

**DIVERSITY AND SPATIAL DISTRIBUTION OF NON-HUMAN PRIMATES IN TOGO'S FOREST ZONE AND ECOLOGICAL ZONE II**

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**ABSTRACT**

The diversity and study of the spatial distribution of non-human primate populations is a research priority in Togo because of the ever-increasing anthropogenic threats to their natural habitat. To analyse their diversity and spatial distribution, investigations and pedestrian surveys were carried out in Togo's forest zone and ecological zone II. In the protected areas of the study area, the count was done along poachers' trails due to the lack of developed trails. Information relating to their numbers, geographical coordinates, their activity and the distance of their observation were reported on an inventory sheet.

The data collected was processed using the Ms Excel 2015 spreadsheet and R software version 3.1.3. The free software Qgis 3.10 was used for spatialization of the distribution of all non-human primates counted. The classical method of counting (recce) was associated with the photographic trapping technique (collection of data by camera trap) for the census and estimation of the numbers of non-human primate populations, particularly in the Fazao-Malfakassa National Park (PNFM). A total of nine (09) out of eleven non-human primate species currently present in Togo have been identified and 724 individuals of all species have been counted in the study area.

Beyond the encroachment and encroachment of these protected areas and the associated ecosystems of the forest zone and ecological zone II, many other threats have been regularly observed. Poaching comes first, followed by habitat destruction and disturbance due to human activities such as agriculture, transhumance and logging. The non-human primate community is therefore in real danger of extinction in Togo if appropriate actions are not taken in time to preserve them.

**Keywords:** Non-human Primates, Threats, Conservation, Ecological Zone Ii, Fazao-malfakassa National Park And Missahohe Classified Forest.

**1. INTRODUCTION**

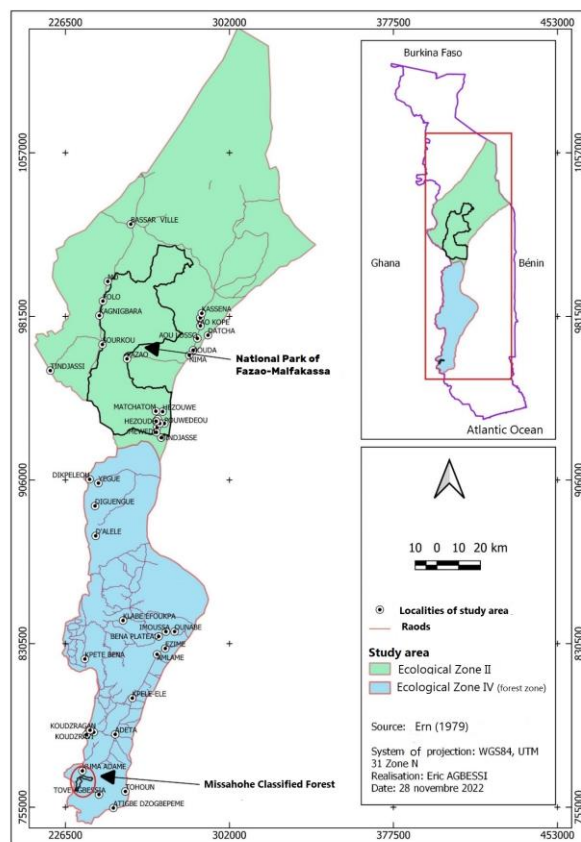
Despite their very important roles in forest cover dynamics, non-human primates in Togo's forest zone and ecological zone II are increasingly threatened by habitat loss as a result of human activities. They also contribute to the maintenance of forest strata through the dispersal of seeds of various plants or forest regeneration (Koné *et al.*, 2008). Beyond their ecological and medical research roles, non-human primates also contribute to the maintenance of ecosystem services and the understanding of human evolution (Weiss and Santos, 2006). They are also a source of income through ecotourism or trade and play an important role in the economy (Macfie and Williamson, 2010). Protected areas and associated ecosystems in the study area where they are frequently encountered are encroached or invaded. Unfortunately, some protected areas are completely invaded despite efforts to conserve them sustainably. Of the eighty-three (83)

