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Snake Diversity and Distribution in an Anthropogenically Altered Landscape: A Case Study from Joseph Sarwuan Tarka University, Nigeria

Alu James Kaior[1], Ikaa Johnson Uloko[1] and Michael Manja Williams[1,2*]

1. Department of Wildlife and Range Management, College of Forestry and Fisheries, Joseph Sarwuan Tarka University, Makurdi, Benue State, Nigeria
2. Biota Conservation Hub Foundation (BiotaCHF), Jos Plateau State, Nigeria

***Corresponding author e-mail:** manja.michael@uam.edu.ng

SUMMARY

Snakes represent a vital component of global biodiversity, with over 3,000 species distributed across various ecological zones. Despite their ecological importance, snake populations in many parts of Nigeria remain poorly studied and misunderstood. This study assessed the abundance and spatial distribution of snake species within Joseph Sarwuan Tarka University, Makurdi (JOSTUM), located in Nigeria's Southern Guinea Savanna zone. Using a line transect method along existing roads, data were collected weekly for six months across three ecological zones of the campus: North Core, Middle Core, and South Core. A total of 143 samples of snake belonging to eight species were recorded. The most abundant was the Carpet Viper (*Echis ocellatus*), constituting 32.9% of all observations, while the least abundant was the Green Mamba (*Philothamnus semivariegatus*) at 5.6%. The South Core recorded the highest snake abundance (n = 66), likely due to its proximity to the River Benue and denser vegetation, while the Middle Core, characterized by greater human activity and landscape modification, had the lowest abundance (n = 33). These findings emphasize the influence of habitat structure and anthropogenic factors on snake distribution. The study highlights the need for periodic monitoring, public education on snake ecology, and targeted conservation strategies to mitigate potential human-snake conflicts, especially concerning venomous species.

Keywords: Snakes, abundance, distribution, savanna, Joseph Sarwuan Tarka University, transect, habitat, venomous, conservation

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INTRODUCTION

Snakes represent a highly diverse group of reptiles found on nearly every continent except Antarctica, Malta, the Republic of Ireland, and New Zealand. Worldwide, more than 3,000 species are distributed across 12 families, inhabiting a broad range of ecosystems that include land, trees, freshwater, and marine environments (Pyron et al., 2013; Ahmed et al., 2024). Their diversity and abundance are particularly pronounced in tropical regions, where warm temperatures allow for continuous activity throughout the year.

Anatomically, snakes are limbless, lack eyelids and external ears, yet exhibit remarkable mobility and sensory perception through specialized chemosensory and tactile systems. They are obligate carnivores, feeding on a broad range of prey using strategies such as venom injection (e.g., Elapidae, Viperidae) or constriction (e.g., Boidae, Pythonidae). While some species specialize in unique diets, such as feeding exclusively on bird or fish eggs (e.g., *Elachistodon westermanni*), and many are generalist predators of rodents, amphibians, and other small vertebrates. Constrictors, for instance, suffocate prey by applying pressure that matches the victim's breathing, a strategy that permits predation on animals ranging in size from mice to small ungulates (Amir et al. 2016; Moon, et al. 2019).

Despite their ecological importance, snakes are among the least studied vertebrate taxa in Africa, partly due to fear, persecution, and lack of expertise in herpetology. In West Africa, conservation efforts tend to focus on mammals, birds, and fish, with reptiles receiving limited attention (Ayeni, 2007). Furthermore, reptiles, especially snakes, face unique conservation challenges due to habitat loss, direct killing, and climate-driven changes. Globally, overexploitation, invasive species, land-use change, and pollution have driven significant reptile declines, often interacting to amplify biodiversity loss (Emmanuel, 2009). Certain species have reached critical endangerment or have already gone extinct, including the Magdalena River Turtle (*Podocnemis lewyana*) and the Round Island Burrowing Boa (*Bolyeria multocarinata*) (Akani et al. 2002; Páez et al., 2015).

