



# Note on the Amphibians and Reptiles of the Mungbwalu (Ituri Province) and Mutwanga (Province of North-Kivu) in DRC

**Franck Masudi Muenye Mali<sup>1, \*</sup>, Zacharie Chifundera Kusamba<sup>2</sup>, Aristote Mwenebantu Mlungu<sup>2</sup>, Celestin Danadu Mizani<sup>3</sup>, Pionus Katuala Gatate Banda<sup>3</sup>, Sylverstre Gambalemoke Mbalitini<sup>3</sup>, Corneille Ewango<sup>4</sup>, Guy Crispin Gembu Tungaluna<sup>3</sup>, Benjamin Dudu Akaibe<sup>3</sup>**

<sup>1</sup>Department of Ecology and Biodiversity of Earth Resources, Centre de Surveillance de la Biodiversité of the University of Kisangani, Kisangani City, Democratic Republic of the Congo

<sup>2</sup>Department of Biology, Centre de Recherche en Sciences Naturelles de Lwiro, Bukavu City, Democratic Republic of the Congo

<sup>3</sup>Department of Ecology and Animal Resource Management, Faculty of Science of the University of Kisangani, Kisangani City, Democratic Republic of the Congo

<sup>4</sup>Department of Ecosystem Management, Faculty of Management of Renewable Natural Resources, University of Kisangani, Kisangani City, Democratic Republic of the Congo

## Email address:

frank.masudi@unikis.ac.cd (F. M. M. Mali), fr.masudi@gmail.com (F. M. M. Mali)

\*Corresponding author

## To cite this article:

Franck Masudi Muenye Mali, Zacharie Chifundera Kusamba, Aristote Mwenebantu Mlungu, Celestin Danadu Mizani, Pionus Katuala Gatate Banda, Sylverstre Gambalemoke Mbalitini, Corneille Ewango, Guy Crispin Gembu Tungaluna, Benjamin Dudu Akaibe. Note on the Amphibians and Reptiles of the Mungbwalu (Ituri Province) and Mutwanga (Province of North-Kivu) in DRC. *American Journal of Zoology*. Vol. 2, No. 2, 2019, pp. 18-27. doi: 10.11648/j.ajz.20190202.11

**Received:** May 10, 2019; **Accepted:** June 5, 2019; **Published:** June 26, 2019

---

**Abstract:** The Democratic Republic of Congo's forests are rich and diversified in biodiversity, particularly in high-altitude regions where they are reputed to be very rich in animal and plant biological diversity, particularly amphibians. Nevertheless, this fauna has not been well documented so far, mainly because of the lack of expertise in this field in the DRC. To contribute to this area, an inventory of amphibians and reptiles had been carried out in the Ituri forest and Mutwanga. We note that the herpetofauna of this region has never been the subject of a recent and thorough study. In order to analyse its biodiversity, 4 sites far from each other, all located in the primary forest, had been sampled. To achieve this, data collection was carried out during the dry season from 25 December 2014 to 12 January 2015 (18 days). The prospecting of the sites took place day and night in view and during the hearing. Amphibians and reptiles had been caught by hand and with the snake stick. All specimens had been digitized, fixed in formaldehyde (10%) and then preserved in alcohol (70%). Muscle necropsies were preserved in Eppendorf tubes containing absolute alcohol (96%). In total, 182 amphibian specimens divided into 32 species, 4 families, all belonging to the Order of the Anurans and 37 reptile specimens diversified into 18 species, 7 families and grouped into two Orders were recorded. The species capture: *Hymenochirus Boulengeri*, *Hyperolius rossii*, *Amietia desaegeri*, *Amietia ruwenzorica*, *Xenopus lenduensis* and *Xenopus ruwenzoriensis* were interesting because these species remain poorly documented in the region.

**Keywords:** Biodiversity, Amphibians, Reptiles, Ituri Forest, Mutwanga-Virunga National Park, DRC

---

## 1. Introduction

In a general way, the study of biodiversity fits into the global policy of the Convention on Biological Diversity. In this research, we hitched to the herpetofauna. In effect, the

amphibians are good bioindicators of biodiversity, especially of the phytodiversity [1]. The herpetology in Central Africa is less known by report to other areas around the world [2- 4] yet they constitute a group very threatened among all vertebrates on the planet [5-6]. Several recent sources, among

which the IUCN [7], indicate that approximately 35 per cent of amphibians, either 159 species and 16% of reptiles are recently extinct [8].

The Democratic Republic of the Congo (DRC) is characterized by several types of ecosystems to know the savannas in the north and the south, the low altitude tropical forest, the forests of the mountains to the east, the mangroves to the west, the plains and the high plateaus. This important habitat diversity gives the country a great opportunity to host a large biological diversity.

Amphibians are characterized by a naked skin and permeable [9], which make it vulnerable to the degradation of the environment and the loss of forest habitats [10-13]. For the moment, the studies on the herpetological fauna in the Ituri region are not exhaustive.

This is why the purpose of this research was to assess the diversity of amphibians and reptiles of the Ituri forest. Knowing that the forests of Ituri are rich and diverse, the rate of diversity would be high in amphibians and reptiles.

## 2. Materials and Methods

### 2.1. Sites of Study

The biological material was collected in four different sites namely Mungbwalu, Toyokona, Bongobongo and Mutwanga. It should be noted that the sites were not easily accessible due to poor road infrastructure.

- a. Mungbwalu (Eastern Province, territory of Djugu, sector of Banyali-kilo, grouping Bilindey, locality of Mabilindey 1, N01. 97230°; E030. 03490°, alt 1164 m). In this site, we had worked during 6 days.
- b. Toyokona (Territory of Djugu, sector of Banyali-kilo, grouping Tshibitshibi, locality Toyokona: N02. 02734°; E030. 06653°, alt 1294 m). The sampling had lasted 3

days.

- c. Bongobongo (N02.197666°; E030.11468° alt 1258 m), 4 days of work.
- d. Mutwanga (N00. 31841°; E029. 74651° alt 1119 m), in the Virunga national park (North sector) at the foot of Mont Ruwenzori. (Province of north Kivu, 3 days of work).

