

Preliminary Inventory of Squirrels (Sciuridae, Rodentia) of Kisangani Region in the Democratic Republic of the Congo

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To cite this article:

Pascal Baelo, Justin Asimonyio, Nicaise Amundala, Dudu Akaibe, Sylvestre Gambalemoke, Erik Verheyen, Anne Laudisoit, Gédéon Bongo, Koto-te-Nyiwa Ngbolua. Preliminary Inventory of Squirrels (Sciuridae, Rodentia) of Kisangani Region in the Democratic Republic of the Congo. *American Journal of Zoology*. Vol. 1, No. 1, 2018, pp. 15-19. doi: 10.11648/j.ajz.20180101.13

Received: May 3, 2018; Accepted: June 1, 2018; Published: July 3, 2018

Abstract: Amongst small mammals, rodents are the largest order in terms of both species and population numbers. They have a high rate of reproduction, are cosmopolitan and have the ability to adapt to a wide variety of habitats. Several studies were carried out on myomorphic rodents in the Kisangani ecoregion, while those on sciuromorphic rodents are very scarce. Therefore, the purpose of this study was to determine the composition of the sciuriform rodent population in the Kisangani ecoregion. This investigation was conducted in five stations of Kisangani and the sampling was performed between April 2014 and December 2016. The external morphometry method was used for species identification according to Kingdon and Schouteden. Using traditional traps, the trapping was done randomly and 75 specimens of squirrels were captured knowing that 75 traps were installed in each station. In total, the capture success was of 27750 night traps with a weak yield of 0.27%. The findings revealed that the highest rate of species was recorded in the Masako station with a capture success of 1.89% while the lowest in the Mombongo station with a capture success of 0.38%. The 75 specimens of squirrels captured belong to 4 genera and 7 species Masako and Yasikia stations presented a high specific richness (SR = 4) than other stations. *Funisciurus anerythrus*, *Heliosciurus rufobrachium*, *Paraxerus boehmi* are constant (C > 50%) and *Funisciurus pyrropus*, *Protoxerus stangeri*, *Funisciurus bayonii*, *Funisciurus congicus* are accessory taxa (25% < C < 50%). Yasikia and Masako are more diversified than other sites, with H' = 1.182 and H' = 1.092, respectively. The current study presents the findings of a preliminary inventory of Sciuridae from Kisangani ecoregion. Further studies on Squirrels are required in order to establish similarities and dissimilarities between different populations of Squirrels living in other regions through inventories and molecular assays to confirm morphological confusing species such as *F. bayonii* and *F. congicus*.

Keywords: Africa's Squirrels, Inventory, Traditional Trapping, Kisangani, Democratic Republic of the Congo

1. Introduction

Amongst small mammals, rodents are the largest order in terms of both species numbers and population numbers. They have a high rate of reproduction, are cosmopolitan in distribution and have the ability to adapt to a wide variety of

habitats [1-2]. The importance of rodents can be seen globally at several levels notably ecological, agricultural, food, medical, health, cultural and even religious. In this respect, the nature conservation authorities must review their strategy so that rodents can be integrated into the biodiversity conservation policy along with the great fauna and flora. [3].

Several studies were carried out on myomorphic rodents in

the Kisangani ecoregion [4-5], while those on sciuromorphic rodents are very scarce [6-7]. Some species of Sciuridae act as reservoirs of various pathologies in humans such as Monkeypox. Disease transmission occurs in a number of ways, either directly by contact or bite, or indirectly through pitting due to their external parasites or by feces that contaminate food and these sciuromorphic rodents are also known as crop predators [8-10]. Moreover, Sciuridae represent a key group of which the diversity, biology, parasitism and phylogeny need to be clearly elucidated while the genetic and taxonomic studies are still fragmentary. In addition, the latest unpublished data suggest that there are still species which need to be identified and described in the Democratic Republic of the Congo (DRC) with its megabiodiversity [11].

In order to increase the knowledge on Sciuridae of the Congolese Central Basin and precisely of the Kisangani ecoregion, this preliminary inventory study presents the arboreal Sciuridae. The aim of the current study was to preserve and document the biological traits of forest Sciuridae around Kisangani ecoregion in Tshopo city, DRC.

