3rd Quarterly Report

West African giraffe (*Giraffa camelopardalis peralta*)

Republic of Niger

February – April 2020

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This report describes the activities referring to giraffe conservation in Republic of Niger and the preliminary home range estimate for the period from 1 February 2020 to 30 April 2020.

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 60 km 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 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).

In November 2018 and August 2019, GCF with support from SCF and the Government of Niger, fitted 19 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 (Feb-Apr 2020) describes the home range (HR) size and movement patterns of the GPS tagged giraffe during this period.

During the quarter, data (hourly coordinate fixes) from 14 giraffe (females) were transmitted; however one unit (3237 F) failed to work after the first few days of February 2020. Six ossi-units transmitted the GPS positions daily, whilst the remainder worked irregularly with several day-long gaps. For the detailed information see Table 1 below.

Table 1 An overview of GPS satellite tagged giraffe from February 1 to April 30 including ID of unit and giraffe, sex of animal, number of transmitted positions, number of days data transmitted and the ID code of giraffe.

Unit ID	Sex	Unit fitted	Nº GPS records	Nº days	Last date of transmitted position	Giraffe ID
3037	F	November 2018	1,303	73	30.4.2020	117/08
3038	F	November 2018	295	40	28.4.2020	279/15
3224	F	August 2019	1,950	87	30.4.2020	114/16
3226	F	August 2019	1,969	87	27.4.2020	308/16
3236	F	August 2019	2,069	90	30.4.2020	112/08
3237	F	August 2019	108	7	12.2.2020	266/15
3238	F	August 2019	2,069	90	30.4.2020	106/08
3241	F	August 2019	2,068	90	30.4.2020	116/08
3243	F	August 2019	1,862	78	18.4.2020	235/14
3244	F	August 2019	2,158	90	30.4.2020	218/13
3245	F	August 2019	1,996	84	24.4.2020	42/05
3247	F	August 2019	998	42	30.4.2020	34/05
3248	F	August 2019	2,158	90	30.4.2020	389/18
3249	F	August 2019	2,158	90	30.4.2020	107/08

Home range

Home range (HR) of an animal is described as an area used during its normal activities of foraging, mating and caring for young. Any animal can make an "unusual" movement outside the HR resulting in outlier points which are not considered as part of its normal activity area unless observed regularly (Burt 1943).

Animal tracking technology has increased the capacity of collecting data, and the methods to analyse them have evolved consequently (e.g. analytical tools for addressing 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, implement and comparable, 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), they become dependent and highly autocorrelated (Noonan 2018).

Methods

For assessing the preliminary West African giraffe´s HR size in Niger, the R package continuous-time movement modelling (ctmm) version 0.5.7 was used (Calabrese and Fleming 2016). The ctmm package is based on Autocorrelated KDE (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 mean, range and standard deviation of 95% AKDE and 50% AKDE was calculated by in Microsoft Excel (Microsoft Office 365 ProPlus). For statistical analyses Statistica (TIBCO Software Inc 2018) was used. For comparison the 50% AKDE and 95% AKDE among three quarters Kruskal-Wallis test was run. The quarterly HR was estimated for the 12 giraffe for the period from February to April 2020; unit 3237 was excluded because of the low number of transmitted data. Additionally, giraffe (3226 F) was not included into any analysis because of a very unusual movement pattern and as such considered to be non-resident during the quarter. The female giraffe did not create a 'normal' HR and AKDE applied on this movement pattern resulted in 95% HR exceeding 20,000 km^2. See Table 2 which highlights the results of 95% and 50% AKDE for first quarter, second and third quarter.

Results

The average quarterly HR size for giraffe was 806.7 km^2 ± 769.9, ranging from 88.6-2,897.1km^2 (n=12). The mean size of their core area was 165.6 km^2 ± 148.8 ranging from 24.6-535.6 km^2 (n=12). There is a significant difference (p=0.0314; n=40; H= 6.922) in the size of the core area (50% AKDE), with the third quarter being significantly smaller than the first and the second one The difference in HR size using 95% AKDE is also apparent, but not statistically significant (p=0.0944; n=40; H=4.721).

*Table 2. The preliminary Home Range (HR) size for first quarter (Aug-Oct 2019), second (Nov-Dec 2019, Jan 2020) and third quarter (Feb-Apr 2020) of GPS satellite tagged West African giraffe in Niger. Marked values * are not included in the mean and standard deviation calculations as they are not considered as 'normal' HR.*

	First quarter (August-September-October 2019)			Second quarter (November-December 2019-January 2020)			Third quarter (February- March- April 2020)		
ID/sex	Nº of records	50 % AKDE (km^2)	95% AKDE (km^2)	Nº of records	50 % AKDE (km^2)	95% AKDE (km^2)	Nº of records	50 % AKDE (km^2)	95% AKDE (km^2)
3037 F	1,386	185.3	837.1	1,340	91.5	420.5	1,303	61.4	259.2
3038 F	54			579	15.9	97.8	295	277.3	1057.0
3224 F	2,023	1,762.2	9,225.2	2,114	194.8	641.5	1,950	24.6	88.6
3226 F	2,023	713.8	3,518.9	1,958	1,119.6	6,223.6	1,969	5,284.7*	20,282.2*
3236 F	2,023	506.2	1,955.4	2,115	523.1	1,937.5	2,069	80.8	398.9
3237 F	530	55.3	335.9	485	775.8	3,028.3	108		
3238 F	2,023	39.1	175.6	2,114	1,111.2	4,998.8	2,069	113.6	437.2
3241 F	2,023	13,649.97*	56,438.63*	2,114	20,233.5*	80,549.3*	2,068	535.6	2,897.1
3243 F	2,021	641.5	2,507.1	2,182	915.4	4,031.4	1,862	160.3	638.8
3244 F	2,023	181.8	851.8	9,142	514.2	2,126.9	2,158	46.6	200,8
3245 F	2,023	27.2	125.9	2,187	162.5	826.3	1,996	111.5	558.6
3246 M	1,389	424.9	1,648.8	80					
3247 F	2,020	162.8	717.6	2,209	148.5	680.9	998	376.7	1,507.6
3248 F	2,023	831.2	3,188.4	2,187	153.8	858.8	2,158	151.1	845.4
3249 F	2,023	621.5	2,570.0	2,187	652.3	2,937.1	2,158	48.2	184.8
3250 F	2,023	334.5	1,333.6	2,084	589.2	2,244.1			
MEAN		**463.4**	**2,070.8**		**497.7**	**2,218.1**		**165.6**	**806.7**
STANDARD DEVIATION		**442.8**	**2,250.9**		**367.4**	**1,786.6**		**148.8**	**769.9**

The size difference between second and third quarters may be influenced by local climate, with the hot dry season starting in March until May. Giraffe moved away from core area (Kouré) mostly to close to Dallol riverbed, which dried up during the dry season but there are some water points still present, despite the fact that giraffe are not water dependent (Leeuw et al. 2001, Fennessy 2009). The Dallol has and continues to provide valuable seasonal forage for the West African giraffe. However, the HR size is smaller this quarter, similar to HR wet season estimates in Tsavo National Park, Kenya - 220.9 km^2 in the dry season versus 634.3 km^2 in the wet season. In Tsavo National Park the giraffe wandered far during the wet season while in dry season concentred feeding along the river (Obari 2014). Our results contrast the findings of Le Pendu and Ciofolo (1999) for this same West African giraffe population when they suggested that the dry season HR was twice the size than that during the rainy season (90.7 km^2 and 46.6 km^2, respectively).

