



## Survey on the Movements and migration corridors of *Loxodonta africana cyclotis* (Proboscidea: Mammalia) in the Monzo Forest of Bosobolo Territory (Nord-Ubangi Province, Democratic Republic of the Congo)

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### ABSTRACT

Recent findings revealed that 90% of elephants are decreased, mainly due to hunting for ivory and the rapid expansion of human activities both in protected and non-protected areas including trans-boundary regions. Habitat fragmentation is also a problem faced by many species all over the world due to human activities. The aim this study is to carry out a survey on the movements and migration corridors of *Loxodonta africana cyclotis* in the Monzo Forest of Bosobolo Territory, Nord-Ubangi Province, the Democratic Republic of the Congo. The present study was carried out into three steps: pre-survey (which consists in questioning the Territory Administrator, the heads of sectors and the supervisor of the Territorial Environment Service), survey (on 100 hunters and 100 farmers) and *in situ* biomonitoring to search elephant indices through the transect technique. The following parameters were taken into account in the survey: The presence of elephant (movement and migration corridors) via indices like dung density, field damage; the level of encounters with elephants; the migration season; the cause of extinction and regular migrations. Results revealed that the majority of respondents have over 5 years of experience in elephant hunting. Among these hunters 64.4% are active and 35.5% inactive. The main livelihood activity was agriculture (53.3%). 84.4% of the respondents encountered live elephants or their dung. The intense frequencies of elephant were observed from 1997 to 2002 while elephant disappearance was certified from 2002 to 2012 and the reappearance confirmed from 2012 to 2017 (90%). From 1997 to 2017, 16.6% of respondents think that hunters killed 1 to 25 elephant heads while 14.4% of respondents reveal that hunters killed more than 100 heads during this period. The mobility is high in January and from June to December and moderate from February to May. The conservation of these mammals and their habitat would be of great importance, as elephants play a very important ecological role in the forests, particularly in maintaining high productivity. It is therefore necessary to zoning the site in order to obtain precise geographical coordinates of the migration corridors of elephant in the Monzo Forest; to install camera traps for the monitoring of elephant and to access the population size.

**Keyword:** Forest, biodiversity conservation, *Loxodonta africana cyclotis*, Nord Ubangi, Democratic Republic of the Congo

### INTRODUCTION

Habitat fragmentation is a problem faced by many species all over the world due to human activities. Because of such fragmentation, the migration between the fragmented areas has been greatly hampered. As a result, many species are threaded in their existence, some even facing extinction. One of the species facing these problems is the African elephant, as they require large areas of natural range than any other mammal species, and therefore are one of the main animals to suffer the consequences of human activities. In Central Africa, it was reported that 90% of elephants are decreased, mainly due to hunting for ivory and the rapid expansion of human activities both in protected and non protected areas including transboundary regions [1, 2]. As the amount of habitat shrinks, the biodiversity they support is at increasing risk of extinction. Yet, elephants are ecologically important as "gardeners" of the landscape and a source of income for national economies and/or as crop destroyers [3]. The exploitation of land for food crops reduces the surface area and closes wildlife migration routes thus; animal species such as elephants are being pushed back into smaller areas. The increasing conversion of forest into agricultural land in Nord Ubangi Province (NUP) is affecting the population of many

species, especially forest elephants, which need a very large area to live [4]. According to Ngbolua et al. [5-7], NUP belongs to the Ubangi eco-region, a subgroup of *Northeastern Congolian lowland forests*. This eco-region is one of the 200 globally priority terrestrial eco-regions known as the "G200" and constitutes a reservoir of terrestrial biodiversity. With its large forest massifs (composed of the Abumombazi, Bokunda, Mobayi-Mbongo and Monzo forests in which the elephant's habitat is reduced by agriculture) the survival of elephant is threatened by poaching, sub-regional insecurity and war [8-11]. It should be noted, however, that the fragmentation of the habitats of these large mammals as a result of the effect of pressure from human expansion puts at risk by fragmenting the migration corridors thus adversely affected the migratory movements of the elephants. These corridors are however necessary to facilitate dispersal and the migration processes, which are critical to species persistence. It is thus urgent to examine the possibility of protecting appropriate corridors for elephant migration in Nord Ubangi in order to increase the number of these large mammals [11, 12]. It is therefore necessary to collect information on large mammals of this eco-region. The aim this study is to carry out a survey on the movements and

migration corridors of *Loxodonta africana cyclotis* in the Monzo Forest of Bosobolo Territory, Nord-Ubangi Province the Democratic Republic of the Congo.

