Elephant movement in W Regional Park, western Africa

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Abstract

Few studies have focused on the elephant population of W Regional Park in western Africa (Benin, Burkina Faso and Niger) with an essentially national perspective rather than a transfrontier one. During a four-month period from April to July 2004, two elephant females were radio-tracked to establish their transfrontier movements. A total of 556 locations were recorded. Home range sizes calculated using the 95% Kernel method were estimated at 2572 km^2 for one female and 1970 km^2 for the other. Home ranges for the two females largely overlapped with close associations recorded during the tracking period. Movements from Niger to the central part of the park (Burkina Faso) through northern Benin were observed at the beginning of the rainy season along the Mekrou River. Regional survey and management practices should be encouraged to allow this remaining large elephant population to maintain itself.

Additional key words: Argos, home range, radio telemetry

Résumé

Peu d'études se sont portées sur la population d'éléphants du Parc Régional du W, en Afrique de l'Ouest (Bénin, Burkina Faso et Niger), et c'était dans une perspective essentiellement nationale plutôt que transfrontalière. Pendant quatre mois, d'avril à juillet 2004, deux femelles éléphants ont été équipées de colliers radio pour connaître leurs déplacements transfrontaliers. Cela a permis de rapporter 556 localisations. La taille des domaines vitaux calculée par la méthode de Kernel 95 % a été estimée à 2.572 km^2 pour l'une et 1.970 km^2 pour l'autre. Les espaces vitaux des deux femelles se recouvraient fortement et elles étaient étroitement associées pendant la période concernée. Les déplacements des animaux du Niger vers la partie centrale du parc (au Burkina Faso) en passant par le nord du Bénin ont été observés au début de la saison des pluies, le long de la rivière Mekrou. Il faudrait encourager des études régionales et l'adoption de pratiques de gestion transfrontalière pour permettre à cette grande population restante d'éléphants de se maintenir.

Mots clés supplémentaires : Argos, domaine vital, radio télémétrie

Introduction

During the 20th century, human population grew exponentially and led to large habitat conversion and fragmentation, which still are the main threats to elephant survival. In West Africa, elephant range currently covers approximately 221,000 km^2 (Blanc et al. 2002), representing less than 7% of the area they had occupied in 1900 (Roth and Douglas-Hamilton 1991). Barnes (1999) highlighted the relationship between human densities and elephant distribution in West Africa, illustrating the vulnerability of elephants in arid areas to increasing human disturbance. The main savanna elephant population currently occupies a fairly continuous range of protected areas (extending over 30,800 km^2). These areas comprise Arly National Park and its several contiguous hunting zones and reserves in Burkina Faso, Pendjari Biosphere Reserve, Atakora and Djona Hunting Zones in Benin; Tamou Total Reserve in Niger; and finally, W Regional Park

(WRP), shared by these three countries. In 2002 this park became the first transfrontier biosphere reserve in Africa.

Funded by the European Union since 2001, the W Regional Park Ecopas Project has two global objectives—to reverse the degradation of natural resources and to preserve biodiversity in this regional ecocomplex. The programme comprises research and scientific support including describing megaherbivore populations, especially elephant distribution and dynamics relating to resources and habitat distribution. Information on elephant movement is crucial to harmonizing management over the three countries, and to understanding the role of human activity surrounding the park in conditioning elephant home ranges. Radio telemetry techniques were used to explore movements of female elephants within this transfrontier protected area as part of a study initialized in 2003, focusing on the savanna elephant population of W Regional Park.

This paper summarizes data on range size and movement pattern comprising the seasonal shift in home range between dry and rainy seasons of two collared female elephants collected during four months from April to July 2004.

