



# New Data on Snake Diversity (ophidia) in the Lokutu Square Degree and its Surroundings

<sup>1</sup>Kihambu Fundji, <sup>2</sup>Katuala Gatate Banda, <sup>3</sup>Iyongo Waya Mongo and <sup>4</sup>A. L. Lokasola

<sup>1,3</sup>Faculty of Renewable Natural Resource Management, University of Kisangani

<sup>2</sup>Faculty of Sciences, University of Kisangani

<sup>4</sup>Department of Agricultural Techniques, Higher Institute of Agronomic Studies of Bengamisa

## ARTICLE INFO

### Article history:

Received: 9 April 2025;

Received in revised form:

12 May 2025;

Accepted: 28 May 2025;

### Keywords

Central Africa Region,  
Central Congo Ecoregion,  
Congo Basin,  
Species *Dendroaspis jamesoni*,  
*Toxycodryas adamanteus*.

## ABSTRACT

Studies on species diversity of Ophidians are less advanced in the Central Congo forest ecoregion than in other ecoregions of the central Congolese basin. In other words, the diversity of Ophidians in this region remains poorly known. Preliminary research indicates that the central Congolese basin harbours remarkable diversity of Squamates (Lokasola & al. 2017), but this remains to be confirmed by updated studies on snakes, a group that has been little studied in the sector. The most extensive study of the herpetofauna of this area dates from the colonial period, conducted by Schmidt (1919). It is now obsolete (Lokasola & al. 2017, Lokasola, 2022). Therefore, the present article examines the diversity of Ophidian species in the Lokutu square degree, with the objective of producing a species list and reporting their ecological preferences, conservation status, and the harmfulness of their bites. The main aim is to test the hypothesis that the species list of snakes presented by previous studies on the sector is incomplete. To achieve this objective, a team composed of four people (Felix Kihambu, our dissertation supervisor, and two local guides) conducted surveys across a range of habitats within the Lokutu square degree. The habitats studied included forests, wetlands, rivers, and agricultural lands. The studies were conducted both during the day and at night, to maximise the chances of encountering both diurnal and nocturnal species. Collections were carried out randomly on reconnaissance trails and were time-limited to obtain semi-quantitative binary presence/absence data. A total of 31 snake species were reported, thus adding ten species to the twenty or so already known to exist in this sector. Although still short of the forty species expected based on predictions rooted in the continuity of the Congolese equatorial forest and the absence of biogeographical barriers for snakes, our results are highly significant as this is the first time the threshold of 24 species has been surpassed in this sector. We recommend further systematic studies using genetic markers and more extensive sampling of certain taxa to gain a more comprehensive understanding of the subject.

© 2025 Elixir All rights reserved.

## 1. Introduction

The most comprehensive study of snakes in the central Congolese basin, conducted in 1919, identified 24 distinct morphological species. During the Belgian colonial period, a number of expeditions were conducted in the surroundings of Lokutu, notably by Loveridge (1924) and Schmidt (1919). However, considering the current situation after a century of agricultural development in the region, the integrity of snake populations today is questionable.

An international research team led by Belgian scientists carried out a study in the Lokutu region of the Democratic Republic of Congo (DRC) in 2010, specifically in the locality of Bomane on the occasion of the fiftieth anniversary of the DRC's independence, and found 21 species (Lotana, pers. comm.).

Later, Gvozdik (2015), working in the neighbouring province of Mongala, documented around fifteen species. He recorded the presence of *Calabaria rheinardti* among the

Boidae, *Dasypeltis fasciata*, *Dipsadoboa weileri*, *Grayia ornata*, *Grayia cf. smithii*, *Hapsidophrys lineata*, *Natriciteres* sp., *Toxicodryas blandingii*, and *Toxicodryas pulverulenta* among the Colubridae, *Naja melanoleuca* among the Elapidae, *Boaedon olivaceus*, *Bothrophthalmus lineatus*, and *Gonionotophis* sp. for the Lamprophiidae, *Bitis gabonica* and *Causus maculatus* for the Viperidae.

