1st Rufford Small Grant

Project number: 45910-1

Scaling up pangolin research and conservation in West Africa - Identification of Priority Hotspots in Guinea.

Photo of the project leader collecting LEK data in the field

Progress Report

Compiled by Abass CAMARA (Project leader)

February 2026

Project Update

I. Introduction

In Guinea, the GFBH includes key biodiversity areas, notably the Mount Nimba Strict Nature Reserve and the Ziama Biosphere Reserve, both of which are UNESCO-listed sites. These two sites are home to the three species of pangolins found in West Africa: the white-bellied pangolin (Phataginus tricuspis) and the giant pangolin (Smutsia gigantea), both classified as "endangered " (IUCN Red List 2024), and the black-bellied pangolin (Phataginus tetradactyla), classified as "vulnerable" (IUCN Red List 2024). These three species are classified in category A, which means that they are fully protected from hunting and trade in accordance with Article 57 of Law L/2018/0049/AN of 20 June 2018, which classifies wildlife in Guinea into two categories (fully protected species and partially protected species) based on the level of threat (MEDD, 2018). However, these species are threatened by significant exploitation for consumption and for the manufacture of medicinal products at local and global levels. Despite these known threats, literature and research on pangolins is limited, resulting in a lack of quantitative information needed to guide effective conservation measures.

With the support of the Ruford Foundation, we conducted a survey of 239 respondents in 19 villages in the Upper Guinea region, including 10 villages bordering the Niger-Source National Park classified forest in the Faranah prefecture and 9 villages in the Diwasi classified forest in the Kankan National Park Wildlife Reserve (Flonigbè). The survey aims to document local knowledge about pangolins and other wildlife species, their presence, their rarity, and community perceptions related to their conservation.

II. Specific objectives

1. Use species distribution modelling to identify sensitive areas within the GFBH for three pangolin species through a better understanding of the ecological and anthropogenic factors that influence their distribution and how this distribution could change in response to climate change by October 2025.
2. Study local perceptions and knowledge of local communities in the GFBH regarding observations (e.g., frequency, locations, and seasons), population trends, and key anthropogenic threats to white-bellied, black-bellied, and giant pangolins using local ecological knowledge (LEK), and identify variations in these perceptions across countries by October 2025.

III. Methods

a) Exploration of existing data on presence

The survey design was based on peer-reviewed literature from databases such as Web of Science and Google Scholar, as well as reports from members of the IUCN Pangolin Specialist Group, to obtain occurrence data from their fieldwork. We also consulted reports from wildlife conservation organisations and final reports from grant recipients of funding bodies to collect potential occurrence data, where available, and/or to obtain contact details. Online data repositories such as GBIF and iNaturalist were also consulted to collect existing data on the presence of pangolins. Since GBIF and iNaturalist are always imprecise (at least 30 kilometres from the original observation) in order to protect the species from potential threats that could result from publishing its original location, observers were contacted individually by email to obtain the original location of the observation and GPS coordinates.

In addition, citizen science data was collected from social media (e.g., Facebook, X, Flickr, YouTube groups focused on wildlife observation). To do this, the words "pangolin" and "Africa" were entered into the search engine, and each post was reviewed to determine its relevance to our study. Once relevance to our study was confirmed, the author's information was used to contact them and obtain more details about the sighting. This process was intended to increase reliability and mitigate biases associated with opportunistic reporting (Pocock et al., 2017). This approach optimised resources by reducing redundant fieldwork, contextualised field data within broader regional patterns, and identified priority sites through preliminary distribution mapping, although it required critical assessment of data quality and potential geospatial inaccuracies. Specifically, these integrated sources facilitated the collection of pangolin presence data, which is essential for habitat suitability modelling (Elith & Leathwick, 2009; Phillips et al., 2006).

b. Site selection criteria and how the selected sites specifically meet these criteria

Site selection was based on rigorous ecological and strategic criteria to fill gaps in knowledge about pangolin distribution and habitat preferences, in line with existing wildlife survey protocols (Newing, 2011). The main selection criteria were as follows: (1) lack of existing data on occurrence, giving priority to areas where data are absent or limited in order to generate new baseline information essential for mapping the species' range and identifying conservation priorities; (2) vegetation types, prioritising diverse vegetation types to ensure collection of presence data across various vegetation types; (3) habitat and landscape characteristics, encompassing tropical forests, wetlands, and wooded savannahs for comparative analysis; (4) proximity to known occurrences, ensuring distance from documented sites to explore new areas and potentially detect expansions in distribution range or isolated populations; and (5) altitude, incorporating altitude gradients to assess climatic and distributional influences.

