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SPATIAL DISTRIBUTION OF SAVANNAH BUFFALO (*SYNCERUS CAFFER*) POPULATIONS IN THE LAMTO SCIENTIFIC RESERVE, CÔTE D'IVOIRE

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ABSTRACT

Background: The African buffalo (*Syncerus caffer*) is a large herbivore occurring in many protected areas. Understanding its spatial distribution is a prerequisite for effective management and conservation strategies.

Methods: The study was conducted in the Lamto Scientific Reserve, Côte d'Ivoire, from September to November 2025. Direct observations and surveys of buffalo signs were carried out along 500-m transects laid out across the entire reserve. Data were recorded in an Excel spreadsheet and subsequently analysed.

Results: High concentrations of buffalo were found along the Bandama River, near temporary waterholes and marshy areas, and in grassy savannahs close to gallery forests. Buffalo moved in herds of 5 to 20 individuals, mainly in the early morning and late afternoon. Six types of presence signs were recorded, with hoof prints being the most frequent. Water availability was the main factor associated with buffalo distribution. Signs of human pressure were observed on the periphery of the reserve. During the dry season, buffalo congregated near wetlands, whereas in the wet season they were more widely dispersed.

Conclusion: Buffalo distribution in Lamto is shaped by water availability, habitat, and human disturbance. Protecting water points and managing peripheral areas are essential for their conservation.

Keywords: African buffalo, *Syncerus caffer*, Spatial Distribution, Habitat Use, Wildlife Conservation, Lamto Scientific Reserve, Côte d'Ivoire

1 INTRODUCTION

In Africa, large herbivores play a central role in ecosystem functioning by regulating vegetation, dispersing seeds, and influencing nutrient cycling and food webs (Pringle et al., 2023). Beyond their ecological role, they are of considerable economic importance, as wildlife viewing is a major component of tourism in African protected areas (Naidoo et al., 2016). Among them, the African buffalo (*Syncerus caffer*) stands out for its ability to shape the plant communities in which it lives and feeds (Eby et al., 2014). Its populations exhibit contrasting demographic and spatial trends depending on the region and subspecies. In 2022, the savannah buffalo population was estimated at over 595,000 individuals. The most abundant subspecies, the Cape buffalo (*S. c. caffer*), accounted for 91% of this total and occurs predominantly in Tanzania (65%), South Africa (12.5%) and Mozambique (12.2%) (Cornélis et al., 2023).

In Côte d'Ivoire, the situation is of serious concern, as the buffalo population has declined sharply. In 1998, approximately 8,330 individuals were recorded in the country, whereas by 2023 the figure had fallen to about 1,500 (East & Rod, 1998; Cornélis et al., 2023). This marked decline raises important questions about the conservation status of the species, which is likely driven by a combination of environmental and human factors. The spatial distribution of buffalo within their habitat results from the interaction of several ecological factors, notably food availability and quality, access to water, and seasonal variations in environmental conditions (Rabeil, 2003; Taylor et al., 2023; Deng et al., 2026). Furthermore, climate change is likely to alter the distribution of suitable habitats and, consequently, the range of African buffalo populations (Lawer et al., 2025).

The Lamto scientific Reserve, located at the interface between dense forest and Guinean savannah, is a unique zone of climatic transition, characterised by marked variations in temperature and rainfall (Bigot et al., 2004). This transition fosters a mosaic of habitats and a rich biodiversity.

Despite the ecological importance of the reserve, up-to-date data on the spatial distribution of buffalo within it remain limited. Yet pressures such as changes in vegetation cover, poaching, and land-use change in surrounding areas could influence how the species uses the landscape. A detailed characterisation of buffalo distribution is therefore needed to address this knowledge gap and guide management actions.

In this context, the present study aimed to analyse the spatial distribution of the savannah buffalo (*Syncerus caffer*) in the Lamto Scientific Reserve by identifying areas of high occurrence and the main environmental factors associated with its distribution.

