SCOPING REPORT
FOR A TFCA ACROSS THE
LIUWA-MUSSUMA
LANDSCAPE

AFRICA RANGE-WIDE
CHEETAH CONSERVATION INITIATIVE

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SCOPING REPORT FOR A TFCA ACROSS THE **LIUWA-MUSSUMA** LANDSCAPE

ANGOLA E ZAMBIA
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Cover picture: A juvenile cheetah in Liuwa Plain National Park. Anna Kusler. ZCP.

Back cover picture: Wildebeest and spotted hyena in Liuwa Plain National Park. David Elizalde. 2022.

Pictures: Unless noted otherwise, photographs in this report were taken by CCI in the course of its fieldwork activities.

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Figure 1 - Wildebeest herd in Liuwa Plain National Park.

EXECUTIVE SUMMARY

The survival of Africa's great migrations depends on protecting the landscapes that sustain them, directly safeguarding the wildlife, and supporting the livelihoods of the people who depend on them.

The Liuwa-Mussuma Transfrontier Conservation Area (LMTFCA), spanning the border between Angola and Zambia, **represents one of the last great opportunities to restore a vast and interconnected landscape of global ecological importance**. It has the potential to revive Africa's second-largest wildebeest migration and reestablish functional ecosystems where large carnivores like cheetahs, lions and hyenas can once again thrive.

Preserving essential habitats like floodplains and wetlands is central to this effort. These landscapes provide multiple vital ecosystem services, including water purification, flood mitigation, groundwater recharge, climate regulation through carbon sequestration, biodiversity support, and sustaining local livelihoods by providing resources like fish, reeds, and medicinal plants. Additionally, wetlands and floodplains act as critical habitats for numerous species, enhance soil fertility through nutrient cycling, and offer recreational and tourism opportunities, contributing significantly to local economies and cultural heritage.

Zambia has made measurable progress in surveys, monitoring and managing its portion of the LMTFCA, particularly in Liuwa Plain National Park and adjacent Game Management Areas. Angola, however, hampered by the need for postwar recovery, has lacked the necessary ecological data. To address this gap, the Angolan Ministry of Environment — building on a longstanding partnership— commissioned the Africa Range-wide Cheetah Conservation Initiative (CCI) to assess the Mussuma landscape. This commission initiated a seven-year investment in research, community engagement, and ecological monitoring that forms the foundation of this report.

The Zambian portion of the survey was conducted in collaboration with the Zambian Carnivore Programme (ZCP).

The core study area assessed in this report encompasses approximately 9,300 km^2, including the proposed Mussuma conservation area in Angola and the Upper West Zambezi Game Management Area (UWZGMA) in Zambia, which provides the connectivity with Liuwa Plain National Park (Figure 2). The landscape is part of the Bulozi alluvial plains—a vast seasonal wetland stretching 800 km between Zambia and Angola. The landscapes are characterized by large floodplains, savannas, miombo woodlands, and riparian forests. The region has a complex hydrological system, with perennial rivers like the Lungué-Vungo and Luanguinga creating alluvial plains and flood zones.

This multi-method study evaluated wildlife populations, habitat integrity, human-wildlife conflict, socio-economic dynamics, and community perceptions. It revealed significant declines in large mammal populations both in Angola and Zambia, largely due to unsustainable hunting and habitat degradation. Yet, encouraging signs—such as carnivore crossings and the first recorded wildebeest migration into Angola—highlight the **landscape's potential for natural recovery**.

Could this landscape become the Serengeti of Southern Africa—generating meaningful revenue for local communities and national governments, while safeguarding natural heritage and ecosystem services for generations to come?

Local communities are central to the future of this initiative. While immediate application may face practical constraints, especially in Angola, a community-led approach should be embedded from the outset. Community-Based Natural

Resource Management (CBNRM) models—proven successful across Southern Africa—can be adapted to Angola's context to foster both conservation and sustainable development. From the beginning, efforts should empower local communities as central actors, progressively building toward fully community-led conservation initiatives. Sustainable additions—such as carbon credits, agroforestry, and small local enterprises—can help balance environmental protection with economic growth. Moreover, the restoration of leadership structures could strengthen community governance, essential for long-term success.

This report introduces a zoning proposal (see Figure 127 – Proposal for Conservation Zonation of the LMTFCA and Surrounding Connectivity Areas) that outlines a **core conservation area spanning 3,600 km^2**. Additionally, the proposal explores expanding protection across **neighbouring connectivity areas, covering over 45,000 km^2** allowing to **link with key conservation sites such as Cameia and Mavinga National Parks, along with the western Moxico wilderness areas**. If realized, this interconnected protected landscape would extend into the KAZA region, potentially adding over 100,000 km^2 of protected area. This vast network could emerge as one of the continent's critical strongholds to secure habitats and ensure the long-term survival of threatened species like cheetahs, lions, African wild dogs, and allow the recovery of the wildebeest migration, joining a handful of ungulate migrations surviving on the African continent.

By protecting and connecting these ecosystems, this initiative could significantly **contribute – by adding between 0.5% and 3.5%** of Angola land protected areas- **to the 30x30 global conservation target**, reinforcing Angola's role in international biodiversity commitments.

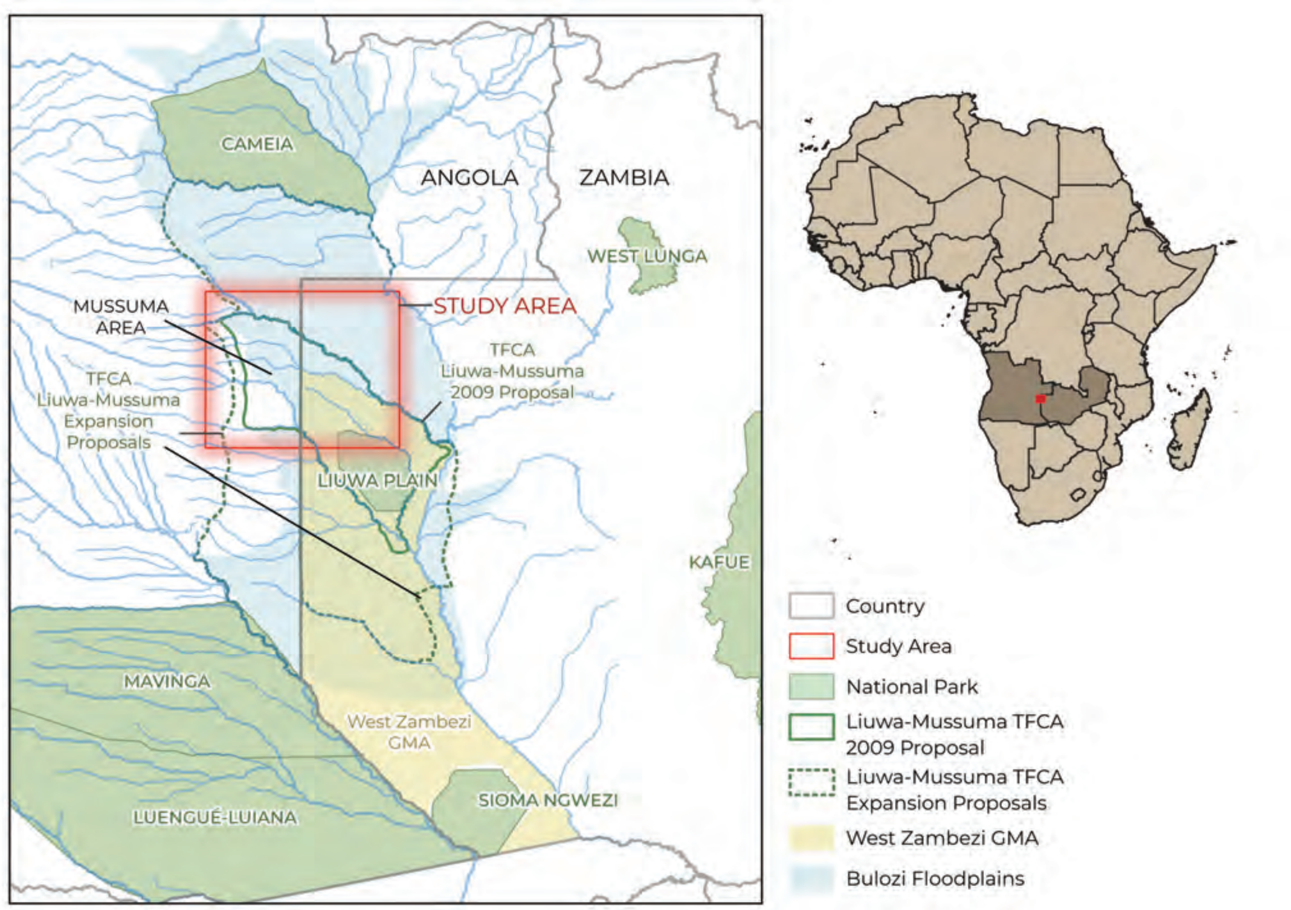

Figure 2 - Map showing the location of the Liuwa-Mussuma Transfrontier Conservation Area (TFCA) within the African continent, highlighting its position between Angola and Zambia. The map also delineates the specific study area assessed in this report.

RECOMMENDATIONS

The report outlines a phased strategy combining short-term priorities, long-term goals, and research needs:

Short-Term Priorities include establishing a base camp and airstrip to support logistics, launching community wildlife monitoring, and conducting participatory mapping and public consultations. These efforts will guide land use planning, support human–wildlife coexistence, enable sensitive habitats regulation, and build the foundation for formal conservation status and cross-border TFCA implementation.

Long-term priorities focus on formalizing the TFCA through bilateral agreements, restoring connectivity with Cameia, Mavinga, and Western Moxico, securing community land tenure, supporting locally governed conservancies, restoring Cameia National Park, promoting climate-resilient planning, and implementing CBNRM models that link conservation with sustainable livelihoods.

Research should focus on ecosystem dynamics, soil and hydrology in the Bulozi system; assess nature-based economic opportunities and water resource use; monitor wildlife recovery and movement for adaptive management; and identify legal and institutional barriers to implementing community-based conservation in Angola, including land use governance and cross-border policy alignment.

By implementing these recommendations through collaborative partnerships, the Liuwa-Mussuma TFCA can emerge as a leading model for ecological restoration, climate resilience, and sustainable livelihoods on the African continent.

Figure 3 - Oribi in the Mussuma landscape.

CONCLUSION

The **Liuwa-Mussuma Transfrontier Conservation Area** presents a **rare and transformative opportunity to re-establish ecological connectivity** between Angola and Zambia through a model that unites ecological integrity, community empowerment, and cross-border cooperation. This report lays the foundation—ecological, social, and political—for the formal designation of a protected area in Mussuma, Angola, and the broader transboundary TFCA with Zambia. It highlights not only the landscape's irreplaceable biodiversity—home to critical habitats and wide-ranging species—but also its cultural significance and the resilience of communities emerging from conflict.

The data show that, despite decades of disruption, **this landscape retains the ecological structure and potential to support the recovery** of key wildlife populations, including large carnivores and the iconic wildebeest migration. With Liuwa Plain National Park serving as a regional stronghold, Mussuma offers both a natural extension and a buffer that can secure long-term viability of migratory routes, gene flow, and climate-resilient ecosystems. Furthermore, the recent documentation of **cross-border movements of lions, hyenas, cheetahs, and wildebeest underscores the urgency to restore connectivity** across this dynamic landscape.

Achieving success **will require a deliberate and inclusive process**: community-based natural resource management must be embedded at the heart of the conservation strategy. Participatory governance, equitable benefit-sharing, and culturally sensitive planning—including recognition of traditional leadership and local naming—are prerequisites for legitimacy and long-term sustainability. Equally vital is the **strategic mitigation of threats**: from **unsustainable hunting** and land **conversion** to **uncontrolled fires** and the looming **pressure of mining developments** in ecologically sensitive floodplains.

With its potential to link more than 100,000 km² of contiguous wilderness and **contribute meaningfully to the global 30x30 conservation target**, the Liuwa-Mussuma TFCA is more than a regional project— it is **a model for transboundary conservation and ecological restoration** across Africa, particularly **in post-conflict and development-challenged regions**. Its success would signal that **landscapes once divided** by conflict **can be reconnected through cooperation**, that **ecosystems** under pressure **can recover with protection**, and that **communities** once marginalized from conservation **can be its strongest stewards**. Through participatory processes, targeted investments, and international collaboration, this initiative has the potential to secure long-term benefits for people, wildlife, and the planet.

The foundation has been laid, the partnerships are forming, and the natural systems are ready to rebound. Now is the time for **bold, coordinated action to transform this momentum into lasting impact**—securing the full potential of the Liuwa-Mussuma TFCA for the region, for conservation, and **for generations to come**.

ACKNOWLEDGEMENTS AND PARTICIPATION

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1. INTRODUCTION

At the dawn of the 20th century, African wildlife entered a perilous phase marked by rapid habitat loss and dramatic declines in numerous species. As human activities intensified, the continent's rich biodiversity came under siege, leading to significant alterations of natural landscapes. Wide-ranging threatened species such as cheetahs and African wild dogs epitomize this crisis. With fewer than 7,000 individuals of each species remaining in the wild, these iconic predators face escalating challenges that threaten their very existence.

Habitat loss and fragmentation—driven by agricultural expansion, urban development, and infrastructure projects—have isolated populations, undermining the genetic diversity essential for their resilience and adaptability. These disruptions break up the large, contiguous landscapes that cheetahs and wild dogs require to hunt and reproduce effectively. Rapid human population growth only intensifies pressure on land and resources, with more areas converted for agriculture and settlements. As natural habitats shrink into smaller, disconnected patches, predators are increasingly forced to navigate human-dominated landscapes, leading to more frequent human-wildlife conflicts and rising mortality rates.

Compounding these threats is the widespread depletion of prey through unsustainable bushmeat harvesting. Driven by poverty, population pressure, and rising demand in urban centres, many communities turn to wildlife as a source of food and income. This overexploitation not only erodes the prey base crucial to predator survival but also weakens entire ecosystems, triggering cascading impacts and reducing ecological resilience.

The situation is further exacerbated by the lack of effective conservation measures, integrated land use planning, and enforcement of wildlife protection laws in many regions. As a result, large carnivores are left with fewer places to live and hunt, further threatening the long-term viability of their populations.

In response, the concept of Transfrontier Conservation Areas (TFCAs) emerged, promoting landscape-scale preservation through transboundary cooperation addressing the fragmentation of wildlife habitats and ecosystems that do not conform to political boundaries (SADC, 2024). Furthermore, TFCAs in Southern Africa were established to promote regional cooperation, biodiversity conservation, and socio-economic development by managing natural and cultural resources across national borders and playing a crucial role in promoting peace and cooperation among neighbouring countries (SADC, 2024; Chitakira et al., 2022).

In 2002, the Peace Parks Foundation, the Development Bank of Southern Africa, and the Regional Tourism Organisation of Southern Africa commissioned a review of potential TFCAs in the SADC Region (DNPW, 2016, PPF, 2009). The Liuwa-Mussuma TFCA (LMTFCA) between Zambia and Angola, was then identified to protect the wildlife migratory species that roam from Liuwa Plain National Park (LPNP) through the Upper West Zambezi Game Management areas and into unprotected wilderness areas in Angola. Of particular ecological importance is the blue wildebeest migration—Africa's second-largest after the Serengeti-Mara.

Located in the heart of the Bulozi Floodplains, this wetlands landscape also holds unmeasurable ecological and economic value. The LMTFCA is comprised mostly by a vast complex of seasonally flooded grasslands and savanna intertwined with perennial rivers and riparian forests within the upper Zambezi River basin. It's a centre of endemism for reptiles and plants and considered of critical importance for birdlife. These wetlands provide diverse ecosystem services crucial for societal welfare. These services include, among others, climate regulation, nutrient cycling and storage, aquifer recharge, food web support, and carbon sequestration (Turpie et al., 1999; Turner, 1991). The Bulozi Floodplains system also significantly contributes to the Zambezi River flood attenuation during the wet season and maintaining water flow during the dry season, benefiting downstream areas (Turpie et al., 1999).

The idea of the LMTFCA was largely embraced both by former Zambian Wildlife Authority (ZAWA) and the former Angolan National Direction for Protected Areas (DNAP) during the first few years since its conception in 2002. A feasibility study was commissioned, and a MoU was drafted after several formal meetings (PPF, 2009).

Despite progress in Zambia's LMTFCA management framework (DNPW, 2016), critical gaps remain in understanding the ecosystem dynamics, wildlife distribution, and human population utilization within the Angolan counterpart, hindering effective conservation strategies. The LMTFCA is still under its conceptual phase, without an official mandate from the participating countries.

Recognizing the urgent need for comprehensive wildlife population assessments, in 2018, the Angolan Ministry of the Environment commissioned the Africa Range-Wide Cheetah Conservation Initiative (CCI) to conduct an assessment of the area, including a survey of the large and medium-sized terrestrial mammals, aiming to gain critical insights into the region's ecological balance.

The aftermath of the armed conflict in Angola and the rapid economic development of Zambia have severely reduced mammal populations within most unprotected parts of this landscape. Despite these challenges, since 2018, monitored large carnivores—including several lions, two cheetahs, and a spotted hyena—have been recorded crossing from Liuwa Plain into Angola, along with a wildebeest in 2022. These crossings confirm the transboundary nature of these populations and have motivated the present study to re-activate the TFCA development.

Protecting this habitat could facilitate the recovery of the wildebeest and zebra migration and reestablish connectivity between Zambia and Angola. This would enable recovery of the wildlife populations, including migratory species, and increase the resilience of the landscape in the face of climate change.

Below: **Figure 4 -** Spotted hyena in the Upper West Zambezi Game Management Area.

1.1 LOCATION AND STUDY AREA EXTENT

The LMTFCA ecosystem (see Figure 5) has been subjected to several tentative delineations, but no formal boundaries have yet been established. Initially, it was proposed to cover approximately 15,000 km^2, with around 5,000 km^2 in Angola and 10,000 km^2 in Zambia[1] (PPF, 2009). However, recent proposals suggest expanding the Zambian portion southward to reach the border of the Kavango Zambezi Transfrontier Conservation Area. Under this new proposal, 16% of the area would be in Angola and 84% in Zambia (DNPW, 2016).

Liuwa Plain National Park (LPNP), covering 3,236 km^2, serves as the core conservation area on the Zambian side of the LMTFCA. Since 2003, LPNP has been managed by African Parks (AP) in partnership with the Department of National Parks and Wildlife (DNPW) and the Barotse Royal Establishment (BRE). DNPW, AP and the Zambian Carnivore Programme (ZCP) conduct monitoring and research on the park's wildlife populations. Currently, LPNP boasts healthy, though still recovering, herbivore populations and a nearly complete large carnivore guild, including over 300 spotted hyenas and increasing populations of lions, cheetahs, and African wild dogs. Liuwa is, therefore, an important source of dispersing carnivores and herbivores to the LMTFCA broader area.

In Zambia, the LMTFCA extends northwest and south (per the latest boundaries defined by DNPW in 2016) through the Upper West Zambezi Game Management Area (UWZGMA). This region has experienced little effective management over the past decades, leading to lower wildlife numbers and habitat degradation due to poaching and human encroachment (DNPW, 2016).

The Angolan component comprises the proposed Mussuma conservation area covering 5,288 km^2, although Peace Parks (2009) acknowledged that these borders were defined without proper field-based information and may need revision. More recently, a 2025 proposal from Angola significantly revised the scope of its contribution, defining a 30,000 km^2 portion that would connect Cameia National Park in the north to Mavinga National Park in the south along the Bulozi floodplains. This expanded vision reflects a growing recognition of the landscape's ecological importance and its strategic potential to restore large-scale connectivity across eastern Angola.

This report focuses on the most understudied part of the LMTFCA. It encompasses the northernmost section of the LMTFCA, focusing on the proposed Mussuma conservation area in Angola and its connectivity with Liuwa Plain National Park through the UWZGMA in Zambia, covering a total area of approximately 9,300 km^2 (see Figure 5).

For some accounts and descriptions, the connectivity area between Mussuma and Cameia National Park along the Bulozi floodplains in Angola is also included.

The segment located between the Lutembo and Lungué-Vungo Rivers on the Zambian side (1,240 km^2 or ~8.3% of the 2009 LMTFCA proposed area) was largely excluded from this study due to its inaccessibility—lacking a river crossing—and its administrative alignment under a different province (Northwestern Province) and traditional authority. Furthermore, during the study period, it was not possible to secure approval from the traditional authority overseeing this area, as they were not on site.

1. No area size consensus has been found among the various sources consulted

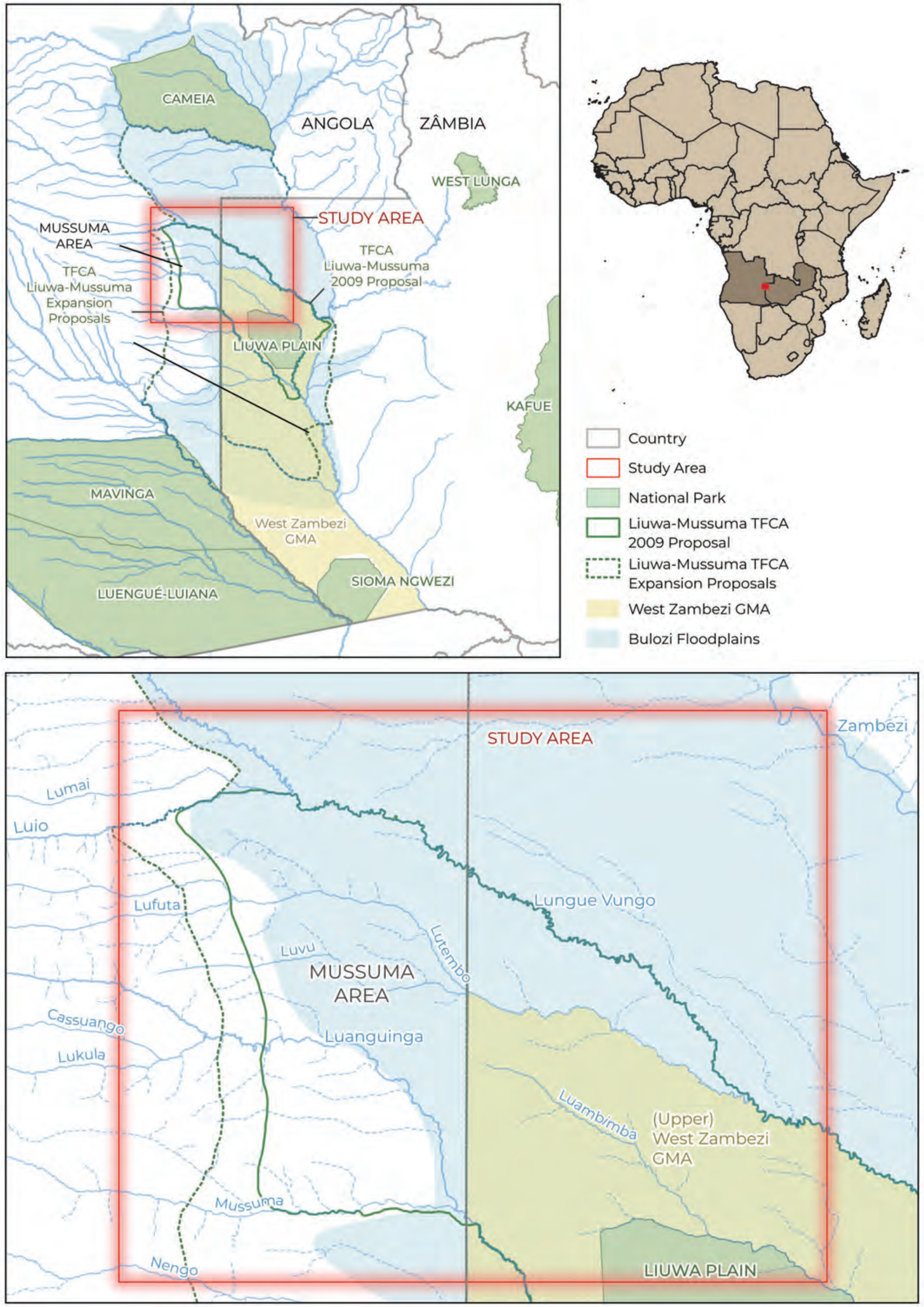
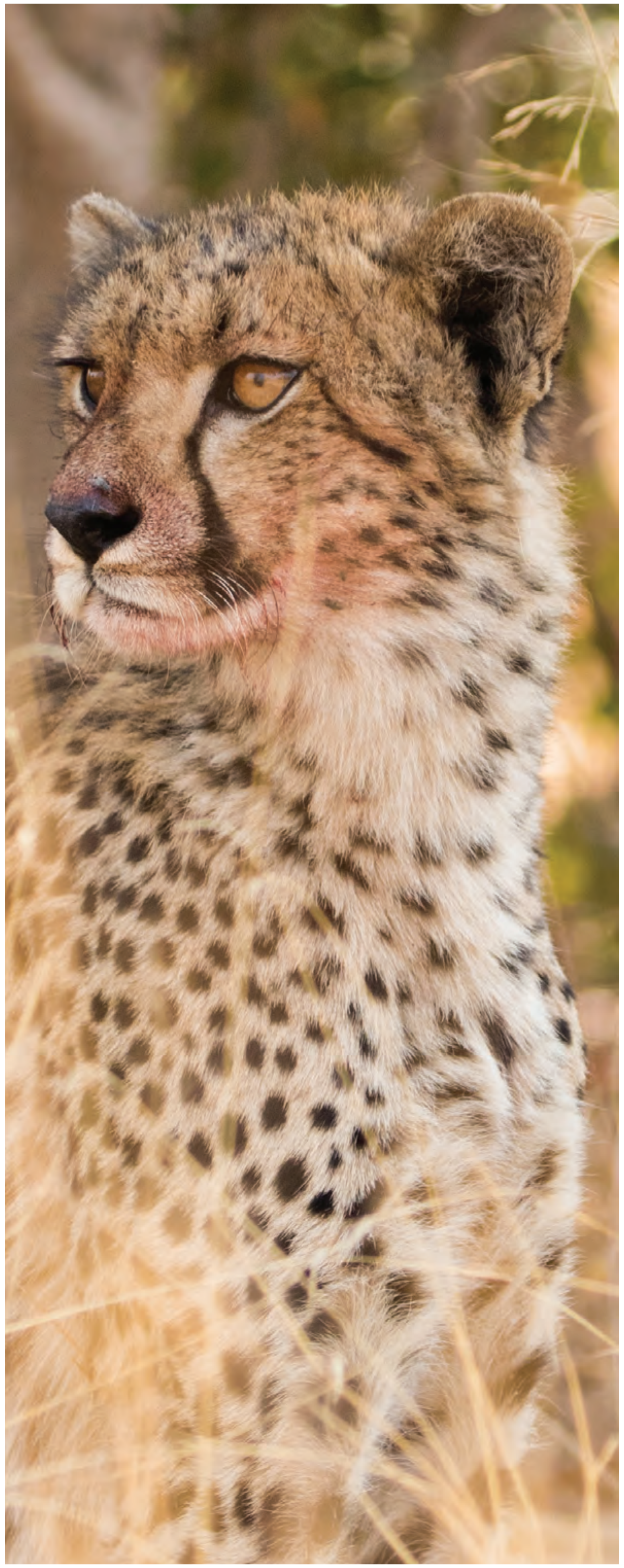


Figure 5 - Location of the Liuwa-Mussuma Transfrontier Conservation Area and Study Area.

1.2 SURVEY AIM AND OBJECTIVES

The principal aim of this survey is to evaluate the potential for wildlife population recovery, particularly for large carnivores and their natural prey. It seeks to inform pivotal political decisions for the formal establishment of a protected area in the Mussuma landscape, Angola, and the transboundary Liuwa-Mussuma TFCA. Beyond its wildlife-focused objectives, the survey aimed to yield extensive baseline data, including, access routes, infrastructure, logistical constraints, socioeconomic profiles, human-wildlife conflict, local attitudes towards wildlife and overall recovery potential, enabling a detailed comparison of the conditions in both countries. This wealth of information supports the TFCA's objectives for wildlife management planning, aiming at sustainable natural resource use and fostering community-led conservation initiatives.



Right: **Figure 6 -** Cheetah in Liuwa Plain National Park. Daan Smit, ZCP.

2. METHODOLOGY AND SURVEY EFFORT

This study applied a multi-method approach to assess the status of medium and large mammals, human-wildlife interactions, socio-economic dynamics, and conservation opportunities across the Mussuma and Upper West Zambezi Game Management Area (UWZGMA) landscapes. Methods combined systematic camera trapping, local ecological knowledge interviews, participatory engagement, and spatial data analysis to provide a comprehensive, evidence-based understanding of the ecological and human dimensions of the region.

Between 2019 and 2024, a total of ten field visits were carried out across Angola and Zambia, totalling approximately six months of fieldwork in Angola and five months in Zambia. The fieldwork was structured in multiple phases. Initial area reconnaissance and baseline interviews with communities and local authorities—both administrative and traditional—were undertaken in 2019. In 2021, three visits to Mussuma focused on deploying and maintaining camera traps, complemented by follow-up interviews. In 2022, one additional mission to Mussuma and one to UWZGMA, in Zambia, enabled additional camera trapping and communities' interviews. A further field visit in 2023 supported continued camera trapping in UWZGMA. In 2024, two visits to Mussuma focused on delivering community conservation education and engaging with local leadership.

This sustained field engagement supported the data collection strategy and ensured a consistent presence on the ground. The methodology combined technological tools such as camera trapping and remote sensing with participatory approaches including interviews and local consultations. This mixed-method design enabled the triangulation of ecological, spatial, and socio-economic data, offering a holistic foundation for the report's findings and recommendations.

2.1 LITERATURE REVIEW

The methodology for this survey incorporated an extensive literature review that included journal articles, published and unpublished reports, books and other publications and online databases (e.g. GBIF portal). Additionally grey literature documents were accessed and evaluated for credibility alongside general publications related to the study area.

2.2 CAMERA TRAPPING

Camera trapping, a non-invasive technique, was employed as a key methodology due to its effectiveness in monitoring wildlife populations, especially cryptic species (Pettorelli et al., 2010). This method utilizes passive infrared and motion sensors in fixed cameras to capture animal movements based on triggered movement and body heat. The data obtained from camera traps, along with georeferenced locations of camera trap sites, provided information on species distribution, habitat use, population structure, and behaviour (Pettorelli et al., 2010; O'Brien & Kinnaird, 2011; Rowcliffe et al., 2014; Belbachir et al., 2015). The effectiveness of this method in Angola has been demonstrated by a growing body of work across multiple ecosystems. Among the many valuable outcomes, notable examples include the rediscovery and range extension of Ansorge's cusimanse after more than a century (Elizalde Castells et al., 2021), and the detection of several melanistic (black) servals during a single survey in the Luando Strict Nature Reserve (Elizalde et al., 2020).

The survey area was divided into a grid of 5 x 5 km (25 km²) cells, treating each cell as a sampling unit. This grid size was aligned with previous surveys in Luando Strict Nature Reserve, Quiçama National Park, Bicuar and Mupa National Parks, Mavinga, and Luengue-Luiana National Parks (Funston et al., 2017; Overton et al., 2017a; Groom et al., 2018; Elizalde et al., 2019) in order to facilitate future comparability, despite slight methodological variations. Additional cameras were deployed in areas where the occurrence of key species, based on local knowledge or track observations, was anticipated, increasing the probability of species detection.

Prior to camera deployment, the team engaged with local and traditional authorities as well as communities residing in the study area to explain the survey's objectives, foster awareness, and address concerns among residents. Given the region's history of armed conflict, some community members were initially suspicious of the study. Concerns included doubts about the true purpose of the research, how long it would last, the exact procedures involved, and in some cases, fears that the camera traps could be hidden explosives or surveillance tools. To alleviate these concerns, the team conducted detailed demonstrations showing how the camera traps worked, explaining their function, duration of deployment, and the nature of the data being collected. In addition, the team presented all the relevant permits obtained from the Ministry of Environment (MINAMB), through the National Institute for Biodiversity and Conservation Areas (INBAC), as well as from the provincial government. The team was also accompanied by two technicians—one from MINAMB and one from INBAC—which further reassured communities of the study's official backing and legitimacy.

A total of 201 camera traps were deployed across the two countries: 96 in Mussuma, Angola, and 105 in the UWZGMA, Zambia, using the 25km² grid to ensure as even distribution as possible. Of these, 168 traps were successfully retrieved—74 from Angola and 94 from Zambia—indicating a higher retrieval rate in Zambia. This is visualized on the map from Figure 7, where retrieved cameras are marked with red dots.

The camera traps operated continuously in Angola from August 2021 to May 2022, while in Zambia the survey was divided in two periods: From September to November 2022 and from June to July 2023. The total number of camera trap days (the sum of the number of days each camera trap was operational) is 13,918, with 7,873 in Angola and 6,045 in Zambia. Table 1 summarises the total camera trap effort.

There were 33 instances of either stolen or malfunctioned cameras, denoted by black crosses on the map of Figure 7, with a higher incidence in Angola (22 cases) compared to Zambia (11 cases). This discrepancy suggests Angola faced more significant challenges with camera trap operations, potentially due to longer field deployment times. Notably, most of these incidents occurred near the border or in adjacent areas, highlighting specific zones of concern. In the Mussuma region, especially, cameras placed along known illicit cross-border routes or at remote waterholes marked by signs of hunting—were particularly affected.

Data analysis followed standard camera trap methodologies to prevent inflated counts from double-counting individuals. Images of the same species occurring within a time-window of 30 minutes were considered as part of the same independent capture event. Naïve occupancy was calculated as the percentage of camera trap sites that captured a certain species. Relative abundance index (RAI) was calculated as the number of independent events of a certain species per every 100 camera trap nights. The RAI therefore serves as a standardized measure to compare abundances across different sites or locations (e.g. Angola Vs Zambia). It is important to be careful when using RAI to compare abundances across different species, as detection rates between species can vary independently of their abundance, due to differences in size and behaviour.

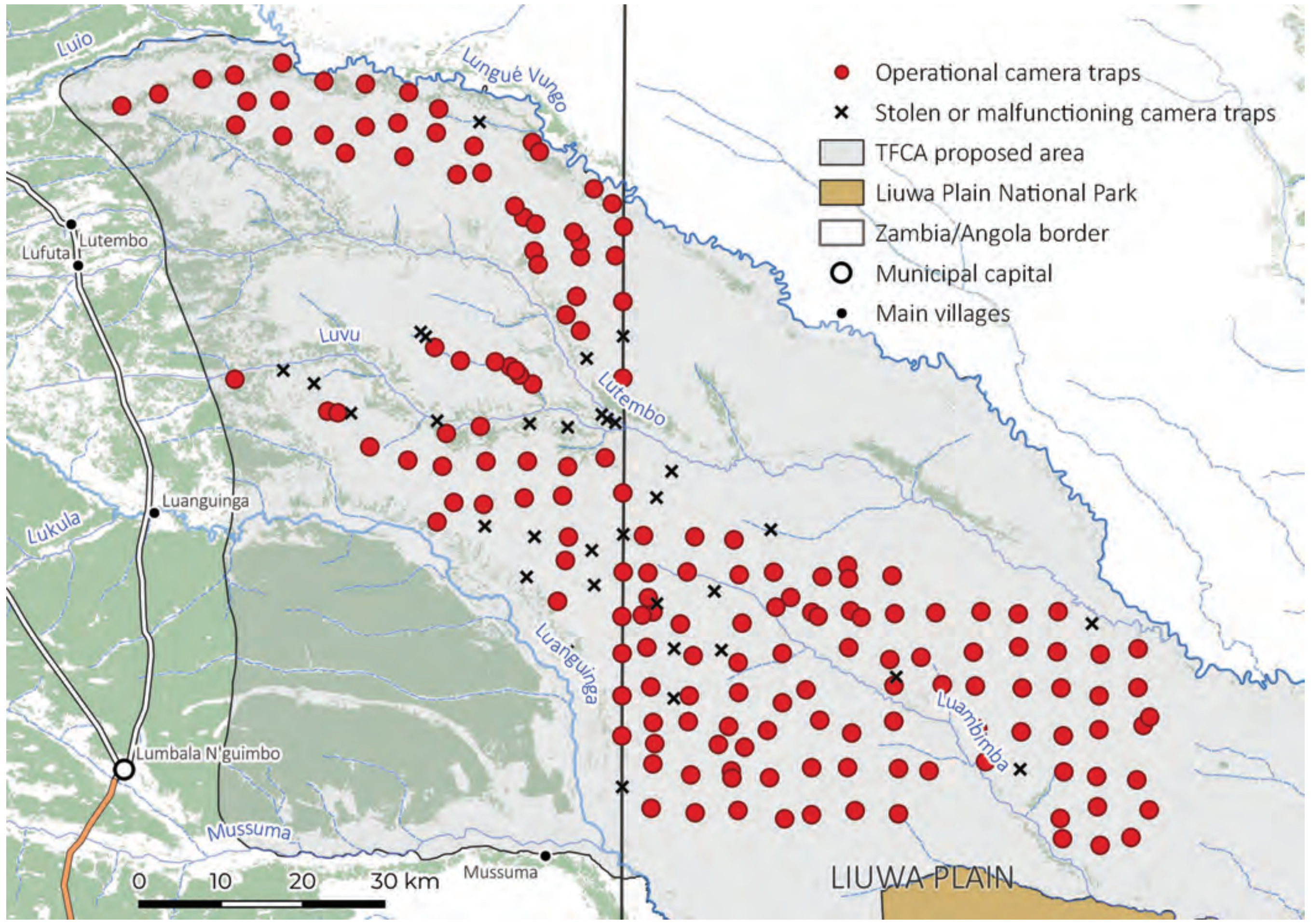


Figure 7 - Camera trap location and operation in Angola and Zambia.

Table 1 - Summary of camera trap effort.

	ANGOLA	ZAMBIA	TOTAL
Camera Traps Deployed	96	105	201
Camera Traps Retrieved	74	94	168
Stolen/Malfunctioned	22	11	33
Camera Trap days	7,873	6,045	13,918

2.3 INTERVIEWS TO DOCUMENT LOCAL ECOLOGICAL KNOWLEDGE, HUMAN-WILDLIFE INTERACTIONS AND SOCIO-ECONOMIC DYNAMICS.

To better understand both current and historical trends in species distributions, human population change and socio-economic aspects, wildlife conflicts, conservation attitudes, and hunting pressures, questionnaires and semi-structured interviews were conducted with local populations and both administrative and traditional authorities. The questionnaires employed in this survey were adapted from those developed by Maddox (2003), Dickman (2009), and Mkonyi et al. (2017).

Before commencing the interviews, participants were fully briefed on the study's objectives and reassured that they could withdraw at any moment, ensuring respect for their autonomy in deciding to participate. To overcome language barriers, a locally trained translator facilitated the conversations.

The interview strategy aimed to include as many villages and settlements as possible, conducting interviews in every community willing to participate. In each village or settlement, interviews involved the traditional leader (Soba, Induna or headman) or their designated representative, as well as two to three community members identified by traditional authorities as being particularly knowledgeable about wildlife and the local environment. It is essential to acknowledge that while interview data is informative, it should be approached with caution due to possible biases, variations in respondent expertise, and challenges in species identification accuracy.

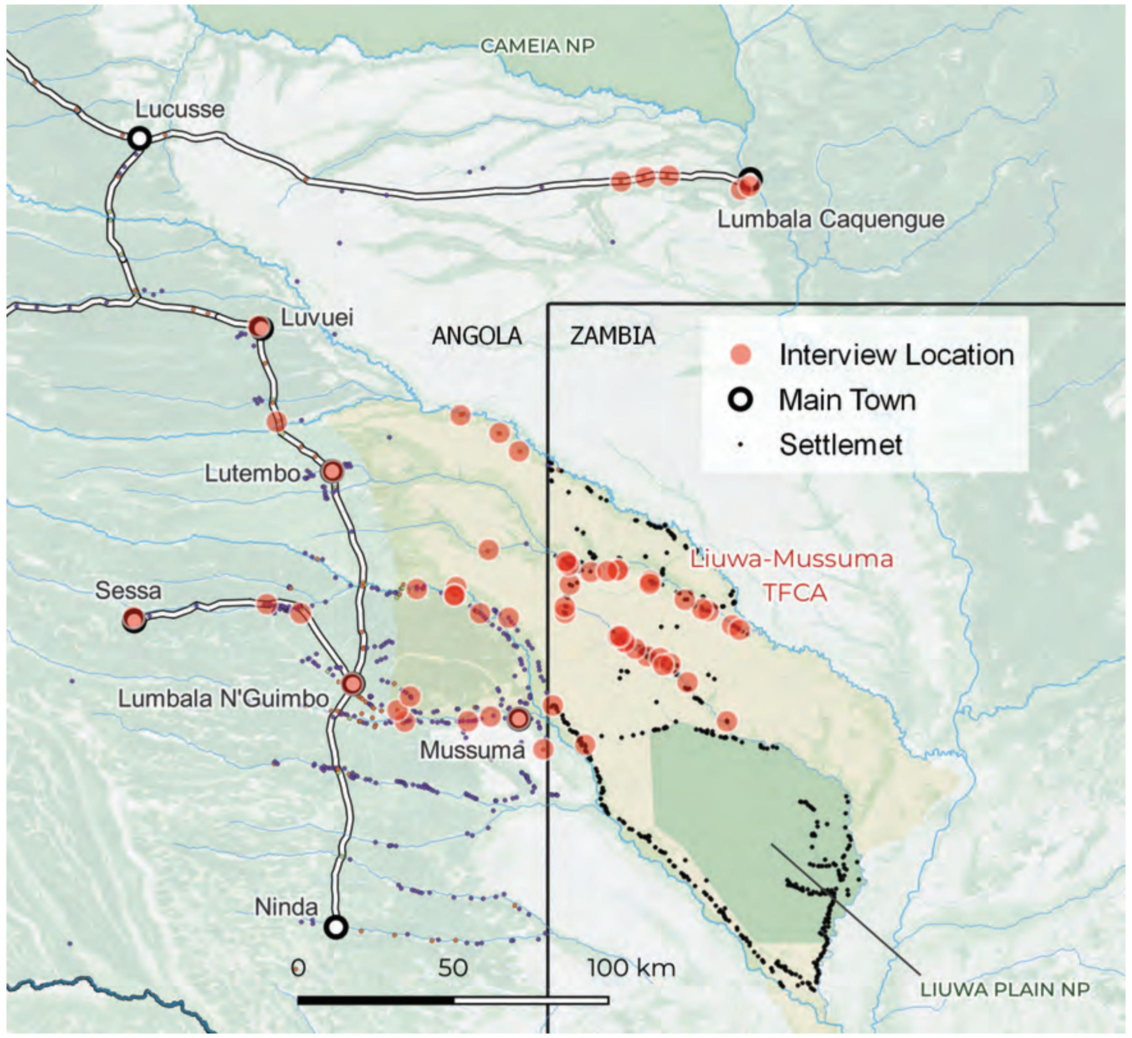


Figure 8 - Locations of interviews conducted during the survey.

Figure 9 - Interview using laminated pictures of mammal species.

In total, 145 interviews were carried out across 73 different communities—comprising 79 interviews in 36 Mussuma communities and 66 interviews in 37 communities within the UWZGMA landscape (see Figure 8).

2.3.1 WILDLIFE PRESENCE AND HUMAN-WILDLIFE CONFLICTS

During interviews, participants were queried about a specific selection of large and medium-sized mammal species. This curated list comprised species historically documented in the area, with the inclusion of certain species which are known not to exist in the region. These species were strategically introduced as quality markers to gauge the accuracy of responses. For the purposes of this report and result analysis these marker species were removed from the dataset. Additionally, species that do not exist in Angola but are present in Zambia (e.g. buffalo) and vice-versa (e.g. yellow-backed duiker) were also removed from the analysis of the respective countries where they do not occur.

It is worth noting that the steenbok was not initially included in the questionnaire due to a lack of historical records for the area. However, during the study, it was observed to be prevalent and therefore later included on the Zambia surveys. Some Angolan respondents might have confused the steenbok with the oribi.

The survey questions were presented using a set of laminated pictures of the species (Figure 9). Respondents were initially tasked with identifying the species depicted. Upon correct identification, they were then questioned about the presence of the species in the area (defined as the distance a person can cover within a day's walk). Species incorrectly identified were removed from subsequent analysis. For those species confirmed to be present, respondents were further prompted to categorize them into three groups: those causing no problems, those causing small problems, and those causing significant problems.

Specific notes regarding the challenges posed by small carnivores and antelopes were recorded. Additionally, conflicts involving large carnivores (lion, spotted hyena, leopard, cheetah and African wild dog) were addressed in a separate section of the questionnaire, ensuring a comprehensive examination of human-predator conflicts and perceptions within the study area. Lastly, a set of questions regarding attitudes towards wildlife and conservation were asked.

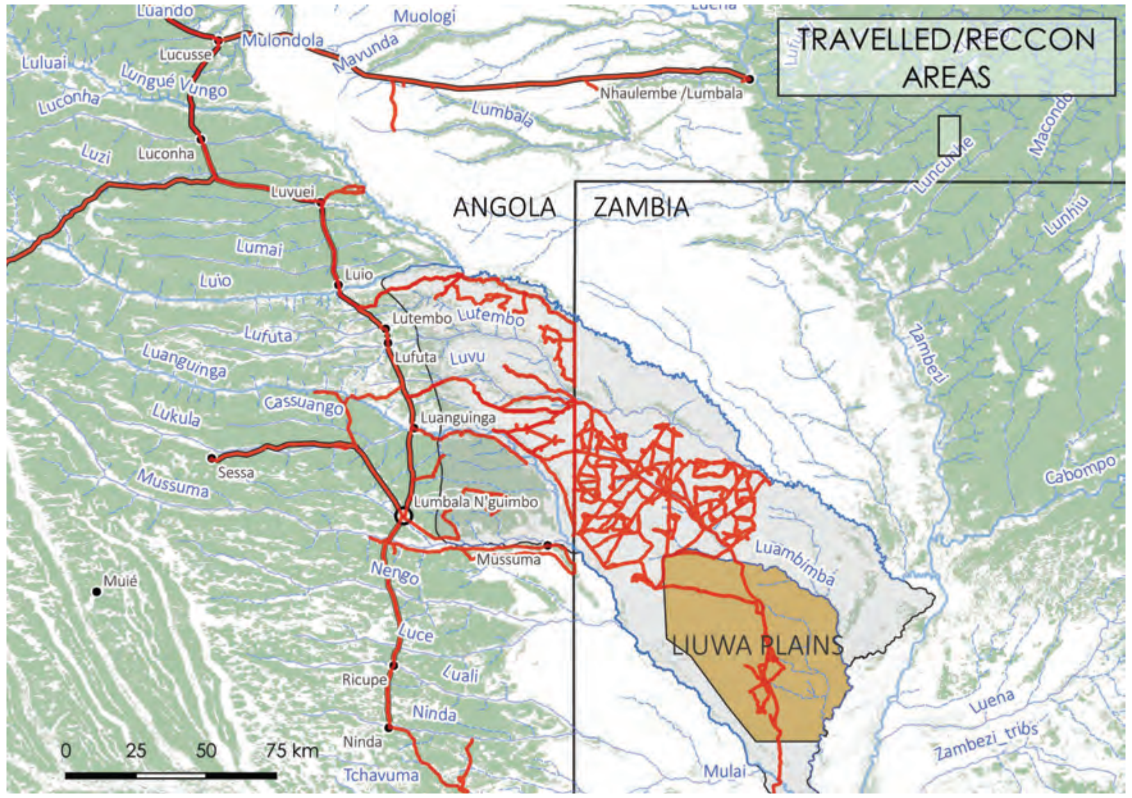


Figure 10: Travelled routes in the survey area.

2.4 AREA RECONNAISSANCE, WILDLIFE OBSERVATIONS AND LANDSCAPE FEATURES

Due to the lack of preliminary information and previous research on the study area, an extensive area reconnaissance was initiated at the start of the survey to record and map roads, trails, waterholes, river crossings and villages.

