Threat analysis: West African giraffe (*Giraffa camelopardalis peralta*) in Republic of Niger

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Overview

The Sudanian savannah currently suffers increasing pressure connected with growing human population in sub-Saharan Africa. Human settlements and agricultural lands have negatively influenced the availability of resources for wild ungulates, especially with increased competition from growing numbers of livestock and local human exploitation. Subsequently, and in context of giraffe (*Giraffa* spp.), this has led to a significant decrease in population numbers and range across the region. Remaining giraffe populations are predominantly conserved in formal protected areas, many of which are still in the process of being restored and conservation management improving.

The last population of West African giraffe (*G. camelopardalis peralta*), a subspecies of the Northern giraffe (*G. camelopardalis*) is only found in the Republic of Niger, predominantly in the central region of plateaus and Kouré and North Dallol Bosso, about 60 km south east of the capital – Niamey, extending into Doutchi, Loga, Gaya, Fandou and Ouallam areas (see Figure 1). Together this area is locally known as the "Giraffe

Zone" and forms part of the Parc W Biosphere Reserve covering more than 1,700 km^2. In addition, towards the end of 2018 eight giraffe were successfully translocated to the Gadabedji Biosphere Reserve in eastern Niger (see Figure 1). The establishment of the first-ever satellite population back into their natural range was a key step for the long-term conservation.

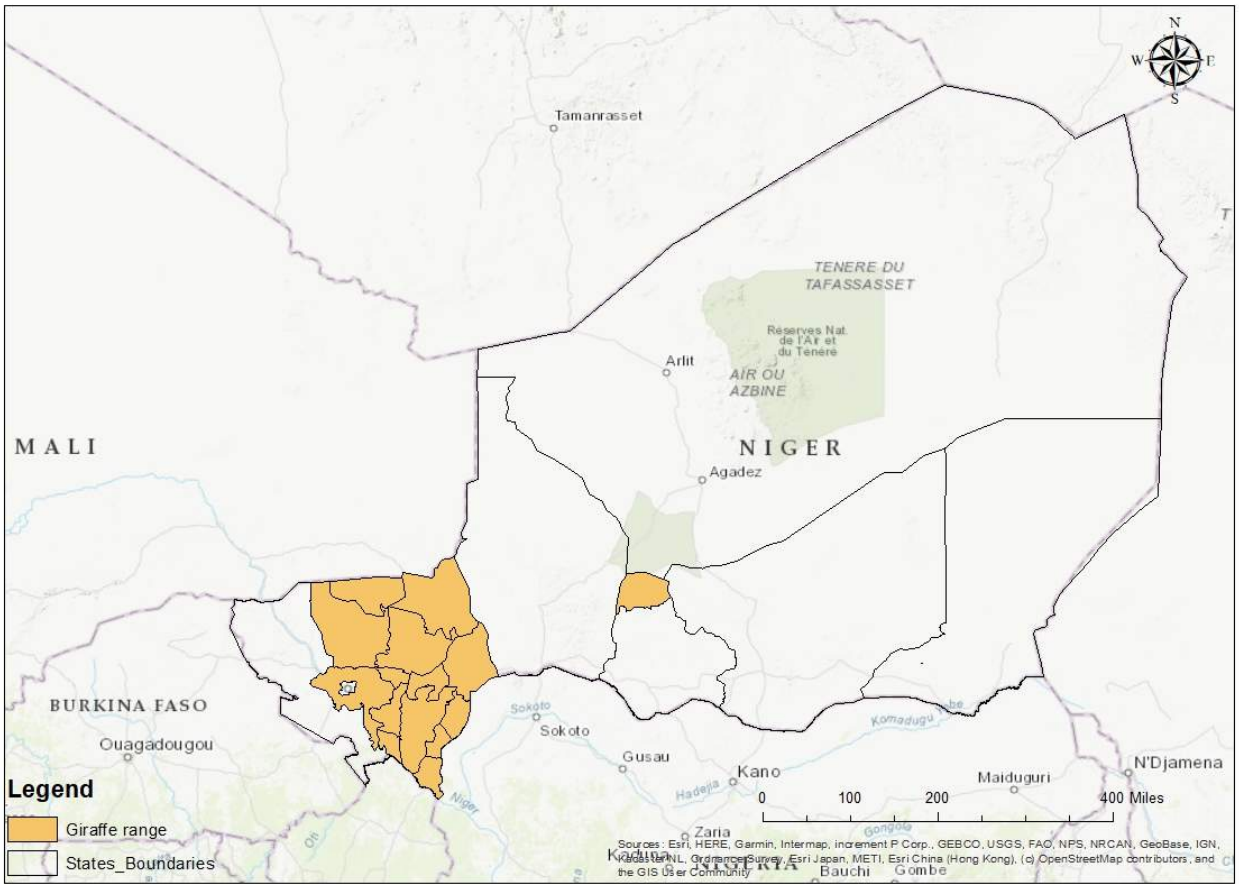

Figure 1. Current West African giraffe distribution in Niger (GCF 2020).