networks of protected areas inherited from the colonial administration, very few are today likely to fulfill their ecological and socio-cultural functions. Apart from the first scientific studies dating back to 1893 (Matschie), and others that followed recently (Segniagbeto *and al*, 2017), non-human primates have generally been poorly documented in the study area. Comprehensive data on their current spatial distribution are also lacking. However, for a rational management and proper functioning of forest ecosystems, it is essential to carry out a good diagnosis through the analysis of the spatial distributions of non-human primates that are still encountered today despite the fragmentation of their habitat generated by ever-increasing anthropogenic pressures. The objective of this work is therefore to contribute to the availability of scientific data and to contribute to a better knowledge of the spatial distribution of non-human primate populations in the forest zone and ecological zone II of Togo as well as their numbers and specific richness through an inventory.

**Equipment and methods**

**Study Site**

The study area consists of the forest zone and ecological zone II of Togo (Figure 1). It is home to two important protected areas where inventories of non-human primates have taken place. These are the Fazao-Malfakassa National Park (PNFM) and the Missahohe Classified Forest (FCM) representative of the study area from an ecological point of view.



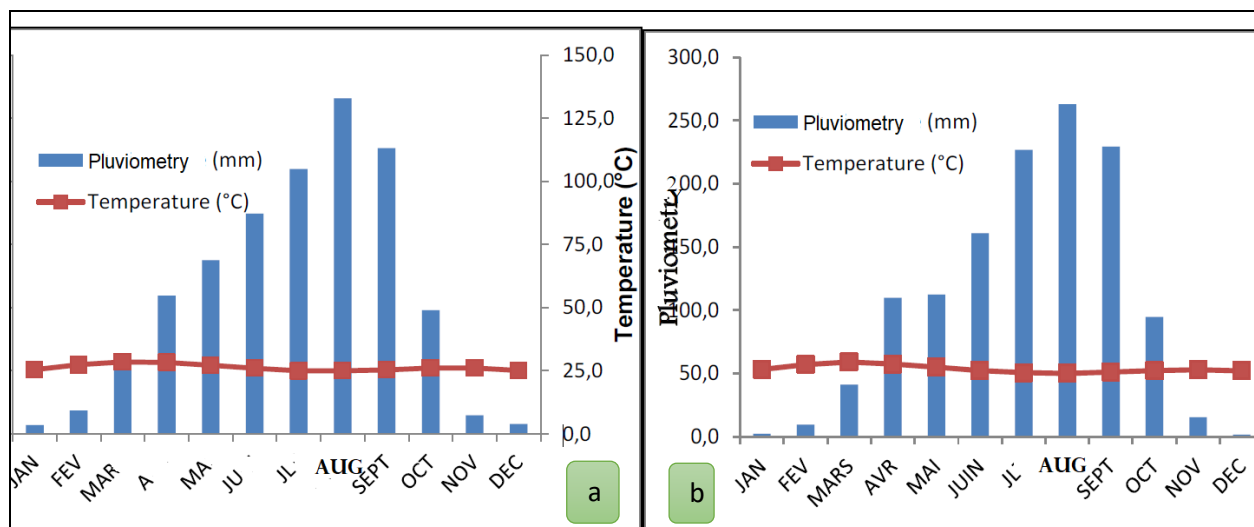
**Figure 1.** Location map of the study area showing the two protected areas

