ELEPHANTS IN THE LOBEKE FOREST, CAMEROON

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ABSTRACT

The Lobeke forest appears to be an elephant refuge during the long, hard, dry season, when the overall density of elephants reaches 2.14±1.23 per km^2 (95% C.L.). By the end of the rainy season, density drops to 0.56 ± 0.33 elephants per km^2 (95% C.L.). The mean defecation rate is estimated at 17.2 ±1.7 (95% C.L.) per day and the mean dung decay rate at 0.0093 ±0.0043 (95% C.L.) per day. Elephant distribution changes with season. The main migratory movement is north-bound.

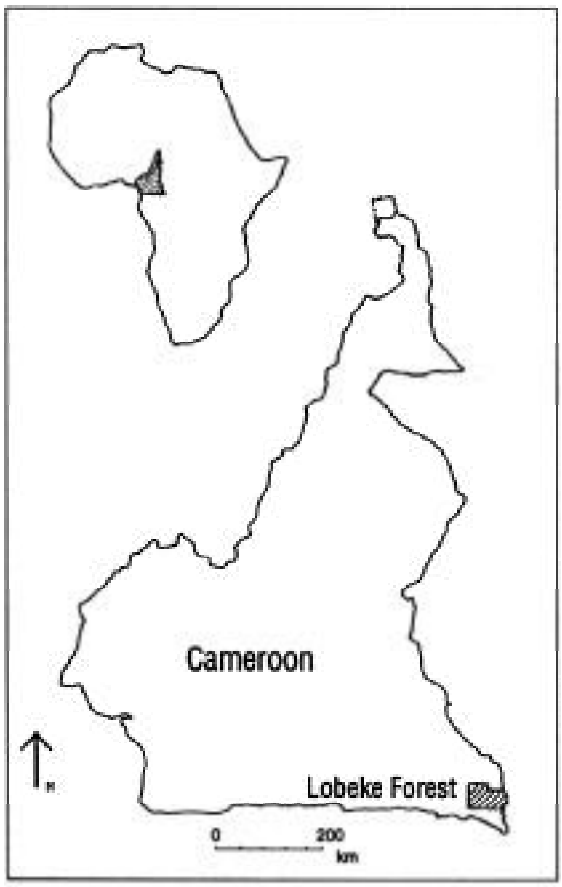

Figure 1. The location of Cameroon and the Lobeke Forest

INTRODUCTION

Since 1992, WWF-US has been engaged in a conservation research programme in the Lobeke forest, located in south-eastern Cameroon (Figure 1). The programme is divided into two main parts: a study of the ecology of the Baka and Bangando people, who are the owners and users of Lobeke forest, and secondly, the design of a future protected area, which will include recommendations for the conservation of the Lobeke-dwelling elephants. The results presented in this paper represent a component of the research programme.

The study area

The proposed Lobeke Forest Reserve covers an area of 2,125km^2. It lies between the latitudes 20 and 2 N and the longitudes 15 the east by the Sangha River (which also serves as the international boundary between Cameroon, Congo and the Central African Republic), to the north by the Lobeke and Longue Rivers, to the west by the Djombi River and to the south by the Boulou and Moko Paka Rivers (Figure 2).

The climate

The climate is equatorial with four seasons. Average annual rainfall is about 1,400mm. The main rainy season runs from September to November and the secondary one from March to June. The long dry season lasts from December to February and the short one from July to August. In 1993, the rainfall pattern differed slightly from the norm with rainfall occurring throughout the year. However, there was still a relatively dry season from December to March and a sharp decrease of rainfall in September. Rainfall reached a maximum of 245mm in April and a minimum of 31mm in September (Table 1).

