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A preliminary study on the herpetological fauna in the forest refuge of Dzu, Dzoo, Nzerku 3 and Nzonzo in Relict Altitude Forest of the Albert Lake Escarpment (RAFALE), (Djugu territory, Democratic Republic of the Congo)

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ABSTRACT: In the relict forest shreds located in Ituri in the territory of Djugu, on the shores of Lake Albert in the Democratic Republic of the Congo (DRC), a preliminary study on herpetofauna was carried out. According to this research, 19 amphibian species and 21 reptile species were harvested in 12 days between April and May 2017. Samples were taken from four research sites: Dzu (N01.94753°; E030.88848°), Dzoo (N01.92742°; E030.89179°), Nzerku 3 (N01.94119°; E030.90612°) and Nzonzo (N01.90352°; E30.91030°). The principal objective of this study was to inventory the herpetological fauna of the Relict Altitude Forest of the Albert Lake Escarpment (RAFALE) landscape. During the night, amphibians were captured by hand by using headlight. A herpetological stick was used to collect reptiles. These biopsies consisted essentially of tissue from the tongue and muscle. Specimens were photographed alive then fixed with formalin (10%), before being preserved in alcohol (70%). Results are interesting and show that the habitats are very rich and diversified. There were more diverse reptiles than amphibians. Considered as a 'red area' where studies are known to be hostile, through this research, it is appropriate to point out that the potential for further in-depth research and focusing efforts for the sustainable conservation of this area is both possible and still urgent.

KEYWORDS: Rift Albertin, amphibians, reptiles, Democratic Republic of the Congo, herpetofauna, RAFALE.

1 INTRODUCTION

Many zoological studies on various taxa have already been carried out in the Albertine Rift [1] & [2]. But [3], [4], [5] & [6] studied herpetology there. There are many types of habitats in the Albertin Rift that support shelter for high biological diversity [7]. The area is a hot spot for endemicity and biological diversity [8], [6] & [4]. As for amphibians, it is one of the most important conservation sites in Africa because 20% of African amphibians are found there [7].

The amphibians are not intensively studied in the relict forests on the Congolese DRC part, precisely in the Rethy area, whereas the region is reputed to be rich in biodiversity and endemism, particularly for birds and amphibians. There are even great apes (*Pan paniscus*) and other carnivores. The Democratic Republic of the Congo's biological diversity is great, less is its knowledge. In the territory of Djugu, the objective of this study was to inventory the herpetological fauna of the relict forest landscape of the Albertin rift located on the shores of Lake Albert. Acknowledging the loss of habitats as the main cause of biodiversity loss [9], [10], [11], [12], [13] & [14], integrating forest area management into the sustainable management of forest ecosystems remains a major priority. Doing nothing to conserve this rich diversity of blogging species will simply be doomed to extinction.

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The scientific interest of this investigation is twofold. In fact, it highlights the specific richness of the RAFALE forest. Then present a plea in favour of the site so that it benefits from a protection status at national or even international level for the conservation of its rich and varied animal and plant biological resources.

2 MATERIALS AND METHODS

2.1 FIELD OF STUDY

The geologists report the presence of oil in the Monts Bleus and Lake Region as a real threat to the conservation of natural resources in this part [2]. That is why impact studies are urgent to prevent and minimize the dangers of probable future pollution, in the event of geological, anthropic or ecological accidents.

2.2 VEGETATION

Mountains forests are still maintained in Djugu and Mahagi territory. The northeastern territories are covered by forests of medium altitude (1200-1500 m) and high altitude (>1500 m) while those of Irumu and Mambasa are of low altitude (<1200m). On the Lendu plateaus, vegetation is currently dominated by grassy savannah but gallery forests persist towards Lake Albert [2]. These galleries are secondary types and border the various rivers that flow into Lake Albert. They are rich in species belonging to the families Sapotaceae, Annonaceae, Cannabaceae, Putrangivaceae, Fabaceae, Sapindaceae, Rubiaceae, Euphorbiaceae, and Boraginaceae. The underbrush is clear but the few underbrush shrubs are mainly represented by Acanthaceae and Rubiaceae (Rothmannia and Coffea). The predominant plant species are *Piper umbellatum* L. (Piperaceae), *Palisota schweinfurthii* (Commelinaceae) C.B. Clarke, *Brilantesia sp*, *Urtica sp* (Urticaceae).

