Forest elephant density and distribution in the southern part of Campo Ma'an National Park, Cameroon

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Abstract

An elephant census was carried out in Campo Ma'an National Park, which is situated in the extreme south-west of Cameroon. Dung was counted for 8 months in 2000–2001. The elephant density was calculated as 0.8 km^{-2} (n = 29, se = 0.2) in the 649-km^2 study area—a relatively high number compared with known elephant population densities in the region. No seasonal differences in density were detected, nor were densities site dependent. The concern is rising that elephants are trapped or compressed within the national park.

Résumé

Dans le Parc National Campo Ma'an, situé dans l'extrême sud-ouest de Cameroun, un recensement des éléphants était fait. Les crottes ont été comptées pendant 8 mois en 2000–2001. La densité d'éléphant était calculée avec comme résultat 0,8/km^2 (n = 29, se = 0.2) dans le région de l'étude conté 649 km^2, un chiffre relativement haut comparé avec les densités connues des populations d'éléphants environnants. Aucune difference en densité saisonnière ne pouvait être déterminée non plus était les densités dépendant du site. Vraisemblablement il se pose un problème que les éléphants sont capturés ou compressés dans le Parc National Campo Ma'an.

Introduction

The Campo Ma'an area, situated in the extreme south-west of Cameroon, is part of the West Equatorial Refuge, a tropical lowland rainforest tremendously rich in species. The area, formerly known as the Campo Reserve, has recently been expanded and re-organized. A national park covering 2640 km^2 was gazetted within the Campo Ma'an project area in January 2000. Part of the area around the national park is considered a buffer zone, in which several activities take place (Tropenbos International 2002).

Accurate baseline data were gathered on density and distribution of forest elephants as one of the focal points in an ongoing ecological monitoring programme. Because a reconnaissance survey showed that most of the elephants were found in the southern part of the new national park, this study focused there. Data collected will contribute to the conservation and management of elephants and other large mammals in the Campo Ma'an area.

Study area

The southern part of Campo Ma'an National Park covers 648 km^2. It is bordered in the west by the Atlantic Ocean, in the east and south by the Ntem River, and to the north by the Bongola River and the road between Mvini and Ebianemeyong (fig. 1). It is habitat to numerous primates including gorilla, chimpanzee, mandrill, and other large mammals such as duikers, sitatunga, hippopotamus, forest buffalo and forest elephant. The study area consists of two parts: Dipikar Island (359 km^2) and the southern corridor (289 km^2). The Bongola separates the two parts. Numerous streams and river branches make the study