## MATERIAL AND METHODS

### Site of the study

The Bosobolo territory is located in the NUP, Democratic Republic of the Congo [9]. It is bordered to the North by the Central African Republic, to the South by the territory of Gemena and Businga, to the East by the Territory of Mobay-Mbongo and to the West by the Territory of Libenge. Concerning the hydrographic network of the Territory, there are tributaries, streams, creeks of different sizes, ponds where several species of fish and ichthyological resources can be found. The Bosobolo Territory is made up of two types of vegetation: forest and savannah. There is a large area of savannah in the hill of Lombo that extends to the Libenge territory [13].

### Methodology

The present study was carried out into three steps:

- (a) The pre-survey which consists in questioning the Administrator of the Bosobolo Territory, the two heads of two sectors of different peripheral groupings of the Monzo Forest Massif and the supervisor of the Territorial Environment Service was carried out in order to collect information on the distribution of elephants and their probable presence in the area.
- (b) The survey

## RESULTS AND DISCUSSION

The table 1 gives the data on the elephant hunting, hunters' experience and their livelihood activity.

Table 1: Information on elephant hunting, work experience and livelihood activity of respondents

Sectors	Work experience			Active hunters		Agriculture		
	≤1	2-5	≥5	Yes	No	Yes	No	Other
Banda	6.6	13.3	66.6	70	30	50	30	20
Bili	66	26.6	70	46.6	53.3	50	33.3	16.7
Bosobolo	0	3.3	96.6	76.6	23.3	60	36.6	3.4
Moyenne	4.4	14.4	77.7	64.4	35.5	53.3	33.3	12.4

It is observed from the table 1 that the majority of respondents have over 5 years of experience in elephant hunting. Among these hunters 64.4% are active and 35.5% inactive. The main livelihood activity was agriculture (53.3%).

The opinion of respondents on the elephant encounters, the interest of their hunting and the estimation of elephant heads per herd are given in the table 2.

Table 2: Encounter with elephants, hunting interest and estimated number of heads per herd (in %)

Sectors	Encounter		No heads per herd		Benefits of elephant hunting	
	Yes	No	1 to 25	≥25	Alimentation	Ivory
Banda	76.6	23.4	56.7	43.3	43.3	56.7
Bili	86.6	13.4	56.7	43.3	56.7	43.3
Bosobolo	90.0	10.0	53.4	46.6	53.4	46.6
Mean	84.4	15.6	55.6	44.4	51.1	48.9

The table 2 revealed that 84.4% of the respondents encountered live elephants or their dung. The rates were 55.6% and 44.4% respectively for the herd between 1 and 25 heads and for the herd above 25 heads. 51.1% of respondents believe that poaching or hunting is carried out for the supply of animal proteins, while 48.9% of respondents believe that it is carried out for the supply of ivory. This situation is similar to Ivory Coast as previously reported [4].

The table 3 gives the results of the presence, frequency, encounter, damage, disappearance and reappearance of elephants in the Monzo forest from 1997 to 2017.

At the end of the reconnaissance (pre-survey), the Monzo forest, was divided into blocks by Sector, corresponding to rare or low (scale 1), medium or moderate (scale 2) and high or intense (scale 3) densities of elephants. Thus a questionnaire was developed to:

- Know the past occupation of the studied sites by elephants: patterns of movement during the 20-year periods, particularly from 1997 to 2017;
- Establish whether elephants live permanently in the sites or make seasonal migrations and, in the latter case, the period of year they appear;
- Whether they cause crop damage and their hunting.

The following parameters were taken into account: The presence of elephant (movement and migration corridors) via indices like dung density, field damage; the level of encounters with elephants; the migration season; the cause of extinction and regular migrations. A total of 200 persons were interviewed (100 persons by sector: 50 hunters and 50 farmers) on the basis of free and informed consent. The selection criteria of the surveyed people were based on the informants who had sufficient knowledge on the species under investigation.

- (c) *In situ* biomonitoring to search elephant indices through the transect technique. Depending on the size of the forest massif, between 40 and 50 transects were made in order to identify presence of dung.

