PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
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Pakistan Journal of Nutrition 9 (12): 1141-1148, 2010
ISSN 1680-5194

Contribution to the Survey of the Food Regime of the Forest Elephant (*Loxodonta africana cyclotis*) in the Peripheral Zone of the National Park Ogooue Leketi

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Abstract: In this survey, the authors analyze the food regime of the forest Elephant (*Loxodonta africana cyclotis*) in a part of the forest sector of the National Park of the Ogooué-Léketi in Republic of Congo. The survey achieved itself on two trails parallel distant of 7.5 km one of the other and covering a total distance of 13.19 km. During two months, of March to April 2010, the authors browsed the 13.19 km while harvesting the data on the plant species consumed by the forest Elephant. Every trail was browsed while using the method of oriented recognition (guided recces) until the discovery of the track of meal. Three methods were used for the collection of the data: opportunist observation of the traces; consistent of the cool tracks borrowed by the Elephant and the analysis of the cool droppings. According to the results of this survey, hundred thirty four (134) species of plants of which sixty ten eight (78) known and fifty six (56) unknown were identified in the rests of food of the Elephant. Otherwise, one notes that the forest Elephant eats the bushes mainly, the trees, the lianas, the monocotyledons and accidentally of ferns. The bush the more clear soup in the zone of survey is *Hugonia sp* 1, a bush lianescent of the family of Linaceae present in the two trails. The parts of the plants preferred by the forest Elephant are the leaves followed the roots, the stems, the fruits and finally the peels. Finally, sixty ten eight (78) droppings were analyzed in which one identified seeds of nine (9) species. Of these species, *Anonidium manii* was present in 50% of the droppings.

Key words: Track of meal, traces, droppings, trail

INTRODUCTION

To find their foods in the different habitats, the Elephants use the zones to strong potentiality of food while borrowing a complex network of the tracks. The tracks of the meals opened by the. Elephants can spread on hundreds of kilometers (Maisels *et al*., 2002; Blake, 2002). These tracks join several points of interest for the Elephants as the big fruit trees, the points of water and the bay named swampy clearings in central Africa (Blake, 2002).

The food regime of the savanna Elephant is relatively very known (Barnes, 1982; Tchamba, 1996). These studies showed the dominance of the herbs in the food of the Elephants during the season of rain and that the leaves, woods and peels become important when rains become rare. They consume the fruits that when they are available (Chapman *et al*., 1992).

The food regime of the forests Elephants is also studied in spite of the fact that this habitat of forest is closed. The studies led in West Africa (Alexandre, 1978; Merz, 1981; Short, 1981) and in Central Africa (Blake, 2002) show that the forests Elephants consume a variety of active food of the leaves, peel, wood, root and fruits. Tsoumou (2008) had found the same food behavior while studying the Elephants of the reserve of fauna of the Léfini, zone of the Tray Batékés of Congo.

To the level of the National Park Ogooué Lékéti, the exploratory polls achieved by the teams of Wildlife Conservation Society (WCS) of which Moukassa and Madzou (1996), Inkamba-Nkulu and Diahouakou (2005), constitute the first given on the food regime of the forest Elephant.

The present survey done in the peripheral forest of the National Park Ogooué Lékéti and neighboring of the fields of the inhabitants of the Simonbondo village, had for global objective, to bring our contribution on the knowledge of the food regime of the forest Elephant.

The specific objectives sum up:

- To produce the list of the plant species consumed by the forest Elephants of the zone of the National Park Ogooué Lékéti,
- To identify the shapes as well as the parts of the plants preferred by the Elephants.

MATERIALS AND METHODS

Localization and characterization of the survey zone

Geographical situation of the survey zone: The survey has been achieved on both sides of the Ogooué river to the level of the Simonbondo village, (Fig. 1), especially in the zone where there is conflict man Elephant and the zone said of conservation. It has been determined for