Despite the important function snakes serve in ecology, they are often persecuted out of fear and conflict with humans. At the intersection of elevated levels of human activity university campuses in Nigeria and natural ecosystems, very little is known about snake population dynamics and the impacts of human activity. Lack of baseline information on the abundance and spatial distribution of snakes in these regions complicates efforts aimed at biodiversity conservation and the mitigation of human–snake conflict. Research on snake populations in Nigeria has mainly focused on protected areas, forests, and rural environments, while semi-urban landscapes like university campuses have received little attention. This gap hinders understanding of how habitat characteristics and human presence affect snake abundance and distribution in these modified ecosystems. To address this, we studied Joseph Sarwuan Tarka University in Makurdi, Benue State, Nigeria. Our objectives were to document snake species diversity and abundance on campus, analyze their spatial distribution across different habitat types, and provide baseline data to support conservation awareness, public safety, and sustainable management of snake populations in academic settings.

MATERIALS AND METHODS

STUDY AREA

The study was conducted at Joseph Sarwuan Tarka University, Makurdi (JOSTUM), located in Benue State, Nigeria (Latitude 7°44'17" N, Longitude 8°37'11" E, Altitude 106.4 m) (Figure 1). The university lies within the Southern Guinea Savanna agro-ecological zone and covers approximately 8,048 hectares, making it the largest agricultural landholding among similar institutions. It is bordered by the River Benue to the south, the River Guma to the east, and the Makurdi–Lafia road (Route A3) to the west (Ikyaagba, 2008). The vegetation is dominated by open savanna woodland with scattered trees, dense shrubs, and tall grasses (up to 2 m). Forest patches occur in lowland areas and along rivers, featuring species such as *Daniellia oliveri*, *Vitellaria paradoxa*, *Vitex doniana*, *Hymenocardia acida*, *Burkea africana*, *Khaya senegalensis*, and *Parkia biglobosa* (Ikyaagba, 2008). The climate is characterized by a wet season (April–October) and a dry season, with annual rainfall between 1,000–1,500 mm, a mean temperature around 30°C, and relative humidity ranging from 60–80%, decreasing in the dry season (Jimoh et al., 2009). For this study, the campus was stratified into three ecological zones: North Core, Middle Core, and South Core, providing a framework for the spatial comparison of snake diversity and abundance.