To better understand the current conservation status of the West African giraffe, and provide a baseline to the planned future review of the National Giraffe Conservation Strategy and Action Plan in Niger, this threat assessment was developed and focuses on the original population in "Giraffe Zone". The specific purpose of threat analysis is to: (1) describe threats (historic and current) to facilitate conservation planning decisions; (2) provide tools that will allow conservation managers to prioritise actions; and, (3) provide data to support comprehensive review of threats.

All identified direct threats were included in Annex I. Threat types were hierarchically categorised according to the IUCN Classification Scheme (version 3.2) with reference to each in the body of the text. These categories are standardised and used for the IUCN Red List status assessments. Following the globally recognised international system helps to better orientate and understand those threats facing the West African giraffe.

Habitat loss

A key habitat of the West African giraffe in the 'Giraffe Zone' is 'tiger bush' (brousse tigrée), and predominantly used during the rainy season (Suraud 2008, 2011; Le Pendu & Ciofolo 1999). It is a unique habitat covering about 22,000 km^2, approximately one third of Sahelian Niger (Galle et al. 1999) and is characterised by regularly alternating bare-soil stripes with dense linear thickets. The dominant woody species are *Combretum micranthum*, *C. nigricans* and *Acacia (Senegalia) macrostachya*; whilst the dominant herbaceous species are *Ctenium elegans* and *Pennisetum pedicellatum* (Manu et al. 1994). Unfortunately, the 'tiger bush' faces many pressures, in particular over-exploitation from local use and supplying the capital Niamey with a fuel source (Annex I. 5.3.2). Importantly, this habitat is of considerable economic interest since it is the main source of livestock forage year-round for local farmers as well as for the wood for domestic energy. Such intensive browsing pressure has resulted in excessive overgrazing and deforestation, respectively (Annex I.; 2.3.1). Over the last few decades, the woody vegetation on the Kouré plateau has decreased from 53% in 1960 to 14% in 1992, while bare soil increasing from 14% to 72% (Wu et al. 2000). Fiorillo et al. (2017) analysed the land clearing and degradation activities on the 'tiger bush' to the south-west of Niamey (Annex I. 11.1). He identified the spatial and temporal dynamic changes through remote sensing digital images (MODIS NDVI and LANDSAT) and observed the percentage of bare soil pixels increased from 29.52 in 1986 to 64.57 in 2012. Therefore, it appears that that degradation processes has accelerated and correlates with previous studies findings.

Figure 2. Illegal harvesting of 'tiger bush' habitat in the 'Giraffe Zone' (photo courtesy of A.R. Zabeirou , GCF-SCF).

A study by Morou (2011) investigated the land use changes in the "Giraffe Zone" comparing satellite images from 1986 and 2003. In 1986 the 'tiger bush' covered ~26% of the surveyed area, and by 2003 had decreased to 10.9% (see Figure 3; Morou 2011). The land use changes are a result of harvesting for fuelwood production, especially in areas adjacent to densely populated centres (Fiorillo et al. 2017; Morou 2011).