### 2.2. Methods

We inventoried the amphibians and reptiles of 25 December 2014 to 12 January 2015 (18 days) in 4 sites various located in primary forests. To do this, the prospecting of sites took place during the day and during the night. For security reasons, catches were between 18 pm and 21 pm, using the frontal headlight. On this, the sampling method adopted was to excavations in the wetlands (streams, ponds, creeks), under the litter under stones, and between the dry bark of trunks of trees with a slow walk interspersed with regular stops.

Also, we have been hit during the day some waters of ponds, the creeks to the aid of small jars in plastic to collect the frogs essentially aquatic. We captured amphibians and snakes non-poisonous with the hand. The specimens been photographed alive and then euthanized by a solution of MS-222, then fixed by the formalin (10%), finally preserved in alcohol (75%). Biopsies were composed of muscle of the specimen preserved in the Eppendorf tubes containing alcohol (96%).

### 2.3. Vegetation

We had captured amphibians and reptiles in the primary forest dominated by the following species: *Erythrina abyssinica* and *Gilbertiondedron deweveri*.



**Figure 1.** From left to right, the Ituri forests: Mungbwalu at the beginning, Bongobongo in the centre and Mutwanga at the end.



**Figure 2.** From left to right, the mining activities in the area of Mungbwalu and urbanization in Mahagi.

## 2.4. Identification of Species

To identify specimens, we used the external morphology. To this effect, we had completed our identification with the identification keys of [14, 15, 13] for amphibians and [16] for the snakes.

## 2.5. Processing of Data

We examined the composition and diversity specific to each habitat. Moreover, the dominance, the Simpson index,

### 3.1.1. Diversity of Amphibians

the index of Shannon-Wiener and evenness was calculated using the PAST software.

## 3. Results

### 3.1. Amphibians

The results of this research show that 182 specimens of amphibians divided into 32 species had been collected.

**Table 1.** List of amphibians caught to Mungbwalu, Bongobongo, Toyokana and Mutwanga.

Order	Family	Genus	Species	Number	%	
	Pipidae Gray, 1825	Hymenochirus Boulenger, 1896	<i>Hymenochirus boulengeri</i> De Witte, 1970	8	4.40	
		Xenopus Wagler, 1827	<i>Xenopus epitropicalis</i> (Fischberg, Colombelli & Picard, 1982)	3	1.65	
				<i>Xenopus CF petersi</i> (Bocage, 1895)	1	0.55
				<i>Xenopus laevis</i> (Daudin, 1802)	1	0.55
				<i>Xenopus ruwenzoriensis</i> (Tymowska & Fishberg, 1973)	1	0.55
				<i>Xenopus lenduensis</i> (Evans, Greebaum, Kusamba, Carter, Tobias, Mendel & Kelly, 2011)	1	0.55
				<i>Xenopus sp</i>	23	12.64
				<i>Sclerophrys sp</i>	5	2.75
				<i>Ptychadena sp</i>	6	3.30
				<i>Amnirana galamensis</i> Duméril and Bibron, 1841	1	0.55
				<i>Phrynobatrachus dendrobates</i> (Boulenger, 1919)	1	0.55
	Bufonidae Gray, 1825	Sclerophrys Tschudi, 1838	<i>Phrynobatrachus auritus</i> (Boulenger, 1900)	1	0.55	
		Ptychadenidae Dubois, 1987	<i>Phrynobatrachus sp</i>	20	10.99	
	Ranidae Batsch, 1796	Amnirana, Tschudi, 1838	<i>Afrixalus equatorialis</i> (Laurent, 1941)	2	1.10	
	Phrynobatrachidae Laurent, 1941	Phrynobatrachus (Günther, 1862)	<i>Afrixalus fulvovittatus</i> (Cope, 1861)	3	1.65	
			<i>Afrixalus laevis</i> (Ahl, 1930)	1	0.55	
			<i>Afrixalus sp</i>	2	1.10	
			<i>Hyperolius castaneus</i> (Ahl, 1931)	1	0.55	
			<i>Hyperolius langi</i> (Noble, 1924)	3	1.65	
			<i>Hyperolius platyceps</i> (Boulenger, 1900)	2	1.10	
			<i>Hyperolius rossii</i> (Calabresi, 1925)	3	1.65	
			<i>Hyperolius sp</i>	27	14.84	
The anurans Duméril, 1806			Hyperoliidae Laurent, 1943	Afrixalus Laurent 1944	<i>Amietia angolensis</i> (Bocage, 1866)	3
	Hyperolius Rapp, 1842	<i>Amietia desaegeri</i> (Laurent, 1972)		10	5.49	
	Pyxicephalidae Bonaparte, 1850	Amietia Dubois, 1987	<i>Amietia lubrica</i> (Pickersgill, 2007)	1	0.55	
			<i>Amietia ruwenzorica</i> (Laurent, 1972)	2	1.10	
			<i>Amietia sp</i>	19	10.44	
			<i>Arthroleptis variabilis</i> (Andersson, 1907)	1	0.55	
			<i>Arthroleptis sp</i>	4	2.20	
			<i>Leptopelis christyi</i> (Boulenger, 1912)	11	6.04	
			<i>Leptopelis millsoni</i> (Boulenger, 1895) "1892"	2	1.10	
			<i>Leptopelis sp</i>	13	7.14	
			<i>Leptopelis sp</i>	13	7.14	
1	Arthroleptidae Mivart, 1869	Arthroleptis Smith, 1849	32	182	100	
		Leptopelis (Günther, 1859)				

It is clear from the table 1, 182 specimens of amphibians were captured and divided into 8 families, 11 genera and 32 species. All amphibians belong in the Order of the anurans and known in the region. However, all families captured, that of the Hyperoliidae is the most diversified with 2 genera and 9 species which are: *Afrixalus equatorialis* (2 individuals, 1.10%), *Afrixalus fulvovittatus* (3 specimens: 1.65%), *Afrixalus laevis* (1 Individual: 0.55%), *Afrixalus sp* (2 specimens: 1.10%), *Hyperolius castaneus* (1 specimen: 0.55%), *Hyperolius langi* (3 individuals: 1.65%), *Hyperolius*

*platyceps* (2 individuals: 1.10%), *Hyperolius rossii* (3 specimens: 1.65%) and *Hyperolius sp* (27 specimens: 14.84%). In this family, the species *Hyperolius sp* is the more abundant.