The giraffe HR size vary across the Africa. 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). The large variation of our HR estimates may be attributed to the local conditions at the site where giraffe occurred during this quarter. The smaller HR size had female (3224) who occupied Dallol Bosso, where the conditions are more favourable in dry season and the HR was estimated to 88.6 km^2. While female 3241 roamed north-west from Niamey, it did not create a “normal” home range and the size was estimated to 2,897.1 km^2.

Movement patterns

The movement patterns are influenced by season; during the dry season the giraffe´s core area mostly covers Dallol Bosso and Harikanassou region. While in rainy season giraffe are more in the Kouré region of the ‘Giraffe Zone’. Being an ancient riverbed with valleys, ponds and marshes, the soil in the Dallol is more fertile with a higher abundance of trees around wetlands than the Kouré region, where the habitat is more Sahelian. Moreover, the browse composition differs for giraffe with seasonally higher amount of fats and carbohydrates than in the Kouré region (Caister et al. 2003).

Giraffe’s use of their habitat is visually different to last quarter. Some individuals have shifted range to the Dallol (riverbed) or in close proximity. Additionally, many of these giraffe who preferred the core area (Kouré) have shifted east into the Dallol. The most significant movement was by a female (unit 3226). At the beginning of February occurred between Dantchandou and Hamdallaye, during the second half of the month, she moved north-west from Niamey where remained till April, then returned to

Dantchandou. This unusual movement resulted in larger HR size than the HR of other giraffe during this quarter. Two giraffe (units 3244 and 3249) remain around Hamdallaye and Dantchandou, likely because of *Faidherbia albida* abundance. It is interesting that the core area is only used minimally by the GPS satellite tagged giraffe during the hot dry season, likely a result of the lack of water points and/or different nutrient plant composition. For a detailed movement pattern of each individual during the quarter see Appendix I.

From these results, giraffe tend to have smaller HR during the hot dry season and more widespread during the cold dry season, when their HR are larger but aggregated in the core area around Kouré.

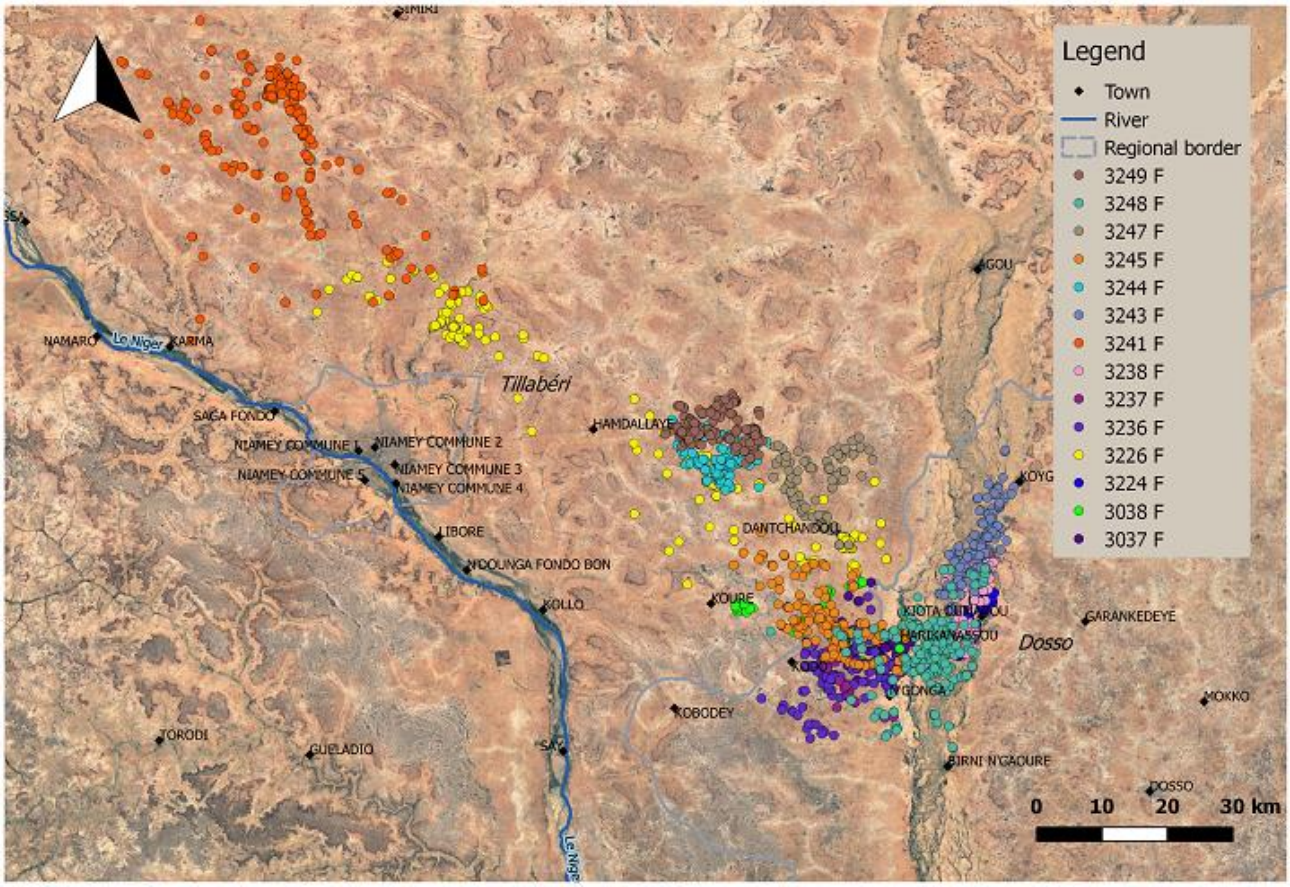

Figure 1 Giraffe habitat distribution of the GPS satellite tagged West African giraffe in Niger during February, March and April 2020.

Fieldwork Overview

At the beginning of 2020 targeted fieldwork and data collection was undertaken towards the PhD of Kateřina Gašparová. The following describes an overview of the methods of data collection, data analyses, preliminary results and brief discussion.