In addition, direct observations of wildlife and its behaviour as well as indirect (e.g. spoor or dung) observations for key species (large carnivores, roan antelope) were recorded. Anthropogenic impacts such as livestock, hunting camps, etc., were also documented. The locations of these observations were systematically recorded mainly through SMART (Spatial Monitoring and Reporting Tool), a widely used software platform designed to aid in the management, monitoring, and reporting of wildlife and natural resources, particularly in protected areas and conservation landscapes.

Figure 10 illustrates the extensive fieldwork conducted during the mammal survey in both countries, where the red lines delineate the routes taken by the survey teams. These paths reflect the diverse activities undertaken, including the deployment of camera traps, conducting interviews with local populations, and performing detailed reconnaissance of the terrain.

2.5 REMOTE SENSING

Remote imagery-based digitization played a crucial role in generating accurate and up-to-date spatial data essential for decision-making and geographical analysis. Prior to the field work, visible features such as rivers and streams, road networks (paved, unpaved, trails), villages, waterholes, were manually traced or digitized in the available satellite imagery of Google Earth to create accurate digital maps. Fire frequency maps were created using MODIS burned area data from Giglio et al. (2021). Additionally, other sources of remote sensed products such as the Hansen et al. (2013) forest cover change datasets were used.

2.6 DATA ANALYSIS

Camera trap images were processed and managed utilizing DigiKam 7.7.0 software. This involved the manual classification of images to eliminate false positives, such as instances triggered by moving grasses, ensuring the accuracy of data. Furthermore, images were tagged with the species name for future analysis and reference.

The analysis of the camera trap data was performed using specialized R packages, namely camtrapR (Niedballa et al., 2016) and vegan (Oksanen et al., 2019). These packages offered robust tools for the comprehensive examination of species occurrence, relative abundance, and diversity derived from the camera trap data.

In addition to camera trap analysis, spatial information obtained during the survey was processed and visualized using the Geographical Information System (GIS) software QGIS 3.16.7. QGIS facilitated the detailed analysis and graphical representation of the spatial data gathered throughout the survey. This included the mapping of camera trap locations and results, deforestation data, and other relevant spatial information, enabling a comprehensive understanding of the ecosystem's characteristics and dynamics.

Below: **Figure 11 -** African wild cat in Liuwa Plain National Park.

3.

GEOGRAPHICAL AND PHYSICAL LANDSCAPE

3.1 LANDSCAPE AND HYDROLOGY

The TFCA falls mostly inside a vast seasonal floodplain system known as Bulozi Floodplains (in historical reference to the Barotseland kingdom - Bulozi in Lozi language). In Angola the area is commonly known as "Chanas or Anharas do Leste". This is considered as probably the largest ephemeral wetland in Africa (Mendelsohn & Weber, 2015) stretching over 800 km from North to South and spanning over 200 km in width and that forms the north-west portion of the upper Zambezi River basin (see Figure 13).

The main habitats of the floodplains are comprised of grasslands and woody savannah, fringed by miombo woodlands along the main river courses in some areas (Huntley, 2023a). The presence of these woodlands indicates areas that are not flooded. A portion of dense miombo/*Cryptosepalum* forest laying between the Luanguinga and Mussuma River has also been gazetted as part of the Mussuma proposed conservation area (see Figure 17).

The TFCA lies on an apparently flat area with a smooth and almost imperceptible rolling profile (Diniz, 2006). Altitude follows a decreasing gradient towards the southeast, with the highest areas reaching 1160 m.a.s.l along the north-western border, and the lowest point being around 1000 m.a.s.l. south of Liuwa Plain National Park. The drainage system falls entirely on the Zambezi River basin, and water flows slowly southeasterly, from Angola to Zambia, producing very wide floodplains with slight slopes. These rivers shape curves and meanders forming frequent oxbow lakes and reed grass marshes. Although currently undocumented, it is likely that extensive peat beds fill the low parts of the river floodplains.

Several perennial rivers (see Figure 13) cross the LMTFCA (PPF, 2009). These include the Lungué-Vungo (Lungwebungu in Zambia) one of the biggest contributors to the Zambezi, flowing along the northern border of the LMTFCA and the only fast flowing river of the area. Its tributary, the Lutembo (Lutembwe in Zambia) is probably the most pristine river habitat on the Angolan side, as no human population is settled within its margins; The Luvu, a Lutembo tributary, carries very slow waters and meets the Lutembo at the border between the two countries; The Luanguinga, the only other direct tributary to the Zambezi within the TFCA, crosses the Mussuma area and then forms the southern border of the TFCA. It produces the largest alluvial floodplain, reaching more than 5km in width at some points. Finally, the Mussuma River forms the southern border of the TFCA on the Angolan side, until it meets the Luanguinga near the border with Zambia. Some of these rivers are navigable by small boats that are used to transport goods between the two countries. None of these perennial rivers are crossable by vehicle on their course through the TFCA, dividing the study area into 4 disconnected portions: Between Lungué-Vungo and Lutembo river; between Lutembo and Luvu; between Luvu/ Lutembo and Luanguinga; and between Luanguinga and Mussuma rivers.

Numerous ephemeral rivers and drainage lines (mulolas) also cross the floodplains. Most of them have waterholes and large pools that hold water until late into the dry season, providing freshwater access to antelopes, birds and a refugia for fish that are harvested by local populations. On the Zambian side, the main ephemeral river, the Luambimba, bisects the TFCA, running parallel to the Lungué-Vungo and Luanguinga and forming permanent large pools, lagoons and marshy areas that persist over the dry season.

Figure 12 - Wildebeest with calf in a waterhole in Liuwa Plain National Park.

The geological and lithological characteristics of the area are relatively simple, with a landscape predominantly shaped by Kalahari sand deposits. These deposits consist of a thick layer of aeolian (wind-blown) quartz materials, combined with seasonally waterlogged gleysol clays (Diniz, 2006; Mendelsohn & Weber, 2015). Additionally, frequent hardpan layers beneath the surface lead to saturation, impeding tree growth (Huntley, 2023a; Mendelsohn & Weber, 2015).

Although there have been no ground soil surveys in the study area, FAO & IIASA (2023) predicts that the most probable dominant soils in the study area are gleysols (hydromorphic soils) and arenosols.

Gleysols, typically located in the study area floodplains, experience significant moisture variations with seasonal flooding in summer and drier conditions in winter. They are characterized by intense redox reactions and a distinct gleyic layer from which iron is removed, leaving it without the typical brown and red hues of iron-rich soils. The top layer, rich in organic matter, offers a relatively fertile ground ideal for horticulture, though the practice is constrained by the area's flooding patterns. (Mendelson & Martins, 2018).

Arenosols, prevalent in the forested parts of the study area, are nutrient-poor, wind-blown sediments with inherently low water storage capacity. While all soils

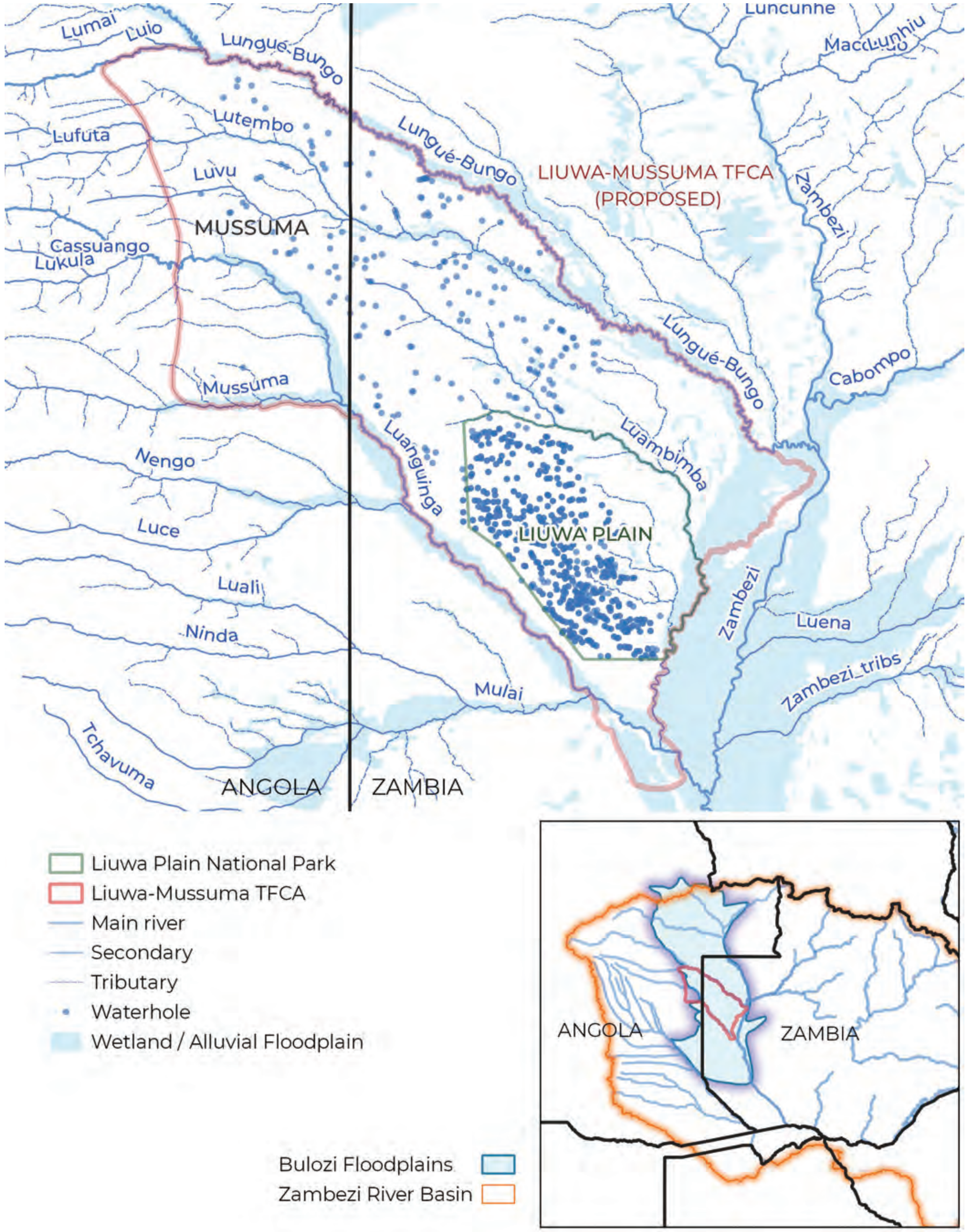


Figure 13 - Top: rivers, wetlands, and water features on the Liuwa-Mussuma TFCA landscape. Bottom: location in relation to the Bulozi floodplains and the Zambezi River basin. River data: RAISON/CCI. Wetlands data: OpenStreetMap, 2024.

can become saturated during rainfall, arenosols differ in that they drain very quickly due to their coarse texture, leading to a rapid decline in available moisture shortly after rainfall events. They contain mainly quartz and feldspars, with kaolin as the predominant clay type, all of which contribute to their limited ability to retain water. These soils are typically acidic and nutrient-depleted, supporting natural vegetation primarily through nutrient recycling. Due to their poor fertility and water retention, cultivation is discouraged as it tends to be economically unviable and ecologically unsustainable. While certain crops like cassava and sweet potatoes are feasible, and cattle ranching shows potential, the overall low fertility and water capacity limit agricultural productivity (Mendelson & Martins, 2018).

In summary, the seasonal flooding in the gleysols area, combined with nutrient leaching due to high rainfall in the arenosols area and their acidic nature, means the area is generally unsuitable for agricultural purposes (Mendelsohn & Weber, 2015; WWF, 2018).

The flooding in the Bulozi floodplains starts typically three months after the beginning of the rainy season (Zigelski et al., 2018). Once the rains have started, the combination of high precipitation, relatively low gradient, and an impermeable hardpan causes a seasonal rise in the water table saturating the soil and inundating the area during about four months -between January and May-with shallow water of about 0.5meters in depth (Mendelsohn & Weber, 2015; Zigelski et al., 2018). The water then evaporates or drains very slowly towards the main rivers, and soon after the rainy season ceases, the landscape turns dry again (Mendelsohn & Weber, 2015). In some areas, overflowing of rivers during the rainy season may also contribute to the raising waters within the floodplains (Zigelski et al., 2018).

Two of the most remarkable natural features of the floodplains landscape are the termite mounds and fossilized sand dunes (Mendelsohn & Weber, 2015) that slightly raise the surface above the flooding level (typically around 1 meter), providing better conditions for geoxylic suffrutices species and also trees, palms, and shrubs (Huntley, 2023a). These form an intricate network of thousands of tall woody vegetation islands that sometimes resemble beautiful garden arrangements (Figure 20).

Most of the floodplains shallow channels are transversed by long man-made earth barriers that act like small dams, typically around half a meter high (Figure 14), set up to trap fish that migrate to the plains during the flood season (Mendelsohn & Weber, 2015; Zigelski et al., 2018).

Below: **Figure 14 -** Fishing barrier in the ephemeral floodplain.

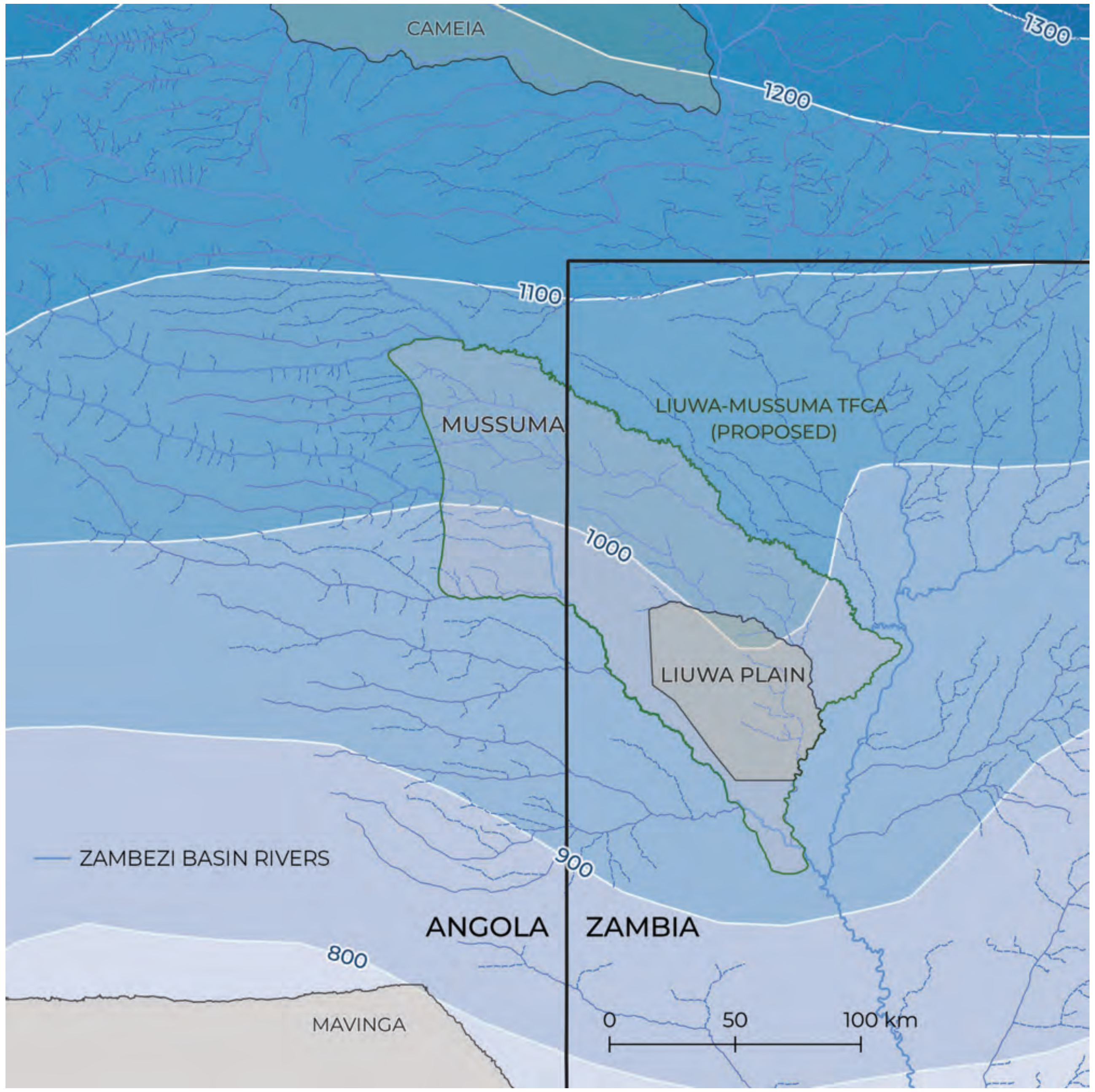


Figure 15 - Isohyet map of annual mean precipitation in the Liuwa-Mussuma TFCA. Data from (Fick & Hijmans,2017).

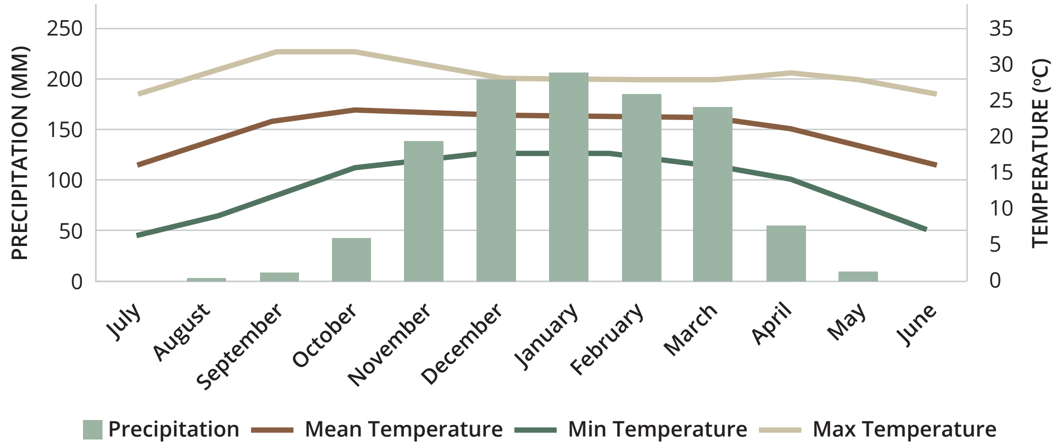


Figure 16 - Monthly precipitation; and mean, minimum and maximum temperatures in the Liuwa-Mussuma TFCA. Data from (Fick & Hijmans,2017).

3.2 CLIMATE

The LMTFCA is located within the tropical humid climate region of medium altitude (Diniz, 2006), and falls under the Aw class on the Köppen-Geiger climate classification (Kottek et al., 2006), denoting a Tropical Savanna or Tropical Wet and Dry climate characterized by consistently high temperatures throughout the year and a pronounced dry season during the winter months, with the majority of rainfall occurring in the summer. It therefore has two well defined seasons: the rainy season from October to April and the dry season from May to September (Diniz, 2006).

The TFCA falls between the 900 and 1100 mm isohyets on a well-defined south to north gradient (see map in Figure 15). The rainiest months are from December to March with nearly 200mm of rain per month. Between May and September rains are very rare (Fick & Hijmans, 2017).

Average annual temperatures are approximately 21 °C, typically ranging between 16 and 26 °C. Slightly higher temperatures are usually observed during September and October, coinciding with the transition from the dry to the wet season (Figure 16). The coldest months are June and July, when the biggest daily thermal oscillation with temperatures sometimes dropping close to 5 °C (Fick & Hijmans,2017).

3.3 VEGETATION

The vegetation in the study area is a complex mosaic of alluvial floodplains, vast grasslands mixed with underground forest, savanna woodlands, riparian forests and dense miombo/*Cryptosepalum* forests - refer to Figure 20, Figure 21, Figure 22, Figure 23 and Figure 24 for visual illustrations of the landscape. Vegetation patterns in the Liuwa–Mussuma landscape are largely driven by the depth of the water table and subtle variations in elevation. Although these topographic differences may be nearly imperceptible to the eye, they have a strong influence on hydrology—affecting how long areas remain waterlogged or dry—which in turn shapes plant community composition. Although vegetation units have not been formally mapped on the Angolan side, they are readily distinguishable. A broad classification can be derived using tree cover data, particularly by categorizing areas according to tree density (Figure 17).

There are no historical or recent vegetation surveys in the study area of the LMTFCA, hence the species accounts and habitats described in this report have been compiled from studies and reports from similar habitats within the Bulozi floodplain in general and from Cameia National Park in Angola.

The floodplain grasslands are dominated by herbaceous species of mid to low height dominated by *Loudetia simplex* (Barbosa, 1970) along with species of *Acroceras, Andropogon, Aristida, Arundinella, Bothriochloa, Chloris, Cynodos, Echinochloa, Eragrostis, Imperata, Leersia, Monocymbium Oryza, Setaria, Trachypogon, Tristachya, Vetiveria* and *Vossia* (Huntley, 2023a; Zigelski et al., 2018; Barbosa, 1970). Typical woodland-specific grass species are *Ctenium* and *Hyparrhenia* (Zigelski et al., 2018).

Furthermore, in the lower waterlogged areas, the seasonal flooding results in dynamic transitions between aquatic and terrestrial phases that drive changing dominance in plants communities which are further modified by intense fires in the area (Zigelski et al., 2018).

Embedded within the grasslands or at the ecotone between woodlands and grasslands - typically in slightly elevated areas or where the phreatic level is lower and thus less prone to waterlogging - a variety of geoxylic suffrutices species form an "underground forest," with shoots rarely extending more than half a meter above the surface. These species sprout during the dry season, often following fires that remove dense dry biomass and enhance light penetration to the soil surface, which facilitates regrowth (Huntley, 2023a; Zigelski et al., 2018; Diniz, 2006). Among the most common identified geoxylic suffrutices species are *Parinari capensis, Parinari pumila, Syzygium guineense subsp. huillense, Magnistipula sapinii, Annona stenophylla subsp. nana, Eugenia malangensis, Anisophyllea quangensis, Combretum platypetalum,*

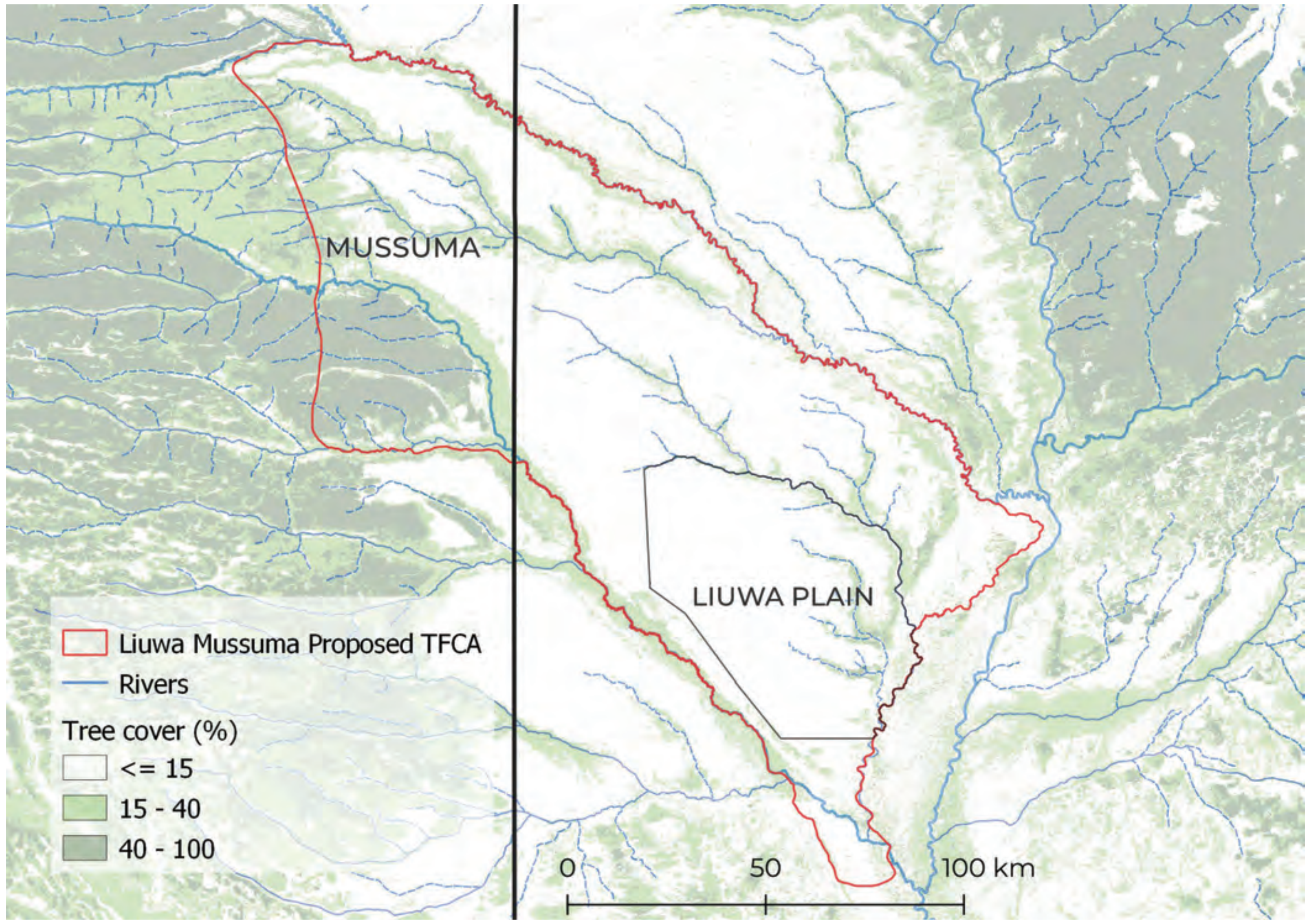


Figure 17 - Tree cover percentage on the Liuwa-Mussuma TFCA. Tree cover data source: Hansen/UMD/Google/USGS/NASA.

and Cryptosepalum exfoliatum subsp. suffruticans (Zigelski et al., 2018; Diniz, 2006; Barbosa, 1970). Common grasses found in the suffrutex grasslands are *Hyparrhenia, Digitaria, Pogonarthria and Cyperaceae* (Zigelski et al., 2018).

Among the most common tree species that dominate the wooded savannas and fringe forest are: *Monotes glaber, Cryptosepalum exfoliatum subsp. pseudotaxus, Syzygium guineense subsp. guineense, Pterocarpus angolensis, Burkea africana, Bobgunnia madagascariensis, Uapaca gossweileri, U. robynsii, Erythrophleum africanum, Baphia massaiensis, Parinari curatellifolia, Pericopsis angolensis Brachystegia longifolia*, and *B. bakeriana* (Zigelski et al., 2018). Several palm tree species (*Raphia sp*) can also be found scattered along the floodplain's grasslands (Diniz, 2006).

Overall, little is known about the vegetation species and ecology of the LMTFCA seasonally flooded grasslands and savanna, and further research is needed to understand the complexities and importance of these dynamic systems (Zigelski et al., 2018; Huntley, 2023a).

3.4 FIRE

The grasslands, savanna, and forests of the LMTFCA are subject to regular fires. Grasslands, in particular, experience frequent burning, often annually (Figure 18). The intensity of these fires is influenced by the accumulated dry matter (fuel) and how late they occur in the dry season; some can become extremely hot and fierce, spreading into forested areas (Mendelsohn & Weber, 2015). These fires, normally set by humans, primarily aim to stimulate the growth of fresh grass for cattle grazing, which also draws wildlife for hunting. The abundance of geoxylic suffrutices -a fire adapted evolutionary form of underground trees- (see section 3.3) within the grasslands and savanna suggest that human presence and fires must have been part of the ecosystem ecology for a very long time (Lock, 1998; WWF, 2018).

However, fires ignited intentionally in grasslands by travellers and villagers to facilitate movement or for protection against predators and snakes often spread into adjacent fringe forests, damaging chances of forest regeneration. Similarly, slash-and-burn agricultural practices frequently result in fires that escape control, extending into nearby savanna, forests, villages, and crop fields (Figure 25). Large, uncontrolled fires have been observed to originate from young children playing near villages or fields. The high regularity of such fires can have devastating effects, destroying new woody growth and killing large trees that are less resilient to frequent fires, can significantly degrade ecosystems by causing soil erosion, destroying carbon sinks such as peatlands and forests, reducing ecosystem services, eliminating new woody growth, and killing mature trees that have low resilience to frequent burning. Additionally, commercial timber extraction and agricultural activities create forest openings that further increase woodland vulnerability to wildfires, exacerbating the degradation of these environments.

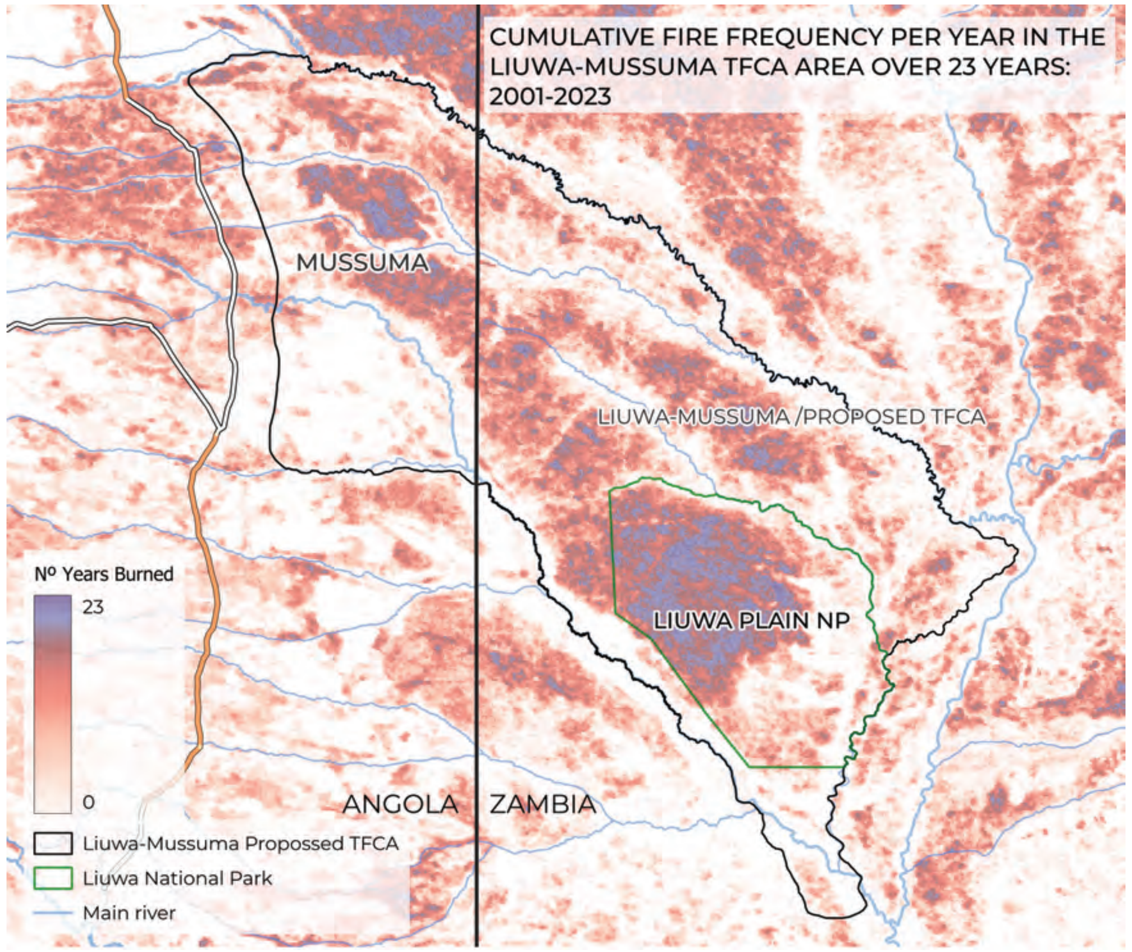


Figure 18 - Annual cumulative fire frequency in the Liuwa-Mussuma TFCA over 23 years (2001–2023). Source monthly burned area data from Giglio et al. (2021).

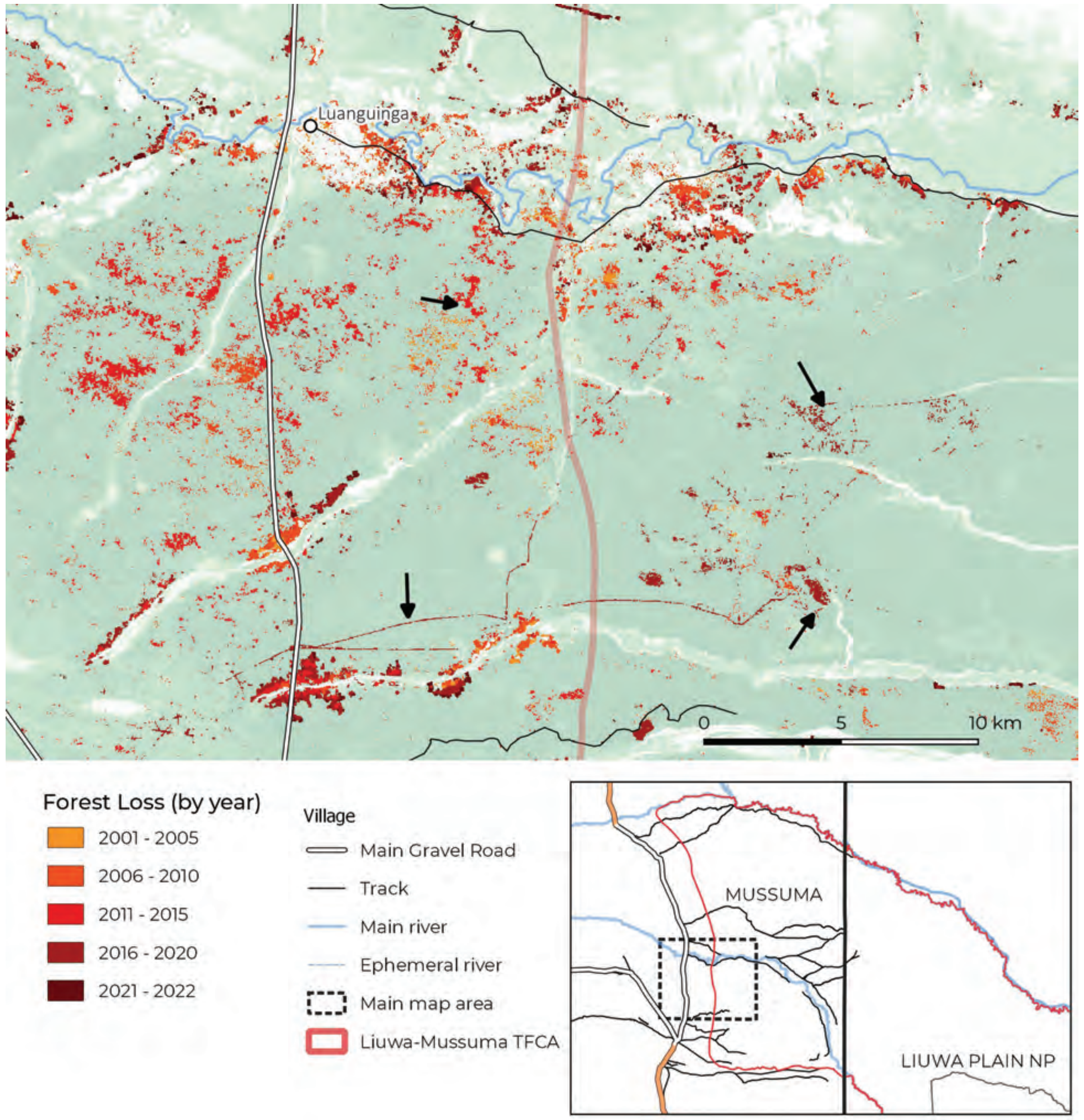


Figure 19 - Detail of forest loss between 2001 and 2022 in a section of the Mussuma area. Black arrows indicate some of scars left by timber exploration. Forest Loss data source: Hansen/UMD/Google/USGS/NASA.

3.5 DEFORESTATION

High levels of deforestation are evident around human settlements, primarily driven by forest clearing for agricultural expansion and the harvesting of wood for fuel. In pursuit of new, "fertile" land, the most densely forested regions – typically associated with higher organic matter in the soil - are targeted, cleared, and burned to establish crop plantations (Figure 28). However, due to the inherently poor nutrient content of these soils, agricultural plots are often abandoned after only a few years, prompting the clearing of additional forested areas for new cultivation. This cyclical pattern of deforestation for subsistence agriculture is clearly observable around villages, expanding radially as fields stretch farther from the settlements each year. Field visits conducted between 2019 and 2022 revealed minimal evidence of commercial-scale charcoal production within the study area, suggesting that fuelwood harvesting in this region remains primarily for local use rather than large-scale commercial purposes.

Figure 20 – A dry drainage line in the Mussuma Area surrounded by savanna grasslands floodplains (Top) consisting of small termite mound elevated islands where woody vegetation and geoxylic suffrutices can grow (middle and bottom).

Over the past two decades, illegal large-scale commercial logging, predominantly targeting Mussivi trees (*Guibourtia coleosperma*), has significantly impacted the forests and savanna on the Angolan side of the TFCA. This intensive logging activity was eventually halted around 2021 by the authorities (Bundas Municipality Administration personal comments), leaving behind several warehouses and bush storage sites filled with abandoned tree logs (Figure 27). Nonetheless, smaller-scale logging operations persisted into 2022 (authors' observation). Figure 19 illustrates the patterns and areas of deforestation resulting from both agriculture expansion and timber extraction.

Despite the scale of logging operations, the local communities saw barely any benefits. The primary gains were limited to temporary and precarious job opportunities, alongside minor incentives (e.g. roof sheets and beer) provided to local headmen with authority over the logging areas. These operations have led to the clearance of hundreds of kilometres of access roads, bulldozed deep into forested areas to reach valuable timber stands. These roads have inadvertently facilitated illegal activities by enabling poachers and resource extractors to reach previously inaccessible areas, often using motorbikes or traveling on foot, leading to unsustainable levels of wildlife hunting and natural resource exploitation (authors observations; Figure 26). Those regions subjected to the most intensive timber harvesting – primarily in the southern portion of the study area in Angola- have suffered the greatest levels of habitat loss, forest degradation, and broader ecological disturbance. Vast clearings now exist where large trees once flourished. These deforested zones are increasingly prone to frequent wildfires, which not only impede natural regeneration but also spread progressively deeper into remaining forest patches each year. This intensifying fire regime is contributing to the accelerating degradation of woodland ecosystems.

Figure 21 - The Lungué-Vungo River and its vast floodplain with ancient river meanders and fringe woodlands. Picture from the Mussuma area.

Figure 22 - A natural waterhole in a dry drainage line in the Mussuma landscape. Some of these waterholes keep water along the whole dry season.

Figure 23 - The Luvu River in the heart of the Mussuma area.

Figure 24 - Grassland floodplains in the Mussuma area.

Figure 25 - Effects of uncontrolled burnings for agricultural and other purposes.

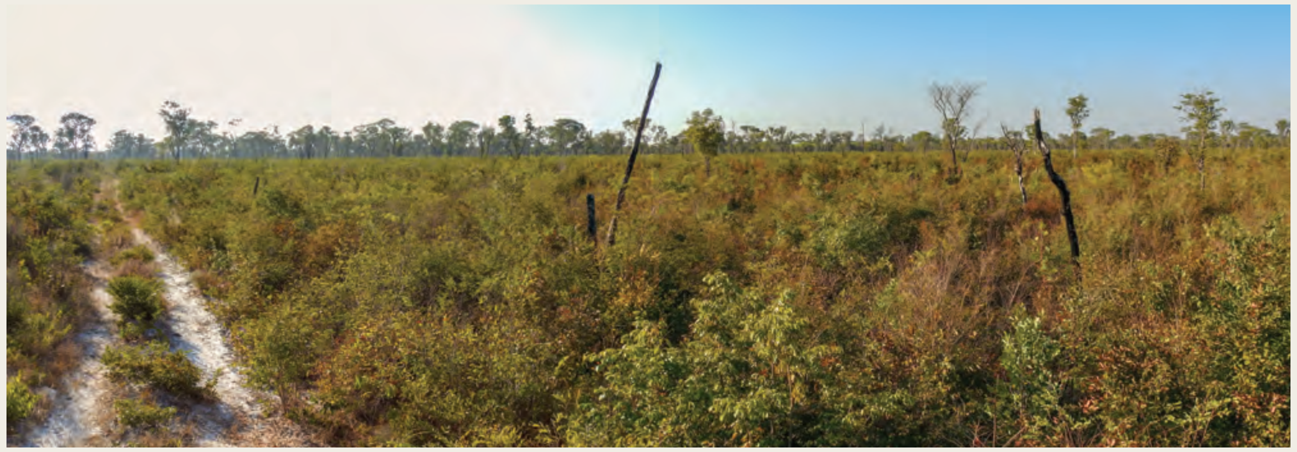


Figure 26 - Abandoned bulldozed road for access timber exploration (Top). Large opening in the forest after timber exploration activities (bottom).

Figure 27 - Abandoned log warehouses from timber exploration operations.

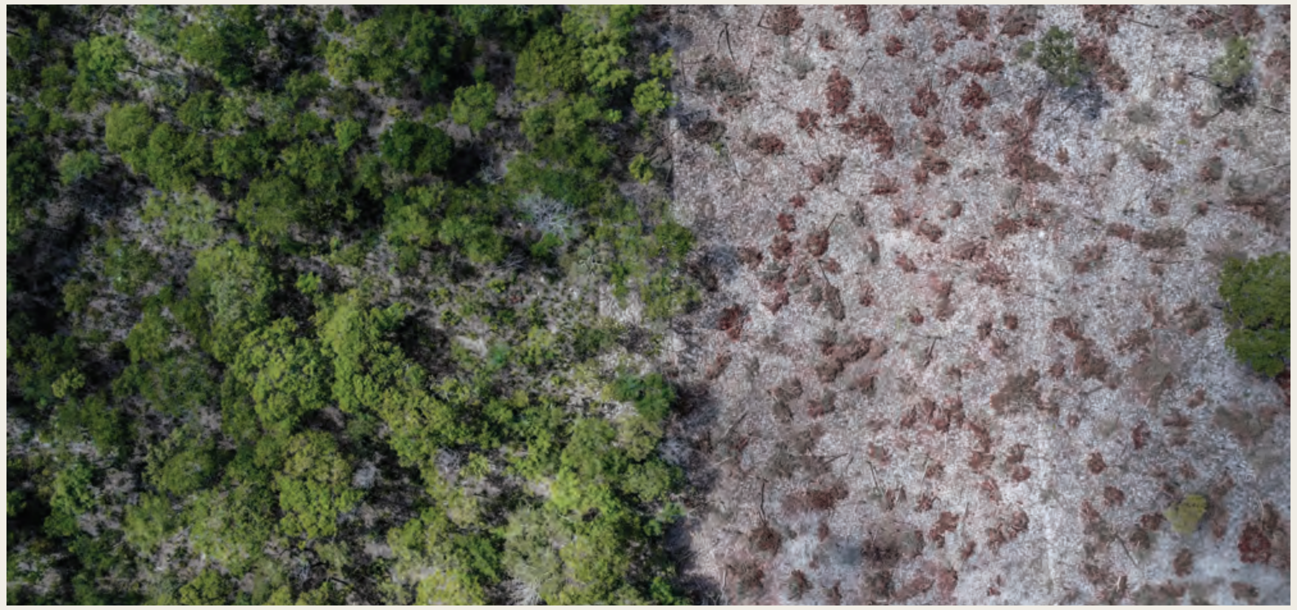


Figure 28 - Clearing of forested areas to give space for new crop plantation is one of the main causes of deforestation in the area.

Comparison with the Zambian Section of the TFCA

Although this report does not directly analyse the issues and causes of deforestation within the Zambian section of the TFCA, existing literature indicates that activities such as agriculture, charcoal production, and timber harvesting have significantly impacted the Zambian floodplains - particularly over the past 60 years (DNPW, 2016; ICOMOS, 2014; Timberlake, 1998; Turpie et al., 1999). In fact, degradation of riparian forests appears more pronounced on the Zambian side compared to Angola, based on both documented reports and visible evidence.

4. SOCIOECONOMIC OVERVIEW

The socio-economic overview presented here is based on the results of the interviews conducted with the local communities, semi-structured interviews with local authorities, literature review, remote sensing and GIS data compilation.

4.1 POLITICAL-ADMINISTRATIVE DIVISION

There are three main levels of political-administrative division in Angola: Provinces, Municipalities and *Comunas* (equivalent to wards in Zambia). The Mussuma landscape is situated entirely within the Moxico and Moxico Leste Provinces. The Moxico provincial capital, Luena, lies approximately 240 kilometres northwest of Mussuma, serving as a central hub for the province's administrative and commerce activities. On the other hand, the Moxico Leste newly designated provincial capital, Cazombo, is less developed and more isolated.

Administratively, until 2024, Mussuma fell entirely under the jurisdiction of the Lumbala N'Guimbo (Bundas) Municipality. Nowadays, since the new political administrative division law nº 14/24 of September 5th, the Mussuma area is divided between the Lumbala Nguimbo and Lutembo Municipality.

The Lumbala N'Guimbo Municipality is subdivided into three *comunas*, while Lutembo is divided in two. Within this structure, the southernmost third of Mussuma, corresponding to the dense woodlands, aligns with the Mussuma Mitete *Comuna*, from Lumbala Nguimbo Municipality, while the remaining area, along the floodplains, falls under the governance of the Lutembo *Comuna*, inside the Lutembo Municipality.

Since the administrative division of Moxico Province changed (law nº 14/24 of September 5th) during the final stages of this report's writing, some maps or descriptions may still reflect the previous division (law 18/16 October 17th).

Zambia has a four-tier administrative hierarchy that comprises provinces, districts, constituencies, and wards. For the purpose of this report, ward and constituency levels are not always considered.

Most of the Zambian side of the study area falls on the Western Province -whose capital town is Mongu- and within the range of the Kalabo and Mitete districts. A small section of the study area located on the north-west side of the Zambian represents the whole of the Matondo Nyachikayi Ward and falls within the Zambezi District from the North-Western Province.

Figure 29 delineates the distribution of the Provinces, Municipalities/Districts and *Comunas*, highlighting the locations the most relevant communal and municipal/district capitals.