In addition, the family of the Hyperoliidae is followed by that of the Pipidae which is also represented by two genera but 7 species. The species are the following: *Hymenochirus boulengeri* (8 individuals: 4.40%), *Xenopus epitropicalis* (3 specimens: 1.65%), *Xenopus cf petersi* (1 specimen: 0.55%), *Xenopus laevis* (1 specimen: 0.55%), *Xenopus ruwenzoriensis*

(1 specimen: 0.55%), *Xenopus lenduensis* (1 specimen: 0.55%), and *Xenopus sp* (23 specimens either a proportion of 12.64%). The family of Phrynobatrachidae about it represented by 3 species namely: *Phrynobatrachus dendrobates* and *Phrynobatrachus auritus* with 1 individual: 0.55% each; and *Phrynobatrachus sp* (20 specimens: 10.99%).

The family of the Pyxicephalidae is represented by 5 species: *Amietia angolensis* (3 specimens: 1.65%), *Amietia desaegeri* (10 specimens: 5.49%), *Amietia lubrica* (1 Individual: 0.55%), *Amietia ruwenzorica* (2 individuals: 1.10%) and *Amietia sp* (19 Individuals: 10.44%). The families of the Bufonidae, Ptychadenidae and Ranidae are monogeneric and monospecific. Then, they are represented respectively by: *Sclerophrys sp* (5 specimens: 2.75%), *Ptychadena sp* (6 specimens: 3.30%) and *Amnirana*

*albolabris* (1 Individual: 0.55%).

Finally, the family of Arthroleptidae is represented by 2 genera and 5 species: *Arthroleptis variabilis* (1 individual: 0.55%), *Arthroleptis sp* (4 specimens: 2.20%), *Leptopelis christyi* (11 specimens: 6.04%), *Leptopelis millsoni* (2 specimens: 1.10%) and *Leptopelis sp* (13 specimens: 7.14%). In addition, the species *Hyperolius sp* (27 Individuals: 14.84%) is abundant followed of *Xenopus sp* (23 individuals: 12.64%), *Phrynobatrachus sp* (20 individuals: 10.99%), *Amietia sp* (19 individuals: 10.44%) and *Leptopelis sp* (13 specimens: 7.14%). But then, species *Afraxalus sp*, *Phrynobatrachus auritus*, *Amnirana galamensis*, *Xenopus lenduensis*, *Arthroleptis variabilis*, *Hyperolius castaneus* are represented by 1 individual each, either a proportion of 0.55%.



**Figure 3.** From left to right, some amphibians caught in the Ituri and Mutwanga forest: *Hymenochirus boulengeri* at the beginning, *Amietia ruwenzorica* in the centre and *Phrynobatrachus sp* at the end.

### 3.1.2. Relative Abundance of Amphibians in the Inventoried Sites

**Table 2.** Relative abundance of amphibians.

Species	Mungbwalu	Toyokana	Bongobongo	Mutwanga	Number	%
<i>Afraxalus equatorialis</i>	2	0	0	0	2	1.10
<i>Afraxalus fulvavitattus</i>	3	0	0	0	3	1.65
<i>Afraxalus laevis</i>	0	1	0	0	1	0.55
<i>Afraxalus sp</i>	2	0	0	0	2	1.10
<i>Amietia angolensis</i>	0	0	3	0	3	1.65
<i>Amietia desaegeri</i>	0	0	0	10	10	5.49
<i>Amietia lubrica</i>	0	1	0	0	1	0.55
<i>Amietia ruwenzorica</i>	0	0	0	2	2	1.10
<i>Amietia sp</i>	0	14	2	3	19	10.44
<i>Sclerophrys sp</i>	2	1	2	0	5	2.75
<i>Arthroleptis sp</i>	1	0	3	0	4	2.20
<i>Arthroleptis variabilis</i>	0	0	1	0	1	0.55
<i>Amnirana albolabris</i>	0	0	0	1	1	0.55
<i>Hymenochirus boulengeri</i>	0	0	8	0	8	4.40
<i>Hyperolius castaneus</i>	1	0	0	0	1	0.55
<i>Hyperolius Langi</i>	3	0	0	0	3	1.65
<i>Hyperolius platyceps</i>	1	0	1	0	2	1.10
<i>Hyperolius rossii</i>	3	0	0	0	3	1.65
<i>Hyperolius sp</i>	16	11	0	0	27	14.84
<i>Leptopelis christyi</i>	0	0	11	0	11	6.04
<i>Leptopelis millsoni</i>	0	2	0	0	2	1.10
<i>Leptopelis sp</i>	1	10	2	0	13	7.14
<i>Phrynobatrachus auritus</i>	0	1	0	0	1	0.55
<i>Phrynobatrachus dendrobates</i>	1	0	0	0	1	0.55
<i>Phrynobatrachus sp</i>	19	1	0	0	20	10.99
<i>Ptychadena sp</i>	6	0	0	0	6	3.30
<i>Silurana epitropicalis</i>	0	3	0	0	3	1.65

Species	Mungbwalu	Toyokana	Bongobongo	Mutwanga	Number	%
<i>Xenopus cf petersi</i>	1	0	0	0	1	0.55
<i>Xenopus lenduensis</i>	0	0	1	0	1	0.55
<i>Xenopus laevis</i>	0	0	1	0	1	0.55
<i>Xenopus ruwenzoriensis</i>	0	0	0	1	1	0.55
<i>Xenopus sp</i>	11	4	5	3	23	12.64
Total	73	49	40	20	182	100.00
Percentage	40,10	26,92	21,97	10,98		
Taxa_S	16	11	12	6	32	
Individuals	73	49	40	20	182	
Dominance_D	0.1537	0.1878	0.1525	0.31	0.07928	
Simpson_1-D	0.8463	0.8122	0.8475	0.69	0.9207	
Shannon_H	2.215	1.921	2.144	1.446	2.874	
Evenness_e^H/S	0.5728	0.6206	0.7109	0.7074	0.5533	
Equitability_J	0.799	0.8011	0.8627	0.8068	0.8292	

The distribution of amphibians was not regular in all sites sampled. This table reveals that 182 specimens of amphibians were captured to Mungbwalu, Toyokana, Bongobongo and Mutwanga. However, 73 individuals (40.10%) had been captured in Mungbwalu, 49 specimens (26.92%) to Toyokana, 40 individuals (21.97%) to Bongobongo and 20 specimens (10.98%) to Mutwanga. As to what is diversity indices observed in all sites, the index of dominance\_D is respectively

0.1537 to Mungbwalu, 0.1878 to Toyokana, 0.1525 to Bongobongo and 0.31 to Mutwanga. The Simpson index 1-D is 0, 8463 in the first site; 0.8122 in the second; 0, 8475 in the third and is 0.69 in the last. Moreover, the Shannon index\_H is 2.215 to Mungbwalu; 1.921 to Toyokana; 2.7144 to Bongobongo and 1.446 to Mutwanga. And, evenness to Mungbwalu (0.799); Toyokana (0.8011); Bongobongo (0.8627) and Mutwanga (0.8068).