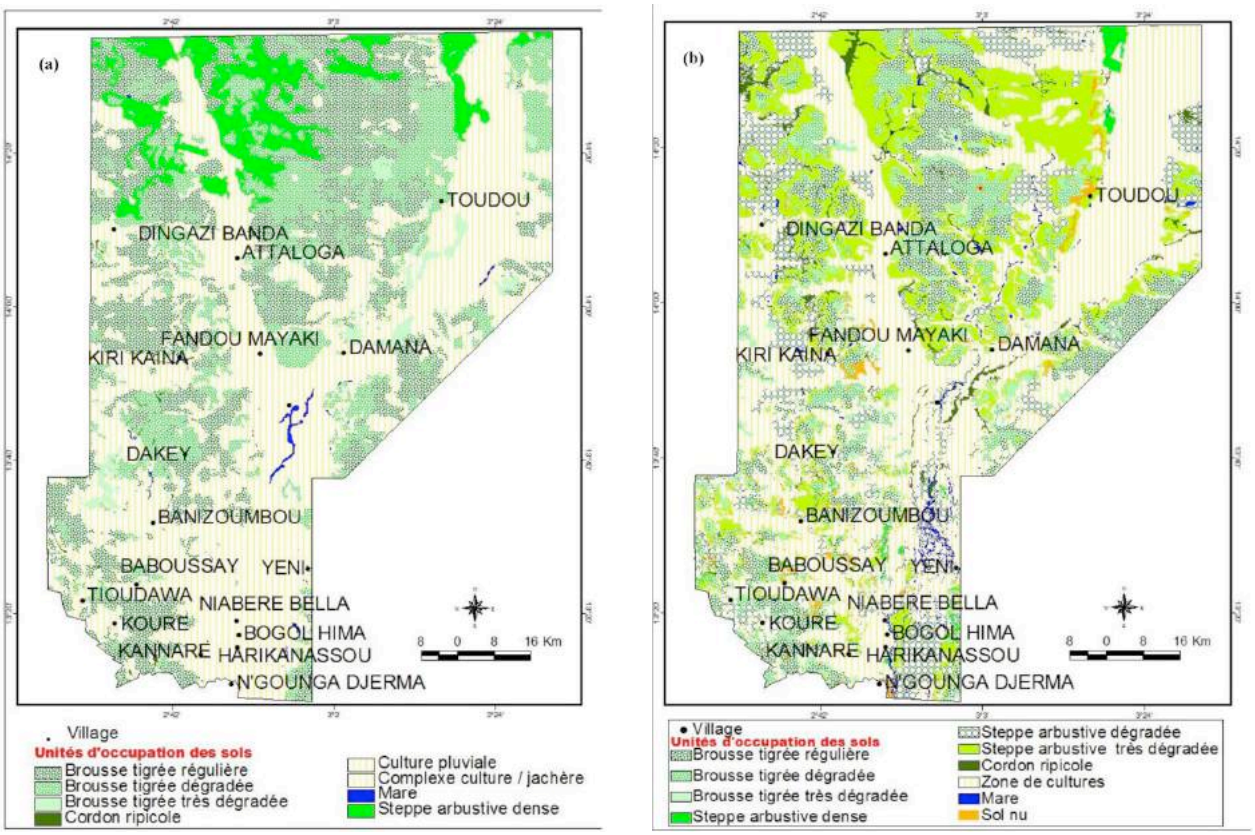

Figure 3. Land use changes observed in Niger, including the 'Giraffe Zone' between (a) 1968 and (b) 2003 (Morou 2011).

It is hypothesised that such vegetation loss and fragmentation has further reduced the amount of water retained leading to further indirect degradation of downslope vegetation bands (Wu et al. 2000). Some area of the plateau are completely bare, and the vegetation can no longer be restored naturally (see Figure 4). In some areas, re-forestation/vegetation programmes have been initiated with terraces dug in the shape of half-moon. These structures can retain water locally which hopefully leads to improvement in soil quality and thus promote the vegetation growth (Simonet 2018). Several NGOs together with government have been and/or are involved in such projects over the last decade e.g. AWF, GIZ, NIGERMAZADA (A.R. Zabeirou pers. comm.), however little analysis has been undertaken about the long-term success of these initiatives.

Figure 4. Deforested and overgrazed habitat in the 'Giraffe Zone' (photo courtesy of A.R. Zabeirou , GCF-SCF).

Human population growth and associated conflict

Due to the population growth and the expansion of agriculture to meet the associated needs, the Kouré area and Dallol Bosso Nord of the 'Giraffe Zone' is heavily subject to over-exploitation, predominantly from cultivation of millet, deforestation and livestock overgrazing (see Figure 5; Annex I. 2.1.2). The Niger human population has significantly increased over the last ten years alone from 16 to 24 million individuals, at a population growth rate of ~3.9% (Worldometers.info 2020; Annex I.; 1.1). The increase in human population goes in parallel with increasing livestock population in the country (see Table 1). Additional to the resource competition between livestock and giraffe, livestock can directly threaten giraffe through disease transmission (Sahailou et al. 2018; Annex I. 8.2).

Table 1. Comparative number of livestock in Niger from 2010 and 2018 (FAO 2020).

Species	2010	2018	Variance (%)
Camel	1,633,569	1,811,395	110.9
Cattle	9,011,897	14,363,595	159.4
Goat	12,722,529	17,411,659	136.9
Sheep	9,680,058	12,746,788	131.7
Total	33,048,053	46,333,437	140.2

It is assumed that giraffe have been less affected by rinderpest when compared to other ruminants (MacClintock 1973); nevertheless, rinderpest has been cited as a major contributing factor to local loss of giraffe across the continent in the last couple of hundred years (Skinner & Chimimba 2005). Giraffe are also susceptible to outbreaks of anthrax, bacterial disease and epidemics of gastroenteritis – albeit to a lesser degree than many species (MacClintock 1973).