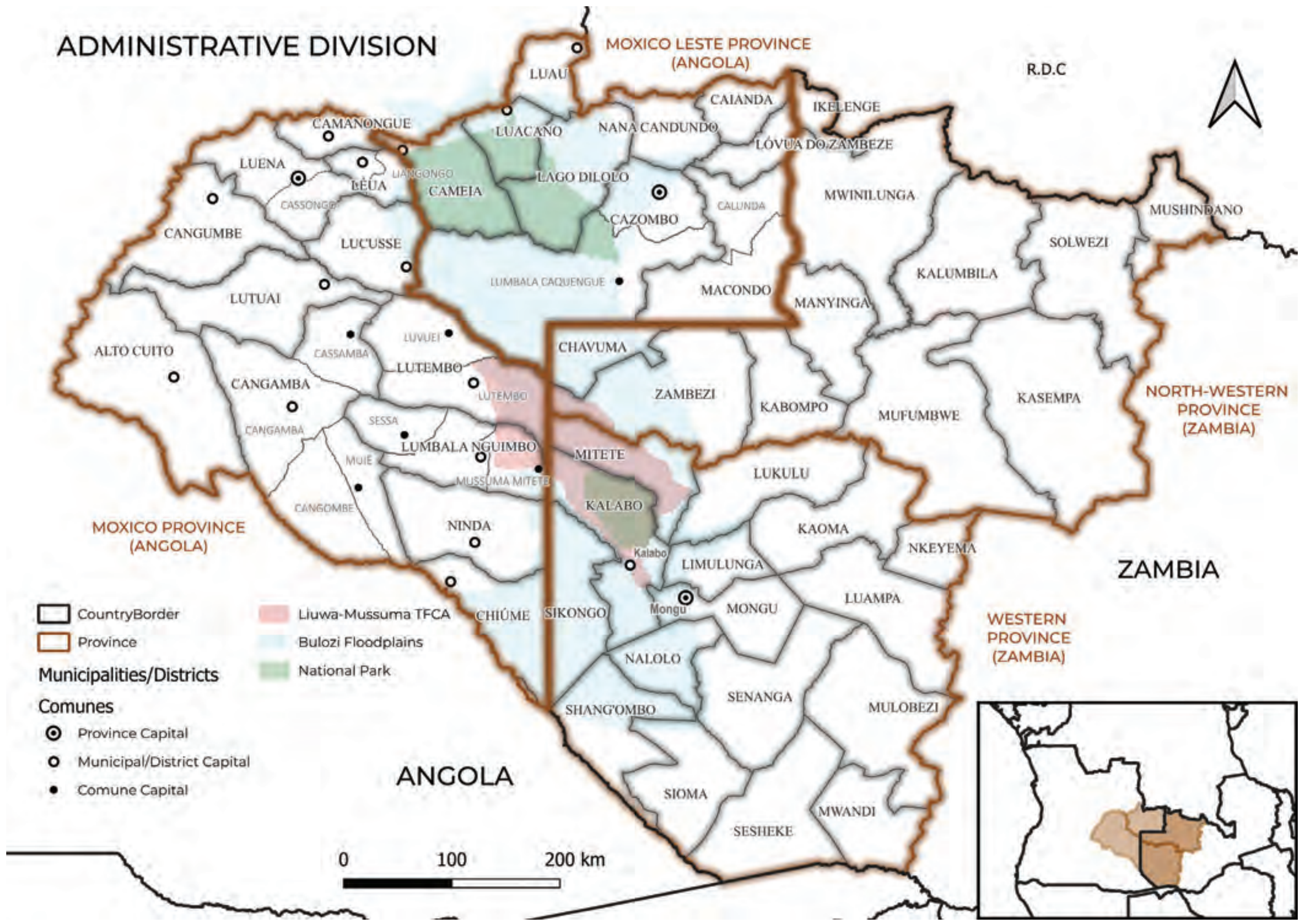


Figure 29 - Administrative division of the study area.

4.2 DEMOGRAPHICS

It is difficult to provide an accurate estimate of population density within the study area, since national census data is based on administrative units that do not align with the ecological boundaries relevant to this report. Nevertheless, we provide some preliminary insights from the latest population Census.

The study region on the Angolan side encompasses roughly half of the Lutembo and Mussuma *Comunas* within Bundas Municipality, Moxico Province. According to Bundas Municipality data from 2016 (MAT, 2016), Lutembo *Comuna* spanned 7,392 km² and had a population of 6,967 in 2015, equating to a density of 0.94 inhabitants per km². Mussuma *Comuna*, covering 3,255 km², had 6,855 residents, resulting in a density of 2.1 inhabitants per km². Given the Country estimated annual population growth rate of 3.1% (MAT, 2016) and the return of war refugees from Zambia (UNHCR, 2007; HRW, 2003), it's likely that these figures have increased significantly in the 8-9 years up until this report. A new Census was carried out between September 19 and November 19, 2024, with preliminary results expected to be released in the first half of May 2025.

On the Zambian side, the study area spans parts of Mitete and Kalabo Districts in Western Province. The 2022 Zambia Population Survey (ZSA, 2022) recorded 39,641 people in Mitete (6.2 inhabitants/km²) and 111,769 in Kalabo (12.3 inhabitants/km²).

It's crucial to note these densities reflect entire districts and *comunas*, where main towns and villages—typically more densely populated—lie outside our study area. Hence, lower population densities within the study's boundaries are expected (refer to Figure 30).

Settlement patterns in both countries tend to follow linear features—mainly roads, rivers, and elevated land near forested zones. The Luanguinga River hosts relatively high population clusters on both sides of the border. In contrast, margins of the Lungué-Vungo River are sparsely populated in Angola but more densely settled on the Zambian side. The Lutembo River floodplain has no permanent settlements in Angola but supports a significant population on the Zambian side. The Luambimba River also hosts a high concentration of settlements in Zambia. Seasonal flooding limits permanent habitation in low-lying areas across the landscape. Figure 30 maps the key roads and settlements in the region.

The demographic data obtained from the questionnaires are described below; however, it's important to note that these demographic profiles do not represent the entire population of the study area, but rather the subset of individuals who were interviewed.

A total of 144 residents were surveyed—78 in Angola and 66 in Zambia. Only 12 respondents were women, evenly split between both countries. The reluctance of women to participate was noted across the study. The average age of respondents was 46.2 years, with Zambians slightly younger than their Angolan counterparts (Figure 31). The mean household size was nine individuals—eight in Zambia and ten in Angola (range: 1–30 people).

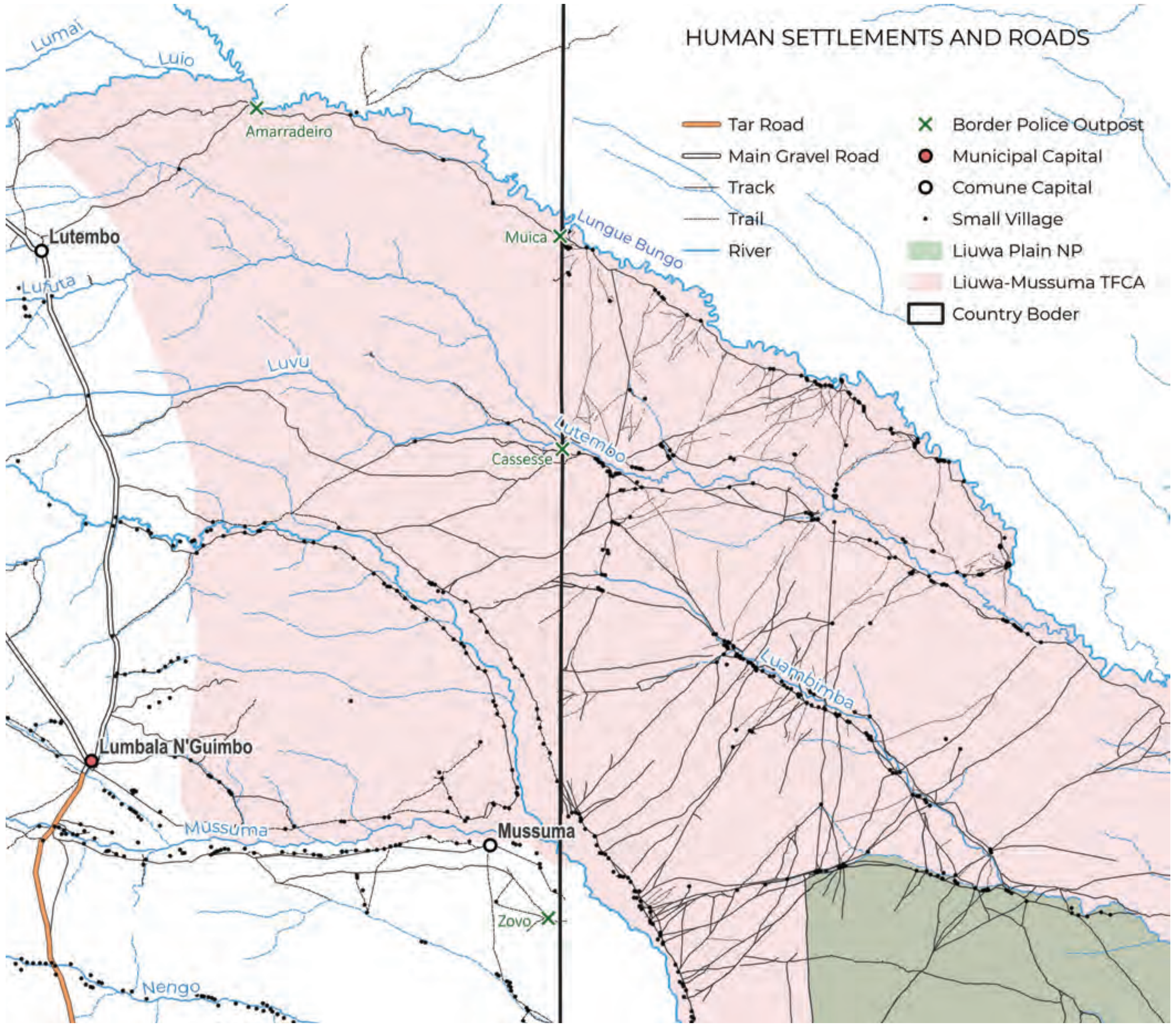


Figure 30 - Human settlements and roads within the study area. Settlements and roads data: CCI.

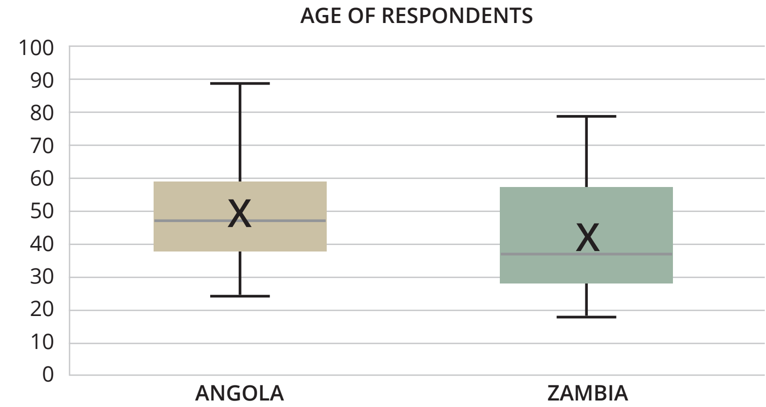


Figure 31 - Boxplot with age distribution of the interview respondents in Angola and Zambia.

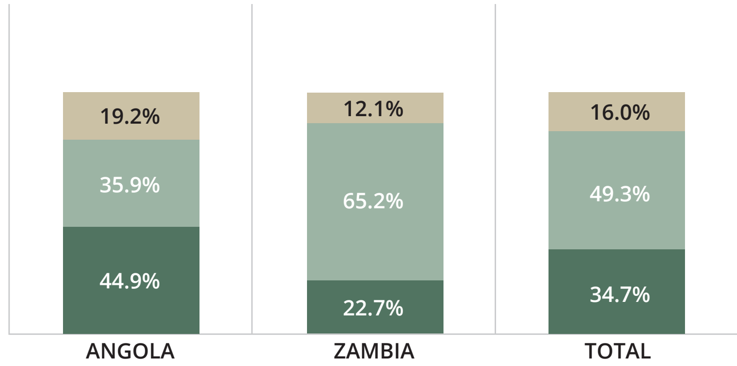


Figure 32 - Education level of respondents in Angola and Zambia.

Uneducated Primary Secondary

Literacy and education levels also varied. Illiteracy was more common in Angola (44.9%) than in Zambia (22.7%). Primary education completion was significantly higher among Zambians (65.2% vs. 35.9%), while Angolans had a slightly higher rate of secondary-level education (19.2% vs. 12.1%) (Figure 32).

4.3 DISPLACEMENT AND RETURN

The demographic realities of the Liuwa–Mussuma landscape are deeply shaped by Angola's long independence and civil conflict (1961-1974 and 1975–2002 respectively) and the regional displacement crisis it produced. More than 600,000 Angolans sought refuge abroad during the war, with Zambia emerging as a major host (ACCORD, 2016; PDES, 2008). Refugees began arriving as early as the 1960s, and formal settlements like Mayukwayukwa (1966) and Meheba (1971) became home to generations of Angolans (UNHCR, 2006b; Charita Zambia, 2023). These settlements offered land for farming and evolved into semi-permanent, self-reliant communities. By 2002, Zambia hosted around 218,000 Angolan refugees, many of whom were integrated into local society, often through intermarriage, economic participation, and shared infrastructure (Barret, 2003; ACCORD, 2016).

Following the end of hostilities in 2002, a repatriation program—coordinated by Angola, Zambia, and UNHCR—facilitated the return of several tens of thousands of Angolan refugees from Zambia between 2003 and 2007. A final phase was launched in 2011–2012 ahead of the formal cessation of refugee status (UNHCR, 2007b, UNHCR, 2012; ACCORD, 2016), bringing back additional groups who had remained in exile. While some remained in Zambia under a local integration program offering land and residency permits (ACCORD, 2016), many returned to Angola—often to ancestral lands in Moxico Province.

These returnees frequently faced severe challenges: destroyed infrastructure, landmines, lack of identity documents, eroded livelihoods and lost sense of belonging and place (HRW, 2003, 2005; PDES, 2008; UNHCR, 2007b). Although reintegration efforts formally emphasized the restoration of health clinics, schools, access to land, and economic opportunities (HRW, 2005; PDES, 2008), field observations and reports suggest that progress has been uneven and, in many cases, extremely limited (PDES, 2008). This is particularly true for communities located away from the main road infrastructure, where access to basic services, demining, and sustainable livelihood support remains critically lacking.

Many of today's Angolan residents in the study area are returnees, or children of returnees, rebuilding their lives in former homeland areas like Mussuma and Lutembo. Among Angolan respondents interviewed, 84.6% (n=66) had been displaced during the war. Of those, 90% (n=60) had lived in Zambia, with smaller numbers displaced to the DRC or internally to Luena and Lucusse. On average, Angolans reported having lived in their current location for only 15 years, compared to 32 years for Zambians (Figure 33), reflecting the more recent return of many Angolan households.

Despite repatriation, cross-border social and cultural ties remain strong. Half of all Angolans interviewed had visited Zambia at least once, and 68% have family residing there. Among Zambian respondents, 46.9% had visited Angola, and 48% have family in the country. These figures reflect longstanding cultural ties, facilitated by shared ethnic identities and histories of movement across the porous border.

The predominant ethnic groups in the study area—Luvale, Mbunda, Luchaze, Macoma and Lozi—span both countries and share language, kinship networks, and customary systems (Authors' observations). These bonds play a critical role in maintaining transboundary connections and will likely influence support for future conservation or land-use initiatives that affect both sides of the border (Table 2).

In summary, the Liuwa–Mussuma landscape is not just ecologically interconnected—it is socially and historically interwoven. It reflects the legacy of mass displacement, prolonged exile, and complex reintegration processes. Returnees are not only rebuilding their lives, but also reshaping local demographics, land use patterns, and social dynamics in ways that must be considered in any long-term land-use or conservation planning across the transboundary corridor.

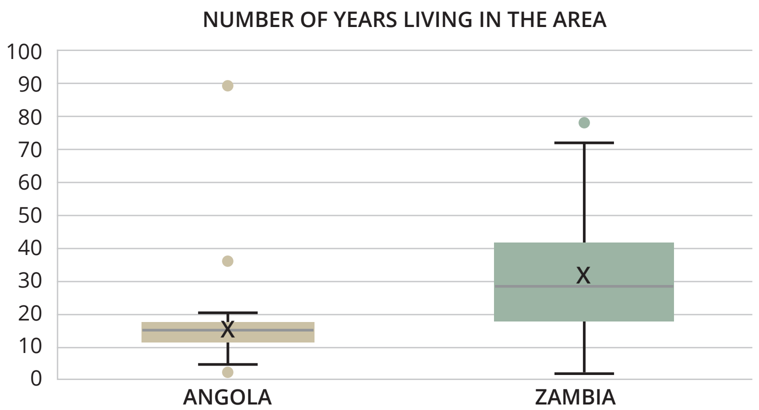


Figure 33 - Boxplot representing the number of years living in the area of Angolan and Zambian participants.

Table 2 – Ethnicities of the respondents.

	ANGOLA		ZAMBIA	
Ethnicity	**N=78**	**%**	**N=66**	**%**
Luvale	25	32.1%	18	23.1%
Mbunda	18	23.1%		
Luchaze	13	16.7%		
Macoma	13	16.7%	28	35.9%
Tchokwe	4	5.1%	1	1.3%
Cambonda	1	1.3%		
Kaluhi	1	1.3%		
Lozi	1	1.3%	14	17.9%
Umbundu	1	1.3%		
Liuwa			4	5.1%

4.4 TRADITIONAL AUTHORITIES

In both Angola and Zambia, the traditional authority system is based on customary law and is led by traditional leaders who are recognized by the government. Each traditional authority controls a certain territory and plays an important role in resolving conflicts and serves as an intermediary between the government and their inhabitants.

During our field visits in Angola between 2019 and 2022, we observed that several chiefdoms (Sobados) lacked a formally elected or recognized Soba. In some cases, disputes over authority were evident, with multiple individuals claiming the title. This situation appears to stem from the prolonged displacement of communities during the Angolan civil war, which disrupted traditional hereditary leadership structures. Furthermore, many resettled or newly formed villages are ethnically heterogeneous (see Table 2), which has weakened the legitimacy and influence of traditional authority systems. The resulting leadership vacuum has led to some tensions and conflicts within and between villages, as reported to our team by local headmen and law enforcement officers. Additionally, the Bundas people—a small but significant ethnic group in the study area—recognize a monarch based in Lumbala N'Gimbo. The last King, Mwene Mbandu III, died in July 2021. His successor, Mwene Mbandu IV, passed away only three months after his enthronement in December 2022. The current King, Mwene Mbandu V, who resides in Zambia, assumed the throne in August 2024.

The traditional authorities in Lutembo *comuna* are divided into two *regedorias*: *Regedor* Arimbango, of Luchaze ethnicity, and *Regedor* Muetepa, of Mbunda ethnicity. They control the west and east sides of the territory, respectively. Both *regedores* are based in Lutembo village, and some disputes over the legitimacy of each other have been observed.

Figure 34 shows a preliminary characterization of the traditional chiefdoms within the Lutembo *comuna* based on information gathered from various sources on the ground. A final version requires further consultations with relevant stakeholders.

The traditional authority's system in Zambia is not just a cultural relic but an active part of the country's governance framework. It coexists with the modern governmental system, often working in tandem to address local issues, promote development, and preserve cultural heritage.

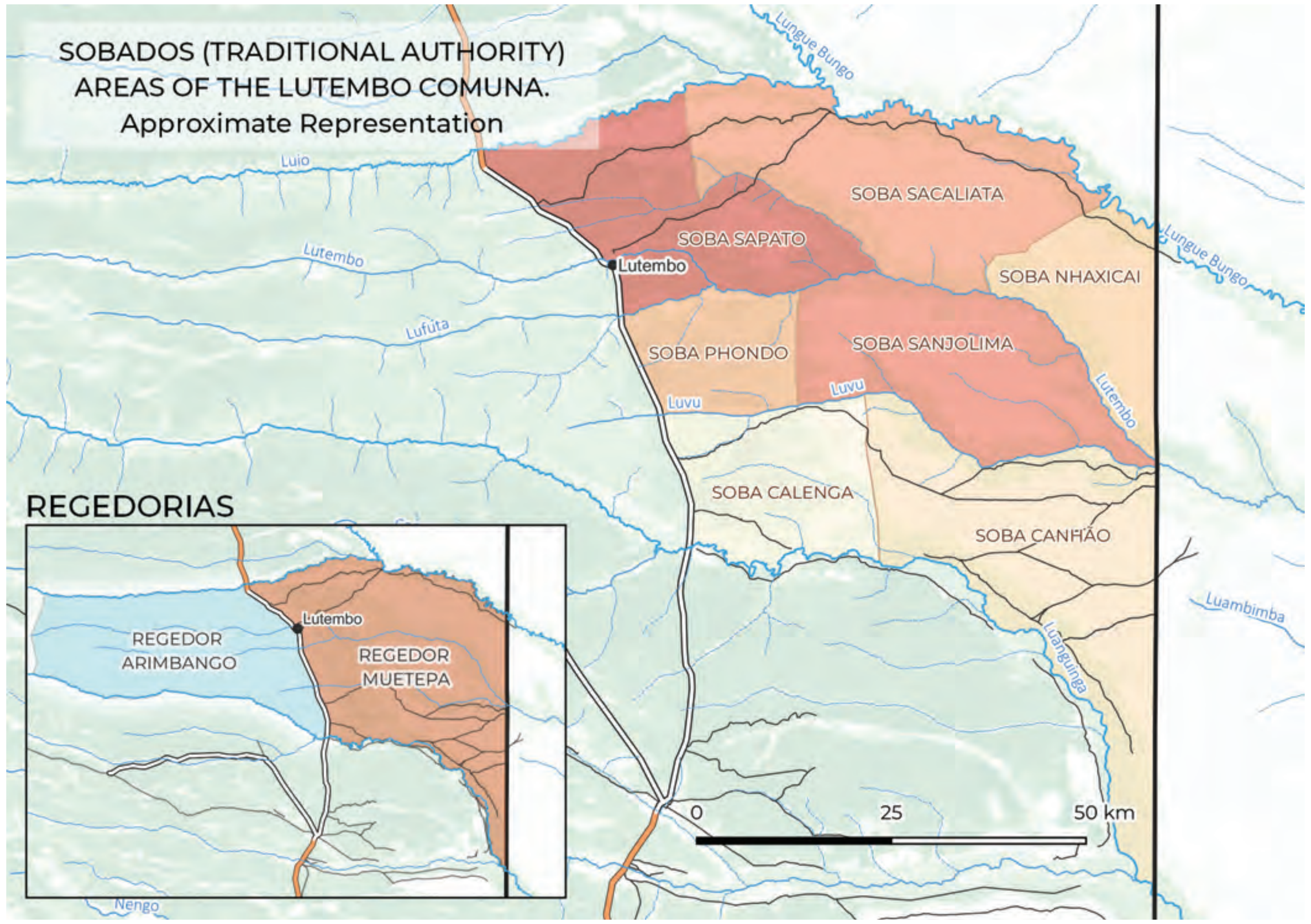


Figure 34 – Main map: Traditional headmen territories within the Mboela Floodplain in Angola. Inlet: Traditional authorities at Regedoria level within the Lutembo Comuna.

Figure 35 – Top left: Regedor Muetepa from Angola, participating in a CCI conservation education activity in a Lutembo school. Top right: Regedora Arimbango from Angola, meeting with CCI technicians. Bottom: Induna Likubi from Zambia and his wife.

In the Western Province (previously known as Barotseland), the Litunga leads the Barotse Royal Establishment, overseeing a governance system that runs parallel to the national government, complete with its own judicial and administrative structures. Assisting the Litunga are Silalo Indunas, who function at the district level and are akin to senior chiefs in other parts of Zambia. At the village level, Indunas act on behalf of the Barotse Royal Establishment, managing tasks such as land distribution, resolving disputes, and regulating access to natural resources.

This governance system has evolved partly due to the Barotseland Agreement of 1964, which grants the Litunga of Barotseland (now Western Province) extensive authority over the administrative and cultural matters of the province. The Litunga also controls and manages land, waterways, and natural resources within the province. This level of authority is unique in Zambia, as no other traditional leaders have maintained such significant influence within their territories or been allowed to retain traditional titles of king (Rajaratnam et al., 2015).

4.5 LAW ENFORCEMENT

The only law enforcement present within the study area is the Angolan border police, located along the Angolan side of the border and the Lungué-Vungo River with four main outposts within the study area (see map on Figure 30). Each outpost has a permanent presence of several policemen (usually around 10) whose main mission is to patrol and protect the border, prevent goods smuggling, control trade and human migration. The border police however have no terrestrial motorized vehicles and have limited infrastructure. The “emabarcadeiro” outpost at Lungué-Vungo had a motorboat that was functional in 2022.

The main villages (Lutembo, Mussuma and Lumbala N'Gimbo) close to the study area have a national police outpost with a few permanent police officers.

There are no border police or any other kind of law enforcement presence on the Zambian side of the study area.

Figure 36 - Angolan border police (PGF) officer on a border landmark while assisting in the camera trap survey.

4.6 INFRASTRUCTURES

4.6.1 ROADS

The road network within the study area is extremely limited, consisting primarily of sandy or gravel tracks and traditional oxcart trails. None of the perennial rivers are crossable with a motor vehicle at any point in the year, as there are no bridges - except for those on the main road in Angola between Lumbala N'Gimbo and Lucusse, which lies outside the TFCA boundary. In certain locations near villages, canoes are used to transport people and, occasionally, motorbikes across rivers (see Figure 37).

The Luambimba River in the Zambian side is crossable during the dry season in a few locations. The section located between the Lutembwe and the Lungwebungo Rivers in Zambia is not accessible by car from Zambia and only reachable by canoe crossing at a few locations. Nevertheless, this section could be reached by car from Angola through the Muica Border Police outpost (see map on Figure 30), although there isn't here an official border crossing.

Similarly, the area between the Lutembo and Luvu Rivers in Angola is not accessible by car anywhere and only possible to reach on foot or motorbike via canoe crossing the Luvu River or on foot from the main road.

4.6.2 SCHOOLS

On the Angolan side, schools are only located along the main road in Luio (5 rooms), Lutembo (2 schools), and Luanguinga (3 rooms). The schools in Luio and Luanguinga offer education from 1st to 6th grade, while Lutembo provides education from 1st to 9th grade. Overall, the schools are poorly maintained, and some remain unfinished (see Figure 38) leading to a general lack of motivation among both students and teachers.

On the Zambian side, all the largest villages have primary schools that serve the smaller nearby villages (authors observations).

Figure 37 - Crossing a motorbike in a canoe is the only option for motorized access to the middle section of the floodplains in Mussuma.

Figure 38 – Main school in Lutembo.

4.6.3 HEALTH OUTPOSTS AND HOSPITALS

In the Angolan side, the most important health infrastructure is the Municipal Hospital located in Lumbala N'Gimbo, the municipal capital. A few health posts with very basic capacity are located along the main road between Lumbala and Lucusse, in the larger settlements such as Lutembo.

The Lutembo health post (Figure 39) is not operational 24/7 and has five nurses who work in shifts that vary based on their availability, as some are currently pursuing higher education. During the reporting period, none of the nurses held a tertiary degree, but one is expected to complete their education in 2025 and another in 2026. Occasionally, a sixth nurse joins for vaccination campaigns. The health post is poorly maintained, lacks running water and electricity and rarely has medicines. The main diseases treated include malaria, chest infections, and diarrhoea. More complex cases are referred to the municipal hospital or the provincial capital, Luena. There are no other medical facilities or services within the study area of Mussuma.

On the Zambian side, small and medium settlements along the study area in the UWZGMA are served by health liaison officers, who are community members with limited paramedic training. They assist with basic health needs and connect the population to the main health outposts and hospitals located outside the study area. These officers are supplied with essential medicines to aid in their duties and typically travel using their own transport, usually a bicycle.

4.6.4 MOBILE RECEPTION

In Angola, Lutembo and Lumbala N'Gimbo are the only villages close to the study area with cellphone and data signal coverage. Closer to the southern parts of the Zambian border, near the Luanguinga river, a weak cellphone signal could be obtained from Zambian telecommunication operators.

On the Zambian side, cellphone and sometimes data signal would only reach the southern parts of the study area.

Figure 39 - Lutembo healthpost poorly maintained, lacking running water and consistent medication supplies.

Figure 40 - Typical artisanal well (cacimba) with contaminated water and used by a border police unit.

Figure 41 - One of the many potentially unexploded ordnance (UXO) found in the study area.

4.6.5 WATER ACCESS

Access to freshwater on the Angolan side was limited to artisanal wells (cacimbas) (see Figure 40) or direct collection from the rivers, permanent waterholes and lagoons. The population frequently reported cases of digestive diseases due to the use of untreated water, particularly from cacimbas, where intensive use - drawing water down to the last drop without allowing time for natural recharge - often resulted in stagnation, green coloration, and foul odours. In contrast, most villages on the Zambian side were equipped with hand pump wells. While generally functional, these wells often showed signs of wear and lacked regular maintenance.

4.7 WAR, LANDMINES, HISTORICAL SITES

The study area and its surroundings have been profoundly impacted by Angola's armed conflicts—first during the war for independence (1961–1974), and later the civil war (1975–2002). The Mines Advisory Group (MAG), active in Angola and Moxico Province since 1994, has identified multiple confirmed and suspected minefields within the Mussuma landscape (see Figure 42). In addition, unexploded ordnance (UXO) remains scattered throughout the region (Figure 41). The most recent landmine survey in the area, conducted in 2018, revealed further contamination. However, limited access at the time, coupled with the ongoing expansion of human settlements, suggests that additional hazardous areas may remain undocumented. Moxico Province is currently considered the most landmine-contaminated province in Angola by land area (MAG, pers. comm.).

To ensure the safety of communities and enable development in the region, it is imperative to conduct updated Non-Technical Surveys (NTS) to verify existing data and assess new risks. Beyond the humanitarian imperative, mine clearance is also foundational for conservation and economic revitalization. In the context of the Liuwa–Mussuma TFCA, it enables safe movement of wildlife, access for rangers and researchers, and the recovery of wildlife-based industries such as tourism. Without demining, key investments in ecological restoration, land-use planning, and community development cannot be safely implemented. Integrated planning between mine action and conservation sectors is therefore essential to unlocking the full potential of this transboundary landscape.

During interviews for our survey, the issue of landmine detonations emerged in conversation. Additionally, during fieldwork, we encountered unexploded ordnance while camping in the area. Although not a specific focus of our research, we opportunistically gathered this information and shared it with the landmine clearance organization to support their efforts in identifying and addressing hazardous areas.

A few war-related historical sites can be found near the study area. One notable location is the site of the Lunhamege agreements, where on October 21nd 1974, a ceasefire agreement was signed between the MPLA and the Portuguese army, leading to the end of the independence war. The site falls in the middle of the floodplains, dozens of kilometres away from the nearest populations, between Cameia National Park and the Mussuma Area, and is marked with a metal sign (Figure 43).

Another significant historical landmark is located in the village of Lucusse, where a metal door lies under a tree by the main road. This door was used to carry the corpse of Jonas Savimbi, the leader of the opposition party, to a helicopter landing side after he was killed in 2002, an event that marked the end of the civil war.

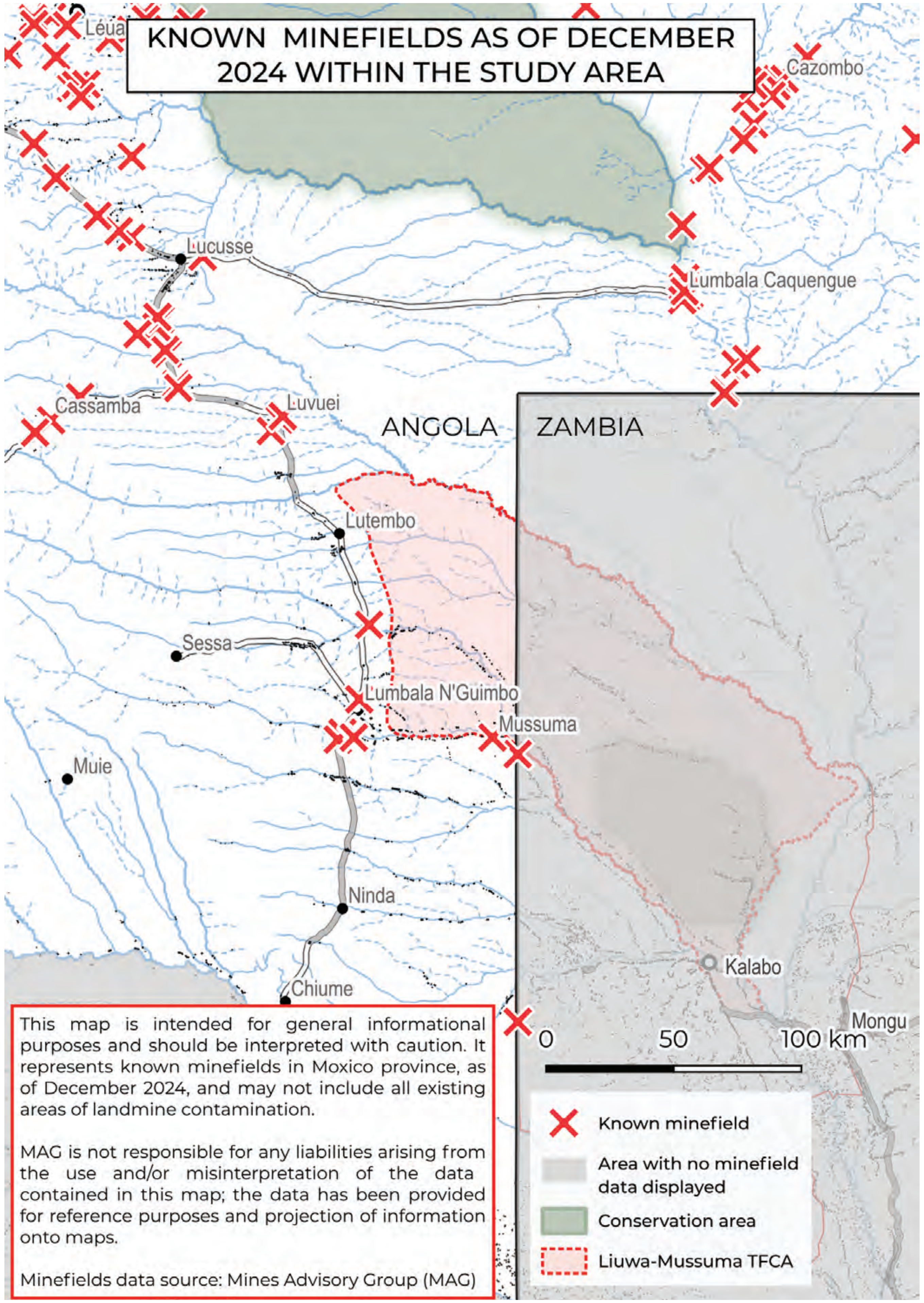


Figure 42 - Known minefiled as of December 2024 within the study area.

Figure 43 - The historical site of the Lunhamege ceasefire agreements in 1974 between the MPLA and the Portuguese Government is located in the heart of the floodplain between the Mussuma area and Cameia National Park.

Top left and right: "Ceasefire" agreement between the MPLA and the Portuguese Government, Lunyameje (Lunhameje), October 1974. Reproduced with authorization from Arquivo Lúcio Lara, Fundo ATD.

Bottom: Indicative sign marking the historical site, still present at the agreement location as of 2019.

4.8 ECONOMIC ACTIVITIES

Interviewees were asked to identify their two primary occupations. Agriculture was significantly more prevalent in Zambia (89.4%) than in Angola (53.8%). This difference was statistically significant with a chi-square statistic of 19.91 ($\chi^2(1, N = 144) = 19.91, p < .05$), indicating a strong association between country and the prevalence of agriculture as a primary occupation.

In contrast, fishing was slightly more commonly reported as a primary occupation in Angola, where 23.1% of interviewees noted it, compared to 15.2% in Zambia. However, this difference did not reach statistical significance, as indicated by a chi-square statistic of 0.97 ($\chi^2(1, N = 144) = 0.97, p = .32$), suggesting that the observed differences in fishing as a primary occupation might be due to random variation.

Hunting was rarely reported as an occupation in Angola (15.2%) and no Zambian mentioned hunting as a source of income.

Additionally, 10.3% of the Angolans and 7.6% of the Zambians interviewed reported being involved in some form of traditional leadership occupation. However, the reported importance of leadership roles is unlikely to be a reflection of the wider population, as leaders of the villages were usually interviewed first.

For a comprehensive breakdown of the diverse occupational activities reported by interviewees, see Table 3.

Table 3 - Main occupation reported.

	ANGOLA		ZAMBIA		TOTAL	
Occupation	**N=78**	**%**	**N=66**	**%**	**N=144**	**%**
Agriculture	42	53.8%	59	89.4%	101	70.1%
Fishing	18	23.1%	10	15.2%	28	19.4%
Hunting	11	14.1%	0	0.0%	11	7.6%
Headmen	8	10.3%	5	7.6%	13	9.0%
Works at the administration	4	5.1%	0	0.0%	4	2.8%
Teacher	3	3.8%	0	0.0%	3	2.1%
Beekeeping	3	3.8%	0	0.0%	3	2.1%
Nurse	2	2.6%	0	0.0%	2	1.4%
Carpenter	2	2.6%	0	0.0%	2	1.4%
African doctor	1	1.3%	0	0.0%	1	0.7%
Armer (builds guns)	1	1.3%	0	0.0%	1	0.7%
Cattle	1	1.3%	1	1.5%	2	1.4%
Construction	1	1.3%	0	0.0%	1	0.7%
Driver	1	1.3%	0	0.0%	1	0.7%
Police	1	1.3%	0	0.0%	1	0.7%
Businessman	0	0.0%	1	1.5%	1	0.7%
Health worker	0	0.0%	2	3.0%	2	1.4%
Councillor	0	0.0%	1	1.5%	1	0.7%

4.8.1 LIVESTOCK AND DOMESTIC ANIMALS

Regarding livestock ownership, 26.9% (n = 21) of Angolan interviewees reported being cattle owners, compared to a significantly higher 57.6% (n = 38) in Zambia. This difference was statistically significant, with a chi-square statistic of 12.65 ($\chi^2(1, N = 144) = 12.65, p < .001$), indicating a strong association between country and cattle ownership.

Interviewees were less likely to report owning smaller livestock. A sole Zambian participant mentioned possessing goats, in contrast to 9 Angolans reported owning goats. Additionally, there is a notable disparity in poultry ownership, with 78.9% (n = 52) of Zambians declaring they keep poultry, while only 46.2% (n = 36) of Angolans reported the same. This difference was statistically significant, with a chi-square statistic of 14.68 ($\chi^2(1, N = 144) = 14.68, p < .001$). A small number of respondents, specifically 3 Angolans and 1 Zambian, mentioned owning pigs. Only 2 Angolans, and no Zambians, reported possessing donkeys.

It is interesting to note that despite 41% of interviewees (n=59) reported themselves to be cattle owners, very few (n=2) mentioned it as a primary occupation.

Figure 44 shows camera trap detection events of cattle. These detections were mainly close to human settlements, indicating that extensive cattle grazing resources were not used or needed, at least during the survey period. The southern section of the study area on the Angolan side showed little cattle activity, but direct observations confirmed that most of the cattle (and human population settlements) concentrate in that area, along the Luanguinga River, away from camera trap placements.

Domestic dogs were detected in camera traps across the study area, including in more remote areas, indicating their likely use for hunting (as confirmed by interview data in section 4.8.4) and for security (Figure 45).

The interplay between human density and the presence of cattle and domestic animals reflects the socio-economic and cultural practices of a region. It also has significant implications for wildlife conservation and management. Higher densities of domestic animals in areas like the UWZGMA can lead to increased human-wildlife conflicts, higher risk of disease transmission, and competition for resources with wild animal populations.

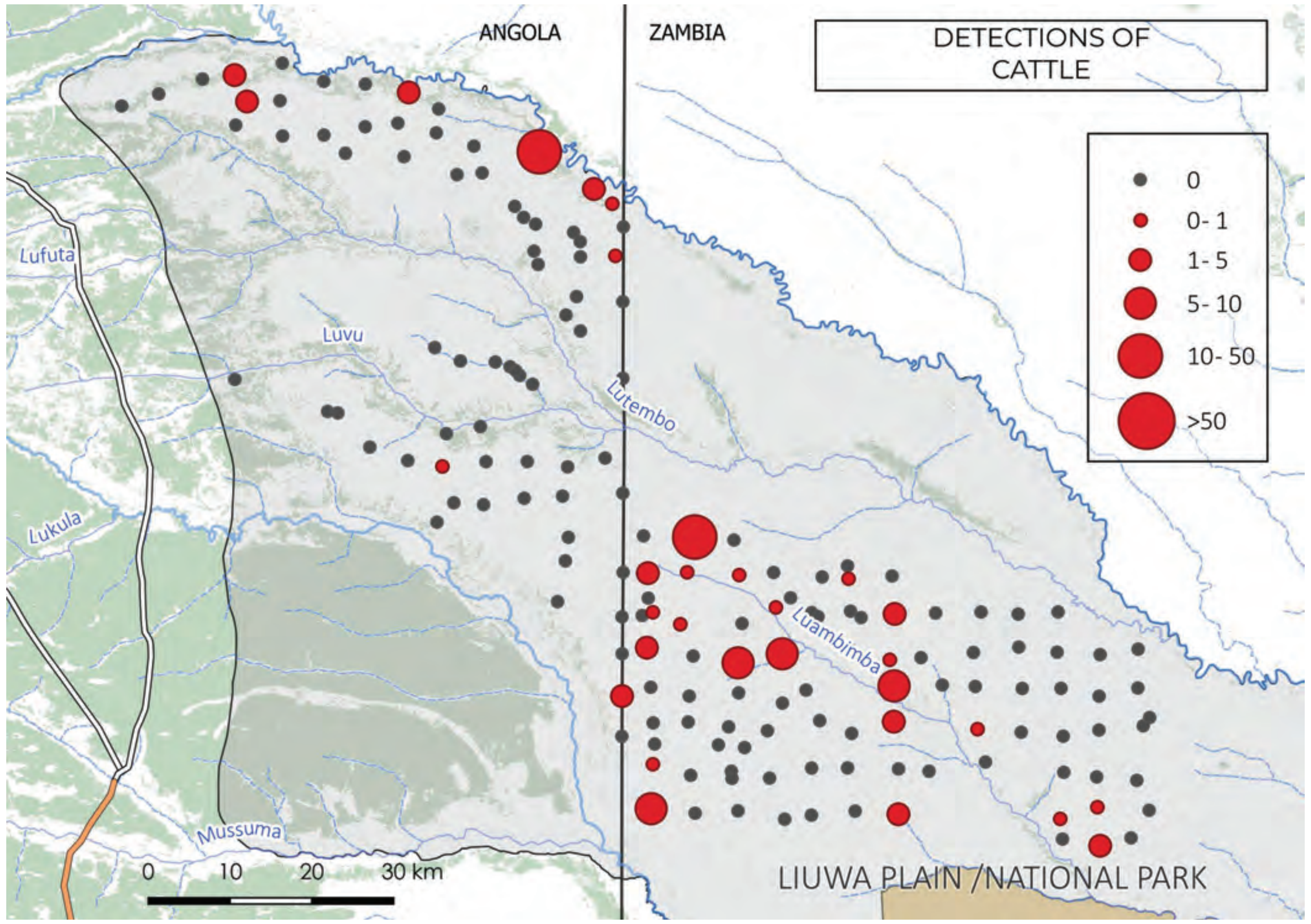


Figure 44 - Detections of cattle by camera traps (top); cattle grazing on the floodplains in Angola near the country border (bottom).

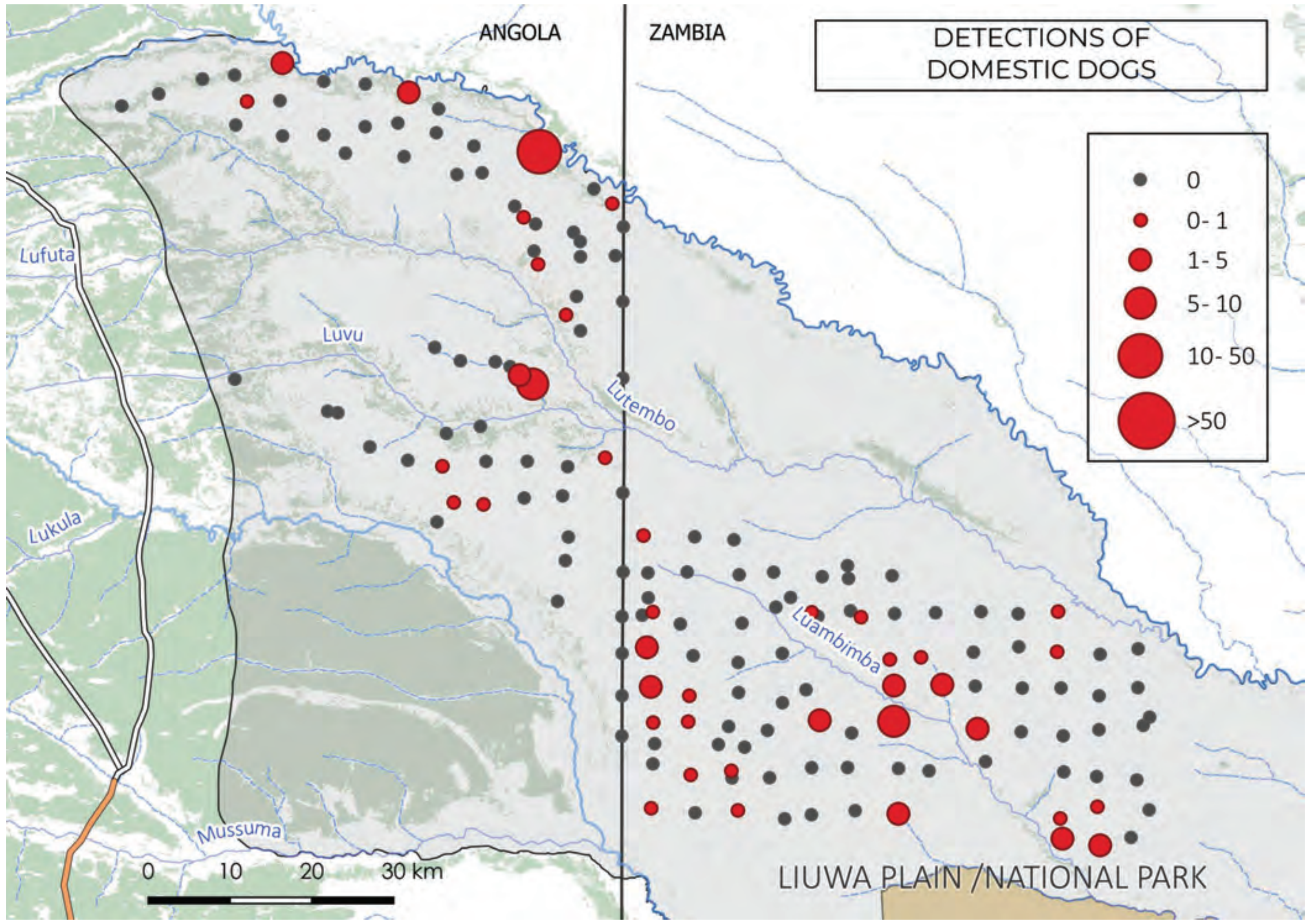


Figure 45 – Detection of domestic dogs by camera traps.

4.8.2 AGRICULTURE

Interviewees were asked to identify the three most important crops they grow.

Among the 67 and 64 respondents that engaged in farming activities in Angola and Zambia respectively, a vast majority - 92.5% and 93.8% respectively - mentioned maize as a vital crop. Manioc was slightly more often reported as an important crop in Angola (89.6%) than in Zambia (64.1%) and millet was reported at similar rates (32.8% - 34.4%) in both regions.

Interestingly, rice was less likely to be reported as an important crop in Angola (11.9%) compared to Zambia (68.8%). This might be related to the wide availability of rice peeling infrastructure in Zambia which are lacking in Angola. Beans were reported to be an important crop by 26.9% of the Angolan respondents whereas no Zambians reported cultivating or finding them important. Other crops reported as important included sweet potato, peanuts, sorghum and other vegetables (Table 4).

Interviews indicated that agriculture is the most significant economic activity in both Zambia and Angola. The majority of agricultural practices observed involved slash-and-burn techniques in forested areas due to the poor soils' low productivity. Additionally, the more fertile floodplains along river margins, particularly along the Luanguinga River, were in some areas extensively utilized for agricultural purposes (maize, potatoes). Occasionally, small cattle kraals were observed strategically positioned within inactive crop fields to enhance soil fertility. Rice cultivation was confined to floodplain areas, with a notably higher prevalence in Zambia compared to Angola.

Table 4 - Most important crops identified by interviews.

	ANGOLA		ZAMBIA		TOTAL	
Crop	**N=67**	**%**	**N=64**	**%**	**N=131**	**%**
Maize	62	92.5%	60	93.8%	119	93.1%
Manioc	60	89.6%	41	64.1%	101	77.1%
Rice	8	11.9%	44	68.8%	52	39.7%
Millet	22	32.8%	22	34.4%	44	33.6%
Beans	18	26.9%	0	0.0%	18	13.7%
Sweet potato	5	7.5%	7	10.9%	12	9.2%
Peanuts	10	14.9%	0	0.0%	10	7.6%
Sorghum	1	1.5%	4	6.3%	5	3.8%
Vegetables	1	1.5%	0	0.0%	1	0.8%

4.8.3 FISHING

23.1% of the Angolan respondents and 15.2% of the Zambian respondents claimed fishing as one of their main economic activities. Assessing fishing activity fell outside the scope of this study, however, it is worth noting that, the field activities and interviews revealed that fishing is an extremely important component of people's livelihoods both as a source of income and food (Figure 46). The use of fishing resources have been extensively assessed in the Zambian side of the Barotse floodplains (Turpie et al., 1999; Timberlake, 1998) and Liuwa Plain (DNPW, 2016). A similar study is required on the Angolan side of the TFCA.