Methods

Data collection

Figure 2 Field observing and data collection of West African giraffe in Niger

To assess giraffe-livestock interactions and the activity budget of the West African giraffe we opportunistically monitored the population for two months (Feb-Mar 2020). The scan sampling method was used combined with focal sampling. When giraffe were found, their numbers, IDs, record of their activities, presence and distance from livestock were entered into CyberTracker® together with supplementary information connected with the observation (date, time, GPS position). If more giraffe were encountered, the scan sampling started with the most left individual and then they were observed one after the other so as not to repeat the same giraffe. During the scan sampling, the distance and absolute angle was measured from the focal giraffe to another giraffe or to livestock or people. People were divided to local adults and children, and tourist. At the beginning the men and women were recorded separately, but because of lack of data there were analysed together and no scan includes tourist. Then for the same individual the focal sampling was conducted with all activities recorded during a 20 min period. Activities were divided into following categories: (1) feeding including browsing and when giraffe was walking around a tree or from one to another for a purpose of browsing; (2) ruminating was considered to be any activities when the animal was standing, lying or walking while ruminating; (3)

movement included walking and running, (4)social behaviour covers necking, maternal behaviour, sniffing each other, etc. (5) Lying; (6) resting was considered to be when giraffe stood and was neither ruminating nor showing vigilance ; and (7) vigilant, recorded when giraffe kept careful watch for possible danger. Additionally, the interaction (watching, walking away, no reaction or livestock walk away) with livestock or people were recorded. People were also divided to several categories (man, woman, children, tourists) then adults were analysed together.

Data analysis

All statistical analyses were run using Statistica (TIBCO Software Inc 2018). All the means, ranges and standard deviations describing distance to giraffe, livestock, human or village were calculated by descriptive statistics. The different distance from giraffe towards livestock and towards giraffe were calculated using the Mann-Whitney U test. The comparison of activity budgets were divided into three time periods (1) morning (8:15-11:59), (2) midday (12:00-14:59), (3) afternoon (15:00-17: 45) was calculated using a Kruskal-Wallis test and multiple comparisons were run.

Results

During the fieldwork we had more than 300 sightings of giraffe, individually identifying 120 giraffe whilst 31 were not found in ID cards, for 15 giraffe the photo was not taken and 40 new born calves were recorded. More females were seen than males; adult female (n=69), subadult female (n=17), juvenile female (n=11), adult male (n=9), male subadult (n=6), male juvenile (n=8). During this period, 132 scan sampling events were undertaken over 27 days (1-9 per day) while 521 measured distances (between giraffe, or giraffe-livestock) were recorded. In total, 111 records (21%) of the distance between giraffe and livestock resulted in mean distance 150.4 ± 104.5 m (range 10.7-457.2 m), which was significantly greater ($p<0.05$; U=11126) than between giraffe only (n= 410; 71.8 ±70.4 m; range 1-327.8 m). The most common livestock were 'shoats' (sheep/goats) and cattle. The distance between giraffe and shoats was significantly smaller (n=41; 99.7 ± 71.1 m; range 20-300 m; p= 0.004; U=281) than between giraffe and cows (n=24; 171.3 ± 100.4 m; range 10-359.9 m). Additionally, we measured distance between giraffe and people, adults and children separately. In total 15 records of distance between giraffe and adult humans was significantly greater (188.7 ± 129.7 m; range 22.9-418 m; p=0.004; U=22) than the distance between giraffe and children (n=10; 116.8 ± 87.1 m; range 21-239.3 m). Ten scan events and nineteen measured distances were undertaken in close proximity to the village, the mean distance was 223.7 ± 108.3 m (range 68.9- 457.2 m).

The giraffe activities recorded during a total 44 hours of focal sampling consisted of 26h (59.7%) feeding behaviour, 5h (11.6 %) ruminating, 4h (9%) movement, 6h (13.8%) resting, 1.5h (2,8%) vigilance, 1h (2.3%) lying and 40min (0.9%) social behaviour. Only the feeding behaviour is significantly (p=0.012;

H=9.16; n=184) different when the multiple comparisons of p values was calculated and resulted in a higher proportion of browsing in the afternoon than in the morning (see Figure 2).

Fourteen hours (31.3%) of activities were recorded when either livestock or people were present. The activities observed in the presence of shoats (38.9%) and cows (37.7%) represented a greater proportion of daily totals when compared to close proximity of children (9.8%), adult local people (9.1%) and tourists (2.7%). Only 1.2% of activities was recorded while another vehicle was in the vicinity. When we compared the giraffe reaction to livestock; in 99% of encounters, the giraffe had no reaction to shoats, and only 1% reaction to watching (vigilant). When comparing activities around cows, the giraffe's predominant reactions were nothing (59.8%), vigilance (20.9%) and walking away (19.3%) from cows. Interestingly, shoats were observed to eat the *Acacia* (*Senegalia*) pods from the ground among giraffe while cattle often changed the direction of the giraffe herd.

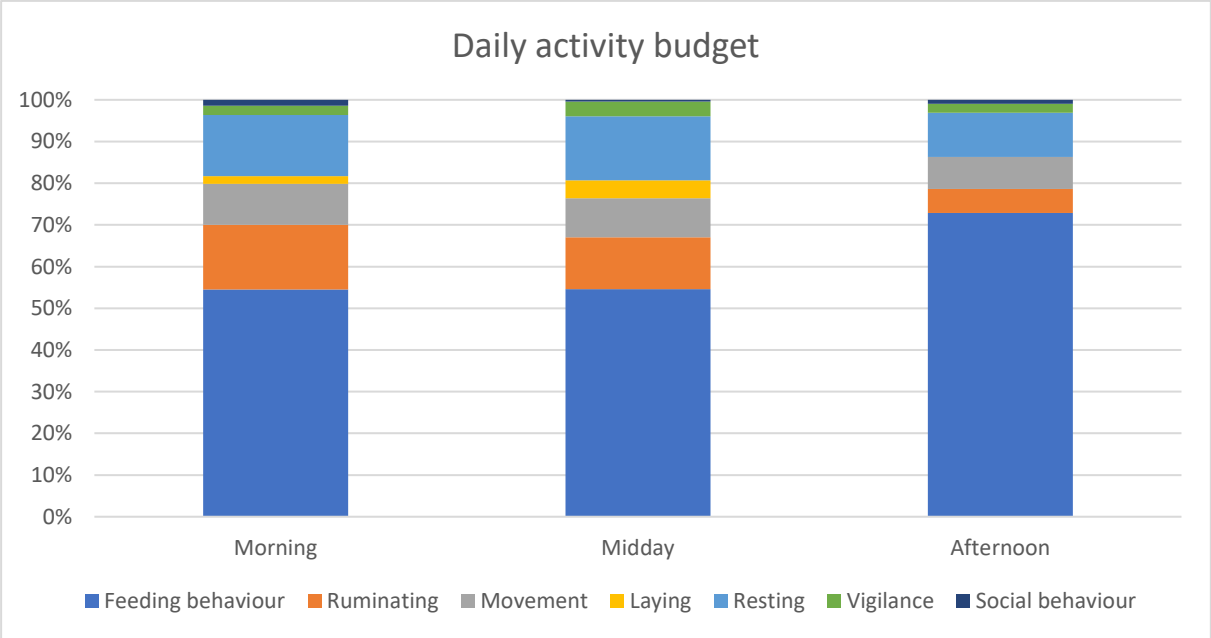

Figure 3 Giraffe daily activity budget in the ´Giraffe Zone´. Note: morning (8:15-11:59), midday (12:00-14:59), afternoon (15:00-17: 45)