The herpetofauna of the Lokutu region was briefly addressed during a 15-day study in 2017 by a team of researchers funded by Conservation International (Thomas M. Butynski and Jennifer McCullough, 2017). This rapid biodiversity assessment of Lokutu, due to the short time available, was unable to produce a complete species list. It documented 9 species, including *Python cf. sebae* (Gmelin, 1789), *Chamaelycus* sp., *Lamprophis cf. fuliginosus* (Boie, 1827), *Philothamnus heterolepidotus* (Günther, 1863), *Dendroaspis jamesoni jamesoni* (Traill, 1843), *Atheris squamigera* (Hallowell, 1854), *Bitis gabonica gabonica*

(Duméril, Bibron & Duméril, 1854), *Bitis nasicornis* (Shaw, 1802), and *Causus lichtensteinii* (Jan, 1859).

However, Kakola (1979), working in the province by combining his own collection and a critical review of the literature on the region, found 37 species, suggesting that the number of species reported to be found in this region was likely underestimated.

The objective of this article is to provide as complete a list as possible of species in the Lokutu square degree and its surroundings. The scarcity and obsolescence of data justify the updating of knowledge on snake biodiversity in this landscape, which is part of the Central Congo Forest ecoregion. This will improve the herpetological coverage of the region. Furthermore, the study will help determine the total number of species present in the landscape.

## 1.1 Material, Study Area and Methodology

### a. Material

In addition to literature data on the biodiversity of snakes in the sector, our study material consisted of snake specimens collected. The work was carried out on 108 snake specimens captured or acquired from local inhabitants.

### b. Study Area

#### Geographical Location

The sampling area, which forms the basis for the conclusions of this study, is the Lokutu square degree. The area in question is located between longitudes 23° East and 24° East and latitudes 0°15' North and 1°15' North, covering an area of 12,100 km<sup>2</sup>. The area is bounded to the west by the Loongo River in the Kokolopori Nature Reserve, to the east by the Lomami River at the meridian passing through the village of Ilondo, to the north by the parallel passing through the town of Basoko, and to the south by the parallel passing through the village of Etoaka.

#### Relief

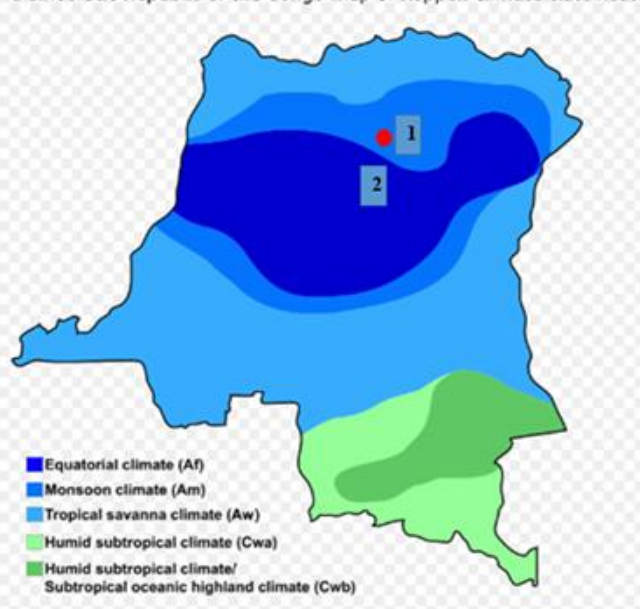
The relief of the area is generally that of an alluvial peneplain, a geological feature characteristic of the floor of the central Congo basin. The elevation of the area ranges between 400 and 550 metres above sea level.

#### Climate

The Lokutu square degree displays a climatic gradient.

Lokutu (in the north) has a tropical monsoon climate (type Am) according to the Köppen-Geiger classification, which categorises climates as follows: Type A = tropical; Type B = semi-arid; Type C = temperate (Vincent Dubreuil & al, 2017). As a result, the Lokutu region is characterised by high rainfall levels. Even during the driest month, the region still experiences a considerable amount of precipitation. The average rainfall for January is 9.4 mm, making it the driest month on average (planificateur.a-contresens.net, 2024). October sees the highest average rainfall of the year, with an average of 140.1 mm. Over the year, the average temperature in Lokutu is 25.8°C, with an average rainfall of 828.5 mm (planificateur.a-contresens.net, 2024). The average annual temperature in the Democratic Republic of Congo is 24°C, with an average rainfall of 680.6 mm. Two distinct dry seasons are observed: the first extends from mid-November to mid-March, while the second runs from mid-June to the end of July.