During the 2018 Niger giraffe translocation activities, giraffe were sampled to run various diagnostic tests, and one giraffe from tested positive for the *Peste des petit ruminants* (PPR) virus (also known as 'goat plague') (P. Chardonnet pers. comm.). PPR is an infectious and highly contagious viral disease of wild and domesticated small ruminants (Jones et al. 1993). PPR occurs in sub-Saharan Africa, the Middle East and Indian subcontinent (Farougou et al. 2013). In 2016 an outbreak of PPR among domesticated sheep and goats in Mongolia caused uncontrolled transmission on several Mongolian wild species (Mongolian saiga, Siberian ibex and goitered gazelle). The most affected was Mongolian saiga resulting in a population declined of ~80% (Pruvot et al. 2020). In Niger, a study conducted by Farougou et al. (2013) tested 253 and 266 unvaccinated sheep and goat respectively in three areas (Tahoua, Tillabéri and Niamey). In Niamey, there was recorded 24.6% of infected animals while in Tillabéri and Tahoua there is 46.1% and 49.3% positive cases respectively. Taking all the above into account, it is important to ongoing assess the impact of transmission and impact of PPR in the current 'Giraffe Zone' and for any future translocations to limit spread of such virus.

Figure 5. Increasing conflict between giraffe and local communities in the 'Giraffe Zone'.

The close cohabitation of giraffe with local communities in Niger has resulted in other issues from time to time. It has been reported that some local communities have threatened giraffe with modified weapons while chasing them away from fields or mango trees where giraffe trample and/or feed on flowers and fruits (Rabeil et al. 2019). However, these conflict situations are decreasing as the majority of mango trees are now fenced (O. Idrissa, AVEN; pers. comm.). In the 'Giraffe Zone', almost a third of the area has been converted to cultivation zones between 1986 and 2003. In 1986 the cultivation zone covered 48.7% in 2003 the surface cover by crops increased to 70.6% (Morou et al. 2011). The increase in development activities at a local level will likely correlate with increasing threats to giraffe – direct and indirect. Expansion of market gardening using human-made "basins" (mini well) has not only reduced the amount of area but also increased the danger to giraffe with one fatality reported in the last year when a giraffe fell down into one of the wells (A.R. Zabeirou pers. comm.).

With the increasing human population in Niger, the infrastructure required also increases (Annex I.; 4.1). The 'Giraffe Zone' is divided by the main national road from Niamey to Dosso which runs through the core area with busy traffic dominated by heavy trucks. Additionally, a relatively dense 'road' network also exists within the "Giraffe Zone" which itself exacerbates movement of people and increasing potential threats. Several giraffe road deaths have been reported over the last few years (see Table 3). Such road accidents, as observed for other wildlife elsewhere, are often caused by high speed and increased frequency of vehicles on roads (Forman et al. 2003; Fahrig and Rytwinski 2009; Carvalho and Mira 2011). Despite lower traffic frequency at night, generally nocturnal animals are usually more often killed on road in comparison with diurnal animals, a result of reduced visibility (Bullock et al. 2011). The roads in "Giraffe Zone" are on some places surrounded by bush and the visibility is low, very often the speed limit is exceeded by drivers (Rabeil et al 2019). This threat does not have potential to impact to whole population, but it is fatal for individual (see Table 3).

Table 3. Comparative road accidents in the 'Giraffe Zone' from 2015-19 (A.R. Zabeirou. pers. comm.).

Year	No. giraffe	Sex/age	Vehicle
2015	1	Adult female	Bus
2017	1	Adult female	Bus
2018	1	Young male	Truck
2019	1	Adult female	Car

Another threat connected with human development is the relatively new railway which was built in Niger a few years ago (see Figure 6, Annex I. 4.1). The railway that runs from Niger-Benin also dissects the 'Giraffe Zone' and despite its current lack of service – it is believed Niger does not own any trains, it can be an insurmountable obstacle for giraffe in some areas. In some sections the railroad is above or under the

ground level and it is impossible for giraffe to cross it (Ministry of Environment 2015). The railway may however represent much serious threat if ever it will get operational in the future.

