1st Annual report

West African giraffe (*Giraffa camelopardalis peralta*)

Republic of Niger

November 2018- November 2019

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This annual report summarises some of our conservation activities and preliminary results which contribute to West African giraffe conservation.

Introduction

The last population of West African giraffe (*Giraffa camelopardalis peralta)* – recently shown to be a subspecies of the Northern giraffe (*G. camelopardalis*) (Fennessy *et al.* 2016; Winter *et al.* 2018) – is only found in the Republic of Niger. Giraffe distribution is predominantly in the Kouré and North Dallol Bosso central region, about 60km south east of the capital – Niamey, and extends to Doutchi, Loga, Gaya, Fandou and Ouallam areas. Together this area is locally referred to as the "Giraffe Zone" and forms part of the Parc W Biosphere Reserve covering more than 1,700 km^2. A new satellite population of giraffe was established in Gadabedji Biosphere Reserve at the end of 2018 by the Giraffe Conservation Foundation (GCF) with the support of the Sahara Conservation Fund (SCF). The next closest known population of giraffe is in northern Cameroon and southern Chad and are identified as Kordofan giraffe (*G. c. antiquorum*) (Fennessy *et al.* 2016; Winter *et al.* 2018).

Niger's giraffe coexist with the local population resulting at times in conflict over space and resources. This IUCN Red Listed 'Vulnerable' West African giraffe subspecies, most recently down listed from 'Endangered' yet still few in numbers, is threatened by various factors including agricultural encroachment and development, climate change and variability, human population growth and natural resource overexploitation. These phenomena have reduced forage, contributing to the disappearance of the West African giraffe that was once represented across several neighbouring African countries e.g. Burkina Faso, Senegal, Mauritania, Mali, Nigeria.

In 1996 it was estimated that only 49 giraffe remained in all West Africa, limited to an area of 840 km^2 of arid Sahelian scrubland north of the Niger River in the Kouré area, Niger (Suraud et *al.*, 2009). The important efforts of the Government of Niger in collaboration with partners (EU, UNDP, etc.) have strongly contributed to the growth in the number of giraffe since. According to the 2015 census, the population was estimated to consist of 499 giraffe, and the most recent census in 2018 estimated ~600 individuals.

Translocation

After years of discussions, planning and raising the necessary support, Operation Sahel Giraffe commenced in early November 2018. Eight giraffe (5 females and 3 males) were individually captured in the 'Giraffe Zone' and transferred to a holding pen (boma), where they were kept for more than three weeks to prepare them for the long journey (~800 km). The eight giraffe were then transported in two groups of four, an arduous journey for both the giraffe and the team, before their successful release in Gadabedji Biosphere Reserve recently. For initial and final location see (Figure 1).

Almost 50 years ago, giraffe became locally extinct in the Gadabedji area because of drought and illegal hunting. Since 2013 Niger's Wildlife Authority, with support from the Niger Fauna Corridor Project/UNDP, has worked diligently towards restoring the region's wildlife and their habitat. The re-introduction of giraffe will further enrich the reserve's biodiversity and contribute to increasing community development and support in the region.

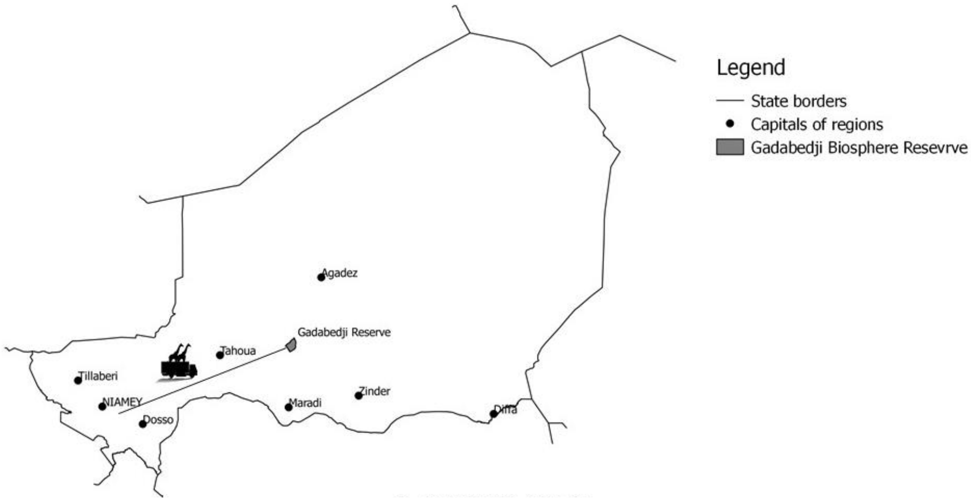

Figure 1. Giraffe translocation

Giraffe Conservation Foundation and Sahara Conservation Fund has worked collaboratively alongside Niger's Ministry of Environment and local communities since 2005, supporting the conservation science and management of West African giraffe in Niger to secure their future. Since the late 2000s, Africa's first-ever National Giraffe Conservation Strategy has guided giraffe conservation efforts in the country. Re-introducing West African giraffe into safe areas within their historical range is a key component of the National Strategy, which is expected to benefit both local communities and wildlife equally. This new founding population in Gadabedji Biosphere Reserve is a critical first step towards the reserve's development as a flagship wildlife reserve in Niger.