2. Material and Methods

2.1. Study Area

The current study was conducted in an area called "Central Northeast" which is a wide expanse of Tropical forest located in Kisangani ecoregion [4]. In this region, the climate is of Af as classified by Köppen (modified by Trewartha). This region is characterized by an average temperature whereby the coldest month is higher than 18°C, a monthly average of precipitation greater than twice the temperature (A) and a rainfall distributed throughout the year (f = fehlt, no dry season). However, the abundant rainfall is poorly distributed over the year [12-13]. In the study area, the sampling was carried out in five different stations located at both banks of the Congo River namely Uma forest, Masako forest reserve, Yasikia forest, Mombongo forest and Mbiye island. On the right bank of the Congo River, we had: the community forest of Uma (N00°33'09.1", E025°55'27.7 " 507m altitude) and the Masako Forest Reserve (N00°36'30.3", E025°15'39.3", 431 m altitude); while on the left bank of the Congo river, we had: the forests of Yasikia village (N00°21'52.2", E025°00'23.2", 471m high) and Mombongo (N01°39'33.7") E023°08'28.8", 409m high). Meanwhile, Mbiye station (N00° 27'00.5" E025°17'57.5", 400 m altitude) is an island located in the Congo River.

2.2. Biological Material

The biological material of the current study was the species of Sciuridae collected in five stations of the Kisangani ecoregion.

2.3. Methods

2.3.1. Trappings

The technique of random trapping was used because it is a

simple and easy method to implement in the field. Before installing the traps, the researcher is called to carry out a preliminary survey or a prospection in the sampling area. The purpose of this prospection is to search for evidence that squirrels are present either by direct observations (observation or squeal) or by indirect observations such as the presence of traces, the remains or the left-overs, branches connecting one tree to another, nests and small streams. Given the inefficiency of the Harvat trap during the arboreal Sciuridae capture (zero capture from 2010 up to date) in Kisangani ecoregion, traditional traps (figure 1) baited with ripe palm nut and placed at a height ranging between 0.32 m and 5.43 m i.e. an average height of 1.58 m, were used.



Figure 1. Traditional trap used for the capture of Sciuridae species.

In each station, 75 traditional traps were installed and 75 specimens of squirrels were captured of which 2 at Mombongo, 15 at Yasikia, 6 at Mbiye Island, 27 at Masako and 25 at Uma. The sampling was performed in different periods starting from April 2014 to December 2016. In the Masako Forest Reserve, the sampling was performed in May 2014, in Uma forest it was in April 2014, in Yasikia (April 2015), in Mombongo (January 2016), and in Mbiye island (December 2016).

The dominant vegetation of prospected habitats during the sampling period was made of primary and secondary forests along with the fallows. Following vegetal species were found in the primary forest: *Gilbertiodendron dewevrei* (De Wild) J. Léonard (Caesalpirriaceae), *Celtis mildbraedii* Engler (Canabaceae), *Megaphrynium macrostachyum* (Benth) Milne-Redh. (Marantaceae), *Scorodophloeus zenkeri* Harms (Fabaceae), *Funtumia africana* (Benth) Stapf (Apocynaceae) and *Pericopsis elata* (Harsm) Van Meeuwen (Fabaceae).

In the secondary forest, the following species were predominant: *Funtumia elastica* (Apocynaceae), *Cynometra hankei* (Caesalpinioideae), *Pycnanthus angolensis* (Myristicaceae) and *Petersianthus macrocarpus* (Lecythidaceae). We also find *Funtumia africana* (Benth) Stapf (Apocynaceae), *Musanga cecropioides* R. Br (Moraceae), *Uapaca guineensis* Mull. Arg. (Euphorbiaceae), *Dioscorea semperflorens* De Wild. (Dioscoreaceae).

The fallows were predominated by shrubs namely *Elaeis guineensis* Jacq. (Arecaceae), *Afromomum sanguineum* (K. Schum.) K. Schum. (Zingiberaceae), *Costuslucanusianus* J. Braun (Costaceae), *Musanga cercopiodes* R. Br (Urticaceae), *Megaphrynium macrostachyum* (Benth) Milne-Redh. (Marantaceae), *Ricinodendron heudelotii* (Baill) Pierreex, *Petersianthus macrocarpus* (P. beauv) Liven, *Manihot esculanta* Crantz (Euphorbiaceae), *Panicum maximum* Jacq. (Poaceae), *Anonidium mannii* (Oliv) Engl & Diels.