2 MATERIALS AND METHODS

2.1 Study site

The Lamto scientific Reserve is a protected area dedicated to research, established on 12 July 1968. It is located in central Côte d'Ivoire, in the department of Taabo (Agnéby-Tiassa region), 160 km north-west of Abidjan, the country's economic capital (Figure 1). The reserve covers 2,617 ha, between 6°9′ and 6°18′ N and 5°15′ and 4°57′ W (Kpankpa et al., 2022). It is bordered by the Bandama River and receives an average annual rainfall of 1,200 mm, with a mean annual temperature of 27 °C (Tiemoko et al., 2020). The vegetation is a forest–savannah mosaic in which savannah encroaches on dense, semi-deciduous forest. The reserve has a transitional equatorial climate, characterised as both sub-humid and humid (Diawara et al., 2014). Given its rainfall (> 650 mm), the savannah is classified as Guinean savannah, with a herbaceous layer dominated by grasses and a woody layer made up mainly of trees and shrubs (about 80%).

This reserve, managed by the Ivoirian Parks and Reserves Office (OIPR), contributes to the protection of animal and plant communities and to the preservation of natural processes in a near-natural state. Its location provides significant natural assets and ecological conditions representative of the surrounding natural environment. These characteristics were key factors in selecting the Lamto scientific Reserve as the site for this study, which could serve as a reference for understanding the spatial distribution of African buffalo in their natural habitat.

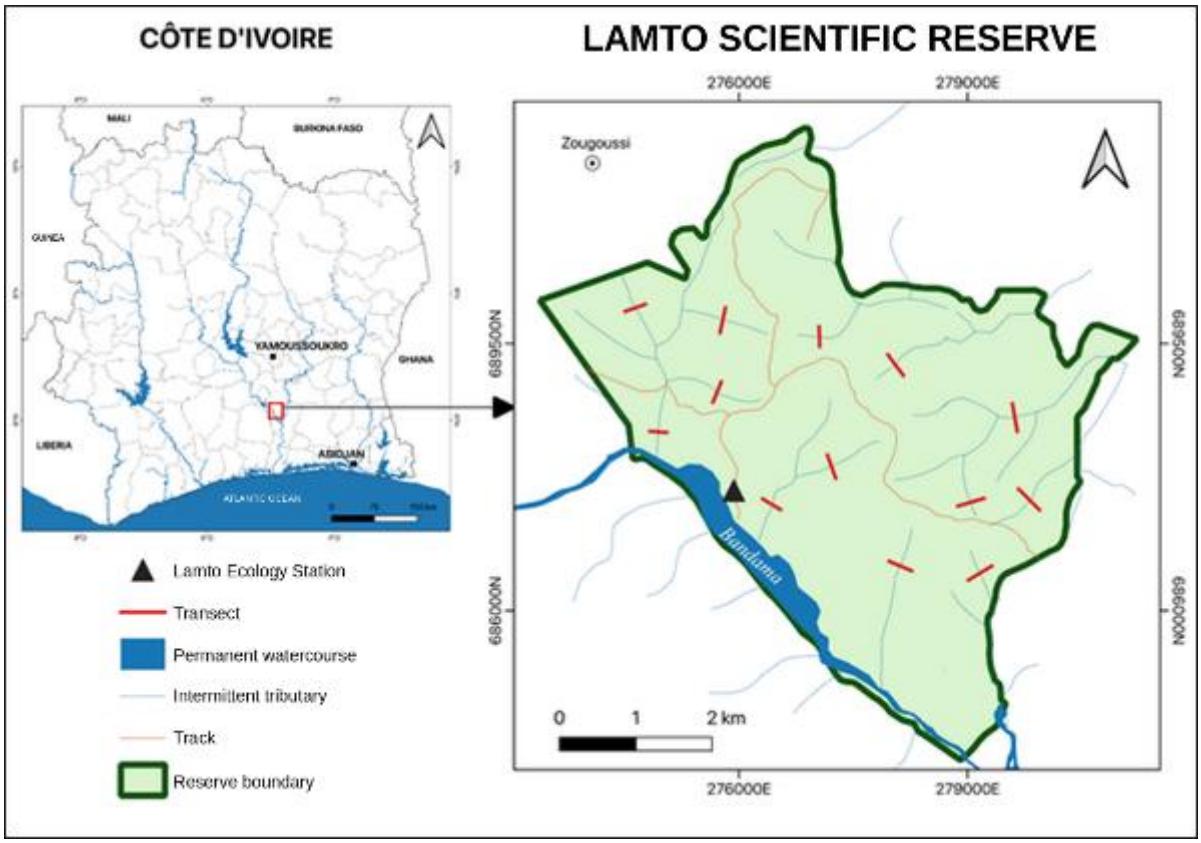


Figure 1: Location of the Lamto scientific Reserve in Côte d'Ivoire and layout of the survey transects.