Operation Sahel Giraffe has been a partnership between the Giraffe Conservation Foundation, Sahara Conservation Fund, Niger's Ministry of Environment, and the Niger Fauna Corridor Project/UNDP.

Post-translocation monitoring

After two-days long journey from "Giraffe Zone" the first group of four giraffe was released in the Gadabedji Biosphere Reserve. Due to their calm behaviour, the team decided to undertake a semi-soft release. After three days, the second group of four giraffe arrived in the reserve and was released similarly.

To assess the post-release space use, social behaviour and interactions with livestock, giraffe were opportunistically monitored for the first two weeks using scan sampling (every 20min) combined with focal sampling. For identification, individual ID cards were developed for each giraffe (Figure 2) including photos from both sides, age and unique code – GDB (for Gadabedji Biosphere reserve), sex - M/F (male/female respectively) and number (1-5).

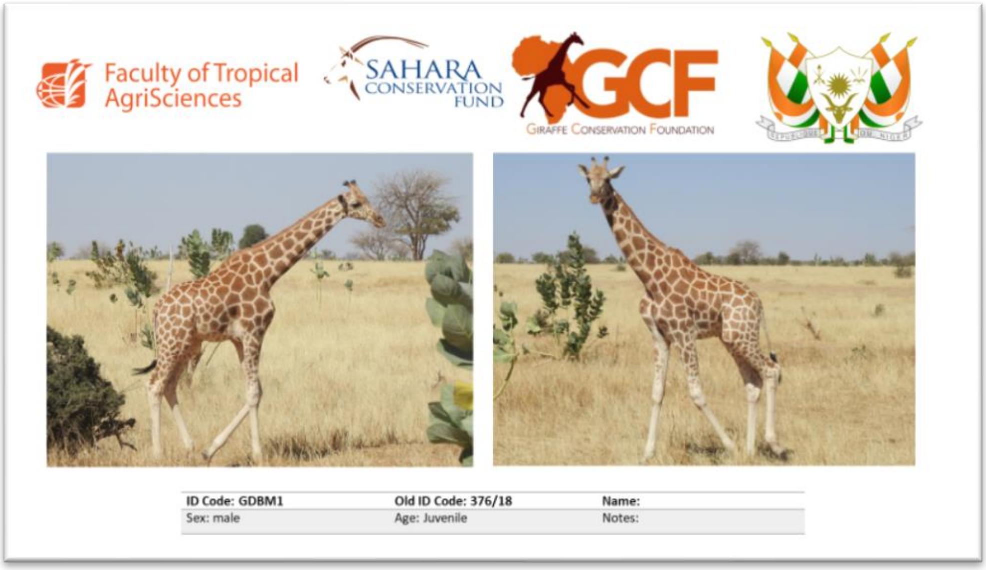

Figure 2. An example of the identification card

Data about giraffe and livestock were collected using CyberTracker version 3.496 and analysed in Statistica (TIBCO Software Inc 2018) and QGIS 2.18.12 (QGIS Development Team 2017). Each record includes date, time, longitude, latitude, ID code, activity of individual, distance and angle from observer.

Preliminary results of post-translocation monitoring

During this initial study period only seven giraffe were observed as one moved immediately out of the reserve with the longest distance travelled in a day recorded immediately after its release (107 km, Figure 3). During the initial monitoring period 73 scan sampling events were undertaken over 9 days (2–14 per day). Two herds of three giraffe was recorded in 56 sightings (77%), consisting only of individuals from their original translocated groups I.e. not mixed together. Two giraffe were recorded together 17 times (23%). In six observations (8%) giraffe were observed in close vicinity of livestock (cow n=2, camel n=3, goat n=1). The mean distance between giraffe and livestock – 50.24m (range 10.35-160.97m) was greater than the distance among giraffe individuals (mean 15.55 ±18.29m, range 1.74-103.98m, N=118) (p=0.022; U=157). The initial activities recorded during total 24h of focal sampling consisted of 16h browsing (66%), 5h ruminating (21%), 2h walking (7%), 1h standing (4%), 4min vigilance (0.28%) and 3min grooming (0.21%). Activity budgets did not statistically differ according to sex, time of day nor release group order.

