International Journal of Environment, Agriculture and Biotechnology
Vol-9, Issue-1; Jan-Feb, 2024
Peer-Reviewed International Journal
Journal Home Page Available: https://ijeab.com/
Journal DOI: 10.22161/ijeab

Wildlife migration corridors from the Community Forest of Nafadji to the Boucle du Baoulé Biosphere Reserve

Les corridors de migration de la faune sauvage de la forêt communautaire de Nafadji à la réserve de biosphère de la boucle du Baoulé

Hady Diallo[1*], Coulibaly Ousmane[2], Yacouba Maiga[2], Aly Poudiougo[1]

[1*] Biology Department of the University Pedagogy Institute (Ex ISFRA), Bamako.
[2] Applied Ecology Department of the Technical and Technological Sciences Faculty, Bamako.
* Corresponding author: Hady Diallo, email: hadys01@yahoo.fr , tel. 69266560/76184877

Received: 07 Dec 2023; Received in revised form: 10 Jan 2024; Accepted: 16 Jan 2024; Available online: 25 Jan 2024

Abstract— *Mali still has natural relics rich in fauna such as that of the Nafadji forest. The study aims to analyze the link between wildlife species and their habitat and to identify the migration corridors they follow. Kings' method was used to inventory the wildlife. The layout of the corridors was carried out both by visual observation of the wildlife and their signs of presence. A survey was carried out among the populations and the technical services to understand the movements of the fauna and the difficulties of management. A total of 366 individuals divided between 14 species, 10 families and 5 orders have been identified. The indirect gradient analysis applied to the matrix of 224 observations x 14 faunal species to understand the relationship between species and their habitats discriminated 4 groups: G1 consisting of Mellivora capenssis, Hystrix cristata, Papio anubis, Orycteropus afer, Tragélaphus scriptus, G2 including Erythrocebus patas, Redunca redunca, Sylvicapra grimmia, Phacochoerus aethiopicus, G3 represented Canis adustus, Gazella dorcas, Hippotragus equinus and G4 with Hyena hyena, Viverra civetta, Papio anubis. The analysis reveals that habitat and food factors condition the distribution of wildlife and their migration along the corridors. Controlling these factors is therefore essential for the effective management of wildlife and their habitat. The involvement of the Nafadji alone is not enough to ensure the protection of wildlife, but it will require close collaboration with the communities and all stakeholders in the forest and along the corridors.*

Keywords— ***wildlife, diversity, Species group, habitat, Nafadji forest.***

Résumé— *Le Mali dispose encore de reliques naturelles riches en faune comme celle de la forêt de Nafadji. L'étude se propose d'analyser le lien entre les espèces de faune et leur habitat et d'identifier les corridors de migration qu'elles suivent. La méthode de Kings a été utilisée pour inventorier la faune. Le tracé des corridors a été réalisé à la fois par l'observation visuelle de la faune et de leurs indices de présence. Une enquête a été menée auprès des populations et des services techniques pour comprendre les mouvements de la faune et les difficultés de gestion. Au total, 366 individus repartis entre 14 espèces, 10 familles et 5 ordres ont été recensés. L'analyse indirecte de gradient appliquée sur la matrice 224 observations x 14 espèces fauniques pour comprendre la relation entre les espèces et leurs habitats a*

discriminé 4 groupes : G1 constitué par Mellivora capenssis, Hystrix cristata, Papio anubis, Orycteropus afer, Tragélaphus scriptus, G2 comprenant Erythrocebus patas, Redunca redunca, Sylvicapra grimmia, Phacochoerus aethiopicus, G3 representé Canis adustus, Gazella dorcas, Hippotragus equinus et G4 avec Hyena hyena, Viverra civetta, Papio anubis. L'analyse révèle que les facteurs habitats et nourriture conditionnent la distribution de la faune et leur migration. Le contrôle de ces facteurs est donc primordial pour la gestion efficace de la faune et de son habitat. L'implication seule de la population de Nafadji ne suffit pas pour protéger cette faune, mais, il faudra une étroite collaboration de tous les intervenants dans la forêt et le long des corridors.

Mots clés— Faune, diversité, groupes d'espèces, habitat, forêt de Nafadji.

I. INTRODUCTION

Mali once had a rich and varied faunal diversity made up of: 136 species of mammals, 647 birds, 106 reptiles including one endemic, 30 amphibians/amphibians with 2 endemics, and 160 fish with 24 endemics and insects/invertebrates including 6 Sphinx Butterflies. The IUCN (1989) listed 70 species of terrestrial mammals. To protect this diversity, it has focused its policy on the creation and implementation of protected areas, currently 26 in number, totaling an area of 9 172 757 ha, or 8% of the territory (MEA, 2012) compared to 12% required by IUCN (2008).

These areas, despite their protection regime, are not immune, like other forest areas, to the combined effect of man and climate (DIALLO et al., 2011). Many studies in Mali carried out in these natural areas have shown that natural resources (flora, terrestrial and aquatic fauna) have declined in Mali, in particular due to poaching and the long drought of the 1970s and 1980s.

Indeed, the assessment to establish the situation of wild livestock by the DNEF (1986), IUCN (1989) reveals that after eight years of hunting closure, large game is still struggling to develop only birds and smaller mammals have seen their numbers increase slightly. Also, the results of research and inventories in Mali on the degradation factors of wildlife and its habitat carried out within the framework of RURGS (1982), AGRER SA (1993); Albignae (1995) highlighted the regression or even the disappearance of a large number of wild animals and the vulnerability of certain large spectacular mammals such as the Elephant, the Derby Elk, the Buffalo, the Giraffe, the Chimpanzee. On the other hand, primates and sedentary birds showed growth. This situation of regression of fauna has been confirmed by studies carried out by the IUCN (2008) and which continues to grow with the extension of crops, transhumant livestock and illegal logging. (IUCN, 2009) ; AID SA (2010); OPNBB (2012); ERSAP (2014). These studies have attributed declines in animal population densities, high mortality rates caused by overexploitation by Malian and Moorish poachers in Mauritania, fragmentation and destruction of natural wildlife habitats for crop cultivation and obstruction of their migration corridor. The resulting ecological changes have always engendered ecological changes in the distribution and habits of wild animal species, the disruption of their reproductive capacities. To ensure their survival, certain species of fauna, especially mammals such as herbivores, move in groups and most often with their predator from one environment with difficult conditions (lack of food and water) to another in search of suitable conditions (better (plenty of food and water). Others migrate passing from one home range to another along the natural movement corridors commonly called corridors (Buard, 2013), then make the reverse path depending on the seasons which condition the availability and/or the insufficient fodder (Spaccapietra *et al*., 2008) at the same rate as transhumant herding (PRODESO, 1997).