Source : CNTIG

2.2 Observation and geolocation

Data were collected in the Lamto scientific Reserve using the linear transect method, which is widely recognised as one of the most effective ways of estimating animal abundance and determining species ranges (Nakashima et al., 2020). Walking transects of 500 m were laid out perpendicular to watercourses or key habitats. One transect was positioned randomly within each cell of a 1 × 1 km grid overlaid on the reserve, using a GPS, a compass and a machete, a few days before the counting sessions. Such short transects allow both direct (animals sighted) and indirect (droppings, tracks) counts, but require intensive sampling effort.

During the counts, transects were walked at 2.5–3 km/h at dawn, between 05:00 and 06:00. Teams of two to three people were equipped with GPS devices, compasses and measuring tapes to measure perpendicular distances and record geographical coordinates. The teams walked silently along each transect, scanning both sides for the slightest sign of buffalo presence. For every sighting or sign of buffalo, the date, time, distance covered, type of evidence, number of instances and geographical coordinates were recorded. Signs of human activity were recorded in the same way.

Transect surveys were supplemented by reconnaissance walks, during which detours were made to detect buffalo or their signs directly or indirectly within a deviation angle of less than 40°, thereby avoiding backtracking. The same information was recorded (type of evidence, number of instances and GPS coordinates). Data were also collected along tracks within the reserve and at animal gathering points such as waterholes, fruit trees and natural salt licks. The spatial distribution of buffalo was mapped in QGIS using kilometric abundance indices (KAI).

2.3 Data analysis

All data on buffalo presence signs were entered into an Excel spreadsheet. The spatial distribution of buffalo was documented using the different types of signs (droppings, hoof prints, feeding signs, etc.). The kilometric abundance index (KAI) was calculated for each transect as the total number of observations (n) divided by the total distance walked (l, in km): KAI = n / l. KAI values were georeferenced and projected onto a map of the reserve using QGIS 2.18.23 to produce the distribution map. The relative frequency of signs (RFS) was calculated as: RFS (%) = (number of signs of a given type / total number of signs recorded) × 100.

3 RESULTS

3.1 Spatial distribution of buffalo

Buffalo signs were not evenly distributed across the Lamto scientific Reserve but were concentrated in specific areas (Figure 2). The distribution map, based on the kilometric abundance index (KAI) of each transect, shows these areas of high occurrence and the environmental factors associated with them.

High concentrations of buffalo were found mainly along the Bandama River, around temporary waterholes and marshy areas, and in grassy savannahs close to gallery forests (Figure 2). Buffalo were most often observed in herds of 5 to 20 individuals, mainly in the early morning and late afternoon (Figures 3a and 3b). During the hottest hours of the day, they sought shade in gallery forests to rest.