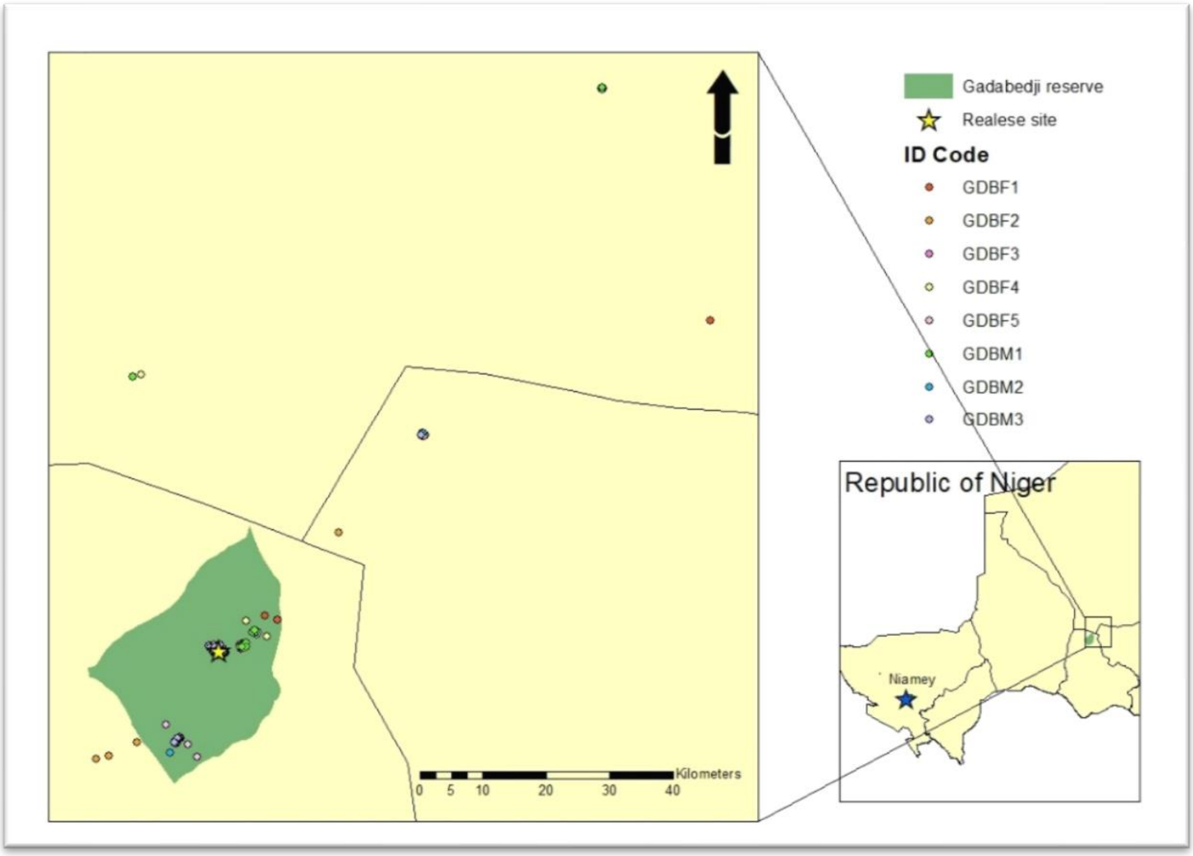

Figure 3 The initial movement of eight giraffe in and around the Gadabedji Biosphere Reserve, Niger during twenty-three days after release.

GPS satellite units

Two missions were undertaken, during which a total of 19 giraffe were GPS satellite tagged with ossi-units to help assess their habitat use and spatial ecology over time. The first one was held in November 2018, when two females and one male were fitted by solar powered GPS satellite units (ossi-units). The second mission took place in August 2019 and 16 giraffe (13 females, 3 males) were tagged. One (3040 M) out of the first three units fitted in November 2018 worked for 150 days until stopped. At the beginning the unit 3037 F transmitted the position daily. After almost year the transmission became irregular with long gaps. The third ossi-unit from the first mission (3038 F) also works very irregularly, with very few GPS positions transmitted per month.

From the second mission, 14 out of 16 satellite units still transmit GPS positions. Two units fitted on males (3239 M and 3240 M) stopped working in September (3rd and 15th, respectively), and were possibly damaged during necking. Units fitted on males do not have a long lifespan across Africa and more research is required to develop a unit that will last longer. Across all programs under the Twiga Tracker Initiative employing ossi-units at the continental scale, there is a failure rate (without correcting for time) of approximately 75% for males. Conversely, the same metric for females is < 40%. In total, data were transmitted 29 and 41 days respectively. Eleven ossi-units transmitted daily the GPS positions whilst the rest worked irregular with several days-long gaps (Table 1). For a detailed review of unit performance, refer to Appendix 1

Table 1 indicate sex, month of fitted ossi-unit, number of GPS records from 10 November, 2018 (first mission) and from 5 August 2019 (second mission) until 31 October 2019 and the date of last transmitted location. Data were downloaded 31 October 2019.

Unit ID	Sex	Month fitted	Nº GPS records	Last date of transmitted position
3037	F	November, 2018	5462	31.10.2019
3038	F	November, 2018	700	27.10.2019
3040	M	November, 2018	3196	23.3.2019
3224	F	August, 2019	2023	31.10.2019
3226	F	August, 2019	2023	31.10.2019
3236	F	August, 2019	2023	31.10.2019
3237	F	August, 2019	530	27.10.2019
3238	F	August, 2019	2023	31.10.2019
3239	M	August, 2019	670	3.9.2019
3240	M	August, 2019	949	15.9.2019
3241	F	August, 2019	2023	31.10.2019
3243	F	August, 2019	2021	31.10.2019
3244	F	August, 2019	2023	31.10.2019
3245	F	August, 2019	2023	31.10.2019
3246	M	August, 2019	1389	31.10.2019
3247	F	August, 2019	2020	31.10.2019
3248	F	August, 2019	2023	31.10.2019
3249	F	August, 2019	2023	31.10.2019
3250	F	August, 2019	2023	31.10.2019

Home range estimation

Home range (HR) is an area used by an animal during its normal activities of foraging, mating and caring young. Any animal can make an "unusual" movement outside the HR resulting in outlier points which are not considered as part it is normal activity area unless observed regularly (Burt 1943). Le Pendu and Ciofolo (1999) divided the 'Giraffe Zone' population into two groups; resident and non-residents, as the West African giraffe showed seasonal movement patterns. Generally, the giraffe´s HR size varies among populations across the continent based on a combination of factors e.g. season, precipitation, habitat type, overlaps and population density, predation risk, fragmentation and people disturbances (Berry 1978, Fennessy 2009, Foster 1966, Le Pendu and Ciofolo 1999, Knüsel 2019).