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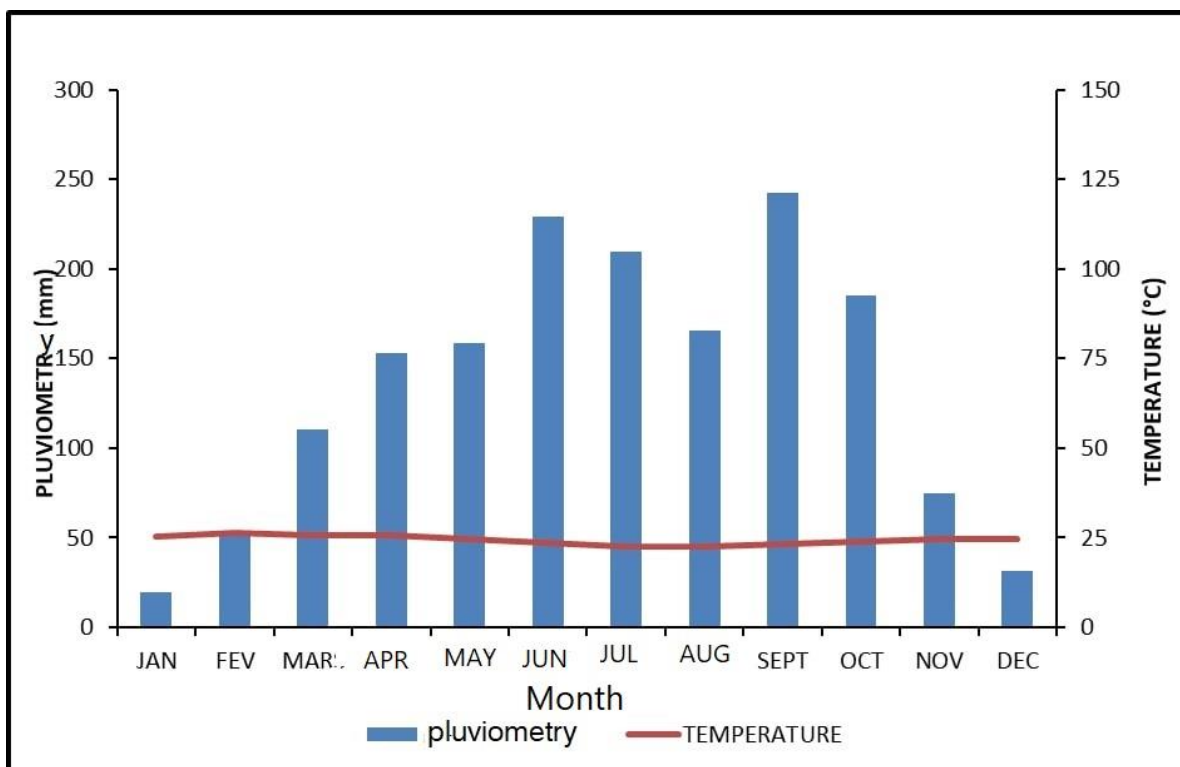
**Presentation of Fazao-Malfakassa National Park (MFPN) and the Missahohe Classified Forest**

With an area of 192,000 ha, Fazao-Malfakassa National Park is located between 8° 30' and 9°18' north latitude, and between 0°35' and 1° 02' east longitude, on the Atacora chain in the central region. It is located in ecological zone II and straddles the central region and the Kara region, some 300 km north of Lomé. The vegetation is characterized by four facies: dense semi-deciduous forests, open forests, wooded savannahs, and degraded savannahs composed of species of the genus *Hymenocardia acida*, *Nauclea latifolia*, *Lophira lanceolata*. The climate is of the "Sudano-Guinean" type, characterized by a dry season (November to March) and a rainy season (late March to late October). During the dry season, the park is under the influence of a dry, semi-cold, semi-hot wind (the Harmattant), while during the rainy season blows a wet ocean wind (the monsoon). The average rainfall reaches 1400 mm/year. The average temperature varies between 25°C and 30°C (Figure 2).