Study area

W Regional Park covers 10,339 km^2 (fig. 1); it is located in the upper Niger basin between 1°59′E and 3°05′E latitude and 12°35′N and 11°22′N longitude. The area experiences Sudanian climatic conditions; mean temperature ranges from a minimum of 21.6 °C to a maximum of 36.1 °C. Annual rainfall, although averaging between 640 mm in the north and 1000 mm in the south, is erratic and limited to the well-marked rainy season (May–September/October). Despite low rainfall, WRP has a dense hydrographical network with the Niger River and its tributaries, the Tapoa and Mekrou Rivers, and other rare perennial water

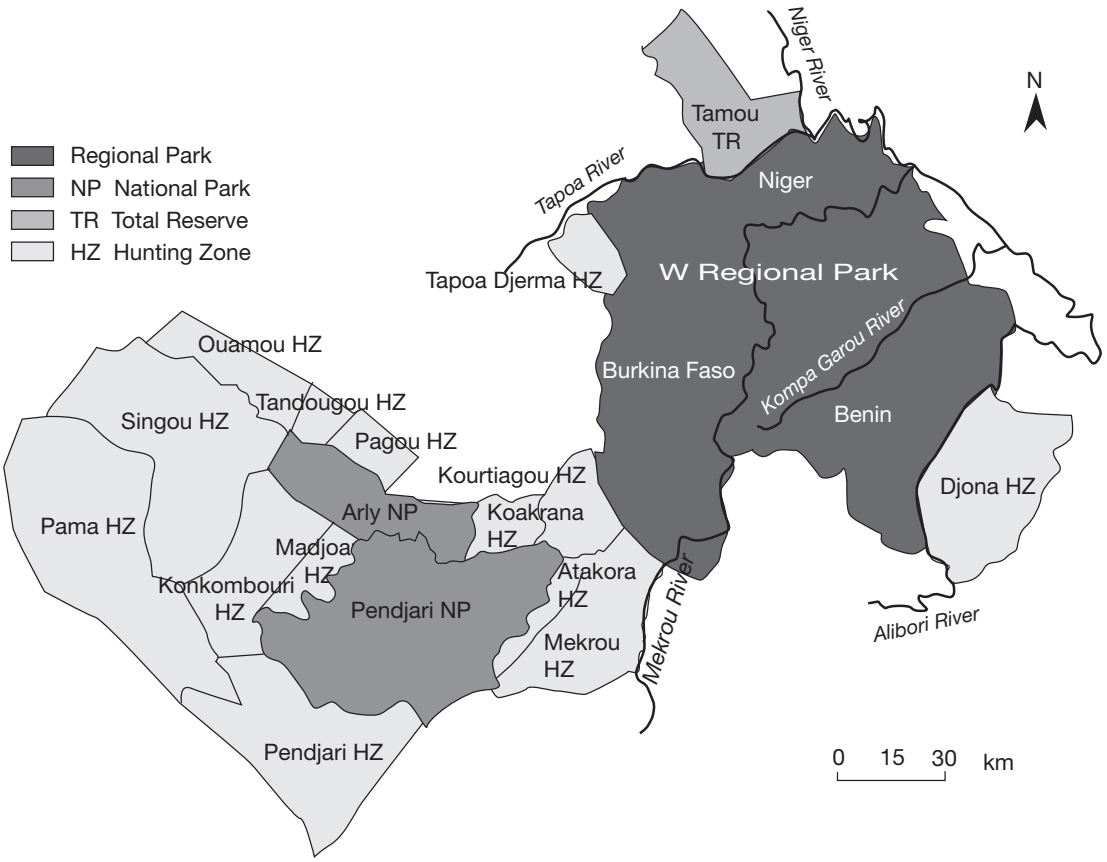


Figure 1. W Regional Park with its contiguous protected areas (modified from the Ecopas Project).

points representing the last source of naturally occurring water with remaining waterholes at the end of the dry season.

Plant species composition and structure change along the north–south gradient between sudano-sahelian and sudano-guinean savannas, with shrubland of Combretaceae dominating in the northern part leading to woodland dominated by legumes (Fabaceae, Caesalpiniaceae and Mimosaceae) in the south.