Animal tracking technology has increased the capacity of collecting data, and the methods to analyze them have evolved consequently e.g. autocorrelation (Noonan 2018). The major estimator tools – Kernel Density Estimator (KDE; Worton 1989) and Minimum Convex Polygon (MCP; Hayne 1949) – are routinely used because they are relatively simple to understand and implement but assume that the data are independent. However, they underestimate the HR size (Fleming *et al.* 2015, Fleming and Calabrese 2017). As the position data are collected with short intervals (daily, hourly), it is becoming to be dependent and highly autocorrelated (Noonan 2018).

Methods

The annual HR in this report was estimated for the three giraffe GPS tagged in November 2018. Because of the very low and unbalanced dataset, little additional analyses could be done. Additionally, quarterly HR estimates for 15 animals tagged during the second mission and one animal from the first. As the West African giraffe has historically shown seasonal movements, the data was analysed separately for dry season (November to May) and rainy season (June to October) (Le Pendu and Cifolo 1999; Leroy *et al.* 2009). The annual and quarterly HR was calculated in R package ctmm version 0.5.7 (Calabrese and Fleming 2016). Continuous-time movement modelling (ctmm) package is based on Autocorrelated Kernel Density Estimation (AKDE). After running 95% and 50% AKDE in R studio, the resulting shapefile was opened in QGIS 2.18.12 (QGIS Development Team 2017) and the area calculated using the $area function.

For a comparison Kernel Density Estimator (KDE) was used. For HR estimation the Animove plugin for QGIS 2.18.12 (QGIS Development Team 2017) was used and the area was calculated using $area function. For KDE method, the data points were manually reduced to three data points per day (usually 0:00, 12:00, 23:00), because KDE explicitly assumes that location data are independent and identically distributed (Noonan 2018). Table 2 shows the results of dry season HR, rainy season HR and annual. Results are rather illustrative and because of the unbalanced dataset they should only be seen as preliminary.

Table 2 include results of dry season HR (yellow), rainy season HR (blue) and annual HR (green).

ID	KDE 50% (km^2)	KDE 95% (km^2)	Nº of records	AKDE 50% (km^2)	AKDE 95% (km^2)	Nº of records
3037 F DS	28.4	184.2	543	42.8	223.4	3,073
3038 F DS	307.7	892	234	586.9	2,500.7	641
3040 M DS	30.2	243.2	422	85.1	406.5	3,196
3037 F RS	66.9	488.7	408	153.4	685.1	2,389
3038 F RS	40.7	74	39	136.91	537.3	59
3037 F An	48.7	379.6	951	127.2	685.3	5,462
3038 F An	142.6	736.8	273	441.5	1,918.27	700

The statistical analyses of quarterly HR were run using Statistica (TIBCO Software Inc 2018). The mean, range and standard deviation of 95% AKDE and 50% AKDE was calculated by descriptive statistic, and for the difference between sex a Mann-Whitney U test was used. All analyses were undertaken on data from the 16 ossi-units still functioning regularly. Unfortunately, one giraffe (3241 F) was not included into any statistical analyses because of the very unusual movement pattern. This giraffe is considered to be non-resident and during the quarter did not create a 'normal' HR, on the contrary, it roamed very far e.g. AKDE on this movement pattern resulted in 95% HR exceeding 56,000 km^2. As mentioned in the definition of HR, the outlier points are not considered as normal activity. These outlier points were also deleted in datasets of three giraffe (3224 F, 3226 F, 3246 and 3249 F). Table 3 highlights the results of 95% and 50% AKDE for the 16 giraffe before and after deleting the outlining points.

*Table 3 shows the results of 95% and 50% AKDE. The highlighted rows (3224 F, 3226 F, 3246 and 3249 F) indicate the result before and after deleting outlining points. * columns with deleted outlining points.*

ID	50 % AKDE (km^2)	95% AKDE (km^2)	Nº of records	*Nº of records	*50% AKDE (km^2)	*95% AKDE (km^2)
3245	27.2	125.9	2,023	2,023	27.2	125.9
3238	39.1	175.6	2,023	2,023	39.1	175.6
3237	55.3	335.9	530	530	55.3	335.9
3239	139.4	579.6	670	670	139.4	579.6
3226	713.8	3518.9	2,023	1,738	138.9	610.5
3247	162.8	717.6	2,020	2,020	162.8	717.6
3037	185.3	837.1	1,386	1,386	185.3	837.1
3244	181.8	851.8	2,023	2,023	181.8	851.8
3250	334.5	1,333.6	2,023	2,023	334.5	1,333.6
3249	621.5	2570	2,023	2,015	369.2	1,455.6
3246	424.9	1,648.8	1,389	1,341	413.6	1,483.6
3236	506.2	1,955.4	2,023	2,023	506.2	1,955.4
3243	641.5	2,507.1	2,021	2,021	641.5	2,507.1
3240	661.8	2,561.7	949	949	661.8	2,561.7
3248	831.2	3,188.4	2,023	2,023	831.2	3,188.4
3224	1,762.2	9,225.2	2,023	1,881	841.7	3,243.9