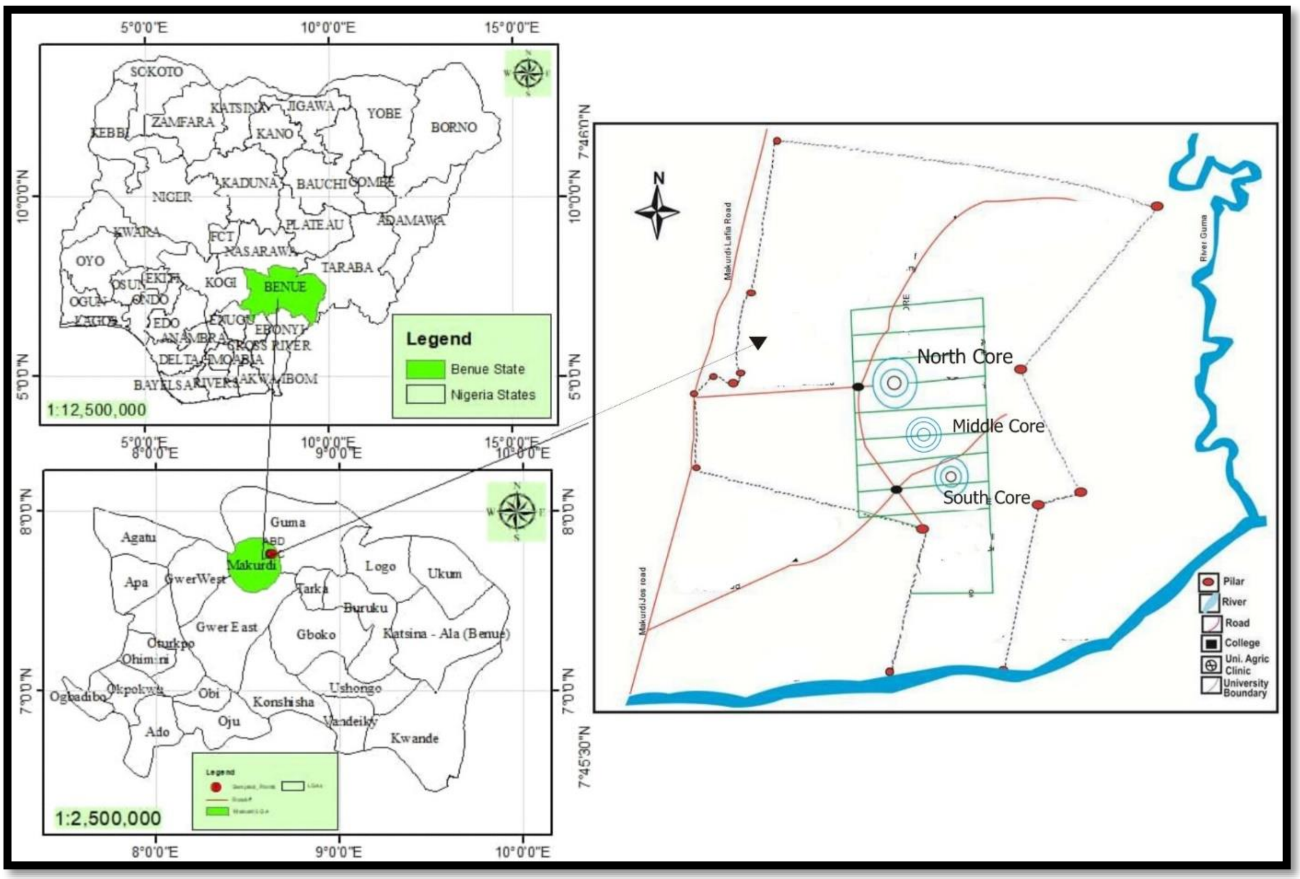

Figure 1: Map Showing the study Sites within Joseph Sarwuan Tarka University, Makurdi.

DATA COLLECTION

Data on snake species were collected using the line transect method along existing roads and footpaths within Joseph Sarwuan Tarka University, Makurdi (JOSTUM). The study area was stratified into three major ecological zones: North Core, Middle Core, and South Core. In each core, three parallel line transects, each 1 km in length and spaced 100 m apart, were established, yielding a total of nine transects across the study site. Each transect was surveyed twice weekly (morning and evening) for a period of six months, spanning both dry and wet seasons to account for temporal variation in snake activity. Observations were carried out by walking slowly along the transect lines and recording all sightings of live or dead snakes.

Direct Observation

Snakes encountered during surveys were directly counted and recorded. Road-killed individuals (carcasses) were noted, photographed, and carefully removed from transects to prevent duplicate counts in subsequent surveys. It was assumed that most road-kills resulted from vehicular collisions, although anecdotal evidence suggests that some snakes may have been intentionally placed on roads after being killed by humans to inflict further damage.

Indirect Observation

In addition to direct sightings, indirect evidence of snake presence, such as shed skins, tracks, and den or nesting sites, was documented. And meeting and interviews with local people (Figure 2)

Figure 2: respondents and local people of study area.

Species Identification

All snake specimens, both live and dead, were identified using the standard taxonomic reference “Snakes of Central and Western Africa” by Jean-Philippe Chippaux and Kate Jackson (2019), alongside species charts from the Wildlife and Range Management Laboratory at JOSTUM. Further verification was done through expert consultation with field herpetologists and institutional wildlife professionals.

DATA ANALYSIS

Data were cleaned and coded prior to statistical analysis. Descriptive statistics, including frequencies, percentages, and species composition, were computed to assess the relative abundance and distribution of snake species across the three core zones. Visualization of species abundance by zone was carried out using bar charts and pie charts generated in SPSS version 20.1. These visual summaries highlighted spatial differences in snake presence. In addition, species richness (number of species observed) and individual abundance (total individuals per species) were analyzed per core zone to detect spatial trends in snake distribution. Line transect data were also used to estimate habitat preference and localized snake activity, informing future conservation and risk mitigation strategies on campus.