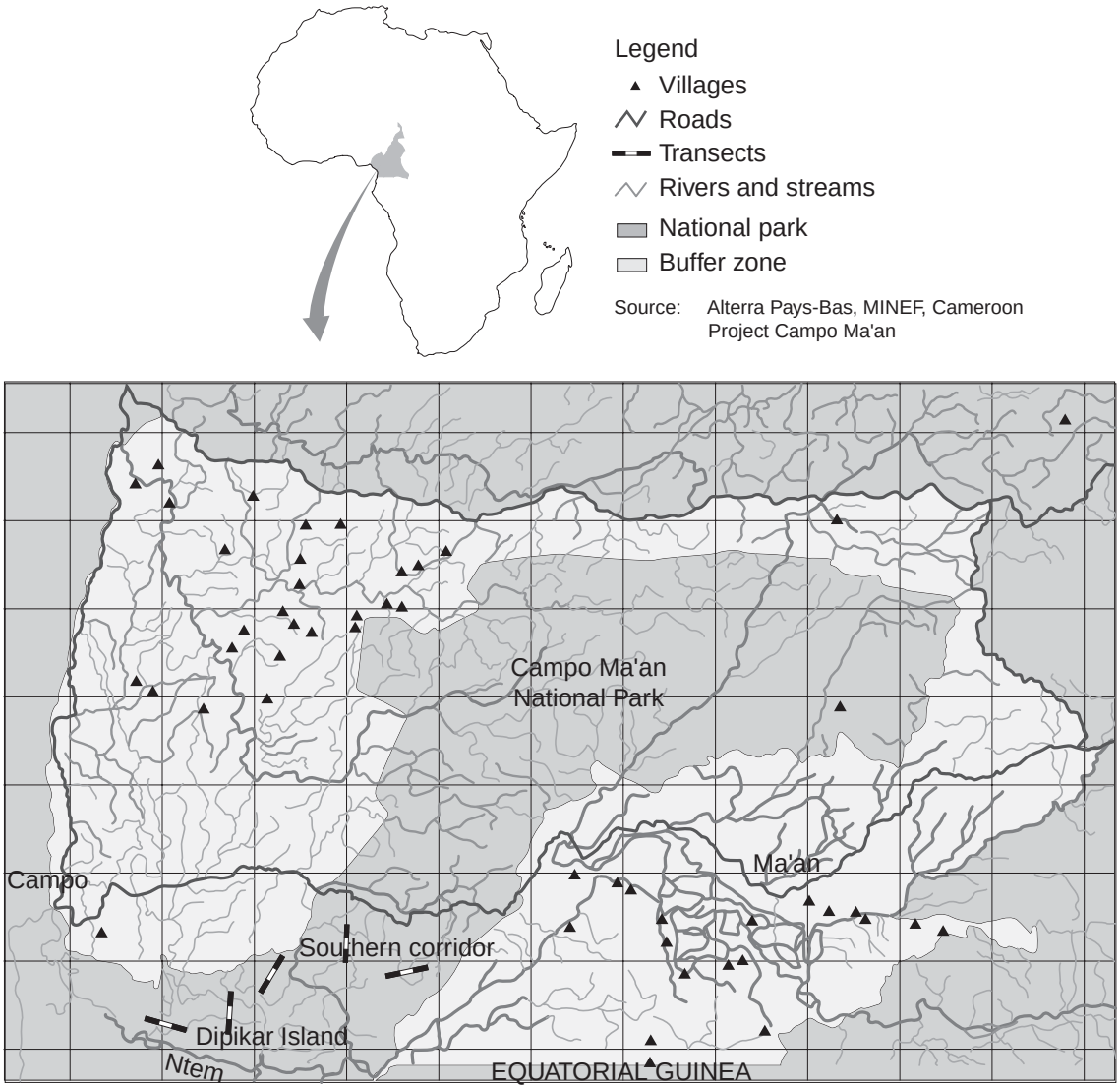

Figure 1. Map of the study area. One square is 12,100 ha.

area abundant in water, and swamps occur locally. Within the area the landscape changes from low-altitude plains in the west (principally Dipikar Island) to a hilly and mountainous zone rising above 700 m in the east (east of the southern corridor).

The vegetation consists mainly of old secondary forest, but patches of dense, humid, evergreen primary forest still occur, mostly closely related with the steep topography of the area. Selective logging took place in the area's level zones around 1994, leaving an infrastructure of logging roads. Nowadays elephants pushing over the young secondary trees maintain the human-created disturbed areas on and next to abandoned logging roads. All transects surveyed include parts of the secondary forest.

The climate of south-west Cameroon is equatorial. Although rainfall occurs throughout the year, two humid seasons and two drier seasons can be distinguished. The heaviest rainy season is from August to November and another rainy season is from April until the beginning of June (estimated average total yearly precipitation is 3000 mm). Drier seasons occur from December to March and from June to July (Gemerden and Hazeu 1997). The area has been officially desig-

nated a national park, providing full protection to flora and fauna. Moderate poaching still goes on but is focused mainly on small duikers and the smaller primates rather than on elephants (Cameroonian Ministry of Environment and Forest, personal information). The area has no human habitation except for a small army base at the extreme western end.

Method

To estimate elephant density, we sampled elephant dung density along five transects over a period of 8 months. Each transect was 5 km long and 1 m wide. Three transects (S1, S2, S3) were positioned at random on Dipikar Island, and two (S4, S5) in the southern corridor. Between September 2000 and April 2001, four strip transects (S1, S2, S3, S4) were surveyed 6 times and one transect (S5) was surveyed 5 times. This way the main part of the rainy season and the major dry season have been included. The narrow strip width was applied because of the high abundance of elephant dung, while the narrowness of the transects made observations more accurate. Every dung pile encountered was marked to prevent double counting. All five transects were investigated by the same team consisting of three persons: one local assistant and one eco-guard from the Cameroonian Ministry of Environment and Forest, both with excellent knowledge of the forest, helped the observer look for dung.

To estimate elephant density (no./km^2) from dung counts, we slightly adapted the equation of Tutin and Fernandez (1984):

Elephant density = $n / flwd$
where
- n = number of dung piles encountered
- f = defecation rate (day^{-1})
- l = transect length (km)
- w = transect width (km)
- d = dung accumulation period (days)

Defecation rate (mean number of dung piles an elephant discharges per day) is taken as 14, after Powell (1998), and the maximum accumulation period (number of days in which the dung could have been deposited) is taken as 65, after White and Edwards (2000). The maximum dung accumulation period equals the dung decay time and was taken into account only when the time lapse between observations was large (like for the first observation). The dung accumulation period was mostly taken as the number of days between observations, since this number was less than the dung decay time (mean number of days in which a dung pile disappeared). Sequential inspection of 146 dung piles during the whole fieldwork period validated this. No difference in dung decay rates was found between seasons (Bekhuis 2002).

A two-way ANOVA, with season and site as fixed factors, was applied to log-transformed elephant density values used to distinguish possible density differences between sample areas and seasons.

Results

Sixty-nine individual elephant dung piles were counted within the transects, 40 on Dipikar Island and 29 within the corridor zone. From this number densities were calculated per transect and per field trip to adjust for the different lengths of dung accumulation periods (fig. 2).

During the main part of the rainy season the mean elephant density over the whole study area was calculated as 0.6/km^2, while during the major dry season the mean density calculation resulted in an estimate of 1.1/km^2. The mean density during the dry season tended to be higher in the corridor (0.9 and 1.3 elephant/km^2 for the rainy and the dry season, respectively) as well as on Dipikar Island (0.4 and 1.0 elephant/km^2, respectively), but differences among seasons and sites were not significant (2-way ANOVA on transformed densities, $P > 0.05$) (table 1).