Methods

Immobilizing and radio telemetry tracking

The basic unit of elephant social organization is the family group or herd. By marking adult female elephants, we can follow movements of the entire family group (Thouless 1996b; Galanti et al. 2000; Galanti et al. 2006). In January 2004, two females were captured and radio tagged in the Niger part of W Regional Park. Their age, estimated by dentition (Laws 1966), was between 15 and 19 years. The elephants were immobilized using gun-propelled syringes containing etorphine. While they were anaesthetized, their vital signs were continuously monitored according to Thouless (1996a). They were fitted with VHF/Argos collars (Sirtrack Ltd) then were given diprenorphine as a reversal drug. The capture and collaring techniques have been detailed elsewhere (Chardonnet et al. 2004). The collar of female 1 (F1) did not start to correctly emit until two months after initial capture. The collar of female 2 (F2) gave reasonable radio locations. Unfortunately, these two collars fell off in mid-July 2004.

Data processing

Argos radio collars were scheduled to function 24 h on and 48 h off. The two females were irregularly tracked during 6 months of the dry–wet season transition, which does not enable any segregation between valuable dry- and wet-season data. To allow comparison, data obtained during a similar transmission period (April to July) were used to calculate 1) total home range size (100% of fixes) using the minimum polygon convex method (MCP), 2) Kernel home range estimators using 95% and 50% (core area) of all locations, and 3) home range overlap (using MCP and 95% Kernel values) between the two females. To describe global movements of each female, one location with the highest precision class attributed by Argos (less than 150 m) was selected for each 'On' period. Females were considered to be associated when they were located within 1 km of each other. Daily movements were described and expressed for each elephant by accumulating successive distances between all obtained fixes (10 fixes per day on average) over the 24-hour 'On' period from 0830 to 0830 the next day. Speed was calculated by considering the distance travelled between two successive locations. However, this virtual speed measure, called mean daily translocation, is underestimated when the distance between the two locations was considered as a straight line (Owen-Smith 1988). All data on home range and movement were analysed using the Animal Movement SA 2.0 extension, ArcView GIS 3.2 (ESRI 1997). Statistical analyses were performed with R Project for statistical computing (2006).

Results

Between April and July, there were 297 fixes for F1 and 259 for F2 (fig. 2). Total home range sizes calculated using the 95% Kernel method were smaller than those calculated using the MCP method for both females (table 1). The two methods are presented to

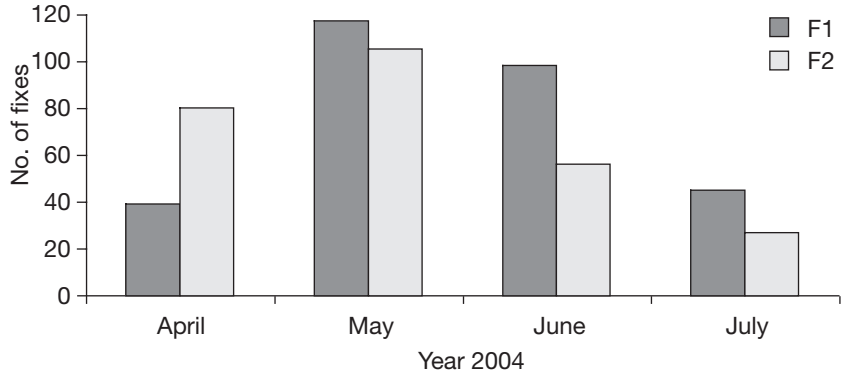
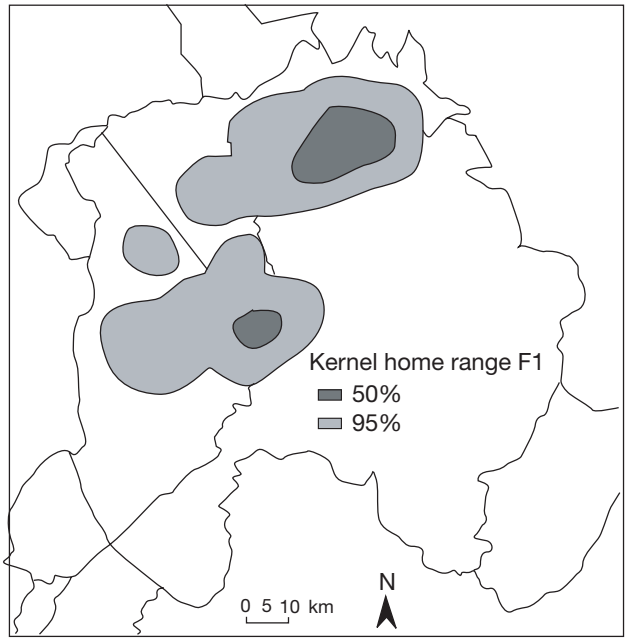
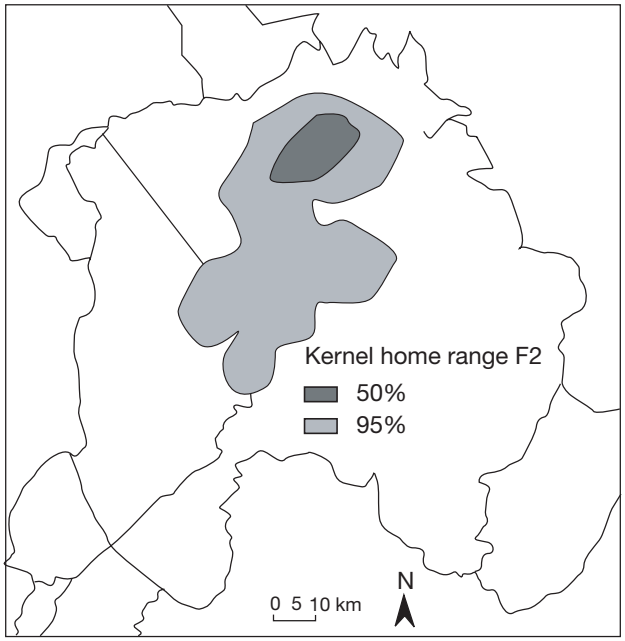