### 3.1.3. Frequency of Species of Amphibians in the Studied Environments

Table 3. Frequency of species of amphibians.

Species	Mungbwalu	Toyokana	Bongobongo	Mutwanga	Constance
<i>Afrixalus equatorialis</i>	+	-	-	-	25%
<i>Afrixalus fulvovittatus</i>	+	-	-	-	25%
<i>Afrixalus laevis</i>	-	+	-	-	25%
<i>Afrixalus sp</i>	+	-	-	-	25%
<i>Amietia angolensis</i>	-	-	+	-	25%
<i>Amietia desaegeri</i>	-	-	-	+	25%
<i>Amietia lubrica</i>	-	+	-	-	25%
<i>Amietia ruwenzorica</i>	-	-	-	+	25%
<i>Amietia sp</i>	-	+	+	+	75%
<i>Sclerophrys sp</i>	+	+	+	-	75%
<i>Arthroleptis sp</i>	+	-	+	-	50%
<i>Arthroleptis variabilis</i>	-	-	+	-	25%
<i>Amnirana albolabris</i>	-	-	-	+	25%
<i>Hymenochirus boulengeri</i>	-	-	+	-	25%
<i>Hyperolius castaneus</i>	+	-	-	-	25%
<i>Hyperolius langi</i>	+	-	-	-	25%
<i>Hyperolius platyceps</i>	+	-	+	-	50%
<i>Hyperolius rossii</i>	+	-	-	-	25%
<i>Hyperolius sp</i>	+	+	-	-	50%
<i>Leptopelis christyi</i>	-	-	+	-	25%
<i>Leptopelis millsoni</i>	-	+	-	-	25%
<i>Leptopelis sp</i>	+	+	+	-	75%
<i>Phrynobatrachus auritus</i>	-	+	-	-	25%
<i>Phrynobatrachus dendrobates</i>	+	-	-	-	25%
<i>Phrynobatrachus sp</i>	+	+	-	-	50%
<i>Ptychadena sp</i>	+	-	-	-	25%
<i>Silurana epitropicalis</i>	-	+	-	-	25%
<i>Xenopus cf petersi</i>	+	-	-	-	25%
<i>Xenopus lenduensis</i>	-	-	+	-	25%
<i>Xenopus laevis</i>	-	-	+	-	25%
<i>Xenopus ruwenzoriensis</i>	-	-	-	+	25%
<i>Xenopus sp</i>	+	+	+	+	100%
Total	16	11	12	6	

This table shows that on 32 species of amphibians collected in four sites, 16 species had been inventoried to

Mungbwalu. These species are: *Afrixalus equatorialis*, *Afrixalus fulvovittatus*, *Afrixalus sp*, *Sclerophrys sp*,

*Arthroleptis sp*, *Hyperolius castaneus*, *Hyperolius langi*, *Hyperolius platyceps*, *Hyperolius rossii*, *Hyperolius sp*, *Leptopelis sp*, *Phrynobatrachus dendrobates*, *Phrynobatrachus sp*, *Ptychadena sp*, *Xenopus cf petersi* and *Xenopus sp*. By contrast at Toyokana, 11 species had been

collected, 12 to Bongobongo and 6 to Mutwanga. Among these species, *Xenopus sp* is ubiquitous. But the species: *Leptopelis sp* and *Sclerophrys sp* was observed in all of the sites studied, except to Mutwanga. However, *Amietia sp* had not been observed to Mungwalu.

**3.2. The Reptiles**

**3.2.1. Diversity of Reptiles**

37 specimens of reptiles diverse in 18 species had been collected.

*Table 4. List of reptiles inventoried.*

Order	Family	Species	Number	%	
Squamata	Agamidae	<i>Acanthocercus sp</i>	11	29,72	
	Viperidae	<i>Bitis gabonica</i> (Duméril, Bibron & Duméril, 1854)	1	2,7	
	Colubridae	<i>Grayia ornata</i> (Bocage, 1866)	2	5,4	
		<i>Philothamnus angolensis</i> (Bocage, 1882)	1	2,7	
	Gekkonidae	<i>Grayia toloni</i>	1	2,7	
		<i>Hemidactylus brookii</i> (Gray, 1845)	2	5,4	
		<i>Hemidactylus mabouia</i> Moreau de Jonnés, 1818	2	5,4	
		<i>Hemidactylus sp</i>	2	5,4	
		<i>Kinixys erosa</i> (Schweigger, 1812)	2	5,4	
	Testudines	Testudinidae	<i>Trachylepis striata</i> (Peters, 1844)	1	2,7
Scincidae		<i>Trioceros bitaeniatus</i> (Fischer, 1884)	2	5,4	
		<i>Trioceros gracilis</i>	1	2,7	
Chamaeleonidae		<i>Kinyongia adolffriderici</i> (Sternfeld, 1912)	1	2,7	
		<i>Chamaeleo bitaeniatus</i> (Fischer, 1884)	1	2,7	
		<i>Chamaeleo ellioti</i> (Günther, 1895)	2	5,4	
		<i>Chamaeleo gracilipes</i>	1	2,7	
		<i>Trioceros oweni</i> (Gray, 1831)	2	5,4	
		<i>Rhampholeon boulengeri</i> Steindachner, 1911	2	5,4	
2		7	18	37	

The review of this table indicates that 37 individuals had been collected in the Ituri forest and to Mutwanga. They are divided into 2 levels, 7 families and 18 species. The family of Chamaeleonidae is the most diversified with 8 species below: *Trioceros bitaeniatus* (2 specimens captured on 37 in total, or a proportion of 5.4%), *Trioceros gracilis* (2.7%), *Kinyongia adolffriderici* (2.7%), *Chamaeleo bitaeniatus* (2.7%), *Chamaeleo ellioti* (5.4%), *Chamaeleo gracilipes* (2.7%), *Trioceros oweni* (5.4%) and *Rhampholeon boulengeri* (5.4%). The families of the Agamidae, Scincidae, Viperidae and Testudinidae was represented each by one genera then one specie respectively by *Acanthocercus sp* (11 specimens: 29.72%), *Trachylepis striata* (2.7%), *Bitis gabonica* (1 specimen: 2.7%) and *Kinixys erosa* (2 specimens: 5.4%).