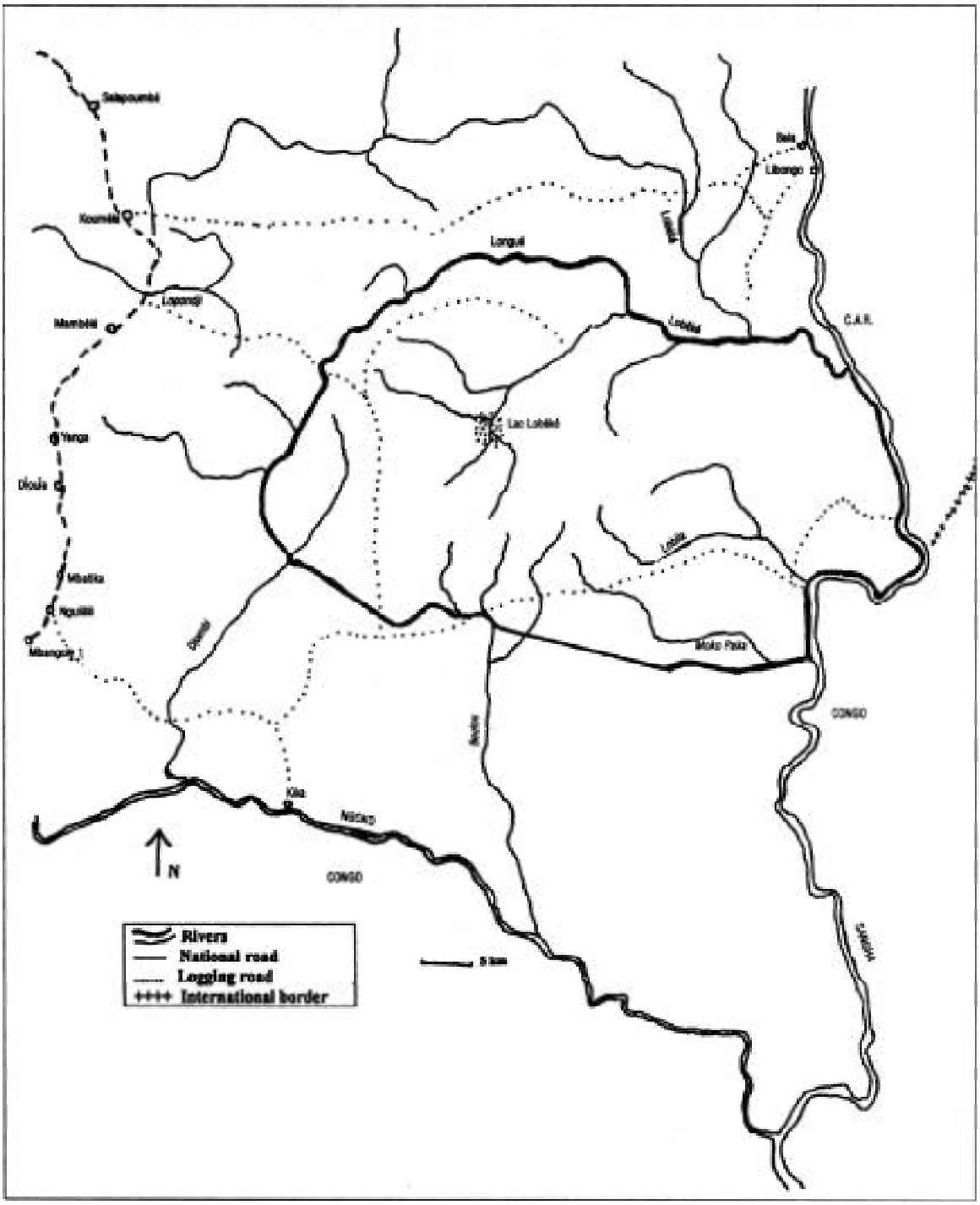

Figure 2. The proposed Lobeke Forest Reserve.

Table 1. Rainfall (mm) in the Lobeke Forest, 1993.

Jan	Feb	Mar	Ap	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
62	52.5	72.5	245	94	192	164.5	158	31	223	95	87	1476.5

The mean annual temperature is 24 and relative humidity remains high throughout the year.