Special events

With respect to giraffe-human coexistence, it appears that giraffe are more vigilant and afraid of people with any kind of stick. Several times a giraffe was recorded more vigilantly watching herders who sometimes had a wooden stick. On one occasion the giraffe appeared afraid of women with post-harvest remnants of millet, which looks similar to a wooden stick. This hypothesis was also supported by the AVEN guide Tawey, and further observations are required to substantiate this.

In terms of cohabitation with livestock, when one giraffe approached a tree with a donkey tied it, the donkey appeared scared and tried to escape. When the giraffe realised the donkey could not walk away, it changed the direction and foraged on another tree close by. On the other hand, giraffe were observed feeding on cut branches on the ground together with goats. It could be supposed that giraffe avoid conflict over sources with another browsers. In this environment, the species who has the most similar forage preferences is camel. No camels were observed close to giraffe during the study period. However, sometimes they are seen browsing in close proximity to giraffe (Tawey, AVEN).

Discussion

The most common livestock were shoats followed by cattle, corresponding with previous data (FAO 2020). The habitat used by giraffe and livestock is almost identical, however their dietary preferences differ markedly. The only livestock that possibly directly compete with giraffe are camels. However, during the survey no camel were observed close to giraffe. Giraffe appeared to be less relaxed in the presence of cows when compared to shoats, with the later sometimes observed browsing together. The AVEN guide proposed that one of the reasons why giraffe avoid cattle is the that the cattle herd increase dust.

As assumed based on previous giraffe work across the continent, giraffe feeding behaviour consumes the largest proportion of their diurnal activities. The percentage spent by giraffe browsing varies across different species throughout Africa. In the Masai Mara National Reserve female Masai giraffe spent 36% of daytime foraging with males spending slightly higher (39%) (Adolfsson 2009). Pellew (1984) observed even higher feeding percentage by Masai giraffe females (65%) compared to males (48%) in the Serengeti National Park, Tanzania. In study conducted in Namib desert the Angolan giraffe (*Giraffa camelopardalis angolensis*) spent 50.1% (males) and 64.5% (females) of their daily activity by foraging in cold dry season and 53.2% (males)and 55.8% (females) in hot dry season (Fennessy 2004). The diurnal feeding study of West African giraffe conducted by Ciofolo (2002) showed a significant difference in foraging between the dry and rainy season, 46% and 22.8% respectively. To better understand the activity budgets of the West African giraffe, more observations are required and over different seasons.