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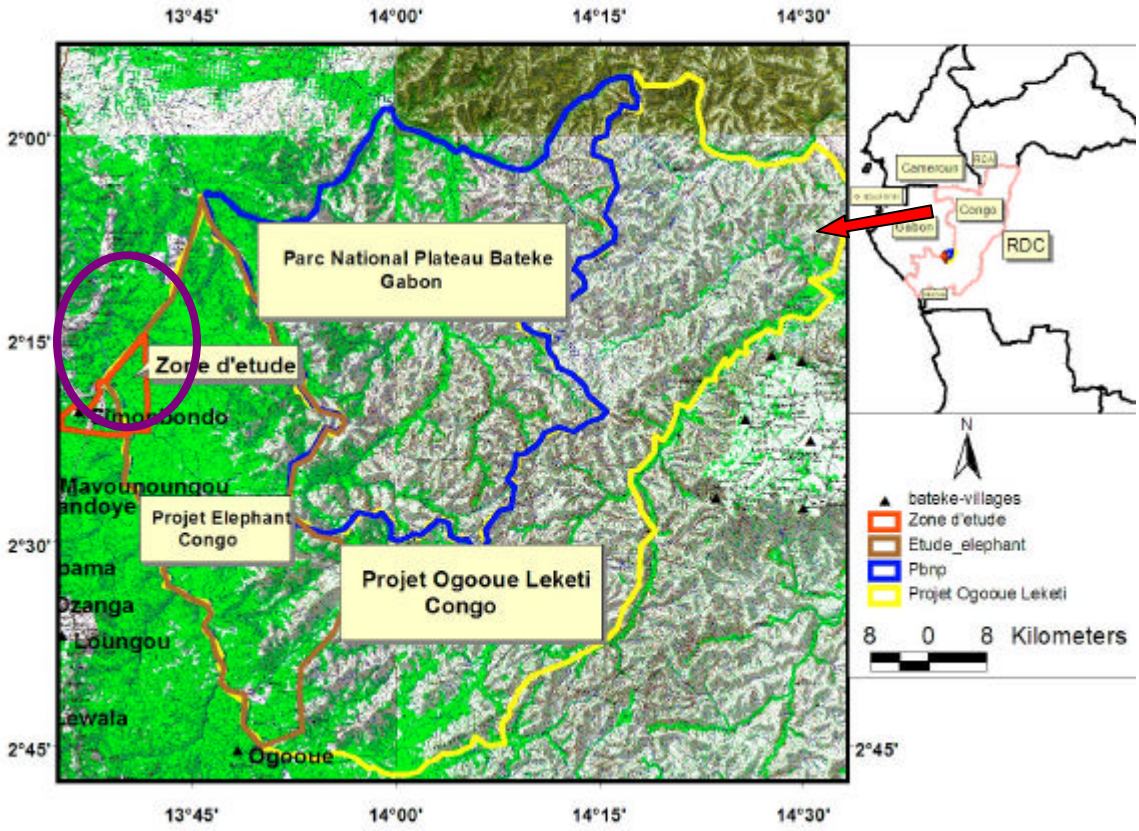

Fig. 1: Presentation of the survey zone

this survey a surface of 81.52 km^2 for the tracking of the Elephants. The main types of habitats that overflow the zone are: open mixed forests, forests mixed closed, flooded forests, savannas, marshes and rivers. These natural factors are susceptible to influence the distribution and the movements of the animals.

The zone of survey is limited at the North is by the National Park Ogooué Lékéti and Republic of Gabon; to the South by Republic of Congo and the banal zone to multiple exploitations. A carriage able road joins the zone of survey to the villages as Mavounoungou, Bandoy, Bambama and other.

Description of the abiotique middle

Climate: The zone of survey is one of the components of the Léconi-Batéké-Léfini landscape that is submitted to a tropical climate of transition of the sub-equatorial type (Elenga and Ikoli, 1996). It is a characterized climate by: of the precipitations of the order of 1200-1700 mm (INRAP, 1976); a dry season that lasts between 1 and 3 months; a yearly thermal amplitude adjoins 5°C; a yearly middle temperature of 25°C.

Geomorphology: The relief of this zone consists of many trays whose altitude oscillates between 600 and 700 m, cut at the bottom of which, sink the rivers (200-300 m). The zone of the National Park is located geomorphologique of the Tray Tékéses on the whole (Elenga and Ikoli, 1996). It individualizes herself/itself in two very different wholes composed of the trays and hills.

Geology and pedology: Soils are clayey sablo freeing the dust or the mud depending on whether one is in dry season or in rainy season. These climatic features and edaphique confer him an essentially forest vegetation (INRAP, 1976). Indeed, the geological cover essentially decomposes itself in two tertiary formations of which will and sandy silts then will and the argilite. these two geological formations drift several types of soils: on the high trays of soils yellow ferralitiques impoverished on the materials sandy argilo; on the low and pouring of the trays, of soils yellow ferralitiques impoverished on sandy materials.