Table 3: Presence, frequency, encounter, damage, disappearance and reappearance of elephants in relation to the period from 1997 to 2017 (in %)

Parameters	Period			
	1997-2002	2002-2007	2007-2012	2012-2017
Intense or high frequency (scale 3)	100	0	0	0
Medium to moderate frequency (scale 2)	67.7	25.3	1.1	5.6
Low or rare frequency (scale 1)	19.9	60.0	11.1	9.0
Encounter	0	3.3	67	93.3
Damage	1.1	0	1.1	97.8
Disappearance	0	26.6	63.3	7.7
Reappearance	0	1.1	8.9	90.0

The table 3 revealed intense frequencies of elephant from 1997 to 2002. Elephant disappearance was observed from 2002 to 2012 while the reappearance was confirmed from 2012 to 2017 (90%). The reappearance and disappearance of these mammals in this region has been justified by cross-border mobility and the search for suitable conditions and the war that has occurred in Central Africa remains one of the causes. The elephant frequency was intense and moderate during the peace period; however, low during the war period.

The opinion of respondents on the number of head slaughtered by sector was collected and the results are recorded in table 4.

Table 4: Opinion of respondents on the number of head slaughtered by Sector from 1997 to 2017

Sector	Slaughtered heads					Free sale of useful products	
	1-25	26-50	51-75	76-100	≥100	Yes	No
Banda	23.3	6.6	3.3	0	10	3.3	96.7
Bili	13.3	10.0	3.3	6.6	13.3	20	80
Bosobolo	13.3	6.6	3.3	0	20	0	100
Mean	16.6	7.7	3.3	2.2	14.4	7.7	92.3

The table 4 shows that from 1997 to 2017, 16.6% of respondents think that hunters killed 1 to 25 elephant heads while 14.4% of respondents reveal that hunters killed more than 100 heads during this period. Those who freely sell the meat of this large mammal represent 7.7% of the expressed opinion; they do so with a slaughter authorization. Poaching remains one of the factors that significantly reduce the population of mammals in African forests [8, 9, 14].

The seasonal migration of elephants was observed and the results are shown in figure 1.

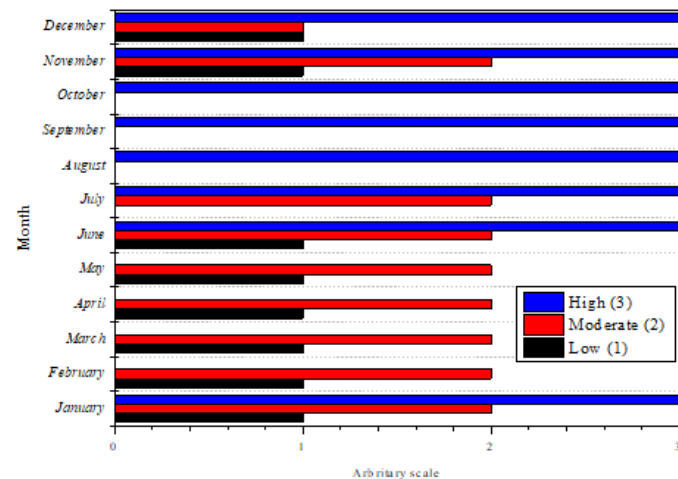


Figure 1: Movement in relation to the season

The figure 1 shows that mobility is high in January and from June to December and moderate from February to May. This alternation is justified by the fact that this mammal lives in watery and dry conditions [7, 12].

The present survey revealed also that the causes of the disappearance of elephants in the Monzo Forest are the uncontrolled circulation of weapons, poaching, rebellion, and lack of regulation and bush fires. Those of reappearance are the presence of the appropriate ecosystem, war in the Central African Republic, regulation of the sector, multiplication, peace in the Democratic Republic of the Congo (DRC). Among these causes,

poaching and rebellion remain the predominant causes of the extinction of this animal; this corroborates with those obtained in Garamba Park where wildlife has been severely affected by poaching exacerbated by political instability in the area [12]. In recent years, intense poaching of elephants for ivory and meat in much of Central Africa was observed, where it has been concluded that this area is the main source of the ivory that currently supplies the illegal trade [15]. Awareness raising and increased monitoring are used as a measure to reduce this pressure; either farmers are sensitized on the methods to be used or more suitable systems such as shifting cultivation and zero grazing are used to encourage them to use livestock in stabling [12]. Elephant transhumance is high in a less perturbed habitat. However, since 2013, the Central African Republic (CAR) remains the zone of crackling and detonation of weapons that are the basis of this regular migration from CAR to DRC [12, 16]. It has been observed that 100% of the respondents are in favour of the conservation of this endangered large mammal.