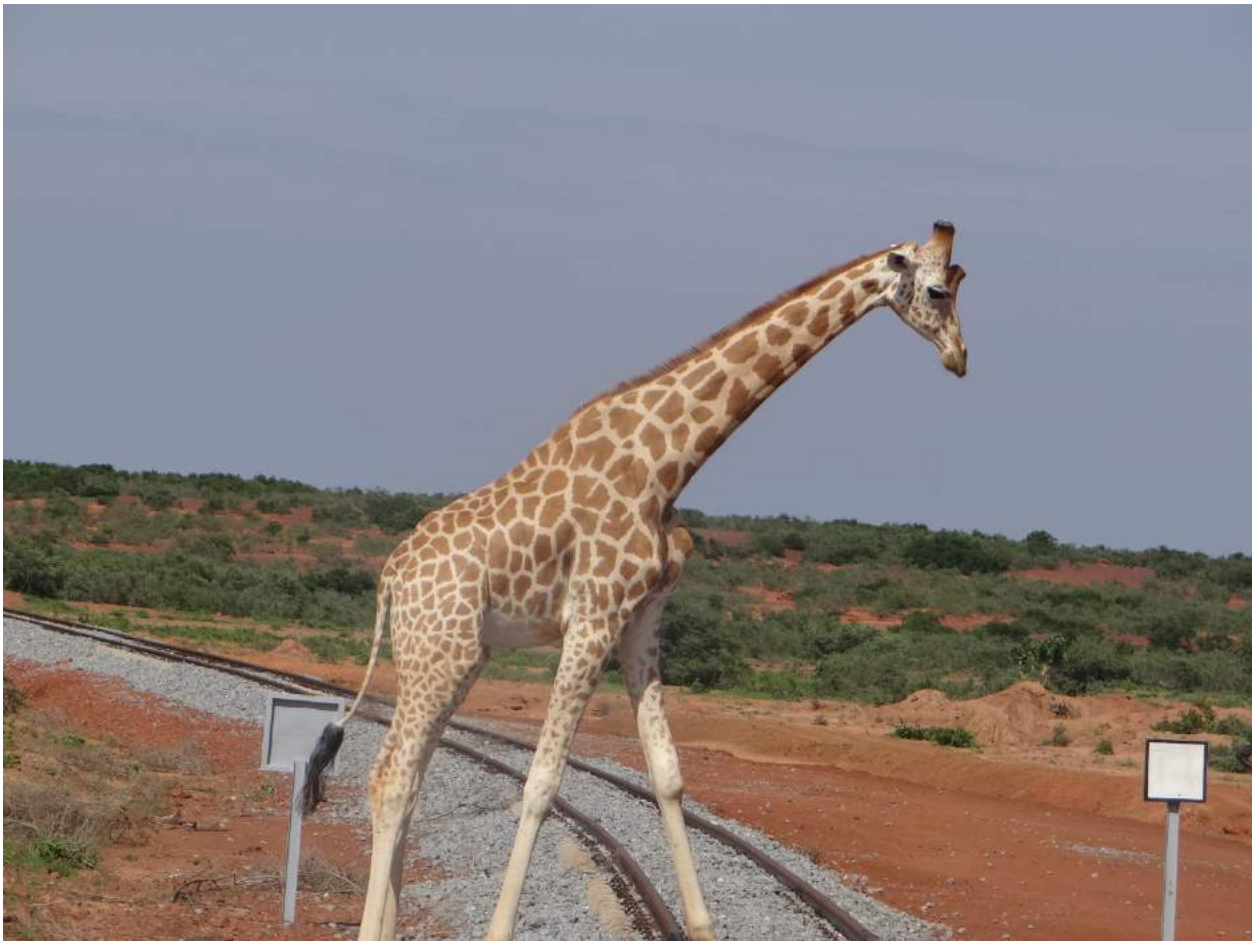

Figure 6. Giraffe crossing railway in 'Giraffe Zone'.

Climate Change

The 'Giraffe Zone' lies in a semi-arid region where the mean annual total rainfall is ~350mm/year and the daily mean temperature average is 29°C (National Climate Change Profile: Niger 2018). Rainfall decreases and interannual variability of rainfall increases from south to north. The majority of Niger experiences moderately high rainfall variability on an inter-annual basis. On decadal time scale, Niger also experiences clear variability with some periods being relatively drier or wetter than others. Long-term trends show consistent upward trends of increasing temperature over the period 1979-2015, on average 0.21°C annually. The total rainfall increased by 26.3mm per decade, but the rainy days decreased by 2.1 days/decade (National Climate Change Profile: Niger 2018, Annex I. 11.2).

Projection of future climate based on (Couple Model Inter-comparison Project) [1]CMIP5 GCM simulations

[1] Couple Model Inter-comparison Project (CMIP) is a coordinate activity amongst international modelling centres to produce a suite climate simulations using common experiment parameters. CMIP5 is currently the primary

under the [2]RCP8.5 pathway predict increase of temperature by 2.5°C by 2050s with changes evident in the next decades. The total annual rainfall trend is estimated to be normal to increasing, ranging anything up to an additional 50% by 2050 and even stronger by the end of the century (National Climate Change Profile: Niger 2018).

After a dry period with prolonged droughts in the 1970s and 1980s (see Figure 7), many scientists worried that large areas of the Sahel were irreversibly degraded (Ayoub 1998, Dregne 2002). However, recent scientific results suggest that the decades of abnormally dry conditions in the Sahel have been reversed by positive rainfall anomalies in the early 2000s (Hermann et al. 2005, Brandt et al. 2015). Various remote sensing studies observed a positive trend in vegetation greenness over the last two decades – the 're-greening of the Sahel'. However, this trend is not uniform throughout the Sahel when looked at on a finer scale (Fiorillo et al. 2017). The greening and degradation are heterogenous and caused by combination of both climate and anthropogenic factors such as historical increase in cropped areas, changes in land use, shortening of the fallow duration, an increase in the grazing pressure intensity during the rainy season and the decline of soil fertility (Derdel et al. 2014).