RESULTS AND DISCUSSION

Our survey at Joseph Sarwuan Tarka University, Makurdi (JOSTUM) recorded a total of A total of 143 individual snakes belonging to eight species were recorded across Joseph Sarwuan Tarka University, Makurdi (JOSTUM). Species composition and abundance are presented in Table 1. The Carpet Viper (*Echis ocellatus*) was the most frequently encountered species, accounting for 32.9% of all records (n = 47). This was followed by the Puff Adder (*Bitis arietans*) and the Garter Snake (*Thamnophis sirtalis*), each representing 14.7% (n = 21). The Russell's viper (*Daboia russelii*), Green Vine Snake (*Oxybelis fulgidus*), Taiwan Coral Snake (Sinomicrurus sauteri), and Cobra (*Naja naja*) occurred at lower frequencies, while the Green Mamba (*Philothamnus semivariegatus*) was the least abundant at 5.6% (n = 8).

Table 1: Abundance of snake species in the study area.

Sr.	Scientist Name	Common Name	Tiv Name	Frequency	Percentage
1	*Echis ocellatus*	Carpet viper	Gbinde	47	32.9
2	*Bitis arietans*	Puff adder	Ihyom	21	14.7
3	*Naja naja*	Cobra	Abuku	10	7
4	*Philothamnus Semivariegatus*	Green mamba	Kyarem	8	5.6
5	*Thamnophis sirtalis*	Garter snake	Agenga iyo	21	14.7
6	*Oxybelis fulgidus*	Green vine	Gbaka	13	9.1
7	*Sinomicrurus sauteri*	Taiwan coral	Kuhe	9	6.3
8	*Daboia russelii*	Russell's viper	Vyevyese	14	9.8
		Total		**143**	**100**

ABUNDANCE PATTERNS AND ECOLOGICAL IMPLICATIONS

The dominance of *Echis ocellatus* across the study area supports previous observations that this viper is one of the most adaptable and widely distributed snakes in West African savannas (Eniang and Luiselli, 2002). Its success is closely tied to the open savanna mosaic of tall grasses, shrubs, and scattered trees found within JOSTUM, which provides suitable ambush sites, thermoregulatory opportunities, and abundant prey such as rodents and amphibians (Ikyaagba, 2008). Similar findings have been reported elsewhere in tropical Africa, where vipers thrive in disturbed habitats and agricultural mosaics (Luiselli et al., 2007; Barlow et al., 2019; Buldain *et al*., 2024).

The moderate abundance of colubrids such as *Thamnophis sirtalis* and *Philothamnus semivariegatus* reflects the ecological flexibility of this family. Colubrids are generally more tolerant of semi-urban environments and can exploit diverse food resources (Chippaux and Jackson, 2019). However, the relatively low representation of elapids (*Naja naja* and *Sinomicrurus sauteri*) may indicate habitat constraints or targeted persecution, as cobras are often killed on sight due to their perceived danger (Wüster et al., 2018).

SPATIAL DISTRIBUTION OF SNAKES

Snake encounters varied significantly across the three ecological zones (Table 2). The South Core recorded the highest number of individuals (n = 66, 46.2%), followed by the North Core (n = 44, 30.8%), with the Middle Core recording the lowest (n = 33, 23.1%). Notably, *Echis ocellatus* was abundant across all zones, but its highest concentration occurred in the South Core (n = 22). The South Core also supported the majority of *Bitis arietans*, *Thamnophis sirtalis* and *Daboia russelii* observations. The spatial dominance of the South Core can be attributed to its proximity to the River Benue, which enhances soil moisture, vegetation density, and prey availability. Riparian corridors and wetland edges are globally recognized as biodiversity hotspots for ectotherms because they provide thermal refugia, prey-rich environments, and structural complexity (Lillywhite, 2014; Buldain et al., 2024). Comparable studies in other tropical savannas have shown snake richness to peak near water bodies, particularly where habitat heterogeneity supports both arboreal and terrestrial taxa (Luiselli, 2006).