Notwithstanding, the families of the Colubridae and Gekkonidae are represented respectively by the species: *Grayia ornata* (2 specimens: 5.4%), *Philothamnus angolensis* (1 Individual: 2.7%), *Grayia toloni* (1 Individual: 2.7%). On the one hand, species *Hemidactylus brookii*, *Hemidactylus mabouia* and *Hemidactylus sp* are represented with 2 individuals, or 5.4% each. The species *Acanthocercus sp* is the more abundant with 11 inventoried specimens, or 29.72%. On the other hand, species *Trioceros oweni*, *Chamaeleo ellioti*, *Trioceros bitaeniatus*, *Hemidactylus mabouia* Moreau de Jonnés, 1818, *Grayia ornata* are all represented by 2 individuals each, or 5.4%. *Bitis gabonica*, *Trioceros gracilis*, *Kinyongia adolffriderici*, *Chamaeleo gracilipes* are represented by 1 individual, either 2.7% each.



**Figure 4.** From left to right, some reptiles caught in Mungbwalu, Toyokana, Bongobongo and Mutwanga: *Rhampholeon boulengeri* at the beginning, *Acanthocercus sp* in the centre and *Chamaeleo gracilipes* at the end.

**3.2.2. Relative Abundance of Reptiles in the Inventoried Sites**

*Table 5. Relative abundance of reptiles.*

Species	Mungbwalu	Toyokana	Bongobongo	Mutwanga	Number	%
<i>Achantocercus sp</i>	2	4	3	2	11	29.73
<i>Bitis gabonica</i>	0	0	1	0	1	2.70
<i>Chamaeleo bitaeniatus</i>	0	0	1	0	1	2.70
<i>Chamaeleo ellioti</i>	0	0	2	0	2	5.41
<i>Chamaeleo gracilipes</i>	1	0	0	0	1	2.70
<i>Graya ornata</i>	2	0	0	0	2	5.41
<i>Graya toloni</i>	1	0	0	0	1	2.70
<i>Hemidactylus brookii</i>	0	1	0	1	2	5.41
<i>Hemidactylus mabouia</i>	1	0	0	1	2	5.41
<i>Hemidactylus sp</i>	2	0	0	0	2	5.41
<i>Kinyongia adolfifrideric</i>	0	1	0	0	1	2.70
<i>Kinixys erosa</i>	0	0	2	0	2	5.41
<i>Philothamnus angolensis</i>	0	0	1	0	1	2.70
<i>Rhampholeon boulengeri</i>	0	0	2	0	2	5.41
<i>Trachylepis striata</i>	1	0	0	0	1	2.70
<i>Trioceros bitaeniatus</i>	0	0	2	0	2	5.41
<i>Trioceros gracilis</i>	0	0	1	0	1	2.70
<i>Trioceros oweni</i>	2	0	0	0	2	5.41
Total	12	6	15	4	37	100
Percentage	32.43	16.21	40.54	10.81	100	
Taxa_S	8	3	9	3	18	
Individuals	12	6	15	4	37	
Dominance_D	0.1389	0.5	0.1289	0.375	0.1205	
Simpson_1-D	0.8611	0.5	0.8711	0.625	0.8795	
Shannon_H	2.023	0.8676	2.119	1.04	2.561	
Evenness_e^H/S	0.9449	0.7937	0.9244	0.9428	0.7192	
Equitability_J	0.9728	0.7897	0.9642	0.9464	0.886	

The analysis of this table shows that 37 individuals of reptiles had been collected. They are divided by 12 individuals (32.43%) to Mungbwalu, 6 specimens (16.21%) to Toyokana, 15 individuals (40, 54%) to Bongobongo and 4 specimens (10.81%) to Mutwanga. The dominance to Mungbwalu, Toyokana, Bongobongo and Mutwanga is

respectively 0.1389; 0.5; 0.1289 and 0.375. While the Simpson index\_1-D in the 4 sites is respectively: 0.8611; 0.5; 0.8711 and 0.625. The Shannon index\_H (2.023; 0. 8676; 2.119 and 1.04). Finally, the Equitability is respectively: 0.9728; 0.7897; 0.9642 and 0.9464.

**3.2.3. Frequency of Species of Reptiles in the Environments Studied**

*Table 6. Frequency of species of reptiles.*

Species	Mungbwalu	Toyokana	Bongobongo	Mutwanga	
<i>Achantocercus sp</i>	+	+	+	+	100%
<i>Bitis gabonica</i>	-	-	+	-	25%
<i>Chameleo bitaeniatus</i>	-	-	+	-	25%
<i>Chameleo ellioti</i>	-	-	+	-	25%
<i>Chameleo gracilipes</i>	+	-	-	-	25%
<i>Graya ornata</i>	+	-	-	-	25%
<i>Graya toloni</i>	+	-	-	-	25%
<i>Hemidactylus brookii</i>	-	+	-	+	50%
<i>Hemidactylus mabouia</i>	+	-	-	+	50%
<i>Hemidactylus sp</i>	+	-	-	-	25%
<i>Kinyongia adolfii friderici</i>	-	+	-	-	25%
<i>The genus Kinixys erosa</i>	-	-	+	-	25%
<i>Philothamnus angolensis</i>	-	-	+	-	25%
<i>Rhampholeon boulengeri</i>	-	-	+	-	25%
<i>Trachylepis striata</i>	+	-	-	-	25%
<i>Trioceros bitaeniatus</i>	-	-	+	-	25%
<i>Trioceros gracilis</i>	-	-	+	-	25%
<i>Trioceros oweni</i>	+	-	-	-	25%
Total	8	3	9	3	

It is clear from this table that 18 species had been collected to Mungbwalu, Toyokana, Bongobongo and Mutwanga. The

site the most diversified Bongobongo is with 9 of 18 species in total (50%). The species inventoried are: *Achantocercus*

*sp.*, *Bitis gabonica*, *Chamaeleo bitaeniatus*, *Chamaeleo ellioti*, *Kinixys erosa*, *Philothamnus angolensis*, *Rhampholeon boulengeri*, *Trioceros bitaeniatus* and *Trioceros gracilis* monitoring of Mungbwalu (8 Species: 44.44%). The sites: Toyokana Mutwanga and are the same (3 Species: 16.66%) each.