Geology and soils

The Lobeke forest is located on a plateau belonging to the Sangha basin. The region is of Precambrian origin, consisting of a crystalline base of granite and metamorphic rocks overlain with schists, limestone and sandstone quartzite. It is a flat relief, with few hills or steep slopes. The altitude rises from 400m in the valleys to 700m on three hills, which lie on a SW-NE alignment in the proposed reserve. The Lac Lobeke itself is a large, shallow, swampy clearing.

In general, soils are ferrous, red or red-brown, being derived from the ancient metamorphic bedrock. They are acid and clay-like, with a thin, humic layer which bears little organic material and ins low in nitrogen and exchangeable bases. Soils in some areas bordering the Sangha River, including part of the Lac Lobeke basin, are hydromorphic due to permanent stagnant water, making them rich in organic material.

Vegetation

The area was mapped by Letouzey (1985). He classified Lobeke as a transitional forest between the Dja evergreen forest and the semi-deciduous forest. The Lobeke forest is dominated by semi-deciduous forest (60% of the area) and is rich in Meliacees *(Entandrophragma spp),* Sterculiacees *(Nesogordonia, Triplochiton, Sterculia spp., Eribroma, Pterygota),* Mimosacees *(Piptadeniastrum, Tertrapleura, Pentaclethera, Albizia spp.),* Sapotacees *(Autranella, Gambeya spp., Omphalocarpum),* Annonacees *(Anonidium, Polyalthia, Xylopia)* and also *Terminali superba, Pterocarpus soyauxii* and *Drypetes gossweileri.* The undergrowth is rich in herbaceous monocotyledon plants, in particular Maranthacees *(Megaphyrnium macrostachyus, Ataenida conferta, Haumania dankelmanniana, Sarcophyrynium spp.),* Zingiberacees *(Aframomum spp)* and Commelinacees *(Palisota spp).* There are also two types of transitional forests: the Dja evergreen forest with semi-deciduous elements (covering 19% of the area), and the semi-deciduous forest with elements of Dja evergreen (which covers 21% of the area). The Dja evergreen forest is marked by a poverty of Caesalpiniaceae. One notable exception is the abundant *Gilbertiodendron dewevrei,* a Caesalpiniaceae which grows in extended single-species stands. The flora of the semi-deciduous forest is dominated by the families of Sterculiaceac and Ulmaceae. Other species are well represented, particularly *Terminalia superba, Entandrophragma cylindricum* and *Pericopsis alata.*

Drainage

The northern, eastern, south-eastern and central part of the proposed reserve are drained by the Lobeke, Longue, Lobila and Moko Paka Rivers which flow east as tributary of the Sangha River. The west and southwestern part of the proposed reserve are drained by the Djombi and the Boulou Rivers which flow in a southerly direction to the Ngoko River. There are thus two major drainage systems within the proposed reserve.

The local people

The local people are the Baka and Bangando. They are concentrated along the Moloundou Yokadouma national road. They have no permanent settlements in the proposed reserve. The principal cash crop of the largely subsistence farming community is cocoa. The dominant industry is forestry. Other minor commercial activities include trading of bush meat and fish.

METHODS

The estimation of the number of elephants living in a given forest is generally only possible through dung counts, whereby the density of dung-piles in a given area is translated into the density of elephants, taking into consideration the rate of elephant defecation and the dung decay rate in the forest. A line transect dung count, a defecation rate experiment and a dung decay rate experiment were all therefore initiated for the study. The results of dung density, elephant density, elephant distribution and estimates are presented and discussed in this paper. Defecation and decay rate results are presented here (since they are used in the calculation of elephant density) but will be described and discussed elsewhere.

Dung density measurements

The Lobeke forest was divided into 80 strata of 25km^2, as illustrated in Figure 3. One 2.5km line transect was randomly cut into each of the first 78 strata, making sure that each transect started from one of the existing five base-lines (Figure 3). A total length of 195km of line transect was therefore cut along 235km of baseline. A minimum of 860km was covered on foot to survey the whole area. Dung density measurements were taken three times during the year (January to March 1993; May to August 1993; November 1993). Burnham et al., (1980) and Barnes and Jensen (1987) provide a good description of the theoretical and practical aspects of the line transect sampling method used in this study.