These criteria guided the selection of two sites in Guinea that rigorously meet the predefined ecological and strategic criteria for pangolin research. The Source-Niger National Park project and the Kankan Fauna Reserve meet the criteria due to the lack of data, the transitional vegetation between savannah and forest, and their isolation from existing data. Taking these criteria into account ensured the representation of little-studied and ecologically relevant landscapes for collecting data on the presence of pangolins in the GFBH based on local ecological knowledge (LEK).

c. Survey based on local ecological knowledge in the selected sites

In order to assess local knowledge and uses of pangolins in the study area, we used a semi-structured interview questionnaire comprising both open-ended and closed-ended questions (Newing, 2011). The questionnaire included sections on: (i) respondent information, (ii) general knowledge about wildlife in the area, (iii) specific knowledge about pangolins, including frequency of sightings, location of sightings, GPS coordinates of sightings, population trends and reasons for population decline, and (iv) local perceptions and beliefs about wildlife in the area. The survey instrument was written in English, then translated into French and cross-checked with the original English to ensure accuracy. At each site, villages were selected using stratified random sampling to ensure that local knowledge in the study area was representative. In order to capture possible variations in responses to the questions, we conducted interviews with at least 10 people per village (Guest et al., 2006; White et al., 2005). Before conducting fieldwork, we called village chiefs and relevant institutions working in the project area, particularly in areas where the team had no contacts, to explain the purpose of our study. Once we arrived in the villages, we contacted the chiefs to inform them of our intentions and ask for permission to conduct our activities. The village chiefs then introduced us to an experienced member of the community who served as our local guide. The local guide helped us select experienced members of the community using the chain reference method (also known as "snowball sampling"), which is useful when researchers are looking for a particular hidden population to interview (Newing, 2011). The first respondent was selected by the local guide, while subsequent respondents were recruited by asking respondents at the end of each interview to refer the team to individuals who they believed might have good knowledge of wildlife and its local use in the area. Before each interview, verbal consent was obtained from all respondents, who were informed that the interview was anonymous and that they could interrupt it at any time without any problem.

Data was collected throughout July and August 2025 using the *KoboCollect* application on smartphones and digital tablets to ensure efficient data collection and management . When respondents reported seeing pangolins, they were invited to accompany the field teams into the bush to accurately record the GPS coordinates of the exact location. If direct access was not possible due to logistical constraints or respondent availability, the location of the sighting was estimated using the GPS device's "measure distance" function, based on the distance and direction indicated by the respondent from a known reference point. This dual approach ensured accurate georeferencing of occurrence data for spatial analysis and habitat suitability modelling. Individuals under the age of 18 were not interviewed, and only one respondent per household was interviewed to ensure the independence of responses.

d. All analytical methods used to date, if applicable

Prior to descriptive analysis of the LEK dataset, data cleaning was performed. This involved excluding missing, empty, or ambiguous records where necessary to ensure the quality and reliability of subsequent analyses. In addition, certain levels within categorical variables, such as reasons for pangolin population decline, were grouped together to ensure adequate sample size within each level and improve interpretability. Summary statistics, including observation frequency, observation locations, observation seasonality, population trends, and reasons for population changes, were calculated for each species in the LEK dataset. Data visualisation was performed primarily using R software. Stacked bar charts and tables represented species-specific occurrence frequencies for different categorical variables (e.g., season, location, population trend).

All occurrences were graphically represented, ensuring that data sources were clearly highlighted, namely precise extracted data, imprecise extracted data, and occurrences from LEK surveys. All statistical analyses were performed in R 4.0.2 (R Core Team, 2020), and the map was plotted using ArcGIS 10.5 software.

e. Proposed analytical methods for the future

Construct binomial generalised linear models (GLMs) with a logit link function for dependent variables with two outcomes, such as species observations, to test the relationship with independent variables such as age, gender and occupation.

Construct an ordinal logistic regression for ordered dependent variables such as population trends and the last time the species was observed to test the relationship with independent variables such as age, sex, occupation, and time spent in the village.