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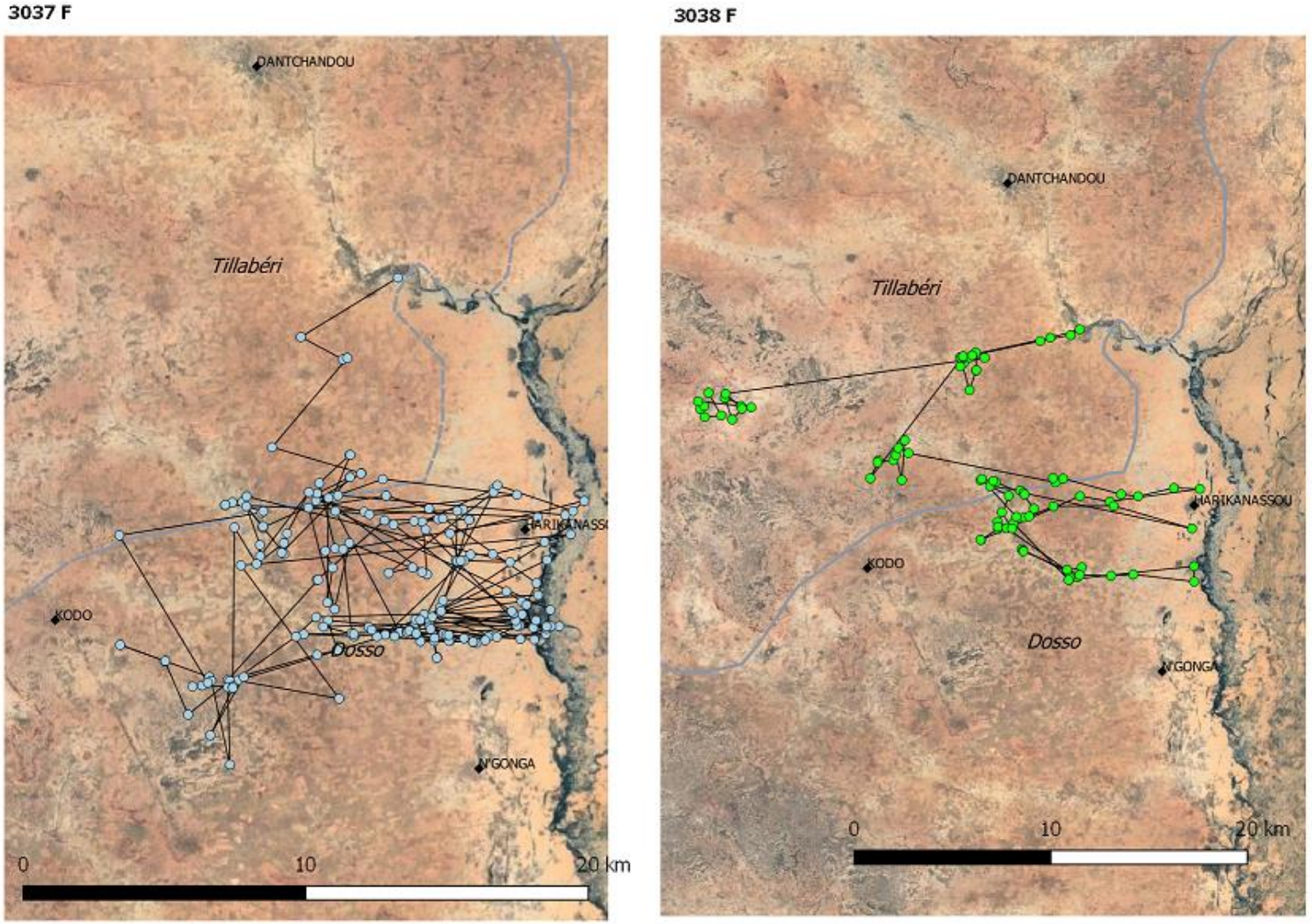
Appendix I.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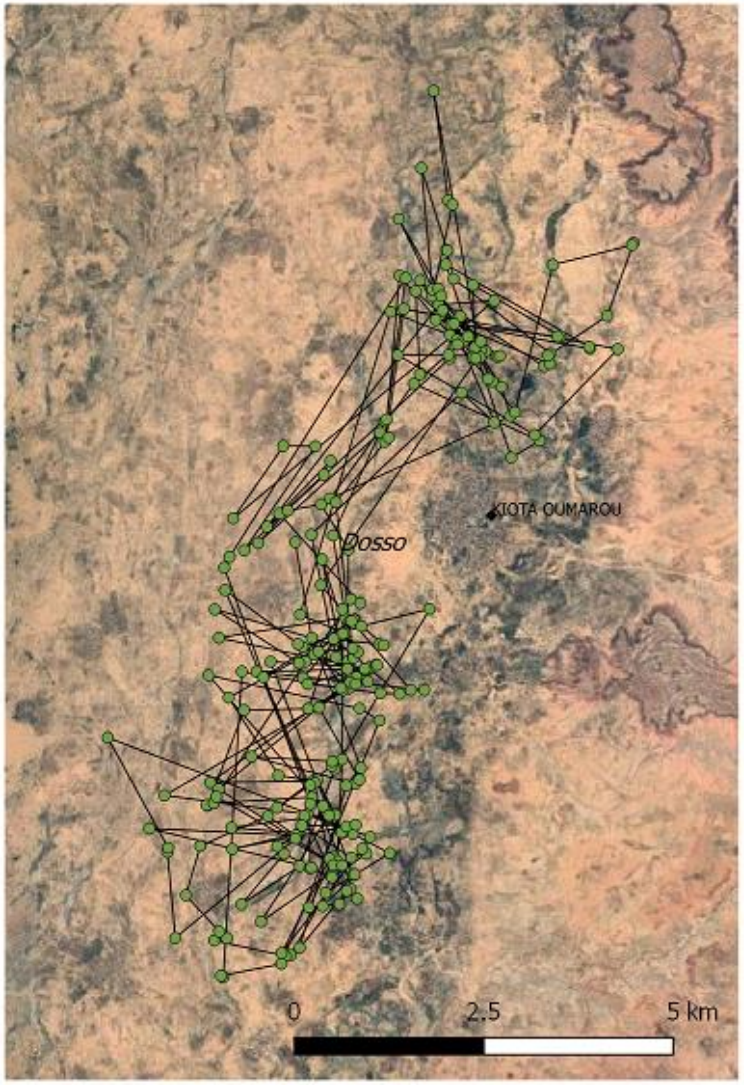
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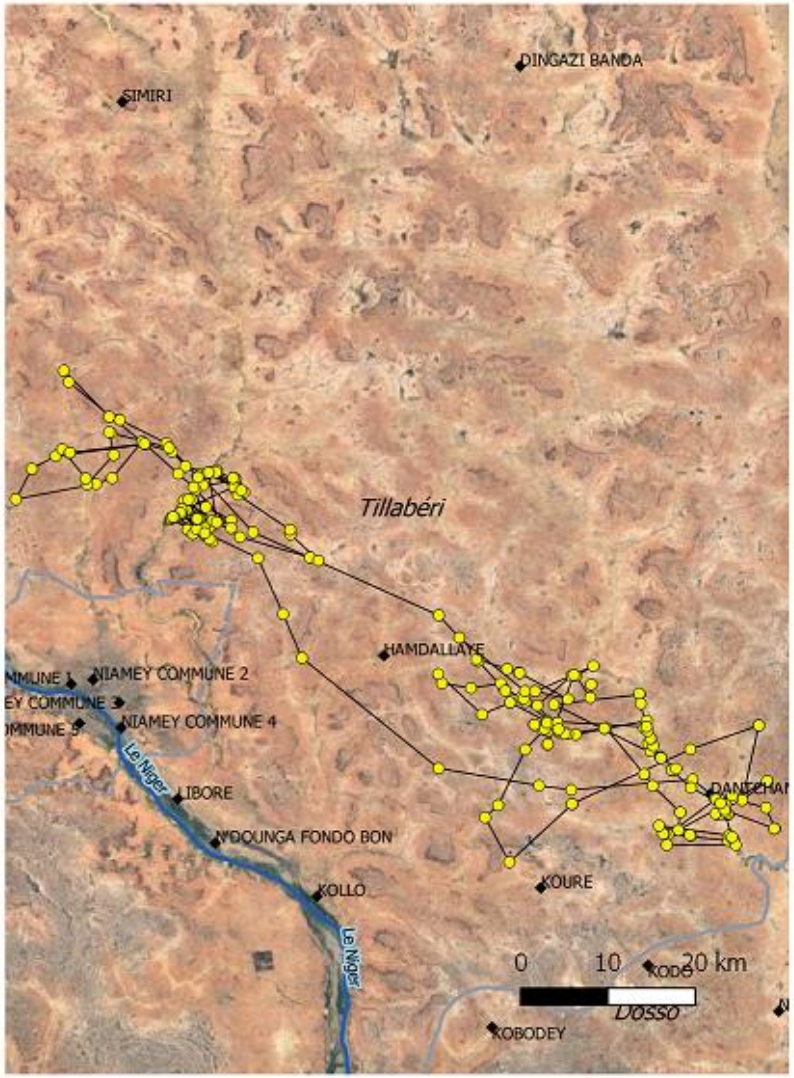
