utilisation models to determine core giraffe habitat and influence of biotic and abiotic factors on giraffe movement.

Diseases affecting giraffe populations

Giraffe are not only at risk due to anthropogenic sources, but are vulnerable to disease outbreaks. Giraffe populations have previously been significantly affected by outbreaks of rinderpest (McNeil Jr. 2011), anthrax (Kaitho et al. 2013), papillomavirus infection (Karstad & Kaminjolo 1978; Van Dyk et al. 2011) and lumpy skin disease (Woods 1988; Hunter & Wallace 2001). However, the epidemiology and pathology of these diseases are well understood given that they occur in a variety of mammalian taxa. In the past 20 years, new diseases have emerged in giraffe populations and have gained little conservation and epidemiological attention. Giraffe Skin Disease (GSD) and Giraffe Ear Disease (GED) have been recorded in various giraffe populations across East Africa, though GSD was first observed in Uganda in 1995 (Kalema 1996) and in Tanzania in 2000 (Epaphras et al. 2012). The generic names describing the infections indicate how little researchers know about them (Karimuribo et al. 2011). More importantly, the role of these diseases in the decline (or not) of giraffe populations remains unknown.

Giraffe Skin Disease is characterised by the presence of greyish-brown lesions on the body of affected individuals and has shown regional variation on the anatomical location of the putative lesions (Muneza et al. 2016). The disease is reportedly caused by a nematode then complicated by secondary fungal infections (Mpanduji et al. 2011) but it is important to note that the specific nematode has not been identified, and the fungal species recorded in affected individuals also occur in healthy giraffe (Muneza et al. 2016). Currently, GSD has been recorded in seven African countries (Kenya, Uganda, Tanzania, Namibia, Botswana, Zimbabwe and South Africa), and the disease shows variation in proportion of population affected and severity (Fig. 1; Muneza et al. 2016). East Africa appears to be a hotspot of GSD with some of the highest rates recorded to date (Brown & Fennessy 2014; Muneza et al. 2017). Importantly,

researchers have observed that individuals with severe GSD in Tanzania (Fig. 7) appear to have difficulty moving, standing in one area for a prolonged period of time, and have poor body condition (Epaphras et al. 2012). This has led some to suggest that giraffe with severe GSD will have increased vulnerability to lion predation. Hence, it is crucial to investigate the aetiology and pathophysiology of GSD to better understand its effects on giraffe populations.