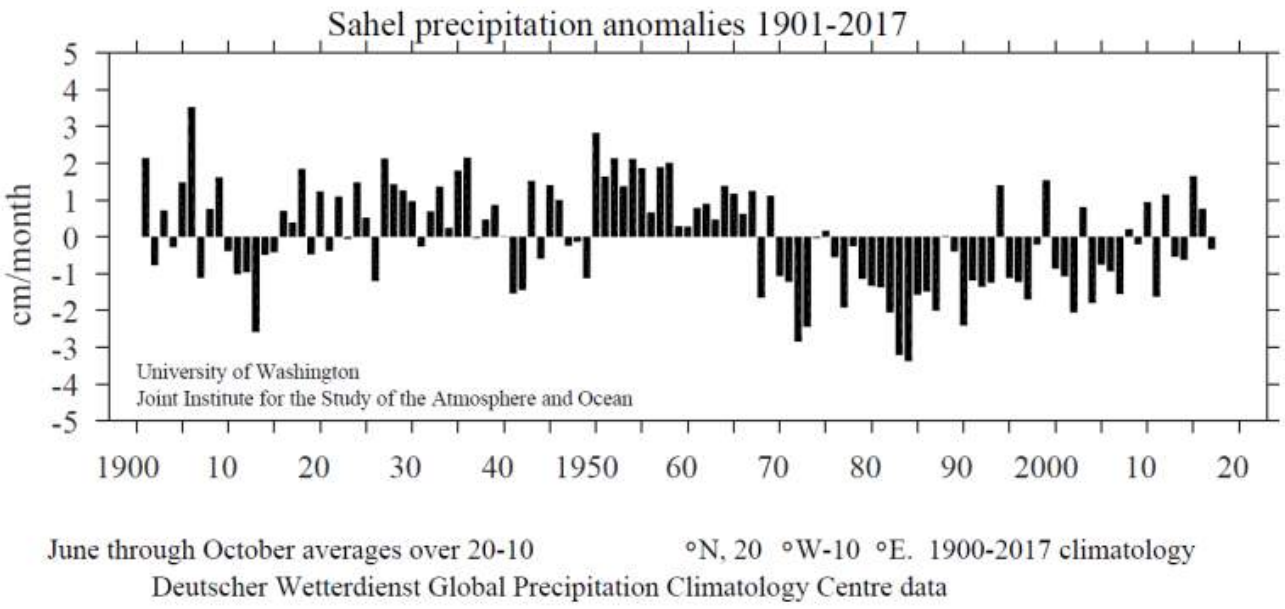

Figure 7. Sahel precipitation anomalies since 1900 (source: JISAO)

Droughts can cause serious problems, with that of the early 1970s supposedly one of the last issues that led to the local extirpation of giraffe from the current day Gadabedji Biosphere Reserve (Suraud et al. 2008). Additionally, large herds were also reported to be in the Tanout area, between Agadez and Zinder, however

source of global to regional scale climate projections and extensively informed the IPCC Fifth Assessment Report (AR5).

[2] Emissions/development pathway represent the "worst-case scenario", at this stage it is the most realistic reflection of the recent progression of anthropogenic emission.

they also likely disappeared because of drought. In 1984, the giraffe in the Ayorou area was reported to also became locally extinct in 1984. Whilst the droughts in all of these areas likely played a role, one can also presume that such harsh conditions led to illegal hunting by local communities in each of these areas – a combination of direct and indirect threats (Boulet et al. 2004).

Illegal hunting (poaching)

In the early 20th century the West African giraffe occurred across the Sudano-Sahelian zone. One of the main drivers of their disappearance was illegal hunting (poaching) (Ciofolo 1998). In Niger, efforts to curb illegal hunting was initiated in the early 1980s (Pfeffer 1981), yet the decline continued. In 1996 only 49 West African giraffe remained in the wild and were concentred in the 'Giraffe Zone' close to capital Niamey (Ciofolo 1998; Le Pendu & Ciofolo 1999). The Government of Niger with support from local and international partners increased their effort to enforce legislation preventing the illegal killing of the last West African giraffe. Dedicated community education and awareness campaigns coordinated by PURNKO (Projet d´Utilisation des Resources Naturelles de Kouré), ASGN (Association for Saving the Giraffes of Niger) and AVEN (Association pour la Valorisation de l´Ecoturisme au Niger) were established with international support to help save the last West African giraffe before it was too late (Fennessy et al. 2018). However, they are more vulnerable to illegal hunting in neighbouring Mali or Nigeria with the long-distance movements sometimes occurring north-west to Mali and east to Gaya (Nigeria border) (Le Pendu & Ciofolo 1999). The same was recorded by (Boulet et al. 2004). Suraud et al. (2008) observed two giraffe moving to Nigeria in 2007, at least one was immediately poached. The most recent long-distance movement was observed in October 2019, when one of GPS satellite tagged giraffe approached Nigeria, ~30 km from the border (Gašparová et al. 2019). As the West African giraffe population grows and expansion of range increases we will likely these dispersals more often and can be a future threat that needs monitoring and awareness creation in the local community.