Perform habitat suitability modelling using Wallace to determine the factors that predict pangolin habitat suitability and the effects of climate change on their future distribution.

IV. Results

1. Survey of local ecological knowledge

a) Survey effort

A total of 19 communities, representing 239 individuals, were surveyed, representing a total of 22 days spent collecting data. The demographic section below describes the group of respondents.

b) Demographic data of the study population

The majority of respondents were male (72.4%, N = 173). The average age was 44 years. Agriculture was the predominant occupation (78.2%, N = 173). The average length of time respondents had lived in the villages was 29.3 years.

Table 1: Demographic data of the study population

Characteristic	Number of respondents (N=239)	%
Gender		
Male	173	72.4
Women	66	27.6
Age (years)		
Average (standard deviation)	44	14.4
Range	21 - 87	

Occupation, n (%)		
Agriculture	187	78.2
Hunting/Fishing	14	5.9
Other	35	14.6
Administration	3	1.3
Time spent in the village (years)		
Average (standard deviation)	29.3	19.4
Range	1–83	

c) Species observations

Pangolin sightings reported by respondents at the two sites suggest significant variations in species prevalence. Of the three species, the white-bellied pangolin stands out as the most frequently observed species, with the highest number of sightings reported (32.22%). For the BBP, we recorded a similar number of sightings as for the WBP (30.96%). Our results showed that the GP was the least observed species among the three African pangolins, according to respondents at the sites studied, with only 9.21% of observations. Figure 2 shows the percentage of respondents who observed each pangolin species.

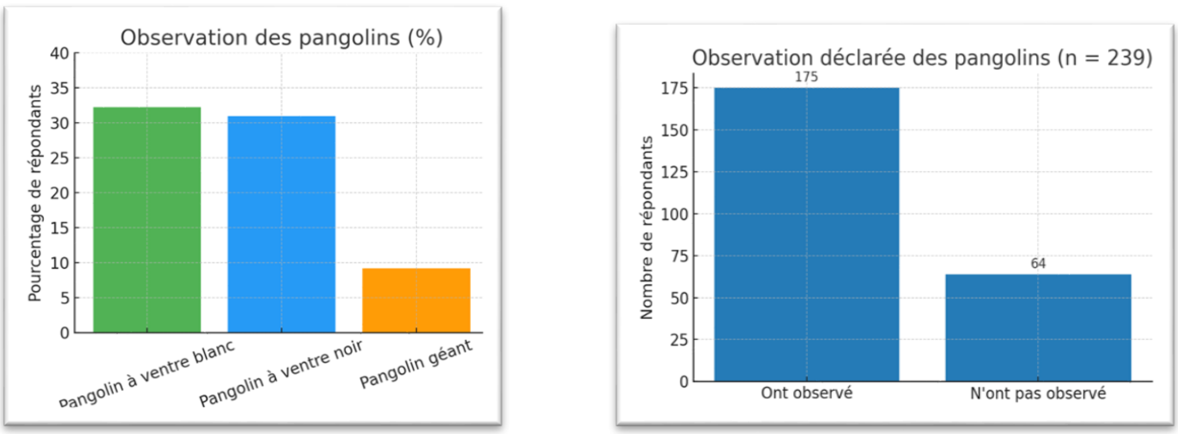

Figure 1: Summary of pangolin sightings by species

d) Location of pangolin sightings

Of the two sites studied, the WBP came out on top with 60.49% (49 out of 77) of observations in forests, while for the BBP, 51% (39 out of 76) of respondents reported observations in forests, and for the GP, 55% (12 out of 22) of respondents reported observations in forests.