During data collection, it was ascertained that each transect was a straight line by following trees along a compass bearing. The centre of the line was determined by using a 50m measuring tape which was also used for measuring transect length. The line transect survey was carried out by a team of five, consisting of a leader (the author), two labourers and two assistants. The leader was responsible for making sure that the selected compass bearing was maintained. He also conducted dung searching and recorded the data. The two labourers were responsible for clearing the transect along the compass bearing, while the two assistants helped with measurements, dung searching, and ensuring that the measuring tape lay straight on the ground. The "hunter's technique" was used to cut the transects. It entails marking trees along the compass bearing with cutlasses, breaking a few shrubs, and cutting climbers and some undergrowth where it is too thick. This technique proved advantageous for the survey, since neither elephants nor poachers used the transects. Care was taken during data collection not to miss any dung-piles on the line, and to measure accurately distances to the nearest centimetre with measuring tapes. None of the dung-piles (being immobile objects) were counted twice. It was assumed that the sighting of one dung-pile was independent of the sighting of another.

The following data were recorded when a dung-pile was seen: the distance of the pile along the transect using a 50m measuring tape; the. distance from the centre of the transect line to the centre of the dung-pile, using a 20m measuring tape; the dung-pile grade (as defined in the decay rate experiment), a description of its location and the surrounding vegetation types. In addition, information on other elephant sigus (feeding, footprints. digging, etc.), vegetation change (primary forest, logged forest, secondary forest, swampy forest, clearing, etc.), human activities, and presence of streams and swamps, were also recorded.

Before doing any analysis, the strata were grouped into five different zones as follows:

Zone 1: Very highly used areas (number of dung-pile sightings ≥ 100)
Zone 2: Highly used areas (number of dung-pile sightings ≥ 50 and < 100)
Zone 3: Moderately used areas (number of dung-pile sightings ≥25 and <50)
Zone 4: Lowly used areas (number of dung-pile sightings ≥ 10 and <25)
Zone 5: Very lowly used areas (number of dung-pile sightings <10)

Data analysis

Data analysis was facilitated by the computer programme ELEPHANT, offered for use in the study by the Wildlife Institute of India. The programme ELEPHANT is divided into four parts:

Part 1 is based on the Line Transect Sampling and the Fourier Series Model (Burnham *et al.*, 1980). It analyses perpendicular distance data and outputs dung density.

Part 2 estimates the decay rate. The decay rate is expressed as the proportion of dung disappearing per day.

Part 3 calculates the defecation rate.

Part 4 calculates elephant density. It is based on the equation E=Y* r/D (Barnes & Jensen, 1987) where Y = dung density; r = dung decay rate; D = defecation rate.

RESULTS

Elephant densities and numbers

These were calculated from dung densities, dung decay rates and defecation rates.