Figure 2. Distribution of fixes for the two females during the radio-tracking period.

Table 1. Total home range size (MCP, 95% and 50% Kernel) and home range overlap (%) between elephants

Elephant	MCP (km^2)	95% Kernel (km^2)	50% Kernel (km^2)	Overlap (%)	
				MCP	Kernel (95%)
Female 1	2756	2572	360	75	65.2
Female 2	2722	1970	209	76	85.1





allow comparison with other studied elephant populations. Figure 3 shows the Kernel home range (including 95% and 50% of locations) drawn for the two fitted females.

During the same collar-transmission period, the two females remained inside the park. Their ranges largely overlapped (65–85% based on Kernel estimation and 75–76% based on MCP contour), which included most of the Niger side and more specifically a large buffer area along the Mekrou River. This river partly dried as the dry season progressed but offered several pools. Movement patterns of the two females were also similar. Both females were captured on the Niger side of the park and stayed in that zone until the end of the dry season. As soon as the first rains appeared in the central part of the park in April, F1 and F2 similarly moved towards that sector. F1 stayed in this area during April and the first half of May. F2 spent only two weeks. Then they returned to their original home range in the north. Finally, at the beginning of June for F2 and July for F1, both animals moved southward, returning to the central part. Close associations occurred between the females on 10 June and 12 July (fig. 4).

Daily movements were expressed for each elephant by accumulating successive distances between fixes over the 24-hour On period from 0830 to 0830 the next day. Figure 5 presents daily movements calculated for each On session. No significant difference (Kruskal-Wallis chi-squared = 285.6, $P = 0.51$) was found in the average distance travelled per session by female F1 (4.03 ± 2.81 km) and female F2 (6.31 ± 5.59 km).

Figure 3. Total home range of females F1 and F2 (from April to July 2004) using Kernel's method.