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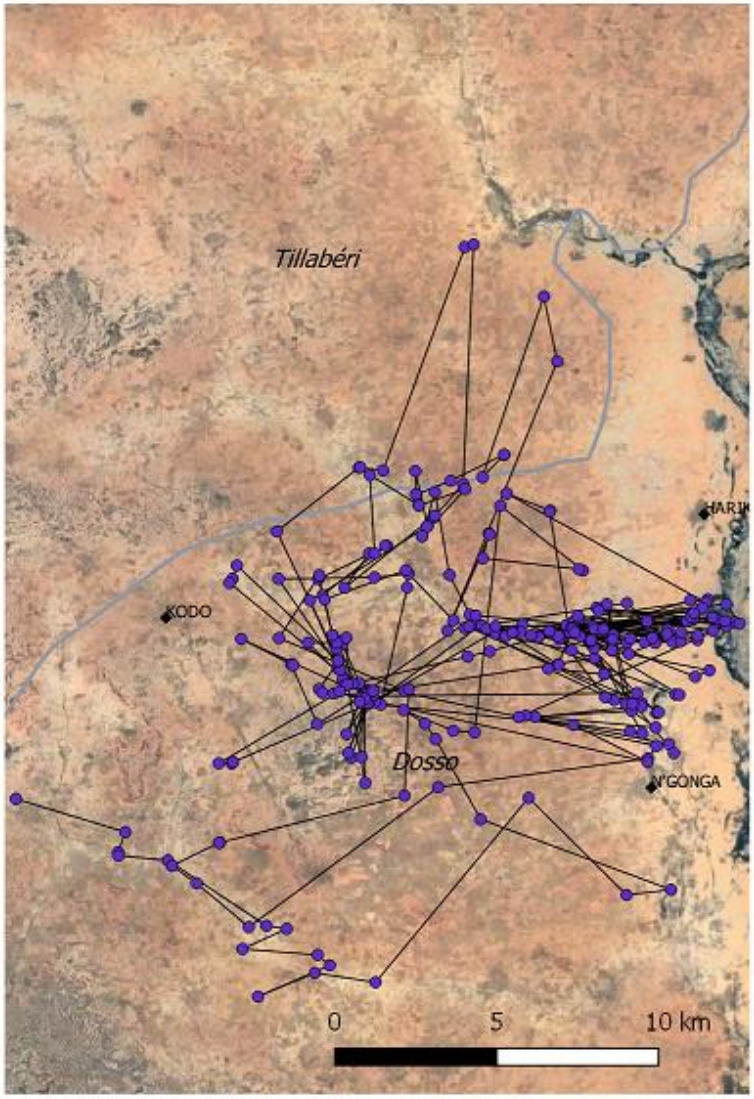
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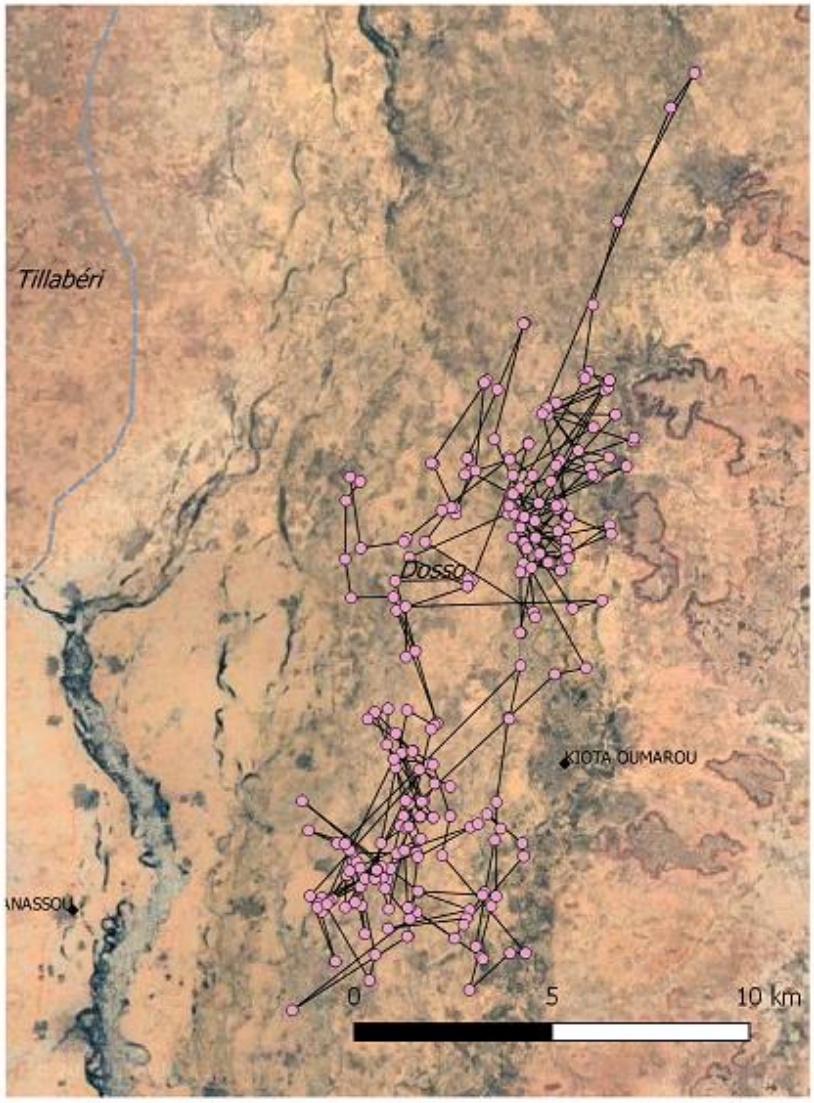
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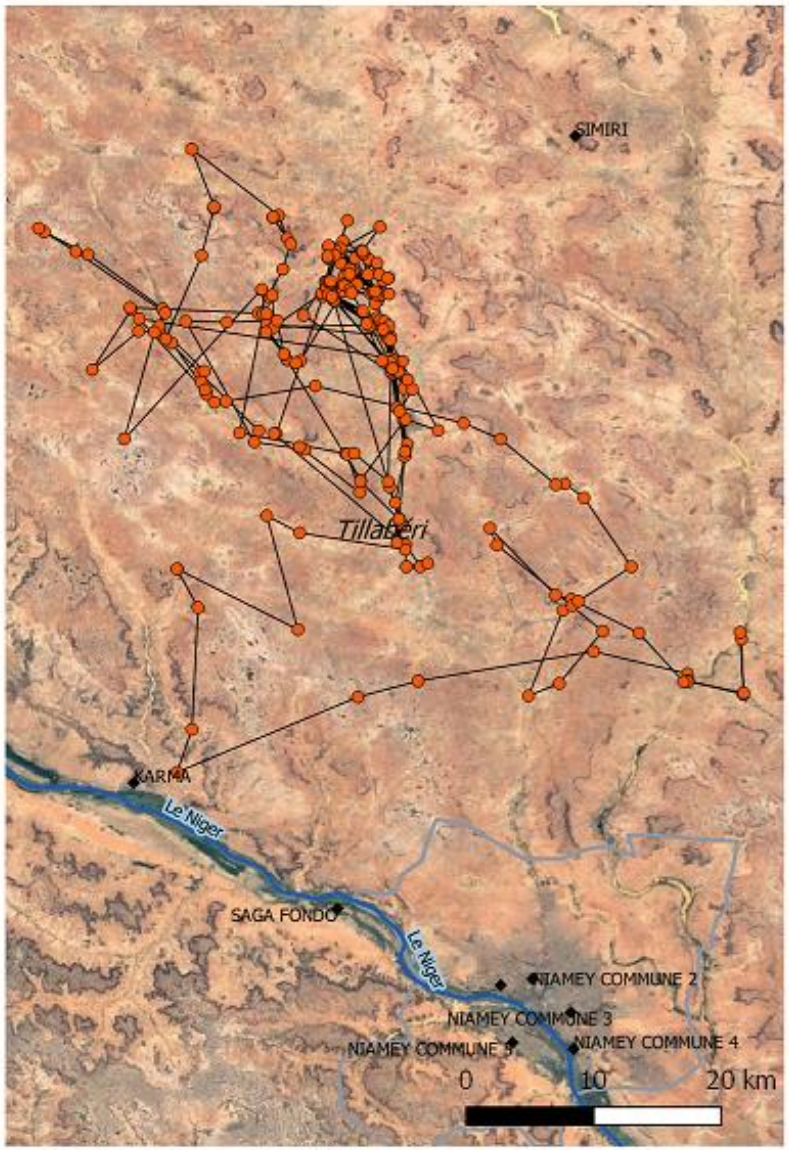
10 km