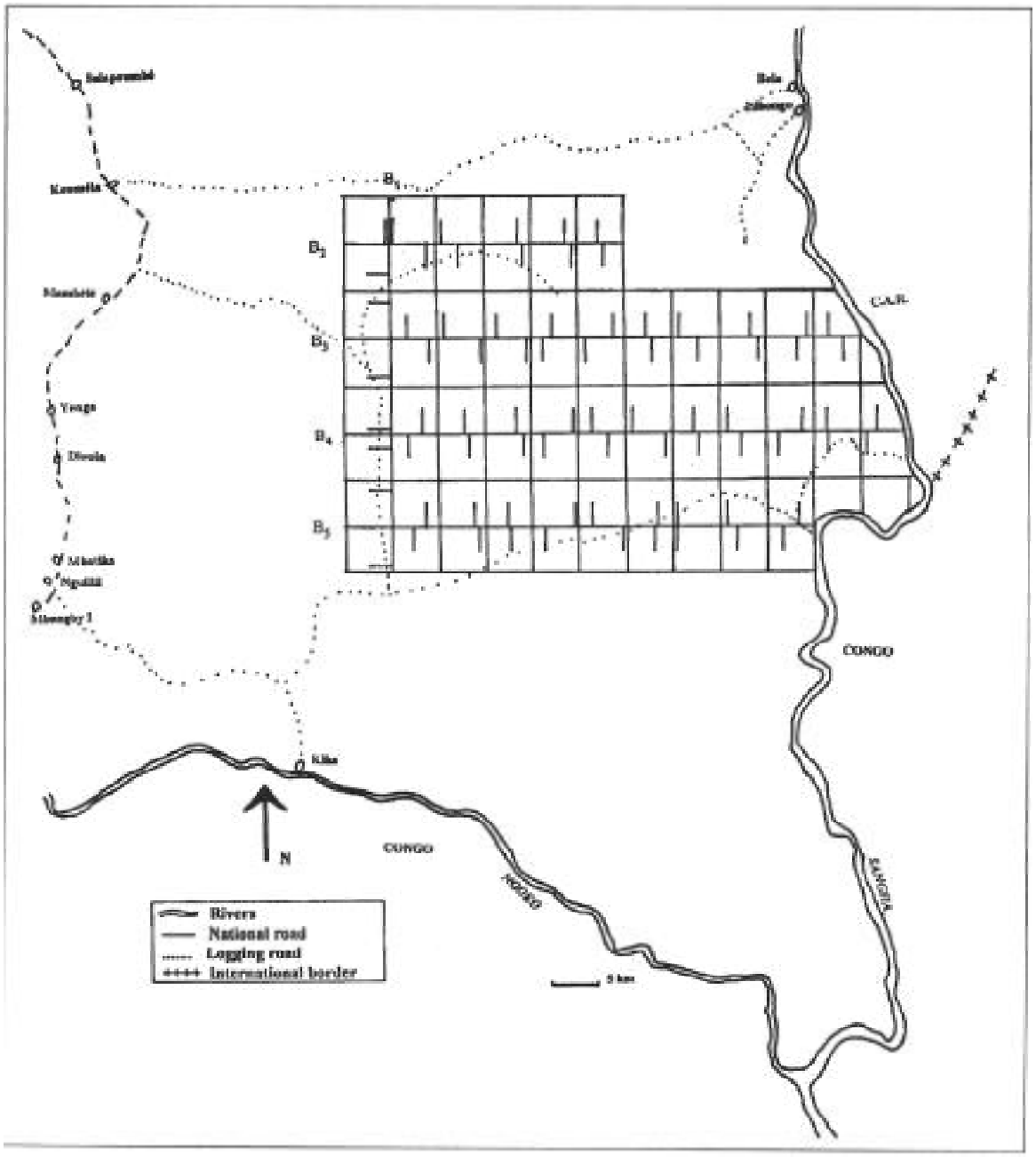

Figure 3. The location of 80 strata, five base-lines B1- B5) and 78 transects, the latter totaling 195km, in the Lobeke Forest

Table 2. Results of the long dry season line transect survey (January-March 1993).

Zone	Estimated dung density/km² (95% C.L)	Estimated elephant density/km² (95% C.L)	Area (km²)	Estimated number of elephants (95% C.L)
Zone 1	12,302.41 ± 2,203.71	6.64 ± 3.82	209.5	1,391 ± 800
Zone 2	7,480.36 ± 1,122.89	4.04±2.31	375	1,515±866
Zone 3	3,385.58 ± 542.80	1.83 ± 1.05	333.5	610 ± 350
Zone 4	1,626.77 ± 283.35	0.88 ± 0.51	592.5	520±302
Zone 5	794.14 ± 254.65	0.43±0.28	475	204±133

Table 3. Results of the short rainy and short dry season line transect survey (May-August 1993).