Today, it must be recognized that the progressive obstruction of these mobility corridors has a negative impact on wildlife potential. This potential is seriously reduced and some species are on the verge of extinction, and the current method of managing forest resources does little to promote the conservation and enhancement of wildlife resources that are hard hit in their diversity (IUCN, 2009 ; OPNBB, 2012).

However, despite the various threats, Mali still has some natural areas rich in wildlife that can still be saved. These are difficult-to-access relics of classified forests and protected areas located in the south-west of the territory and which are of particular importance from a national and global point of view (DNEF, 2014). These isolated and difficult to access areas such as the Nafadji forest still contain most of the diversity of mammals (DNEF, 2014).

This study is part of the perspective of deepening knowledge of the wildlife resources of the Nafadji ecosystem and their pendular migration corridors followed to ensure their survival. This specifically involves: (1) analyzing the link between the fauna species recorded and their habitat, (2) identifying the seasonal migration corridors used by the fauna species.

II. MATERIALS AND METHOD

1.1. Environment Study

Located in the Senegal River basin between the Sahelian zone in the North and the Sudanian zone in the South, the Nafadji forest bearing the name of the village of Nafadji (Figure 1) is located in the rural commune of Séfeto ouest, Kita cercle, region of Kayes covering an area of approximately 10,000 ha. According to the PIRT studies (1982), Nafadji is located in the agro-ecological zone of upper Kaarta, the mountain range in particular: the Sangarou, the Kouroufing and the extension of the Galla Kourou. Distant about 360 km northwest of the capital Bamako, it is limited between latitude 13.54° to 14.24° North and longitude 9.97° to 10.17° West. The mountains also form the administrative boundary between the Diallan rural commune (Bafoulabé circle) to the north and Séfeto Ouest (Kita circle) to the south.

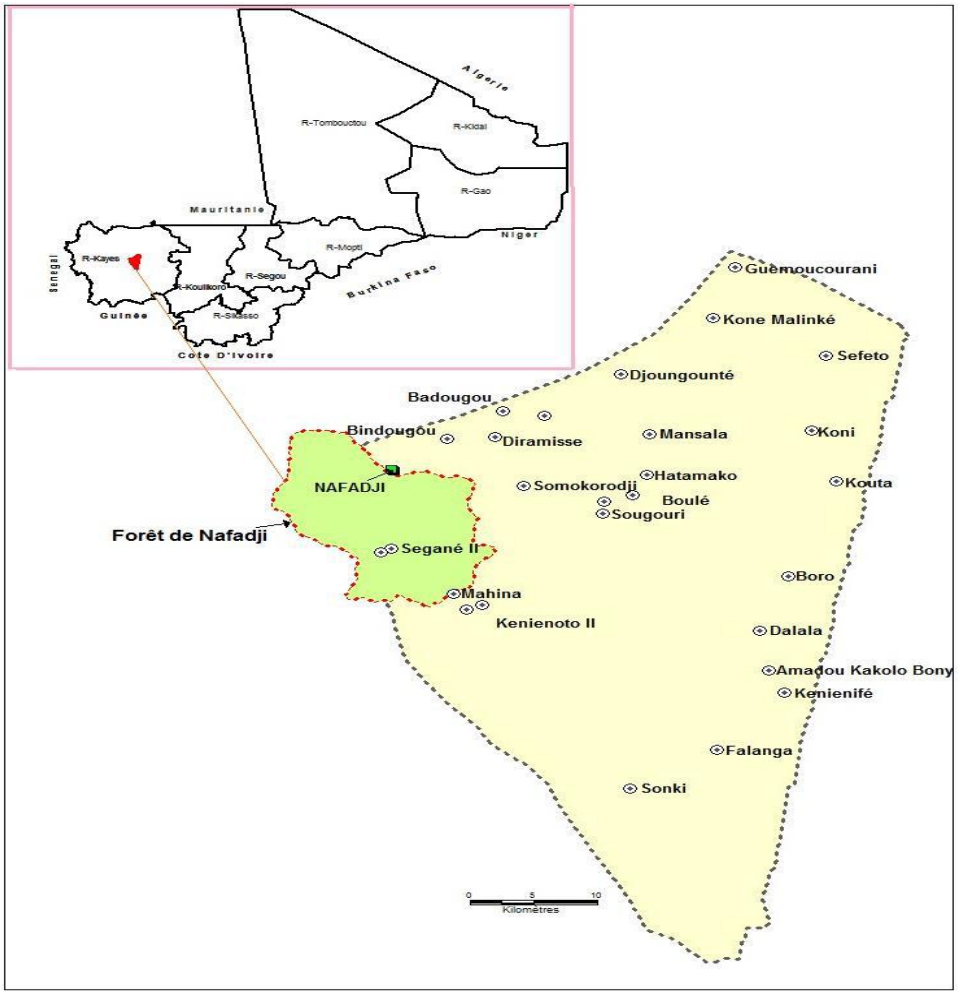

Fig.1. Geographic location of area study.

The villages and hamlets bordering the study area are: Nafadji, Seramissé (commune of Sefeto Ouest), Samine and Sobé (Commune of Diallan). The climate is of the northern Sudanese type with alternating dry and rainy seasons with a general downward trend. The rainy season begins in the area from the month of May to reach its peak in August where the heights of rain can be greater than or equal to 250 mm. This period of heavy rain corresponds to the high humidity period and mild temperature (25°C). The hot weather rages during the dry season between March and May and gradually fades from June. It is also during this period that evapotranspiration is high and would correspond to a sunshine duration of around 2969 hours (SLA Kita, 2010).