2.3.2. Laboratory Work

In the laboratory, captured specimens of squirrels were identified according to the identification keys of Kingdon and Schouteden [12-14]. Morphometric parameters (total lengths: head-body, tail, hind foot, ear and weight) were measured. Ectoparasites were collected while tissue fragments (throat, liver or kidney) were removed freshly from each specimen and stored in 1.5 mL eppendorf tubes (VWR) containing alcohol (70-94%) while blood were collected on blotting paper. These tissues are kept for further analyses precisely for subsequent genetic analyses related to the molecular phylogeny of Congolese arboreal Sciuridae and the detection of zoonotic pathogens. The carcasses were finally labeled and stored in a barrel containing a formalin solution (10%). These carcasses are kept in the collection room of the Biodiversity Surveillance Centre of University of Kisangani University for further studies.

3. Results and Discussion

The trapping success of different stations of the Kisangani ecoregion is presented in the table below.

Table 1. Trapping success in different prospected sampling sites.

Stations	NbP	NbJ	NbSpC	EC	SC (%)
Yasikia	75	15	15	1125	1.33
Uma	75	25	25	1875	1.33
Mombongo	75	7	2	525	0.38
Masako	75	19	27	1425	1.89
Mbiye Island	75	8	6	600	1
Total	375	74	75	27750	0.27

Legend: NbP: number of installed trapping, NbJ: number of days that the traps were in the sampling site, NbSpC: Number of captured species, EC: capture success, SC: trapping success (%)

In all the stations, the total EC is 27750 trap nights with a low yield of 1.35%. At each site, 75 traditional traps were placed but the number of days that traps remained in place varied. Despite these variations, the capture success was the same in Yasikia and Uma (SC = 1.33). At Mbiye Island, the capture success is 1% while in Masako, the capture success is of 1.89% and the lowest capture success of all the sites surveyed is 0.38% found in Mombongo.

The systematic list of Sciuridae species collected in different sampling stations of the Kisangani ecoregion is presented in the following table.

Table 2. Systematic inventory and Constancy of each species.

Species	Mombongo	Yasikia	Mbiye Island	Masako	Uma	Total	C (%)
<i>Funisciurus anerythrus</i> (Thomas, 1890)	2	6	6	11	18	43	100
<i>Funisciurus pyrropus</i> (Cuvier, 1833)	0	0	0	3	0	3	25
<i>Heliosciurus rufobrachium</i> (Waterhouse, 1842)	0	2	0	1	0	3	50
<i>Paraxerus boehmi</i> (Reichenow, 1886)	0	0	0	12	5	17	50
<i>Protoxerus stangeri</i> (Waterhouse, 1843)	0	0	0	0	2	2	25
<i>Funisciurus bayonii</i> (Bocage, 1890)	0	6	0	0	0	6	25
<i>Funisciurus congicus</i> (Kuhl, 1820)	0	1	0	0	0	1	25
Total	2	15	6	27	25	75	100
Percentage	2.66	20	8	36	33.33	99.99	-
Specific Richness (SR)	1	4	1	4	3	7	-
Shannon Wiener Index (H')	0	1.182	0	1.092	0.761	-	-
Simpson 1-D Index	0	0.6578	0	0.6228	0.435	-	-
Equitability	0	0.8528	0	0.788	0.692	-	-

From the above table, it is clearly shown that 75 specimens of squirrels were captured at the five sites. These squirrels belong to 7 species (*Funisciurus anerythrus* (figure 2), *Funisciurus pyrropus*, *Heliosciurus rufobrachium*, *Paraxerus boehmi* (figure 3), *Protoxerus stangeri*, *Funisciurus bayonii*, *Funisciurus congicus*). The capture was distributed between different study sites as follows: 27 specimens including 4 species were captured in the Masako Forest Reserve; 25 specimens including 3 species in community forests of Uma. At Mbiye Island, 6 specimens belonging to a single species (*F. anerythrus*) were captured, and in Mombongo 2 specimens of the same species were captured. However, in Yasikia, 15 specimens grouped in 4 species were captured. *F. anerythrus*, *H. rufobrachium*, *P. boehmi* are constant (C > 50%) while the other species *F. pyrropus*, *P. stangeri*, *F. bayonii* and *F. congicus* are accessory taxa (25% < C < 50%). The diversity indices show that Yasikia and Masako are more

diversified than other sites, with H' = 1.182 and H' = 1.092, respectively.