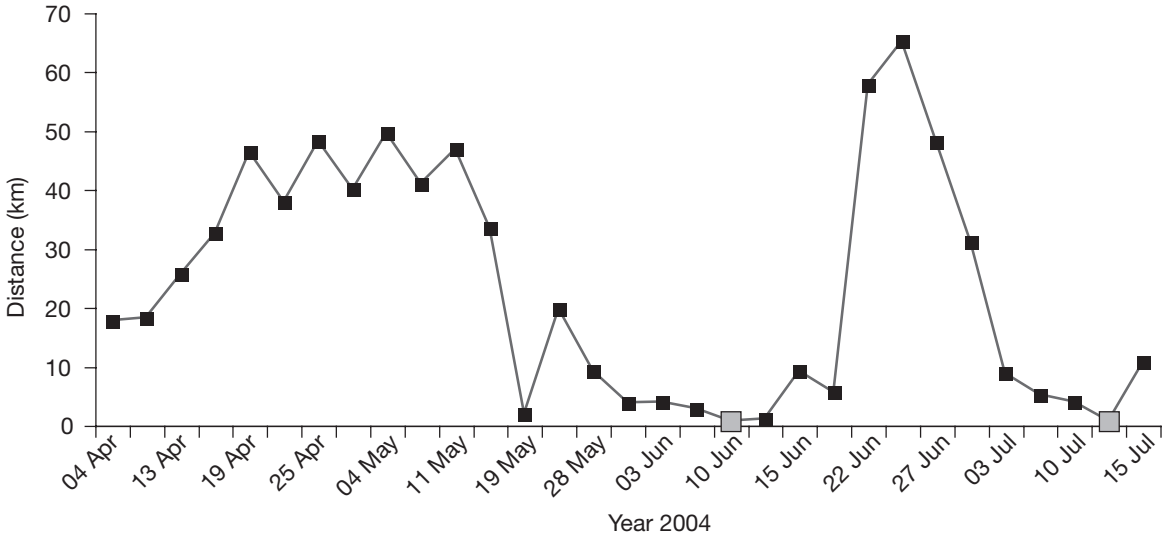


Figure 4. Daily distances between females. Grey squares indicate when distance between the two females was less than 1 km.

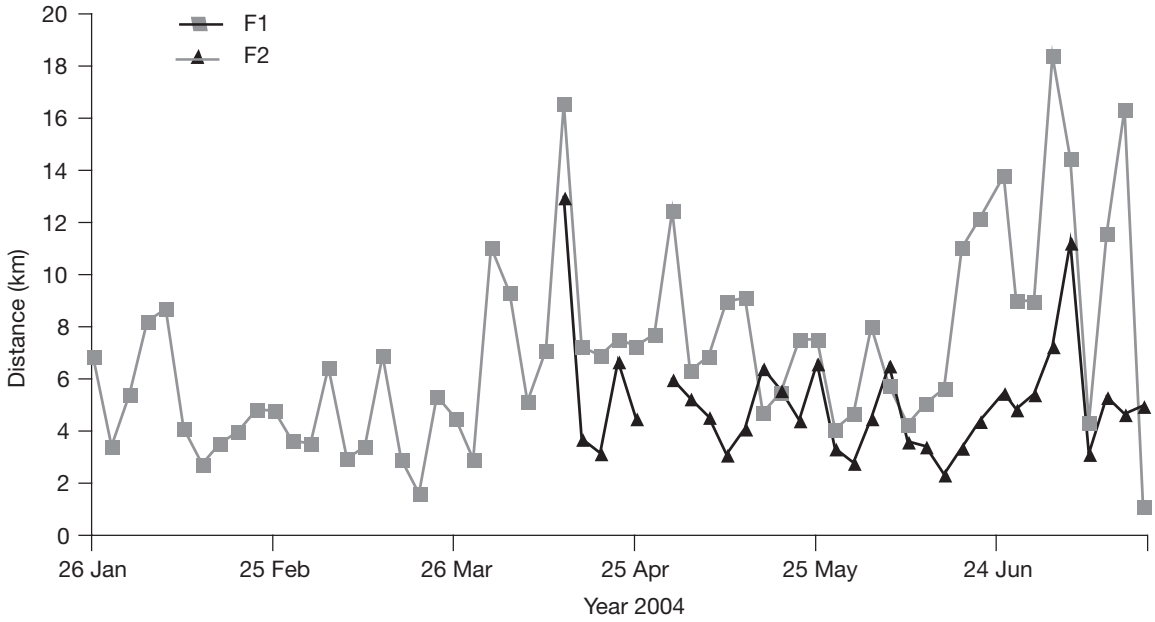


Figure 5. Daily distances travelled by the two females.