The climate is mountainous (altitude varies from 1600 m to 2456 m). Temperatures range from 18-25°C. Heavy rainfall periods are observed in April, September and October.

Fig. 1. Sites for amphibians and reptiles 1. ISPT shallows, 2 and 6. Lake Albert, 3. Dzu, 4. Dzoo and 5. Nzerku 3

2.3 THE RESEARCH METHODOLOGY

During the day, amphibian capture sites were prospected and retained. For reptiles, catches were made at night and during the day. This was done by raking into the forest following a stream. Amphibians were captured at night between 7 pm and 10 pm by the bare hand. They were indeed flushed out in the dark by the dazzling light of a headlamp. The captured animals were stored and then transported alive or dead in a plastic bag from the forest to the work camp.

Specimens of amphibians captured were digitized alive on millimeter khaki paper using a digital camera. As we advocate less invasive data collection, a sample of an amphibian population was collected and then killed by a lethal injection of alcohol into the lungs. Additional specimens from the same population were simply released into the wild. After the following information had been taken on the specimen, including assigning a tag number, determining genus and species, taking geographic coordinates, taking photo numbers of the specimen, etc., the following step was to clean the specimens with the watt.

The thigh muscle and tongue tissue were removed and stored in a numbered Eppendorf tube containing alcohol (70%). The tissues will later be used for molecular analyses. Shears and pliers were used for dissection. After each handling on a specimen, they were washed rigorously with a soapy solution then rinsed with alcohol. This to avoid contamination between the preceding individual and the specimen to be treated. Specimens of amphibians were stored in alcohol (70%) in accordance with (Roelke & al., 2011).

We first identified the specimens by the external morphological characteristics and confirmed them with the different keys. The snakes [15] & [16], the amphibians [17], [18] and authoritarian amphibian sites (Frost & al. The amphibians of the world).

3 RESULTS

3.1 AMPHIBIANS CAUGHT IN THE LANDSCAPE RAFALE

In table (1), 149 amphibian specimens were collected in Dzu, Dzoo, Nzerku 3 and Nzonzo. They are subdivided into 19 species, 9 genera and 8 families. The family with the most abundant is that of Pyxicephalidae Bonaparte, 1850 with the species *Amietia sp* (25 individuals: 16.78%), *Amietia wittei* (Angel, 1924) with (4 specimens: 2.68%), *Amietia angolensis* (Bocage, 1866) (12 individuals: 8.05%). In addition, the family Ptychadenidae Dubois, 1987 comes next with 3 following species *Ptychadena cf aequiplicata* (Werner, 1898) (5 individuals : 3.36%), *Ptychadena cf oxyrhynchus* (Smith, 1849) (3 specimens : 2.01 %) and *Ptychadena mascariensis* (Dumeril & Bibron, 1841) (30 individuals : 20.13%). The Bufonidae family is the most diversified with 4 species: *Sclerophrys cf guttularis* (Power, 1927) with 3 specimens (2.01%), *Sclerophrys maculatus* (Hallowell, 1854) (12 specimens: 8.05%), *Sclerophrys regularis* (Reuss, 1833) (4 individuals: 2.68%) and *Sclerophrys sp* (15 specimens: 10.07%). The least represented is the family of Phrynobatrachidae which is monospecific (*Phrynobatrachus sp* with 3 specimens, or 2.01%).