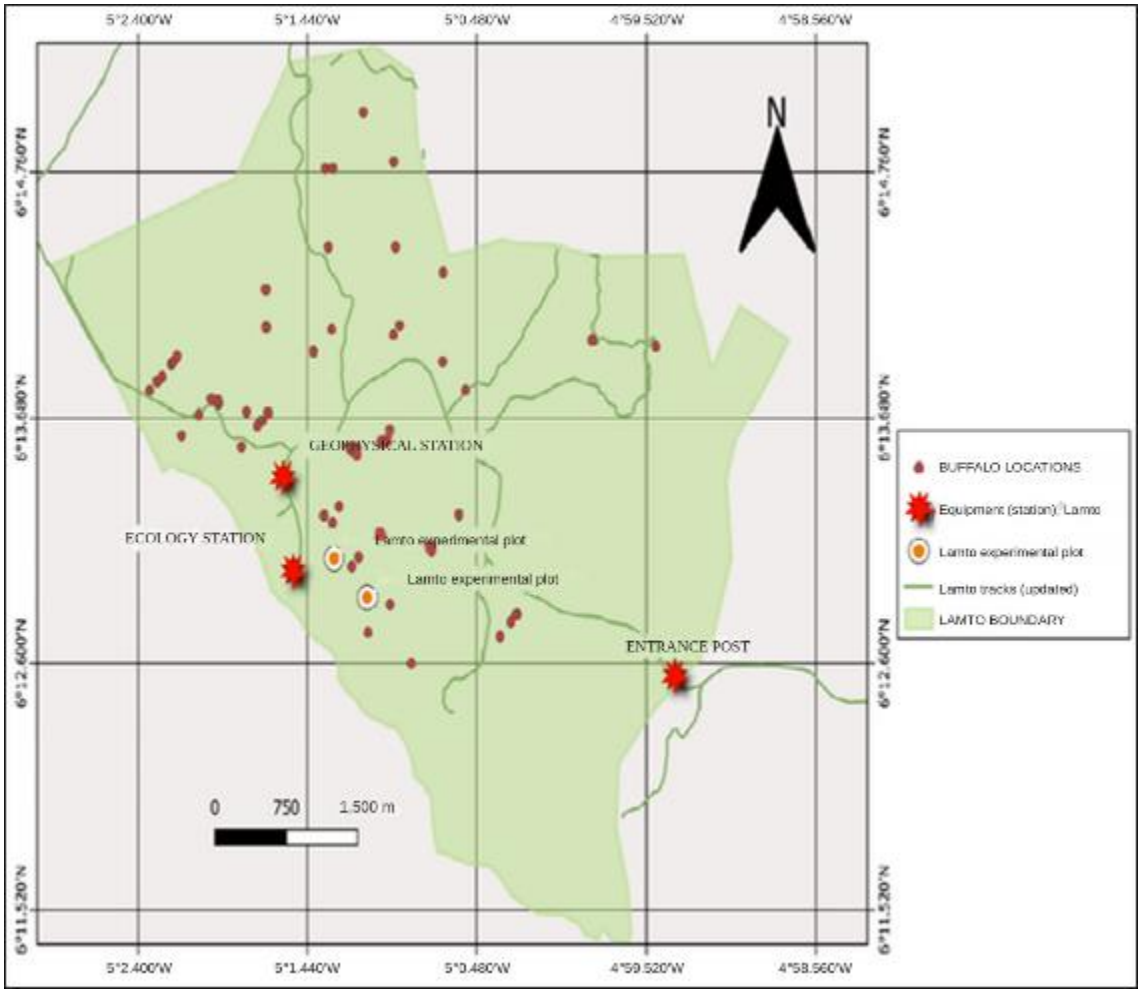


Figure 2: Spatial distribution of buffalo (*Syncerus caffer*) locations recorded in the Lamto scientific Reserve, September–November 2025.

Source: OIPR/DZC/SL; field data from this study.

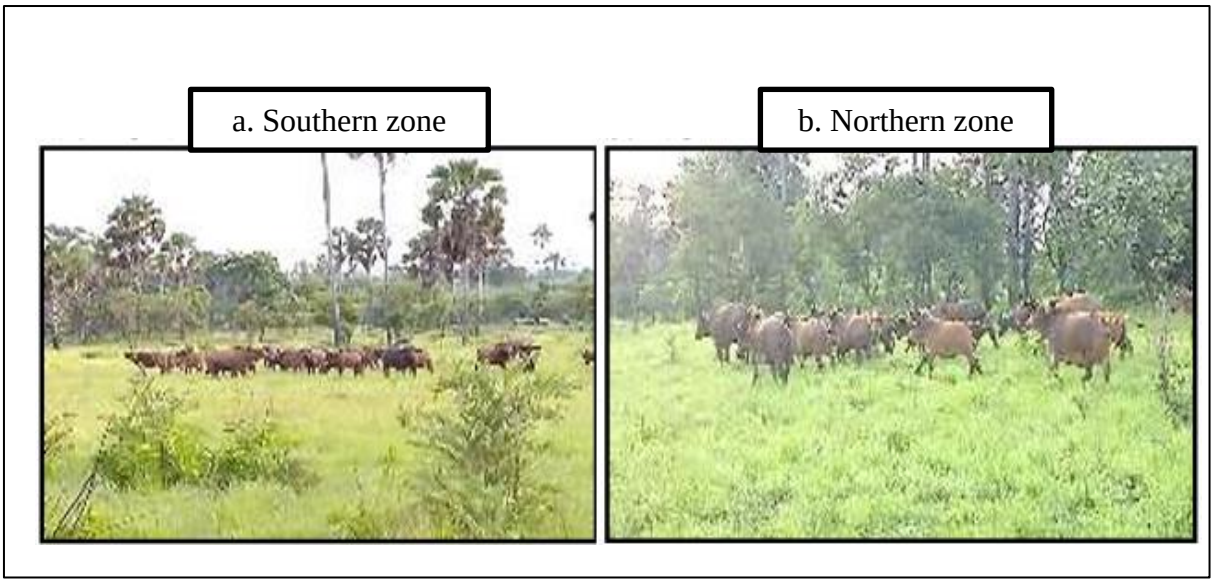


Figure 3: Buffalo herds observed in the Lamto scientific Reserve: (a) southern zone; (b) northern zone. (photographed at 06:30 on 12 October 2025)