Democratic Republic of the Congo map of Köppen climate classification



[Legend: Climate map of the study area. To the north is Lokutu (1) with a climate of type Am and to the south is Maringa-Lopori (2) with a climate of type Af. Source: fr.wikipedia.org, 2024]

In Maringa-Lopori, in the south of the ecoregion, precipitation during the driest month exceeds 60 mm, marking the transition to an equatorial climate of type Af.

Monthly rainfall in the region ranges from 9.4 mm in January to 140.1 mm in October. It increases from January to May and shows a dip in June, which marks the start of the brief second dry season. Rainfall thus shows a trimodal distribution with peaks in May, August, and October. Snakes generally live in humid environments. The natural humidity of the air helps maintain moisture in the skin and respiratory tract.

The average temperature in the month of February is 27.7°C. February is therefore the month with the highest average temperature of the year. The coldest month of the year is August. The average temperature for the period considered was 24.8°C (planificateur.a-contresens.net, 2024). The monthly distribution of temperatures shows a peak in February and a second peak in November. The majority of reptile species, including snakes, prefer a ground temperature between 20° and 28°C.

## 2. Methodology

A series of inventories was carried out over a period of 60 days, from 24 July to 20 September, encompassing both the wet and dry seasons in the study area. This approach allows the capture of potential seasonal variations in snake activity. The study design included a combination of active surveys through visual encounters and opportunistic collections during field expeditions.

### 2.1. Sampling

A team consisting of myself, my thesis supervisor and two local guides conducted surveys across a series of habitats within the Lokutu grid square. The habitats studied included forests, wetlands, rivers, and agricultural land. The surveys were conducted both during the day and at night, with the aim of maximising the likelihood of encountering both diurnal and nocturnal species. Active efforts were made to search for snakes. Observed snake specimens were captured or photographed.

Sampling was conducted during the peak activity period for snakes, between 7 a.m. and 11 a.m. in the morning and between 4 p.m. and 9 p.m. in the evening. In this way, binary qualitative data on the presence or absence of snakes were collected along reconnaissance tracks, using restricted time limits. To supplement the time-limited surveys, observations of snakes encountered during routine activities or brought by villagers from their traditional traps were recorded. This was done with the aim of maximising the probability of observing various possible species. The advantage of this qualitative data collection is that it quickly increased the area coverage and allowed us to report on biodiversity that we would not have observed if we had relied solely on standardised sampling. It should be noted that snakes not captured personally but which have been documented in previous publications were mentioned, with asterisks to distinguish them from current data. In addition, archived data on the GBIF website were incorporated into the qualitative analysis.

Identifications were made using dichotomous identification keys by Chippaux and Schmidt. Tissue samples were preserved for each species and biopsies were taken and stored in Eppendorf tubes containing 99% ethanol. These data are held at the Biodiversity Monitoring Centre of the University of Kisangani.

The sex of the snakes was determined by inserting a small probe into the cloaca. The probe was gently inserted caudally into the cloaca. If the probe entered and stopped just after the cloacal opening, the snake was female. On the other hand, if the probe continued to enter for several centimetres (due to the presence of a hemipenis), it was a male snake.

## 2.2. Statistical Data Processing

The species richness of the study area was assessed using species accumulation curves and the EstimateS software.

## 3. Results

### 3.1. EstimateS Cumulative Curve Projecting the Number of Species Present in the Area

After statistical analysis of the species cumulative curve, the EstimateS software indicates that there are between 31 and 49 snake species in the study area, specifically the Lokutu grid square. During our field collections, we recorded 31 snake species. The range of 31–49 species in the study area means that with additional capture efforts, up to 17 more species may remain and could be recorded.