Hydrography: The essential of the hydrography of the survey zone is the presence of the Ogooué river. This river takes the source to Congo and finished his/her/its race in Gabon. All along his/her/its passage, the Ogooué river receives the water of the different affluents of which

Rented it, Moba, Létili and other. The Ogooué rivers and Lékétis constitute the set of the hydrographic network of the water tower that throws himself the some toward the Congo stream and the Mpassa in Gabon.

Description of the biotique middle
Vegetation
Savannas: In the zone of the Park, the savannas cover close to 60% of the surface of the reserve and 40% by the forest. The survey of the vegetation savanicole in the Tray Batékéses has been led by several authors. Three groupings savanicoles exists (Makany, 1976; Moutsamboté, 1998):

- Savanna to *Hyparrhenia diplandra* that associates to *Bridelia ferrugina* on the trays. These savannas are composed on the one hand of the *Hyparrhenias diplandra* and *Nauclea latifolia* and on the other hand by *Hyparrhenia diplandra* and *Annona arenaria*,
- Savanna to *Loudetia demeusei* is characterized by a generally high herbaceous carpet and *Hymenocardia acida* on the flanks of hills,
- Savanna to *Loudetia simplex* and *Monocymbium ceresiiforme*, mainly in the shallows or on the banks inondables.

Forests: The studies of vegetation in the zone of the National Park Ogooué Lékéti is inexistent. A team of Botanical Garden had achieved an inventory floristique in the forest part in 2009 where have been identified close to 300 plant species. The forests of the reserve were classified in three big types:

- The forests on soils hydrornorphes are composed of the forests ripicoles colonizers to *Alchomea cordifolia* or to *Ancistrophyllum secundiflorum*, of the forests ripicoles to *Treculia tracaganta*, *Irvingia gabonensis*, of the swampy forests and inondables to *Lasiodiscus sp*,
- The forests of firm earth regroup the forests of trays and the forests of slopes or dry valleys. These forests are constituted by a diversity of the plant gases among which we can mention: *Aucoumea klaineana*, *Anonidium mannii*, *Piptademiastrum africana*, *Uapaca guinensis*,
- Of the spaces important of the forests monodominantes to *Pterocarpus soyauxii* and *Uapaca guinensis* to the under almost clear wood.

In these forests of firm earth there are places well tightened by lianas that are for most composed of *Laccosperma* rattans, *Ancistrophilums* and *Eremospathas* generally (*Arecaceae*).
In the other places there is the presence of the big woods of which the under wood is either clear is dominated by *Palisota* sp (*Commelinaceae*), *Megaphrinium sp.* (*Marantaceae)*.

Fauna: The inventories mammaliens achieved in the National Park Ogooué Lékéti had counted to the minimum 28 different species going from the leading species to the small mammals (Moukassa and Madzou, 1996; Inkamba and Diahouakou, 2005; Inkamba *et al*., 2009). These species of mammals of which some of fundamental importance for the conservation, include, the Chimpanzee (*Pan troglodytes troglodytes*), the Buffalo of forest (*Syncerus caffer nanus*), the Sitatunga (*Tragelaphus spekei*), the Leopard (*Panthera pardus*), the Jackal (*Canis adustis*), Hippo (*Hippopotamus amphibius*), Céphalophes, small Monkeys and the forest Elephant (*Loxodonta africana cyclotis*).
Although there are not some inventories on the plants and the birds in the National Park Ogooué Leketi, of the studies led on the other side of the border to Gabon by. Christy (2001) had counted 260 species of birds while including an endemic species of *Cisticola;* and beyond 300 species of the plants (Walters, 2005) with at least 2 endemic species in the Tray Batékéses.

Human populations: The zone kept for this survey is localized close to the Simonbondo village (District of Bambama in the Department of the Lékoumou). In this District, outside of the Pygmies (Babongo), the autochthonous Bantus are of two ethnic groups of which the Tékéses and the Mbambases. The other villages that adjoin the Park are localized along the road that joins Sibiti in Congo in Franceville in Gabon. The villages that have a direct influence on the Park are: Ogooué, Loungou, Mavounoungou and Simonbondo.