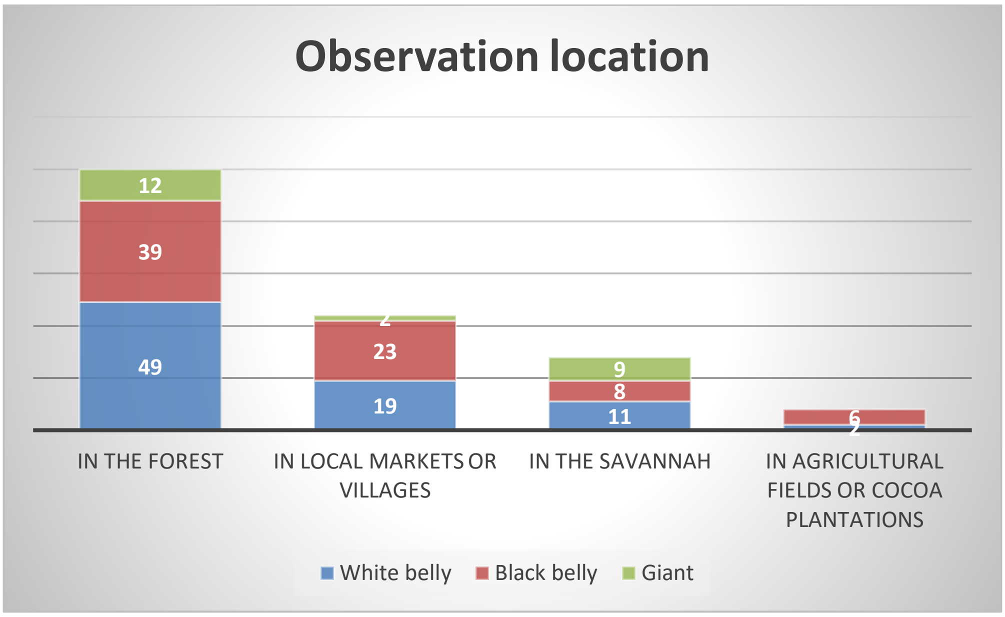

Figure 2: Locations of pangolin sightings by species

e) Frequency of observations

At the study sites, WBP was observed occasionally by 67.53% (52 out of 77) of respondents, with frequent observations by only 2.60% (2 out of 77), and GP was rarely observed by 63.64% (14 out of 22) of respondents. The BBP was occasionally observed by 62% (46/76).

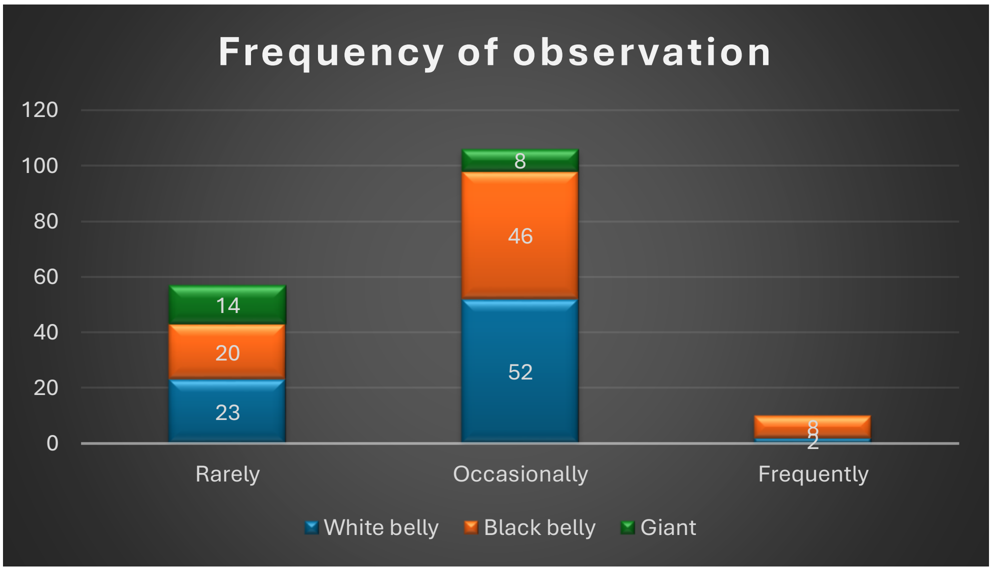

Figure 3: Frequency of pangolin sightings by country and species

f) Seasons of pangolin observation

BBP was frequently observed during both seasons by 53.24% (42 out of 76) of respondents, WBP by 26.60% (35 out of 77) and GP by 31.81% (7 out of 22).

Table 2: Seasons of pangolin sightings by country and species

Species	Both seasons	Seasons Dry	Rainy season	Unknown
BBP	54.54% (42)	26.31% (20)	18.42% (14)	0.00% (0)
GP	31.81% (7)	50% (11)	18.18% (4)	0.00% (0)
WBP	45.45% (35)	31.16% (24)	219.77% (15)	4% (3)

g) Perceived trends in pangolin populations

Perceived changes in the abundance of each pangolin species at the study sites revealed varying trends. The WBP was considered much less common by respondents (64.94% (50 out of 77)), the BBP by 59.21% of respondents (45 out of 76) and the GP also much less common (100%, 22 out of 22), indicating a significant decline in this species.

