







1st Quarterly Report

West African giraffe (*Giraffa camelopardalis peralta*)

Republic of Niger

August-October 2019

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Introduction

The last population of West African giraffe (*Giraffa camelopardalis peralta*) – recently shown to be a subspecies of the Northern giraffe (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 km². A new satellite population of giraffe was established in Gadabedji Biosphere Reserve at the end of 2018 with the support of Giraffe Conservation Foundation (GCF) and Sahara Conservation Fund (SCF). The next closest known population of giraffe is in northern Cameroon and southern Chad and are 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' 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 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 km² 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.

In November 2018 and August 2019, GCF with support from SCF and the Government of Niger fitted nineteen West African giraffe with solar powered GPS satellite units (ossi-units) to help assess their habitat use and spatial ecology over time. This Quarterly Report (Aug-Oct 2019) describes the initial movement patterns and home range (HR) size of the GPS tagged giraffe.

During the quarter, data (hourly coordinate fixes) from 18 giraffe (16 females and 3 males) were transmitted by satellite but only 16 units transmitted for the whole period, two units fitted on males (3239 M and 3240 M) stopped to work in September (3rd and 15th, respectively). In total, data were transmitted 29 and 41 days respectively. Eleven ossi-units transmitted daily the GPS positions. The rest worked irregular with several days-long gaps. For the detailed information see Table 1.

Unit ID	Sex	Month fitted	Nº GPS records	Last date of transmitted position		
3037	F	November, 2018	1385	31.10.2019		
3038	F	November, 2018	54	27.10.2019		
3224	F	August, 2019	August, 2019 2023 31.10.			
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	М	August, 2019	670	3.9.2019		
3240	М	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	М	August, 2019 1389 3		31.10.2019		
3247	F	August, 2019	2020	31.10.2019		
3248	F	August, 2019	2023	31.10.2019		

Table 1 indicate sex, month of fitted ossi-unit, number of GPS records from 5th August till 31st October and the date of last transmitted location. Data were downloaded 31st October. The highglited animals were not included to any analyses because of either low data set or unusual movement pattern.

3249	F	August, 2019	2023	31.10.2019
3250	F	August	2023	31.10.2019

Home range

Home range 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 so to the methods analysing them 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

For assessing the preliminary giraffe's HR estimation, the R package ctmm version 0.5.7 was used (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 and the area calculated using the \$area function. The statistical analyses 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 the 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 km². As it mentioned in definition of HR, the outlier points are not considered as normal activity. These outlier points were also deleted in datasets of four giraffe (3224 F, 3226 F, 3246 F and 3249 F). Table 2 highlights the results of 95% and 50% AKDE for the 16 giraffe before and after deleting the outlining points.

Table 2 shows the results of 95% and 50% AKDE. The highlighted rows (3224 F, 3226 F, 3246 F and 3249 F) indicate the result before and after deleting outlining points. * columns with deleted outlining points

Unit ID	50% AKDE (km²)	95% AKDE (km²)	Nº GPS records	* Nº GPS records	*50% AKDE (km²)	*95% AKDE (km²)
3037	185.3	837.1	1386	1386	185.3	837.1
3224	1762.2	9225.2	2023	1881	841.7	3243.9
3226	713.8	3518.9	2023	1738	138.9	610.5
3236	506.2	1955.4	2023	2023	506.2	1955.4
3237	55.3	335.9	530	530	55.3	335.9
3238	39.1	175.6	2023	2023	39.1	175.6
3239	139.4	579.6	670	670	139.4	579.6
3240	661.8	2561.7	949	949	661.8	2561.7
3243	641.5	2507.1	2021	2021	641.5	2507.1
3244	181.8	851.8	2023	2023	181.8	851.8
3245	27.2	125.9	2023	2023	27.2	125.9
3246	424.9	1648.8	1389	1341	413.6	1483.6
3247	162.8	717.6	2020	2020	162.8	717.6
3248	831.2	3188.4	2023	2023	831.2	3188.4
3249	621.5	2570	2023	2015	369.2	1455.6
3250	334.5	1333.6	2023	2023	334.5	1333.6

<u>Results</u>

The average HR size, irrespective of sex, was 1,383.0 km² \pm 1,038.6, ranging from 125.9-3,243.9 km² (n=16). The mean size of their core area was 346.3 km² \pm 277.2 ranging from 27.2-841.7 km² (n=16). There was no significant difference (p>0.05; U=16) in the 95% HR size between males (n= 3; 1596.7 km² \pm 992.1) and females (n=13; 1333.7km² \pm 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 male (n=3) was 408.7 km² \pm 261.6 km², and for female (n=13) 331.2 km² \pm 288.9 km².

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, but are proven to underestimate results (Fleming et al. 2015, Fleming and Calabrese 2017). Our preliminary findings were calculated using AKDE and KDE, as per those 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 km², compared HR size calculated in the same study by 95% KDE (268.8 km²). 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 giraffe 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 the human dominated, fragmented and agricultural landscape of the Sahelian zone with an annual rainfall ~400 mm, it is very probable that the aridity and fragmentation is a main driver of increased HR. For comparison of HR size of populations across Africa see Table 3.

Movement Patterns

When visualizing the quarterly data there appears to be regular patterns in habitat use and movement of the giraffe (Figure 1). The giraffe occurred mostly in the core area between Kouré, Kobodey, N'Gonga, Harikanassou, Oumarou, Dantchandou and Hamdallaye village with some migration. The most significant movement was that of females 3241 who walked ~125 km east from Kouré, and 3224 who walked ~120 km west from Kouré. Interestingly, the 3224 travelled close (within ~30 km) to the Nigerian border, walking ~80 km over three days west and then back the same way over three days to where it essentially began. For a detailed movement pattern of each individual giraffe see Appendix I.



August, September, October 2019

Figure 1 Giraffe distribution from August to October 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. c. giraffa	4 (M)	22.8				Langman	1973	100% MCP
S. Africa	G. c. giraffa	3 (F)	24.6				Langman	1973	100% MCP
Kenya	G. c. reticulata	28	13				Moore-Berger	1974	
S. Africa	G. c. 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. c. giraffa	1(F)	282	282			du Toit	1988	100% MCP
Niger	G. c. peralta	14 (F)	324	151-1378			LePendu and Ciofolo	1999	
Niger	G. c. peralta	6 (M)	641	127-1559			LePendu and Ciofolo	1999	
Tanzania	G. tippelskirchi	М	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. c. angolensis	68 (F)	92.2.	12.7-352.6			Brand	2007	
Namibia	G. c. angolensis	21 (M)	148	2.49-1000.5			Brand	2007	
Namibia	G. c. angolensis	16 (F)	100	8.33-702.1			Fennessy	2009	
Namibia	G. c. angolensis	44 (M)	355.5	11.5-1773			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. c. reticulata	(F)			64.2	60.8-67.6	Vanderwaal et al.	2013	75% FKDE
Kenya	G. c. reticulata	(M)			97.7	92.4-99.0	Vanderwaal et al.	2013	75% FKDE
Botswana	G. c. giraffa	1(F)	67.5		47.1		McQualter et al.	2015	
Botswana	G. c. giraffa	3 (F)	323	138.3-623.4	258.6	94.5-536.5	McQualter et al.	2015	
S. Africa	G. c. 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

 Table 3 The results of HR estimates from other research conducted across Africa (source: D'haen 2019)

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Appendix I.







9











3039 M

















3046 M