Results

Despite an interest in comparing the seasonal movements and seasonal HR size, it is obvious from the limited data at hand that this is currently insufficient. For preliminary comparison giraffe 3037 F was chosen, the dataset for dry and rainy season being similar, despite the fact, that the rainy season is shorter (5 months). The home range size was larger in rainy season (685.1 km^2) than in the dry season (223.4 km^2). The result is the opposite to that observed by Le Pendu and Ciofolo (1999). In their study the average HR size during rainy season was 46.6 km^2 and from dry season 90.7 km^2. A study conducted in Tsavo West National Park, Kenya, in contrary estimated the HR size during the wet season to be much larger (634.3 km^2) than in dry season (220.9 km^2). In Kenya the giraffe wandered far during the wet season while in dry season concentred feeding along the Tsavo River (Obari 2014). As mentioned, additional data and further analyses for longer period is needed. For a comparison of seasonal movement of 3037 F see Figure 4. From the picture is visible that in dry season giraffe was closer to riverbed, which dried up during the dry season but there are some water points, despite the fact that giraffe are not water dependent (Leeuw et al 2001, Fennessy 2009), this place also provides more forage resources.

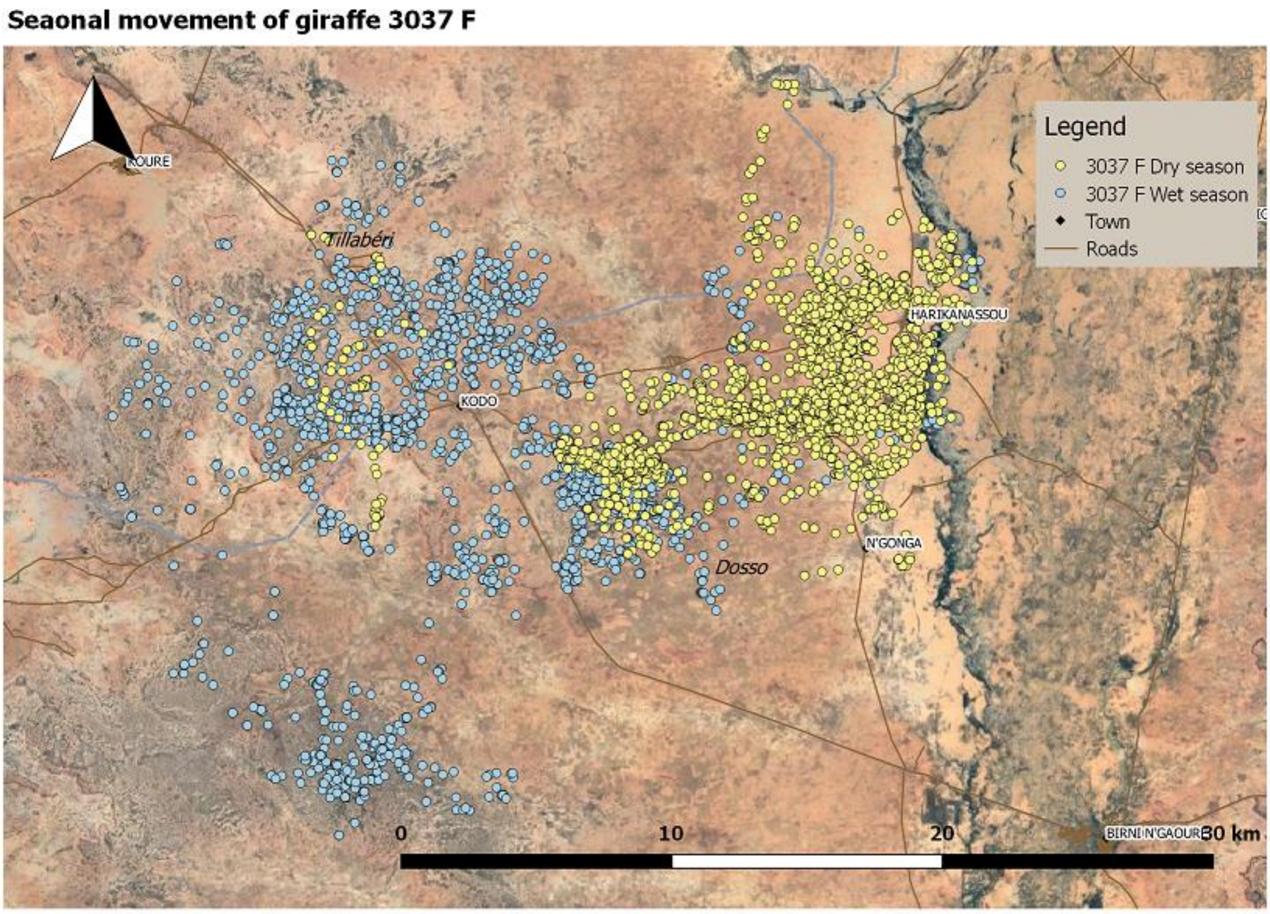

Figure 4 The movement pattern of 3037 F. Yellow represent dry season and blue wet season.