Table 1. Amphibian's biodiversity in the landscape RAFALE

Order	Family	Genus	Species	Total	%
Anura	Hyperoliidae Laurent, 1943	Afrixalus (Laurent, 1944)	*Afrixalus fulvovittatus* (Cope, 1861)	7	4.70
	Pyxicephalidae Bonaparte, 1850	Amietia (Dubois, 1987)	*Amietia sp*	25	16.78
			Amietia wittei (Angel, 1924)	4	2.68
			Amietia angolensis (Bocage, 1866)	12	8.05
	Arthroleptidae Mivart, 1869	Arthroleptis (Smith, 1849)	*Arthroleptis sp*	6	4.03
	Dicroglossidae Anderson, 1871	Hoplobatrachus (Peters, 1863)	*Hoplobatrachus occcipitalis* (Günther, 1858)	4	2.68
	Hyperoliidae Laurent, 1943	Hyerolius (Rapp, 1842)	*Hyerolius cinnamomeoventris* (Bocage, 1866)	2	1.34
			Hyperolius ocellatus (Günther, 1858)	3	2.01
			Hyperolius sp	2	1.34
	Phrynobatrachidae Laurent, 1941	Phrynobatrachus (Günther, 1862)	*Phrynobatrachus sp*	3	2.01
	Ptychadenidae Dubois, 1987	Ptychadena Boulenger, 1917	*Ptychadena cf aequiplicata* (Werner, 1898)	5	3.36
			Ptychadena cf oxyrhynchus (Smith, 1849)	3	2.01
			Ptychadena mascariensis (Duméril & Bibron, 1841)	30	20.13
	Bufonidae Gray, 1825	Sclerophrys Tschudi, 1838	*Sclerophrys cf guttularis* (Power, 1927)	3	2.01
			Sclerophrys maculatus (Hallowell, 1854)	12	8.05
			Sclerophrys regularis (Reuss, 1833)	4	2.68
			Sclerophrys sp	15	10.07
	Pipidae Gray, 1825	Xenopus Wagler, 1827	*Xenopus cf laevis* (Daudin, 1802)	6	4.03
			Xenopus sp	3	2.01
1	**8**	**9**	**19**	**149**	**100**

The richness is great as shown in the figures below (figure 2).