Collection of the data
Plan of poll of the survey zone: The zone of survey, of a surface of 81.52 km^2, is localized between 13°35,5'-13°41,8'E and 2°14,8'-2°22'S. She/it occupies a part of the Project Elephant of the Tray Batékéses within the future area protected from the National Park Ogooué Lékéti.
The DISTANCE program (Thomas *et al*., 2006) was used to establish the plan of poll in this zone of survey. Two parallel trails of variable length (trail 1 measuring 3.87 km) in the zone close to the Simondondo village where is installed the fields of the peasants and the trail 2, having 9.32 km of length and situated in the zone of the National Park Ogooué Lékéti. The two trails had separated one of the other of 7.6 km (Fig. 2). These two trails had to be browsed while following a direction determined of 152°. This orientation has been chosen in such a way that most fields of the populations of the Simondondo village are represented in order to measure the impact of the Elephants in the different types of vegetation is wild vegetation is of plantation.

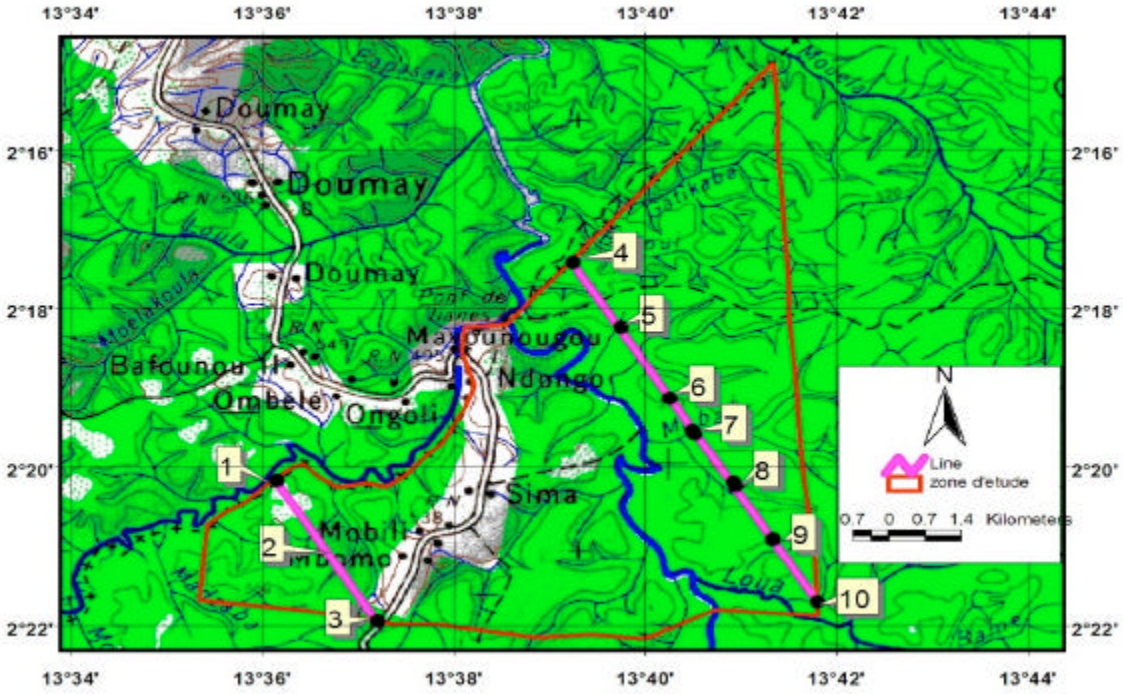

Fig. 2: Plan of poll of the survey zone

Material of land and technique of collection of data: Two missions of lands were organized for the collection of the data in the tracks of meal of the Elephants. The first mission had taken place in the month of March in the trail 1 situated close to the Simondondo village and the second mission was achieved in April in the trail 2 situated in the zone of the National Park Ogooué Lékéti. The observations were made every day between 7h30' and 12h00' then between 13h00' and 17 through the oriented recognition method or recces guided (Blake, 2002).

In the guided recces, the team walks on a right line while following the direction indicated in the compass. When a cool track of meal was marked along the main trail, the team should begin the tracking while counting and noting all traces and the rests of food of the Elephant. All signs of the Elephants (droppings and traces of foods) were noted in a strip of two meters (a meter of the observer's side) and all others signs (traces of the humans, direct observations of the animals and all nests of the big Monkeys) are recorded to all distances from the main trail.