The Classified Forest of Missahohe (FCM) is classified by Order No. 185-53/EF of 17 March 1953 and is located entirely in the forest zone still called the ecological zone IV of Togo (Ern, 1979). It is located 5 km northwest of the city of Kpalimé, on the Kpalimé-Tomégbé road. The Classified Forest of Missahohe is located between 6° 54 and 7° 55 North and 0° 34 and 0° 38 East with an area of about 1487 ha. The climate is subequatorial to a single rainy season, from February to November, interrupted by a decrease in rainfall in August. The months of June, July, September and October are the rainiest. The average annual rainfall is 1750 mm (Figure 3). It is a Guinean mountain climate with a dry season of about 2 months. (MERF, 2010). Many streams are present and are, for the most part, small streams draining ravines (MERF, 2020). The Missahohe Classified Forest is composed of a mosaic of mesophilic or semi-deciduous forests (Akpagana, 1989) and savannahs. It is highly anthropized because of human settlements and both cash and food crops.



**Figure 2.** Umbrothermic curves of Sotouboua (a) and Sokodé (b) from 1981 to 2010. Source: DGMN



**Figure 3.** Umbrothermic curve of the Missahohe area

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**Data and Methodology**

**Technical equipment**

The technical field equipment used is composed of:

- Garmin 64 st GPS for the collection of spatial data relating to the positioning of trap cameras in the protected area and observation points of non-human primates during pedestrian surveys;
- Camera trap to collect data on primates for enumeration.
- interview guide with local populations.
- Non-human primate identification chart based on Jonathan Kingdon's Guide to African Mammals (Kingdon, 1997).
- digital camera for taking images of ecosystems and indices of human activities;
- pair of binoculars for remote observation of non-human primates in the field;
- headtorch for the inventory of nocturnal non-human primates (prosimians) thanks to the fluorescence of their eyes;
- le software, open source, Qgis 3.16.

To achieve the specific objectives of enumeration of non-human primates, appropriate methods were used.

**2. METHODOLOGY**

**Participatory identification of non-human primate species and potential habitats**

In order to identify and appreciate the specific diversities of non-human primates in each locality surveyed, an illustration plate of probable primates of Togo according to the bibliographic review was produced in particular from the field guide of primates of West Africa by Oates (2011). The board was presented to resource persons (forest administration, water and forestry officers, trackers, guides, hunters, farmers, Union of Village Associations for Participatory Management of Protected Areas, members of the committee of Village Associations for Participatory Management of Protected Areas), in order to collect information on the presence or absence of non-human primates in the locality surveyed. During the interviews, information was gathered on their habitats, ethology, frequency, abundance, rarity and possible disappearance from the locality concerned. Ethnozoological aspects were also taken into account during the interviews. Once the species have been identified and listed, as well as their probable sites indicated, they are visited for direct observations and/or the collection of possible signs of presence. This technique has already been used successfully by Nekaris (2004), Campbell and al (2005), Djégou-Djossou and al (2009), Hounghédji *and al* (2012 ), Ségniagbéto *and al* (2015 ) and Agbessi *and al* (2017).

**Inventory of non-human primates in FCM**

The line transect technique (Southwick *and al.*, 1972; Silveira *and al.*, 2003) and the transect point (Campbell *and al.*, 2005) are the most widely used methods for primate enumeration. Other techniques and means are also used to estimate population sizes, including: determining the most likely size based on discussions with local hunters and/or loggers in remote sites; the sampling method to obtain an average density over a large area or by a fairly accurate count based on the assumption that most individuals in the area were known (Kühl, 2009).