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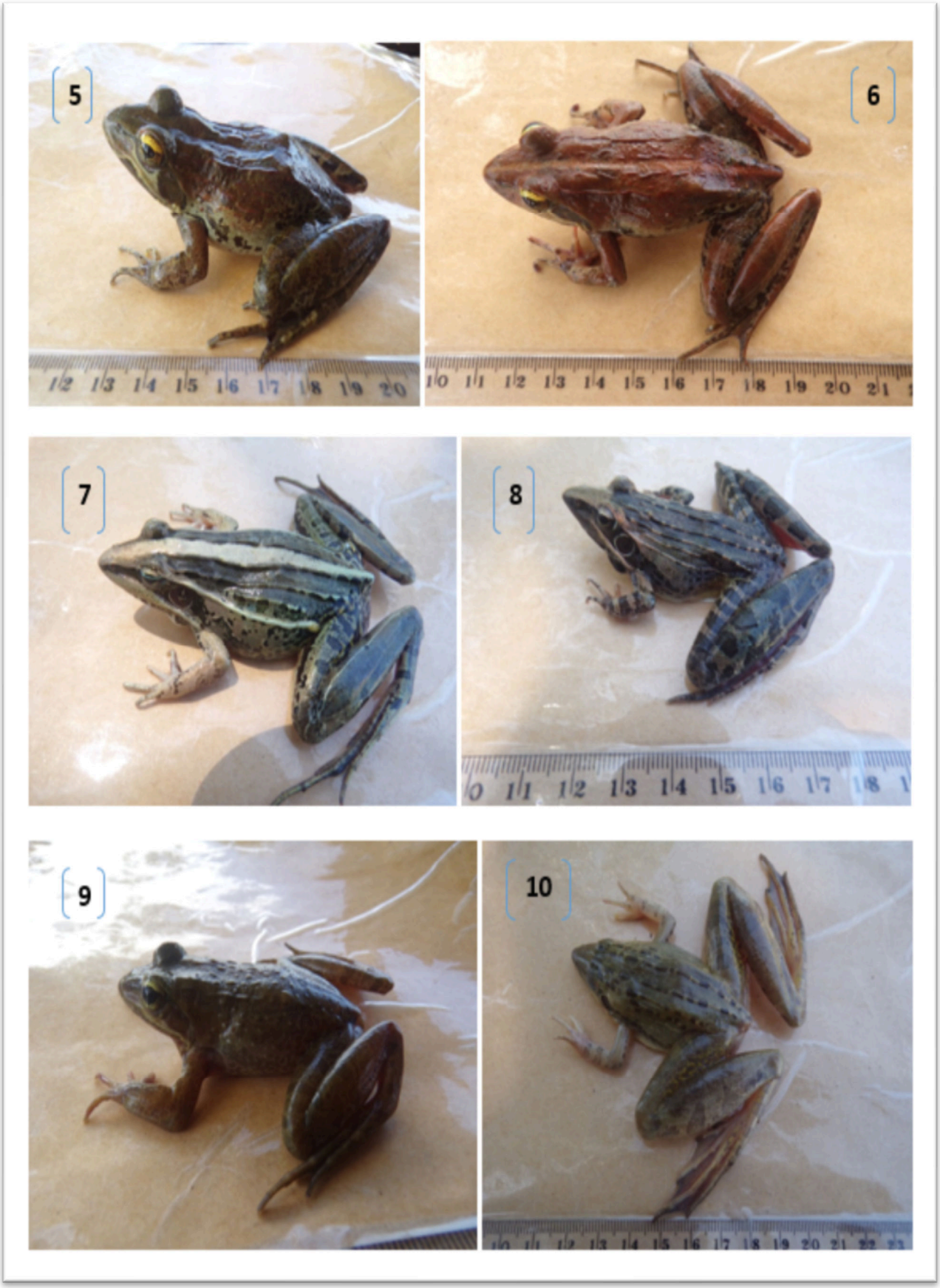
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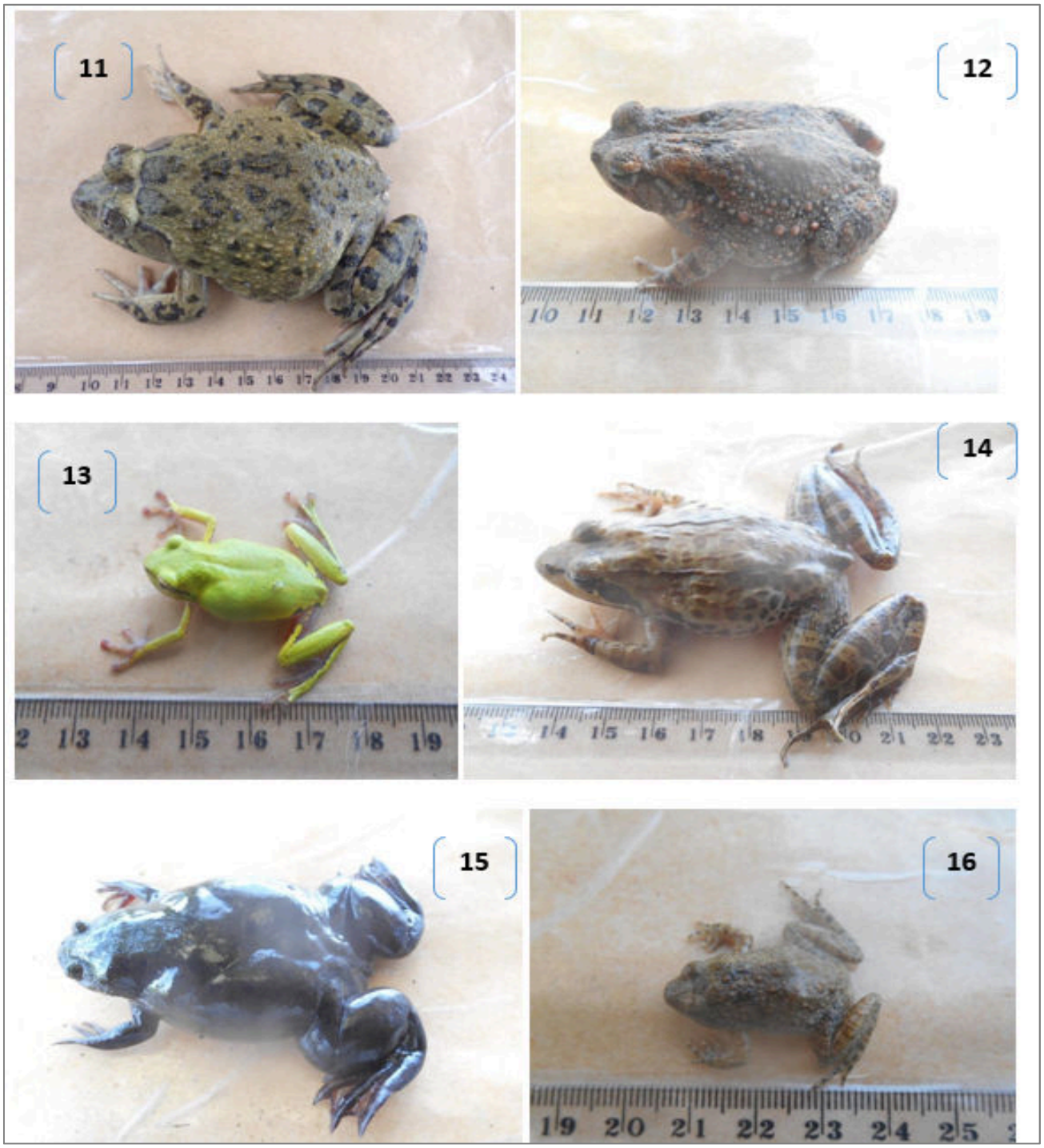