Since 2015, Niger has been waging an open war against Boko Haram, a jihadist insurrection founded in north-eastern Nigeria that has spread to neighbouring countries (Annex I. 6.2). The Government of Niger declared a State of Emergency (SoE) in 2017 across the country including Diffa Region, Ouallam, Ayrorou, Bankilare, Abala and Banibongou (Tillabéri Region), and Tassara and Tillia (Tahoua Region). This SoE was in response to an escalation in terrorist attacks, especially in the Tillabéri Region. In the last year alone there have been several terror attacks particularly in the Diffa and Tillabéri Regions (www.gov.uk):

- 9 January 2020: terrorists killed 89 Nigerien soldiers at their base in Chinegodrar, Tillabéri
- 10 December 2019: terrorists killed 71 Nigerien soldiers at their base in Inates
- 1 July 2019: terrorists killed at least 18 Nigerien soldiers at an army base in Tillabéri

- 19 June 2019: gunmen killed 2 police officers at the north Niamey Gates
- 16 May 2019: terrorists killed 28 Nigerien soldiers in Tillabéri
- 27 March 2019: suicide bombers and gunmen killed 12 people in Diffa.

Additional to Boko Haram, there are number of other terrorist groups active in the region. These include Jamaat Nusrat al-Islam wal Muslimeen (JNIM), Islamic State West Africa (ISWA), Islamic State Greater Sahara (ISGS), Al Qaeda in the Islamic Maghreb (AQIM), Al Murabitoun and Ansar Dine (www.gov.uk). These terrorist groups make work and travel difficult in the majority of Niger, in particular around key border areas of Burkina Faso, Mali and Nigeria (see Figure 8).

Figure 8. British travel advice for Niger highlighting areas of concern for travellers – essentially all the country is advised against travel although the 'Giraffe Zone' and Gadabedji Biosphere Reserve are in the orange areas (www.gov.uk).

During civil or regional conflicts it is not surprising that militant and terrorist groups are sometimes involved in illegal hunting of wildlife and potentially trade, to either feed soldiers and/or generate funding. Historically, and likely still ongoing, groups such as the Lord´s Resistance Army (LRA´s) have illegally hunted elephant across parts of East and Central Africa; the Janjaweed Arab militia of Sudan has been accused of killing thousands of elephant in Cameroon, Chad and the Central African Republic (Christy 2015); and, Resistência Nacional Moçambicana (RENAMO) traded in rhino horn and ivory during Mozambique´s civil war (Naylor 1999). In 1970-80s militant groups such as UNITA (União Nacional para a Independência Total

de Angola) in Angola as well as the military of numerous African governments illegally killed thousands of elephant for bushmeat and ivory (Benz & Benz-Schwarzburg 2011). Bushmeat from illegal hunting is often a valuable a source of food for militants and civilians during conflicts, and as such can have dire impacts on wildlife populations. Insecurity and violent conflicts are and may continue to be a serious potential threat for the West African giraffe if terrorists turn to illegally hunting them for food, resulting in a decrease in the population size or possibly leading to extinction (Annex I. 5.1.1).

In addition to insecurity through civil unrest, community members own insecurity may lead to illegal activities. The current corona virus pandemic may be one such threat. The disruption of the global tourism, restricting movements, grounding daily activities and shutting down of unessential businesses may lead to unpredictable economic and social consequences. The indirect impacts of such a threat and associated 'lockdown' measures may result in trouble for wildlife. Not only does the lack of tourism reduce one of the main sources of revenues for local communities, private business and government, but also anti-poaching activities and other conservation work is also restricted – leading to areas possibly being poorly protected during such vulnerable times. If local (or neighbouring) communities do not have any other alternatives for income (or access to food), it is predicted that illegal hunting may result for local consumption and/or trade (Deliso 2020). And interlinked with this and other threats highlighted above, the lack of resources may also drive local communities towards the cooperation with illegal terrorist organisations.