During this study, six types of buffalo presence signs were recorded: droppings, feeding traces, hoof prints, watering points, resting sites and direct sightings of herds (Figure 4). The geographical location of each sign was recorded, together with the number of occurrences of each type (Table 1). In total, 11 signs were recorded, of which hoof prints were the most frequent (RFS = 27.27%). Resting sites and feeding traces were the least frequent, with a single occurrence each.

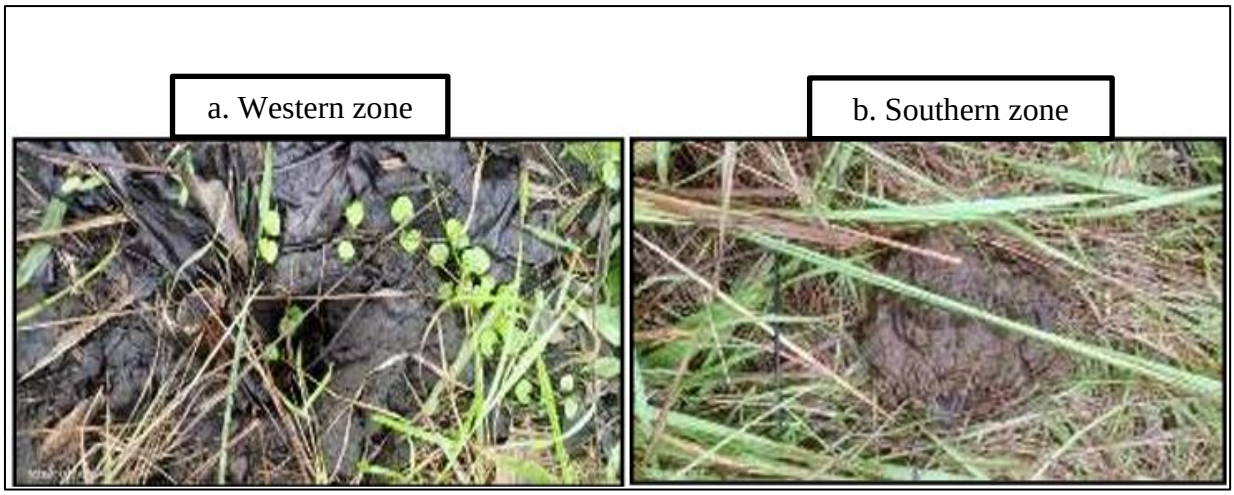


Figure 4: Buffalo droppings observed in the western and southern parts of the Lamto scientific Reserve

Several factors were associated with buffalo distribution in the Lamto scientific Reserve. Water availability was the factor most strongly associated with their distribution : buffalo signs were mainly found within 500 m of water sources (the Bandama River, pools and waterholes). Buffalo were also frequently recorded in grassy savannahs with tall grasses, which are likely used for foraging, whereas gallery forests appeared to serve as shelter. Signs of human pressure and habitat disturbance were recorded in some peripheral areas of the reserve, which are frequented by local populations, and few or no buffalo signs were found there. During the dry season, buffalo congregated near wetlands, whereas in the wet season their distribution was more dispersed, probably because water and fresh grass were more widely available.

Table 1: Types and occurrences of buffalo presence signs recorded in the Lamto scientific Reserve.

Category	Type of sign	No. of occurrences	RFS (%)	Site coordinates (UTM zone 30N, E / N)
1	Hoof prints	3	27.27	S1: 0279695 / 0689400
				S2: 0279034 / 0689454
				S3: 0276977 / 0690221
2	Direct sightings of herds	2	18.18	S1: 0277709 / 0689057
				S2: 0276570 / 0688528
3	Droppings	2	18.18	S1: 0277342 / 0687755
				S2: 0277342 / 0686782
4	Watering points	2	18.18	S1: 0278222 / 0687230
				S2: 0276303 / 0689555
5	Resting sites	1	9.09	S1: 0277634 / 0688050
6	Feeding traces	1	9.09	S1: 0276906 / 0687323
Total		11	100	

RFS: relative frequency of signs (number of signs of a given type / total number of signs × 100). Coordinates are easting / northing (m).