Fig. 2. Selected amphibian species caught in the RAFALE landscape: Ptychadena cf oxyrhynchus (1), Amietia sp (2, 6, 9 and 14), Amietia angolensis (5), Ptychadena sp (3, 7, 8 and 10), Hyerolius cinnamomeoventris (13), Arthroleptis sp (4 and 16), Hoplobatrachus occipitatlis (11), Sclerophrys sp (12), Xenopus sp (15), Arthroleptis sp (16).

3.2 LIST OF REPTILES COLLECTED IN THE RAFALE LANDSCAPE

In Table (2), 27 specimens of reptiles divided into 21 species grouped into 19 genera and 11 families were recorded in Dzoo, Dzu, Nzerku 3 and Nzonzo. The individuals collected belong to the Order of Squamates. Sincidae family is the most abundant with the species: *Trachylepis quinquetaeniata* (Lichtenstein, 1823) (4 specimens: 14.81%), succeeded by Pythonidae (Python sebae (Gmelin, 1789) with 3 individuals collected, or 11.11%. The family of Agamidae is the most diversified with 3 species. Most of the genera identified are mono specific (table 2).

Table 2. Reptiles collected in the RAFALE landscape

Family	Genus	Species	Total	%
Agamidae	Acanthocercus	*Acanthocercus sp*	1	3.70
	Agama	*Agama cf africana* (Lichtenstein, 1823)	1	3.70
		Agama sp	1	3.70
Viperidae	Bitis	*Bitis arientans* (Merrem, 1820)	1	3.70
Chaemeleonidae	Chaemeleo	*Chaemeleo sp*	1	3.70
Gekkonidae	Cnemaspis	*Cnemaspis sp*	1	3.70
Colubridae	Dipsadoboa	*Dipsadoboa viridis* (Peters, 1869)	1	3.70
Lamprophidae	Duberria	*Duberria sp*	1	3.70
Gekkonidae	Hemidactylus	*Hemidactylus brookii* (Gray, 1845)	1	3.70
		Hemidactylus mabouia (Gray, de Jonnès, 1818)	1	3.70
Gekkonidae	Lygodactylus	*Lygodactylus sp*	1	3.70
	Trachylepis	*Trachylepis sp*	2	7.41
Elapidae	Naja	*Naja melanoleuca* (Hallowell, 1857)	1	3.70
Scincidae	Panaspis	*Panaspis sp*	1	3.70
Colubridae	Philothamnus	*Philothamnus angolensis* (Bocage, 1882)	1	3.70
Lamprophidae	Prosymna	*Prosymna sp*	1	3.70
	Psammophis	*Psammophis sp*	1	3.70
Pythonidae	Python	*Python sebae* (Gmelin, 1789)	3	11.11
Colubridae	Thelotornis	*Thelotornis kirtlandii* (Hallowell, 1844)	1	3.70
Scincidae	Trachylepis	*Trachylepis quinquetaeniata* (Lichtenstein, 1823)	4	14.81
Varanidae	Varanus	*Varanus niloticus* (Linnaeus, 1766)	1	3.70
11	**19**	**21**	**27**	**100**


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Fig. 3. Some of the reptile species caught in the RAFALE landscape
Cnemaspis sp (1), Trachylepis quinquetaeniata (2), Python sebae (3), Trachylepis sp (4), Philothamnus angolensis (5 and 10), Thelotornis kirtlandii (6), Duberria sp (7), Bitis arientans (8), Lygodactylus sp (9).