Population viability – risk of small population

Small populations are in real danger of going extinct, predominantly due to: (1) genetic issues resulting from loss of genetic variability; (2) demographic fluctuations; and, (3) stochastic events. Genetic variability is important in enabling a population to adapt to a changing environment. In a small population there is a significant probability of losing the variability in each generation due to chance (Primack 2000). Once a population size is small, the mechanism to prevent inbreeding can fail, potentially resulting in inbreeding depression (Ralls et al. 1988). Loss of genetic variability in a small population may limit the ability of the population to respond to long-term changes in environment, for example the new diseases or climate change (Ellstrand 1992; Figure 9).

Another problem which can arise in a small population is that of a "bottle neck effect" or "founder effect". When the population is greatly reduced in size, rare alleles may be lost if individuals do not survive and reproduce, hence unable to pass them along. The "founder effect" may happen when few individuals leave large populations to establish a new one. The new population has potentially less genetical variability and lower probability of persisting (Bryant et al. 1998). When the population become small the demographical and environmental stochasticity becomes crucial factors, the population has higher probability of extinction due to chance alone (Lacy & Lindenmayer 1995). Small populations are also more threatened by random

unpredictable catastrophes such are the natural factors (drought, storm, flood, disease, etc.) (Young 1994). As well as by political and social conflicts, which may significantly affect the wildlife and their habitat (Kanyamibwa 1998).

Figure 9. Small population size of West African giraffe has rebounded however the long-term monitoring of their genetics is key to their future management (photo courtesy of S. Viljoen).

Despite the fact that West African giraffe population rapidly dropped to 49 individuals in 1996 (Ciofolo 1998) the population has high level of genetic diversity (heterozygosity) in comparison with other giraffe population. However, some level of inbreeding is likely to be present in the population. According to molecular genetic research, it is evident that the population went through a bottleneck (Suraud et al. 2008). Management of threatened population should take into account the possible existence and effect of inbreeding depression (Frankham & Ralls 1998). Therefore, efforts such as conservation translocations and establishment of satellite populations are important measures to help improve long-term viability of the West African giraffe with critical monitoring, including genetic, a tool to help assess its success and ongoing management.

Conclusion

The most serious threat currently facing the West African giraffe, as for the majority of Sahelian wildlife species, is habitat loss. With the ever increasing human population in Niger, the space for wildlife is becoming greatly reduced. Much of the original 'tiger bush' habitat, tiger bush on the plateaus has been converted to fields or pastures. Deforested, overgrazed and degraded land continues to rapidly occur throughout the 'Giraffe Zone' and the current conservation agriculture projects are unable to turn the tide. A looming threat is that of current and increasing infrastructural development programmes including roads and railway, and associated traffic. These threats may not affect the entire population, however, the impacts are fatal.

An ongoing threat to the West African giraffe population, especially with their expanding range, is that of illegal hunting. If the country continues to faces unpredictable natural catastrophes (drought, disease, etc.) or political unrest (civil war, terrorism, etc.), illegal hunting may become a direct threat if giraffe is seen as an alternative source of food and/or income. With the current coronavirus disease (COVID-19) resulting in an international pandemic, social, economic and political instability may fuel local civil unrest and terrorism activities, leading to illegal activities involving wildlife. As always, climate change combined with all the other threats will continue to have an impact on giraffe and their habitat – this is something that may not be able to managed but monitored and appropriate actions undertaken.

Fortunately, over the last two and a half decades targeted activities supporting the long-term conservation of the West African giraffe in Niger have enabled the population to bounce back from a critical threshold.

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Annex I. – Threat analysis overview of the West African giraffe (IUCN categories)

Threats			Current level	Potential Future level	Impact on Population
1. Residential & Commercial Development	1.1 Housing & Urban Areas		High	High	Medium
2. Agriculture & Aquaculture	2.1 Annual & perennial non-timber crops	2.1.2 Small-holder Farming	High	High	High
	2.3 Livestock Farming & Ranching	2.3.1 Nomadic Grazing	High	High	High
4. Transportation & Service Corridors	4.1 Roads & Railroads		Medium	Medium	Medium
5. Biological Resource Use	5.1 Hunting & Collecting Terrestrial Animals	5.1.1 Intentional Use (species being assessed is the target	Low	High	High
	5.3 Logging & Wood harvesting	5.3.2 Intentional Use: large scale (species being assessed is the target) [clear cutting of hardwoods, fuel wood collection]	Medium	High	Medium
6. Human Intrusions & Disturbances	6.2 War, Civil Unrest & Military Exercises		Low	High	High
8. Invasive & Other Problematic Species, Genes & Diseases	8.2 Problematic Native Species/Diseases		Low	Medium	High
11. Climate Change & Severe Weather	11.1 Habitat Shifting & Alternation [desertification]		Medium	High	High
	11.2. Droughts		Medium	High	High