The relief is rugged, made up of a set of plateaus with an altitude of 200 to 500 m dotted with residual reliefs such as the "Kita Kourou" which culminates at 500 m from the central plain and serving as refuges for wildlife. It is flat on the south side and very uneven towards the north and west part of the forest and the soil is of type Tc4 (Armoured Earth) whose soils are characterized by a moderate depth before reaching the armor according to PIRT (1982) which corresponds to armored terrain whose soils are characterized by a moderate depth before

reaching the armor. The Nafadji forest is entirely located on this type of soil. The surface texture is loamy, often sandy with fine silt. Below the surface, it becomes clay silty with the presence of gravels. The structure is weak and subangular blocky or granular. The soil is friable when moist throughout the profile. The pH ranges from moderately to strongly acidic at depth.

The hydrographic network is marked by small streams that originate at the top of the hills of Kouroufing, Sagarou, Galla kourou and Naliokourou. The most important is the Kouaga river with its tributaries which flow into the Bagoue at the level of Badoumbé.

The forest contains at least six (6) permanent water points Malandji, Gnonketo, Dialanikorodji, N'Gagnadji, Kitora, Wontimé which are very important for wildlife and livestock resources in the area. The area also contains large streams that dry up as soon as the rains end. However, it is influenced by the course of the Bakoye River which constitutes the natural limit to the north.

The population of the study area is 4,084 inhabitants for the two major villages in the area, including 3,000 inhabitants for the village of Nafadji and 1,084 inhabitants for that of Siramissé with a number of women (50.4%) slightly higher than that of men (49.6%). In addition to this permanent workforce, the village of Nafadji includes five cultivation hamlets (Kéniénoto I and II, Mahina, Segané I and II) which are only inhabited during the rainy season to set up crop fields there.

Agriculture is the main activity of the people. It is extensive with basic equipment and revolves around cereal crops (sorghum, maize, pearl millet, cowpea, lowland rice) mainly intended for local consumption and cash crops (peanuts and cotton) and production. market gardening (onion, shallot, sweet potato, papaya, okra, carrots, pepper, tomato, cucumber, and cabbage) which contribute significantly to the local and regional economy.

Livestock is developing gradually (1,371 cattle, 1,375 sheep/goats, 256 donkeys and 12 horses) and constitutes a more or less secure means of saving, especially for women.

1.2. Methods

Satellite images and national topographic maps were used to identify the topography of the study area, the link with the Baoulé loop reserve. The survey sheets (interview guides) and wildlife inventories were used to report the information collected. Two tapes of 50 m and 100 m were used to measure the viewing distance of wildlife. A SUUNTO brand compass was used to measure the angles of view of the animals and two (2) binoculars for distant visions, a high resolution Nikon digital camera was used for shooting to illustrate the thesis. The global positioning system (GPS) was used for the georeferencing of the forest and all phases of wildlife inventories.

Photo n°1: Some materials used for the works

1.2.1. Collection of data

- Socio-economic surveys

The so-called “participatory mapping” method (Clouet, 2000), which consists of using the knowledge of local actors to map their land, was applied. With the help of the populations of Nafadji, a sketch on paper of the various land use zones that they recognize on their land is made. These areas, as well as the limits of the land following the natural limits (watercourses, hills), were then surveyed using a Garmin 90 GPS, circumscribed on the spot with the collaboration of the villagers.

Beforehand, a documentary search was made to summarize the work and studies carried out in the Baoulé reserve (Block of Badinko), the Social and Economic Development Programs of the circle of Kita and other documents (annual reports of the Water Cantonment and Kita Forests) served to deepen knowledge of the environment and especially of the wildlife resources of the study area. Individual interviews and group meetings based on an interview guide developed for this purpose are organized with institutional actors, associative structures and resource persons. The approach taken is much more semi-structured leaving a large part to the discussion and exchanges with the interlocutors. The purpose of these meetings was to discuss in order to identify the different wildlife species in the current environment, endangered species, potential habitats, natural water points on the site, identification of migration corridors, human pressure on wildlife resources, wildlife conservation methods at the local level, etc. The villages and hamlets bordering the Nafadji forest were covered by the interviews.

- Wildlife inventory work

The nature of the environment and the means available were the determining criteria in the choice of the inventory method. After reading the Topo funds to 200 thousandths (Sandaré ND_29 XIV and Bafoulabé ND_29 VIII) and prospective field visits, the transect sampling method (King, 1930) was used (figure 2). It consists of counting on foot to cover a restricted area in order to provide clues to the presence of animals (Norton-Griffiths, 1978]; Bouché, 2001). In the field, the chosen route is traveled by counting the fauna by visual or auditory contact on either side of the line of progression. The length of the transect, defined beforehand on a map with the coordinates of the entry and exit points varies from 8 to 11 km, and in an East-West direction and separated from each other by 2 to 5 km to minimize the risk of double counting. The census in the transects was done early in the morning and in good weather when the animals showed up more vigorously.