4 DISCUSSION

African buffalo face significant conservation challenges across the continent. Understanding their distribution is therefore essential for the effective management of their populations and of wildlife more broadly (Cornélis et al., 2023). This study described the spatial distribution of the African buffalo (*Syncerus caffer*) in the Lamto Scientific Reserve. Our results indicate that buffalo distribution is closely associated with the availability of key resources, namely water and vegetation. High concentrations of buffalo were found mainly along the Bandama River, around temporary waterholes and marshy areas, and in grassy savannahs near gallery forests.

Buffalo were mainly recorded within 500 m of water sources. This is much closer than distances reported elsewhere, such as 20-40 km from surface water (Cornélis et al., 2014) and a 15 km radius around surface water bodies (Western, 1975). This difference may be explained by the small size of the reserve (2,617 ha) and the density of its waterholes, which place most of the area within a short distance of water. Water availability is widely reported as a main factor influencing the distribution, abundance and movements of buffalo (Naidoo et al., 2020; Rumiano et al., 2021; Taylor et al., 2023).

Distribution also varied with season: animals congregated near wetlands in the dry season and were more widely dispersed in the wet season. A similar seasonal pattern has been described for buffalo in other African savannah ecosystems (Fynn et al., 2014; Sianga et al., 2017; Atta et al., 2020; Deng et al., 2026). Buffalo are water-dependent and have a high water turnover rate, drinking around 45 litres per day (Prins, 1996; Taylor et al., 2023). Their concentration around wetlands may also reflect an adaptive strategy that balances dietary requirements, thermal stress and predation risk (Owen-Smith et al., 2010; Taylor et al., 2023). This highlights the importance of wetlands for buffalo in the ecological functioning of the reserve.

Herds of 5 to 20 individuals were observed mainly in the early morning and late afternoon. This is comparable to the herd sizes reported for forest buffalo in Gabon, where herds averaged 12 individuals (range 3–24) (Korte, 2008). The peaks in sightings at the start and end of the day suggest that buffalo are most active in open areas at these times, as also documented by Megaze et al. (2018) and Taylor et al. (2023).

One strength of this study is that it is, to our knowledge, the first to describe the spatial distribution of buffalo in the Lamto scientific Reserve. It provides baseline information for the management and conservation of this large herbivore in a protected area where it had been little studied. Recording signs of presence confirms that buffalo actually use the reserve. Among the types of signs recorded, hoof prints were the most frequent. This result should be interpreted with caution, as it may reflect the detectability of signs rather than the true frequency of the corresponding behaviours.

Despite the reserve's protected status, anthropogenic disturbance was observed, particularly in peripheral zones. Buffalo appeared to avoid these areas, which may have increased their concentration in central zones and near water

sources. This is consistent with previous studies showing that animals respond to human disturbance in a way comparable to predation risk (Frid and Dill, 2002; Cornélis et al., 2014).

This study has several limitations. It relies on direct observations and presence signs, which do not allow reliable estimates of abundance or precise quantification of individual movements. In addition, the number of signs recorded was small, and sampling covered only a short period. Further studies combining GPS collar tracking, habitat-use modelling, population structure analysis and vegetation characterisation would help clarify the effect of each factor and guide the management of the reserve.

5 CONCLUSION

This study shows that African buffalo occur in the Lamto scientific Reserve with a patchy spatial distribution. High concentrations were found along the Bandama River, around temporary waterholes and marshy areas, and in grassy savannahs near gallery forests. These results suggest that buffalo distribution is closely associated with water and herbaceous vegetation, and that it varies seasonally: animals congregated near wetlands in the dry season and were more widely dispersed in the rainy season. Despite the reserve's protected status, signs of human disturbance were recorded in peripheral areas, where few buffalo signs were found. These findings highlight the importance of protecting the reserve's waterholes and wetlands and of managing its peripheral areas. By providing baseline data on buffalo distribution in Lamto, this study offers a basis for monitoring and for sustainable management and conservation measures.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

The authors declare no conflicts of interest.

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