The types of vegetation have been described qualitatively as one advanced along the trails and every time that there was a change. To move on the land us used the Global Positioning System (GPS) Garmin XL. All way dawned of the beginning and the end of the trails was recorded in the GPS before beginning the work of land. At the time of the coming down on the land, we used the GoTo function from the GPS to reach the beginning and the end of every trail. We took the care to note a point each 10 min in the trail to permit the establishment of the card of the itineraries followed and to help with the géo référencement. The data were noted in a notebook of land according to the time GMT. The watch and the GPS operated synchronous manner. Thus, all collected information were géo. referenced. These data of land were recorded then in a file meadow prepared of Excel in a portable computer before being submitted to the analyses.

Collection of the traces of the elephants

Data on the tracks of meal: He/it is nearly impossible in the habitat of closed forest to approach an Elephant in order to see what he/it even eats to a distance of less than 10 meters. In this survey we used the signs indirect of the rests of old food of at least 48 h let by the Elephants thus. Three methods were used for the collection of the data: Opportunist observation of the traces, followed of the cool tracks borrowed by the Elephants and the analysis of the cool droppings.

Opportunist observations of the traces: In order to produce an exhaustive list of food of the Elephants, we counted all signs of different ages that testify the damages caused by the Elephants. For what is foliages, he/it was kept to consider that the cool or recent signs of the Elephants associated by the presence of the prints, the dug holes and the damage of vegetation. The nutrition of the peels of the trees was distinctive even though the signs dated of several months.

The identification of the plant species consumed by the Elephants was is made directly on the land by the specialist of the Elephants in the project WCS Tray Batékés. In the event the species dealt with us unknown, a small herbarium of land was conceived while noting the least detail to allow his/her/its identification the laboratory. The works of botanies next one, Letouzey (1969), White and Abernethy (1996) and the list of the plants made by Nsongola *et al*. (2006), allowed us to identify some species of the plants collected. These species of the plants were classified then according to their taxonomie.

Tracking of the cool tracks: The cool tracks of the Elephants were followed through the zone of survey to a distance of 1 km in theory of which 500 meter of every side of the trail.

The method of tracking was to follow the cool track of meal once it was discovered from the main trail. The tracking was made with the aid of a hunter experimented in the hunt of the Elephants. The number of the individuals in the group was estimated from the sizes and the number of their prints in age/sexe (children, juvenile, sub-adult, adult females and adult males) of the Elephants in the group.

The distance browsed in the track of meal was measured while using the topo thread. The change of vegetation and all details on the types of the plants and food behaviors were recorded.

Analysis of the droppings: The cool droppings met in the trails or in the tracks of meal were analyzed while following the method described by Blake (2002). The analysis had started with the measurement (cm) with a flat rule. We used two tips of sticks to see the content of the dropping, the nature and the abundance of the components (leaf, fiber, woods peel, fruit) were discovered thus. The relative abundance of content of the droppings was estimated while using the scale of abundance (1 = rare, 2 = little, 3 = common, 4 = abundant). All seeds were identified on the land by the specialist of the Elephants. The unknown seeds met in the dungs were dried and were placed in the small sachets in plastics for their identification by specialists.

Treatment of the data: To the term of this work, he/it was question to determine the food régime of the Elephants in the two trails followed. The data descended of the tracks of meal were cleaned and were regrouped by families and type of plant. He/it has been established in every trail the first ten plant species the more consumed by the Elephants. Of a general manner, the analyses were made from a software Excel. To be easily assimilated, the percentages have been calculated from the relation:

$$\% = (n/N)*100$$

Where:

% = Percentage,
n = Sum of the signs in a track,
N = Total Sum of all signs.

RESULTS

Types of plant formations in the tracks of meal of the Elephants: In this zone of survey, there was a diversity of types of plant formations in the tracks of meal of the Elephants. This diversity makes appear of the resemblances in their specific compositions in all tracks. The main recorded plant formations were composed of the closed mixed forest (fmf), open mixed forest (fmo), swampy forest (fmr), the savanna (sav) and the flooded forest (fi).

We identified fourteen (14) cool tracks of meal covering a total distance of 7227.7km. Of this distance, the closed mixed forest was represented by 50%, consistent by the open mixed forest 34%. The three other types of plant formations were less represented of which the swampy forest 9%, the savanna 6% and the forest flooded 1% (Fig. 3).