Figure 46 - An Angolan fisherman in one of the permanent lagoons of the study area.

4.8.4 HUNTING

A preliminary assessment of hunting activities was conducted in the Mussuma area on the Angolan side of the TFCA. Because many participants were selected based on their knowledge of wildlife, the interview sample was likely biased toward individuals with direct experience in hunting. Unlike its Zambian counterpart, the Mussuma region lacks conservation status. This lack of protection, coupled with unclear hunting legislation and lack of law enforcement in Angola, encouraged respondents to provide open and useful insights into their hunting practices. In contrast, interviewees from Zambia were uncomfortable discussing hunting, leading to the removal of such questions from their questionnaires. Nevertheless, several hunting activities and indicators of hunting activity were observed in both countries during field work including bushmeat for sale (at markets or along the main roads), carcases, gun shells, hunting camps and hunters (see Figure 47 and Figure 49). Camera trap images also provided additional corroboration of hunting activities (Figure 48), indicating a higher incidence in Mussuma (10 events) than in the UWZGMA (1 event).

Of the 78 respondents interviewed in Mussuma, 52.6% (n=41) stated they had never hunted, while 47.4% (n=37) acknowledged some level of involvement in hunting. Among these, 28.2% (n=22) reported hunting regularly, 16.7% (n=13) occasionally, and one respondent indicated past involvement only.

Among the interviewees who acknowledged participating in hunting (n=37), 78.4% admitted to using wire snares, 43.2% reported using firearms, 24.3% used bow and arrow, and 13.5% reported using hunting dogs.

51.4% of respondents reported having hunted within the last week; and 13.5% within the last month; 18.9% within the last year. Only 8.1% reported their last hunt as more than a year ago, and 8.1% didn't know.

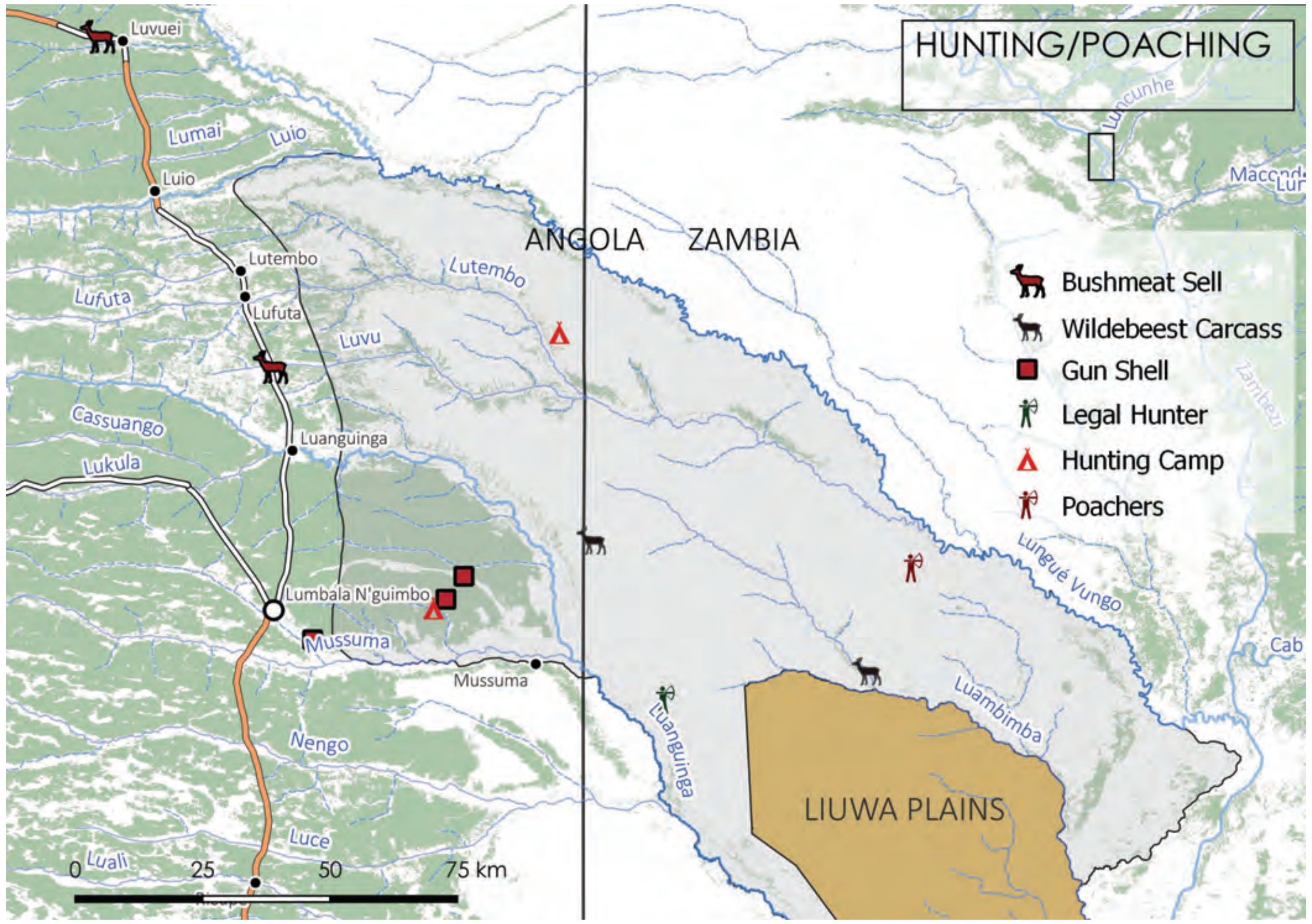


Figure 47 - Hunting evidence observed during fieldwork.

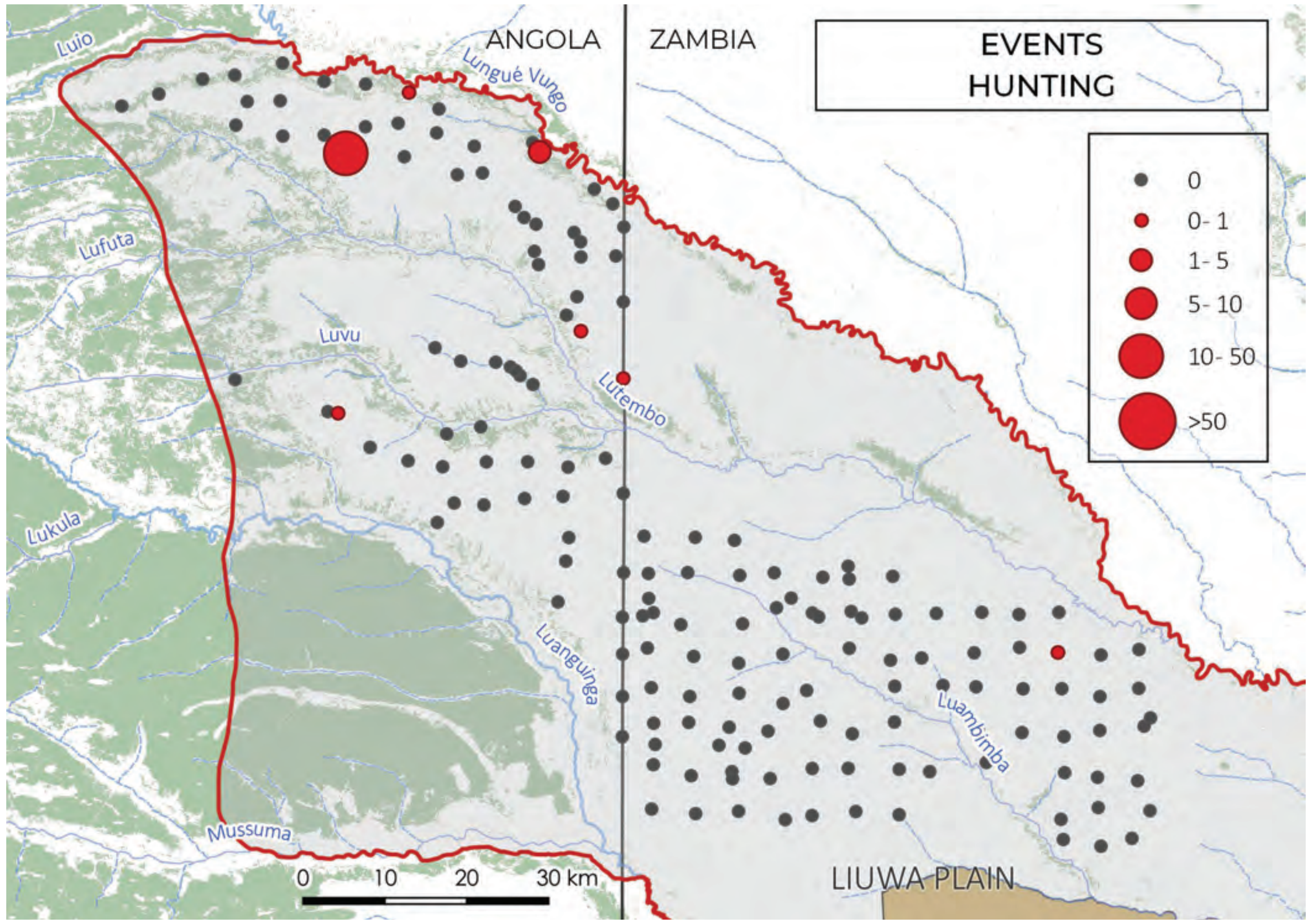


Figure 48 – Hunting events captured by camera trap.

Regarding the most recent species hunted, 51.4% reported capturing common duiker, 16.2% reported blue duiker and another 16.2% reported reedbuck (Table 5).

Hunting was reported as a widespread and important economic activity across the Angolan side of the study area. Informal interviews with local hunters revealed that they typically only consume the brains and guts of the animals themselves and sell the meat, either fresh or dried, to generate income. From 2019 to 2022, hunters reported that over 15 days, they typically catch 50 parts (around 10 animals), each part being one leg of a common duiker or pieces of sitatunga and reedbuck.

These 50 parts are sold for 50,000 AOA (for common duiker, average 100 USD[2]) and 85,000 AOA (for sitatunga and reedbuck, average 170 USD), meaning one leg of a common duiker sells for 1,000 AOA (2 USD). The bushmeat is usually transported by oxcart to the main road, which charges 10,000 - 15,000 AOA for transport, leaving a net gain of 35,000 AOA (75 USD) to be shared between

Table 5 - Last species hunted according to interviews in Angola.

Last species hunted	N	%
Common duiker	19	51.4%
Blue duiker	6	16.2%
Reedbuck	6	16.2%
Bushpig	3	8.1%
Monkey	3	8.1%
Sitatunga	3	8.1%
Mongoose	1	2.7%
Lechwe	1	2.7%
Yellow backed duiker	1	2.7%

2. Approximate average USD to AOA exchange rate from 2019 to 2021.

Figure 49 - Left, Hunter in the Mussuma area with a freshly hunted blue duiker. Right, A hunting camp in the Angolan side with more than 18 poached common duikers being dried.

the hunters, who usually work in groups of 2 to 3. Although these earnings may seem modest, they represent one of the few viable cash income opportunities in the region. Additionally, a fresh common duiker could be sold directly along roadsides for around 10,000 AOA (20 USD).

Due to uncontrolled and excessive hunting, animal scarcity has caused prices to significantly increase over the last two years. Locals are expressing concerns over food security, as many can no longer afford to buy meat (Lutembo villagers pers. comm.). Some hunters also disclosed the presence of a network of bushmeat traders who recruit them to gather bushmeat, which is then transported to major urban markets such as Luena and Saurimo. Nearly all hunters interviewed expressed concern about the decreasing wildlife densities, which are forcing them to apply much greater effort and travel to more distant areas to maintain a regular supply of bushmeat and sustain their livelihoods.

In the Moxico province, hunting and the consumption of bushmeat is deeply embedded in local customs (Figure 43) and it can be easily found for sale in both urban and rural markets. Despite the illegality of hunting for commercial purposes without a valid license[3,4] -which are not issued in the Moxico Province-, bushmeat is openly advertised on the menus of many leading restaurants in Luena, the provincial capital, where it is priced similarly to a dish of national chicken. This highlights its cultural significance and widespread acceptance. Conversations with provincial authorities revealed frequent misinterpretations of the law, particularly regarding the definition of “subsistence use” right. This provision allows the hunting of small species for personal or family consumption without a license and tolerates the occasional sale of surplus meat within the local community[4]. As a result, although technically not in full compliance with the law, the sale of bushmeat—especially of smaller species—is widely permitted and routinely overlooked.

Figure 50 - A hunting scene artwork framed on a hotel in Luena city, Moxico.

3. Article 162º of the Law nº6/17, specifically subparagraph h), which states that “the sale of wood or fauna resources obtained by ‘the usage of the subsistence right’ constitutes a legal infraction.

4. Decreto Presidencial nº 222/24. Article 65º of Decreto Presidencial nº 222/24 that states that ‘the surplus of hunting products obtained for subsistence purposes cannot leave the area from where they were obtained and can only be sold among neighbours when part of the customary traditions or within the hunters community’.

4.8.5 EXPLORATION OF MINERAL RESOURCES IN THE MOXICO PROVINCE – ANGOLA

The exploration of mineral resources in Moxico Province has been a recurring topic in both the Angolan and international press over the past two years, with Rio Tinto (MIREMPET, 2024) and Ivanhoe Mines (MIREMPET, 2023) identified as the main beneficiaries of two large-scale concessions within the Liuwa–Mussuma Landscape.

- Moxico Base Metals Concession (2024): In January 2024, Rio Tinto signed a mining investment contract with Angola’s Ministry of Mineral Resources for the *Moxico* concession in eastern Angola (MIREMPET, 2024). This concession, covering approximately 9,959 km², is located in Moxico Province (see Figure 51) and targets base metals—primarily copper, zinc, cobalt, and titanium (Lobito Corridor, 2024). Under the agreement, Rio Tinto committed an initial investment of USD 5.7 million, securing a five-year prospecting period (extendable by two years), followed by a potential 35-year exploration and exploitation license if viable deposits are confirmed (Lobito Corridor, 2024).
- Moxico & Cuando Cubango Copper Exploration (2023): In November 2023, Ivanhoe Mines was awarded a large-scale greenfield exploration license covering 22,195 km² across Moxico and Cuando Cubango provinces in southeastern Angola (see Figure 51) (Mining Technology, 2023). The license grants Ivanhoe an initial five-year exploration term, extendable up to seven years, to search for mineral deposits (Ivanhoe Mines, 2024). The area is considered highly prospective for copper, with Ivanhoe suggesting it may contain a southern extension of the Central African Copperbelt. Fieldwork began in 2024 with surveying and initial drilling programs (Ivanhoe Mines, 2024).

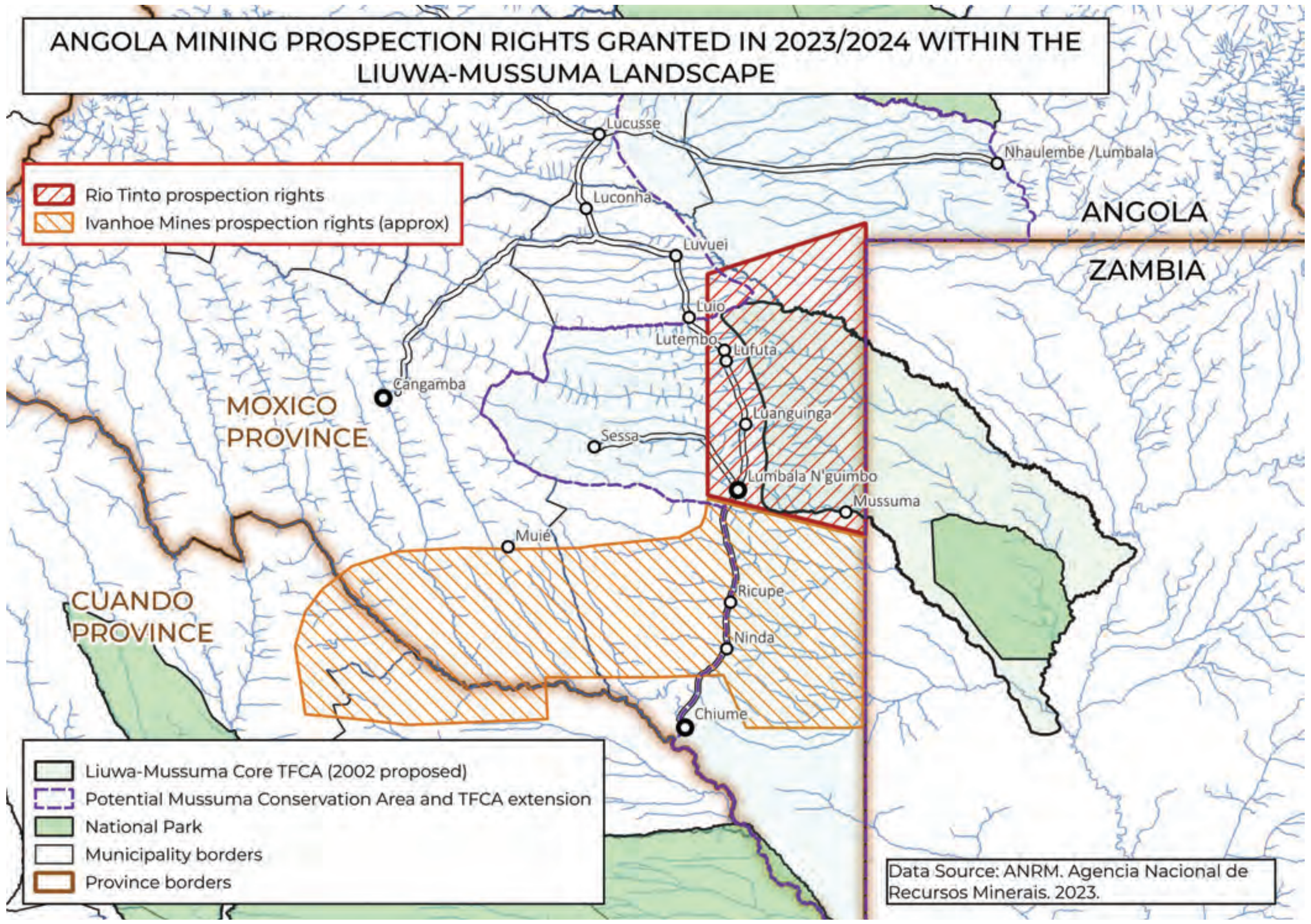


Figure 51 - Location of mining exploration rights granted in 2023/2024 to Rio Tinto and Ivanhoe Mines within the Liuwa-Mussuma Landscape. Data from Agencia Nacional de Recursos Minerais. 2023.

A review of multiple sources—including advertisements from the Geographic and Cadastral Institute of Angola (*Instituto Geográfico e Cadastral de Angola*, IGCA) in Jornal de Angola and documentation from the National Agency for Mineral Resources (*Agência Nacional de Recursos Minerais*, ANRM)—confirms the geographic extent of both concessions in eastern Moxico. These areas stretch from south of Cameia National Park to the Cuando River, along the Zambian border (see map in Figure 51). Notably, this zone overlaps with the region currently under consideration for the proposed Liuwa–Mussuma Transfrontier Conservation Area.

Whilst culturally and environmentally-considerate mining activities may bring a much-need economic lift to the area, mining in this ecologically valuable and sensitive landscape poses significant risks – not only to biodiversity conservation and ecological connectivity, but also to vital ecosystem services. As the region functions as an important water catchment, pollution from mining operations could compromise water quality and potentially impact the health and livelihoods of millions of people downstream. This makes strict compliance with Angola's legal framework on environmental protection and responsible mining essential to mitigate its impact on biodiversity, water resources, and local communities.

Additionally, in March 2025, Angola's upstream regulator, the National Oil, Gas & Biofuels Agency (ANPG), reached an agreement with Vietnamese energy firm Xuan Thien Group (XTG) to collaborate on the research and exploration of the Etosha and Okavango basins—areas which similarly intersect with the Mussuma portion of the TFCA. (Energy Capital & Power, 2025).

4.8.6 ORCHID TUBER HARVEST AND CROSS-BORDER TRADE

Evidence indicates that Angola, particularly Moxico province, is emerging as a source for the illegal harvest of terrestrial orchid tubers used in Zambia for the traditional dish chikanda (Veldman et al., 2014, 2018). During our fieldwork at the Moxico–Zambia border within the wider Mussuma landscape in 2019, we observed medium-sized trucks transporting loads of "bulbs from river floodplains." These findings are consistent with orchid tubers from genera such as *Disa, Satyrium, Habenaria, Brachycorythis* and *Platycoryne* (B. Bytebier, personal communication, 2020). While chikanda was historically a subsistence food, it has developed into a large commercial market, with an estimated 2–4 million orchid tubers trafficked annually from Tanzania alone to supply Zambian demand and increasingly sourced from neighbouring countries including Angola (Veldman et al., 2018). As all orchids are listed under CITES Appendix II, cross-border trade without permits is illegal. However, weak enforcement and limited awareness among border officials facilitate this trafficking. In fact, traffickers report that customs authorities often tax the consignments as potatoes, since the bulbs are not recognised as orchids. The Mussuma floodplains host an exceptional diversity of orchids — in a single 15-minute walk along the Luvu River floodplain — within the Mussuma landscape—, we recorded more than 11 species. Without proactive monitoring and enforcement, Angola risks becoming a significant supplier to this unsustainable trade, with rapid depletion of orchid populations as has already occurred in Zambia and Tanzania.

Figure 52 - Selection of orchid species recorded within a 15-minute walk along a river floodplain in the Mussuma area. Species shown (from top right, clockwise): *Platycoryne mediocris*, *Eulophia malangana*, *Disa welwitschii* subsp. *welwitschii*, *Eulophia calanthe*, *Orthochilus trilamellatus*, *Satyrium buchananii*, *Satyrium trinerve*, and *Platycoryne guingangae*. Identifications by B. Bytebier.

5. WILDLIFE

5.1 OVERALL SURVEY RESULTS

The surveys conducted in both countries confirm that large mammal populations have significantly declined from historical levels. In Liuwa Plain National Park, in Zambia, however, there are encouraging signs of recovery. Since African Parks Zambia assumed management of the national park in 2003, effective law enforcement measures have been implemented, resulting in gradual improvements across species. Core populations of wildebeest, zebra, tsessebe, oribi, steenbok, common duiker, reedbuck, and hyena have been maintained, illustrating the positive impact of sustained protection and management.

In contrast, Angola's Mussuma region has experienced severe declines in mammal populations over the past two decades, primarily due to intense hunting pressure. These pressures have been further exacerbated by the return of refugees in the aftermath of armed conflict, in a context where natural resource governance remains weak and enforcement of regulations is largely ineffective.

Despite these challenges, data from Mussuma suggest relatively higher naïve occupancy percentages for several species—such as common duiker, side-striped jackal, steenbok, wildcat, roan antelope, Malbrouck monkey, and reedbuck—compared to the UWZGMA (see Table 6). Moreover, eleven species (bushpig, aardvark, blue duiker, marsh and banded mongoose, thick-tailed and lesser galago, yellow-backed duiker, leopard, springhare, and rat) were only detected via camera traps in Mussuma. However, this apparent advantage does not necessarily imply healthier or more abundant populations in the Angolan site. Instead, these results are best interpreted in the context of differing survey efforts, detection probabilities, and landscape characteristics.

Notably, the UWZGMA recorded a significantly higher number of direct sightings (117 in UWZGMA vs. 57 in Mussuma, see Table 7). This disparity is likely the result of multiple compounding factors. The UWZGMA survey benefited from a considerably more intensive sampling effort, supported by a larger field team operating two vehicles, stronger logistical infrastructure—including proximity to ZCP and AP basecamps—and better access conditions that enabled off-road excursions. A larger team also naturally translates to more observers, increasing the likelihood of direct wildlife observations. Additionally, the UWZGMA landscape is generally more open—either due to its natural topography or anthropogenic modifications—further enhancing visibility and detectability of animals.

In contrast, Mussuma's denser and relatively less disturbed vegetation likely reduced the probability of direct sightings during fieldwork. This underscores the importance of camera trap data in such environments. Unlike traditional observational methods, camera trapping enables standardized effort correction and is less biased by team size or habitat density. Therefore, in Mussuma, where detections were dominated by camera trap data, the results may offer a more reliable depiction of species presence, with direct sightings serving as complementary evidence.

The observed differences in species detection—reflected in variations in naïve occupancy, relative abundance indices (RAI), and direct sightings—are likely shaped by a complex interplay of ecological, geographical, and anthropogenic factors. The UWZGMA is characterized by higher human population density and more pronounced habitat fragmentation, which may contribute to lower RAI and occupancy estimates for some wild species, as wildlife tends to avoid areas with high human influence. Notable species-specific differences between the two regions are further discussed in the individual species accounts.

Table 6 - Camera trap summary results by species.

	EVENTS		RAI		SITES		NAÏVE OCC	
	MUSSUMA	UWZ GMA	MUSSUMA	UWZ GMA	MUSSUMA	UWZ GMA	MUSSUMA	UWZ GMA
WILDLIFE SPECIES								
Common duiker	548	494	6.96	8.17	67	82	90.54	88.17
Blue wildebeest		55		0.91		7		7.53
Steenbok	99	43	1.26	0.71	28	21	37.84	22.58
Roan antelope	59	8	0.75	0.13	21	8	28.38	8.60
Southern reedbuck	95	14	1.21	0.23	13	8	17.57	8.60
Oribi	31	10	0.39	0.17	11	6	14.86	6.45
Blue duiker	132		1.68		9		12.16	
Yellow-backed duiker	3		0.04		2		2.70	
Cape porcupine	46	3	0.58	0.05	15	3	20.27	3.23
Bushpig	55		0.70		20		27.03	
Aardvark	16		0.20		10		13.51	
Thick-tailed galago	3		0.04		2		2.70	
Lesser galago	2		0.03		2		2.70	
Malbrouck monkey	121	9	1.54	0.15	19	8	25.68	8.60
Leopard	1		0.01		1		1.35	
Spotted hyena	5	3	0.06	0.05	3	3	4.05	3.23
Side-striped jackal	194	179	2.46	2.96	44	51	59.46	54.84
Banded mongoose	12		0.15		5		6.76	
Marsh mongoose	3		0.04		2		2.70	
Genet spp	6	13	0.08	0.22	6	9	8.11	9.68
Serval	24	7	0.30	0.12	10	6	13.51	6.45
African wild cat	24	12	0.30	0.20	15	9	20.27	9.68
African civet	28	1	0.36	0.02	11	1	14.86	1.08
Selous mongoose	10	7	0.13	0.12	6	5	8.11	5.38
Striped polecat	5	7	0.06	0.12	4	7	5.41	7.53
Springhare	1		0.01		1		1.35	
African savanna hare	50	5	0.64	0.08	12	5	16.22	5.38
DOMESTIC SPECIES AND HUMAN ACTIVITY								
Domestic dog	41	49	0.52	0.81	14	27	18.92	29.03
Domestic cow	44	69	0.56	1.14	9	22	12.16	23.66
Hunting	10	1	0.13	0.02	6	1	8.11	1.08

Historically, the Mussuma and UWZGMA regions have been understudied, making it difficult to determine the historical presence of certain species. Table 8 offers a preliminary comparative assessment of the status of large and medium-sized mammal species across Mussuma, UWZGMA, and Liuwa Plain. Data for Liuwa Plain were sourced from existing literature, whereas the information for Mussuma and UWZGMA was derived from our survey results and local knowledge.

The study assessed 51 species, confirming the presence of 39 in Liuwa Plain, 29 in Mussuma, and 24 in the UWZGMA. There was an absence of evidence of continued persistence - hence presumed local extinction - for 5 species in Liuwa Plain (10% loss), 9 in Mussuma (18% loss), and 6 in the UWZGMA (12% loss). Table 9 provides a summary of the comparative species status across the three areas.

Table 7 - Wildlife species direct observations.

WILDLIFE SPECIES	ANGOLA	ZAMBIA	TOTAL
Common duiker	10	58	68
Oribi	17	20	37
Steenbok	17	18	35
Reedbuck	1	12	13
Malbrouck monkey	6	2	8
Roan antelope	4	2	6
Banded mongoose		2	2
Side-striped jackal	1	1	2
Bushpig	1		1
Spotted hyena		1	1
Plains zebra		1	1

Figure 53 - Oribi in Liuwa Plain National Park.

Table 8 – Comparative large and medium sized mammal species status in the Mussuma, UWZGMA and Liuwa Plain areas.

Data deficient - Insufficient information to assess historical and/or current status.
Never Existed - No historical or current evidence of presence in the area.
Presumed local extinction - Historically present – Absence of evidence of continued presence.
Rare - Known to exist in the area but in very low numbers or limited occurrences.
Existing - Adequate evidence of current presence, including stable, declining, or recovering populations.

ORDER	SPECIES	STATUS		
		MUSSUMA	UWZGMA	LIUWA
Artiodactyla	Hippopotamus	Rare	Rare	Rare
	Roan antelope	Existing	Existing	Rare
	Sable antelope	a,b	a,b	Presumed local extinction
	Blue wildebeest	Presumed local extinction	Existing	Existing
	Buffalo	Presumed local extinction	Presumed local extinction	Existing
	Eland	Presumed local extinction	Presumed local extinction	Existing
	Southern lechwe	Rare	Rare	Existing
	Lichtenstein's Hartebeest	Presumed local extinction	Presumed local extinction	Presumed local extinction
	Bushbuck	c	c	Presumed local extinction
	Sitatunga	Existing	Existing	Existing
	Tssessebe	Presumed local extinction	Presumed local extinction	Existing
	Southern Reedbuck	Existing	Existing	Existing
	Oribi	Existing	Existing	Existing
	Steenbok	Existing	Existing	Existing
	Common duiker	Existing	Existing	Existing
	Yellow-backed duiker	d	a,b	Never Existed
	Blue duiker	Existing	e	Presumed local extinction
	Bushpig	Existing	e	Existing
Perissodactyla	Zebra	Presumed local extinction	Existing	Existing
Orycteropodidae	Aardvark	Existing	e	Existing
Pholidota	Temminck pangolin	c	c	Existing
Rodentia	Cape porcupine	Existing	Rare	Existing
	Springhare	Rare	e	Existing
Lagomorpha	African savanna hare	Existing	Existing	Existing
Primates	Malbrouck monkey	Existing	Existing	Existing
	Thick tailed greater galago	Existing	c	Data deficient
	Lesser galago	Existing	e	Existing
Carnivora	Lion	f	Rare	Existing
	Leopard	Rare	Presumed local extinction	Presumed local extinction
	Spotted hyena	Rare	Existing	Existing
	Cheetah	Presumed local extinction	Rare	Existing
	African wild dog	Presumed local extinction	Presumed local extinction	Existing
	Side-striped jackal	Existing	Existing	Existing
	Serval	Existing	Existing	Existing
	Caracal	c	c	Rare
	African wildcat	Existing	Existing	Existing
	African civet	Existing	Existing	Existing
	Genets spp1	Existing	Existing	Existing
	Selous mongoose	Existing	Existing	Existing
	Swamp mongoose	Existing	e	Existing
	Banded mongoose	Existing	Existing	Existing
	White-tailed mongoose	e	e	Existing
	Slender mongoose	e	e	Existing
	Egyptian mongoose	e	e	Existing
	Dwarf mongoose	e	e	Data deficient
	Striped polecat	Existing	Existing	Existing
	African striped weasel	e	e	Data deficient
	African clawless otter	e	e	Existing
	Spotted-necked otter	e	e	Data deficient
	Honey badger	c	c	Data deficient

Footnotes:
a. Currently not present.
b. Lack of historical information.
c. Species not found, but could be present in unsurveyed areas, i.e: The forested areas in the southern part of Mussuma; The fringe forested areas north of the UWZGMA. Historical presence is also unclear, although distribution and habitat preferences match the species description.
d. Represents an extension of the known species range.
e. Species not found in survey but likely to happen either in low densities or in less intensely surveyed habitats.
f. No resident population known, but transient or dispersing individuals or pairs frequently reported.
1. Common genet (Genetta genetta) and Large-spotted genet (Genetta maculata).

Table 9 – Summary table for comparative species status between the Mussuma, UWZGMA and Liuwa Plain areas.

	NUMBER OF SPECIES (N=51)		
	MUSSUMA	UWZGMA	LIUWA
Data deficient	12	20	5
Never Existed	0	0	1
Locally Extinct	9	6	5
Rare	5	5	3
Existing	24	19	36

5.2 SPECIES ACCOUNTS

5.2.1 HIPPOPOTAMUS
(Hippopotamus amphibius)

Frequent mentions of hippopotamus emerged during interviews conducted in both Angola's Mussuma area and the UWZGMA in Zambia, primarily in the context of human-wildlife conflict. These accounts provide indirect confirmation of the species' current presence within the study area. The historical presence of the hippopotamus in Angola's Mussuma survey area remains doubtful (Crawford-Cabral & Veríssimo, 2005), despite existing records of their occurrence in the middle and lower sections of various rivers in the Cubango-Okavango and Zambezi basins (Beja et al., 2019). In Zambia, the acknowledged habitat of the species extends to the UWZGMA.

5.2.2 ROAN ANTELOPE
(Hippotragus equinus)

Our study collected two main types of primary data on roan antelope: direct visual observations and camera trap records. In total, we recorded six direct observations—two in Zambia (UWZGMA) and four in Angola (Mussuma)—as well as 59 independent camera trap events across both areas. In the Mussuma region, most of these records (both camera and direct) were broadly distributed and closely associated with the availability of water sources. However, there was one specific zone—the central part of Mussuma between the Luvu and Lutembo rivers—where roan antelopes were not captured on camera traps. In this area, their presence was instead frequently reported by local interviewees. These second-hand reports, while not confirmed by camera trap data, suggest possible persistence of the species in this subregion, where detection may be limited due to dense vegetation and difficult access.

For the rest of the study area, both camera trap data and direct sightings confirmed the presence of roan antelope. In the UWZGMA, their distribution appeared more dispersed and generally further from human settlements.

Of the six direct sightings, one involved a herd of eight individuals, another involved four individuals, two sightings included two individuals each, and two were of solitary animals (see Figure 56 for the distribution of direct and indirect observations). Camera traps recorded 39 instances of solitary roan antelopes and 20 group sightings, 12 of which featured groups of four or more individuals. The largest herd captured on camera consisted of 10 animals. Reproductive indicators were also recorded, with camera traps capturing yearlings on 13 occasions and calves on 11 occasions.

In terms of behavioural indicators, three of the direct observations involved relaxed animals that appeared unaware of our presence at an average distance of 650 m. The other three were of animals that fled upon detection at an average distance of 125 m. These flight distances provide insight into the species' fear response to humans, with the longer distances suggesting substantial hunting pressure (Ndaimani et al., 2012; Mremi et al., 2023).

In the southern section of Mussuma (between the Luanguinga and Luvu Rivers), only 12 independent captures were recorded, all of which were of single individuals, and just one of these captures featured a yearling. On the other hand, the northern section of Mussuma (between the Lungué-Vungo and Lutembo Rivers) was where all large herds, including those with calves and yearlings, were observed. In Zambia, camera traps mostly detected solitary individuals, with a single capture of two adults and no sightings of yearlings or calves.

Sometime before the independence of Angola, the roan antelope was considered the country's most common large antelope, particularly abundant in several protected areas. However, after this period, intense poaching activities—including in Cameia National Park—significantly reduced their numbers. This decline was so pronounced that, aside from a sustainable population in Bicuar National Park, the roan antelope was nationally classified as a threatened species (Cabral & Veríssimo, 2005).

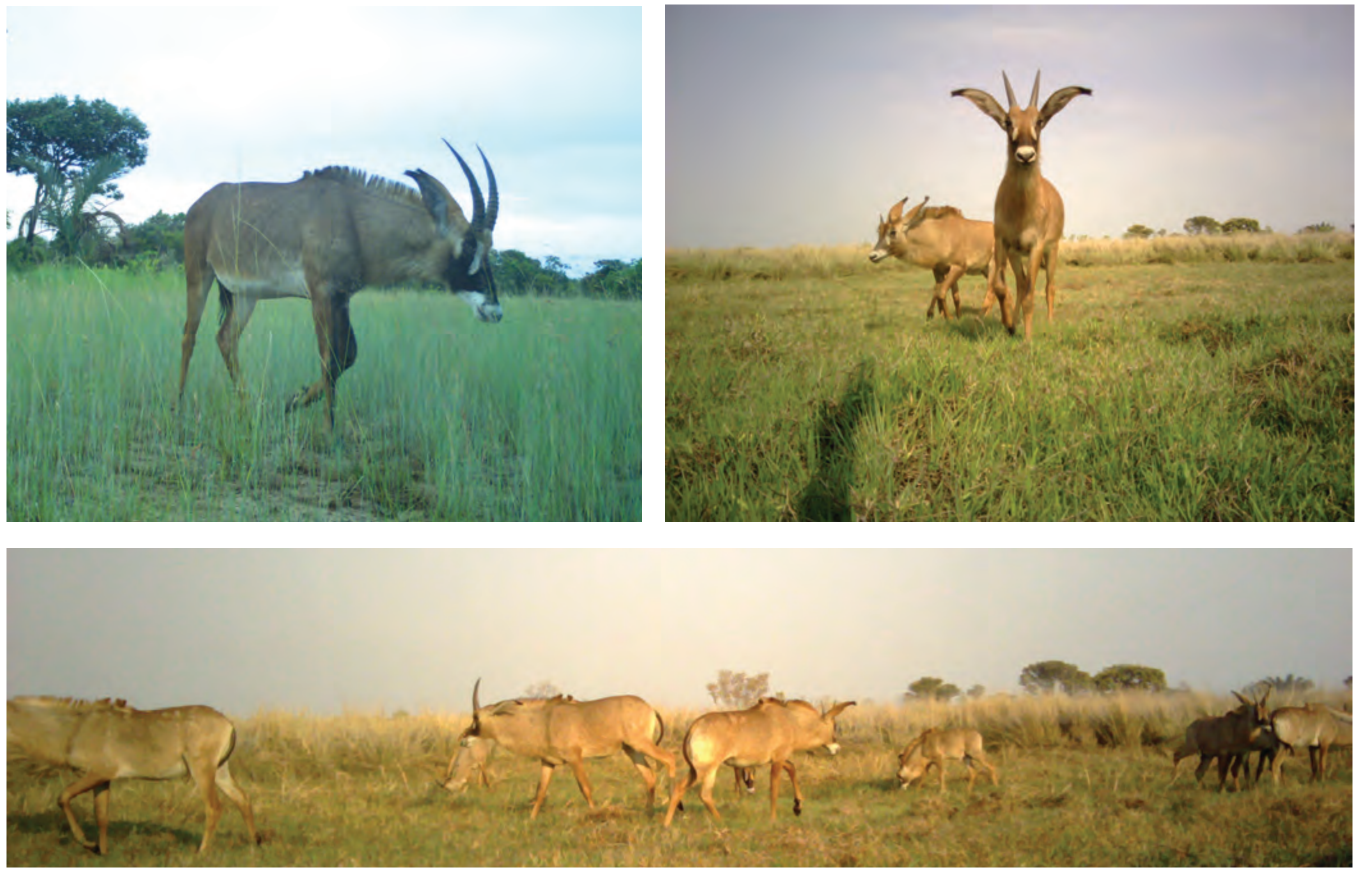


Figure 54 - Selection of camera trap captures of roan antelope. The lower image shows a breeding herd with calves and yearlings.

The findings of our survey highlight critical conservation concerns, particularly regarding the viability of the increasingly isolated roan antelope populations in the southern section of Mussuma and the UWZGMA. To reduce the risk of local extinction, the immediate implementation of targeted and site-specific conservation strategies is imperative. Prompt action is critical to securing the long-term survival and ecological resilience of this iconic and ecologically important species.

The evident contrast in camera trap detections between Mussuma (59 events, RAI = 0.75) and the UWZGMA (8 events, RAI = 0.13) is statistically significant ($Z = 5.20$, $p < 0.000001$), based on a Poisson rate test using independent capture events and total camera trap effort, and highlights the influence of various factors on antelope distribution. These factors include, but may not be limited to, anthropogenic pressure, with the UWZGMA experiencing higher human density, which likely influences antelope distribution. According to Chardonnet & Crosmary (2013), the behavioural tendencies of roan antelopes indicate that they avoid areas with high herbivore density. This avoidance is primarily because predators tend to prefer roan antelopes over other herbivores. Consequently, the high density of other herbivores attracts carnivores, putting roan antelopes at greater risk of predation in these regions. Moreover, the presence of large herds of other grazing species in the UWZGMA—such as blue wildebeest and plains zebra—may further affect roan antelope distribution. These species often graze the grass to a height that is less suitable for roan antelopes, leading to minimal overlap in their respective habitats. All of these insights are drawn from Chardonnet & Crosmary's (2013) synthesis of interspecific interactions and predation risk in large herbivore communities.

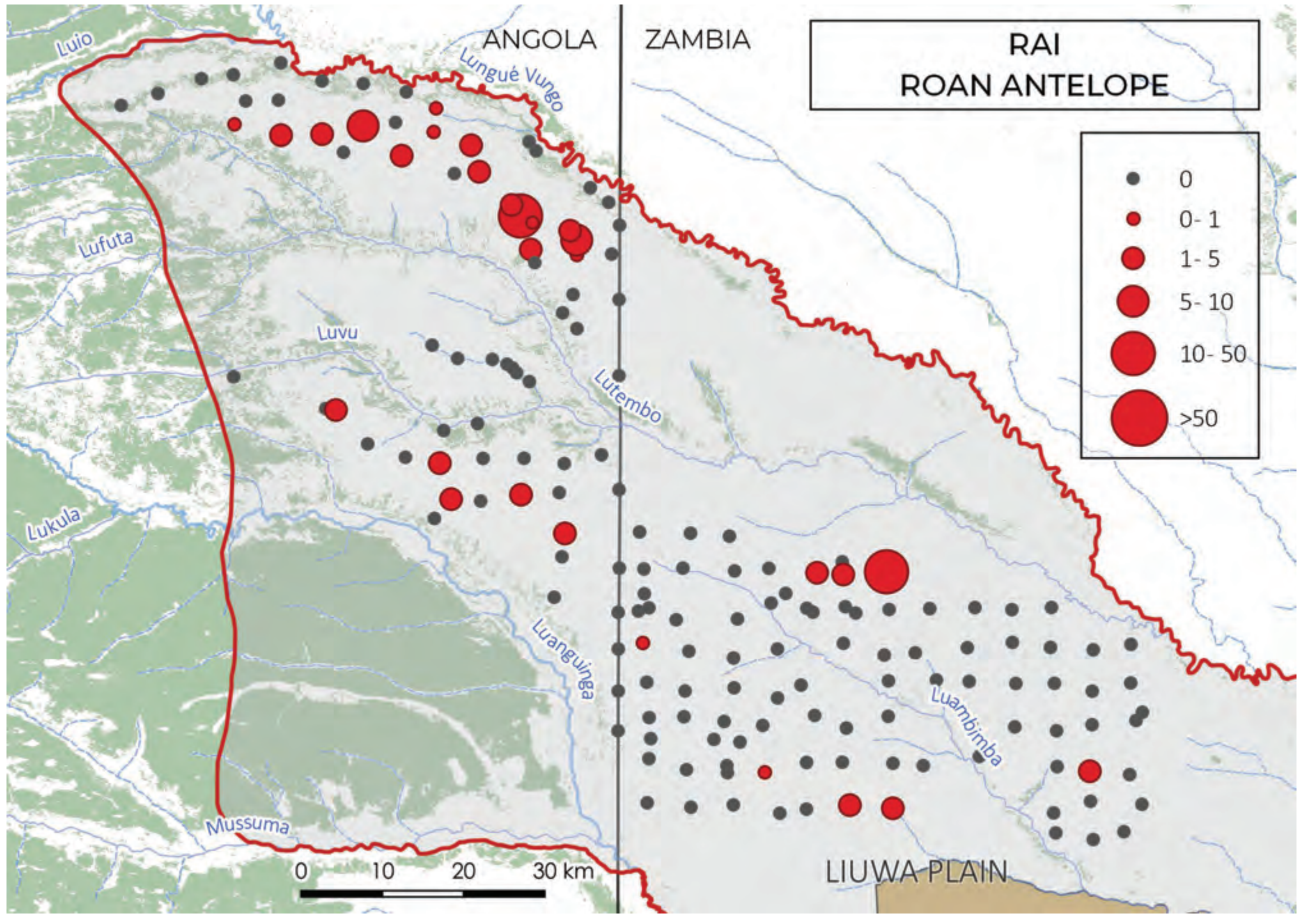


Figure 55 - Roan antelope relative abundance Index (RAI) map derived from the camera traps data.

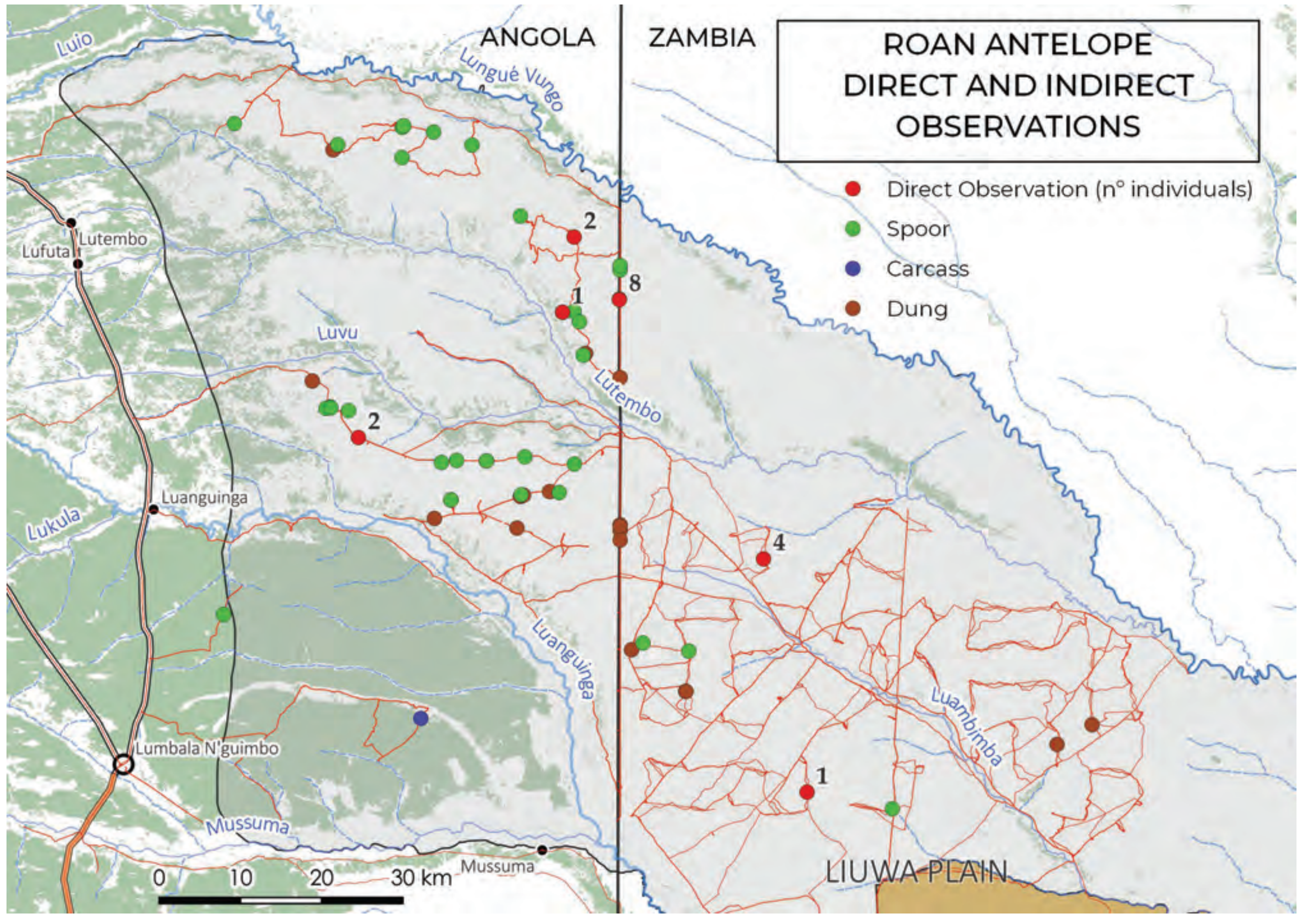


Figure 56 - Roan antelope direct and indirect observations location.