Zone	Estimated dung density/km² (95% C.L.)	Estimated elephant density/km² (95% C.L.)	Area (km²)	Estimated number of elephants (95% C.L)
Zone 2	9,633.66 ± 2,443.02	5.20 ± 3.01	116.5	606 ± 351
Zone 3	3,793.83 ± 308.97	2.05± 1.15	876.5	1,797±1,008
Zone 4	2,851 .53 ± 418.61	1.54 ± 0.88	542.5	835 ± 477
Zone 5	959.53 ± 323.41	0.52 ± 0.3	450	234 ± 153

Table 4. Results of the rainy season survey (November1993).

Zone	Estimated dung density/km² (95% C.L.)	Estimated elephant density/km² (95% C.L.)	Area (km²)	Estimated number of elephants (95% C.L)
Zone 3	2,336.20 ± 366.39	1.26 ± 0.72	323	407 ± 233
Zone 4	1,697.42 ± 283.08	0.92 ± 0.53	575	529 ± 305
Zone 5	306.96 ± 101.72	0.17±0.11	1,087.5	185±120

The results of the defecation rate experiment (not described) are:

Total number of observations: 46
Total number of elephant hours: 571.93
Mean defecation rate: 17.2205 per day
95% confidence limits: ± 1.7162

The results of the dung decay rate experiment (not described) are:

Number of fresh dung-piles initially marked for regular observations: 40
Number of observations in data file: 29
Mean decay rate: 0.0093 per day
Standard deviation: 0.00218
95% confidence limits: ± 0.0043

The long dry season survey

The total number of elephants estimated to use the study area during the long dry season was 4,241 ± 2,451. The overall elephant density was calculated as 2.14 ± 1.23 elephants per km². For the proposed reserve (2,125 km²) the estimated number of elephants is estimated at 4,548 ± 2,614. Table 2 gives the breakdown of results according to the five zones.