4 DISCUSSION

The current study on amphibians in the Dzu, Dzoo and Nzonzo portion of the Albert Rift, and even at low elevations near Lake Albert to the Congolese side, shows that repeated and extensive amphibian research is less important because less is published on them. We are limited to make a substantive comparison of our results. We will indeed focus on the work done by other researchers on the other part of the Rift.

The Albertine Rift is a region in Central Africa that extends 30 km north of Lake Albert to the southern tip of Lake Tanganyika, including the western rift valley and escarpment slopes less than 100 km east of the border with the Democratic Republic of Congo (DRC). Studies on amphibians on the Albertine Rift have shown that it is particularly rich in amphibian diversity and endemism (Sinsch et al., 2011). Approximately 20% of amphibians in Africa are found in the rift (Plumptre et al., 2003, 2007). Newer species descriptions in the genera Hyperolius (Dehling 2012, Channing et al. 2013), Xenopus (Evans et al., 2008, 2011) in (Greenbaum et al., 2013) and Leptopelis (Portillo & Greenbaum submitted, a,b) in (Greenbaum et al., 2013) have added to the known amphibian diversity on the Albertin Rift.

We have found, as confirmed (Greenbaum et al., 2013), that the herpetological fauna of the Rift is rich and diverse (Table 1 and 2). As for the species recorded, 7 specimens of *Afrixalus fulvovittatus* (Cope 1861) had been caught mainly on the Poaceae (Herbaceae) located in the swamps. Most of the species gathered were vocal, especially the males. These were numerous between 7 pm and 9 pm. Many of these, we noted, were in amplexus. As for the genus Amietia, they were mostly caught in

open areas such as mixed maize-corn and cassava leaf fields. These fields are located near streams. There were others that had been collected on litter in the forest, on rocks, and on the land. The species of this genus were generally discrete and vocalized less. From 19:00 hours to 21:00 hours, their capture was active. *Arthroleptis sp* were mostly caught in the morning. Some were collected in the forest under a closed canopy. In all surveyed sites, *Hoplobatrachus occipitalis* had not been caught except on Lake Albert. They are very active at night from 7 pm and onwards.

There are three species of the genus Hyperolius. These species had all been collected from the Poaceae in swampy areas where they actively vocalized during the night. The species *Phrynobatrachus sp*, was caught during the night in the shreds of forests on a small branch of tree located not far from the ground. Most Ptychadena species were caught on the banks of rivers from 7 p.m. All the inventoried Sclerophrys species were found on litter in the forest and others were completely in the water. We captured Xenopus in muddy marshes containing water and rotten foliage with twigs of trees.

5 CONCLUSION

The RAFALE investigation is preliminary and of short duration, but the results are very interesting. These results show that RAFALE relict forests contain a high diversity of herpetological biodiversity. We suggest that long-term research be conducted in this area to allow us to know the herpetological fauna of the surroundings of Rethy. From the aforementioned, we make recommendations to consider several other herpetological field excursions in the region to more fully study RAFALE landscape biodiversity as preliminary results are very encouraging. Afterwards, that other research be focused in 2 or several stables sites in order to finally bring out other ecological aspects which are not highlighted by this study. It remains a challenge for the future to verify the paternity of certain species within the different forest blocks of this region (RAFALE) which are naturally separated by natural barriers for certain species. To achieve this, more elaborate ecological studies must be undertaken in order to highlight the ecological role, the diversity between various valleys and possibly specifically compare the abundance, constancy or even rarity of amphibians from one site to another according to ecological parameters.

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