Figure 57 - A solitaire roan antelope at the Mussuma floodplains in 2022.

5.2.3 COMMON DUIKER
(Sylvicapra grimmia)

Data from our survey confirm that the common duiker is widely distributed across both study areas. We recorded 548 camera trap events in Mussuma (RAI = 6.96) and 494 events in the UWZGMA (RAI = 8.17), making it one of the most frequently detected species in both regions. This high level of detection, along with consistently elevated RAI values compared to other species, indicates the species remain relatively abundant and widespread. Despite the slightly higher encounter rate in the UWZGMA, these results suggest that the distribution and density of common duikers do not differ markedly between the two regions.

However, in Angola, combined evidence from camera traps and community interviews points to significant hunting pressure on this species. This is reflected in the spatial pattern of detections: common duikers are more frequently recorded at greater distances from human settlements. This trend suggests a likely inverse relationship between human presence and duiker occurrence, with individuals avoiding areas near habitation or water sources where hunting activity is concentrated. These findings imply that common duikers may be shifting their distribution in response to anthropogenic pressure, concentrating in zones that offer relative refuge from hunting.

Historically, the common duiker was considered the most widespread antelope species in Angola, with the largest distributional range (Cabral & Veríssimo, 2005). Our findings affirm its broad presence today but also point to the need for targeted conservation measures. Ensuring the sustainability of duiker populations will require addressing hunting pressure, particularly in regions where they are heavily targeted by hunters.

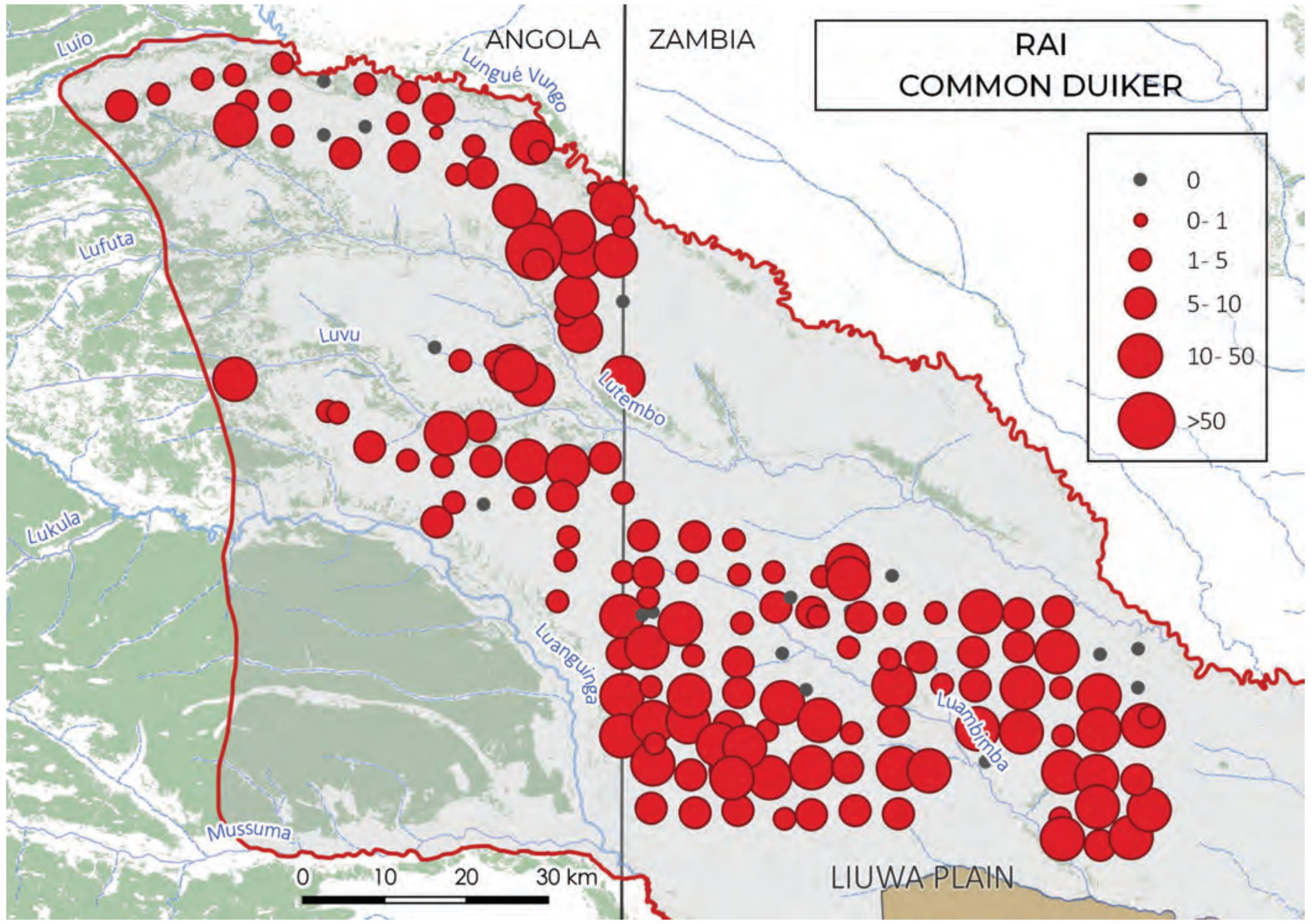


Figure 58 - Common duiker relative abundance Index (RAI) map derived from the camera traps data.

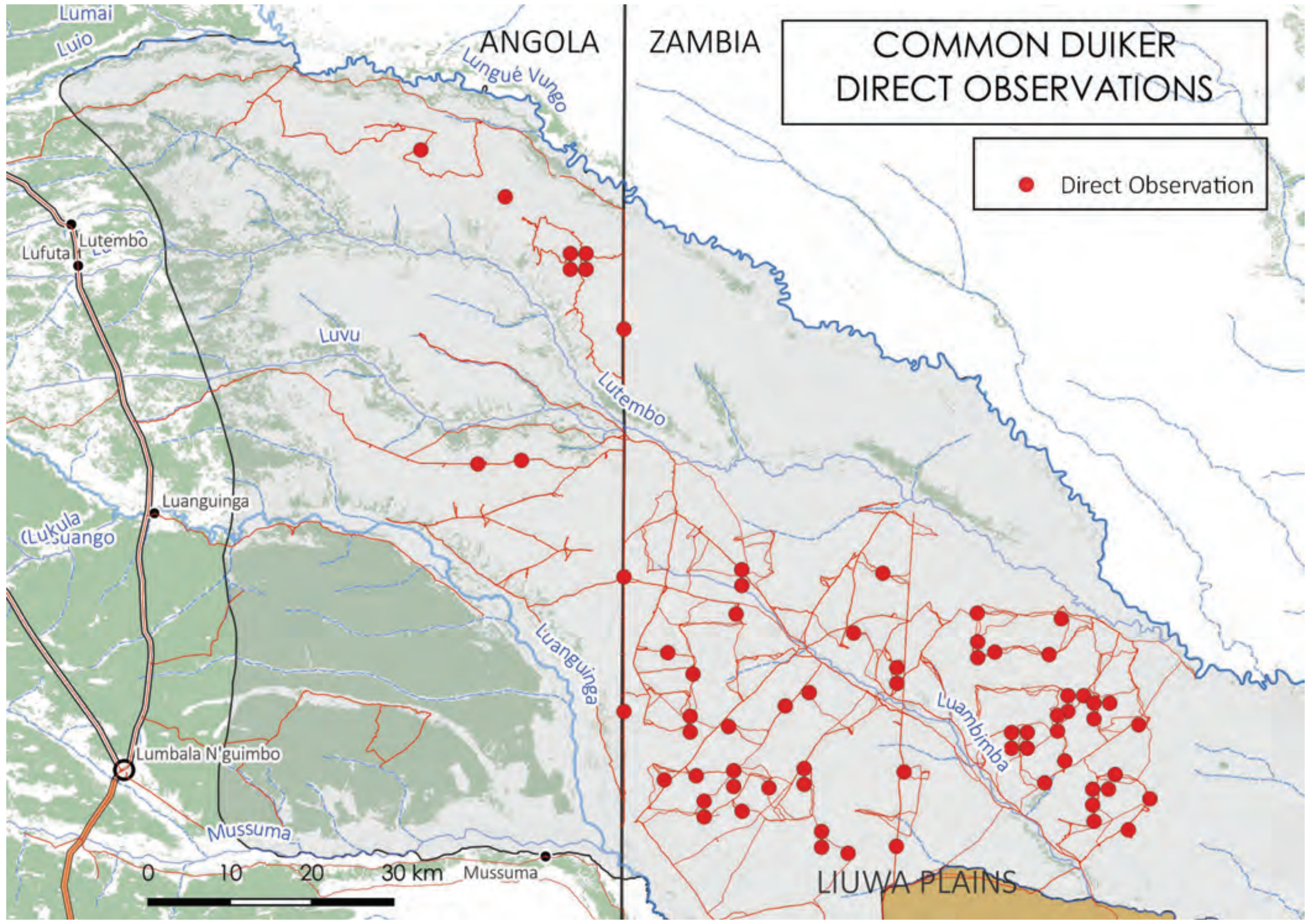


Figure 59 – Common duiker direct observations.

Figure 60 - Common duiker camera trap picture in Mussuma.

5.2.4 SOUTHERN REEDBUCK
(Redunca arundinum)

Our survey revealed a stark contrast in southern reedbuck detections between Mussuma and the UWZGMA. In Mussuma, we recorded 95 camera trap events (RAI = 1.21), while only 14 events were recorded in the UWZGMA (RAI = 0.23), indicating a notably higher relative abundance in the Angolan portion of the landscape. However, given the additional effort in Zambia, twelve direct observations were made in the UWZGMA and only one in the Mussuma area.

Historically, reedbuck were widespread in eastern Angola, including areas like Cameia National Park, but the species experienced a marked decline by the 1990s (Crawford-Cabral & Veríssimo, 2005). Although their relative abundance in Mussuma is encouraging, interview data suggest the species is under substantial hunting pressure. This is reportedly driven by a strong local preference for reedbuck meat, their vulnerability to hunting with dogs, and the practicality of transporting their carcasses due to their manageable size (Kingdon & Hoffmann, 2013).

Alarmingly, reedbuck are often specifically targeted for meat during celebratory events, with hunting reportedly demanded by local authorities—even within the protected boundaries of Cameia National Park. This information, shared during informal interviews with law enforcement personnel, highlights the sensitive and systemic nature of this pressure. Without immediate and targeted conservation action, the future of the southern reedbuck in this landscape remains uncertain and highly precarious.

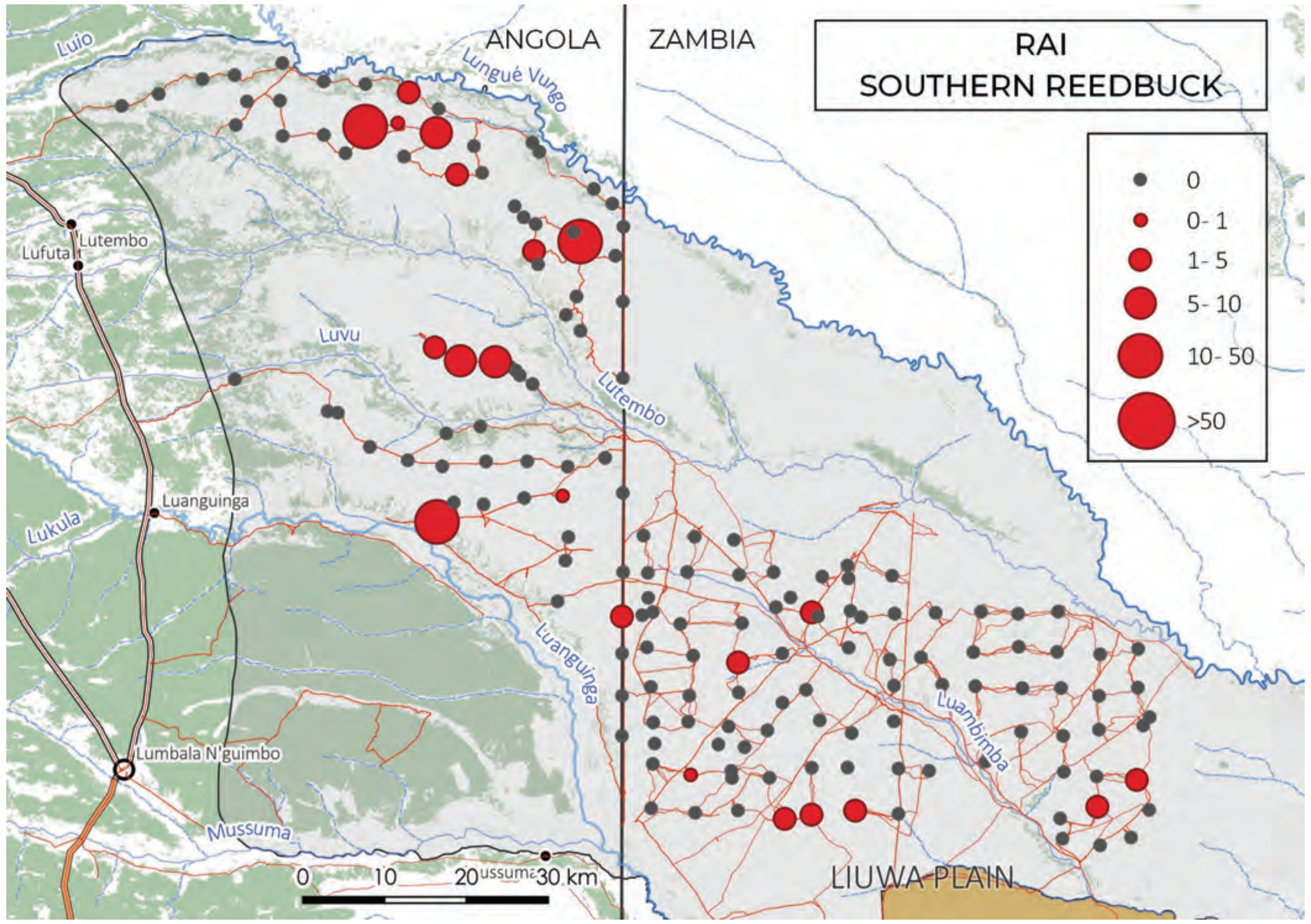


Figure 61 -Southern reedbuck relative abundance Index (RAI) map derived from the camera traps data.

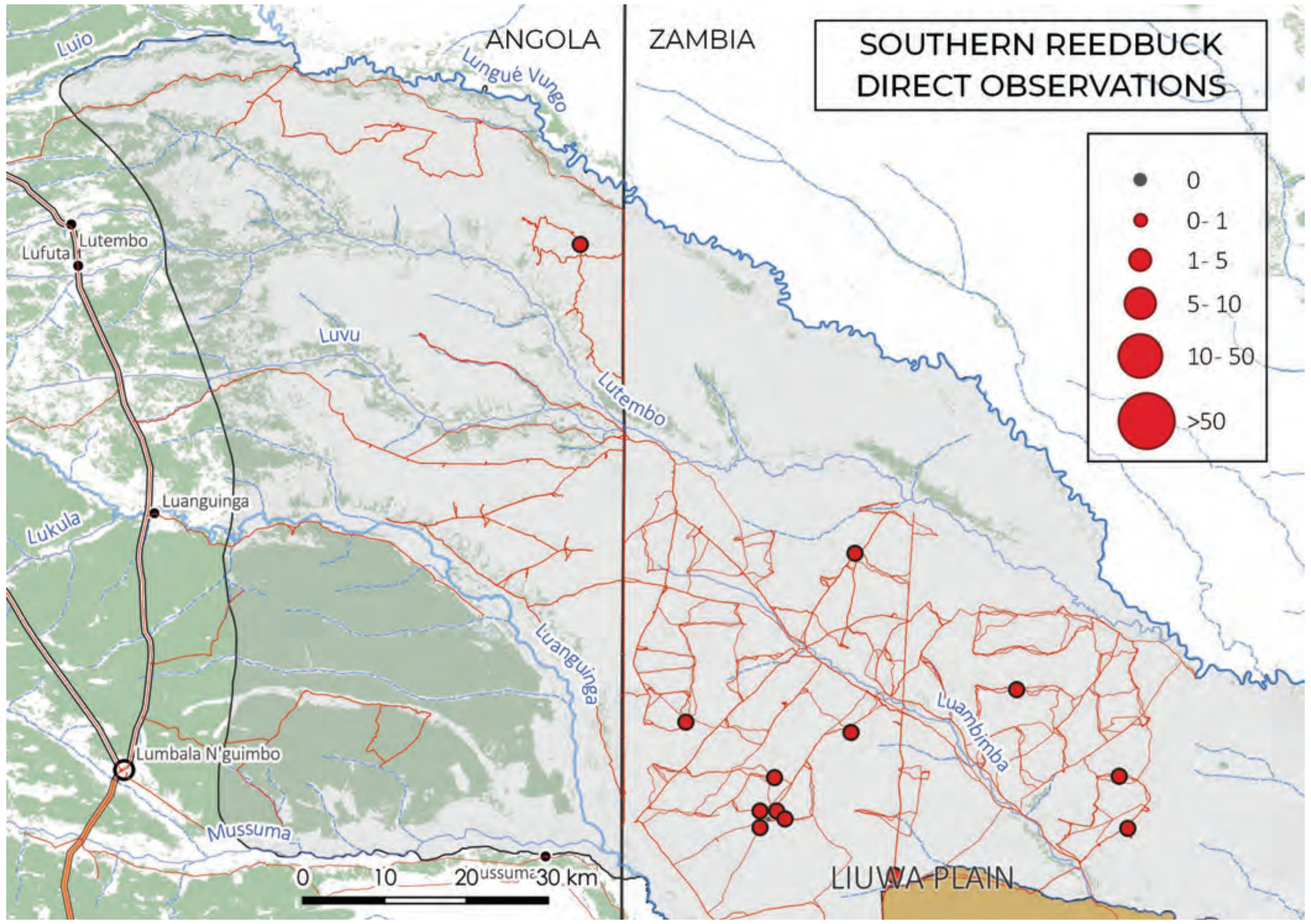


Figure 62 – Southern reedbuck direct observations.

Figure 63 - Southern reedbuck camera trap picture taken in Mussuma during the peak of the rainy season.

5.2.5 ORIBI

(Ourebia ourebi)

Our survey identified very localized populations of oribi in both Mussuma and the UWZGMA, with a higher number of detections in Mussuma. We recorded 31 camera trap events in Mussuma (RAI = 0.39) compared to just 10 events in the UWZGMA (RAI = 0.17). Similar to reedbuck, oribi are frequently targeted by hunters, driven by the high desirability of their meat and their strong site fidelity, which makes them particularly vulnerable to repeated targeting in known areas (Brashares & Arcese, 2013). This hunting pressure may contribute to their current restricted distribution and low detection rates.

Historically, oribi were commonly found and widely distributed across Angola in the 1970s. Although their numbers had declined by the 1990s, they still occupied a substantial portion of their historical range (Crawford-Cabral & Veríssimo, 2005). While this historical context pertains specifically to Angola, our current survey—spanning both Angola (Mussuma) and Zambia (UWZGMA)—offers a broader, present-day picture of the species' status. The results underscore the urgent need for effective conservation measures to prevent further decline and ensure the oribi's long-term survival in the region.

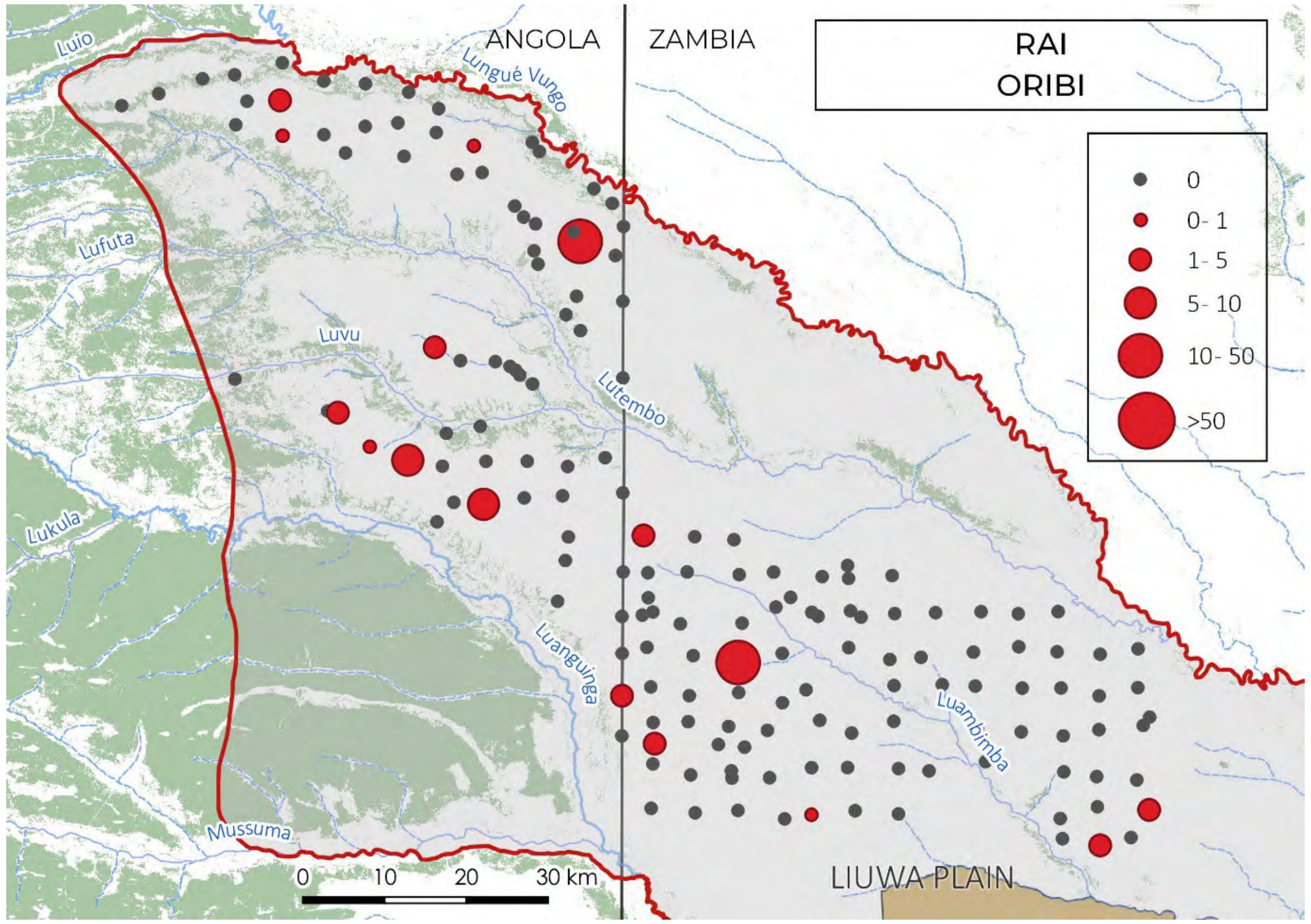


Figure 64 - Oribi relative abundance Index (RAI) map derived from the camera traps data.

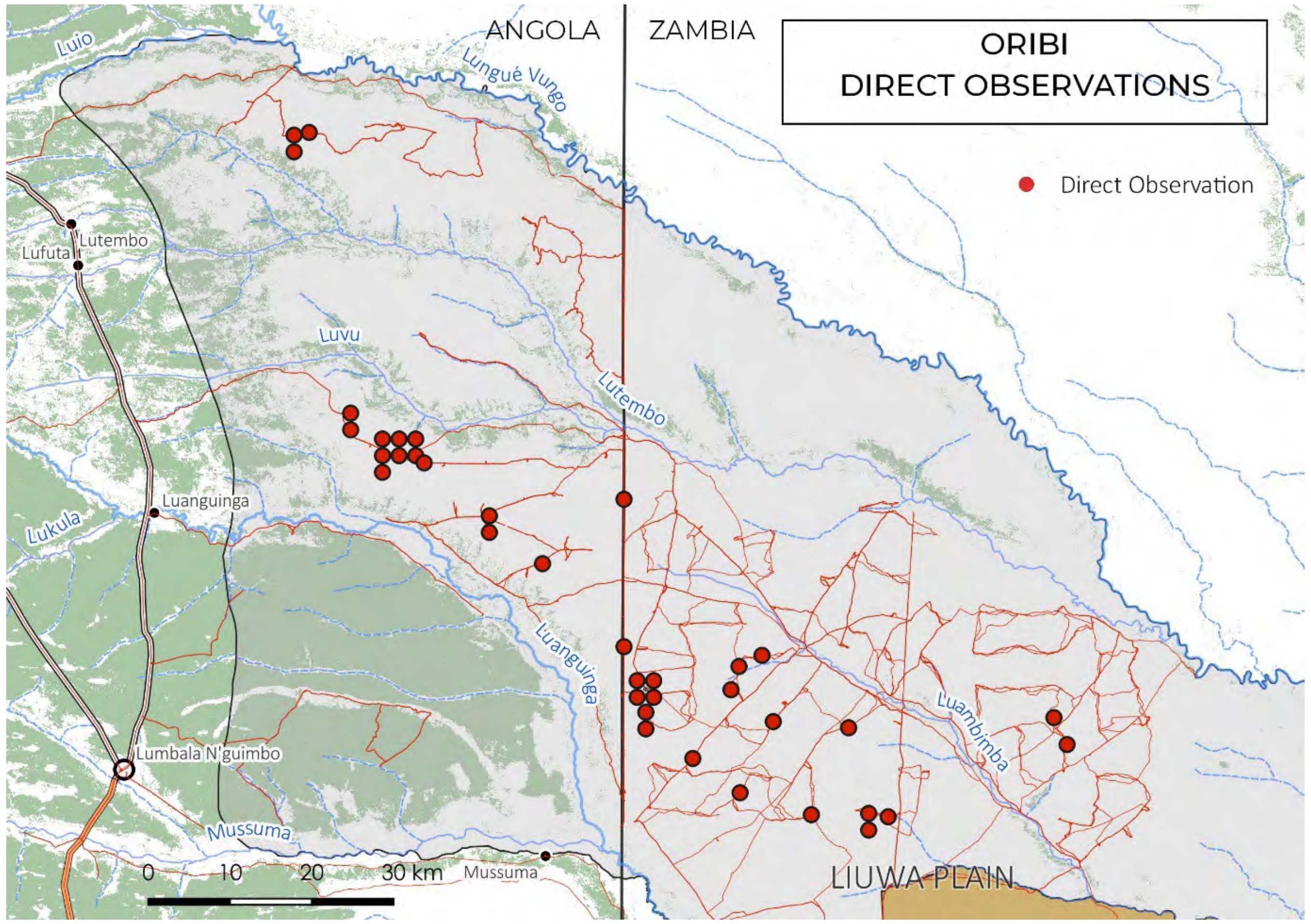


Figure 65 - Oribi direct observations.

Figure 66 - Oribi female and male picture from Liuwa Plain National Park.

5.2.6 STEENBOK

(Raphicerus campestris)

In our survey, the steenbok was the second most frequently recorded antelope species after the common duiker. We documented 99 camera trap events in Mussuma (RAI = 1.26) and 43 in the UWZGMA (RAI = 0.71), indicating higher relative abundance in Angola. Steenbok were broadly distributed across the study area, with the species particularly prevalent in the southern part of Mussuma. Although the steenbok was clearly present in both regions, we also considered the potential occurrence of Sharpe's grysbok (*Raphicerus sharpei*), a closely related species documented near the Angolan border in western Zambia (Beja et al., 2019). However, no individuals of Sharpe's grysbok were detected through either camera trapping or direct observation in our survey.

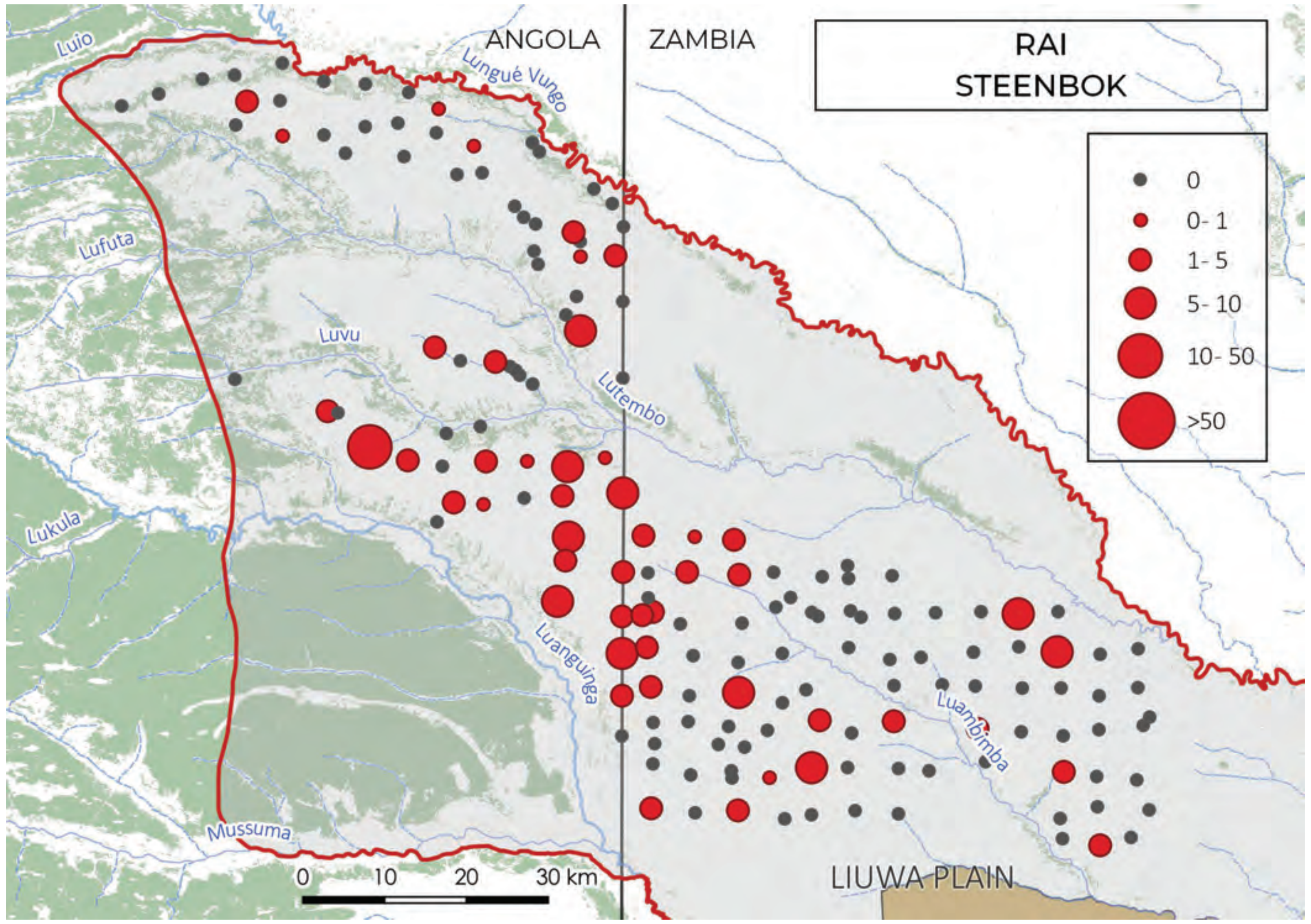


Figure 67 - Steenbok relative abundance Index (RAI) map derived from the camera traps data.

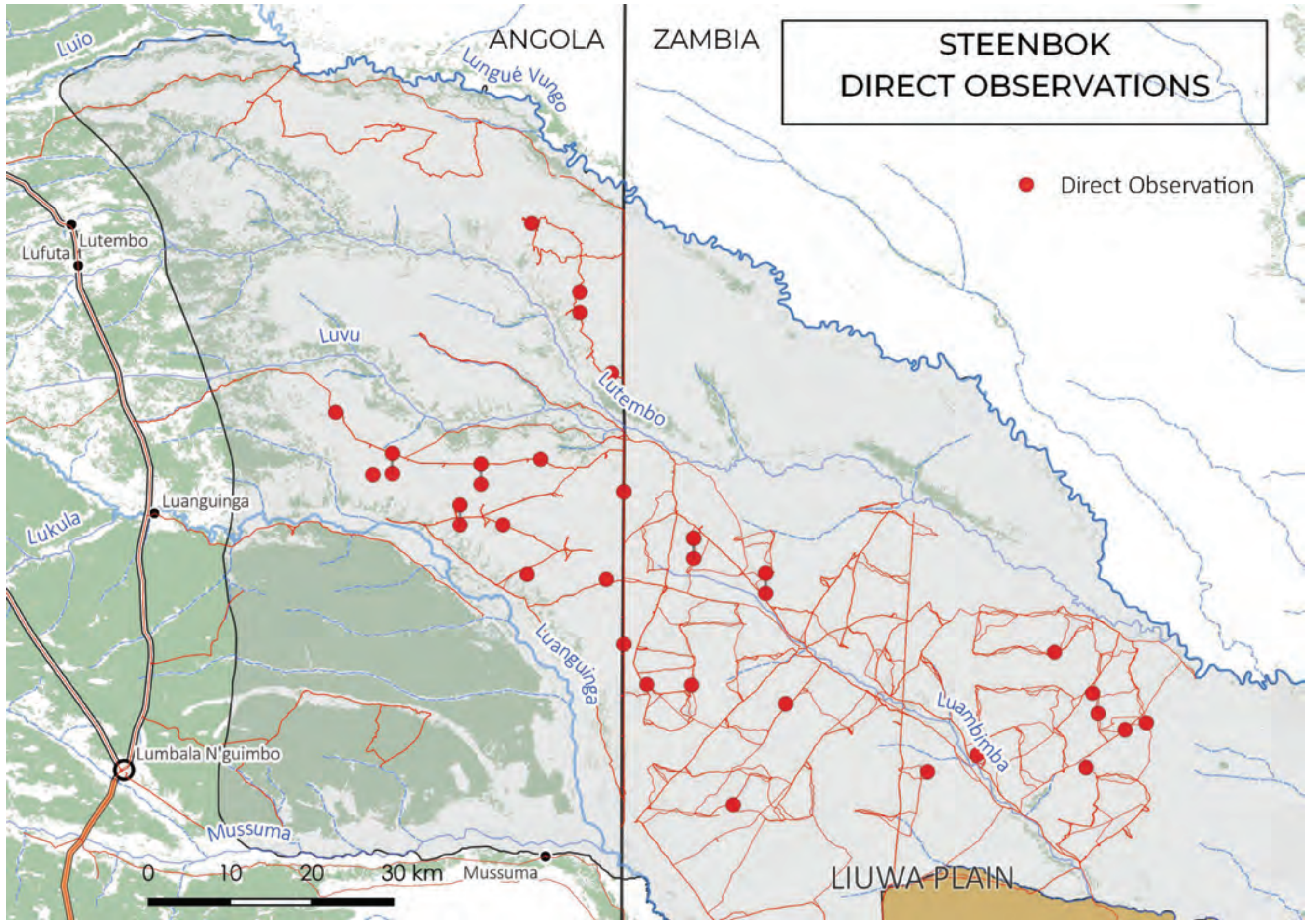


Figure 68 – Steenbok direct observations in the study area.

Figure 69 - Steenbok camera trap picture in Mussuma.

5.2.7 YELLOW-BACKED DUIKER *(Cephalophus silvicultor)*

Our survey recorded only three camera trap events of yellow-backed duiker in Mussuma, Angola, resulting in a low Relative Abundance Index (RAI = 0.04), indicating that the species is rare in the surveyed area. All detections were restricted to gallery forests located between the Luvu and Lutembo Rivers. No individuals were recorded in Zambia's UWZGMA. Despite its limited presence, this finding is ecologically significant, as it extends the known southern range of the species by approximately 250 kilometres (Cabral & Veríssimo, 2005; IUCN SSC, 2016; Kingdon & Lahm, 2013; NGOWP, 2018).

The absence of observations of yellow-backed duiker in the UWZGMA may be attributed to multiple factors or a combination of these. Firstly, the prevailing habitat conditions in the area may not meet the species' specific ecological requirements, as habitat fragmentation and degradation are significantly higher than in Angola. Secondly, anthropogenic pressures, such as hunting and other human activities, could also play a major role in their absence. Lastly, it is possible that the species simply does not utilize the specific areas included in our survey.

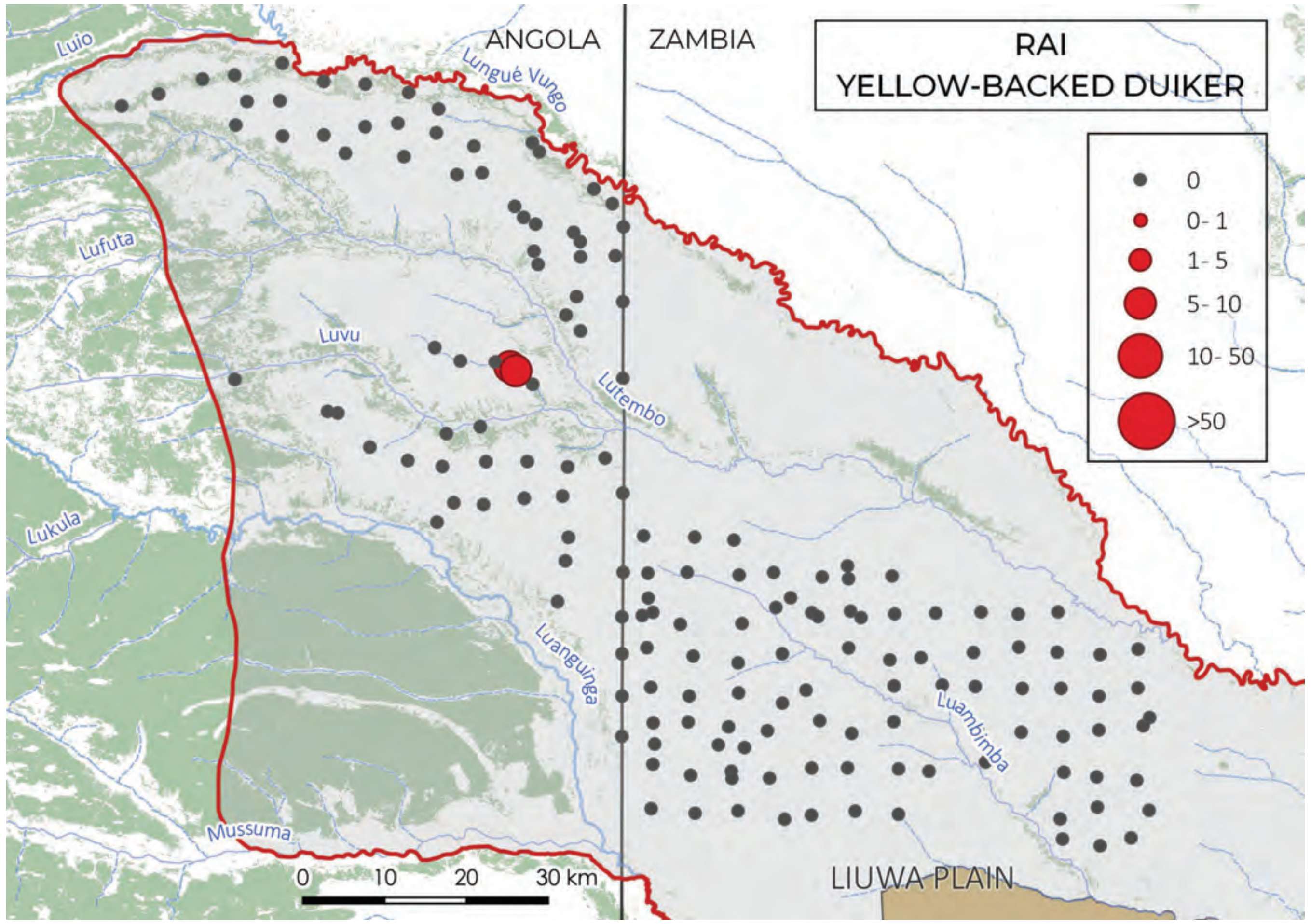


Figure 70 - Yellow-backed duiker relative abundance Index (RAI) map derived from the camera traps data.

Figure 71 - Yellow-backed duiker camera trap picture taken in Mussuma.

5.2.8 BLUE DUIKER *(Philantomba monticola)*

Our results indicate that the blue duiker was detected only in Angola (Mussuma region), with no occurrences recorded in the UWZGMA (Zambia). Within Mussuma, we recorded 132 camera trap events, yielding a moderate Relative Abundance Index (RAI = 1.68). To our knowledge, this is the first time the presence of the blue duiker has been confirmed in this specific part of Angola. Previously, the species was thought to inhabit regions primarily north of -13º latitude and west of 20º longitude (Cabral & Verissimo, 2005; Beja et al., 2019). Our research found that the blue duiker was exclusively located in the riverine forests of the Angolan sector. This correlates with existing knowledge that the blue duiker can thrive in small forest patches, even those that are modified or degraded (Hart & Kingdon 2013). The distribution of the blue duiker in our study also matched that of the malbrouck monkey, a singularity seen elsewhere in Angola (e.g. Groom et al., 2018). In the Mussuma region, the blue duiker is under considerable hunting pressure, and its meat is commonly seen being sold on main roads. The species is known to have highly variable pelage tonality and, in this survey, we recorded a distinct light brown coloration, which stands in contrast to the more commonly reported shades of grey for this species in other areas of Angola (e.g. Groom et al., 2018; Elizalde et al., 2019)

Similarly to the yellow-backed duiker, the absence of blue duiker from the UWZGMA is likely due to unsuitable habitat conditions, increased habitat fragmentation and degradation, and anthropogenic pressures such as hunting and other human activities. Additionally, the species may simply not utilize the specific areas covered in our survey.

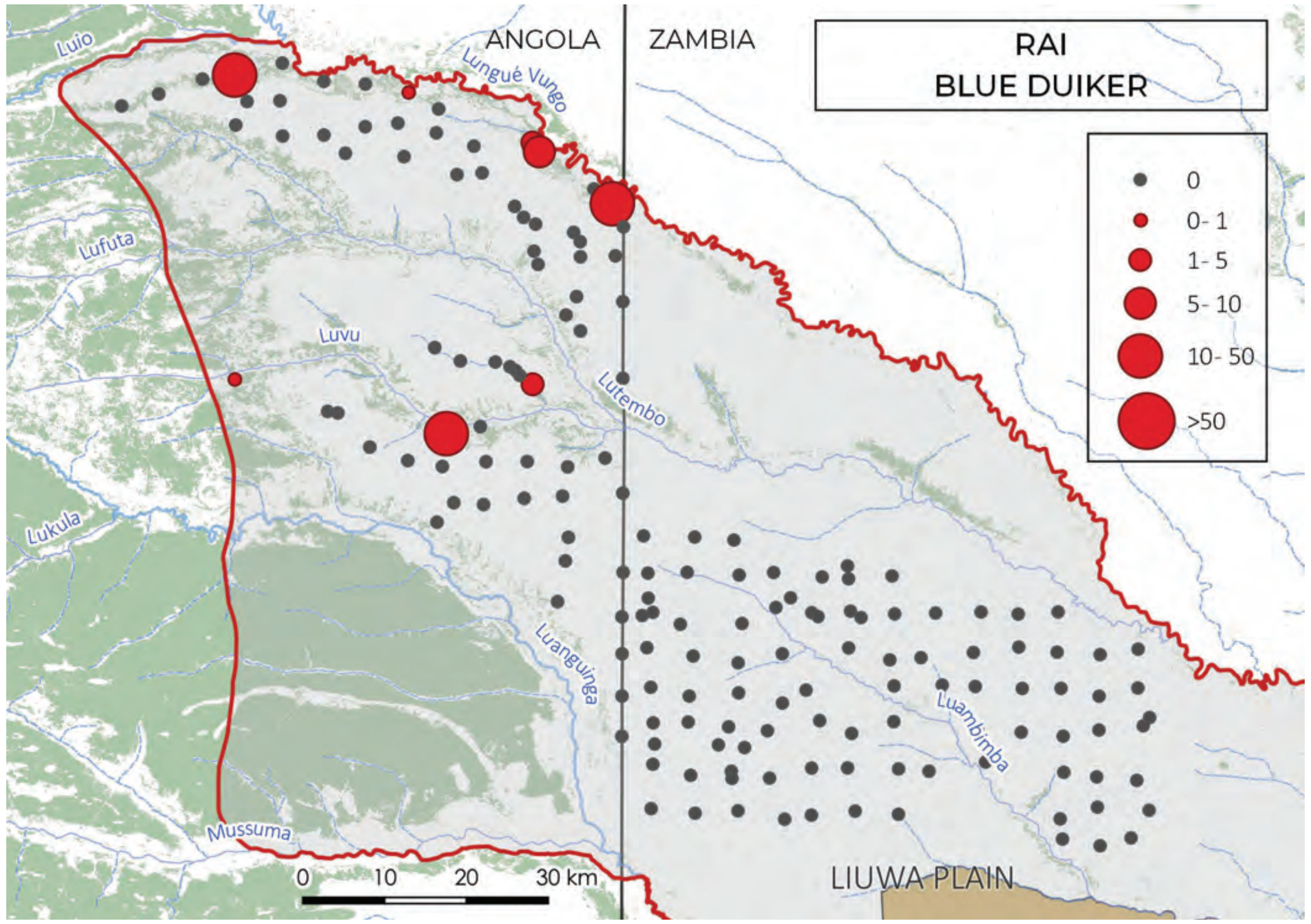


Figure 72 - Blue duiker relative abundance Index (RAI) map derived from the camera traps data.

Figure 73 - Hunted blue duiker carcass for sale on the tar road near Mussuma.

Figure 74 - Blue duiker camera trap picture in Mussuma.

5.2.9 BUSHPIG
(Potamochoerus larvatus)

In the Mussuma region, we recorded bushpigs on 55 camera-trap events, resulting in a moderate Relative Abundance Index (RAI = 0.70). While the bushpig distribution in Angola was previously thought to be limited to sporadic and isolated populations in central and western regions, predominantly within protected areas (Crawford-Cabral & Veríssimo, 2005), recent findings challenge this view. The bushpig has been widely sighted beyond these designated zones (NGOWP, 2018). These findings clearly demonstrate a broader geographical distribution for the species than previously documented, indicating that their regular presence should be expected in suitable habitats within this landscape.

The notable absence of bushpig sightings in the UWZGMA may be due to a lack of suitable habitat, characterized by densely vegetated areas that provide essential resources such as food, shelter, and water. Other potential factors include human disturbances or hunting pressure. Notably, bushpigs were observed in the northern part of Liuwa Plain National Park, right at the border with the UWZGMA (authors observations), suggesting that habitat conditions and/or lower anthropogenic pressure inside Liuwa may be more favourable for the species.

Figure 75 - Bushpig camera trap picture in Mussuma.