Figure 2. *Funisciurus anerythrus*.



Figure 3. *Paraxerus boehmi* on the trap.

The present study reports the findings of trapping success from five different sites in the Kisangani ecoregion in DRC. In total, seven species (*F. anerythrus*, *F. pyrropus*, *H. rufobrachium*, *P. boehmi*, *P. stangeri*, *F. bayonii* and *F. congicus*) were inventoried. The specific richness is higher at Yasikia ($r = 4$) and Masako ($r = 4$) compared to other sites, Uma ($r = 3$), Mbiye Island ($r = 1$) and Mombongo ($r = 1$). *F. bayonii* and *F. congicus* were only captured in the left bank of the Congo River while the other species were captured in both banks of the Congo river.

F. bayonii was captured out of its natural habitat because its limit of distribution is known to be at the left bank of Kasai river in the western part of DRC according to Kingdon [12-13], Schouteden [14] and Nowak and Grubb [15, 16, 21]. Therefore, in all the localities where this species was collected are outside of the Central African forest block where it is believed to be a kind of woodland savannah mosaics.

P. boehmi species is known to be a species of the left bank of the Congo River and this species was captured at Yasikia. In the Dimonika biosphere reserve in Congo-Brazzaville, Diamouangana [22] has inventoried 6 species of squirrels namely, *P. stangeri*, *E. ebii*, *F. lemniscatus*, *F. pyrropus*, *A. poensis* and *M. pumilio*. This author used the direct observation method and reported that the majority of species were observed in the fallows. Duplantier [23] inventoried 9 species of squirrels namely: *E. wilsoni*, *F. anerythrus*, *F. lemniscatus*, *F. isabella*, *F. pyrropus*, *H. gambianus*, *M. pumilio*, *P. poensis* and *P. stangeri* in the M'passa forest in Gabon. Colyn [24] inventoried 5 species of arboreal Sciuridae precisely *H. rufobrachium*, *P. stangeri*, *F. pyrropus*, *F. anerythrus* and *P. boehmi*. Yasikia and Masako are more diversified than other sites, with $H' = 1.182$ and $H' = 1.092$, respectively. In Mbiye Island, *F. anerythrus* was the only species captured and observed.

F. anerythrus is the most abundant species in all the prospected sites regardless of the presence of ecological barriers such as the Congo and Tshopo rivers. Ndjele and Kingdon [9, 13] indicated the distribution range of *F. anerythrus*, but also *F. pyrropus*, *H. rufobrachium* and *P. stangeri* is widely ranging from the right bank to the left bank of the Congo River. These findings are consistent and we believe that this random distribution of species in the capture sites would be due to the fact that these ecosystems

are subjected to disturbances, a dietary concentration and the periodicity at which sampling was performed; but also the gap of the capture days between different sites. Though the number species is small but this research is very relevant knowing that studies on Sciuridae are very rare and this study helps to update the knowledge of squirrel population of Kisangani ecoregion.

4. Conclusion

The current study presents the findings of a preliminary inventory of Sciuridae from the Kisangani ecoregion. The study was conducted at five stations (Uma, Masako, Yasikia, Mombongo and Mbiye Island) and traditional bait trap was used for capture. A total of 75 specimens of squirrels were captured from which seven species were identified namely, *F. anerythrus*, *F. pyrropus*, *H. rufobrachium*, *P. boehmi*, *P. stangeri*, *F. bayonii* and *F. congicus*. It was noted that *F. anerythrus* was the most abundant in all the sites surveyed while *F. bayonii* and *F. congicus* were captured only in Yasikia. Further studies on Squirrels are required in order to establish similarities and dissimilarities between different populations of Squirrels living in the Kisangani ecoregion using inventories and molecular assays for confirmation of certain species such as *F. bayonii* and *F. congicus*.

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