Plant species consumed by the Elephants in the zone of survey: In the fourteen (14) tracks of meal, we counted in food consumed by the Elephants, hundred thirty four (134) species different from plants (Fig. 4) exits of 40 known families and 39 species whose families are unknown. These species were collected from 414 parts different from the plants (leaves, peels, woods, stems, branches, roots and fruits). Of these 134 species different of plants, 78 species were identified either directly on the land is from the botanical works to our disposition. Fifty six (56) other species remained unknown. These unknown samples were placed in a small herbarium of land for their identification ulterior to the level of the survey Center on the Plant Resources (CERVE) of Brazzaville.

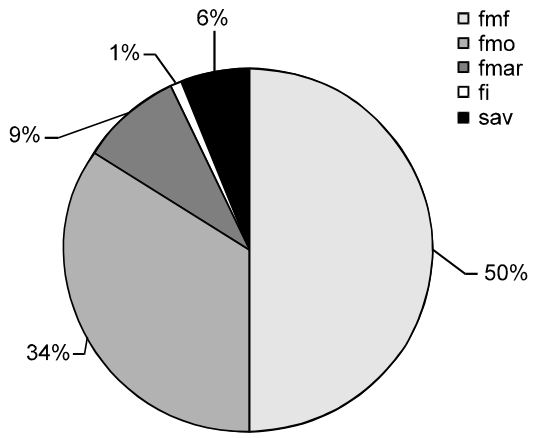

Fig. 3: Percentage of type of plant formations in the tracks of the meals of the Elephants

Table 1: The 10 species the more consumed by the Elephants in the zone of survey

Trail 1	N	% of consumption	Trail 2	N	% of consumption
Hugonia sp1	10	8.13	*Hugonia sp1*	23	7.90
Palisota hirsuta	6	4.88	*Cephaelis peduncularis*	19	6.53
Caloncoba welwitschii	5	4.07	*Chaetocarpus africanus*	16	5.50
Macaranga sp1	4	3.25	*Palisota hirsuta*	15	5.15
Pseudosabicea mildbraedii	4	3.25	*Anonidium mannii*	12	4.12
Bridelia ferruginea	3	2.44	*Pentaclethra macrophylla*	10	3.44
Chaetocarpus africanus	3	2.44	*Haumania liebrechtsiana*	10	3.44
Craterosiphon scandens	3	2.44	*Costus afer*	10	3.44
Eremospatha wendlandiana	3	2.44	*Mammea africana*	7	2.41
Haumania liebrechtsiana	3	2.44	*Manniophyton fulvum*	6	2.06
Total de ces 10 espèces		35.77	Total de ces 10 espèces		43.99
Nbre des espèces		67.00	Nbre des espèces		99.00
Nbre de fois consommé		123.00	Nbre de fois consommé		291.00

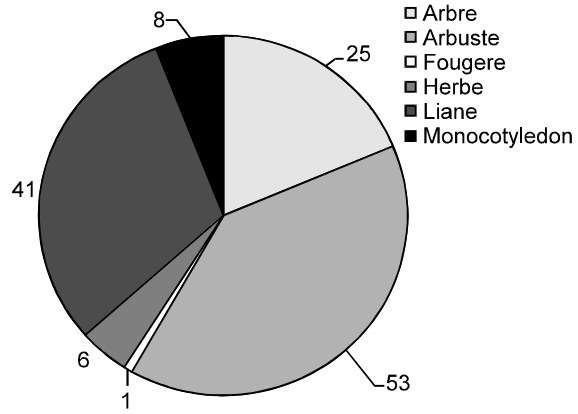

Fig. 4: Number of known plant species (N = 134) consumed by the Elephants in the zone of survey