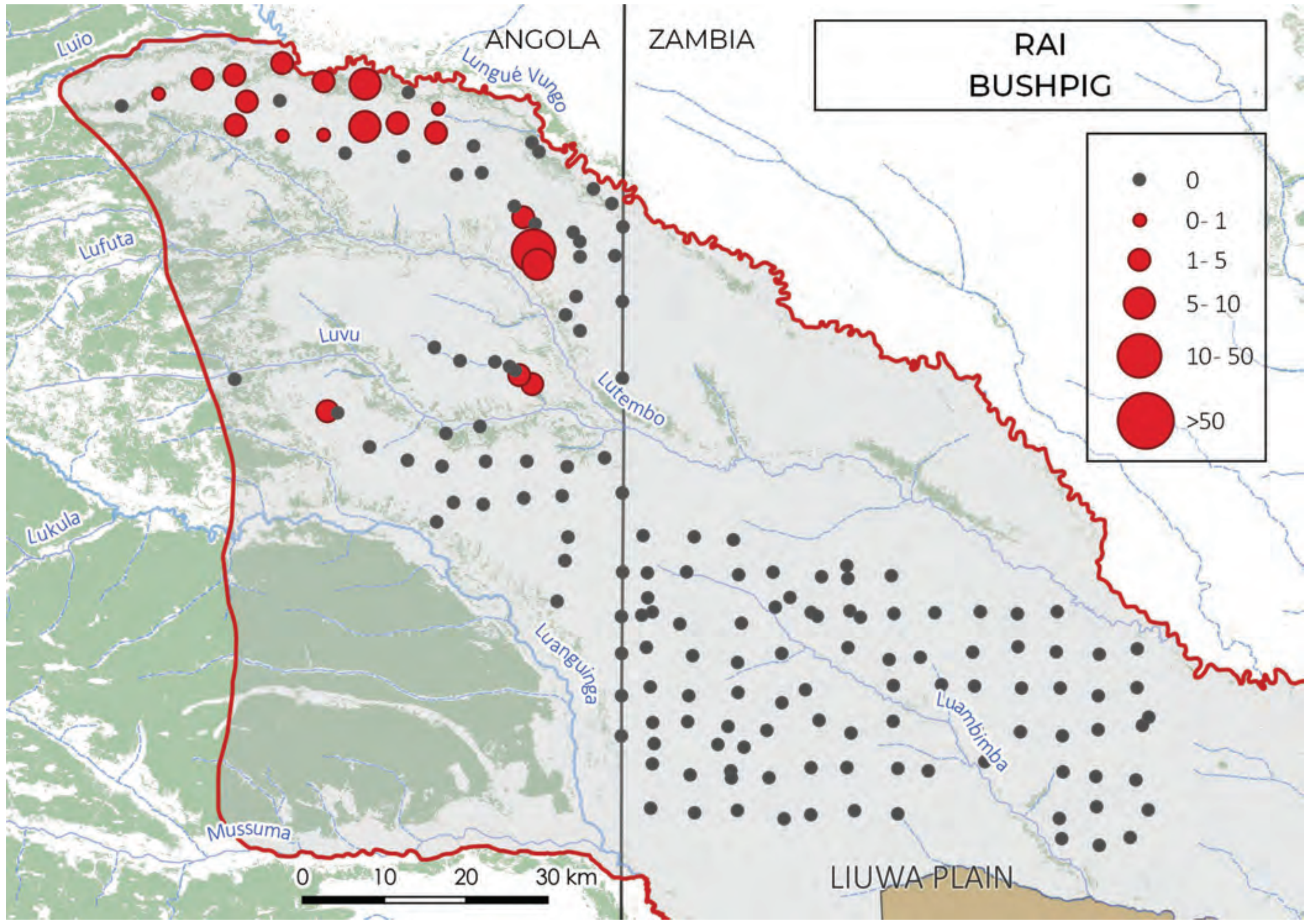


Figure 76 - Bushpig relative abundance Index (RAI) map derived from the camera traps data.

5.2.10 AARDVARK
(Orycteropus afer)

The presence of the aardvark in Angola's Mussuma region—recorded through 16 camera-trap events and a Relative Abundance Index (RAI) of 0.20—contrasts with its complete absence from the UWZGMA in Zambia. This difference could be explained by a combination of ecological and anthropogenic factors. According to Taylor (2013), aardvark distribution is largely determined by the availability and distribution of suitable ant and termite species, their primary food sources. Additionally, their presence is significantly affected by human-related pressures, including habitat degradation due to human activities and hunting. Aardvarks are particularly vulnerable in areas where their meat is prized, often resulting in diminished populations (Taylor, 2013). Nevertheless, the precise reasons for their absence from the UWZGMA remain unclear, highlighting the need for further research to understand the underlying causes for the observed differences in distribution between the two regions.

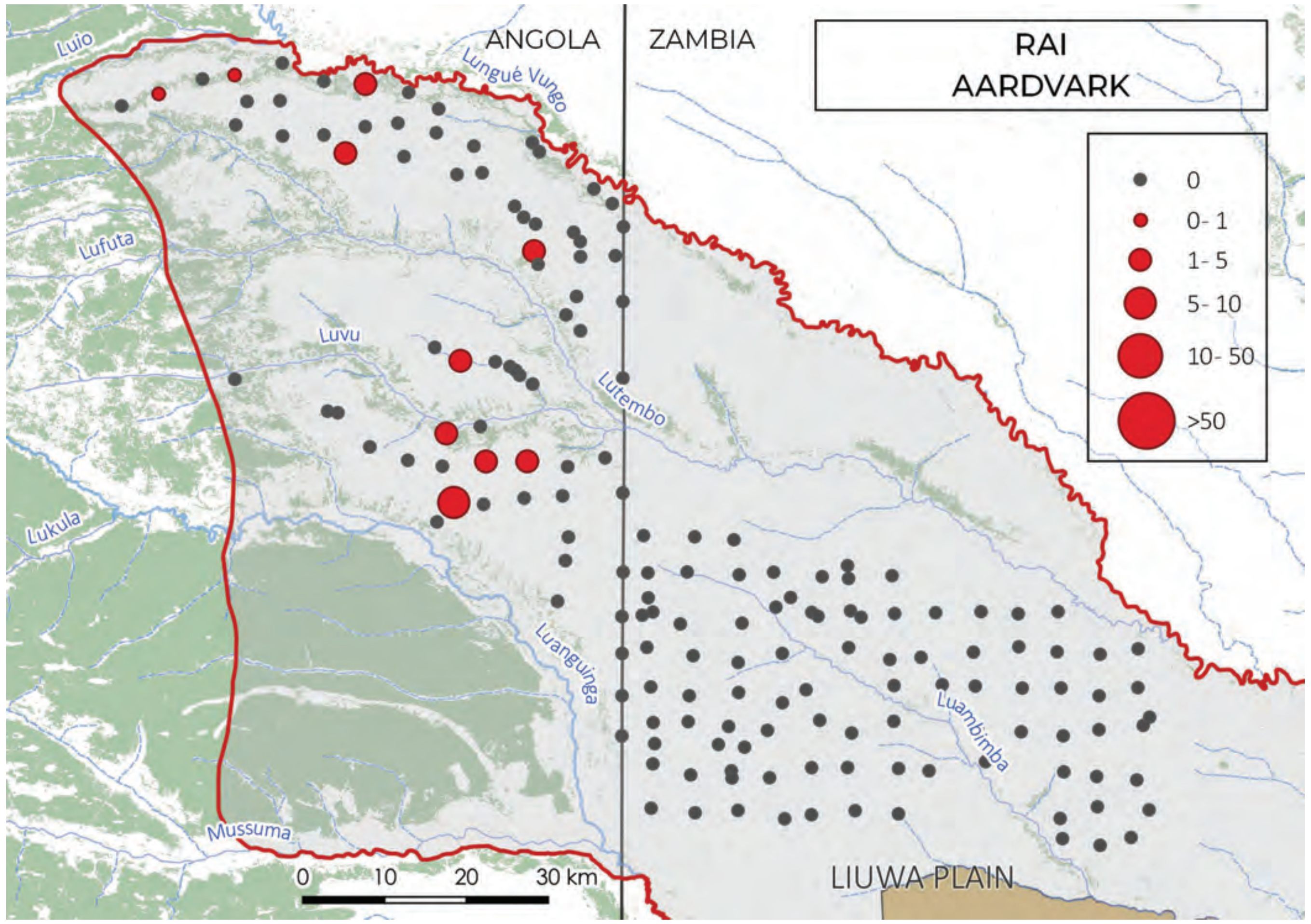


Figure 77 - Aardvark relative abundance Index (RAI) map derived from the camera traps data.

Figure 78 - Aardvark camera trap picture in Mussuma.

5.2.11 CAPE CRESTED PORCUPINE
(Hystrix africaeaustralis)

The presence of Cape porcupines in Mussuma is accompanied by low but detectable levels in the UWZGMA. In Mussuma, we recorded 46 camera-trap events (RAI = 0.58), while in the UWZGMA only 3 events were recorded (RAI = 0.05). In Mussuma, their distribution was concentrated in better-preserved forest habitats, which aligns with their known preference for woodland and forested environments, as described by Happold (2013a). This suggests that the significantly more degraded forest cover in the UWZGMA may be a key factor contributing to the lower detection rates in that region. Hunting pressure may also play a role.

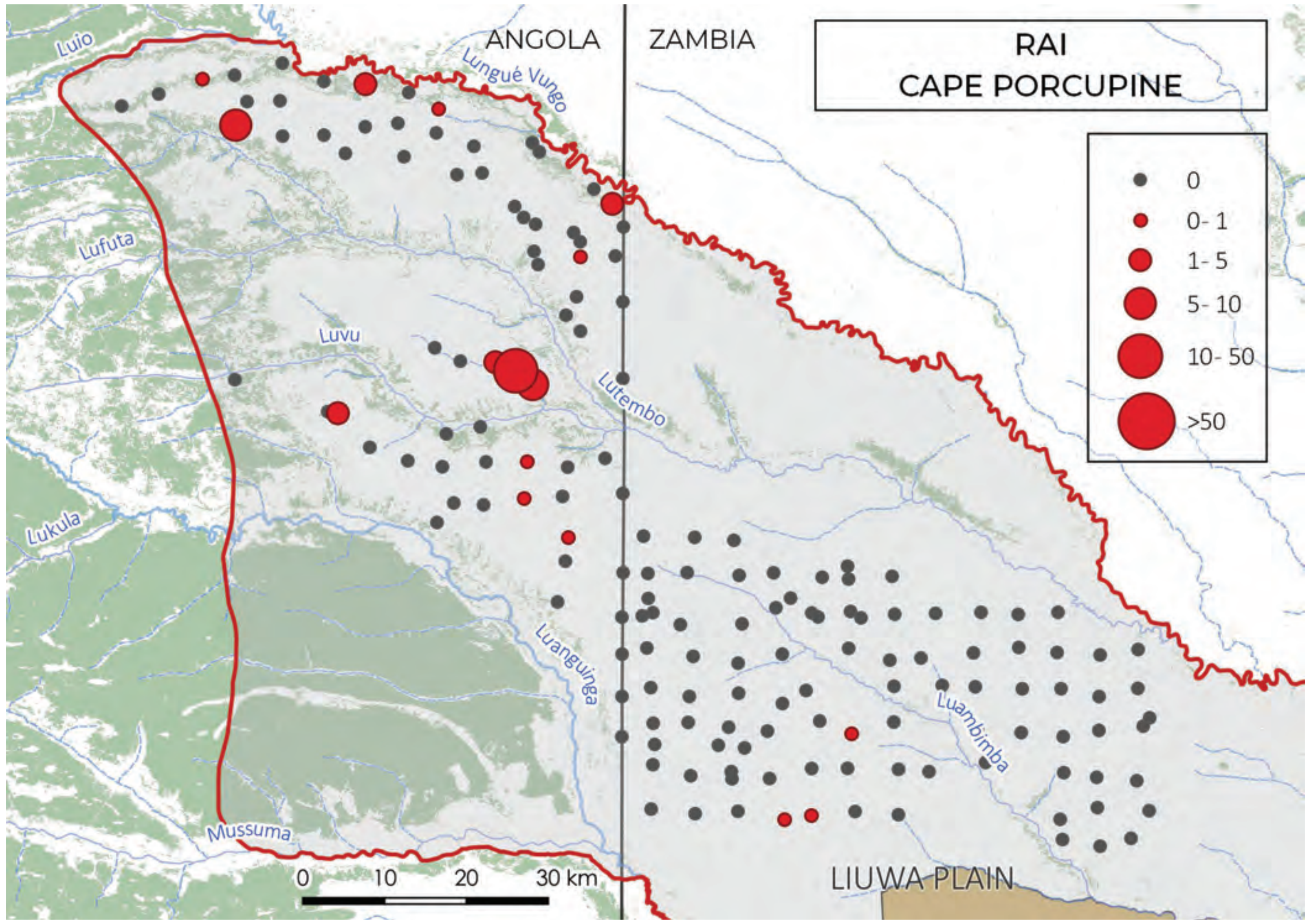


Figure 79 - Cape porcupine relative abundance Index (RAI) map derived from the camera traps data.

Figure 80 – Cape porcupine camera trap picture in Mussuma.

5.2.12 SITATUNGA
(Tragelaphus spekii)

Although sitatunga were not captured by any of our camera traps—likely due to the absence of cameras in key habitats such as marshes and riverine areas—their presence in the Mussuma region was confirmed through multiple lines of evidence. These include a direct sighting at the Luvu River, identification of tracks, bushmeat records, and consistent reports from local interviews. Fragmented populations are still reported to inhabit suitable swamp and riverine areas, particularly along the Luanguinga River, and the species is likely present in other similar habitats, including the southwestern fringes of Liuwa Plain National Park (DPNW, 2016). Historically, the sitatunga was never abundant in Angola (Cabral & Veríssimo, 2005), though it is expected to occur in wetlands draining toward Zambia between the Cuando and Lungué-Vungo Rivers.

Interview data suggest that sitatunga populations are under considerable hunting pressure in the Mussuma region. Some respondents reported that even calves are targeted, primarily through hunting with dogs or as a result of fires deliberately set in grasslands and reedbeds along rivers. One account described a sitatunga fleeing from such a fire near a village and seeking refuge within the premises of a primary school. This pressure appears to stem from a local perception of sitatunga as easy targets, with indications that children are at times encouraged to hunt them (Figure 81).

To ensure the long-term preservation of sitatunga populations within the study area, it’s crucial to establish a conservation strategy that encompasses a network of extensive, permanent swamps. This network should also include the surrounding seasonal swamps, floodplains, and connected gallery forests. The size of this conservation area needs to be substantial enough to offer resilience against fires, ensuring a sustainable habitat for sitatunga amidst environmental challenges. (May & Lindholm, 2013).

Figure 81 - Sitatunga calf skin, the result of a hunt carried out by children with dogs near the Luanguinga River, Mussuma region.

5.2.13 SOUTHERN LECHWE
(Kobus leche)

Despite its historical presence, the species was not recorded on camera traps and is likely absent from most of the surveyed areas. However, small remnant populations of lechwe may persist at low densities on the Angolan side, as evidenced by two aerial sightings of four individuals between Cameia National Park and the Mussuma area in 2018. During the dry season, fragmented populations of the species can be found together with sitatunga in the immediate southwestern region of LPNP, and on the southern plains inside the park during the wet season (DPNW, 2016).

In the 1970s, the lechwe thrived as a relatively abundant species in Angola, with numerous populations documented across the expansive drainage plains of Moxico province, particularly within the Luena and Lungué-Vungo valleys (Cabral & Verissimo, 2005). Evidence of this historic abundance is the village of Catalasongue, whose name translates to ‘looking at the lechwe’. Situated within our study area, Catalasongue is perched strategically above the Luvu River, offering a vantage point from which locals once observed large herds of lechwe grazing on the floodplains.

Figure 82 - Three female southern lechwe observed from an aerial recon south of Cameia National Park in 2018.

5.2.14 BLUE WILDEBEEST
(Connochaetes taurinus)

The presence of blue wildebeest within the Mussuma area was not recorded during the survey. In contrast, Liuwa's wildebeest, along with zebra, are prevalent throughout the park. They migrate from the southern portion of the park to the northern boundary and beyond, through the UWZGMA towards the Angolan border, during dry season (M'soka et al., 2017) with recent GPS collaring data confirming that some animals have crossed into Angola in 2022 (ZCP, personal comms).

In discussions with officials from the Lutembo *comuna*, it was noted that the availability of blue wildebeest meat (locally known as 'boi cavalo') in local markets has significantly declined or disappeared. Interviewees from the Mussuma area displayed limited knowledge about blue wildebeest, suggesting an absence of the species from the region for an extended period. Therefore, the presence of blue wildebeest meat in the local market puzzled the team until interviews conducted on the Zambian side suggested that Angolan military personnel occasionally cross the border to hunt these animals. Interviewees in Zambia identified hunting pressure as a significant reason that prevented the species recovery and migrating into Angola, although factors such as land use (e.g. rice plantations in the UWZGMA) fire, flooding, predation and other ecological aspects should also be considered in future studies. The transboundary migration of the wildebeest is further discussed on the 'Wildlife Transboundary movements' at section 5.4.2.

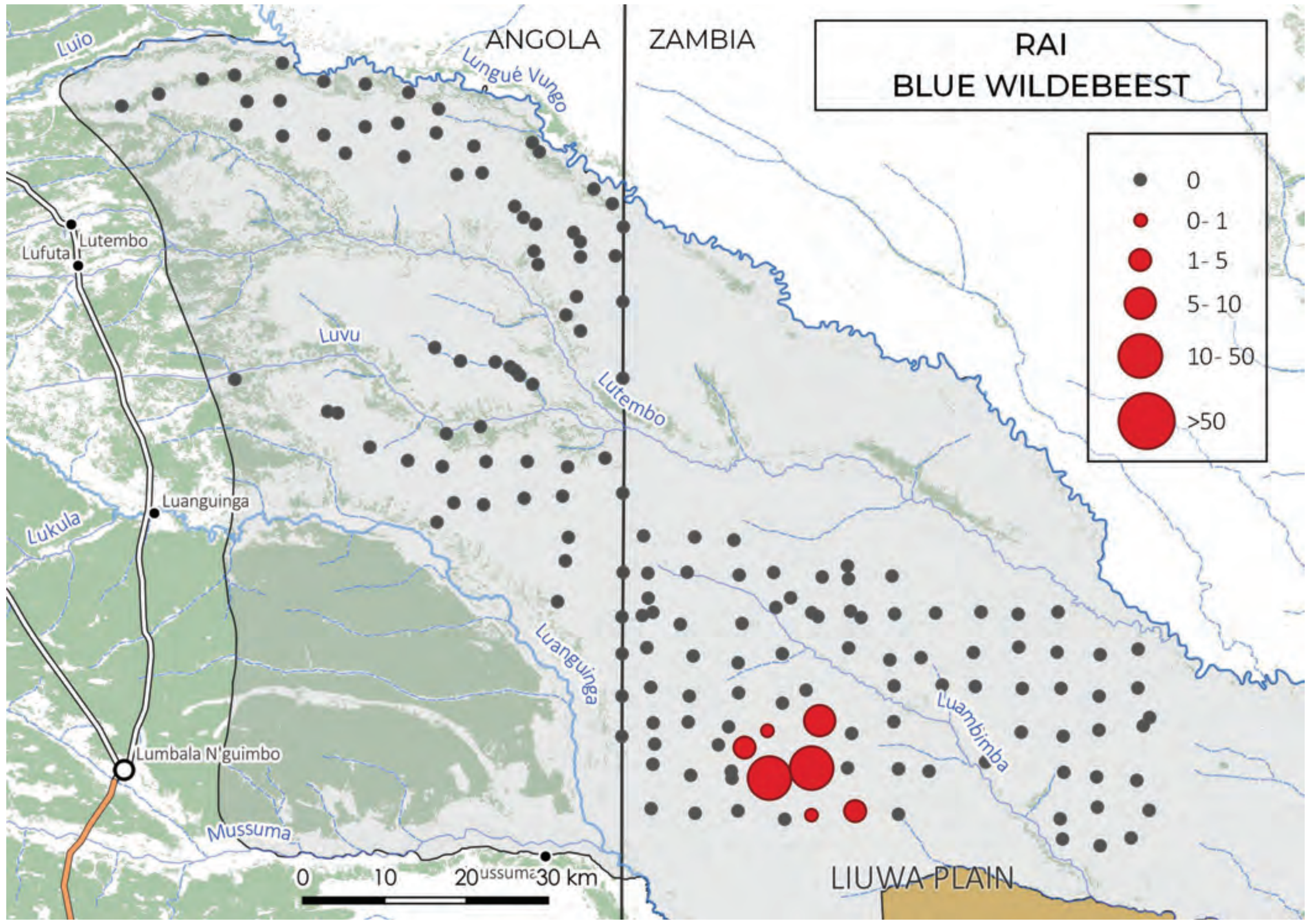


Figure 83 - Blue wildebeest relative abundance Index (RAI) map derived from the camera traps data.

Figure 84 - Blue wildebeest with calves in Liuwa Plain National Park.

5.2.15 ZEBRA *(Equus quagga)*

Our surveys detected no presence of plains zebras in either study area, with no individuals recorded on camera traps across the full survey period. This absence aligns with reports from interviews conducted in the Mussuma landscape, where respondents indicated that the species has been absent from the ecosystem for a prolonged period. In contrast, within the UWZGMA, the presence of zebras was confirmed through a small number of direct sightings and corroborated by interview data.

There remains no clear consensus on the historical or current distribution of plains zebras in Angola—particularly in Moxico Province and the broader study region—due to conflicting accounts in the literature (Crawford-Cabral & Veríssimo, 2005; Klingel, 2013; Beja et al., 2019). However, a notable and recent exception emerged during fieldwork: a local authority in Luvu reported observing a herd of zebras, believed to have originated from Zambia, that had ventured as far as the 'laterite' area in Angola—approximately 35 km west of the border, between the Luvu and Luanguinga Rivers. This account supports the possibility that zebras may historically have migrated between the two regions, highlighting the need for further investigation into transboundary movements and population connectivity.

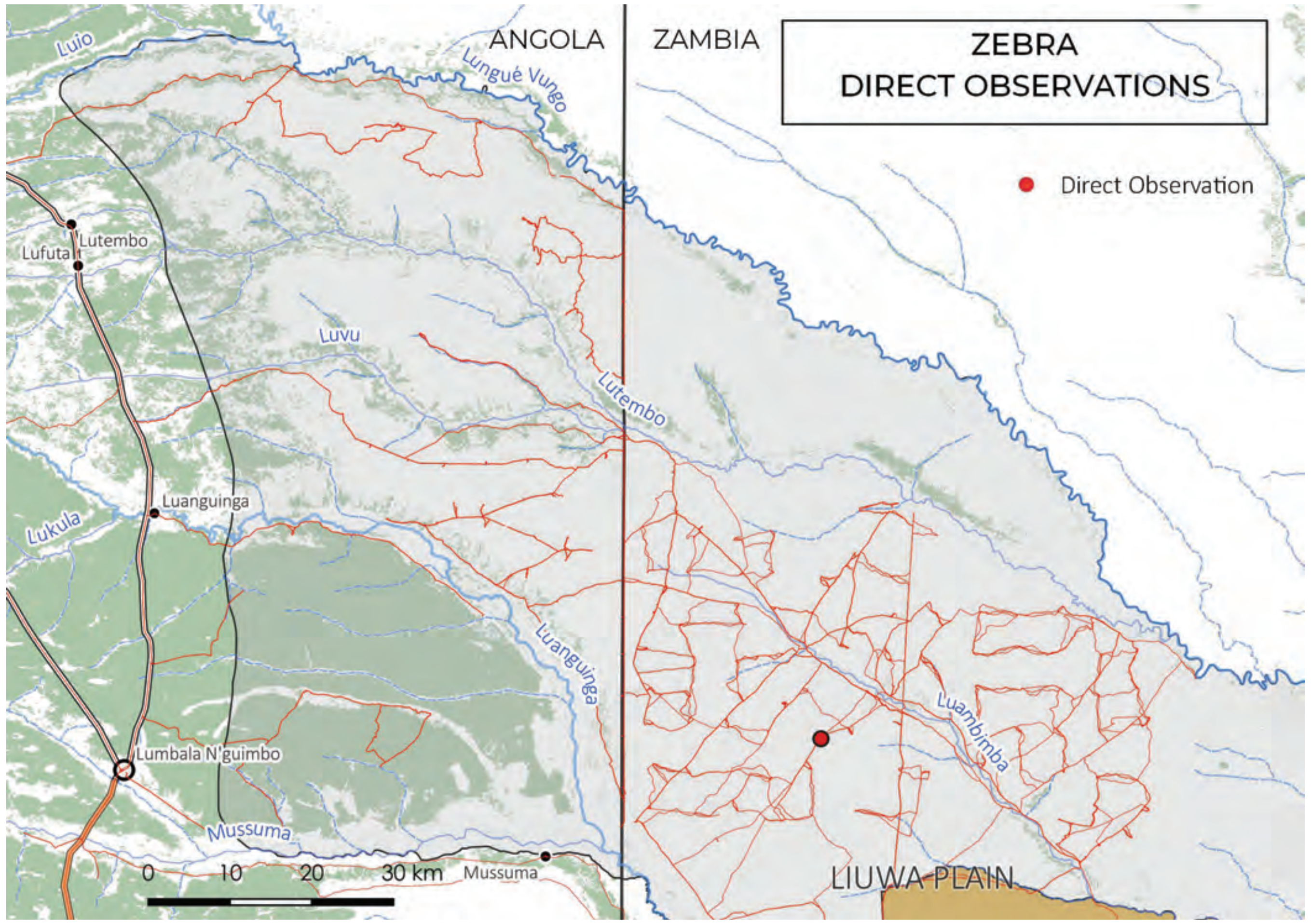


Figure 85 - Plains zebra direct observations.

Figure 86 - Plains zebras in Liuwa Plain National Park.

5.2.16 MALBROUCK MONKEY
(Chlorocebus cynosuros)

In our survey, the Malbrouck monkey was recorded in 121 camera-trap events in Mussuma (RAI = 1.54) and only 9 events in the UWZGMA (RAI = 0.15), indicating a markedly higher abundance in the Angolan study area. Interestingly, within our survey area in Angola, the distribution of Malbrouck monkeys overlapped with that of the blue duiker, aardvark, and Cape porcupine, suggesting similar habitat use in the surveyed landscape.

The geographic range of the Malbrouck monkey is expected to extend deep into both Angola and Zambia. However, in Angola, its distribution remains poorly known—particularly in the eastern half, where no museum specimens have been collected, possibly reflecting either a relatively lower abundance (Sarmiento, 2013), or simply the region's inaccessibility and limited research effort.

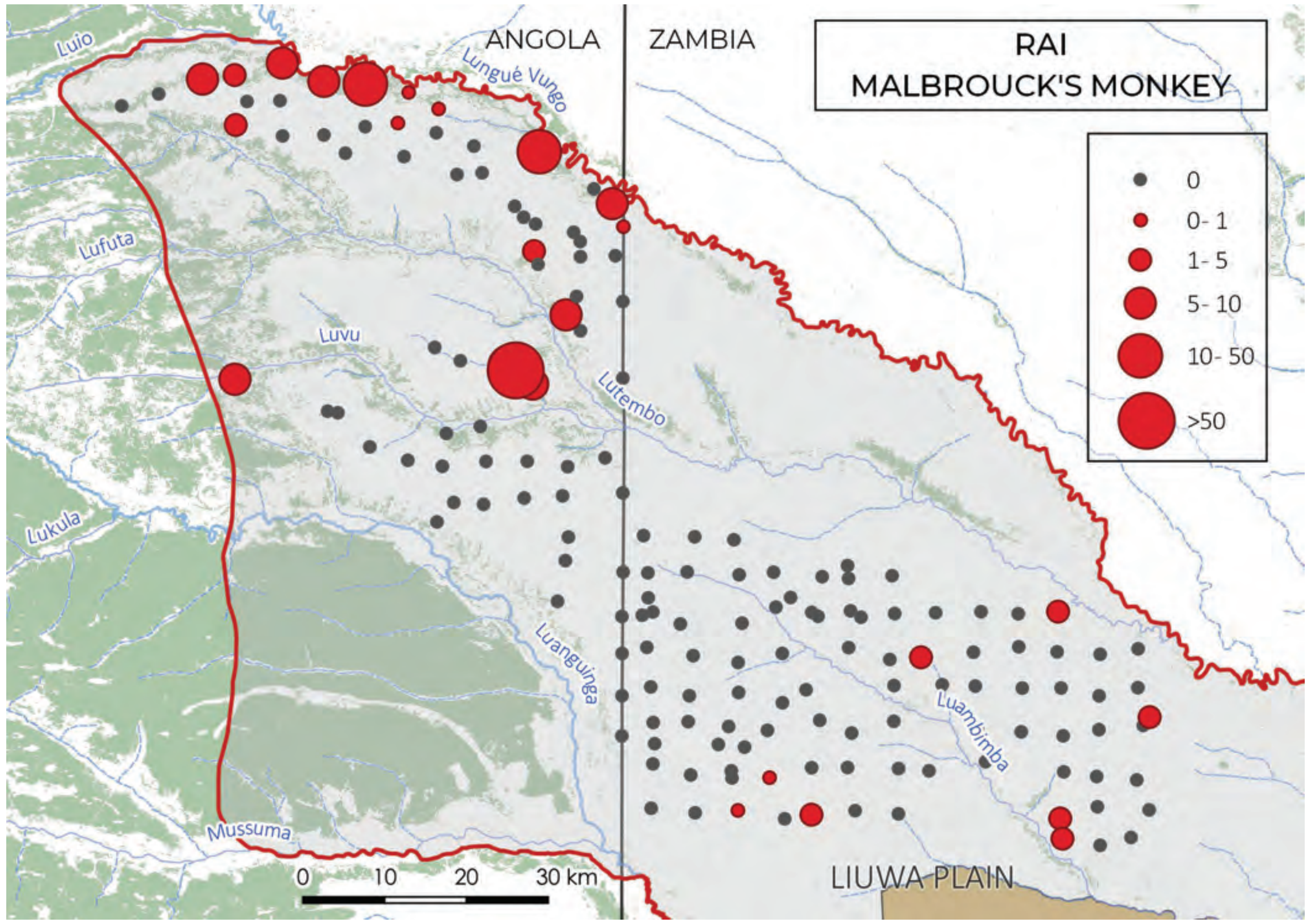


Figure 87 - Malbrouck's monkey relative abundance Index (RAI) map derived from the camera traps data.

Figure 88 - Malbrouck's monkey camera trap picture from Mussuma.

5.2.17 GALAGO SPECIES

Although the study area falls within the recognized range of both the Thick-tailed Greater Galago (*Otolemur crassicaudatus*) and the Southern Lesser Galago (*Galago moholi*), these species were only detected on the Angolan side during our camera trapping survey. The Thick-tailed Greater Galago was recorded in 3 camera-trap events (RAI = 0.04), and the Southern Lesser Galago in 2 events (RAI = 0.03). Additionally, the Southern Lesser Galago was frequently observed by the research team while camping in the forest strip in the northern section of the Angolan study area, near the Lungué-Vungo River. Galago distribution appears to be closely tied to the availability of tree gum. For the Lesser Galago, land clearing is a major limiting factor, as the species is unable to traverse large gaps lacking woody vegetation (Bearder & Svoboda, 2013; Pullen & Bearder, 2013). Consequently, habitat degradation in Zambia may be the primary reason for its absence in our survey there.

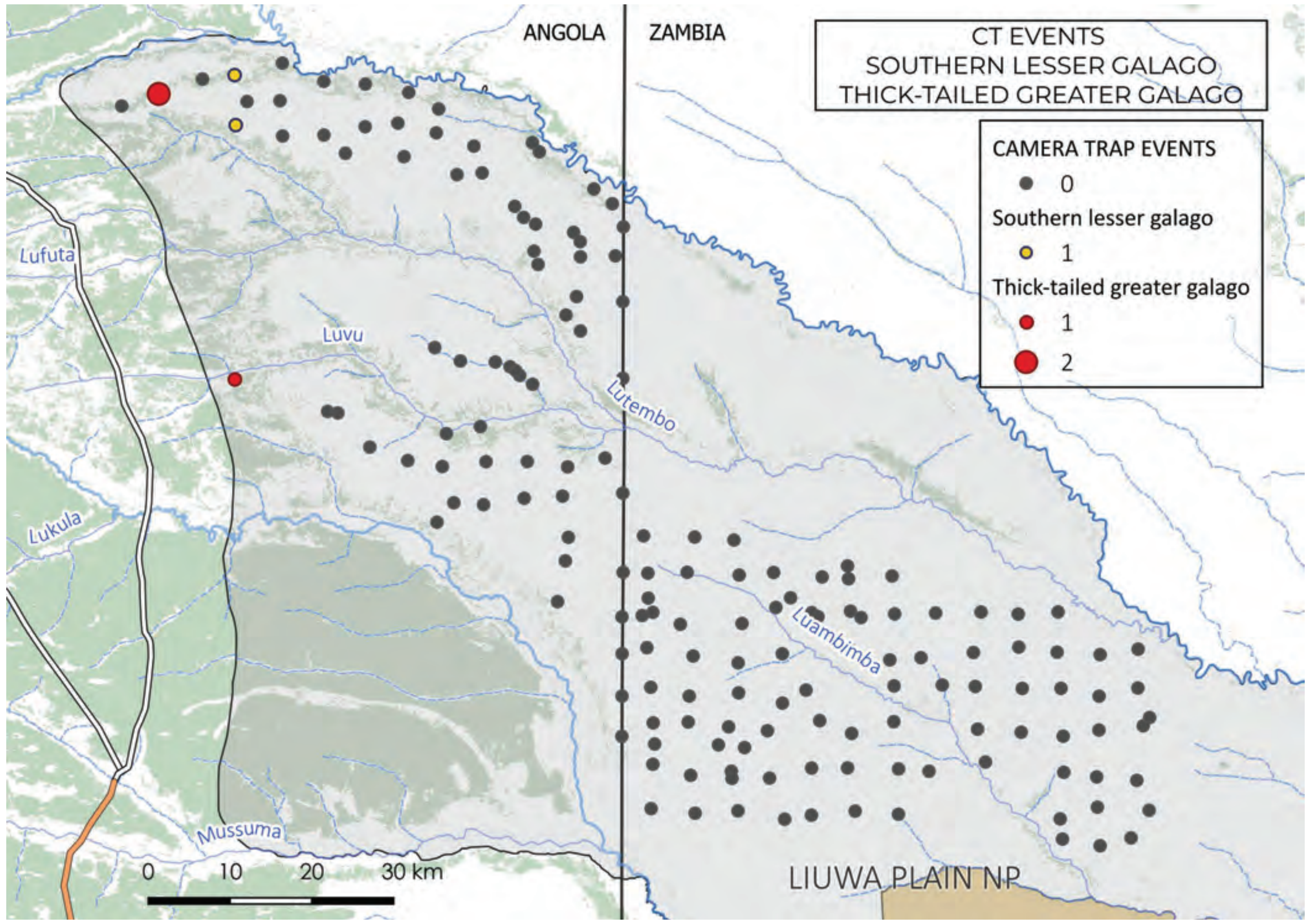


Figure 89 – Event distribution map of southern lesser and thick-tailed greater galago species, derived from camera trap data.

Figure 90- Southern lesser galago (left) and thick-tailed galago (right) camera trap pictures.

5.2.18 AFRICAN SAVANNA HARE
(Lepus victoriae)

Smaller mammal species were included in the report as they provide valuable insights into the biodiversity of the study areas. Our camera trap survey recorded 50 events in Mussuma (RAI = 0.64) and 5 events in the UWZGMA (RAI = 0.08), indicating a higher relative abundance of hares in the Angolan study site compared to the Zambian study area. According to Happold (2013b), fire frequency can influence distribution patterns, as hares are often attracted to newly sprouting grasses following burns. However, since both regions experience frequent burning, other factors—such as grazing pressure and hunting—may play a more significant role. The Zambian site is heavily stocked with domestic cattle, which may compete with hares for resources. In contrast, hunting appears to be a more pressing issue in Angola, though it likely affects larger mammals more. In Zambia, weak but existing law enforcement in the UWZGMA may encourage hunters to target smaller species, which are easier to conceal.

Happold (2013b) also notes that the relationship between hares and large grazing mammals is not straightforward. In some cases, increasing numbers of large herbivores have been linked to declines in hare populations. However, this interaction appears to be context dependent. Little is known about how hares respond to specific large mammal species, or how herbivore-driven changes to grassland structure might benefit or disadvantage hares.

Figure 91 - African savanna hare captured on a camera trap.

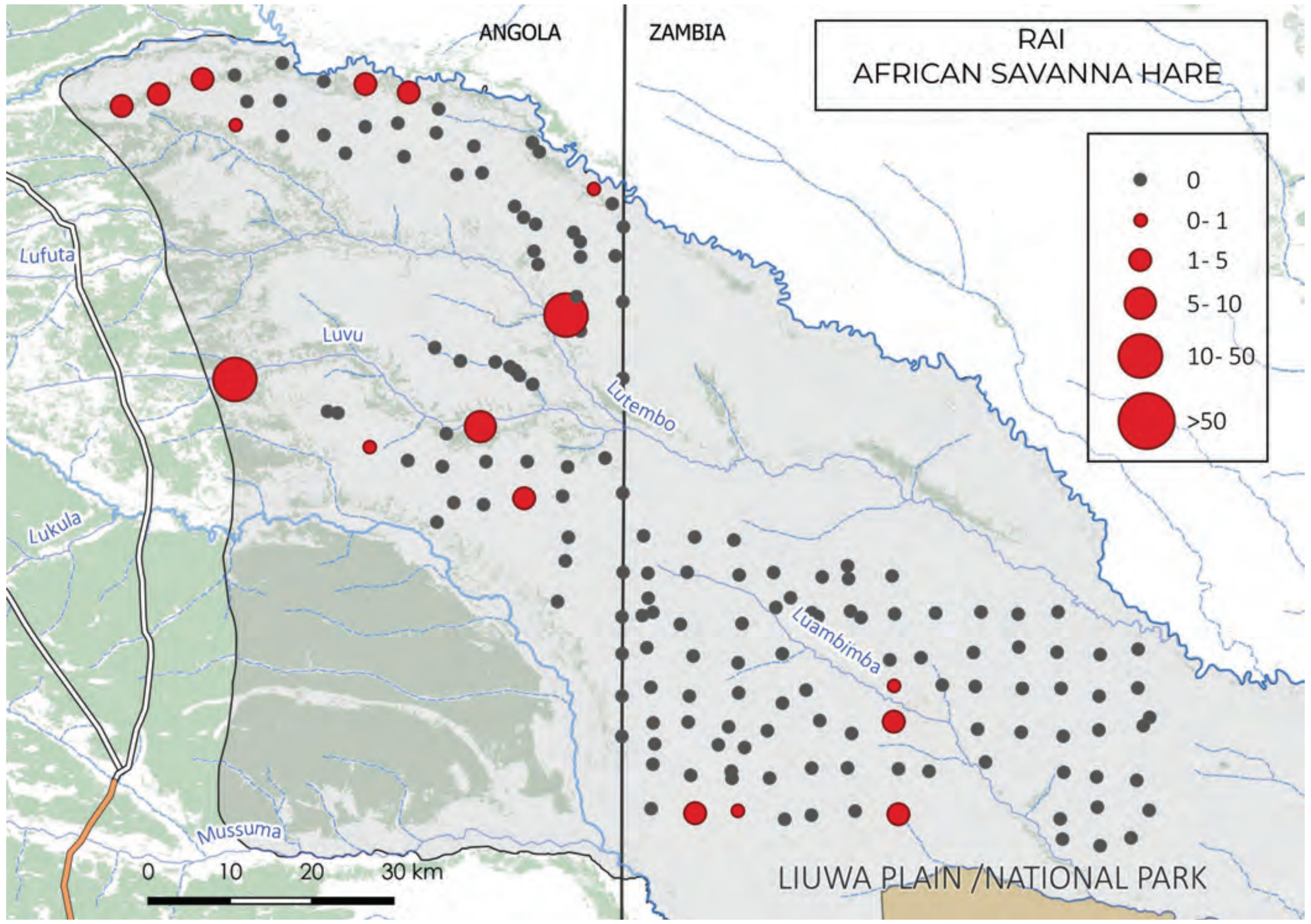


Figure 92 - African savanna hare relative abundance Index (RAI) map derived from the camera traps data.

5.2.19 SOUTH AFRICAN SPRINGHARE
(Pedetes capensis)

Although both our Zambian and Angolan study areas fall within the species' known geographical range, only a single springhare was recorded in our entire survey through camera trapping—highlighting the species' apparent rarity in the region and aligns with broader concerns about its decline. According to Butynski (2013), springhare populations are rapidly declining across much of their range. This decline is primarily driven by habitat degradation caused by overgrazing from domestic livestock, habitat loss due to agricultural expansion, and overhunting. The species is also regarded as an important crop pest.

Overgrazing and agricultural conversion are not yet major concerns in Angola. Therefore, as with other species, overhunting is likely the primary reason for the springhare's low abundance in this region of the country. In Zambia, however, a combination of these factors—particularly the prevalence of overgrazing and habitat conversion—may explain the species' apparent absence from the area.

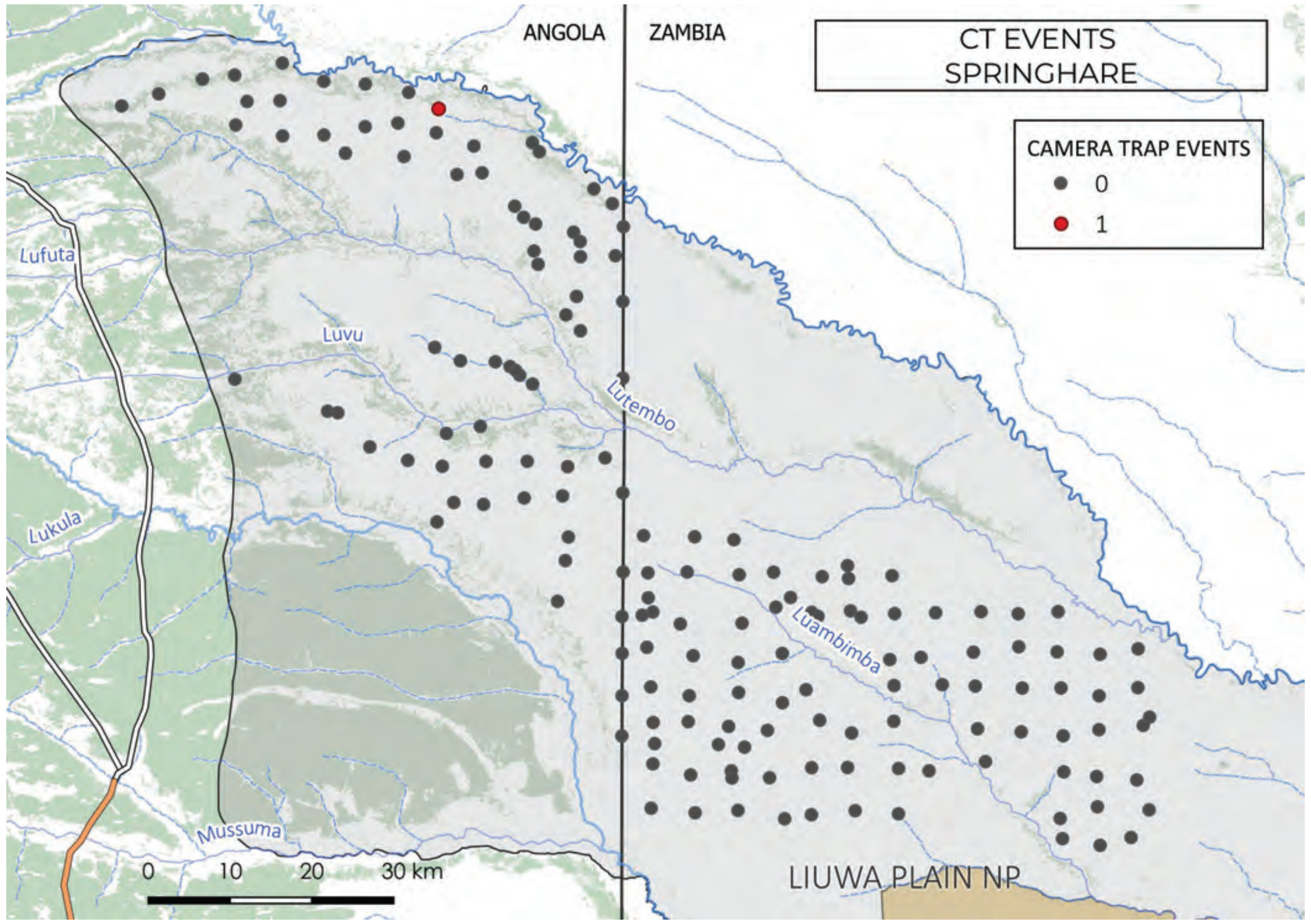


Figure 93 - Event distribution map of springhare, derived from camera trap data.

Figure 94 - Springhare camera trap picture.

5.2.20 SIDE-STRIPED JACKAL
(Lupulella adusta)

The side-striped jackal was recorded in 194 camera-trap events in Mussuma (RAI = 2.46) and 179 events in the UWZGMA (RAI = 2.96), confirming its widespread presence across both study areas. This consistent occurrence highlights the species' remarkable adaptability and apparent resilience to many of the pressures that restrict other mammal populations. Its success is likely linked to dietary flexibility and an ability to coexist with humans, particularly along the edges of settlements and towns. However, side-striped jackals remain vulnerable in areas affected by severe disease outbreaks (Loveridge & Macdonald, 2013). In Angola, interviews indicated suspected cases of rabies among jackals, with reports of unusually aggressive behaviour, particularly during the dry season. In 2019, three jackal carcasses were found within the study area, possibly indicating disease-related mortality. Notably, denser jackal populations in Angola were mainly observed near the Zambian border. Although this study did not include a formal dietary analysis, the frequent observation of jackal faeces containing seeds of *Parinari curatellifolia* (locally known as "tongo") suggests this fruit plays a notable role in their diet.

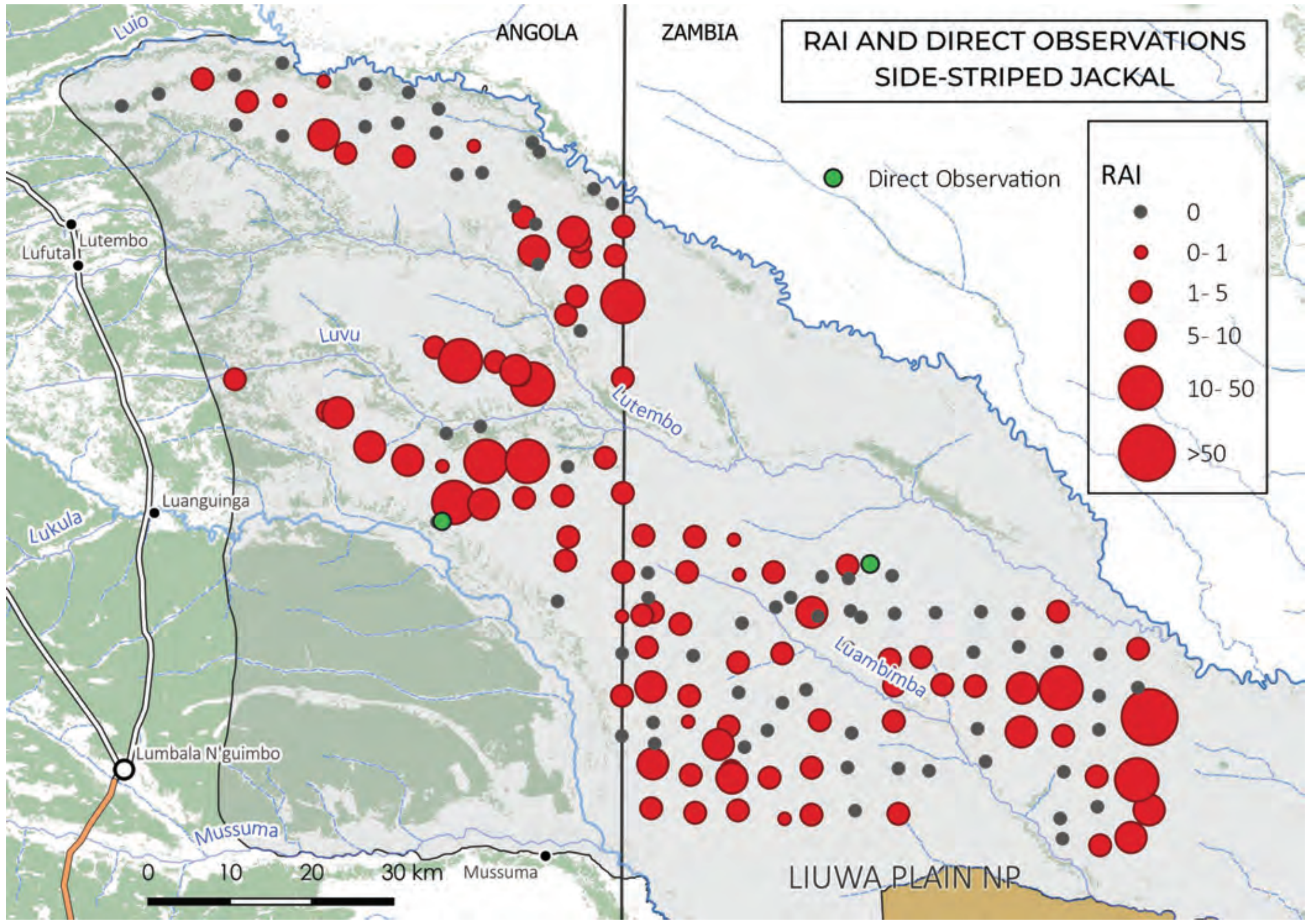


Figure 95 - Side-striped jackal relative abundance Index (RAI) map derived from the camera traps data.