### 3.2. Species List

A total of 108 snakes were collected from four sites: Lokutu, Lobolo, Djolu, and Kokolopori, spread across 6 families and 31 species. The collected species were mainly forest-dwelling despite the severe degradation observed in the PLC plantation at Lokutu. No species new to science were discovered. There were additions of new observations for the area. These new observations are given in Table 1, where they are marked with an asterisk in brackets.

29% of the captured species are endemic to the DRC, giving the region a certain conservation value. These endemic species are: *Naja melanoleuca*, *Naja multifasciata*, *Naja annulata*, *Pseudohaje goldii*, *Dendroaspis jamesoni*, *Atheris squamigera*, *Atheris lichtensteini*, *Thelotornis kirtlandi* and *Dasypeltis fasciata*.

Some species were commonly encountered, including *Bothrophthalmus lineatus*, *Causus maculatus*, and *Philothamnus* spp. These species are notable for not being consumed by the local population. No IUCN Red List species were collected. 36% of the captured snakes are venomous. These include *Naja melanoleuca*, *Naja multifasciata*, *Naja annulata*, *Pseudohaje goldii*, *Dendroaspis jamesoni*, *Bitis gabonica*, *Bitis nasicornis*, *Atheris squamigera*, *Atheris lichtensteini*, *Causus maculatus*, *Thelotornis kirtlandi* and *Toxicodryas adamanteus*.

Such diversity of venomous snakes suggests the possibility of frequent envenomations in the area.

The population recognises six medically important venomous snake species: *Naja annulata*, *Naja melanoleuca*, *Dendroaspis jamesoni*, *Pseudohaje goldii*, *Bitis nasicornis* and *Thelotornis kirtlandi*. The others not cited are not necessarily less dangerous but may be encountered less frequently. *Naja multifasciata* is fossorial and the *Atheris* genus is arboreal. Images of the medically important venomous snakes collected are shown in Figure 2.

## 4. Discussion

The results of this study are consistent with the expected number of species in the region. Out of a maximum prediction of 49 species, we observed or captured 31 species. This number is only exceeded by the work carried out in the province in 1979 by Kakola, who recorded a total of 37 species in Kisangani and its surroundings. The difference mainly stems from additions he made using literature reviews rather than direct field collection. Indeed, he captured 61 snake specimens and supplemented his data with 112 snake records from literature sources relating to the region.

If we were to proceed similarly, the following would be added: *Toxicodryas blandingii* reported in Isangi by Nagy et al. (2011), *Lamprophis cf. fuliginosus* in Lokutu by Penner & Rödel (2014), and *Grayia cf. smithii* reported in neighbouring Mongala by Gvozdk (2015).

Venomous snake species show great diversity, and several species have medical importance due to the harmfulness of their bites. This situation suggests the necessity of future studies on the epidemiology of envenomation in the region and the management thereof, both through modern clinical methods and radiotherapeutic support.