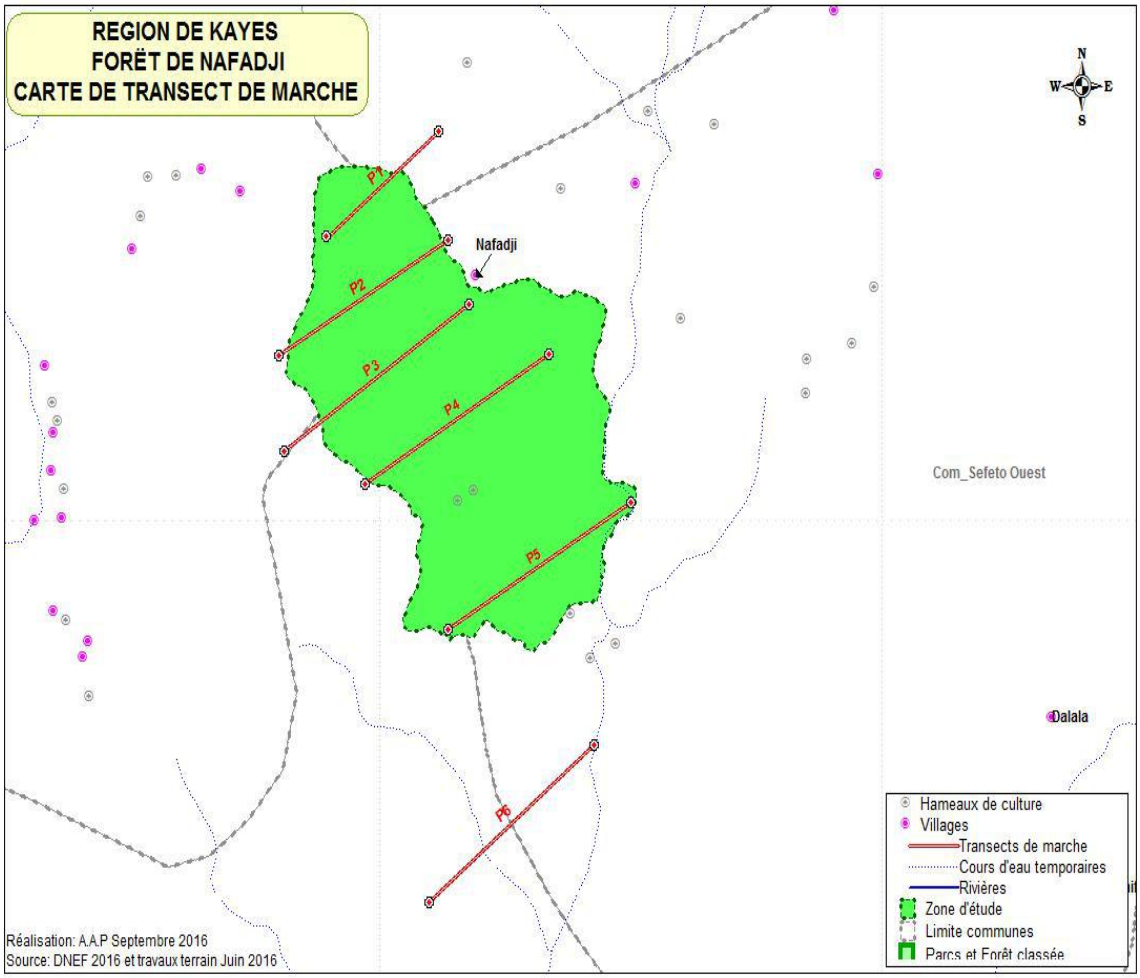

Fig.2. Wildlife transect map of Nafadji Forest.

- Determination of global wildlife diversity

Wildlife diversity was established by counting all the species encountered their traces (droppings, prints, carcasses, etc.). The document "Guide to Mammals-Reptiles and Birds by Clark and Niagaté (2004) was used to identify the mammals and determine, with the support of the hunting guide, the sex of the species either by the difference in size, or by peeling, etc.

- Determination of the relationship between wildlife species and their habitat

It was made using principal component analysis (PCA), which is an indirect gradient analysis method that applies to quantitative or semi-quantitative variables (Fallissard, 1998 in Diallo, 2014) in order to look for the existing correlations between them.

In our case, it is the correlation between wildlife species and their preferred habitat. For this purpose, we used a matrix of 6 transects (224 observations) x 14 faunal species. The "flexible beta" or soft aggregation method was combined with Sorensen's relative similarity distance (McCune & Grace, 2002) to assess distance differences between count transects and group identification of

wildlife species. The choice of the "flexible beta" method is justified by the fact that it allows a better understanding of the ecological processes involved in the distribution of fauna species.

- Determination of wildlife migration corridors

The determination of the wildlife migration corridors was made by reconciling the technical-scientific knowledge with the local traditional knowledge of the hunters and a forest guide. Thanks to the accompaniment of the latter and a hunter from Nafadji, some passages frequented by various species and groups of species of wildlife reported by hunters were followed. It is therefore about the passages of the places of stay and the places frequented to stop and to move. The layout of the routes taken, qualified as passage corridors by Bonnin (2008) , was carried out both by direct visual observation of fauna species and indirect visual observation of these through their presence indices (borrowed, faeces among others) along the routes followed or frequented.

- Data processing and analysis

The counting, processing and analysis of the data collected were carried out using Word and Excel programs used respectively for data entry and processing.

The PcOrd software was used to establish the link between the species and their habitat and that of MapInfo 10.5 was used to produce the maps and also to generate the boundary coordinates of the study area.

III. RESULTS

3.1. Wildlife diversity

It was counted in the forest of Nafadji (Table 1), a total number of 366 individuals divided between 5 orders, 10 families, 14 species. This number of species is low. For all the species observed, *Papio anubis* (25.37%) and *Erythrocebus patas* (17.91%) are the most abundant. These two species are followed in terms of abundance by the species: *Phacochoerus aethiopicus*, *Canis adustus*, *Sylvicapra grimmia* and *Gazella dorcas*. In terms of frequency, *Erythrocebus patas* and *Canis adustus* are the most frequent at 15% and 12% respectively. The weakly observed species are among others *Redunca redunca*, *Tragelaphus scriptus* and *Viverra civetta*.

Table 1. Inventory of Individuals species identified.

Order	Family	Species	effective	%
Primates	Cercopithecidae	*Papio anubis*	66	17.91
Artiodactyle	Bovidae (Cephalophinae)	*Sylvicapra grimmia*	22	5.97
Carnivores	Canidae	*Canis adustus*	27	7.46
Carnivores	Viverridae	*Viverra civetta*	5	1.49
Artiodactyles	Bovidae (Gazelophinae)	*Gazella dorcas*	22	5.97
Artiodactyles	Bovidae (Tragelaphinae)	*Tragélaphus scriptus*	5	1.49
Carnivores	Hyenidae	*Hyena hyena*	16	4.48
Artiodactyles	Bovidae (Hippotrague)	*Hippotragus equinus*	11	2.99
Tubilidentes	Oryctéropidae	*Orycteropus afer*	16	4.48
Artiodactyles	Suidae	*Phacochoerus aethiopicus*	44	11.94
Rongeurs	Hystricidae	*Hystrix cristata*	16	4.48
Carnivores	Mustelidae	*Mellivora capenssis*	16	4.48
Primates	Cercopithecidae	*Erythrocebus patas*	93	25.37
Artiodactyles	Bovidae (Reduncinae)	*Redunca redunca*	5	1.49
Total (5)	**(10)**	**(14)**	**366**	**100**

2.2. Relationship between wildlife species and their environment or habitat

Principal component analysis (PCA), an indirect gradient analysis on the matrix of 6 transects (224 observations) x 14 faunal species gives a discrimination of 4 distinct groups. The eigenvalues and corresponding variance percentages are summarized in Table 4. According to this table, the first 4 axes explain 94.17% of the total variance and highlight the dispersion of information on the factorial

axes. Axes 1 and 2 represent more than 61.77% of this variance.