Figure 96 - Side-striped jackal camera trap pictures.

5.2.21 SPOTTED HYENA *(Crocuta crocuta)*

Although camera trap detections were limited—5 events in Mussuma (RAI = 0.06) and 3 in the UWZGMA (RAI = 0.05)—our survey confirmed the presence of spotted hyenas in both study areas. Additional indirect evidence, including spoor and vocalizations, was also frequently recorded, reinforcing the conclusion that the species is present, albeit at low densities. These findings suggest a broader distribution than previously recognized and support the more inclusive range proposed by East & Hofer (2013), who consider nearly the entire Angolan territory part of the species' range.

This contrasts with more restrictive assessments by Crawford-Cabral & Simões (1988) and Beja et al. (2019), which exclude eastern Angola—including our study area—from the species' distribution. While hyena densities appear low in Mussuma and the UWZGMA, they are known to be the dominant predator within Liuwa Plain National Park and adjacent areas, with an estimated population of around 350 individuals, frequently observed in clans of up to 50 animals (DNPW, 2016; Watson et al., 2022).

Notably, one image captured in Angola features a hyena monitored (GPS collared) by the ZCP, demonstrating the cross-border movement of these carnivores between Angola and Zambia. Throughout the study areas, spotted hyenas are frequently implicated in human-wildlife conflicts, particularly due to their predation on livestock (see section 6.2.5).

Figure 97 - Spotted hyena camera trap picture in Mussuma.

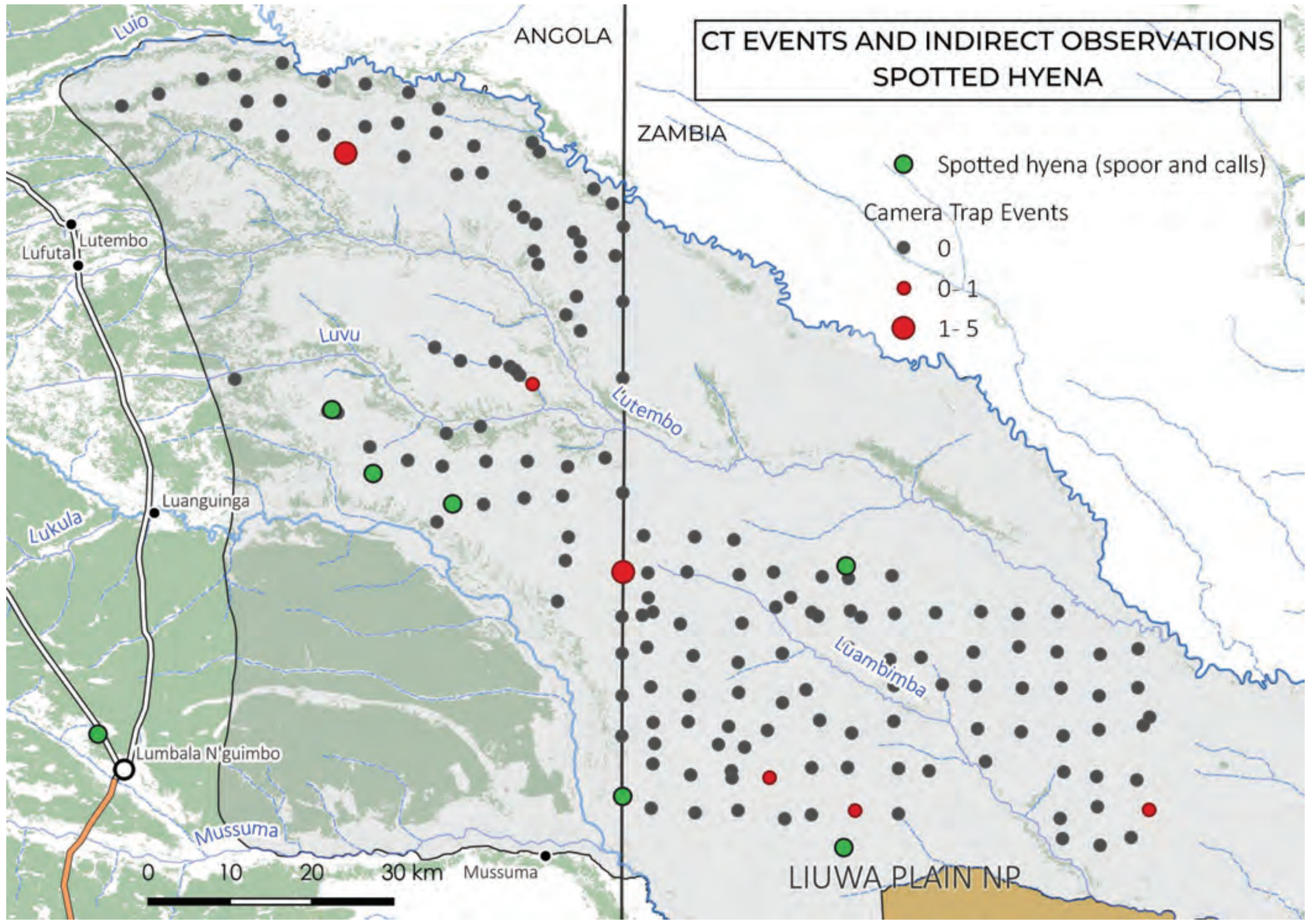


Figure 98 - Spotted hyena indirect observations and camera trap independent events.

5.2.22 LEOPARD *(Panthera pardus)*

Only a single camera trap image of a leopard was captured during the surveys, in the northern part of the Mussuma landscape. The camera was situated within a section of riverine forest. Additionally, leopard spoor was observed during a reconnaissance visit within the forest south of the Luanguinga river. While historical evidence suggests a low-level and possibly transient leopard presence in Liuwa Plain National Park, no confirmed records have been documented there since systematic wildlife surveys began in 2003 (DNPW, 2020). Additionally, historical records reveal that Mongu was a significant centre for leopard skin trade (PPF, 2009), which may have contributed to the potential local extinction of the species in Zambia. Altogether, these findings underscore the critical significance of conserving these forested regions and the connection between Mussuma and Liuwa, ultimately to allow leopards to recolonise Zambia.

Figure 99 - Leopard camera trap capture from near the Lungué-Vungo River in the Mussuma area.

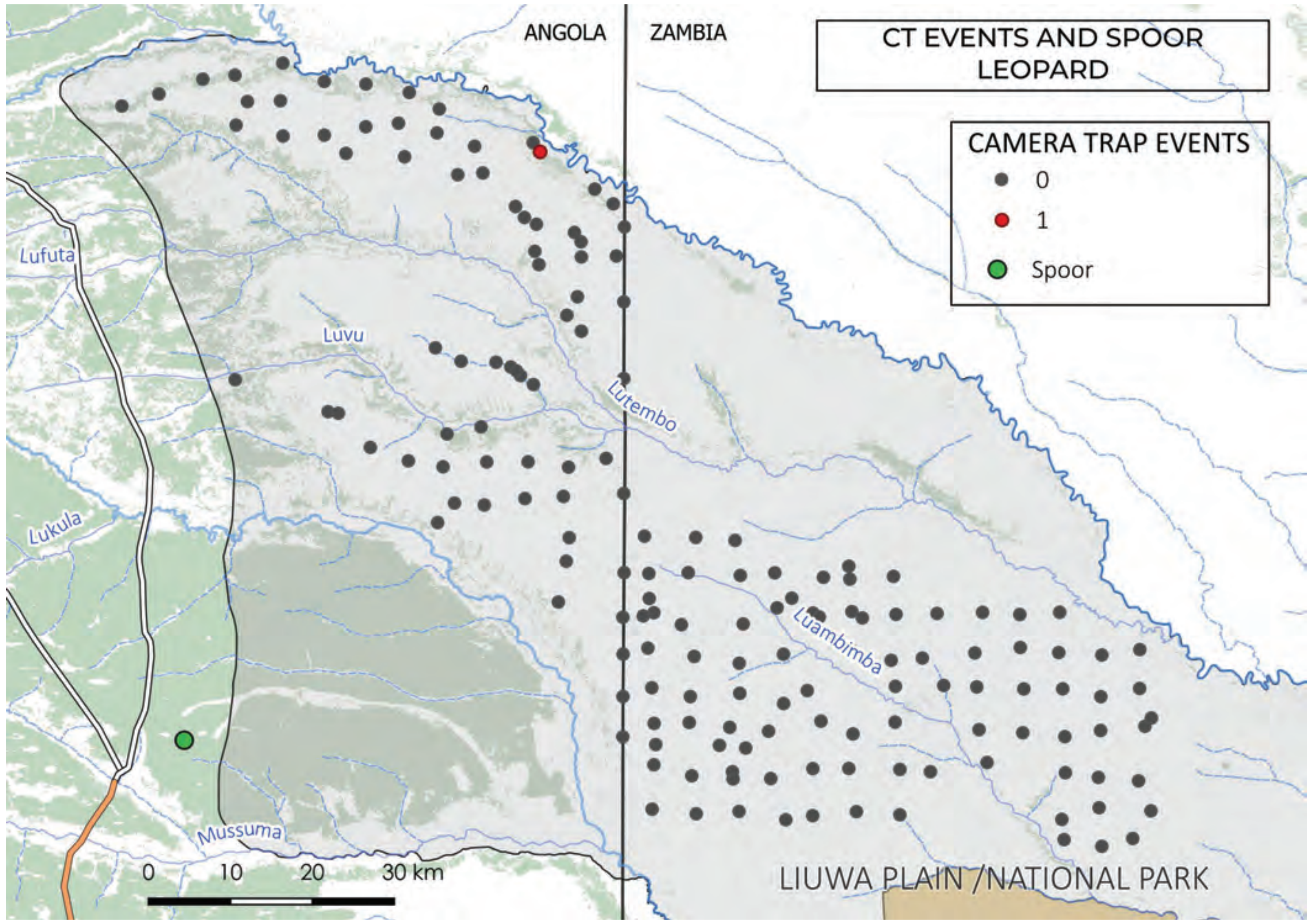


Figure 100 - Leopard spoor observations and camera trap independent events.

5.2.23 SERVAL *(Leptailurus serval)*

Our camera trap survey recorded relatively low numbers of serval detections in both study areas: 24 events in Mussuma (RAI = 0.30) and 7 events in the UWZGMA (RAI = 0.12). This suggests low apparent abundance despite the availability of seemingly suitable habitat in both regions. The presence of wetlands—with their abundant permanent water sources, tall grasses for refuge, and likely ample rodent prey— would ordinarily indicate highly suitable habitat for servals. This low detection rate may be attributed to several factors, including limited camera coverage in preferred serval habitats, particularly marshes and riverbanks. Additionally, degradation of grasslands—exacerbated by annual burning—has likely impacted serval populations negatively (Hunter & Bowland, 2013). Insights from interviews with local communities further highlight human-wildlife conflict as a contributing factor: servals are often persecuted for preying on poultry (particularly in Angola) and hunted for consumption (notably in Zambia), which may also help explain their low detection across the survey area.

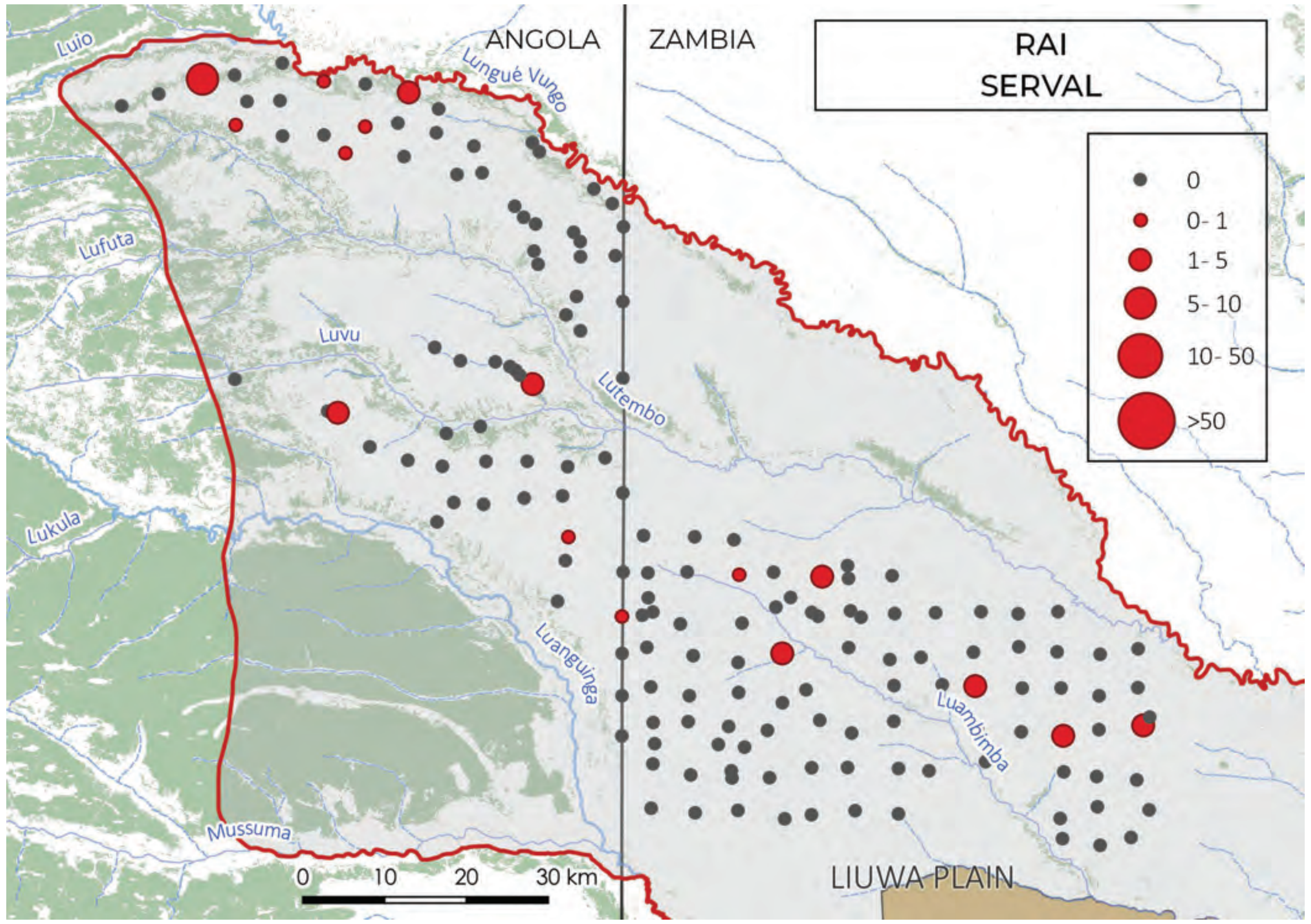


Figure 101 - Serval relative abundance Index (RAI) map derived from the camera traps data.

Figure 102 - Serval captured on a camera trap.

5.2.24 AFRICAN WILDCAT *(Felis lybica)*

Our survey recorded 24 camera-trap events of African wild cats in Mussuma (RAI = 0.30) and 12 events in the UWZGMA (RAI = 0.20), indicating a higher detection rate in the Angolan portion of the study area. Although African wild cats are known for their adaptability and are frequently observed near cultivated areas and human settlements (Stuart et al., 2013), our results imply that less disturbed environments may still offer more favourable conditions for the species.

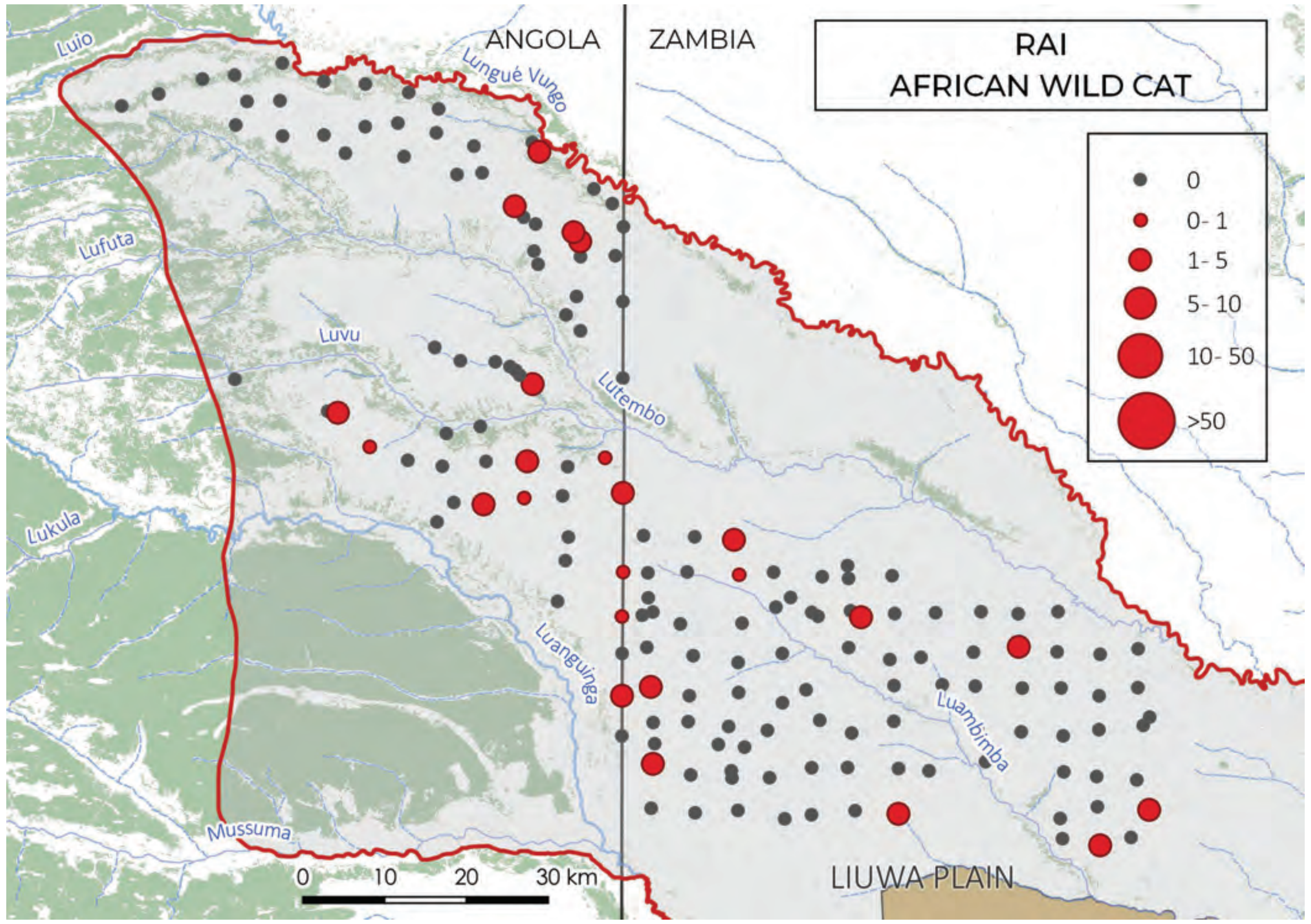


Figure 103 - African wild cat relative abundance Index (RAI) map derived from the camera traps data.

Figure 104 – African wild cat with a hunted rodent camera trap picture.

5.2.25 AFRICAN CIVET *(Civettictis civetta)*

In our survey, African civets were detected far more frequently in Mussuma than in the UWZGMA, with 28 camera-trap events in Mussuma (RAI = 0.36) compared to just 1 event in the UWZGMA (RAI = 0.02). This marked difference suggests a much higher presence or detectability of the species in the Angolan portion of the study area. The disparity may be linked to varying levels of hunting pressure, as African civets have been commonly recorded in bushmeat markets in other regions of Zambia (Overton et al., 2017b). While the known distribution of the species in Angola has been primarily concentrated in the western region, recent records—including our findings—confirm its presence in the east and southeast as well (Funston et al., 2017). This survey represents the first confirmation of the African civet in the Mussuma area.

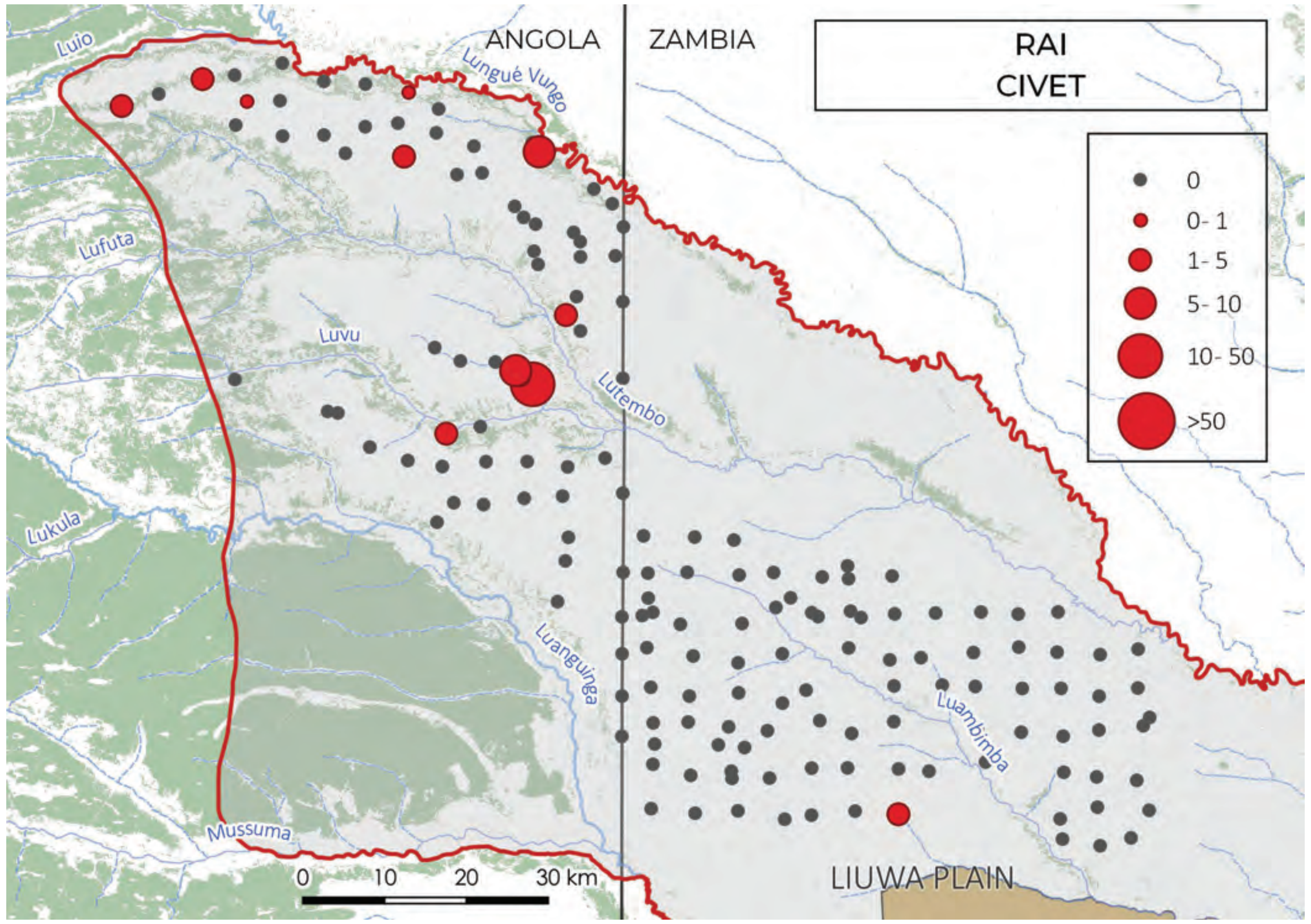


Figure 105 – Africa civet relative abundance Index (RAI) map derived from the camera traps data.

Figure 106 - African civet camera trap picture.

5.2.26 CHEETAH *(Acinonyx jubatus)*

Our survey did not detect cheetahs through camera traps, spoor, or other direct or indirect methods. However, interview data revealed occasional reports of cheetah activity on both the Angolan and Zambian sides of the study area, with slightly more frequent reports from Zambia. Notably, a scat detection dog survey conducted in 2012 by the Zambian Carnivore Programme in Liuwa Plain National Park and the UWZGMA confirmed the presence of at least 18 different cheetahs in that landscape (Becker et al., 2017).

Cheetahs are naturally rare across their range due to their inherently low population densities. In Zambia, they have been most consistently recorded in Kafue National Park (Purchase, 2007), while records elsewhere remain limited. In eastern Angola, their current distribution appears to be primarily confined to Cuando Cubango Province—particularly Luengue-Luiana and Mavinga National Parks (Funston et al., 2017)—Cuatir Reserve (Cuatir, 2025), as well as wilderness areas in western Moxico and eastern Bié provinces, west of our study area (NGOWP, 2018). Sporadic sightings have also been reported in Cameia National Park (INBAC-MINAMB, 2016).

Given that the areas of Liuwa Plain National Park and Mussuma alone may be too small to sustain a viable cheetah population due to the species' wide-ranging nature (Durant et al., 2024), enhancing ecological connectivity between these areas—and further extending it to Cameia National Park and the eastern Moxico wilderness area—is essential. Strengthening these linkages could help support any existing cheetah populations in these areas or facilitate their natural re-establishment. Moreover, such efforts would significantly contribute to the range expansion of the global cheetah population, providing a major boost to the long-term conservation of this vulnerable species.

5.2.27 LION *(Panthera leo)*

Our survey recorded no sightings or detections of lions through camera traps, spoor, or visual sightings within the study area. However, data from satellite-collared lions monitored by the Zambian Carnivore Programme (ZCP) reveal that individuals regularly move into the UWZGMA and across the border into Angola (see Figure 110). These lions often roam for several months, with outcomes ranging from returning to Liuwa Plain National Park (LPNP) to, in at least one documented case, being killed after crossing into Angola. Interviews conducted during our study further support evidence of lion movement in the Angolan segment of the landscape, suggesting occasional dispersal into the area. Additionally, interviews revealed negative perceptions of lions among local communities, with concerns about potential conflict due to livestock predation and threats to human safety. One incident was referenced in which a lion attacked a person attempting to protect cattle.

Lion populations have been severely impacted in the surveyed landscape. The current distribution of lions suggests they may be extinct in the eastern half of Angola, where our study area is located. Interestingly, a recent confirmation of their presence approximately 200km west of our research site in Angola (NGOWP, 2018) hints at their persistence in the region. The species was highly impacted by trophy hunting in the UWZGMA and by 2003, LPNP had only one solitary lioness remaining. In an effort to stimulate breeding, APZ, in collaboration with the DNPW and ZCP, reintroduced to the park two male lions in 2009, two females in 2011 and one male in 2016. Since then, the pride has grown to more than 20 individuals (ZCP, pers. comms.; DNPW, 2016; Watson et al., 2022).

With the lion population in Liuwa Plain NP steadily increasing, further dispersal into Angolan territory is anticipated. The Liuwa National Park Predator Management Plan (DNPW, 2020) forecasts a rise in both resident and migratory prey populations in northern LPNP and the UWZGMA between 2025 and 2029, conditions likely to support the establishment of a lion pride in this landscape. During this period, strengthening ecological connectivity and enhancing human-wildlife conflict mitigation along the corridor with Angola will be crucial. From 2030 onward, continued conservation efforts in the adjoining Mussuma system is expected to further support the formation of a transboundary lion population within the proposed Liuwa-Mussuma TFCA. Ensuring prey availability and functional connectivity between these lion populations is crucial for enhancing the overall conservation of the species, offering promising avenues for their protection and management on a global scale.

5.2.28 SMALL CARNIVORES

The known distribution range of banded mongoose (*Mungos mungo*) includes both survey areas, and its presence was confirmed in our study through 12 camera-trap events in the Mussuma region (RAI = 0.15) and direct observations in the UWZGMA. Among its identified predators, Marabou Storks - known to prey on mongoose kits (Cant & Gilchrist, 2013)- were frequently observed.

The marsh mongoose (*Atilax paludinosus*) was documented exclusively in camera trap surveys in the Mussuma landscape, with 3 camera-trap events (RAI = 0.04), primarily along the margins of the Lungué-Vungo River. Additionally, the species was also found for sale as bushmeat along the main road in this area. Considering its reliance on riverine vegetation for shelter, the species faces additional threats from the habitual setting of man-made fires in the vegetation around bodies of water (Baker & Ray, 2013).

Selous's mongoose (*Paracynictis selousi*) was the second most frequently documented mongoose species in our camera trapping surveys, with 10 events in Mussuma (RAI = 0.13) and 7 in the UWZGMA (RAI = 0.12), indicating a widespread presence throughout the survey area.

The Striped polecat (*Ictonyx striatus*) was recorded in camera traps in both survey regions, with 5 events in Mussuma (RAI = 0.06) and 7 in the UWZGMA (RAI = 0.12), indicating a slightly higher incidence in the Zambian portion of the landscape. Potential threats to the species, include the rising rural human population and the corresponding increase in the number of dogs, which could impact its survival (Stuart & Stuart, 2013a).

The Common genet (*Genetta genetta*) and Large-spotted genet (*Genetta maculata*) were both captured by camera trapping in our study area, with a higher number of capture events occurring on the Zambian side. Reports from interviews indicate that genets face direct persecution due to their reputation as poultry predators.

Other small carnivore species, such as the Egyptian mongoose (*Herpestes ichneumon*), Slender mongoose (*Herpestes sanguineus*), White-tailed mongoose (*Ichneumia albicauda*), Dwarf mongoose (*Helogale parvula*), African striped weasel (*Poecilogale albinucha*), honey badger (*Mellivora capensis*) African clawless otter (*Aonyx capensis*) or the Spotted-necked otter (*Hydrictis maculicollis*), which are known to have distribution ranges within our survey areas (Crawford-Cabral & Simões, 1987; Kingdon & Hoffmann (eds), 2013), were not detected during our study.

Figure 107 - From left to right, top to bottom. Camera trap pictures of Banded mongoose; marsh mongoose, striped polecat, Selous mongoose; genet sp.

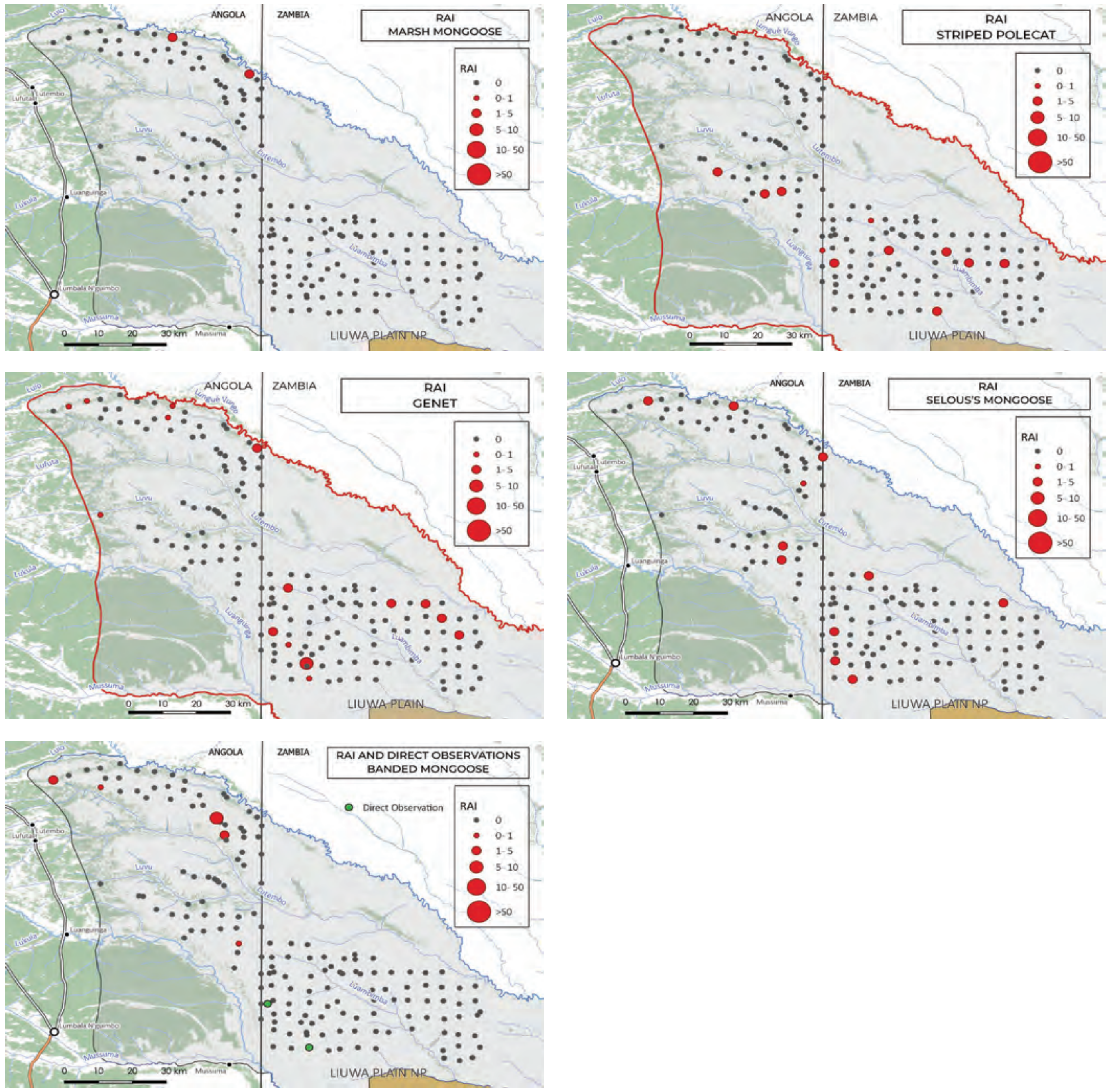


Figure 108 - Small carnivores relative abundance Index (RAI) map derived from the camera traps data. Direct observations are also included for banded mongoose.

5.3 SPECIES NOT ENCOUNTERED ON THE SURVEY

5.3.1 AFRICAN WILD DOGS

(Lycaon pictus)

Although African wild dogs were historically present in Angola's Mussuma landscape (Crawford-Cabral & Simões, 1988), our camera trap survey yielded no evidence of their current occurrence. This absence aligns with consistent reports from local residents in the floodplains near the Zambian border, who indicated that the last sightings in that area occurred over a decade ago. The combination of these two independent data sources—camera traps and local ecological knowledge—strongly suggests a possible local extinction of the species in this portion of the landscape.

In contrast, in the forested regions to the west of Mussuma, more than ten interviewees reported sightings of wild dogs as recently as the previous year, suggesting the species may still persist in these less accessible areas. One particularly detailed account from Sessa, approximately 73 km west of Lumbala Nguimbo, not only confirmed a recent sighting but also revealed prevailing negative attitudes toward wild dogs in the area (see section 6.2.3), which may pose additional conservation challenges.

Additional evidence of wild dog persistence in the broader region includes detections from a camera trap survey conducted approximately 200 km west of Mussuma (NGOWP, 2018), as well as recent sightings in Muié, 113 km southwest of Lumbala Nguimbo (Foster, pers. comm.). Notably, the species has been successfully reintroduced in Liuwa Plain National Park, Zambia, where a population of at least 13 individuals was confirmed at the time of our survey (ZCP, pers. comm.).

These records collectively highlight the potential for regional recovery and genetic exchange among African wild dog populations, provided that ecological connectivity is restored and maintained. Establishing a secure link between currently occupied habitats and the Mussuma landscape could support long-term population viability and enhance resilience through gene flow. However, this strategy is contingent on the recovery or re-establishment of a viable population within Mussuma.

Natural recolonization and long-term persistence of African wild dogs in the Mussuma landscape will depend on the restoration of several key ecological conditions, foremost among them the recovery and stabilization of the prey base. Prey densities are currently low and will require targeted interventions to reduce hunting, protect critical habitats, and allow wildlife populations to rebound. If prey populations recover alongside effective rabies control, reduced human-wildlife conflict, and reestablished habitat continuity within the Greater Liuwa–Mussuma ecosystem, the likelihood of natural recolonization remains high (DNPW, 2020).

Successfully re-establishing African wild dogs in Mussuma and securing ecological corridors with neighbouring landscapes would not only support local conservation but also strengthen regional and global efforts to safeguard this endangered and ecologically important species. Given their sensitivity to prey depletion, habitat fragmentation, and disease, integrated, transboundary management will be essential to ensuring their persistence in the broader Liuwa–Mussuma system.

5.3.2 AFRICAN BUFFALO *(Syncerus caffer)* & ELAND *(Taurotragus oryx)*

Despite the known range of the African buffalo extending across parts of eastern Angola (Prins & Sinclair, 2013), including the Mussuma landscape, and covering the majority of the UWZGMA in Zambia, our survey failed to detect the presence of this species. In Angola, the African buffalo has faced significant declines, largely attributable to the prolonged periods of civil unrest and warfare in Angola. In the UWZGMA, local extinction of the buffalo population may stem from overgrazing and competition for essential resources like grass and water (Prins & Sinclair, 2013).

The eland, known for its widespread distribution across Angola, historically roamed the Mussuma landscape, albeit as one of the less common antelope species in this region (Crawford-Cabral & Veríssimo, 2005). Its range encompasses the entirety of Zambia, highlighting its extensive presence in the survey area (Thouless, 2013). Despite this, our camera trap surveys failed to capture evidence of eland in the survey area.

Both species were once common on the LPNP but became extinct in the area during the 1970s. A reintroduction program was initiated, bringing 51 elands and 16 buffalo back into the area in 2009. Since their introduction, the eland have been free ranging, producing calves and growing to a population of 100 by 2015. Additional buffalo reintroductions took place in 2013 with 12 individuals, and in 2015 with 9. The buffalo population has also shown significant growth, reaching 110 individuals by 2015 (DNPW, 2016). Given these positive outcomes, the establishment of the Liuwa–Mussuma TFCA could play a critical role in facilitating the natural dispersal of both species into suitable habitats on the Angolan side. Enhancing connectivity across the border would not only support species recovery but also contribute to the restoration of ecological processes historically shaped by large herbivores in this landscape.

5.3.3 BUSHBUCK
(Tragelaphus scriptus)

Despite the absence of historical records of bushbuck in the Mussuma region of eastern Angola (Crawford-Cabral & Veríssimo, 2005), the species' known distribution spans nearly the entire country (Plumptre & Wronski, 2013). This apparent discrepancy may reflect a historical lack of targeted survey effort in this part of the landscape. Notably, bushbuck were neither captured on camera traps nor detected through direct observations or indirect signs—such as tracks or dung—at any point during our study, across both survey regions. In Liuwa Plain National Park, the species is also currently considered absent, although historical records confirm its former presence there (DNPW, 2018). Nonetheless, the forested habitats in both the Angolan and Zambian survey zones appear suitable for bushbuck, and the species may persist in the denser vegetation between the Luanguinga and Mussuma Rivers in Angola. Given their known ecological adaptability, bushbuck could potentially exhibit seasonal movements similar to those observed in the Zambezi Valley, where individuals shift between riverine thickets and upland forests depending on seasonal conditions (Plumptre & Wronski, 2013).

5.3.4 HONEY BADGER
(Mellivora capensis)

Despite encompassing both surveyed areas in Angola and Zambia within their range, honey badgers were neither captured nor detected, directly or indirectly, throughout our study. The species was not included in the interviews conducted in these regions. Should the species truly be missing from these ecosystems, several factors might underlie this absence. These include outbreaks of diseases such as rabies or canine distemper, which are known to affected honey badger populations; deliberate persecution by beekeepers; entrenched hostility towards carnivores leading to direct persecution; or hunting pressures stemming from the depletion of other preferred bushmeat species (Begg et al., 2013).

5.3.5 WATERBUCK
(Kobus ellipsiprymnus)

Our camera trap surveys in both Angola and Zambia failed to detect Defassa's waterbuck. The species was not included in the image set used during community interviews, as we prioritized species most likely to be present; as a result, local knowledge regarding its presence was not assessed. The distribution of Defassa's waterbuck in Angola spans various regions, though its historical occurrence in the Mussuma area remains doubtful (Crawford-Cabral & Veríssimo, 2005). In Zambia, the recognized range of this species does not include the UWZGMA.

5.3.6 TSESSEBE *(Damaliscus lunatus)*

Our survey failed to detect any presence of tsessebe within the study area, and interviews with local communities consistently indicated that the species is no longer present. Only a few older individuals were able to correctly identify tsessebe and only one interviewee (1%) in Angola and three in Zambia (5%) indicated their presence in the area. This suggests the species may have been absent from the local ecosystem for a considerable period. Although tsessebe were observed in Liuwa Plain National Park, none were detected within the UWZGMA. Historically, tsessebe were described as prevalent in the plains of Cameia National Park and considered relatively common and widespread along the eastern border of Angola, extending northwards to the upper Zambezi drainage (Crawford-Cabral & Veríssimo, 2005). Both tsessebe and wildebeest are pivotal to the ecosystem of the study area, each fulfilling unique ecological roles and presenting a complementary use of habitat. Tsessebe show a preference for the seasonally flooded valley bottoms, thriving in areas with tall, rank grasses, whereas wildebeest favour the expansive, flat pastures characterized by shorter grass (Duncan, 2013).

5.3.7 LICHTENSTEIN'S HARTEBEEST
(Alcelaphus buselaphus)

Lichtenstein's hartebeest was not detected in our study area, and interviewees consistently reported that the species is no longer present. Only a few older individuals were able to accurately identify it, indicating that Lichtenstein's hartebeest may have been locally extinct in both Angola and Zambian side of the study area for an extended period. Historically, this subspecies was found in Cameia National Park and throughout eastern Angola, with a strong preference for miombo woodland zones (Crawford-Cabral & Veríssimo, 2005). Its known distribution also encompasses the UWZGMA, but it is currently considered locally extinct in the region (Gosling & Capellini, 2013; DPNW, 2016). The return of Lichtenstein's hartebeest would be important for reestablishing the integrity of the ecosystem.

5.3.8 SABLE ANTELOPE
(Hippotragus niger)

Sable antelope was not detected in our study area, and interviewees consistently reported that the species is no longer present. The absence of previous surveys in this region of Angola (Crawford-Cabral & Veríssimo, 2005), both recent and historical, prevents us from confirming the historical presence of sable antelope in the Mussuma area. However, the species was recently captured in a camera trap survey in the eastern Moxico wilderness area, west of our study area, close to the Lungué-Vungo River (NGOWP, 2018). The species historically occurred in Liuwa Plain but is currently considered extinct, although reintroduction efforts are considered a possibility (DNPW, 2016). According to DNPW et al. (2018), a recent observation was recorded near Sikongo in the Zambian GMA.

5.3.9 CARACAL *(Caracal caracal)*

Despite being within its recognized distribution range, the caracal has not been historically documented within our survey area (Crawford-Cabral & Simões, 1987) nor was it detected in this study. In areas where the caracal is present, it is generally classified as uncommon to rare (Stuart & Stuart, 2013b), therefore, future research could offer new perspectives on the presence/absence of this species. The species' presence in Liuwa Plain is rare (DNPW et al., 2018), with an unconfirmed caracal sighting reported by ZCP researchers in 2014.

5.3.10 AFRICAN SAVANNA ELEPHANT
(Loxodonta africana)

The African savanna elephant was not recorded in our camera trap survey, yet part of the study area lies within the species' known distributional range. Interviewees in the western portion of the Angolan study area (Sessa region) reported sightings of elephants a few years ago, although no recent evidence was found. While our research did not find confirmed historical records of elephant presence within Cameia National Park or the Mussuma region, a semi-fictionalized narrative based on the wartime experiences of a cavalry officer stationed in the region during the 1960s (Fonseca, 2015) describes an encounter with the species just south of the park. Additionally, an Agricultural and Forestry reconnaissance report from 1956 references the species near Lumbala N'Gimbo (Crawford-Cabral & Veríssimo, 2005). These accounts suggest that the African savanna elephant may have once occurred more broadly across the study area but is now likely extirpated from the region.

5.4 WILDLIFE TRANSBOUNDARY MOVEMENTS

5.4.1 LARGE CARNIVORES

Ongoing research from the Zambian Carnivore Programme (ZCP) provides information on the movement of carnivores within the area for the proposed Liuwa-Mussuma TFCA, spanning Angola and Zambia. Data collected indicates that carnivores roam freely between the borders of the two countries. Lion and hyena presence appears to be sustained by livestock predation, while occasional cheetah movements seems to be supported by the availability of wild prey populations.

In 2018, a young male lion, tracked with a satellite collar by African Parks in Liuwa Plain National Park, spent several months in the Angolan portion of the TFCA before returning to Liuwa Plain. Similarly, in 2020, another collared lion crossed from Zambia, traversed the Mussuma area, and headed south. Tragically, the GPS collar's signal indicated it was likely killed near the Cuando River. During the same year, a cheetah briefly ventured into Angola but promptly returned to Zambia within the day. Reports from June and December of 2021 indicated lion conflicts with domestic animals, indicating the presence of dispersing animals in the Mussuma area. In 2021, a collared spotted hyena crossed into Angola, wandering more than 50km to the west towards the main road. Its presence recorded by CCI's camera traps (see Figure 109). In May 2023, two young dispersal lions from Liuwa briefly entered the Angolan side to then return to the UWZGMA in Zambia. In May 2025, another collared cheetah from Liuwa Plain wandered into Angola for an entire week, penetrating more than 30 km into the country before turning back and returning to Zambia. See Figure 110 with locations of all the above carnivore crossing accounts (ZCP, unpublished data; CCI, unpublished data).

These documented crossings confirm the transboundary nature of carnivore populations in the region, validating long-held assumptions about their movements across political boundaries. Protecting these habitats is therefore essential to restoring a critical stronghold for carnivores and other wildlife within this ecosystem. The Mussuma area—together with its ecological link to Liuwa Plain—is central to the recovery of large carnivores and the facilitation of genetic exchange across Angola's conservation and wilderness landscapes. This potential is underpinned by the existence of largely intact habitats and natural corridors connecting Mussuma to key regions such as Cameia National Park to the north, Mavinga National Park to the south, and the remote eastern Moxico wilderness to the west. In the latter, a camera trap survey conducted between 2016 and 2018—approximately 200 km west of Mussuma—confirmed the presence of lions, cheetahs, leopards, African wild dogs, and spotted hyenas (NGOWP, 2018), underscoring the broader significance of this transboundary landscape for large carnivore conservation).

Figure 109 - A GPS collared spotted hyena from Zambia captured on camera trap in Angola.