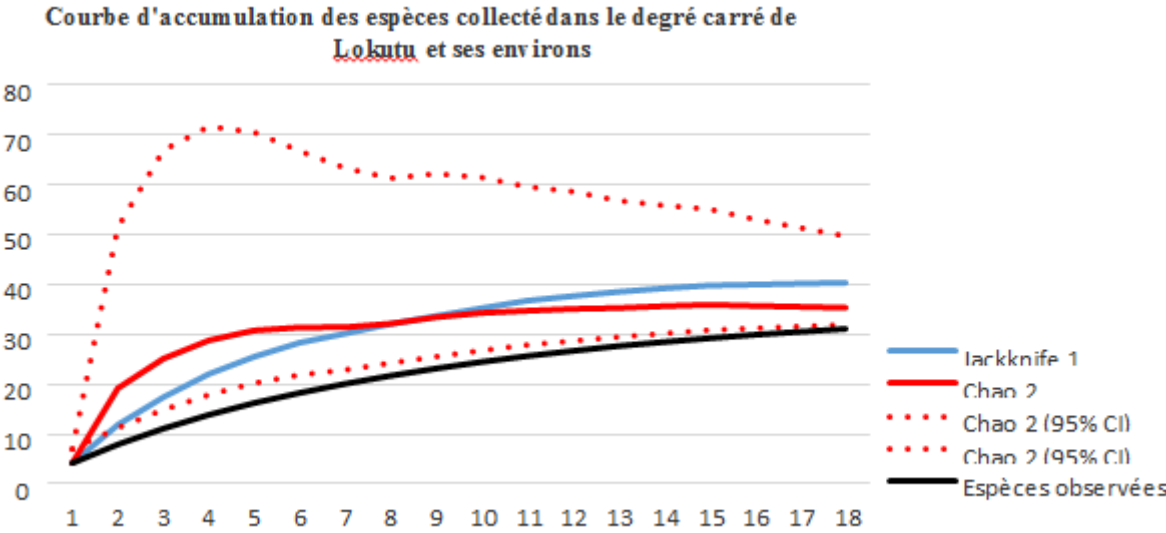


Figure I: Cumulative curve representing the total number of individuals in the region and the number already collected

	Espèce	Site	Indice de présence	Notes
	<b>Colubroidea aglyphes</b>			
	Colubridea			
1	<i>Boaedon olivaceus</i>	Lokutu, Yetee	++	
2	<i>Bothrophthalmus lineatus</i>	Lokutu, Lobolo, Yetee, Yalokenge	+++	
3	<i>Chamaelycus sp.</i>	Lokutu	+	
4	<i>Dasypeltis fasciata</i>	Lobolo, Yalokole	+	
5	<i>Gonionotophis cf. brussauxi</i>	Lokutu, Yetee	+	
6	<i>Grayia ornata</i>	Lokutu, Yetee	+	
7	<i>Hapsidophrys smaragdina</i>	Djolu, Kokolopori	+	
8	<i>Hapsidophrys lineata</i>	Lokutu, Yasao	+	
9	<i>Limnoformosa savorgnani</i>	Yetee	++	
10	<i>Lycophidion laterale</i>	Lokutu	+	
11	<i>Lycophidion sp.</i>	Lokutu, Yetee	+	
12	<i>Mehelya poensis</i>	Lokutu, Lobolo, Yetee	+++	
13	<i>Natriciteres olivacea</i>	Lokutu	+	
14	<i>Philothamnus angolensis</i> (*)	Lokutu, Yetee	++	
15	<i>Philothamnus carinatus</i> (*)	Lokutu	+	
16	<i>Philothamnus heterolepidotus</i>	Lokutu, Yetee	+++	Gregarious
17	<i>Thrasops jacksoni</i>	Yamongo	+	
	<b>Colubroidea opisthoglyphes</b>			
18	<i>Dipsadoboa weileri</i>	Lokutu	+	
19	<i>Toxycodryas adamanteus</i> (*)	Lilenga, Yetee	+++	
20	<i>Thelotornis kirtlandi</i>	Djolu, Lilenga, Yamongo, Yetee, Yalokenge	+++	
	<b>Colubroidea Solenoglyphes</b>			
	<b>Viperidae</b>			
21	<i>Atheris squamigera</i>	Lobolo, Yamongo	+	

22	<i>Atheris lichensteini</i>	Lobolo	+	
23	<i>Bitis gabonica</i>	Lokutu, Lobolo, Yetee, Yalokenge	+++	
24	<i>Bitis nasicornis</i>	Lokutu, Lobolo, Yetee, Yalokenge	+++	
25	<i>Causus maculatus</i>	Lokutu	+++	
	<b>Colubroidea proteroglyphes</b>			
	<b>Elapidae</b>			
26	<i>Naja melanoleuca</i>	Lokutu, Lobolo, Yetee, Yalokenge	++	
27	<i>Naja multifasciata</i> <sup>(*)</sup>	Lokutu	+	
28	<i>Pseudohaje Goldi</i> <sup>(*)</sup>	Yetee	+	
29	<i>Dendroaspis jamesoni</i>	Yamongu, Yetee	+	
	<b>Boidae</b>			
30	<i>Calabaria rheinardti</i>	Lokutu, Lobolo, Djolu, Yetee	+++	
31	<i>Python sebae</i> <sup>(*)</sup>	Lokutu, Lobolo, Simba, Yetee, Yalokole	+++	