## 4. Discussion

### 4.1. Amphibians

#### 4.1.1. Diversity of Amphibians

According to these studies [17-22] recognize that the Congo Basin is diversified in herpetofauna. But, the forests of the eastern Democratic Republic of the Congo in general and those of Ituri in particular are also rich in fauna and flora [23, 24, 25]. There are several endemic species, including *Leptopelis karissimbensis* and *Leptopelis kivuensis* [26] to mention only those. Furthermore, although the literature on the amphibian fauna of the Democratic Republic of the Congo is less exhaustive, 226 species are known of the country of which 59 species are endemic (AmphibiaWebdatabase, consulted on 23 September 2017).

It should be noted that a total of 50 species had been identified (32 for amphibians and 18 for reptiles), which is significantly higher than in Rwanda, for example, where 9 amphibian species belonging to 5 families (Arthroleptidae, Bufonidae, Hyperoliidae, Phrynobatrachidae and Pipidae) had been recorded and 17 species in Boteka (DRC, Equateur Province) [27-21].

Among these species, we encounter the species characteristic of the region as *Amietia ruwenzorica*, *Xenopus lenduensis*, *Xenopus ruwenzriensis*, *Hyperolius rossii*, *Xenopus cf petersi*. If although some species seem to be characteristic for an environment, a few observations can be made. It is the case of the species: *Afrixalus equatorialis*, *Amnirana Amnicola*, *Cardioglossa gratiosa*, *Dimorphognathus africanus*, *Hyperolius cf lateralis* and *Leptopelis ocellatus* including their distribution is heard up to Lokutu in Eastern Province Reported by the study [1], and *Leptopelis mackayi* by (Greenbaum *et al.*, 2016). From another point of view, all of these species observed by [1] had been observed by this research except *Cardioglossa gratiosa* and *Dimorphognathus africanus*. On this, in relation with this observation, it proves that when several investigations will be carried out in the region, the distribution map of several species could also be amended.

#### 4.1.2. Relative Abundance of Amphibians in the Inventoried Sites

It is obvious that the distribution of living beings is not regularly in several different habitats. Such is the case for this study. That is why, on 182 specimens of amphibians caught, 73 individuals (40.10%) had been sampled to Mungbwalu, 49 specimens (26.92%) to Toyokana, 40 individuals (21.97%) to Bongobongo and 20 specimens (10.98%) to Mutwanga. As we have just seen, several specimens were collected at Mungbwalu. It is because there was more inventoried as the

other sites. As to what is diversity indices observed, the index of dominance<sub>D</sub> is respectively 0.1537 to Mungbwalu, 0.1878 to Toyokana, 0.1525 to Bongobongo and 0.31 to Mutwanga. For what is the Simpson's index<sub>1-D</sub>, we observed 0.8463 in the first site; 0.8122 in the second; 0.8475 in the third and is 0.69 in the last.

In addition, the Shannon index<sub>H</sub> is 2.215 to Mungbwalu, 1.921 to Toyokana, 2.7144 to Bongobongo and 1.446 to Mutwanga. The evenness to Mungbwalu (0.799), Toyokana (0.8011), Bongobongo (0.8627) and Mutwanga (0.8068). Among all the species sampled, only the species *Xenopus sp* is ubiquitous. In the same way that we confirm with these studies [28, 29, 30] that this species is invasive.

#### 4.1.3. Frequency of Species of Amphibians

Among the 32 species of amphibians harvested in the four sites, 16 species (50%) had been inventoried to Mungbwalu between other: *Afrixalus equatorialis*, *Afrixalus fulvovittatus*, *Afrixalus sp*, *Sclerophrys sp*, *Arthroleptis sp*, *Hyperolius castaneus*, *Hyperolius langi*, *Hyperolius platyceps*, *Hyperolius rossii*, *Hyperolius sp*, *Leptopelis sp*, *Phrynobatrachus dendrobates*, *Phrynobatrachus sp*, *Ptychadena sp*, *Xenopus cf petersi* and *Xenopus sp*.

For example, the *Arthroleptis* Smith, 1849 genus is endemic in the sub-Saharan region in Africa. It meets in several habitats, but several are in the forest [31]. This genus had been captured in the wetlands mainly on the species of Poaceae developed around ponds located in the holes of the forest. The *Arthroleptis* were harvested on the litter. By contrast, the *Hyperolius* and *Leptopelis* genera had been sampled in full forest.

Not only agricultural activities are very well installed in the region but still, the agricultural scale encroachment on forestlands have long dates provided spaces favorable to parasylvicoles species [13]. Given that we had worked in the area of altitude (more than 1000 m), the results have shown that the species captured belong to surely orophile procession or orobiontes which is the turning point which marks the scarcity or the disappearance of species planitiaires. Among the species inventoried, *Phrynobatrachus auritus* is a species terrestrial woodland and *Afrixalus laevis*, a silvicultural species. The amphibian fauna of the studied environments is composed of a single species ubiquitous (*Xenopus laevis*).

### 4.2. The Reptiles

#### 4.2.1. Diversity of Reptiles

The Ituri forest and the Rift are deemed more diversified in the herpetofauna. Many species have already been described in the region, between other *Kinyongia gyrolepis sp. nov.* [32] for not only be limited to Chamaeleonidae. For this study, the results show that 18 species of reptiles had been collected. In effect, the family of the Chamaeleonidae is the most diversified with 8 species. *Kinyongia adoliffriderici* (Sternfeld, 1912), its type locality, the forest of Irumu-Mavambi (DRC). It is located in Burundi, DRC, Rwanda and Uganda. *Trioceros oweni* (Gray, 1831), its type locality is in Equatorial Guinea (Fernando Poo). This species has a wide

distribution: Angola (Cabinda), Cameroon, the Democratic Republic of the Congo, the Republic of the Congo, Equatorial Guinea, Gabon, Nigeria and Uganda. And, *Rhampholeon boulengeri* has for its type locality Mont Nzawa to Moba (Katanga), DRC.