The protected areas in the study area are poorly developed and there are no well-developed runways and adequate development plans that are operational and implemented. It was therefore difficult to precisely determine the density by the line transect technique. The renee method

(reconnaissance walk) was therefore used to inventory non-human primate species in the Missahohe Classified Forest. Recce have the advantage of allowing the team to cover more areas in a period of time, while having minimal impact on the environment (Walsh and White, 1999). Efforts are made on areas or sectors likely to support the species previously identified thanks to the results of the interview with riparian populations including resource persons. It was then a direct census based on the count of non-human primates directly observed with the naked eye and, or thanks to binoculars during pedestrian surveys. Three teams of three people (a guide, a hunter and a forestry officer/biologist) for 4 days per sector. Each team has a technical sheet that it must fill in as the observations take place (Agbessi *and al*, 2017). Practicable trails were used in the absence of developed trails. At each observation, the following information is recorded on the count sheet: the time of observation of the primate or group of primates, their number, the type of habitat, the GPS coordinates of the contacts (the position of the observer), the estimation of the distance between the observer and the individual, the activity at the time of the observation. Any evidence (or sign) of animal presence or human activities was also recorded on the card. The inventory of diurnal non-human primates (mainly simians) begins every day at 5:30 a.m. with a walking speed of 0.5 to 1 km/h and ends no later than 5 p.m. All inventory teams begin counting at the same predetermined time to avoid double counting of groups, which travel very little. This method has been successfully used by Agbessi *and al* (2017), Ségniagbéto *and al* (2015) and Houngbédji *and al* (2010). The inventory of nocturnal non-human primates (prosimian) begins at 7 p.m. and ends at about 10 p.m. (potential hours of their activity). The collected data is entered into a spreadsheet (Excel 2013) for the finalization of the processing and the determination of the total size.

Developed in 1958, the kilometric abundance index (IKA) is a method for measuring a relative abundance of species along a range. It is defined as the ratio of the number of individuals observed to the distance travelled. His calculation made it possible to appreciate the relative abundance of each species in the Missahohe Classified Forest. Its formula is as follows:

$$TH = \frac{\text{Number of individuals observed for the species}}{\text{Total distance travelled}}$$

**1.2.2.3 Inventory of non-human primates using camera trap in the MFNP.**

In addition to the recce method used to conduct primate inventories throughout the study area, the photographic trapping method was tested in Fazao-Malfakassa Park to estimate the size of non-human primates over a five-month period (February-June 2019).

Photographic trapping refers to the use of cameras that automatically trigger and take images of everything in front of them thanks to a passive infrared sensor that detects a moving object hotter than ambient temperature, such as animals, people or vehicles etc. The trap camera is most often used to take images of medium to large terrestrial mammals and birds, but has also recently been used for arboreal mammals (Oliveira-Santos *and al*. 2008). The trap camera technique is a non-invasive method that generally causes little disturbance to the target species. Detailed planning is

required before starting field data collection. For most surveys, the equipment required is as follows:

- camera traps and cables to fix them on trees
- a sufficient amount of memory cards and batteries
- a portable GPS device to record the location of camera traps

The great advantage of photographic trapping over other methods used to record medium-sized terrestrial mammals is that the photographs provide objective recordings, or evidence, of the presence and identification of an animal. In addition, camera trapping provides information on the behavior and characteristics of the coat that allows individual identification and thus avoids double counting. Survey effort is usually measured as the number of camera traps multiplied by the number of sampling days. However, despite the relatively large proportion of species that can be recorded, some species may not be detected even after several thousand days of camera traps (Tobler *and al.* 2008a). This has important implications when designing a study because a significant trapping effort does not guarantee the completeness of the study, and failure to detect a species does not mean that it is absent. To maximize trapping success, camera traps were installed along trails or at other locations where evidence of non-human primates was detected. The camera traps were attached to trees about 50 cm to 100 cm above the ground. The shaft is chosen according to the optimal distance between the camera trap and the point along the track in order to obtain representative images.

Each camera trap is uniquely coded for identification purposes. The code is mentioned with a permanent marker on the housing of each camera trap. The images of the non-human primates obtained are organized in a database and analyzed afterwards, with the code of each trap camera, the date and time, and the scientific name of the species that appears in the photograph.