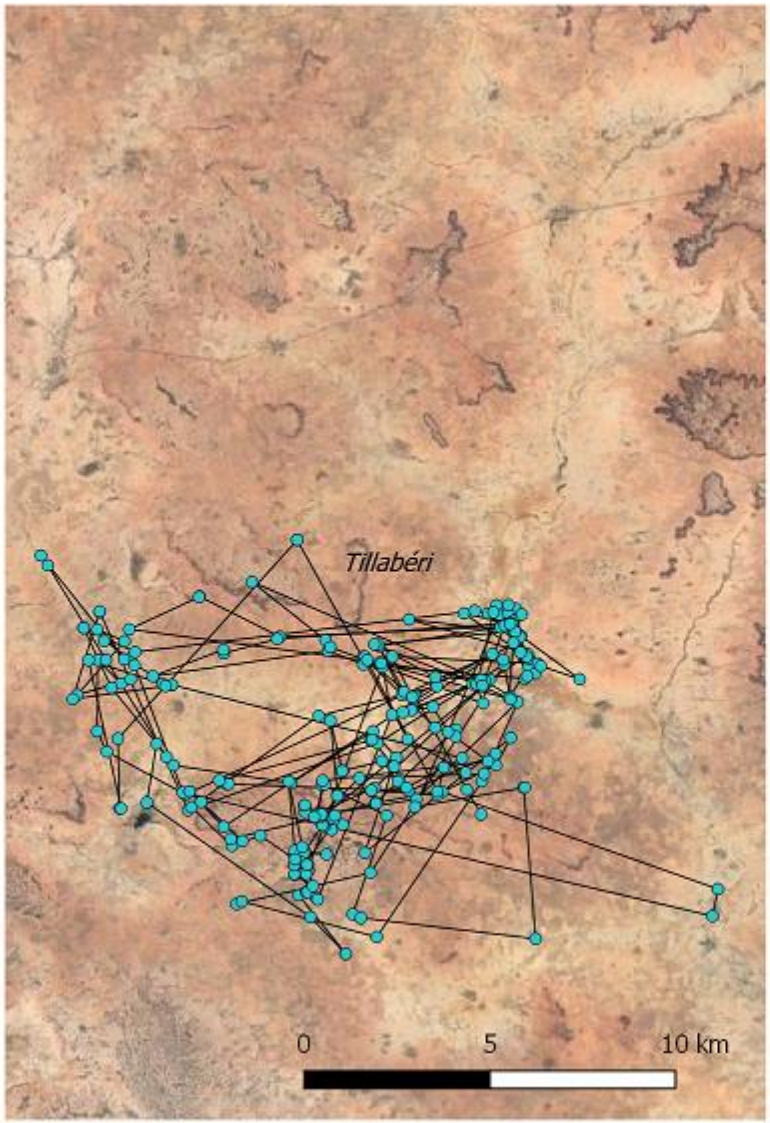
3241 F


SIMIRI
Tillabéri
KARMA
Le Niger
SAGA FONDO
Le Niger
NIAMEY COMMUNE 2
NIAMEY COMMUNE 3
NIAMEY COMMUNE 5
NIAMEY COMMUNE 4
0
10
20 km