The average quarterly HR size, irrespective of sex, was 1,383.0 km^2 ± 1,038.6, ranging from 125.9-3,243.9 km^2 (n=16). The mean size of their core area was 346.3 km^2 ± 277.2 ranging from 27.2-841.7 km^2 (n=16). There was no significant difference (p>0.05; U=16) in the 95% HR size between males (n= 3; 1596.7 km^2 ± 992.1) and females (n=13; 1333.7km^2 ± 1081.8). Nor was there any significant difference (p>0.05; U=15) in the 50% AKDE between males and females. The average core area of males (n=3) was 408.7 km^2 ± 261.6 km^2, and for females (n=13) 331.2 km^2 ± 288.9 km^2.

In comparison with other studies published on giraffe´s HR, the preliminary results of the West African giraffe HR size this quarter are relatively large. This result can be attributed to several factors. Firstly, the methods used traditionally for HR estimating are KDE and MCP, both proven to underestimate results (Fleming *et al.* 2015, Fleming and Calabrese 2017). Our preliminary findings were calculated using AKDE and KDE, as per similar methods for giraffe recently published (D´haen at al. 2019). As an example, in this quarter the average HR size of six giraffe calculated by 95% AKDE was 934.3 km^2, compared to the HR size calculated in the same study by 95% KDE (268.8 km^2). Undoubtedly, the HR size are influenced by numerous environmental and anthropogenic factors with smaller HR on average observed in populations with higher rainfall resulting in greater productivity and access to critical resources (Fennessy 2009, Knüsel 2019). Giraffe living in arid ecosystems have larger HR on average as the productivity is lower and giraffe have to roam further to reach resources and find mates (Le Pendu and Ciofolo 1999, Fennessy 2009). Knüsel (2019) indicated significant differences in HR size between Masai giraffe in Tanzania living in close proximity of towns and those living far from human settlements. The farther from developed human areas, the smaller the giraffe HR size was observed (Knüsel 2019). As the West African giraffe live in a human dominated, fragmented and agricultural landscape of the Sahelian zone with an annual rainfall ~400 mm, it is more likely that aridity and fragmentation is a main driver of increased HR than proximity to people. For comparison of HR size of populations across Africa see Table 5.

Future plans

The next year will start up with second translocation from “Giraffe Zone” to Gadabedji Biosphere reserve. The mission is planned for January/February and eight animals will be captured and re-introduced into the GBR. If conditions are suitable regarding the weather, the schedule and giraffe behaviour, 3-5 giraffe from the first translocation will be tagged with ossi-units. In January and February next fieldwork will be conducted and more data about their daily activity, social behaviour and giraffe-livestock interaction will be collected. The questionnaire survey will also take place during the fieldwork period, with focus on local people´s knowledge and attitude towards giraffe. The study will compare the cultural importance, habits and practices between “Giraffe Zone” and Gadabedji Reserve.

A new survey, possibly combined aerial and ground will be carried out during the hot season.

A new design based on systematic surveys to monitor the population will be proposed and discussed with wildlife authority and local partners during the annual workshop dedicated to update and review the national strategy objectives. The workshop will take place before the annual wet season survey with the plan of implementing the new design for the annual survey.

Figure 5 The results of HR estimates from other research conducted across Africa (source: D´haen 2019)