Table 2: Distribution of Snake species in three sites within JOSTUM.

Sr.	Common Name	North core		Middle Core		South core	
		Frequency	%	Frequency	%	Frequency	%
1	Carpet viper	15	34.1	10	30	22	33
2	Puff adder	7	15.9	5	15	9	14
3	Cobra	3	6.8	2	6.1	5	7.6
4	Green mamba	2	4.5	2	6.1	4	6.1
5	Garter snake	5	11.4	6	18	10	15
6	Green vine	4	9.1	3	9.1	6	9.1
7	Taiwan coral	3	6.8	2	6.1	4	6.1
8	Russell's viper	5	11.4	3	9.1	6	9.1
	Total	**44**	**100**		**100**	**66**	**100**

In contrast, the Middle Core had the lowest abundance, likely due to higher levels of anthropogenic disturbance. The presence of infrastructure such as the sports complex, solar farm, and major academic buildings reduces vegetation cover and microhabitat availability, thereby deterring snake activity. Disturbed areas also increase human–snake encounters, which often lead to persecution and direct killing (Ajong et al., 2021). The rocky terrain in this zone may further limit habitat suitability for species requiring loamy soils for burrowing or egg-laying. These findings echo global patterns where habitat fragmentation and urbanization negatively impact reptile populations (Todd et al., 2010).

BROADER CONSERVATION SIGNIFICANCE

The observed distribution patterns within JOSTUM highlight the sensitivity of snakes to environmental gradients ranging from natural riparian systems to heavily modified semi-urban landscapes. The study provides critical baseline data for Nigeria, where snake ecology remains poorly understood compared to other vertebrate groups (Ayeni, 2007). At a global scale, the results contribute to broader debates on reptile declines driven by land-use change, persecution, and climate variability (Böhm et al., 2013). Importantly, the high abundance of *Echis ocellatus* has direct public health implications, as this species is responsible for the majority of snake-bite envenomations in West Africa (Habib, 2013). The co-occurrence of dense human populations and venomous snakes on university campuses underscores the need for integrated conservation and safety strategies. Awareness programs, habitat-sensitive land-use planning, and continued monitoring can reduce conflict while sustaining the ecological role snakes play in regulating prey populations.

CONCLUSION

This study provides one of the first comprehensive assessments of snake species abundance and spatial distribution within Joseph Sarwuan Tarka University, Makurdi. A total of 143 samples representing eight species were recorded, with the Carpet Viper *(Echis ocellatu*s) being the most abundant. Spatial analysis revealed notable differences across the three ecological cores of the campus, with the South Core hosting the highest species count and the Middle Core recording the lowest. These variations likely reflect differences in habitat structure, vegetation density, water proximity, and human disturbance levels. The findings emphasize the importance of maintaining and protecting the South Core's wetland-riparian ecosystems, which appear to serve as a refuge for many snake species. Conversely, the reduced abundance in the Middle Core underscores the need for sustainable land use practices in areas with increasing infrastructure development. Given the ecological role of snakes in controlling rodent populations and maintaining ecosystem balance, as well as the public health concerns associated with venomous species like *Echis ocellatus* and *Bitis arietans*, this study offers critical insights for future wildlife management and environmental planning within the university and similar savanna landscapes.

RECOMMENDATIONS

1. Establish a campus-wide wildlife monitoring program to track temporal changes in snake populations, especially in response to infrastructure expansion and habitat alteration.
2. Conserve and manage key habitats, particularly in the South Core, which supports the highest snake diversity. This should include riparian buffer zones along the River Benue.
3. Increase environmental education and awareness campaigns targeting students, staff, and local communities to reduce unnecessary killing of snakes and promote coexistence.
4. Develop safety protocols and medical preparedness for snakebite incidents, especially in zones with higher frequencies of venomous species.
5. Conduct follow-up ecological studies to assess seasonal variations in snake abundance, prey availability, and reproductive behavior, which are currently under-documented in the region.
6. Collaborate with herpetologists and conservation agencies to create a baseline database of reptiles within the university and contribute to regional biodiversity conservation planning.

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