## References

- A-contresens. (2024). *Planificateur de voyages*. <https://planificateur.a-contresens.net>
- Butynski, T. M., & McCullough, J. (Eds.). (2007). *A rapid biological assessment of Lokutu, Democratic Republic of Congo* (RAP Bulletin of Biological Assessment No. 46). Conservation International. ISBN 978-1-934151-04-4.
- Dubreuil, V., Fante, K. P., Planchon, O., & Sant'Anna Neto, J. L. (2017). Les types de climats annuels au Brésil : une application de la classification de Köppen de 1961 à 2015. *EchoGéo*, (41).
- Johannes Penner and Mark-Oliver Rödel. 2007. Amphibians and Reptiles of Lokutu. In: Butynski, T.M. and J. McCullough (eds.). 2007. *A Rapid Biological Assessment of Lokutu, Democratic Republic of Congo*. RAP Bulletin of Biological Assessment 46. Conservation International, Arlington, VA, USA.
- Kakolo, K. 1979. *Contribution à l'étude des Ophidiens du Haut-Zaïre*. Unpublished dissertation, Faculty of Science, University of Kisangani, 52p.
- Lokasola, A.L., Botsuna, L.C., Badjedjea, B.G., Gembu Tungaluna, C. 2017. Distributional Data of the Lizard Fauna (Sauria) of the Maringa-Lopori-Wamba Landscape, Democratic Republic of the Congo. *Journal of Environmental Science and Engineering B*, 6 (2017) 151-159. doi:10.17265/2162-5263/2017.03.006
- Lokasola, A.L. 2022. *Diversité et biogéographie des Lacertiliens (Squamata: Sauria) dans la cuvette centrale congolaise*. Doctoral Thesis, unpublished, Faculty of Science, University of Kisangani, 123p.
- Loveridge, A. (1924). Check list of the Reptilia recorded from the British territories in East Africa. *Journal of the East Africa and Uganda Natural History Society*, Special Supplement 3, 1–16
- Penner, J., & Rödel, M.-O. (2007). Amphibians and reptiles of Lokutu. In T. M. Butynski & J. McCullough (Eds.), *A rapid biological assessment of Lokutu, Democratic Republic of Congo* (RAP Bulletin of Biological Assessment No. 46, pp. 37–41). Conservation International. <https://doi.org/10.1896/978-1-934151-04-4.37>
- Schmidt, K.P. 1919. Contributions to the Herpetology of the Belgian Congo Based on the Collection of the American Museum Congo Expedition 1909–1915. Part I. Turtles, Crocodiles, Lizards and Chameleons. *Bulletin of the American Museum of Natural History*, 39, p. 385–624, figs. 1–27, pl. VII–XXXII.
- Vaclav Gvozdk & Gabriel Badjedjea. 2015. Herpetological survey in the Mongala Province, within a project on the phylogeography of the Congo Basin. Unpublished survey report, 4p.
- Zoltán T. Nagy, Zacharie Chifundera Kusamba, Guy-Crispin Gembu Tungaluna, Albert Lotana Lokasola, Jonathan Kolby & Jos Kielgast. 2011. Foraging Acrobatics of *Toxicodryas blandingii* in the Democratic Republic of the Congo. *Herpetology Notes*, Volume 4: 091–092 (2011).

## ANNEXE

Here are some photos of the snakes taken during our field harvest in the agricultural landscape of the square degree of Lokutu and its surroundings:





Photo@félixkihambu\_mars2025



Photo@félixkihambu\_mars2025

*Thelotornis kirtlandii*

Photo@félixkihambu\_mars2025

*Bitis nasicornis*

Photo©félixkihambu

*Causus maculatus*

Photo©félixkihambu

*Atheris squamigera*

Photo©félixkihambu



*Boaedon olivaceus*



Photo©félixkihambu



Photo©félixkihambu



Photo©félixkihambu





*Bothrophtalmus lineatus*



Photo©félixkihambu



*Philothamnus angolensis*



*Afrotyphlops angolensis*