Country	Species	No. (sex)	MCP 95% (km^2)	Range (km^2)	KDE 95% (km^2)	Range (km^2)	Source	Year	Notes
Kenya	*G. tippelskirchi*	10 (M)	62				Foster and Dagg	1972	dot-grid method
Kenya	*G. tippelskirchi*	10 (F)	85				Foster and Dagg	1972	dot-grid method
S. Africa	*G. g. giraffa*	4 (M)	22.8				Langman	1973	100% MCP
S. Africa	*G. g. giraffa*	3 (F)	24.6				Langman	1973	100% MCP
Kenya	*G. reticulata*	28	13				Moore-Berger	1974	
S. Africa	*G. g. giraffa*	1 (F)	41				Langman	1977	100% MCP
Zambia	*G. tippelskirchi*	4 (F)	68	60-82			Berry	1978	100% MCP
Zambia	*G. tippelskirchi*	12 (M)	82	47-145			Berry	1978	100% MCP
Kenya	*G. tippelskirchi*	50 (F)	161. 8	8.8-483.8			Leuthold and Leuthold	1978	100% MCP
Kenya	*G. tippelskirchi*	60 (M)	163.6	5.0-654.4			Leuthold and Leuthold	1978	100% MCP
Tanzania	*G. tippelskirchi*		120				Pellew	1984	
S. Africa	*G. g. giraffa*	1 (F)	282	282			du Toit	1988	100% MCP
Niger	*G. c. peralta*	14 (F)	324	151-1,378			LePendu and Ciofolo	1999	
Niger	*G. c. peralta*	6 (M)	641	127-1,559			LePendu and Ciofolo	1999	
Tanzania	*G. tippelskirchi*	M	5.2	0.1-21.5			van der Jeugd and Prins	2000	100% MCP
Tanzania	*G. tippelskirchi*	F	8.6	0.5-27			van der Jeugd and Prins	2000	100%MCP
Namibia	*G. g. angolensis*	68 (F)	92.2.	12.7-352.6			Brand	2007	
Namibia	*G. g. angolensis*	21 (M)	148	2.49-1,000.5			Brand	2007	
Namibia	*G. g. angolensis*	16 (F)	100	8.33-702.1			Fennessy	2009	
Namibia	*G. c. angolensis*	44 (M)	355.5	11.5-1,773			Fennessy	2009	
Kenya	*G. c. camelopardalis*	13 (F)	7.1	3.03-12.08			Anyango and Were-Kogogo	2013	100% MCP
Kenya	*G. c. camelopardalis*	17 (M)	11.7	8.07-16.21			Anyango and Were-Kogogo	2013	100% MCP
Kenya	*G. reticulata*	(F)			64.2	60.8-67.6	Vanderwaal et al.	2013	75% FKDE
Kenya	*G. reticulata*	(M)			97.7	92.4-99.0	Vanderwaal et al.	2013	75% FKDE
Botswana	*G. g. giraffa*	1 (F)	67.5		47.1		McQualter et al.	2015	
Botswana	*G. g. giraffa*	3 (F)	323	138.3-623.4	258.6	94.5-536.5	McQualter et al.	2015	
S. Africa	*G. g. giraffa*	8 (F)	206	65.2-437.7			Deacon and Smit	2017	
DR Congo	*G. c. antiquorum*	4 (M)	340.3	134.4-598.5	268.2	168.2-379.8	D´haen et al.	2019	
DR Congo	*G. c. antiquorum*	2 (F)	654.6	339.2-970.0	269.3	93.6-445.0	D´haen et al.	2019	
Tanzania	*G. tippelskirchi*	109 (F)	27.8		110.4		Knusel et al.	2019	100% MCP
Tanzania	*G. tippelskirchi*	23 (M)	26.1		126.2		Knusel et al.	2019	100% MCP

Appendix I: GPS Tracking Unit Performance Diagnostics

Iri2016-3037:

(Collecting every 60 minutes; Reporting every 6 hours). This unit has relatively consistent recharging, but the power draw brings the voltage close to the shutoff threshold. Although it's currently not an issue, I recommend changing the reporting schedule to every 12 hours to limit unnecessary power draw

Iri2016-3038:

(Collecting every 60 minutes; Reporting every 6 hours). This unit has an erratic charging profile with sporadic data collection. The power draw and recharging behavior of this unit suggests something may be wrong with the unit. Beginning in March 2019, there was a rapid drop in power with subsequent erratic charging. Although it is not certain that this process will stop the spotty data collection, it is recommended to change the reporting schedule to every 12 hours to limit unnecessary power draw.

Iri2016-3040:

(Collecting every 60 minutes; Reporting every 6 hours). This unit failed in late March 2019. The associated voltage profile exhibited no chronic draws, and it is uncertain what precipitated the unit's failure.

Iri2016-3224:

(Collecting every 60 minutes; Reporting every 6 hours). This unit is regularly collecting and transmitting data.

Iri2016-3226:

(Collecting every 60 minutes; Reporting every 6 hours). This unit is regularly collecting and transmitting data.

Iri2016-3236:

(Collecting every 60 minutes; Reporting every 6 hours). This unit is regularly collecting and transmitting data.

Iri2016-3237:

(Collect every 60 minutes; Reporting every 12 hours). This unit has a very erratic recharging profile. Power dropped rapidly after the unit was deployed in early August and recharges only irregularly. The reporting schedule was changed to every 12 hours on November 15, 2019 in attempt to conserve power.

Iri2016-3238:

(Collecting every 60 minutes; Reporting every 6 hours). This unit is regularly collecting and transmitting data.

Iri2016-3239:

(Collecting every 60 minutes; Reporting every 6 hours). This unit was performing well with consistent power draw and recharge until it stopped communication on September 3, 2019. There were no power issues or indication of rapid power loss, suggesting that the unit may have fallen off in a position that was inaccessible to iridium communications or that it was destroyed. Notably, this unit was on a male. The last fix was 13.32701, 2.712763

Iri2016-3240:

(Collecting every 60 minutes; Reporting every 6 hours). This unit was performing well with consistent recharge until a rapid loss in power in mid-September. The unit may have fallen off the animal and landed in a position where it was unable to charge. Attempt to recover at 13.27227,2.7131

Iri2016-3241:

(Collecting every 60 minutes; Reporting every 6 hours). This unit is regularly collecting and transmitting data.

Iri2016-3243:

(Collecting every 60 minutes; Reporting every 6 hours). This unit is regularly collecting and transmitting data.

Iri2016-3244:

(Collecting every 10 minutes; reporting every 12 hours). This unit was collecting and transmitting data regularly until recently (despite the large data demands of 10 minutes sampling intervals). Very recently (end of Nov 2019) there was a rapid drop in voltage. Although it has not yet resulted in loss of data, it will likely reach these critical levels soon. It is important to note that this unit is programmed to collect fixes every 10 minutes, which may be a bit overkill, depending on your questions. Additionally, the unit was programmed to constantly emit for the UHF beacon, which could also be a potential draw on the battery. On Dec 2, the unit was reprogrammed to turn of the UHF beacon.