Table 4: Values of the variance of the faunal composition explained by the 3 axes or principal components of the matrix of 6 transects (224 observations) x 14 species.

ACP Axes	Inertia value	% variance explained	% cumulative explained variance	own value
1	4,885	34,890	34,890	3,252
2	3,764	26,888	61,778	2,252
3	2,770	19,782	81,560	1,752
4	17,66	12,616	94,176	1,418

The ecological interpretation of the axes from the observations made on the 6 transects (figure 3) are on the whole correlated with the positive axis 1 and the positive axis 2 with a marked tendency of the groups. This figure shows the breakdown of four (4) groups within individualized wildlife species.

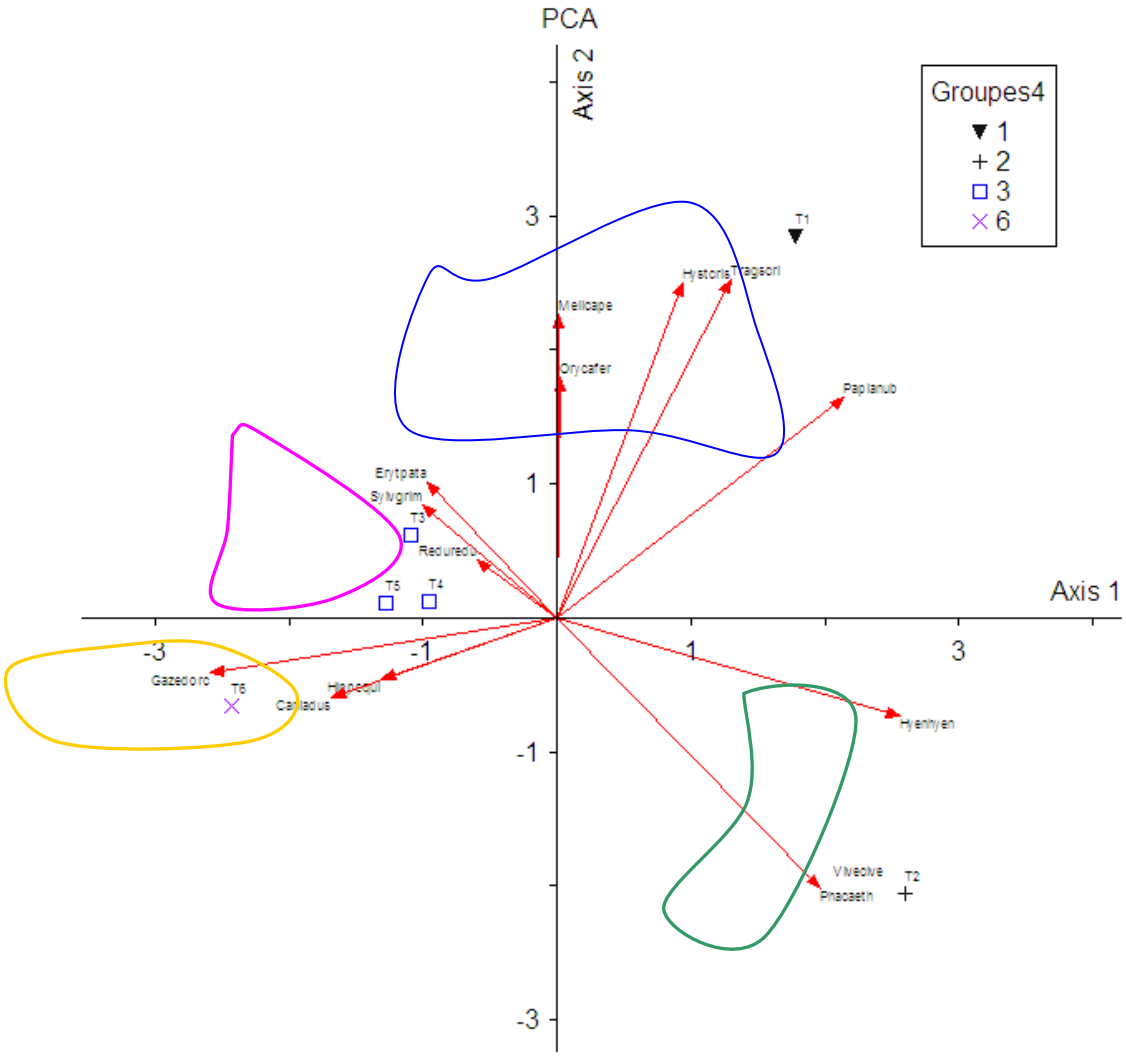

Fig.3: Factorial plane of the principal component analysis (PCA) of the groups of 224 observations along the 6 transects x 14 species. The sites are represented by small circles and the species by vectors, the score of the species corresponds to that of the small circle indicated by the end of the vector.

The first G1 group made up of the *Mellivora capensis*, *Hystrix cristata*, *Papio anubis*, *Orycteropus afer*, *Tragelaphus scriptus* subservient to transect 1 is practically correlated with the positive axis 1 corresponding to the middle of hills or plateaus with very steep valleys and escarpments (510 m altitude according to the GPS readings on the top of the Sagourou hill). The G2 group is represented by the species *Erythrocebus patas*, *Redunca redunca*, *Sylvicapra grimmia*, P*hacochoerus aethiopicus* recorded on transects T3, T5 correlated to the positive axis 2 corresponding to the valley, to the temporary flood zones. The G3 group with species such as *Canis adustus*, *Gazella dorcas*, *Hippotragus equinus* which are distributed between transects T4 and T6 corresponding to the vast plains with savannah formations correlated to the negative axis 1 and the G4 group with species such as *Hyena hyena*, *Viverra civetta*, *Papio anubis* also corresponding to the vast plains with savanna formations correlated to the negative 2 axis.

Four habitats (Table 5) including G1 (in the plateaus), G2 (the valleys), G3 (intermediate zone) and G4 (the grassy plains) are discriminated.

Each group represents the distribution of a set of faunal species with similar affinities for habitat, as well as indices of abundance, specificity and interdependencies between species for each type of habitat. For example, the species *Canis adustis* is characteristic of G1 and *Redunca redunca* for G2. On the other hand, certain species such as *Erythrocebus patas*, although having a specific preference for one environment, can adapt to others, as evidenced by their presence in three of the four ecological environments. The results of this analysis show that each species is characteristic of a habitat to which it is dependent and which determines its survival (food, shelter, etc.).