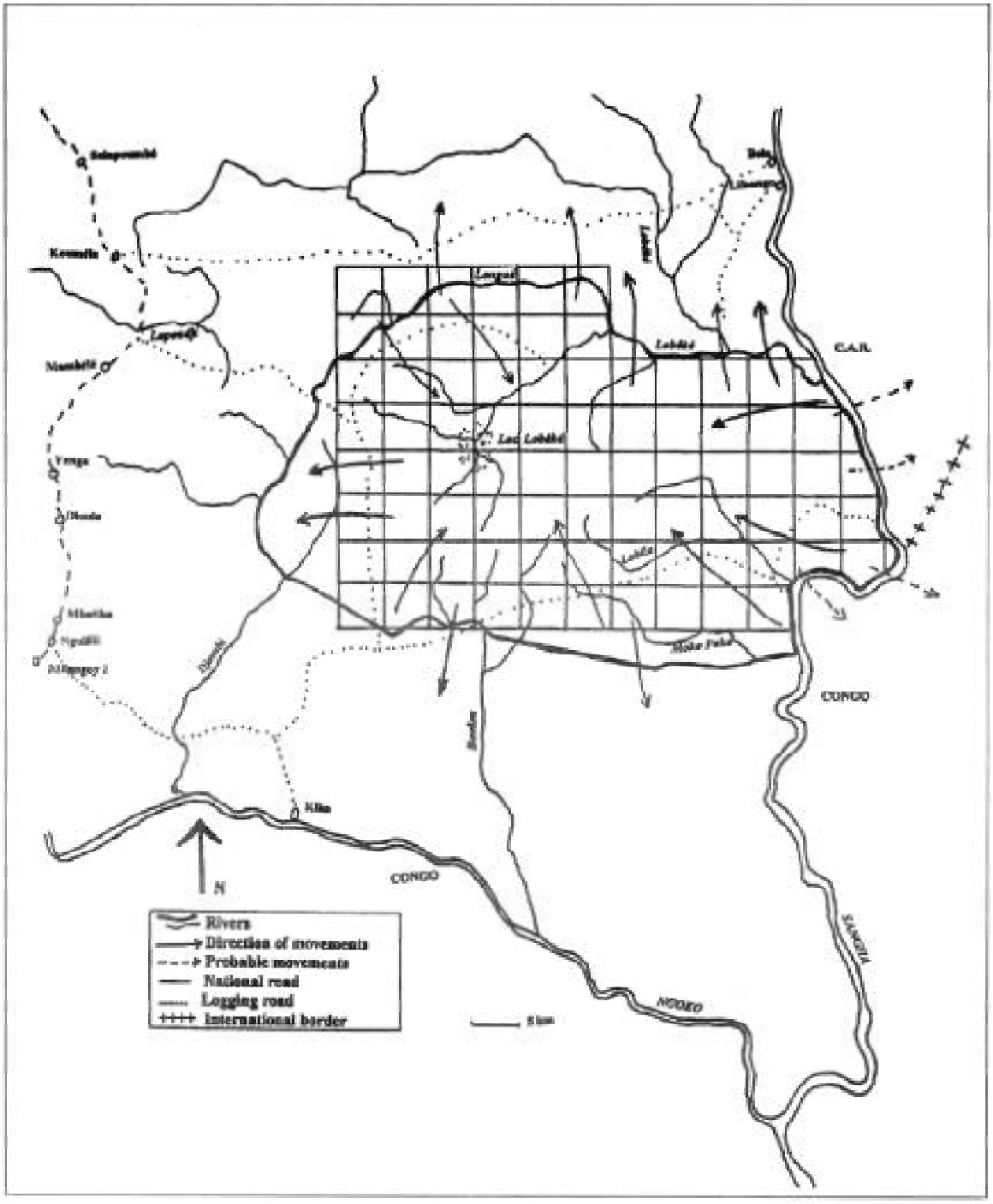

Figure 4. Movements of elephants in the Lobeke Forest.

The short rainy season and short dry season survey
The total number of elephants estimated to use the study site during the short rainy and dry season was 3,472 ±1,989, with an overall elephant density of 1.75 ± 1.00 elephants per km^2. For the proposed research, the estimated number of elephants is 3,719 ± 2,125. Table 3 shows the breakdown of results by zone.

The long rainy season survey
The number of elephants estimated to use the study site during the long rainy season was 1,121 ± 658, which gives an overall density of 0.56 ± 0.33 elephants per km^2. For the proposed reserve, the estimated number of elephant is 1,190 ±701. The breakdown of results by zone is shown in Table 4.

Movements

By the end of the long rainy season, 74% of elephants had migrated out of the Lobeke forest. Two types of movements were observed, as illustrated in Figure 4:a centripetal (reduced) movement and a centrifugal movement.

DISCUSSION

Stromayer and Ekobo (1992) estimated a density of 4.64 elephants per km^2 for the Lobeke forest. The highest overall density estimated during this study was 2.14 ± 1.23 elephants per km^2 during the long dry season. The large difference between these two densities might be explained by the high mean decay rate (0.0233 per day) and the low mean defecation rate (17 per day) used in the 1992 calculations. This discrepancy highlights the necessity of undertaking decay and defecation rate experiments specific to the site, in order to arrive at a more accurate density estimation.

The above results suggest that the Lobeke forest becomes an elephant refuge during the long dry season, from January to March. Densities of more than one elephant per km^2 were mainly located around the Sangha and Longue-Lobeke Rivers during this period. The distribution of elephants in November, and from May to August, were much more homogenous, perhaps because of a more even distribution of resources during these two periods.

The centripetal movements begin with the short rainy season and become more accentuated in the short dry season when fruits are available all over the Lobeke forest.

The centrifugal movements tend to be directed towards the north. Movements towards the southern and eastern parts of the Lobeke forest are very reduced. Elephants do not appear to go very far beyond the Djombi River. A questionnaire survey of inhabitants from Salapoumbé to Kika indicated that for the time being, elephants have not been crop-raiding in the area. Careful monitoring of the Molondou-Yokadouma road from Moloundou to Salapoumbé did not reveal any elephants crossing the road, or any elephant footprints. It is not yet known how far elephants go northwards, and if they cross the Sangha River. We hope to find out during the second phase of the project.

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