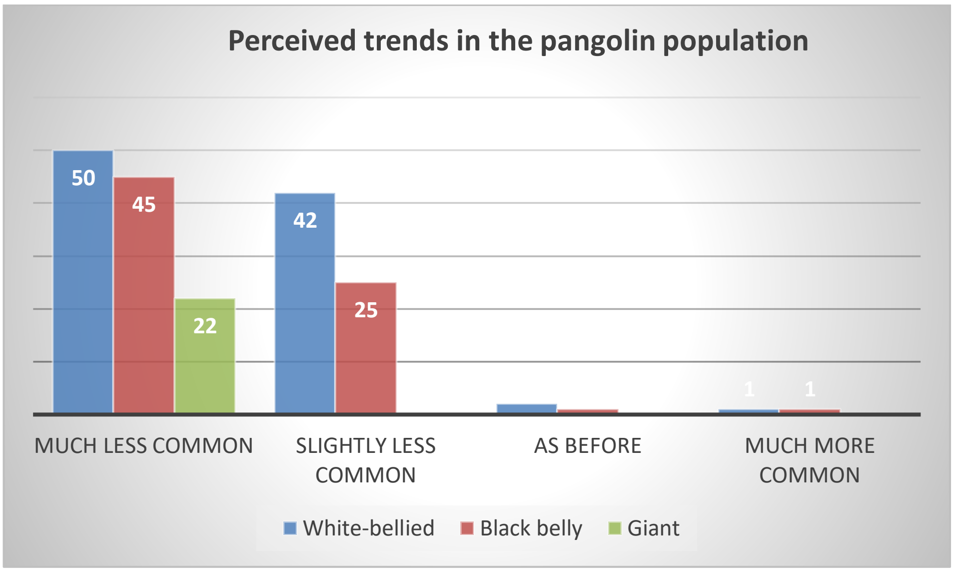

Figure 4: Perceived trends in pangolin populations by country and species

h) Reasons given to explain the decline in the pangolin population

The perceived threats to pangolins across all sites highlighted various factors affecting their population decline.

The BBP was reported to be highly threatened by excessive hunting for local consumption (73.68% 61 out of 76) and 28.94% 22 out of 76) for traditional medicine. The WBP was reported (72.72%, 56 out of 77) for use in traditional medicine (9.09%, 7 out of 77). The GP was reported (45.45%, 10 out of 22) times for local consumption. These trends are detailed in Figure 5.

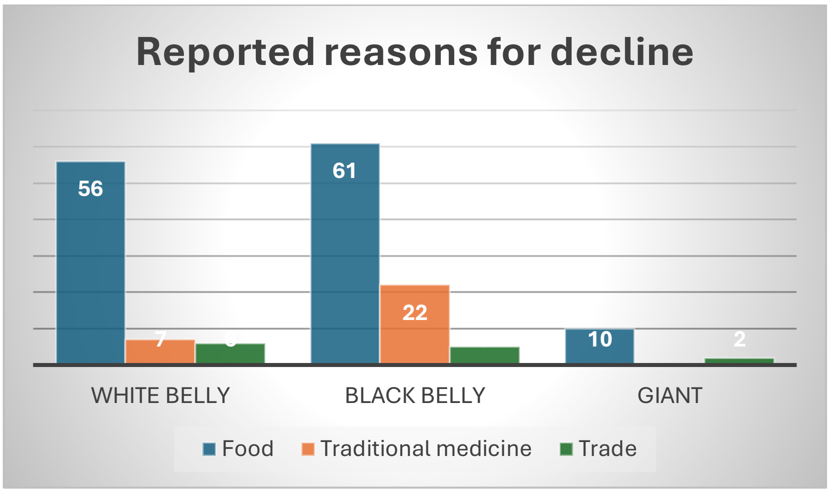

Figure 5: Reported reasons for the decline in pangolin populations by species

2. Distribution of pangolin occurrences collected through data mining and a survey based on local knowledge

In total, we collected 1,634 occurrence points from data mining and the local knowledge survey. The GP accounted for the majority of records (850 or 52.01% of total observations), with the local knowledge-based dataset contributing the smallest number of occurrences (175 records), followed by inaccurate extracted data (490) and accurate processed data (969). The BBP had fewer records overall (442, or 27.05%), but was disproportionately represented in the inaccurate extracted dataset (176 records), with 175 records coming from LEK data. The GP was best represented in the accurate extracted dataset (730 records), while the LEK survey yielded only 22 records. Table 4 shows the number of records collected by data type and species.