### **3. OUTCOMES AND DISCUSSIONS**

#### **3.1 Current distribution of non-human primates in the study area outside protected areas**

In addition to ethnozoological surveys, pedestrian surveys based on the RECEES technique, and the photographic trapping method were carried out respectively in the Missahohe Classified Forest and in the Fazao-Malfakassa National Park. They made it possible to enumerate the population of non-human primates and spatialize their current distribution in the study area.

In ecosystems outside protected areas, ethnozoological surveys have confirmed the presence of nine (09) species namely: *Chlorocebus tantalus*, *Papio anubis*, *Erythrocebus patas*, *Cercopithecus petaurista petaurista*, *Cercopithecus mona*, *Colobus vellerosus*, *Galago senegalensis*, *Galagoides thomasi*, *Perodicticus potto juju*. A few individuals were observed directly during the investigation. The species *Procolobus verus*, and *Cercopithecus e. erythrogaster* although present in Togo do not belong to ecological zones IV and II (Study Area). Based on interviews, the numbers of each species were estimated and recorded in Table 7. A total of 2438 individuals all species combined were recorded between 2018, 2019 and 2020 across localities such as, Yikpa-Dzigbé, Klabè Ofoukpa-Klabè, Kouma Konda.

**Table 1. Estimating non-human primates at locations**

Locations	Size estimates by species								
	<i>Erythrocebus patas</i>	<i>Chlorocebus tantalus</i>	<i>Papio anubis</i>	<i>Cercopithecus petaurista,</i>	<i>Cercopithecus p. s mona</i>	<i>Colobus vellerosus</i>	<i>Galago senegalensis</i>	<i>Galagoides Thomasi</i>	<i>Perodicticus potto juju</i>
Yikpa-Dzigbé	33	42	15	26	58	27	18	19	12
Klabè									
Ofoukpa	31	15	20	14	50	65	10	30	20
Kouma Konda	22	20	30	20	40	50	16	33	12
Village Fazao	200	15	45	60	70	105	40	20	14
Kabré-Mango	50	30	50	45	45	50	52	30	25
Koui	60	20	45	40	20	30	60	45	12
Elavagnon	12	45	20	15	25	45	50	30	35
Pagala-station	10	30	15	25	30	60	10	20	15
Total	388	217	205	245	323	432	256	227	145

### 2.3 Current distribution of non-human primates in Fazao-Malfakassa National Park (MFNP)

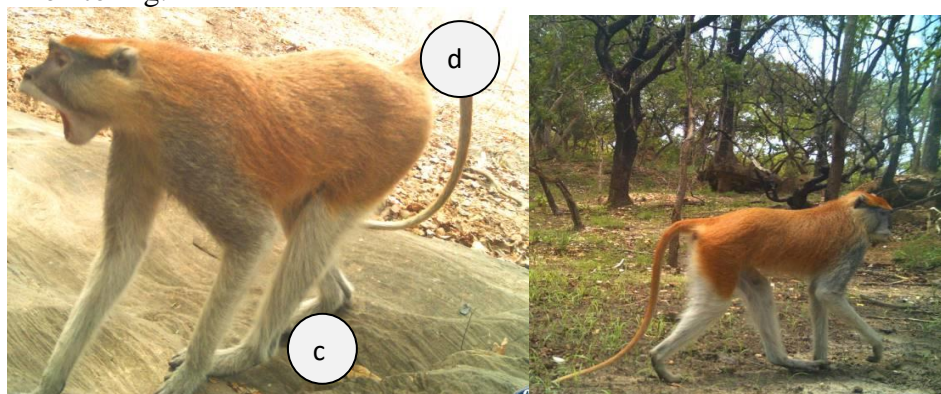
Six (6) localities were identified during participatory surveys with riparian communities including the forest administration and, also thanks to the results of the mapping of the land cover of the area. A total of 724 individuals belonging to three species (*Erythrocebus patas*, *Chlorocebus tantalus* and *Papio anubis*) were counted through forty-four thousand two hundred and three (44,203) images from the eighty-eight (88) camera traps that actually worked well out of the 95 installed for three months. Seven trap cameras were defective and would be stolen or damaged by the trampling of the pachyderms of the protected area during their passage, rendering the memory cards unusable. Analysis of trap camera images showed that only forty-seven (47) of the eighty-eight (88) trap cameras actually collected images of non-human primates in addition to other animals present in the protected area and buffer zones. The rest (the other 41 trap cameras) detected other animals, other than non-human primates. Non-human primates were indeed detected through trap cameras at all sites corresponding to the six riparian localities with the exception of the locality of Elavagnon. The absence of non-human primates in this locality could be explained by the displacement of groups that would exist on the site to other localities or by the repellent effects of human activities. This absence could also be attributed to a strong anthropization reflected in poaching and illegal and abusive logging that would have disturbed their habitat and caused their migration to other relics of habitats. It is a locality with high agricultural activity. Land use change is constantly observed and is of high intensity. The images of the photographic traps collected on the five (5) other localities favorable to the conservation of non-human primates (Bounako, Point de vue, Kouï, Kalare and Cabane) have identified three species of non-human primates namely Patas, baboons and tantalum (photos 2 and 3) that are frequently observed in the protected area (Figure 5).