Table 5: Distribution of species by group with similar habitat affinities.

Espèces	**G1**	**G2**	**G3**	**G4**
Canis adustus	-	+	-	-
Erythrocebus patas	+	+	+	-
Gazella dorcas	-	+	-	-
Hippotragus equinus	-	+	-	-
Hyena hyena	+	-	+	+
Hystrix cristata	+	+	-	-
Mellivora capensis	+	+	-	-
Orycteropus afer	+	+	-	-
Papio anubis	+	-	+	+
Phacochoerus aethiopicus	-	-	+	-
Redunca redunca	-	+	-	-
Sylvicapra grimmia	+	+	-	-
Tragélaphus scriptus	+	-	-	+
Viverra civetta	-	+	+	+
Total species	**8**	**10**	**5**	**4**

(+) = presence; (-) = absence.

2.4. Identification of seasonal migration corridors of wildlife large and medium-sized.

The study area from Nafadji, including that from the said forest to the river, constitutes a migration corridor for large fauna. If no status exists for this area, it receives various wildlife species from the Badinko block reserve, in the Baoulé and Fina blocks and sometimes in the Kongosambou classified forest between January and February (which is the period decline of the Badinko River) and the return at the beginning of the rains (May-June) in search of more favorable environmental conditions and tranquility according to the managers of the Baoulé reserve. This corridor (Figure 4) over 60 km long is rich in terms of grazing for wildlife, water resources (tributaries of the Badinko River) and less occupied today

by agro-pastoralists. Only the village of Sonki was listed on the axis during the inventory work.

The types of plant formations are composed of galleries along the courses, sandstone plateaus with shrubby savannahs, vast floodplains and wooded to shrubby savannahs including *Combretum glutinosum*, *Combretum nigricans*, *Combretum velutinum* to which must be added *Pterocarpus erinaceus*, *Pterocarpus lucens*, *Strignos spinosa*, *Crossopteryx febrifuga*, *Hexalobus monopetalus*, *Terminalia avicennioides*, *Terminalia macroptera*, *Lannea acida*, *Lannea velutina*, *Pteleopsis suberosa*, *Detarium microcarpum*, *Grevia sp.*, etc.

The wooded savannahs of the area are the domain of tall grasses with a continuous herbaceous cover and exceeding 2 meters in height, in particular composed of *Antropogon pseudapricus*, *Andropogon gayanus*, *Cymbopogon gigantus*, *Pennicetum pedicelatum*. These plant formations are well appreciated by wildlife for their food and tranquility.

IV. DISCUSSION

- Diversity

The results of the wildlife inventory in the Nafadji forest made it possible to count 366 individuals divided between 14 species, 10 families and 5 orders. The number of species is very low compared to that of the 70 species of terrestrial mammals listed by the IUCN (1989) in Mali, which once had a capital of extraordinary faunal species (Afrique Nature Internationale, 2009) declining and most of which only survive today in small groups considered endangered (IUCN/BRAO, 2008 ; Nomoko, 2008). As in Mali, in many African countries wildlife has declined due to harsh living conditions marked by overexploitation and habitat destruction (Ntiamoa-Baidu, 1998 ; Craigie *et al.*, 2010 ; Ogutu *et al.*, 2011). However, with the isolation of the Nafadji forest and the favorable conditions of its current habitat, a biological rise is perceptible in terms of species and individuals according to the populations who have become aware of the need to protect wildlife.

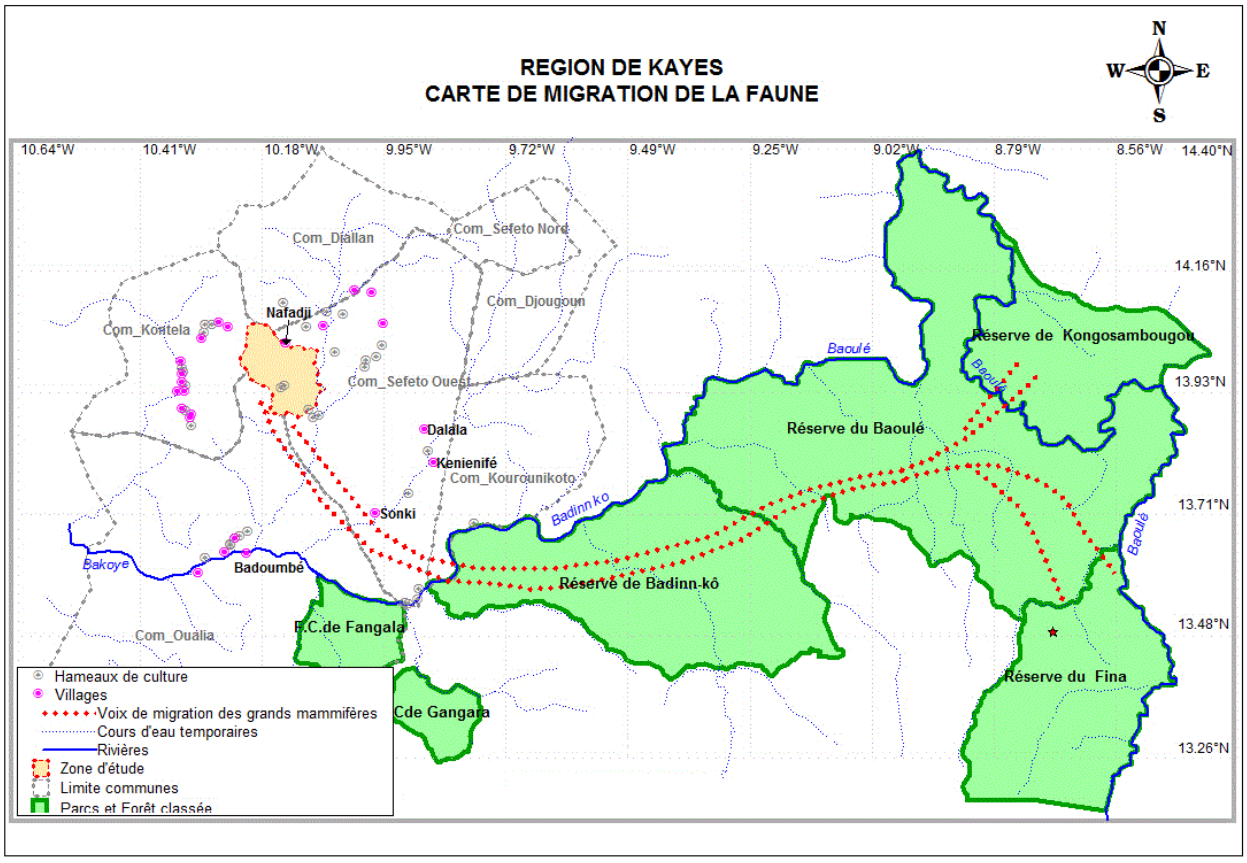

Fig.4: migration map of medium and large wildlife.