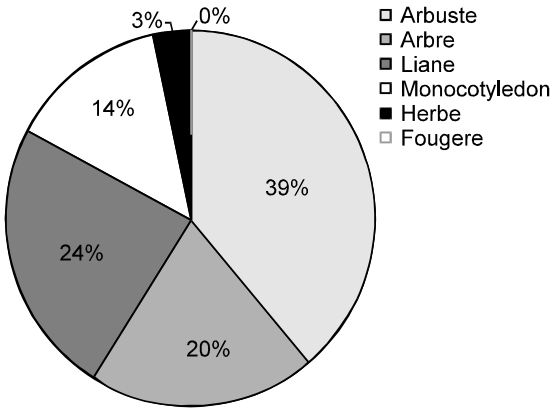

Fig. 5: Percentage of the shapes of the plants consumed by the Elephants

Of the hundred thirty four (134) species of plants, one noted that ten (10) were consumed more by the Elephants (Table 1). Of these ten (10) species, one notes that 4 species were common in the two trails of which *Hugonia sp 1*, *Palisota hirsuta*, *Chaetocarpus africanus* and *Haumania liebrechtsiana*. The other species are present in one or the other trail. The species *Hugonia sp1* is the more consumed with the frequencies of 8.13% in the trail 1 and 7.9% to the trail 2. on the other hand the species the less consumed in the lists of the first 10 species is the *Manniophyton fulvum* with a frequency of 2.06% in the trail 2.

Frequency of shape of plant consumed in the tracks of meal: To make itself/themselves an idea of the preference of shape of plant consumed by the Elephants in this zone, we classified these plants in six shapes: tree, bush, lianas, ferns, monocotylédone and herbs, (Fig. 5). The exam of the Fig. 5 shows that on the whole, the nutrition of the Elephants was composed more of the bushes (39%) consistent by the lianas (24%) and the trees (20%). The three other shapes of plants were less represented of which Monocotylédone (14%), grass (3%) and the fern is consumed accidentally (0.2%).

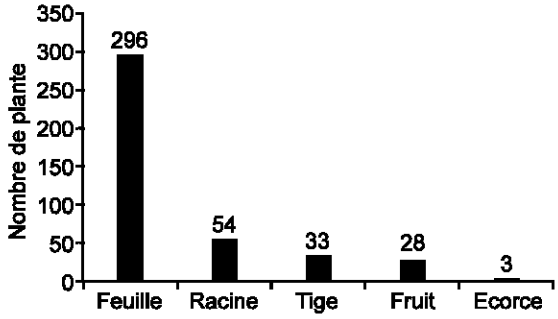

Fig. 6: Frequency of the parts preferred of the plants consumed by the Elephants

Frequency of the consumption of the parts of the plant: The results on the parts of the plant preferred by the Elephants are represented in the Fig. 6. Had to the total 414 parts of plant that the Elephants had eaten in the two trails followed. The exam of the Fig. 6 shows that the nutrition to basis of the leaves was raised very in relation to the peels with a percentage of 71.5% and 0.72% respectively. The other left from the plant of which the roots (13.04%), the stems (7.97%) and the fruits (6.76%) present intermediate values between the leaves and the peels.

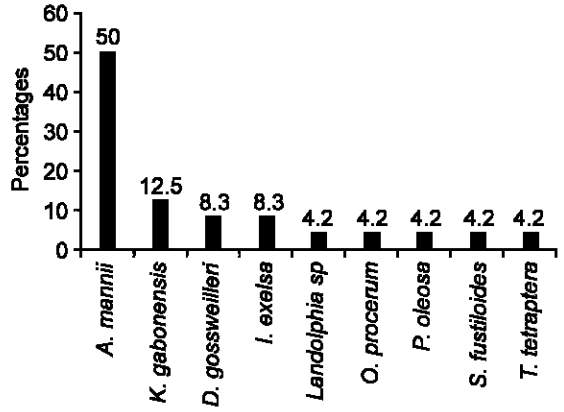

Fig. 7: Plant species found in the droppings of the Elephants

Analysis of the droppings: During this survey, we analyzed 78 cool droppings of Elephants. Of these droppings, we identified seeds of nine plant species. The species the more represented is the *Anonidium mannii* (50%) and the other species present some values lower to 13% (Fig. 7).

DISCUSSION

Of the general surface kept for this survey, the tracks of meal of the Elephants followed were only limited along two distant parallel trails of 7.5 km one of the other while following a declension of 152° degree. This declension appeared us important for the fact that the tracks of meal would owe arrivals in the fields of the populations of the Simondonlo village. This possibility had to allow us to make us an idea of that that the Elephants ate in the fields of the villagers. Unfortunately, the two trails, drawn by the DISTANCES Program moved away of the fields to the point where no track of meal had reached the fields of the villagers. Although the Elephants didn't arrive in the fields, one observed their tracks nevertheless to the level of the trail 1, an easy access zone. Indeed, the zone where is located the trail 1 is a zone of forest to closed canopée with opened one coins wood. This vegetation contains for most cases of the big trees with the abundance of fruit trees eaten by the Elephants like *Irvingia excelsa*, *Anonidium manii* and *Baillonella toxisperma*. During the period of our survey, a lot of fruits walls fallen of these trees dragged to soil and that the feet of these were the places of meeting of several animals including the forest Elephant.