Speed was measured to detect the impact of threat (wildfires, poaching and human disturbance) on elephants. F1 moved on average at 1.9 ± 2.1 km/h while F2 walked at 2.4 ± 2.9 km/h, with no significant difference (Kruskal-Wallis chi-squared = 2.36, $P = 0.12$).

Discussion

Radio-tracking data gave precious information on movement patterns of two females from WRP's elephant population. The total home ranges of the two distinctly comprised a large buffer zone along

the Mekrou River, main core areas (covering 50% of relocations) being located in the northern part of the WRP. They could regularly fulfil their water needs in large pools remaining in the riverbed. Elephant migration routes are likely to partially depend on permanent river and pool systems, as observed in various sites such as in southern Tanzania (Mpanduji et al. 2002). On 13 April, both females simultaneously travelled long distances while heading southward, 10 days after the first rains fell in the central part of WRP, crossing the extreme northern part of Benin. This movement could probably be ascribed to differences in forage quality as new rapidly growing grasses and fresh water availability were probably attractive to elephants (Western and Lindsay 1984; Viljoen and Bothma 1990). Wide movement was also observed on 3 July for female F1 and 24 hours later for female F2, as they both were in the neighbourhood of the Mekrou River. The key factor responsible for this event was thought to be disturbance from humans as several field observations showed that the Mekrou River was frequented by poachers and illegal fishermen. But no firm evidence for this relationship was found.

Both females were captured in the northern part of WRP. Home ranges, which can be considered large, covered 2572 km^2 and 1970 km^2, according to the 95% Kernel estimator. In more intensively studied populations, female elephant home ranges varied between 102 and 5527 km^2 in northern Kenya (Thouless 1996b), 115 and 465 km^2 in South African nature reserves (De Villiers and Kok 1997) and 126 and 2716 km^2 in Tanzania (Galanti et al. 2006). Results also suggest they are quite sedentary, occupying the core area of WRP within its limits. In 1974, Poché reported that elephant herds were also occupying the main part of the Tamou Total Reserve in Niger. They exhibited yearly migrations from the Torodi area (extreme north of the reserve) to the Niger, Tapoa and Mekrou Rivers during the latter part of the dry season. This extended phenomenon is not observed any more because of increasing human pressure in this area (poaching, illegal domestic livestock grazing). No segregation between dry- and wet-season home ranges was made, considering the small number of locations.

From a management point of view, it should be pointed out that even if only two females were radio-tracked during four months, they both globally followed the same movement pattern and crossed borders within WRP; their total home ranges encompassed portions of all three countries. This result is important because it demonstrates the existence of transboundary elephant movements, confirming earlier suggestions by some WRP agents, local populations, Poché (1974), Bousquet (1984) and Green (1988). Therefore, this elephant regional population must be considered as one.

Although the movement patterns are consistent in this part of the park, a different situation occurs in the extreme south-eastern part. Each dry season, an elephant population inhabits the Djona hunting zone: in 2002, 59 different groups of 361 individuals were recorded (Alfa Gambari Imorou 2002). In that region, human–elephant conflicts occurred regularly, as elephants would cross communal lands to find available water outside the hunting zone (Kidjo 1992). They would reach Goungoun and Sota classified forests, damaging crops, especially maize (*Zea mais*) and cotton (*Gossypium* sp.) (Alfa Gambari Imorou et al. 2004). More collars are expected to be deployed to address these questions.

These preliminary results highlight the necessity to consider and to manage WRP as a single protected area, encouraging cooperative efforts already initiated by the three countries: Benin, Burkina Faso and Niger. Further analyses will concentrate on understanding ecological parameters that influence WRP elephant dispersal. Results could provide insight into which areas are important for that population.

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