- Link between wildlife and its habitat

In the Nafadji forest, wildlife has a close relationship with its habitat. The analysis of the distribution of faunal species reveals that the maximum number of species is located on the topographic units of valleys rich in water resources and under vegetation in dense thickets and gallery forests. Bélem (2008)] and Sgard (2010)

emphasized the close link between species and suitable habitat conditions. The 4 groups of species G1, G2, G3 and G4 identified according to their topographical position respectively on the plateaus, the valleys, in the intermediate zone and on the grassy plains of the Nafadji forest indicate that each species is subservient to a group according to of this positioning which conditions either its survival for a preference in food (food, water), in shelter for more security or peace of mind. In the same space, species can be linked by a relationship of prey-predator interdependence, as is the case in the groups of species G1 of the prey *Tragelaphus scriptus* a bovidae and its predator *Hyena hyena* and G2 with prey species *Hippotragus equinus*, *Sylvicarpas grimmia*, and their prey *Canis adustus*, *Mellivora capensis*, *Viverra civetta*. Other species and groups of species find themselves in competition on the same space to exploit the same resources (competitive relationship for the resource) between herbivores on the different grazing areas, particularly in grassy plains and valleys. The same observations were made by Czudek (2001) and Bélem (2008). The latter emphasizes that the relationship of interdependence between prey and predators makes it possible to regulate the populations of species in the same space and promote the maintenance of the biological balance.

- Identification of seasonal migration corridors of wildlife large and medium-sized.

Movements of species in the Nafadji forest along the two identified corridors which all lead into the Baoulé loop biosphere reserve. The frequentation of this reserve by species is motivated by an interest such as the natural conditions (natural habitat) favorable for the needs of a large area, tranquility (along natural obstacles that are often inaccessible) and above all a wealth of food that can allow each individual to meet basic needs on a daily basis. These movements illustrate not only the needs to be satisfied in terms of area and richness of species habitats, the presence of congeners (Bonnin, 2008) but also reflect the preferences and capacities of these species to avoid being in competition for the resource (water, fodder, etc.), to be protected from their predator and thus ensure their survival (Geerling *et al*., 1988). Many authors (Bonnin 2008 ; IUCN, 2009 ; Buard, 2013) stipulate that the living environment of wild animals does not offer unlimited resources, especially when this number is increasing, those to avoid being in competition on the same space for the resources or the same places migrate towards the spaces with ecological conditions favorable to their development. However, it is clear that the wildlife suffers from the presence of transhumant livestock that has increased more and more in recent decades and herders who are both poachers on the corridors and in the Baoulé reserve. This presence constitutes a handicap to the seasonal movements of wild animals (especially ungulates) and to their development, even though they are less dependent on running water, and can exploit the rangelands better than domestic herds (Hibert *et al*., 2010). In addition, to minimize spatial interference and competition for resources with livestock, some wild animals take refuge on inaccessible natural obstacles, others on the other hand would adopt nocturnal behaviors. These same observations were made by Binot *et al*. (2006); IUCN (2009); Hibert *et al*. (2010) who point out that the presence of livestock can now hinder the recovery of wildlife through spatial interference or competition over resources.

V. CONCLUSION ET IMPLICATION POUR LA CONSERVATION

The study contributes to the knowledge of the fauna and its habitat in the Nafadji forest and along the corridors. The study showed that faunal diversity is very low. Species have been classified into four groups in relation to natural habitats. Spatially, the ecosystems of the valleys (in the center) contain more faunal species than those of the plateaus to the north and the grassy savannahs to the south. From a methodological point of view, the device used for the inventory (transects) offers more visibility of large fauna in fairly open natural formations. However, the nature of the terrain (escarpment) and the rainy season for the second phase (September) constitute limits in the estimation of individuals in the middle. Also, the inventory period was considered not conducive to identify all the species. The ideal period for the inventory would be the period (October-December) or (May-June) which would correspond respectively to the departure and return of the large fauna from the Badinko reserve to the Guinean part in transit in the Nafadji forest. Corridors frequented by wildlife have not been extensively tracked. Only the resting places and certain places in the corridors frequented were observed. It would be necessary to continue the monitoring of the fauna on these corridors to better refine the routes in order to protect the fauna in its migration.

The study showed that habitat and food factors play an important role in the distribution of fauna. The management of this factor, which will have to be explored further for the rest of the study, would therefore be essential in the management of wildlife.

Finally, the Nafadji forest has a strong link with the Baoulé National Park and its adjacent reserves with a strong commitment from the local population for its protection. However, the sole involvement of this one and that of the neighboring hamlets is not enough for its good

management, it will require close collaboration with the communities, the technical services and other forest stakeholders (transhumant farmers, operators, etc.).

REFERENCES

[1] AGEFORE. 2000. Etude d'Inventaire des Ressources de la Biodiversité de l'Aire Transfrontalière du Bafing – Falemé – 2ème phase Tome I Zone de Gale – Limacole. Rapport final, 68 p

[2] BELEM O. M. (2008). Les galeries forestières de la Réserve de la Biosphère de la Mare aux Hippopotames du Burkina Faso : caractéristiques, dynamique et ethnobotanique ; thèse de doctorat ès Sc. Nat. Université de Ouagadougou. 248 p.

[3] BINOT A., CASTEL V. ET CARON A. (2006). L'interface faune-bétail en Afrique subsaharienne, 17 (1-2) : 349-361.