To the level of the open mixed forest had food also for Elephant as well as the lianas of several species consumed. The marshes also contain a particular vegetation with sometimes of the *Maranthacloas sp*.

In the crossing of every track, at least exist a fruit tree appreciated by the Elephants. What comes back to say that these are the Elephants who create these tracks while following the fruit trees. In addition, they maintain them to be used during the seasons of the fruits. This situation lets believe that the tracks of the Elephants in the habitat of forest are not a fact of the luck. Thus, as affirm it (Blake and Inkamba-Nkulu, 2004; Tsoumou, 2008), the tracks of the Elephants accumulate toward the zones where there is an interest, for example the bay of forests or the Elephants eat the mineral salts.

Finally, the Elephants don't only find their food in the habitat of forest but one also meets them in the savanna where they find the herbs and the other plant species very appreciated. The track of meal 1 that crosses a river then arrives in the savanna, is a good example of use and the selection of food by the Elephants in several habitats.

As our results indicate it, 134 plant species were consumed by the Elephants among which ten were consumed more that of others. While making the comparison of the plants the more consumed in every trail, one notes that it is *Hugonia sp 1* that is the species the more consumed. This species is appreciated a lot by the Elephants can be because his/her/its wood stretch. The Elephants eat all parts of the plant then (leaves, stems, roots). other reasons can justify this preference as the abundance of the species in the zone of survey. This hypothesis seems to confirm the results of our survey.

In the 14 tracks of meal, one notes that the Elephants consume six shapes of plants but with a very elevated preference for the bushes the lianas and the trees Three hypotheses can justify this preference of the Elephants. In the first place, one thinks about the type of plant formation crossed by the Elephants. Indeed, depending on whether the Elephants cross a closed mixed forest composed of big tree or a dominated open mixed forest by the bushes and the lianas, it is obvious that these animals will eat what they find on their path. In second place, there is the accessibility to the plant. Indeed, no matter the type of plant formation that the Elephants cross, they have access more easily to the bushes that to the trees. Finally, it is necessary to signal abundance. It is obvious that the habitats crossed by the Elephants don't have the same composition of the point of view of the quantity of shape of plants. Even though the studies on the composition floristique have not been undertaken in this zone, our results let believe that the habitats crossed by the Elephant were the open mixed forests, composed for most bushes and lianas.

Our results on the parts of the plant the more consumed, raise that the Elephants consume more of leaves that the roots, the stems, the fruits and the peels. These results confirm those of (White, 1994) that raise that the consumption of leaves by the Elephants is always more important than the other left of the plant and that the abundance of the leaves in a determined zone, can influence abundance and the distribution of the Elephants. The exam of the droppings confirms our results besides on this very elevated consumption of the leaves even though the consumption of the fruits notably the seeds of the species *Anonidium mannii* and *Irvingia excelsa* that confirm works of (Chapman *et al*., 1992) presents very elevated values.

Conclusion and perspectives: The survey of the food regime of the Elephants while using the recces guided in the trails and the cool tracks of meal were achieved in the forest sector from the National Park of the Ogooué Lékéti to Congo. A total of 14 cool tracks of meal was browsed during two months.

The results of this survey raise that 134 species of plants were consumed by the Elephants. The plant species the more consumed in the zone of survey is *Hugonia sp1* of the family of *Linaceae*.

In the zone of our survey, the Elephants eat the bushes mainly, the lianas, the trees, the monocotyledones and accidentally of the ferns. The parts preferred of these plants are the leaves, consistent the roots, the stems, the fruits and incidentally the peels.

Such works whose results are henceforth accessible can continue around other parks so that to term the authorities concerned can put in place at a time on the one hand coherent programs to fight against the Elephants who ravage the fields of the populations and on the other hand to protect the Elephants who are killed by the populations while putting some mines around their fields. It is for example about cultivating to the periphery of the fields of the species of trees whose Elephants are sausage rolls and that will have the advantage to slow down their impetus to penetrate in the fields of the villagers.

ACKNOWLEDGEMENTS

The authors thank the persons responsible of the Park National Ogooué Lékéti and the whole personal for the technical help that they brought to them.

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