The families of the Agamidae, Scincidae, Viperidae and Testudinidae are represented with these species: *Acanthocercus sp* is the most abundant (29.72%). By contrast, the species *Trioceros oweni*, *Chamaeleo ellioti*, *Trioceros bitaeniatus*, *Hemidactylus mabouia*, *Grayia ornata* are all represented by 2 individuals each, either 5.4% while *Bitis gabonica*, *Trioceros gracilis*, *Kinyongia adolfifriederici*, *Chamaeleo gracilipes* are represented by 1 individual, either 2.7% each. It is fitting to note that [21] had captured also 18 species of reptiles on his expedition to Boteka in the forest of low altitude of the Tshopo Province (DRC).

#### 4.2.2. Relative Abundance of Reptiles

The analysis of the table 5 indicates that 37 individuals of reptiles had been collected. They are divided into 12 individuals (32.43%) to Mungbwalu, 6 specimens (16.21%), Toyokana, 15 individuals (40.54%) to Bongobongo and 4 specimens (10.81%) to Mutwanga. The dominance to Mungbwalu, Toyokana, Bongobongo and Mutwanga is respectively 0.1389; 0.1289 and 0.375.

#### 4.2.3. Frequency of Species of Reptiles

The site the most diversified Bongobongo is with 9 of 18 species in total (50%). The species inventoried are: *Achantocercus sp*, *Bitis gabonica*, *Chamaeleo bitaeniatus*, *Chamaeleo ellioti*, genus *Kinixys erosa*, *Philothamnus angolensis*, *Rhampholeon boulengeri*, *Trioceros bitaeniatus* and *Trioceros gracilis* monitoring of Mungbwalu (8 Species: 44.44%). The sites: Toyokana Mutwanga and are the same (3 species: 16.66%) each.

## 5. Conclusion

The general objective of this work was to inventory the herpetofauna of the Ituri forest especially to Mungbwalu, Toyokana, Bongobongo and Mutwanga in the province of North Kivu. We inventoried 219 individuals (182 specimens of amphibians divided into 32 species and 37 specimens of reptiles diverse in 18 species). The reptiles are more diverse than the amphibians. To do this, 182 specimens of amphibians were captured divided into 8 families, 11 genera and 32 species while 37 individuals (2 orders, 7 families and 18 species) of reptiles had been inventoried in the Ituri forest and that of Mutwanga. This study has allowed us to know the composition of the herpetological stand of Ituri forest and Mutwanga. All species collected are known in the region. However, we emphasize that our results are not exhaustive because most of species caught (amphibians or reptiles) are described to the rank of genus. The results are interesting, but several systematic research molecular and must be made in order to be fixed in the herpetofauna of the region.

## Acknowledgements

We would especially like to thank Dr Eli GREENBAUM from the University of Texas at El Paso (USA) for his passion for Congolese herpetological research by financing this study with his own funds and identification of specimens. We thank the Centre de Surveillance de Biodiversité (CSB/UNIKIS) of the University of Kisangani for the logistics and administrative formalities. Lastly, we would like to thank MONINGA WANDEGE Jean Claude for his active participation in the research. Thank you for the technical and administrative support of the political authorities of Ituri province as well as that of the local population.

## References

- [1] T. Mr. Bytynski and J. McCullough, *a rapid biological assessment of Lokutu, Democratic Republic of Congo*, Vol. 46. 2007.
- [2] K. Jackson, A.-G. Zassi-Boulou, L.-B. Mavoungou, and S. Pangou, "Amphibians and Reptiles of the TV Lake Community reserve, Likouala region, Republic of Congo (Brazzaville)," *herpetol. Conserv. Biol.*, Vol. 2, pp. 75-86, 2007.
- [3] Z. T. Nagy, C. Kusamba, Mr. collar, and V. Gvoždik, "Notes on the herpetofauna of western Bas-Congo, Democratic Republic of the Congo, *Herpetol. Notes*, Vol. 6, no. September, pp. 413-419, 2013.
- [4] Böhm et al., "The conservation status of the world s reptiles," *Biol. Conserv.*, Vol. 157, pp. 372-385, 2013.
- [5] D. Rödder, J. Kielgast, J., Bielby S. Schmidlein, J. Bosch, T. W. J. Garner, Mr. Veith, S. Walker, Mr. C. Fisher, and S. Lötters, "Global Amphibian extinction risk assessment for the panzootic chytrid fungus," *Diversity*, Vol. 1, no. 1, pp. 52-66, 2009.
- [6] F. T. Brum, L. O. Gonçalves, L. Cappelatti, Mr. B. Carlucci, V. J. Debastiani, E. v. Salengue, G. D. dos Santos Seger, C. Both, J. S. Bernardo-Silva, R. D. Loyola, and L. da Silva Duarte, "Land Use explains the distribution of threatened New World Amphibians better than climate," *PLoS ONE*, Vol. 8, no. 4, 2013.
- [7] R. D. Loyola, C. G. Becker, U. Kubota, C. F. B. Haddad, C. R. Fonseca, and T. Mr. LEWINSOHN, "hung out to dry: choice of priority ecoregions for conserving threatened neotropical anurans depends on life-history traits," *PLoS ONE*, Vol. 3, no. 5, p. 8 pages., 2008.
- [8] K. Zippel, K. Johnson, R. Gagliardo, R. Gibson, Mr. McFadden, R. Browne, C. Martinez, and E. Townsend, "The Amphibian Ark: a global community for ex situ conservation of amphibians," *Herpetol. Conserv. Biol.*, Vol. 6, no. 3, pp. 340-352, 2011.
- [9] A. Quaranta, V. Bellantuono, G. Cassano, and C. Lippe, "Why amphibians are more sensitive than mammals to xenobiotics," *PLoS ONE*, Vol. 4, no. 11, 2009.
- [10] I. Bamba, "Anthropisation and spatio-temporal dynamics of forest landscapes in the Democratic Republic of the Congo," *Univ. Libr. Brussels Fac. Of Sci. Ci. Interfacultaire BioIngénieurs*, p. 205, 2010.