[4] BOUCHE, P CLARK, G, LUNGREN et BERNARD. H. 2004. Recensement aérien total de la faune dans l'écosystème naturel Po-Nazinga-Sissili (PONASI) Burkina Faso.

[5] BOUCHE, P. 2008. Méthode d'inventaire de la grande faune à l'usage des ZCV, 164 p.

[6] BUARD, E. (2013). Dynamiques des interactions espèces - espace - Mise en relation des pratiques de déplacement des populations d'herbivores et de l'évolution de l'occupation du sol dans le parc de Hwange (Zimbabwe). Thèse de doctorat de Géographie, Université Panthéon-Sorbonne, Paris, France 396 p.

[7] CAMARA M. 2010. Impact de la transhumance des animaux domestiques dans la Réserve de la Boucle du Baoulé ; Rapport final. Opération Parc National de la Boucle du Baoulé (OPNBB) et la Commission UNESCO – Mali. 57 p.

[8] CRAIGIE, I.D. et al. 2010. Large mammal population declines in Africa's protected areas. Biol. Conserv. 143(9): 2221-2228.

[9] CLOUET. 2000 Modélisation des agroécosystèmes et aide à la décision, INRA Editions La Librairie du CIRAD.France p 416

[10] CLARK. B et NIAGATE.B.2004. DNCN-Mali. Guide sur des Mammifères-Reptiles et oiseaux. 209 p ;

[11] CZUDEK R. 2001. Utilisation rationnelle de la faune sauvage en Afrique. *Moyen de la conservation des ressources naturelles et de leur diversité biologique, de l'amélioration de la sécurité alimentaire et du développement rural*. Document de travail sur la gestion de la faune sauvage n°1. FAO. 41 p.

[12] DIALLO H. 2014. Influence des gradients anthropique et géomorphologique sur la variation de la biodiversité végétale dans la réserve de biosphère de la boucle du Baoulé. Cas de la réserve de Fina (Mali). Thèse de doctorat de l'Université Libre de Bruxelles (ULB), 322 p et Annexes.

[13] MEA-DNEF, MWH-SODIPLAN, 2009 Normes Techniques d'inventaire Forestier 40p.

[14] DNEF. 2014. Etude Stratégie Nationale des Aires Protégées au Mali Version révisée : Projet Mondial PNUD/FEM/UNOPS - Gouvernement Mali. Rapport final, Bamako. 55 p.

[15] DNEF. 2011. Etude sur l'Efficacité de Gestion d'un échantillon d'Aires Protégées au Mali : Projet Mondial PNUD/FEM/UNOPS - Gouvernement Mali. Rapport final, Bamako. 60 p.

[16] EGEO SARL. 2013. Etude d'Impact Environnementale et Sociale du Calcaire de Nafadji 47P.

[17] ERSAP. 2014. Plan d'Aménagement et de Gestion du Sanctuaire des Chimpanzés du Bafing 151p.

[18] GEERLING C., KEESLER J.J., OHLER F.J.M., TRAORE N., WIJNGAARDEN.W. Région du Baoulé: Aménagement de l'écosystème. Projet RURGS: Direction Nationale des Eaux et Forêts, Mali, Département de l'aménagement de la Nature de l'Université Agronomique de Wageningen : Pays Bas, 1988, 93 p.

[19] HIBERT, F., CALENGE, C., FRITZ, H., MAILLARD, D., BOUCHET, P., IPAVEC A., CONVERS, A., OMBREDANE, D., & DE VISSHER, M. (2010). Spatial avoidance of invading pastoral cattle by wild ungulates: insights from using Point process statistics. Biodiversity and Conservation, 19: 2003-2004

[20] MCCUNE, B. et GRACE, J.B. 2002. Analysis of Ecological Communities. MjM Sofware, Gleneden Beach, Oregon, 300 p.

[21] MEEA/DNEF. 2014. Cinquième rapport national pour la mise en œuvre de la convention sur la Diversité Biologique. Cellule coordination Convention Biodiversité, Mali. 83 p.

[22] MEEA/DNEF. 2014. Stratégie Nationale et Plan d'Actions pour la diversité biologique, Mali. 2015-2020. Bamako (Mali). 155 p.

[23] NOMOKO, M. (2008). - Sauvegarder et restaurer la faune au Mali – SOS faune du Mali. Association malienne pour la conservation de faune et de l'environnement. Rapport inédit, 29 pp.

[24] NORTON-GRIFFITHS M.1978. Counting animal. 2nd edition. Hndbookn°1African Wildlife Foundation. Nairobi. 130 p.

[25] NTIAMOA-BAIDU, Y. (1998). *La faune sauvage et la sécurité alimentaire en Afrique*. Rome: FAO, 1998 : 109 p.

[26] OGUTU, O.J., OWEN-SMITH.N., PIEPHO P. H. & SAID, M.Y (2011) Continuing wildlife population declines and range contraction in the Mara region of Kenya during 1977–2009. *Journal of Zoology*, 285(2):99 – 109.

[27] PIRT, 1982. Inventaire des sols et de la végétation, ministère chargé du développement Rural. USAID, Tippetts, Abbett, Mc Carthy, stratton Ingénieurs conseils PROJET PNUD/GEF PIMS 3926 Mali. 2014. Plan d'aménagement du Parc National du Korounfing, 162 p.

[28] RGPH. 2009. 4e Recensement général de la population et de l'Habitat du Mali. Répertoire des villages, Tome 0. 318 p

[29] SCHIPPER, J. 2008. The status of the world's land and aquatic mammals: diversity, threat, and knowledge. Science. 322: 225–230.

[30] SLA. 2010. Service Locale de L'Agriculture de Kita (Mali).35 p.

[31] UICN. 2008. Evaluation de l'Efficacité de la Gestion des Aires Protégées : parcs et réserves du Mali. Gland, Suisse et Cambridge, 43 p.

[32] UICN. 2009. Peut-on encore espérer sauver les aires protégées du mali ? Evaluation externe indépendante des modes de gestion actuels et potentiels des aires protégées du Mali. Propositions pour leur évolution. Projet PoWPA/Afrique Nature, Mali.106 p.

[33] YOUNG, BE. 2004. NCBI. État et tendances des déclins et extinctions des amphibiens dans le monde entier. Science. 2004 Dec 3;306(5702):1783-6. Epub 2004 Oct 14.