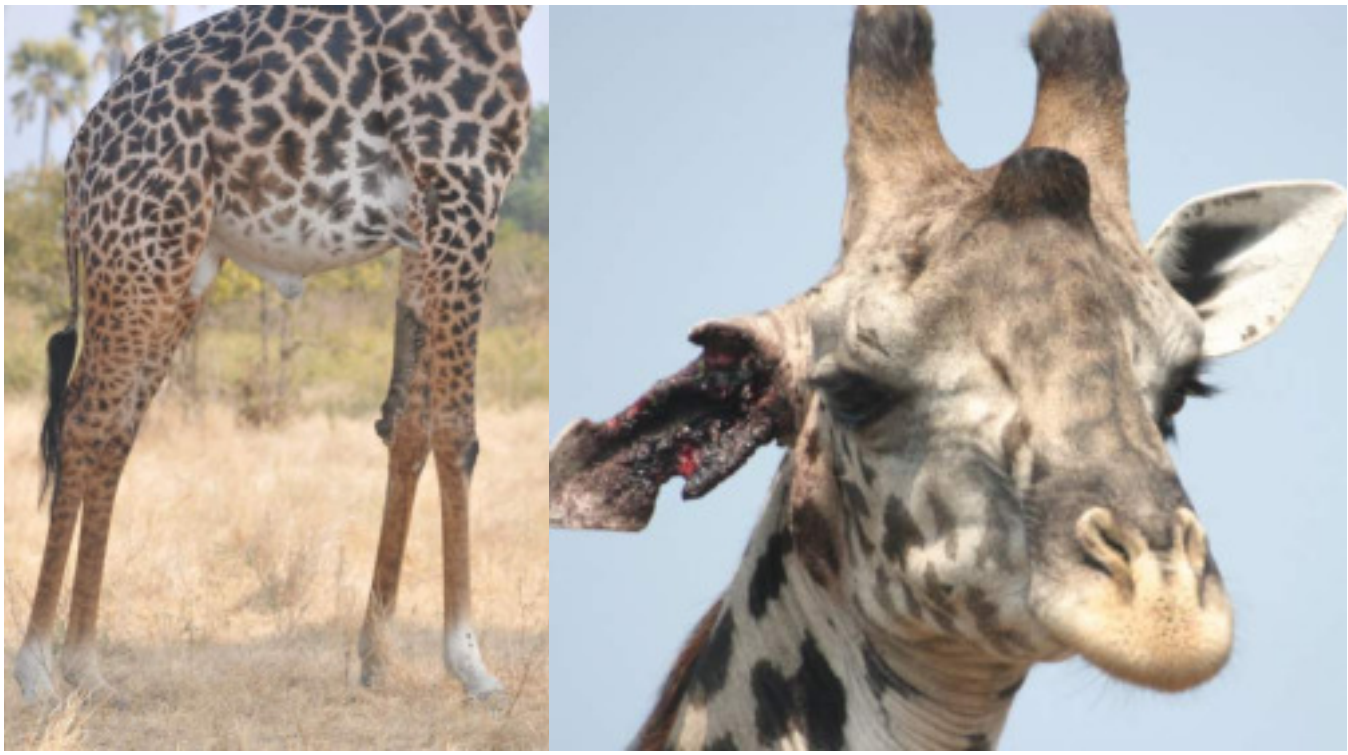

Fig. 7: Male Masai giraffe with severe GSD lesions in Ruaha National Park, Tanzania (Left) and male Masai giraffe with GED in Mikumi National Park (Right; © Pete Coppolillo).

Similarly, GED is poorly understood. The disease is characterised by lesions on the ear that then become droopy and ooze blood (Fig. 7). Unconfirmed reports suggest the disease is caused by the Kikoboga worm, named after a region in Mikumi NP, Tanzania. GED has only been observed in Mikumi NP and very little is known about it effects. It is currently unclear whether GSD and GED are spreading and becoming more common or whether the recent attention on the conservation status of giraffe populations in the wild has encouraged more attention on skin conditions of giraffe. Further investigations into the effects of GSD and GED will generate crucial information for giraffe management, specifically:

- Determining the relation between GSD in Kenya, Tanzania and Uganda and identifying the aetiological agent of GSD/GED;
- Examining and quantifying the indicators of mild, moderate and severe GSD;
- Studying the pathophysiology of GSD to better understand its effects at the individual level;
- Assessing whether diseased individuals are debilitated via observational and movement data to investigate the effects of GSD at the population level;
- Increased partnerships with collaborators to conduct lab tests to study serum chemistry and protein assays to examine markers of inflammation and indicators of systemic parasitism; and

- Assessing GSD as a zoonotic threat given continued encroachment of human beings and livestock in giraffe habitats and especially important for any potential translocations.

Conclusion

Giraffe populations in East Africa remain vastly understudied and increasingly of conservation concern given the significant rates of decline over the past 30 years. Nonetheless, there are measures that can be taken to prevent the declining trend of giraffe populations in the region. As identified, development of targeted National and future Regional/Species Giraffe Conservation Strategies and Action Plans are critical to aid implementation of conservation efforts for long-term impact. Importantly, all key stakeholders and facilitated by government need to come together and coalesce resources to secure the future of giraffe populations in the wild. Targeted conservation efforts will lead to capacity enhancement of local conservation managers and researchers, in addition to the strengthening of wildlife conservation policies and their implementation. Through these efforts and with partnerships across the region, GCF seeks – and is well-placed – with partners to achieve the goals of improving the management and better understanding of the conservation status of giraffe in East Africa and beyond.

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