Table 3: Number of occurrences recorded by data type and species

Data source	White-bellied pangolin	Black-bellied pangolin	Giant pangolin	Total
Exact data extracted	**225**	**14**	**730**	**969**
Inaccurate data extracted	**216**	**176**	**98**	**490**
Data based on LEK	**77**	**76**	**22**	**175**
Total	518	**442**	**850**	**1,634**

The following maps show the distribution of occurrences recorded by data type

Figure 6a: Map showing the distribution of recorded occurrences of WBP in the study area

Map removed for online version

Figure 6b: Map showing the distribution of recorded occurrences of BBP in the study area

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Figure 6c: Map showing the distribution of recorded occurrences of GP in the study area

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V. Discussion of the results themselves

Observations and habitat of pangolin species

All three pangolin species were reported to have been observed by the local population in the study areas, indicating that these cryptic, scaly mammals are still present in the study sites. However, variations between sites were observed in the presence of each pangolin species, which is likely influenced by habitat suitability, hunting pressure and detection probability (Ingram et al., 2018) at the different study sites. Observations were generally fewer for all three pangolin species, indicating a decline in pangolin populations due to overexploitation, habitat loss and/or reduced interactions between humans and wildlife.

The giant pangolin is known to inhabit various types of forests (e.g., primary and secondary forests, gallery forests, swamps, and savannah habitats (e.g., wooded savannah and wet grasslands), forest-savannah mosaics, and areas near permanent watercourses, with less human disturbance (Hoffmann et al., 2020, Nixon et al., 2019). Previous studies suggest that the GP is generally rare and uncommon (Foley et al., 2014; Hoffmann et al., 2020), which is consistent with the rarity of observations at our study sites. The results confirm that the GP is present in low density and is relatively less abundant in the study areas than the WBP and BBP. The decrease in the number of reported sightings could also be due to population decline in the study area, attributed to several factors, including deforestation and excessive hunting.

The WBP was mainly observed in various known natural habitats, including forests and savannah, but also in agricultural land, indicating that the WBP has adapted to both natural and modified habitats. The relatively high number of observations in markets or villages suggests hunting for consumption and/or trade.

With regard to the BBP, the majority of reported sightings were made in forest habitats, corroborating the BBP's known preference for natural habitats, particularly riparian and swamp forests (Gudehus et al., 2020), which are essential for food supply and shelter for reproduction, as the BBP is known to give birth to its young in tree cavities (Gudehus et al., 2020). However, frequent sightings of BBPs in markets or villages may suggest exploitation for local consumption and trade.

Observation of black-bellied pangolin scales in the village of Worokoro by the data collection team

For the GP, sightings remained the least frequent among the three pangolin species in all countries, although it showed a marked dependence on the forest with limited presence in human-modified environments, as indicated by frequent sightings in the forest at our study sites. It is interesting to note that GP sightings in markets or villages were not recorded at our sites.

Seasonality and trends in reported pangolin sightings

Data from local ecological knowledge (LEK) surveys reveal clear seasonal trends in pangolin sightings. At all sites, respondents most often reported seeing pangolins during the dry season and the rainy season. This trend is likely due to various human activities such as hunting and agriculture that may occur during both seasons: the dry season, when visibility and encounter rates are favourable for hunting (Ingram et al., 2018), and the rainy season, when agricultural activities are most frequent.

The majority of respondents indicated that the population of all three pangolin species was declining. The majority of respondents indicated that the WBP and GP were "much less common" than in previous years. These widespread perceptions of decline are consistent with global population trends observed by the IUCN/SSC Pangolin Specialist Group (2023) and corroborate previous regional studies linking decline to ecological pressures and illegal hunting (Challender et al., 2015; Ingram et al., 2018). The particularly rare observations of the GP correspond to its current endangered status, reflecting its vulnerability to habitat disturbance and hunting pressures (Mambeya et al., 2018).