For Dipikar Island mean elephant densities over the whole study period were 0.3/km^2 in the western region, 0.6/km^2 in the central region and 1.2/km^2 in the eastern region. A significant difference in elephant density was not detected between the areas (ANOVA on transformed densities, $P > 0.05$), possibly due to the low sample size. For the southern corridor the densities were 1.1/km^2 in both the low-lying level meadows and the mountainous zone.

For this reason the entire study site is taken as a whole. The mean density for the study area is 0.8 elephants/km^2 (n = 29, se = 0.2), suggesting that with simple extrapolation and an area of 648 km^2 the study area is holding an average of 548 elephant individuals (table 2).

Figure 2. Elephant densities per transect and per field trip; differences are not significant.

Table 1. Mean elephant density (km^2) and number in rainy and dry seasons in Dipikar Island and the corridor; differences among sites and seasons are not significant

Season	Dipikar Island (no.)	Corridor (no.)	Total study area (no.)	Mean elephant (no.)
Rainy season	0.4	0.9	0.6	389
Dry season	1.0	1.3	1.1	713
Average	0.7	1.1	0.8	548

Table 2. Mean elephant density per square kilometre and number of transect observations for different sites in this study; differences among sites and transects are not significant

Location	Mean elephant density (per km^2)	Transect observations (no.)	Mean elephant number
Dipikar Island	0.7	18	251
Western transect	0.3	6	
Central transect	0.6	6	
Eastern transect	1.2	6	
Southern corridor	1.1	11	318
Lower transect	1.1	6	
Mountainous transect	1.1	5	
Total study area	0.8	29	548

Discussion

In this study we found an average forest elephant density of 0.8 elephants/km^2 for the southern part of the Campo Ma'an National Park.

According to Wanzie (1993) the Mount Cameroon area holds an elephant density of 0.15/km^2, while for Dja Reserve an informed guess leads to an estimate of 0.29/km^2 (Tchamba 1998). The relatively high elephant density in the southern region of the Campo

Ma'an National Park might be because it is located much farther away from human activity (villages, fields and roads) than are the two surrounding reserves.

In south-western Cameroon the main threat to elephant was poaching and not habitat disturbance by selective logging (Bekhuis 1997). According to Bekhuis, three habitat requirements account for significant differences in suitability among the various landscapes in south-western Cameroon: food availability, water availability and distance from human activity. A questionnaire given to villagers showed that they considered a suitable distance from human activity was at least 8 km. A field study revealed that sufficient water and food were available in all the landscapes within the area, making distance to human activity the main factor determining elephant presence. Barnes et al. (1995) in Gabon and Blom et al. (2001) in Central African Republic have also reported that human density had a greater effect on elephant density than vegetation type.

These inferences also appear valid in explaining elephant distribution in the Campo Ma'an area. A rapid survey among villagers from different sides of the Campo Ma'an region disclosed elephant presence in and outside the national park but mostly at large distance from villages (> 10 km). No evidence at all has been found of elephants crossing or even approaching the well-used road bordering the Campo Ma'an region in the north and east. From interviews and field sightings it is clear that most of the elephants are located in the southern part of the national park.

Van der Hoeven (2001) carried out a study in the Campo Ma'an region using a classified, more detailed questionnaire to determine densities of nearly all animal species present, among them the elephant. He found that elephants were still present outside the national park (in the buffer zone) but not as numerous as inside it. Both areas have nearly the same abundance of food and water; their difference is mainly the intensity of human activity.

The wide confidence limits (about 25% deviation from means) to the different mean densities found in the corridor and on the island during the two seasons preclude making a statement about more accurate seasonal and site-specific mean densities. The trend in the data suggests to us, as a working hypothesis, that at the beginning of the dry season (December), elephants move from outside the study area into the southern corridor, and elephants from the southern corridor move to Dipikar Island. Elephants then move back from Dipikar Island into the southern corridor zone at the beginning of the rainy season, and also from the southern corridor zone northwards outside the study area.

Attempts have been made to track elephant movement by mapping elephant paths. During the dry season, elephant paths in the study area covered only short distances, with lengths of approximately 3 km, and connected fruiting trees (Bekhuis, unpubl. data). During the rainy season no fresh elephant paths were identified; in general, only during this season do animal tracks show. This lack of tracks may indicate a change in the pattern of elephant activity in different seasons. Tracks do not show movement over long distances.

African elephant movements have always been the subject of much speculation. However, elephants are nowadays unlikely to move far outside of the national park. Around the park in Cameroon, as human activity (villages, roads, fields and hunting activity) increases, it increasingly keeps elephants at a distance. We even suggest that elephants discovered the safety of Campo Ma'an National Park and moved into it.

No information is available yet on forest elephant density or elephant movement in Equatorial Guinea, just south of the study area. The estimated number of the elephants in the Campo Ma'an National Park is most probably a large enough population to be sustainable. But is it possible for these elephants to meet individuals from other populations? Ongoing research is necessary to reveal whether the Campo Ma'an populations of elephants are trapped or compressed in the park.

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