Other species of non-human primates, although present in the area and frequently observed during pedestrian surveys, were not visualized through the trap cameras. These include *Colobus vellerosus*, *Cercopithecus petaurista petaurista*, *Cercopithecus mona* and *Galago senegalensis* etc. which would probably be distributed outside the areas where camera traps would be installed. For the nocturnal species (*Galago senegalensis*), the arrangement of trap cameras about one meter above the ground (in order to maximize the collection of data from diurnal primates), could not allow it to be recorded since the galagos of Senegal are arboreal species and very rarely descend to the ground.

For conservation and sustainable management, these five localities (Bounako, Point de vue, Kouï, Kalare and Cabane) deserve special attention. Forest monitoring will have to be reinforced with regular monitoring.



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**Photo 2.** The species *Erythrocebus patas* captured by the trap camera (c and d)



**Photo 3.** Trap camera images of *Papio anubis* (c) and *Chlorocebus tantalus* (d)

The site called "Point of View" is characterized by open forests and is located almost in the center of the PFM protected area. The Point de vue site is home to more non-human primate individuals with pata dominance (65% of all non-human primates identified on the site) followed by baboons (33%). Unlike other sites, tantulum rarely frequents the locality called "Point of View" and associates little with other non-human primates at the site. It is the site with the lowest tantulum content with a proportion of 2%. The same dominance of the pata species is also recorded on the Kalare site (82%), followed by baboons (13%). *Chlorocebus tantalus* is the least represented, about 5%. The Kalaré site consists for the most part of a more or less conserved open forest. The same case is also found on the site corresponding to the locality of Bounako where patas represent a little more than 50% of the three species recorded on the said locality. Baboons, meanwhile, occupy a proportion of 33%. *Chlorocebus tantalus* is the least represented with 17%. It is the opposite trends that are observed on the site of Cabane where the dominant species is tantulum. The latter represents 52% of the three species recorded on the said site which is characterized by a mosaic of gallery forest, open forests and wooded savannahs. Patas and baboons account for 28% and 20% respectively. The site corresponding to the locality of Kouï is characterized by dense forests and open forests. Only one non-human primate species was

recorded for three months. These are patas whose group size amounts to twenty (20). Rarely, two species exploit the same site at the same time. The same site is most often operated alternately at specific times by each group of species counted.