The two States, DRC and CAR, in particular, must rely on the matter for possible conservation measures in order to save elephant and his habitat. This meets the thesis that, as far as biodiversity conservation is concerned, efforts in Central Africa are concentrated on protected areas and more recently on forest concessions and community forests [17]. These results corroborate with those according to which, it is recognized that reduced populations are more likely to become extinct and the essential objective is to maintain and, where possible, increase them. The need for investment in elephant habitat management, rehabilitation and protection of parks and reserves to improve them has also been identified [4]. Furthermore, while each State is sovereign, in this context, each State has the responsibility to plan and implement the conservation of its natural resources, as

underlined by the Convention on Biological Diversity; it is therefore the joint responsibility of adjacent States to jointly manage common resources. The conservation of these mammals would be of great importance, as elephants perform a very important ecological role in forests, particularly in maintaining high productivity, which shows that, with appropriate management, forest products can be better used as a result of the selective feeding of these animals [13]. Furthermore, it has been stigmatized that in Africa, conservation areas are increasingly being established along national borders where human activities seem less dynamic and where economic exchanges are very active. This view is supported because conservation projects and forest administration can and should contribute to trade liberalisation in order to unlock the economic potential of remote forest areas. This idea is defended because conservation projects and forest administration can and should contribute to trade liberalisation in order to unlock the economic potential of remote and poor forest areas. If accompanied by strict enforcement of the law in cases of illegal and harmful practices, liberalisation policies can help to integrate conservation and development objectives through the creation of tourist sites [18-21]. The establishment of this protected area will be an important land-use planning option to achieve conservation objectives and support sustainable development and poverty reduction policies in the Bosobolo Territory.

The landscape of the Monzo forest ecosystem, the dead collection, field damage and fresh dung as recent indicators of the presence of elephants are shown in figure 2.



Figure 2 : The Monzo forest ecosystem landscape (a-c), the dead collection (d), fresh dung (e) and field damage (f) are recent indicators of elephant presence

The Monzo Forest landscape as visualised in figure 2 above remains the best habitat for elephants according to its rivers and

forest massifs in three Sectors that cover the Bosobolo Territory; the presence of elephants is real in this forest due to the certification of dead collection managed by the farmers, the recent damage to the fields and the fresh dung in the Okpo and Bembe villages. Dung density is considered a relevant measure of elephant occupancy; dung-piles observed on the ground reflect cumulative occupancy over the previous month or two, while the elephant census provides an instantaneous measure of occupancy [4, 21].

Recent field damage caused by elephants is a known case among farmers in the elephant range; this situation has also been observed in Zimbabwe, with reports of damage to crops, granaries and other property [16]. In view of the above, it has been further noted that the passage of elephants in 2018, in the Togbo, Mongo-Mbanza, Mono-Bubanda and Mono-Bili Groups, where at least 9 heads per herd were counted, remains the factor of identification and confirmation of the presence of elephants in the Monzo forest, in the Bosobolo Territory.

The presence of elephants in this territory is evidence that could support the creation of a protected reserve in this area to conserve the biodiversity of the Monzo forest, which is not protected by the networks of state protected areas in the Democratic Republic of Congo, and thus contribute to poverty reduction for the local populations. Indeed, the ecological region of Nord Ubangi is a priority area for the conservation of biodiversity [22].

## CONCLUSION AND SUGGESTIONS

The Monzo forest has elephant corridors as certified by the dead collection (elephant carcass), the presence of dense and fresh dung, and the recent damage observed in the farmers' fields. The movement and migration of elephants in this region is a result of trans-border mobility between the Democratic Republic of the Congo and the Central African Republic. The mobility frequency of these animals is high in January and from June to December and moderate from February to May. It is therefore necessary to zoning the site in order to obtain precise geographical coordinates of the migration corridors of elephant in the Monzo Forest; to install camera traps for the monitoring of elephant and to access the population size.

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