- [11] Mr. D. & C. P. B. Thierry Frétey, "amphibians of Africa Centrale and Angola. Key to the determination shown amphibians of Gabon and the Mbini," *Herpetol. Rev.*, Vol. 43, no. 4, p. 232, 2012.
- [12] T. Dejean, C. Miaud, and Mr. Ouellet, "The chytridiomycose: an emerging disease of amphibians," *Bull. the Herpetological Society Fr.*, Vol. 134, p. 27-46 pages., 2010.
- [13] Amiet Jean - Louis, "The frogs of Cameroon (Amphibians Anura)," p. 591, 2012.
- [14] H. Elizabeth, G. J. Measey, D. Patrick, Mr. Menegon, and J. Vonesh, "Field Guide to the Amphibians of the Eastern Arc mountains and coastal forests of Tanzania and Kenya," *UIC, Print. Press. Singapore.*, p. 316, 2010.
- [15] T. Frétey, Mr. Dewynter, and C. P. White, "amphibians of Central Africa er of Angola. Key to the determination shown amphibians of Gabon and the Mbini.," *Herpetol. Rev.*, Vol. 43, no. 4, p. 232 pages, 2012.
- [16] J. Chippaux, "The Snakes of Western and Central Africa," *IRD Editions Inst. Rech. For the development Collect. Ed. Rev. Augment. Wildlife Flora too.* 35, p. 311, 2006.
- [17] R. C. Bell, R. C. Drewes, A. Channing, V. Gvoždík, J. Kielgast, S. Lötters, B. L. Stuart, and K. R. Zamudio, "Overseas dispersal of *Hyperolius* reed frogs from Central Africa to the oceanic islands of São Tomé and Príncipe," *J. Biogeogr. doi 10.1111/JBI.12412*, Vol. 42, p. 65-75 pages, 2015.
- [18] R. T. Hoser, "A new species of Night Adder (Serpentes: Viperidae) from Central Africa.," No. July, pp. 32-35, 2013.
- [19] S. R. Goldberg, C. R. Bursey, E. Greenbaum, S. T. R. G. Oldberg, C. H. R. B. Ursey, and E. L. I. G. Reenbaum, "gastrointestinal helminths of the Black-necked Agama, *Acanthocercus atricollis* (Squamata: Agamidae), from the Democratic Republic of the Congo gastrointestinal helminths of the Black-necked Agama, *Acanthocercus*," 2012.
- [20] S. Lamprophiidae, R. T. Hoser, P. Road, and P. orchards, "a three-way division of the African Centipede Eating snakes, *Aparallactus* Smith, 1849 (Serpentes: Lamprophiidae: Aparallactinae) and a new subgenus of Wolf Snakes *Lycophidion* Fitzinger, 1843," *Aust. J. Herpetol.*, Vol. 5698, no. June, pp. 10-14, 2012.
- [21] C. O. Connor, B. Coutts, and C. S. Nat, "Herpetological Study for Feronia, Boteka oil palm plantation High Conservation Value Assessment," *Digby Environmental Wells*, p. 23, 2015.
- [22] R. T. Hoser, "Four new species of snake from Central Africa (Serpentes: Colubridae) and (Serpentes: Lamprophiidae).," No. July, pp. 20-25, 2013.
- [23] K. R. Gubista, "small mammals of the Ituri Forest, Zaire: diversity and abundance in ecologically distinct habitats," *J. Mammal.*, pp. 252-262, 1999.
- [24] P. G. B. Katuala, J., a Hart, R. Hutterer, H. Leirs, and A. Dudu, "Biodiversity and ecology of small mammals (rodents and shrews) of the 'Reserve of Fauna has Okapis', Democratic Republic of the Congo," *Belgian J. Mus.*, Vol. 135, No. December, pp. 191-196, 2005.
- [25] C. E. N. Ewango, "The Liana assemblage of has Congolian rainforest: diversity, structure and dynamics," *thesis, Wageningen Univ. Wageningen, NL*, p. 161, 2010.
- [26] C. E. Roelke, E. Greenbaum, C. Kusamba, Mr Aristotle, and E. N. Smith, "Systematics and Conservation Status of two distinct Albertine Rift treefrogs, *Leptopelis karissimbensis* and *Leptopelis kivuensis* (Anura: Arthroleptidae)," *J. Herpetol.*, Vol. 45, no. 3, pp. 343-351, 2011.
- [27] C. E. Roelke and E. N. Smith, "herpetofauna, the Volcanoes National Park, North Province, Republic of Rwanda," *Check List*, Vol. 6, no. 4, pp. 525-531, 2010.
- [28] G. J. Measey, D. Rödder, S. L. Green, R. Kobayashi, F. Lillo, G. Lobos, R. Rebelo, and J. Mr. Thirion, "ongoing invasions of the African clawed frog, *Xenopus laevis*: A Global Review", *Biol. The invasions*, Vol. 14, pp. 2255-2270, 2012.
- [29] V. T. Vredenburg, S. A. felt, E. C. Morgan, S. v. G. McNally, S. Wilson, and S. L. Green, "Prevalence of *Batrachochytrium dendrobatidis* in *Xenopus* Collected in Africa (1871-2000) and in California (2001-2010)," *PLoS ONE*, Vol. 8, no. 5, 2013.
- [30] C. K. and B. J. E. Benjamin L. S. Furman, Adam J. Bewick, TIA L. Harrison, Eli Greenbaum, Vaclav Gvozdik, "Pan-African phylogeography of a model organism, the African clawed frog '*Xenopus laevis*,'" *Molecular Ecology*, Vol. 24, no. 24, pp. 909-925 pages, 2015.
- [31] Mr. O. Rödel, J. Doumbia, A. T. Johnson, and A. Hillers, "A new small *Arthroleptis* (Amphibia: Anura: Arthroleptidae) from the Liberian part of Mount Nimba, West Africa," *Zootaxa*, No. 2302, pp. 19-30, 2009.
- [32] E. Greenbaum, K. A. Tolley, A. Joma, and C. Kusamba, "A new species of chameleon (Sauria: Chamaeleonidae: *Kinyongia*) from the Northern Albertine Rift, Central Africa," *Herpetologica*, Vol. 68, no. 1, pp. 60-75, 2012.