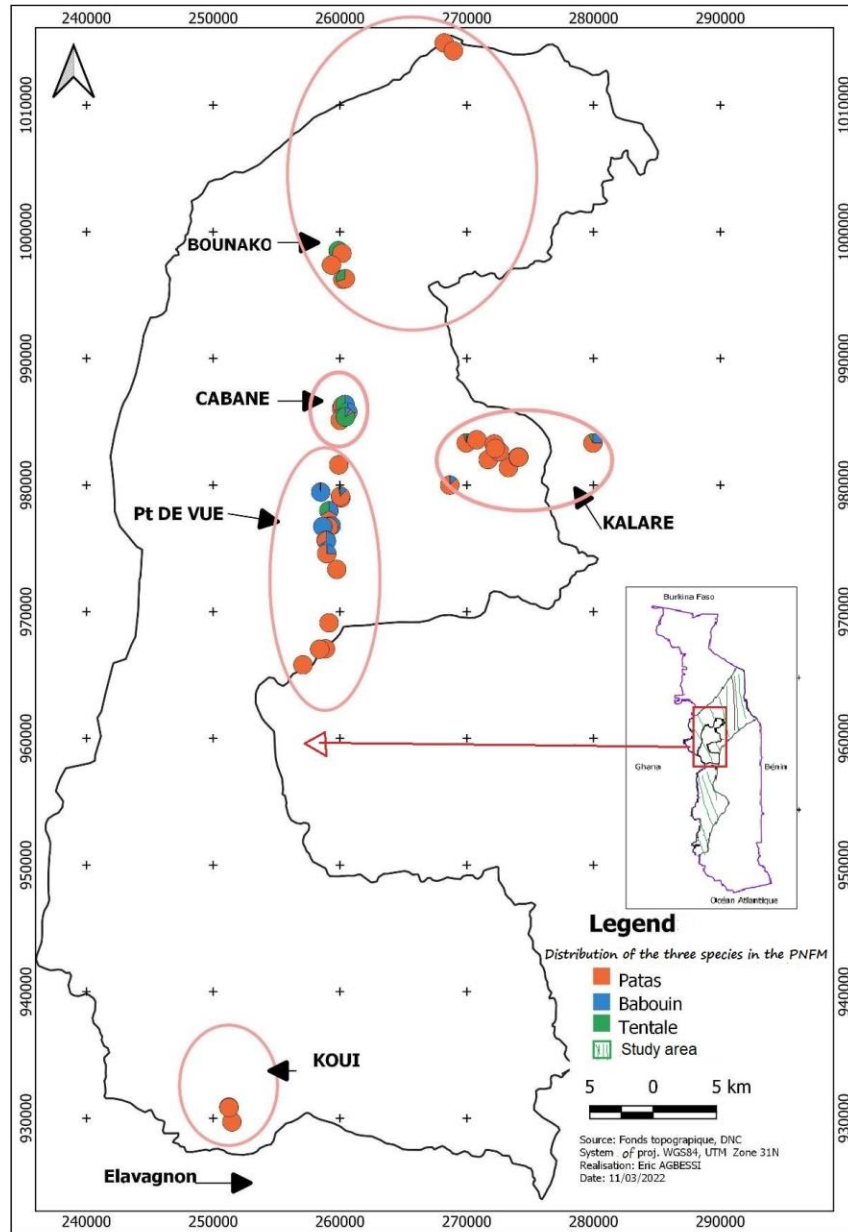


Figure 5. Spatial distribution of the three primate species observed by trap cameras

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**4. CONCLUSION**

The present work has made it possible to spatialize the distribution of non-human primate species in the forest zone as well as their specific richness. All in all, it should be remembered that the disturbance of non-human primate habitats in localities is increasingly strong that some groups have had to move to other habitats very often located in neighboring countries, especially in Ghana where deforestation is very little felt, and habitats are still more or less good conserved. There is a need to restore forest landscapes by appropriate techniques to preserve wildlife habitats, particularly in protected areas that are supposed to serve as safe havens for any animal. The spatial reference database and the thematic map of the spatial distribution of non-human primates in the forest zone will be important decision-making tools, particularly in guiding the management of the forest landscape that shelters them in order to strengthen their sustainable conservation.

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