Iri2016-3245:

(Collecting every 60 minutes; reporting every 12 hours). This unit is regularly collecting and transmitting data.

Iri2016-3246:

(Collecting every 60 minutes; reporting every 12 hours). This unit experienced rapid voltage decline towards the end of September. It then proceeded to exhibit series of stationary clusters in relatively densely inhabited area. A potential scenario that may have resulted in this pattern is that the unit fell off, was picked up by a community member and was eventually passed around between various houses. The last fix was at 13.39082, 2.711153. Notably, this individual was a male.

Iri2016-3247:

(Collecting every 60 minutes; reporting every 12 hours). This unit is regularly collecting and reporting data. There was a small gap in data collection in late Sept 2019, corresponding with a rapid drop in voltage. The unit has since recovered to adequate levels and has been reporting since. Initially, this unit was programmed to report at 4 hours intervals. It was reprogrammed to report at 12 hours intervals and the battery profile seems to be responding favorably.

Iri2016-3248:

(Collecting every 60 minutes; reporting every 12 hours). This unit is regularly collecting and transmitting data.

Iri2016-3249:

(Collecting every 60 minutes; reporting every 12 hours). This unit is regularly collecting and transmitting data.

Iri2016-3250:

(Collecting every 60 minutes; reporting every 12 hours). This unit is regularly collecting and transmitting data.

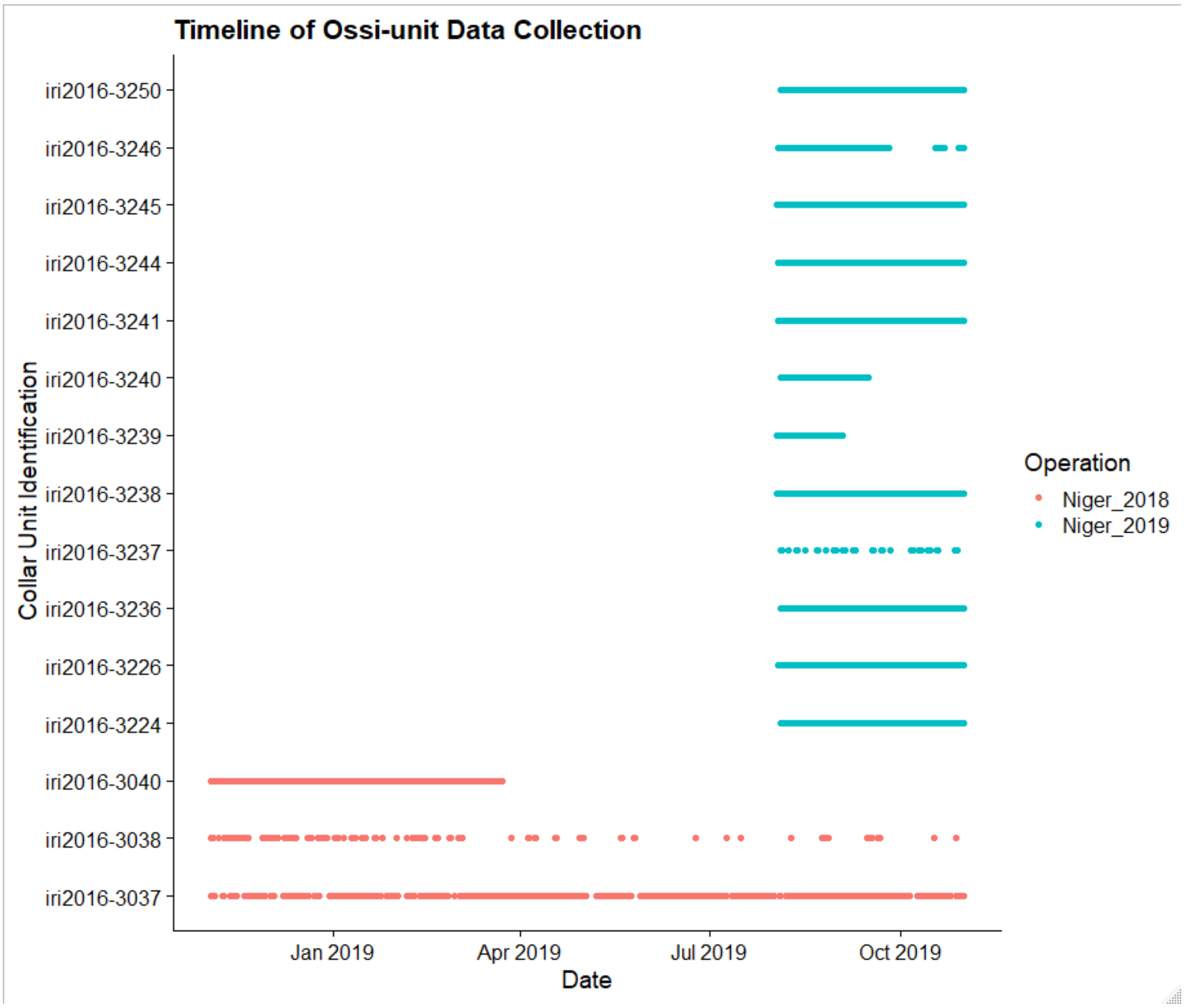

Figure 6 Ossi-unit performance

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