Distribution of collected presence data

The integration of occurrence data from multiple sources, including LEK surveys and data mining approaches (precise and imprecise explored datasets), is invaluable for modelling habitat suitability for threatened, rare and elusive species such as pangolins, with a total of 1,634 occurrence points were collected. This integration of different data sources provides complementary strengths, as LEK surveys provide detailed, context-specific records, often from extensive spatial and temporal coverage, while records from existing literature and free online databases increase the number of records, while guiding fieldwork in data-poor sites, helping to fill gaps and improve habitat coverage. Combining these data reduces the biases inherent in single-source datasets, improves model robustness, and enhances the predictive performance of habitat suitability models, which is essential for conservation planning for cryptic species for which data are scarce (Elith et al., 2006; Guillera-Arroita et al., 2015).

VI. Next steps

The following actions have been identified as the next steps in our project

1. We will validate the accuracy of the species distribution model produced for each pangolin species through field checks and other LEK surveys on the presence of pangolins in at least two randomly selected areas that the model predicts to be suitable or unsuitable habitats for pangolins but which have not yet been explored. We will accomplish this next line of action by using a t of camera traps and linear transects to conduct ecological surveys of pangolins.
2. Refine the species distribution model for each pangolin species based on the results obtained during field verification of the presence of pangolins in randomly selected suitable and unsuitable sites, using ecological and social approaches.
3. Prepare manuscripts to publish our research findings in peer-reviewed journals.

4. Share the final project report with the local communities where the studies were conducted. This report will be written in an easy-to-understand format, in English and local dialects, where applicable.
5. Share the data collected in global biodiversity databases, e.g. GBIF, iNaturalist, etc.
6. Contribute to the development of a regional action plan for pangolins.

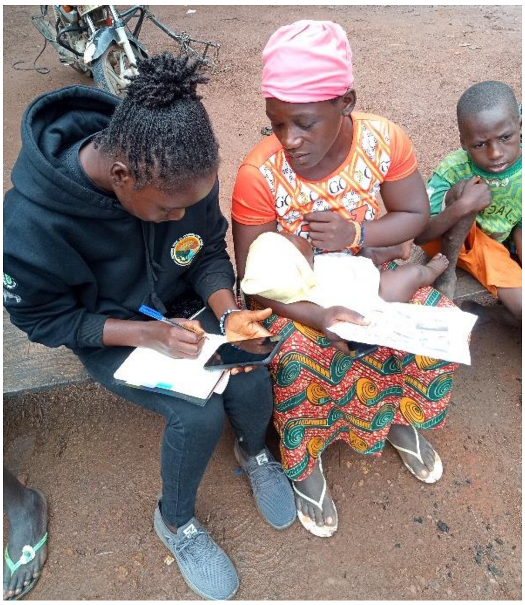
APPENDICES

Appendix 1: List of survey villages **at the two sites**

N	Survey villages	Number of people surveyed	Name of park
1	Bankado	15	Source-Niger
2	Bambaya	13	Source-Niger
3	Farakoro	11	Source-Niger
4	Djibendo	13	Source-Niger
5	Dougouléma	11	Source-Niger
6	Samboudou	10	Source-Niger
7	Missadoubanakoro	12	Source-Niger
8	Sania	16	Source-Niger
9	Kamaro	8	Source-Niger
10	Forokoniah	16	Source-Niger
11	Dadjouni	11	Kankan Wildlife Reserve
12	Iribadougou	11	Kankan Wildlife Reserve
13	Worokoro	13	Kankan Wildlife Reserve
14	Oumalé	14	Kankan Wildlife Reserve
15	Sorokoro	14	Kankan Wildlife Reserve
16	Sansando	12	Kankan Wildlife Reserve
17	Sanakoroni	8	Kankan Wildlife Reserve
18	Dalala	11	Kankan Wildlife Reserve
19	Namouridou	11	Kankan Wildlife Reserve

Appendix 2: Some photos taken by the Guinea team during the LEK data collection

Photos showing signs of black-bellied pangolin presence in the village of Worokoro in Kankan (Kankan Wildlife Reserve).



Photos of LEK data collection by members of the Guinea team.

Photo 2: Project leader explaining the project's objective to a farmer