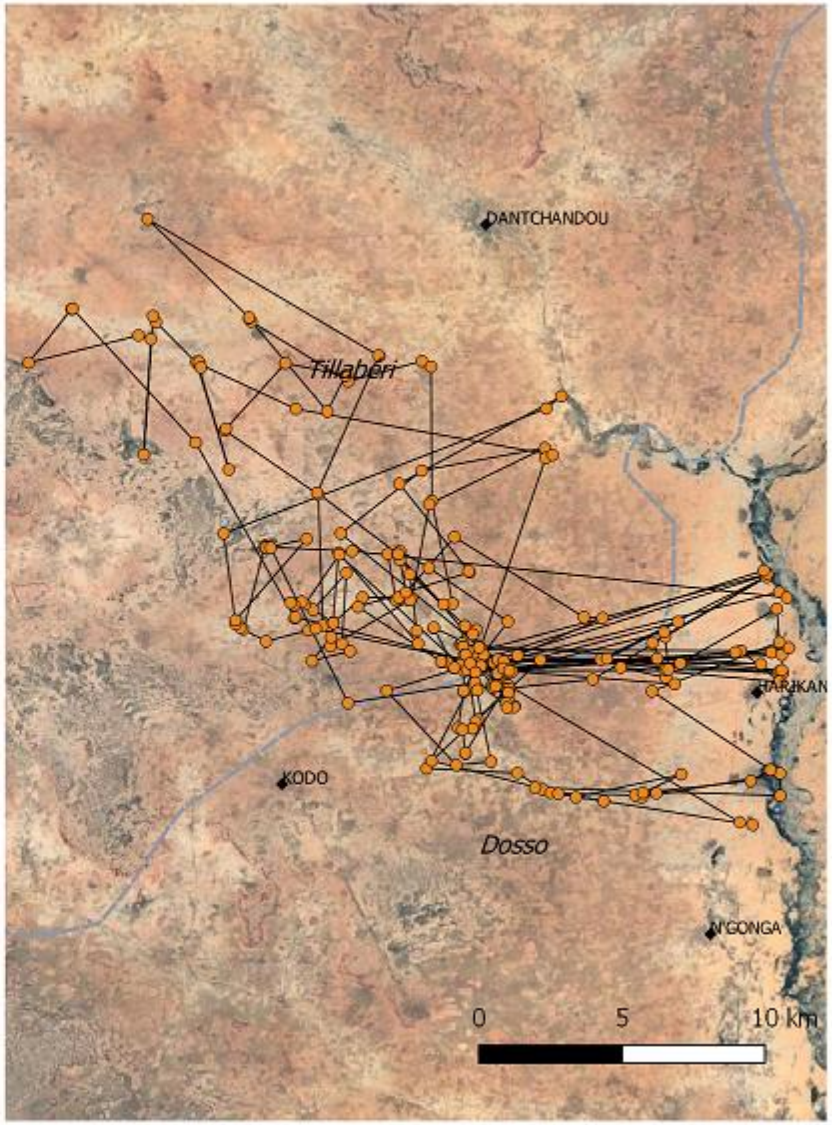
3243 F


Tillabéri
OYGOLO
Dosso
0
5
10 km

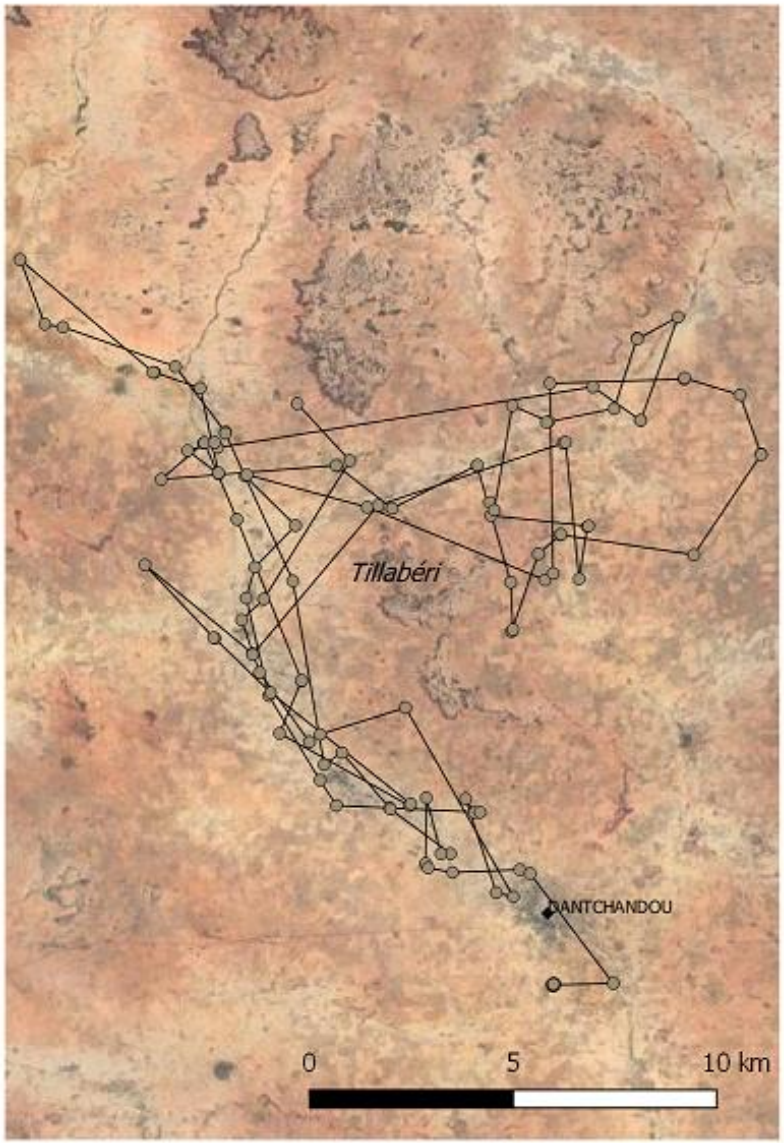
3244 F


Tillabéri
0
5
10 km

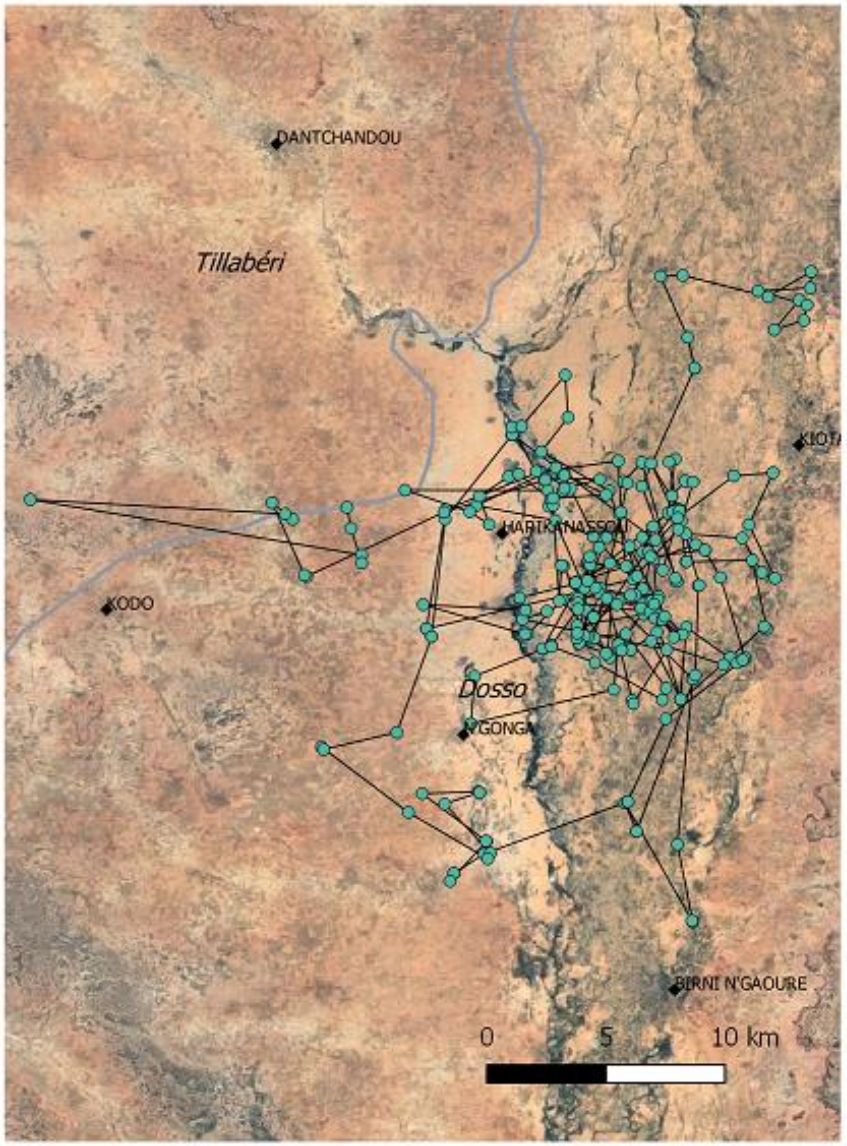
3245 F


DANTCHANDOU
Tillabéri
KODO
Dosso
N'GONGA
0
5
10 km

3247 F


Tillabéri
DANTCHANDOU
0
5
10 km

3248 F


DANTCHANDOU
Tillabéri
KODO
Dosso
BIRNI N'GAOURE
0
5
10 km

3249 F