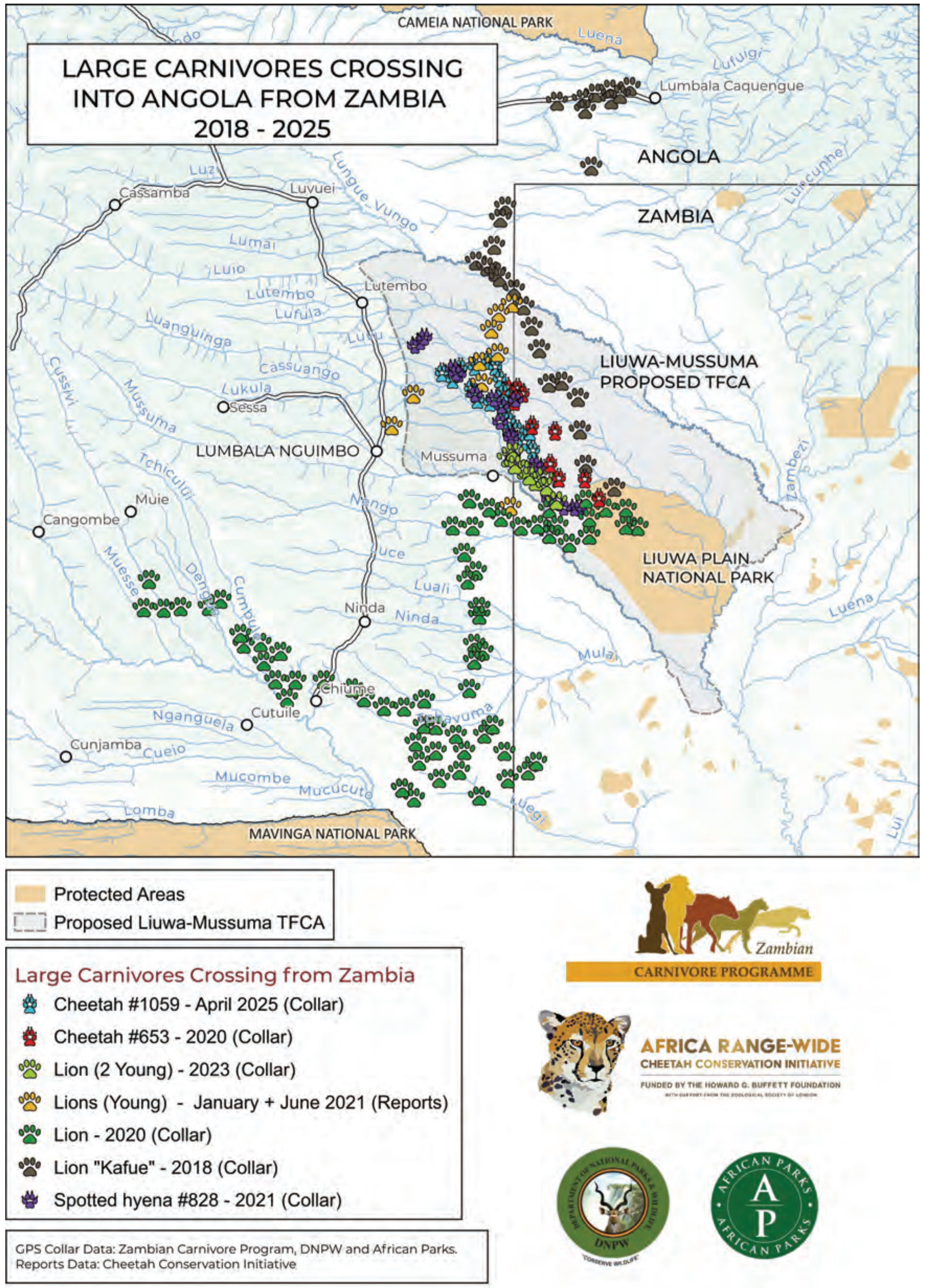


Figure 110 - Large carnivores documented crossings into Angola from Zambia between 2018 and 2025.

5.4.2 WILDEBEEST AND ZEBRA

Although large carnivores move freely across borders, long-term GPS collar studies of wildebeest and zebra in Liuwa Plain have revealed more defined and directional migration patterns. During the wet season, wildebeest occupy the south-central parts of Liuwa Plain National Park before migrating northwest across park boundaries toward the Angolan border in May–June. They remain in that region until October–November, when the calving season begins and herds return to the central grasslands of Liuwa (Watson et al., 2022; Dröge et al., 2019; M'soka et al., 2017; Dooley, 1995). Notably, no transboundary movement into Angola had been documented until 2022 (Watson et al., 2022).

Until recently, no formal evidence confirmed wildebeest crossings into Angola, despite the broader Liuwa migration being long recognized as Africa's second largest, after the Serengeti (Dooley, 1995; Cabral & Verissimo, 2005; East, 1999; Estes, 2013). While little is known about Cameia National Park, it is believed that a similar annual wildebeest migration system might have happened within its borders (PPF, 2009).

Our extensive bibliographic research, including grey literature and reports from colonial expeditions (Capello & Ivens, 1886; Pinto, 1881), has not yet uncovered additional information on this migration. Famous expeditions, such as those led by Capello & Ivens and Major Serpa Pinto, ventured northeast and southwest of the Mussuma area, respectively, leaving this remote Angolan region largely undocumented by colonial explorers. Therefore, definitive historical evidence outlining its range and scale has been challenging to find. Additionally, interviews conducted in the Mussuma section of the survey suggest a prolonged lack of presence of these species and its migration, indicating their possible absence from the ecosystem for an extended period.

Though no historical documentation of this migration was found yet, given the migratory nature of the species, the almost pristine habitat and the low human density in the Angolan side, it is plausible that it could be recovered. In support of this, in 2022, a GPS collared wildebeest female monitored by ZCP, crossed to Angola where it spent 12h, presumably along with its herd (ZCP, 2024, unpublished data). This is the first confirmed record of the wildebeest migration moving between the two countries.

The results from interviews both in Mussuma and the UWZGMA areas suggest that the migration's expansion into Angola could be hindered by significant hunting pressure in the Angolan side of the TFCA and along the border in both countries. Other factors threaten both the existing migratory range of the wildebeest and the possibility of expansion or restoration of their historical cross-border migrations: 1) an accelerated human development, marked by the transformation of land into agriculture, overstocking and habitat degradation within the UWZGMA (Estes, 2013; Watson et al., 2022); 2) The wildebeest herd size not being yet large enough to require larger scale movement in search of grazing resources; 3) Human dominance of the water resources (lagoons and waterholes) along the Angolan side of the border during the migratory season.

Safeguarding the entire potential migratory corridor for wildebeest is vital for maintaining ecosystem functionality and restoring ecological integrity in a rapidly changing, human-impacted landscape. Protecting this corridor supports not only the recovery of wildebeest populations, but also the broader community of species and ecological processes that depend on seasonal movements and habitat connectivity. As noted by Becker et al. (2017), securing the protection of both existing and potential dry season habitats beyond the confines of Liuwa Plain National Park is essential and should be prioritised—not only for the preservation of wildebeest, but also for the well-being of other species that depend on these habitats. The recovery of the wildebeest migration will further contribute to the restoration of the broader ecosystem, including the return of associated large carnivores, thereby enhancing ecological integrity. This ecological recovery will also support the restoration of ecosystem services, including the development of wildlife-based tourism, as large mammal migrations are a proven attraction for international visitors.

5.5 OTHER TAXA

Extensive surveys and understanding of other wildlife taxa, such as small mammals, birds, reptiles, amphibians, fish, and invertebrates is also needed to better understand the richness, value and ecosystem dynamics of the area and should therefore be among future research priorities. Notably, we recorded the presence of wattled cranes in the Lungué-Vungo floodplains, a species listed as Vulnerable (BirdLife International, 2018) underscoring the conservation importance of the region. Species such as the wattled crane should be focal points of future research and recovery initiatives.

Figure 111 - Wattled cranes observed during the aerial survey in 2018 at the Lungué-Vungo floodplains, west of the study area.

6.
HUMAN-WILDLIFE CONFLICT

The interviews with local communities captured perceptions associated with the presence of different wildlife species within their residential areas and surroundings. While the broader survey assessed 26 species to understand historical and current presence, only 22 were included in the analysis of human–wildlife conflict, excluding species considered locally extinct. Among these 22 species, most were more frequently reported as present by interviewees in Angola than in Zambia. Notable exceptions were the blue wildebeest and the spotted hyena, both of which were more commonly reported in Zambia. In particular, the spotted hyena was almost unanimously identified as present by Zambian respondents.

In Angola, an overwhelming 98% of respondents reported the presence of the common duiker in their neighbourhood, and 95% identified the side-striped jackal as present, compared to 79% and 77% in Zambia, respectively. Interestingly, elephants were reported as present by a quarter of Angolan respondents but by none in Zambia. This discrepancy may be due to the proximity of some interview locations in Angola to areas known to support elephants, either currently or historically, towards the west and north of the study area (see Figure 8 for interview locations). The lack of reports of elephant presence from Zambia corroborates previous reports documenting the absence of the species in the Zambian part of the landscape (DNPW et al., 2018; DNPW 2016).

Lions were reported as present fairly equally in both countries, with 67% in Angola and 62% in Zambia. Notably, the reports of the presence of cheetahs and African wild dogs were considerably higher in Angola (59% and 50%, respectively) than in Zambia (12% and 6%). However, this disparity is likely influenced by spatial bias, as most reports in Angola came from the westernmost areas, where these species are more commonly observed.

Respondents were also asked to classify species that they reported as locally present according to whether they perceived them as a big, small, or zero problem. Responses revealed notable differences between Angola and Zambia. In Zambia, the hippopotamus was more often reported as problematic compared to Angola. In contrast, in Angola, species like the sitatunga and common duiker were perceived as more frequently posing a problem than in Zambia, often due to their tendency to damage crops.

The perception of conflict with carnivores showed some parity for species such as the serval and side-striped jackal across both countries. However, larger carnivores, specifically spotted hyenas and lions, were seen as substantially more problematic in Zambia than in Angola. This disparity may reflect underlying ecological and land-use differences: reports of lion conflict in Zambia could be influenced not only by the proximity to an established lion population in Liuwa Plain National Park, but also by higher cattle densities on the Zambian side, which likely increase the frequency and visibility of human-lion interactions. Detailed results on the perception of problematic species are available in Table 10.

Figure 112 - Lioness in Liuwa Plain National Park.

Table 10- Questionnaire results on species presence and conflict perception.

The table presents the number of respondents who correctly identified each species, reported its presence within a day's walk from their home, and perceived it as causing conflict (either major or minor problems). Percentages for reported presence are calculated based on the total number of respondents, regardless of whether they correctly identified the species. Percentages for conflict perception are calculated based on those who reported the species as present.

	ANGOLA (N=78)				ZAMBIA (N=66)			
SPECIES	CORRECTLY IDENTIFIED	REPORTED PRESENT	CONFLICT		CORRECTLY IDENTIFIED	REPORTED PRESENT	CONFLICT	
			MAJOR	MINOR			MAJOR	MINOR
Savanna Elephant	78 (100.0%)	19 (24.4%)	5 (26.3%)	4 (21.1%)	60 (90.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Hippopotamus	76 (97.4%)	47 (60.3%)	10 (26.3%)	10 (21.3%)	62 (93.9%)	39 (59.1%)	19 (48.7%)	6 (15.4%)
Buffalo	53 (67.9%)	1 (1.3%)	0 (0.0%)	1 (100.0%)	54 (81.8%)	1 (1.5%)	0 (0.0%)	0 (0.0%)
Blue wildebeest	50 (64.1%)	7 (9.0%)	0 (0.0%)	0 (0.0%)	52 (78.8%)	27 (40.9%)	6 (22.2%)	3 (11.1%)
Roan antelope	63 (80.8%)	38 (48.7%)	0 (0.0%)	0 (0.0%)	41 (62.1%)	29 (43.9%)	2 (6.9%)	3 (10.3%)
Zebra	68 (87.2%)	4 (5.1%)	0 (0.0%)	0 (0.0%)	64 (97.0%)	21 (31.8%)	4 (19.0%)	0 (0.0%)
Red Lechwe	61 (78.2%)	39 (50.0%)	0 (0.0%)	0 (0.0%)	32 (48.5%)	15 (22.7%)	4 (26.7%)	0 (0.0%)
Southern Reedbuck	72 (92.3%)	72 (92.3%)	14 (19.4%)	7 (9.7%)	49 (74.2%)	36 (54.5%)	4 (11.1%)	1 (2.8%)
Sitatunga	71 (91.0%)	69 (88.5%)	19 (27.5%)	11 (15.9%)	34 (51.5%)	23 (34.8%)	0 (0.0%)	2 (8.7%)
Common duiker	77 (98.7%)	77 (98.7%)	26 (33.8%)	13 (16.9%)	56 (84.8%)	52 (78.8%)	2 (3.8%)	1 (1.9%)
Yellow-backed duiker	60 (76.9%)	53 (67.9%)	0 (0.0%)	0 (0.0%)	2 (3.0%)	2 (3.0%)	0 (0.0%)	0 (0.0%)
Oribi	70 (89.7%)	65 (83.3%)	1 (1.5%)	1 (1.5%)	43 (65.2%)	39 (59.1%)	2 (5.1%)	2 (5.1%)
Tsessebe	8 (10.3%)	1 (1.3%)	0 (0.0%)	0 (0.0%)	7 (10.6%)	3 (4.5%)	0 (0.0%)	1 (33.3%)
Lichtenstein's hartebeest	11 (14.1%)	3 (3.8%)	0 (0.0%)	0 (0.0%)	3 (4.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Lion	78 (100.0%)	52 (66.7%)	14 (26.9%)	4 (7.7%)	65 (98.5%)	41 (62.1%)	20 (48.8%)	0 (0.0%)
Cheetah	55 (70.5%)	46 (59.0%)	5 (10.9%)	3 (6.5%)	40 (60.6%)	8 (12.1%)	0 (0.0%)	0 (0.0%)
African wild dog	70 (89.7%)	39 (50.0%)	0 (0.0%)	2 (5.1%)	49 (74.2%)	4 (6.1%)	0 (0.0%)	0 (0.0%)
Leopard	69 (88.5%)	61 (78.2%)	10 (16.4%)	5 (8.2%)	41 (62.1%)	2 (3.0%)	0 (0.0%)	0 (0.0%)
Spotted hyena	72 (92.3%)	49 (62.8%)	17 (34.7%)	2 (4.1%)	61 (92.4%)	64 (97.0%)	46 (71.9%)	1 (1.6%)
Side-striped jackal	75 (96.2%)	74 (94.9%)	20 (27.0%)	9 (12.2%)	52 (78.8%)	51 (77.3%)	20 (39.2%)	4 (7.8%)
Serval	51 (65.4%)	48 (61.5%)	12 (25.0%)	10 (20.8%)	32 (48.5%)	30 (45.5%)	5 (16.7%)	4 (13.3%)
Steenbok					30 (45.5%)	29 (43.9%)	0 (0.0%)	0 (0.0%)

6.1 MAIN CONFLICTS WITH HERBIVORES AND SMALL CARNIVORES

Although specific questions on conflict were not initially included in the questionnaires, interviewers recorded detailed information whenever interviewees voluntarily raised issues related to human-wildlife conflict. These accounts provided an overview of the reported impacts of potential conflict-causing species on agricultural practices, livestock loss, personal safety and well-being (Table 11).

Table 11 – Main crops and domestic animals affected by conflicts with wild species in the Angolan (top) and Zambian (bottom) side of the study area.

ANGOLA

SPECIES	CROPS					LIVESTOCK	ATTACKS PEOPLE
Elephant							
Hippo	Manioc						Yes
Roan							
Lechwe							
Reedbuck	Maize	Rice	Potato				
Sitatunga	Maize	Sweet potato	Manioc	Cabbage	Rice		
Common duiker	Manioc	Beans					
Yellow-backed duiker							
Oribi	Rice	Sweet potato					
Side-striped jackal	Peanuts					Chicken	Yes
Serval						Chicken	

ZAMBIA

SPECIES	CROPS			LIVESTOCK	ATTACKS PEOPLE
Elephant					
Hippo	Rice	Sweet potato	Maize		Yes
Blue wildebeest	Rice				
Roan	Rice				
Zebra	Rice				
Lechwe	Rice				
Reedbuck	Rice				
Sitatunga	Rice	Carrots			
Common duiker	Manioc				
Oribi	Rice				
Side-striped jackal				Domestic dogs / chicken	Yes
Serval				Chicken	

6.2 LARGE CARNIVORES' PRESENCE AND CONFLICTS

A series of questions were asked in semi-structured questionnaires used in the surveys to get a better understanding of conflict with large carnivores, where such conflict exists. These species are considered both the most problematic for local communities and the most likely to recover if a Transfrontier Conservation Area is established. The questions were adapted from previous questionnaires used in Tanzania and Ethiopia (Maddox, 2003; Dickman, 2009; Mkonyi et al., 2017) and the questions were designed to provide information on the frequency of livestock loss perceived as due to the carnivore species and, for Zambia, gain insights into steps taken by local communities to prevent livestock loss.

Questions focus on the last events, as this is likely to be the best remembered (Maddox, 2003), and responses across multiple respondents can then provide a reasonably reliable index of frequency (Kelly in prep.). It's important to note that the reported attack events may not all be unique occurrences, as some responders may refer to the same incident, reflecting the challenges in accurately tracking each encounter. It is important to note that responses are time relative and "Last year" refers to the year preceding the interview date. For Angola, this typically means 2018, 2019, or 2020; for Zambia, it generally refers to 2021 or 2022.

Table 12 provides a summary of the number of respondents reporting sightings of various large carnivore species

Table 12 – Reported sightings of large carnivore species.

Number of respondents who reported last seeing or hearing each large carnivore species. Percentages are calculated based on the total number of interviews.

ANGOLA (N=78)					
WHEN LAST SEEN/ HEARD?	LION	LEOPARD	AFRICAN WILD DOG	CHEETAH	SPOTTED HYENA
Last year	16 (20.5%)	18 (23.1%)	12 (15.4%)	5 (6.4%)	10 (12.8%)
2 - 5 years ago	4 (5.1%)	5 (6.4%)	4 (5.1%)	5 (6.4%)	4 (5.1%)
6 - 10 years ago	5 (6.4%)	4 (5.1%)	2 (2.6%)	4 (5.1%)	2 (2.6%)
11 - 20 years ago	8 (10.3%)	6 (7.7%)	10 (12.8%)	1 (1.3%)	4 (5.1%)
> 20 years ago	7 (9.0%)	1 (1.3%)	2 (2.6%)	4 (5.1%)	3 (3.8%)
Never	38 (48.7%)	44 (56.4%)	66 (84.6%)	59 (75.6%)	55 (70.5%)

ZAMBIA (N=66)					
WHEN LAST SEEN/ HEARD?	LION	LEOPARD	AFRICAN WILD DOG	CHEETAH	SPOTTED HYENA
Last year	3 (3.8%)	0	3 (3.8%)	2 (2.6%)	42 (53.8%)
2 - 5 years ago	7 (9.0%)	0	3 (3.8%)	1 (1.3%)	4 (5.1%)
6 - 10 years ago	0	1 (1.3%)	2 (2.6%)	0	1 (1.3%)
11 - 20 years ago	0	1 (1.3%)	1 (1.3%)	1 (1.3%)	0
> 20 years ago	2 (2.6%)	1 (1.3%)	2 (2.6%)	3 (3.8%)	2 (2.6%)
Never	54 (69.2%)	63 (80.8%)	55 (70.5%)	59 (75.6%)	17 (21.8%)

In Angola, lion and leopard attacks were reported to have led to human and livestock casualties, with lions particularly noted for causing fatalities and injuries. In Zambia, cattle are the primary victims of lion conflicts. Incidents involving African wild dogs are notably rare and non-aggressive, and cheetah conflicts are minimal. A significant concern in both countries is the high frequency of spotted hyena attacks on livestock, particularly in Zambia. These observations highlight the diverse nature of carnivore-related conflicts in these areas, underlining the imperative for region-specific conservation and management strategies. The following sections provide a detailed analysis of conflicts specific to each of the five large carnivore species found in the region.

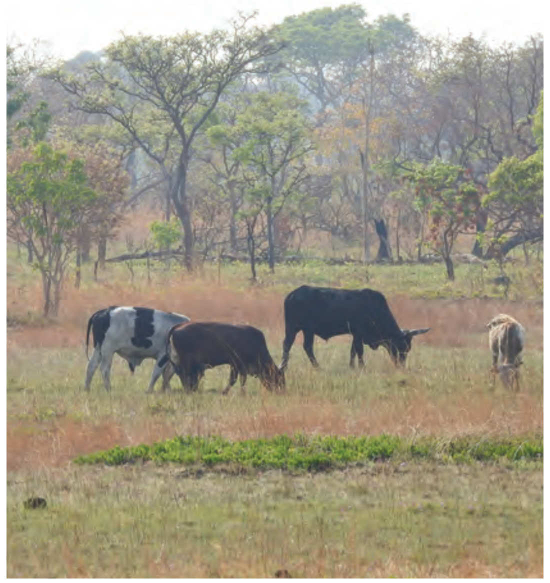


Figure 113 - Cattle at pasture within the floodplains in Angola.

6.2.1 LION

In Angola, four lion attacks on humans were reported in the year preceding the survey, resulting in two fatalities and two injuries. However, all four incidents occurred during the day, and the victims were reportedly herding cattle or near water sources. Attacks on livestock were more frequently reported, all involving cattle. These included five incidents in the past year and nine additional cases within the past 2–5 years. Most respondents indicated that cattle attacks occurred at night (6 cases), followed by daytime (4 cases) and dawn (2 cases). The majority took place in open pastures (7 cases), with a smaller number reported inside bomas (3 cases). See Table 13 for details.

In contrast, no human attacks by lions were reported in Zambia. However, cattle predation was recorded, with two incidents occurring in the past year and seven in the previous 2–5 years. Of these, six attacks took place at pasture and three inside bomas. Five occurred at night and four during the day.

Table 13 – Reported conflicts involving lions.

***Note: Fatality reports likely refer to a single incident, described by multiple respondents.**

LION CONFLICT - ANGOLA (N=78)				
	LAST ATTACK TO PEOPLE (N)	Nº PEOPLE KILLED	Nº PEOPLE INJURED	LAST ATTACK LIVESTOCK (N)
Last year	4	2*	2	5
2 - 5 years ago	0	0	0	9

LION CONFLICT - ZAMBIA (N=66)				
	LAST ATTACK TO PEOPLE (N)	Nº PEOPLE KILLED	Nº PEOPLE INJURED	LAST ATTACK LIVESTOCK (N)
Last year	0	0	0	2
2 - 5 years ago	0	0	0	7

6.2.2 LEOPARD

There were no incidents of conflict with leopard reported in Zambia. However, in Angola there was one reported leopard attack on cattle in 2021, which resulted in the loss of a cow in a pasture.

Leopards were reported to also attack people in Angola, with a total of four attacks reported in the last year, although with no fatalities. All these attacks were reported to take place during hunting activities and in the forested areas near Sessa (see Figure 8 for locations). See Table 14 for details on recorded leopard attacks.

Table 14 - Reported conflicts involving leopards.

LEOPARD CONFLICT - ANGOLA (N=78)				
	LAST ATTACK TO PEOPLE (N)	Nº PEOPLE KILLED	Nº PEOPLE INJURED	LAST ATTACK LIVESTOCK (N)
Last year	4	0	0	1
2 - 5 years ago	0	0	0	0

6.2.3 AFRICAN WILD DOG

In Angola, encounters with African wild dogs were rarely reported. The only incident reported involved a young policeman who, while transporting bush meat on his motorcycle, was chased by wild dogs. The dogs caused him to fall off his bike and subsequently stole the meat, though the policeman himself was not harmed. This incident occurred on the road from Sessa to Lumbala-Ngimbo. In Zambia, there were no reported attacks by African wild dogs on either people or livestock.

6.2.4 CHEETAH

Reports of negative interactions with cheetah are also rare in Angola. Only two incidents were reported: one in 2019, involving a cheetah attack on cattle at pasture during daylight without any fatalities, and another in 2018, where two cow calves were killed at night, also at pasture. Given the species' typically diurnal behaviour, the 2018-night attack is less likely to have been by a cheetah. See Table 15. There were no reports of cheetah attacks on either people or livestock in Zambia.

Table 15 - Reported conflicts involving cheetahs.

CHEETAH CONFLICT - ANGOLA (N=78)				
	LAST ATTACK TO PEOPLE (N)	Nº PEOPLE KILLED	Nº PEOPLE INJURED	LAST ATTACK LIVESTOCK (N)
Last year				1
2 - 5 years ago				1

6.2.5 SPOTTED HYENA

In Angola, spotted hyenas have been implicated in multiple livestock attacks, with most recent incidents occurring within the past five years. These included several cattle deaths, as well as isolated incidents involving a goat and a chicken. The majority of cattle attacks happened at night (12 cases), with seven occurring at pasture and six within nighttime enclosures (bomas). Only two attacks were reported during the day, both at pasture. Human-hyena conflict was rare but included one fatal incident in 2018, involving a young man returning home at night under the influence of alcohol. Two older cases (more than five years ago) were also reported, one of which involved the fatal mauling of a young girl during a bush-based maturity ritual.

In Zambia, hyena attacks on livestock—exclusively involving cattle—were substantially more frequent. A total of 41 incidents were reported, with 40 occurring in 2022 alone. All attacks happened at night: 35 inside bomas and six at pasture, often involving lost or strayed cattle. When asked about response strategies (a question posed only in the Zambian survey), 22 respondents reported shouting to deter the hyenas, three used dogs, and two lit fires. Two additional respondents noted that the animals fled upon seeing people.

Zambia also recorded three attacks on humans in recent years: two non-fatal incidents in the past year and one fatal attack between two and five years ago. All human encounters occurred at night—two in villages and one at a boma. See Table 16 for details.

Table 16 - Reported conflicts involving spotted hyenas.

SPOTTED HYENA CONFLICT - ANGOLA (N=78)				
	LAST ATTACK TO PEOPLE (N)	Nº PEOPLE KILLED	Nº PEOPLE INJURED	LAST ATTACK LIVESTOCK (N)
Last year	1	1		10
2 - 5 years ago			1	4

SPOTTED HYENA CONFLICT - ZAMBIA (N=66)				
	LAST ATTACK TO PEOPLE (N)	Nº PEOPLE KILLED	Nº PEOPLE INJURED	LAST ATTACK LIVESTOCK (N)
Last year	2			40
2 - 5 years ago	1		1	1

Figure 114 - Hyenas with cubs at their den in Liuwa Plain National Park.

7. ATTITUDES TOWARDS CONSERVATION

7.1 LOCAL KNOWLEDGE OF LARGE MAMMALS

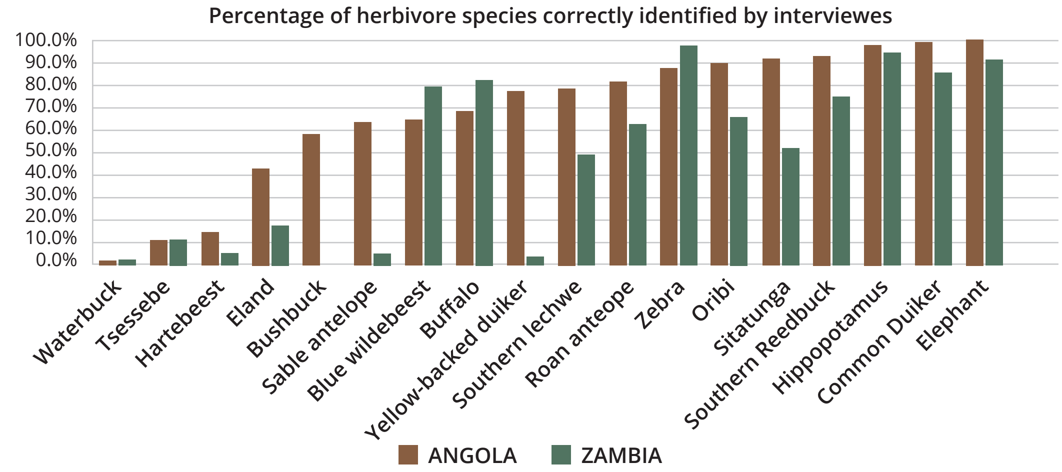
We assessed the knowledge of interviewees regarding local wildlife by determining how accurately they could identify images of 26 large mammal species that currently or historically inhabited their regions (Figure 116). Overall, the respondents demonstrated a reasonably accurate understanding, correctly identifying 75% of the species. Angolan respondents performed slightly better, recognizing 81% of the species, compared to 68% by their Zambian counterparts.

Interestingly, despite living closer to Liuwa Plain National Park— where many of the species featured in our images are more prevalent—Zambian respondents generally scored lower on species identification than Angolans. The only exceptions were the blue wildebeest and zebra, for which Zambians showed a higher identification rate. This pattern likely reflects ecological realities: our survey results indicate that both species have been absent from the Angolan side of the study area for an extended period, while they continue to persist on the Zambian side.

Marked differences were found for several forest-dependent species. The yellow-backed duiker was correctly identified by 80% of Angolan respondents but only 3% of Zambians. Similarly, 58% of Angolans recognized the bushbuck, compared to none of the Zambians. For the sable antelope, 63% of Angolans responded correctly, versus only 5% in Zambia. The lower recognition of yellow-backed duiker and bushbuck among Zambians likely reflects their absence from the habitats of UWZGMA, where dense woodlands—essential for these species—are lacking or highly degraded. In the case of sable antelope, its higher recognition in Angola may be influenced by the status of the giant-sable antelope as a national symbol and emblematic species.

For species not currently present in either study area, such as aardwolf, waterbuck and hartebeest, both groups showed similarly low identification rates. Species still present in Liuwa Plain, such as tsessebe and eland, also had low recognition levels among Zambian respondents.

Figure 115 - Wildebeest in Liuwa Plain National Park.



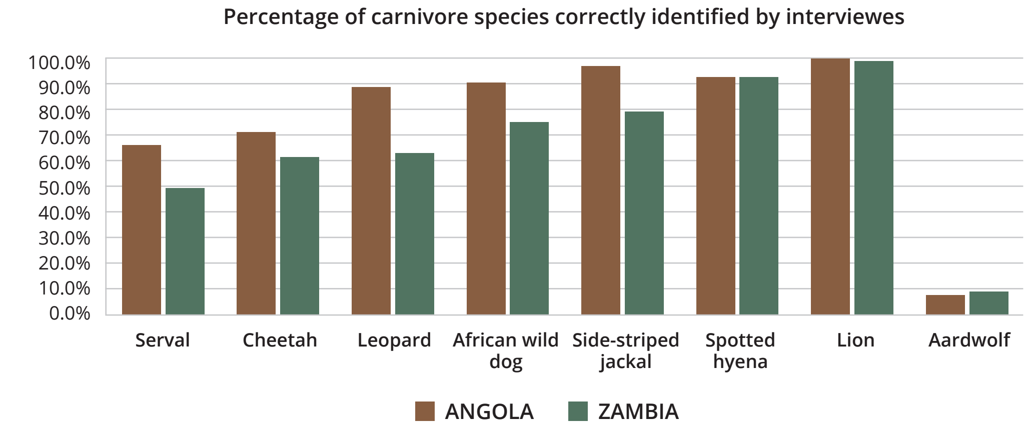


Figure 116 - Percentage of species (herbivores- top; carnivores – bottom) correctly identified by interviewees.

7.2 PERSPECTIVES ON THE COEXISTENCE WITH WILDLIFE - MUSSUMA AND UWZGMA

A small number of questions aimed to capture community perspectives on the presence of wildlife in residential areas, with responses collected from interviewees in Mussuma, Angola, and the UWZGMA region of Zambia.

What are the advantages of coexisting with wildlife?

A noteworthy difference emerged in how Angolan and Zambian respondents perceived the advantages of wildlife presence. In Angolan, 52.6% (n=41) respondents cited that the main advantage of having wildlife present in their neighbourhood was as a food source, a perspective shared by only 1.5% (n=1) of Zambians.

A substantial proportion of participants – 23.1% (n=18) from Angola and 42.4% (n=28) from Zambia – expressed an appreciation for wildlife's aesthetic and ecological significance, beyond any utilitarian value. Notably, among these, 19 Zambian respondents and only 1 Angolan spontaneously clarified that their appreciation excluded large carnivores.

An interesting finding was that 24.3% of all respondents recognized the value of coexisting with wildlife, citing it as an opportunity for future generations to connect with and appreciate animals.

Only a minority – 13.2% – of the respondents perceived no advantages in cohabiting with wildlife. Specifically, 7.7% of Angolans (n=6) and 19.7% of Zambians (n=13) expressed scepticism regarding any advantage of living alongside wildlife.

For a detailed breakdown of responses, refer to Table 17.

Table 17 - Advantages of coexisting with wildlife as perceived by Angola (Mussuma) and Zambia (UWZGMA) populations. Interview results.

	ANGOLA		ZAMBIA		TOTAL	
Advantages of having wildlife in the area	**N=78**	**%**	**N=66**	**%**	**N=144**	**%**
Food source	41	52.6%	1	1.5%	42	29.2%
Aesthetic and ecological reasons	18	23.1%	28	42.4%	46	31.9%
Aesthetic and ecological reasons excluding large carnivores and damaging animals	1	1.3%	18	27.3%	19	13.2%
For future generations to know the animals	15	19.2%	20	30.3%	35	24.3%
No advantages	6	7.7%	13	19.7%	19	13.2%
Don't know	2	2.6%	1	1.5%	3	2.1%
To be like in Zambia	1	1.3%			1	0.7%
Money source (unrelated to tourism)	1	1.3%	1	1.5%	2	1.4%
Tourism attraction			4	6.1%	4	2.8%
Respect God creation	1	1.3%	3	4.5%	4	2.8%

Disadvantages:

Respondents identified livestock predation, human attacks, and crop destruction as the primary disadvantages of coexisting with wildlife. See Table 18 for details.

Livestock predation was the biggest concern among Zambians, with 62% (n=41) expressing this as a disadvantage, while only 19.2% (n=15) of Angolans reported livestock predation to be an issue. Human attacks were more important for Angolans, with 55.1% (n=43) identifying this as a disadvantage to coexistence, compared to 28.8% (n=19) of Zambians. The issue of crop destruction was acknowledged similarly by 15.4% of Angolans and 12.1% of Zambians.

A minority of 3.8% of Angolans and 12.1% of Zambians expressed fear of living among large carnivores on their responses.

Interestingly, 20.5% (n=16) of Angolans and 7.6% of Zambians (5) saw no disadvantage in coexisting with wildlife.

Table 18 - Disadvantages of coexisting with wildlife as reported by Angola (Mussuma) and Zambia (UWZGMA) interviews.

	ANGOLA		ZAMBIA		TOTAL	
Disadvantages of having wildlife in the area	**N=78**	**%**	**N=66**	**%**	**N=144**	**%**
Attack livestock	15	19.2%	41	62.1%	56	38.9%
Attack people	43	55.1%	19	28.8%	62	43.1%
Destroy crops	12	15.4%	8	12.1%	20	13.9%
Fear predators	3	3.8%	8	12.1%	11	7.6%
Can get arrested for hunting			1	1.5%	1	0.7%
No disadvantages	16	20.5%	5	7.6%	21	14.6%
Don't know	2	2.6%			2	1.4%

7.3 PERCEPTIONS OF CHANGE IN WILDLIFE ABUNDANCE - MUSSUMA ONLY

As highlighted in section 4.2, a substantial proportion of 84.6% of Angolan respondents reported that they had left their home areas during the war, with the majority returning only within the last 10 to 20 years. When asked about 'whether there are more animals now compared to when they moved back here', 85.9% (n=67) reported that 'animals are disappearing'—indicating that they perceive a significant decline in animal populations since their return, while 5.1% (n=4) stated that wildlife populations are either constant/at the same level or increasing. Only 9% (n=7) were unsure about the current status.

When questioned about the reasons behind the decline in wildlife populations, 69.2% (n=54) attributed it to hunting, 11.5% (n=9) to animals fleeing human presence, and 5.1% (n=4) to the impact of increased human settlement in the area. Only 7.7% (n=6) associated these declines to the effects of the civil war. The complete list of responses to this question is presented in Table 19.

Table 19 - Perceptions of change in wildlife abundance and the reasons behind it. Interview results from Mussuma (Angola).

Are there more animals now compared to when you moved back here? If less, why?	**N=78**	**%**
Animals are disappearing	**67**	**85.9%**
Hunting	54	69.2%
Running away from people	9	11.5%
War	6	7.7%
Too many people	4	5.1%
Fire	2	2.6%
No water	1	1.3%
They are free	1	1.3%
Animals are not disappearing	**4**	**5.1%**
There are more animals now	1	1.3%
They are not disappearing	3	3.8%
Don't know	**7**	**9.0%**

7.4 ATTITUDES TOWARDS TOURISM AND CONSERVATION AREAS - MUSSUMA ONLY

In Angola, 66.7% of interviewees (n=52) initially stated that they knew what tourism is, while 33.3% (n=26) said they did not. Regardless of prior familiarity, our team provided a brief explanation to ensure all respondents shared a common understanding before continuing. When subsequently asked whether they would like to receive tourists in their area, 87.2% (n=68) responded positively, 9% (n=7) said no, and 3.8% (n=3) were unsure.

Similarly, 91% of respondents (n=71) reported knowing what a conservation area is, while 9% (n=7) did not. Again, an explanation was provided to standardize understanding across participants. After this clarification, 80.8% (n=63) said they would like to have a conservation area nearby, 16.7% (n=13) were opposed, and 2 respondents remained undecided.

Most respondents in Angola reported having seen tourists in Zambia and were aware of the existence of conservation areas across the border. Their impressions of conservation were generally positive and closely associated with development benefits, including improved healthcare, access to clean water, education, roads, employment opportunities, among others. However, it is important to note that while many respondents expressed support for having a conservation area nearby, a significant number also stated that they did not want dangerous animals—such as lions—to be reintroduced.

8.
ADDITIONAL OUTCOMES

8.1 RELATIONSHIPS & PARTNERSHIPS

The surveys conducted in the Zambian region of the proposed Liuwa–Mussuma Transfrontier Conservation Area played a key role in strengthening partnerships among core stakeholders. They laid a critical foundation for cross-border collaboration between the Cheetah Conservation Initiative (CCI), the Zambian Carnivore Program (ZCP), and key institutions including Angola's National Institute for Biodiversity and Conservation Areas (INBAC), the Moxico Provincial Government through its Office for Environment, Waste Management, and Community Services (GPAGRSC), the Zambian Department of National Parks and Wildlife (DNPW), and African Parks (AP), which co-manages Liuwa Plain National Park.

This kind of cross-institutional cooperation will be vital for the successful establishment, governance, and long-term functionality of the TFCA. Beyond stakeholder engagement, the surveys also served as a platform for capacity enhancement. CCI used the opportunity to provide field training to four Angolan team members, one of whom later received support to pursue an honours degree in natural resources management. Peer-to-peer learning between Angolan and Zambian team members further enhanced capacity development, offering valuable role models and practical mentorship to less experienced Angolan staff.

8.2 CAPACITY DEVELOPMENT

CCI is deeply committed to transferring knowledge and skills to wildlife professionals and future conservation leaders wherever it operates. In line with this mission, the surveys described in this report were not only a means of gathering ecological and social data, but also served as critical training opportunities for both Angolan and Zambian participant. These efforts highlight how surveys can contribute meaningfully to long-term capacity development alongside their immediate research objectives.

Figure 117 - ZCP, DNPW and CCI members collaborating in the UWZGMA survey.

Figure 118 - CCI team member being trained by ZCP in Liuwa Plain National Park on carnivore monitoring techniques.

Through these surveys, CCI provided field-based training to multiple Angolan participants in conducting semi-structured questionnaire surveys aimed at gathering local ecological knowledge, as well as an introduction to camera trapping techniques. Trainees included two senior and one junior technician from Angola's Ministry of Environment, appointed by INBAC, who received hands-on experience in human population survey methods and foundational skills in wildlife monitoring. Additionally, an Angolan intern joined the project in 2021 and received intensive training in camera trapping, ultimately enabling him to carry out surveys independently. CCI later supported this individual to pursue higher education in Namibia, with the expectation that he will return to the project in a more senior capacity—marking a significant investment in national leadership for large carnivore conservation in Angola.

This training represented a key step in building Angola's national capacity for wildlife research and monitoring. As part of a practical exchange between CCI and the Zambian Carnivore Programme (ZCP), the Angolan trainee gained field experience in carnivore tracking, observation, and telemetry—a rare opportunity in Angola. He also learned how to assist with collaring operations and use motorcycles for remote fieldwork, tools essential for effective conservation in challenging landscape.

During the 2022 survey work in Zambia, similar training was provided to three ZCP trainees, who, together with the Angolan participant, successfully led a repeat of the Zambian survey in 2023—demonstrating the practical success of this cross-border training model. Furthermore, in 2022, the CCI Angola team led a targeted two-day training course on camera trapping for eight Zambian students and ZCP interns. This hands-on course covered all aspects of camera trap survey design, implementation, data management, and analysis, equipping participants with key skills for future conservation work.

Motivated by the positive outcomes of the surveys and the strong partnership formed with the Moxico Provincial Government, CCI has expanded its outreach in the region since 2023. This includes the creation of the Moxico Environmental Conservation Club—established in partnership with the Moxico Provincial Office for Environment— and the launch of multiple training sessions and environmental education activities, including Geographic Information Systems (GIS) training. These initiatives have engaged a broad audience—ranging from government technicians and local academics to schoolteachers, students, traditional authorities, and religious leaders—both in the provincial capital Luena and in the core community of Lutembo within the Mussuma area.

Figure 119 - DNPW/ZCP and CCI members conducting a camera trap survey.

Figure 120 – Local students and community members during Environmental Education training under the Environmental Conservation Club initiative in Lutembo, Moxico, Angola.

9. DISCUSSION

9.1 INTERNATIONAL AND REGIONAL SIGNIFICANCE OF THE AREA

The establishment of the Liuwa-Mussuma Transfrontier Conservation Area between Mussuma in Angola and Liuwa Plain National Park in Zambia presents a significant opportunity to enhance biodiversity conservation, ecological connectivity, and cross-border collaboration.

At a regional level, this initiative serves not only as critical ecological connectivity but also as a socio-economic catalyst for both regions. Moxico province in Angola and the Western province of Zambia rank among the lowest in human development index and economic growth. However, our survey results highlight contrasting environmental and socio-economic conditions between both countries, which, while presenting challenges, also provide unique advantages for strategic conservation planning.

The proposed TFCA also encompasses significant portions of the Bulozi floodplains, a vital ecosystem for regional biodiversity and global environmental health. As part of the Zambezi River basin, these floodplains act as natural carbon sinks, capturing and storing substantial amounts of carbon, making their protection crucial in the fight against climate change. Furthermore, they play a key role in regulating water flow, mitigating floods during the rainy season, and maintaining water availability in drier months. These floodplains not only provide crucial ecosystem services, but also provide ecological connectivity, enhancing species movement, gene flow, and seasonal dispersal, which are essential for maintaining healthy ecosystems and ecological resilience. They also support a rich biodiversity, providing essential habitats for a wide range of aquatic and terrestrial species. Therefore, safeguarding and restoring this ecological connectivity is vital for halting biodiversity loss, sustaining ecosystem functions, and adapting to climate change.

Connectivity conservation requires innovative governance mechanisms that integrate various land and water use patterns, jurisdictions, and cultural contexts. The Liuwa-Mussuma TFCA represents a scalable solution for addressing environmental, social, and economic challenges by linking ecosystems, facilitating species migration, and promoting climate resilience. The global relevance of this initiative aligns with international biodiversity targets and the objectives of the Convention on Biological Diversity, as well as broader multilateral environmental agreements.

9.2 COMPARATIVE ANALYSIS OF HUMAN DENSITY AND WILDLIFE POPULATIONS

The proposed Transfrontier Conservation Area between Angola and Zambia highlights distinct contrasts in human population densities and ecological conditions, which are fundamental in shaping conservation strategies on either side of the border.

In Angola, the lower human population density and relatively pristine habitats offer a solid foundation for conservation. However, the potential for effective conservation is compromised by significant socio-cultural challenges mainly arising from the aftermath of the civil war. Many local residents, having returned after becoming refugees in Zambia, find themselves disconnected from traditional authority governance structures and with weakened knowledge of the land they once fled. This disconnection exacerbates challenges such as excessive

Figure 121 - Southern lechwe ram in Liuwa Plain National Park.

and uncontrolled hunting, as community-based wildlife management practices and traditional natural resource knowledge and governance have eroded.

On the Zambian side, the Upper West Zambezi Game Management Area (UWZGMA) faces challenges, including habitat degradation linked to higher population density. However, its existing status as a Protected Area, if combined with robust conservation management and restoration practices, could achieve significant improvements in biodiversity recovery and ecological health. The successful conservation efforts in Liuwa Plain over the past two decades, led by various actors including DNPW, The Barotse Royal Establishment, the local communities and African Parks, provide a clear example that restoration is indeed possible.

Results from our camera trap surveys indicated that, while some species such as the common duiker, steenbok, oribi and side-striped jackal have similar indices of abundance in both countries, there appeared to be a much lower prevalence or even absence of many other species including the aardvark, Cape porcupine, bushpig and blue duiker in the UWZGMA. We argue that this disparity results from the pressures from a higher human population density in the UWZGMA, including conversion of large areas of natural habitat to agriculture, which adversely affects the survival of many species. However, further research is needed to fully understand these effects.

In light of these complexities, conservation strategies in Angola should address not only immediate ecological threats—such as unsustainable hunting—but also the underlying social dynamics that contribute to environmental decline. Evidence from interviews highlights increasing pressure on wildlife populations, including reports of declining sightings of key species and reliance on bushmeat. These trends suggest that current levels of hunting may be unsustainable. At the same time, the erosion of traditional governance systems and local management practices has further limited communities' ability to regulate resource use. Rebuilding these structures and revitalizing traditional knowledge will be essential for promoting long-term sustainability and community-led conservation. Meanwhile, in Zambia, conservation efforts should continue to focus on habitat restoration and the implementation of sustainable management practices.

By addressing both ecological and socio-cultural challenges, the transfrontier conservation initiative can leverage Angola's ecological richness and Zambia's structured management approach to achieve balanced and sustainable conservation outcomes across the border, to the benefit of local communities and both countries. Tailoring strategies to the unique circumstances and needs of each area will be crucial in fostering resilience and ensuring the long-term success of conservation efforts.

9.3 SIGNIFICANCE FOR MAMMALS, WITH FOCUS ON CARNIVORES

The strategic positioning of the proposed Transfrontier Conservation Area—linking Liuwa Plain in Zambia with Mussuma in Angola and potentially extending to other key conservation areas such as Cameia National Park, Mavinga National Park, and the wilderness zones of eastern Moxico—holds significant ecological value. This landscape-level connectivity is essential for enabling genetic flow among wildlife populations, which in turn supports genetic diversity and bolsters species resilience to environmental change and human pressures.

The area is particularly important for large carnivores, including wide-ranging species such as cheetahs, whose cross-border movements have been confirmed through GPS collaring (see Figure 110). These regular movements indicate the gradual recovery of viable populations and underscore the potential of this region to function as a source population within the broader TFCA. For large carnivores, the ability to move freely across vast landscapes is fundamental to maintaining healthy populations, as it allows them to access diverse habitats and maintain

Figure 122 - A lioness resting in Liuwa Plain National Park.

genetic exchange across subpopulations (different genetic pools). However, the presence of these carnivores in areas with high human and livestock densities presents considerable challenges. Ensuring effective and lasting connectivity requires not only ecological planning but also strong community involvement. Landscape connectivity must be designed to reflect the natural movement patterns and ecological needs of species, particularly wide-ranging carnivores, while also prioritizing the safety and livelihoods of local people.

Rather than relying on narrow, artificial corridors, a more effective strategy involves restoring and maintaining functional connectivity across broader landscapes—enabling wildlife to move between key habitats without increasing the likelihood of conflict. Achieving this balance calls for the integration of conflict mitigation strategies, participatory land-use planning, and robust community engagement. Through such an inclusive approach, the TFCA can serve as a model for conservation that supports both biodiversity and the wellbeing of local communities, ensuring shared benefits for people and wildlife alike.

Section 9.12 provides a preliminary and broad analysis of the potential connectivity.

9.4 WILDEBEEST MIGRATION

The recent confirmed record of a GPS collared wildebeest female, monitored by ZCP and which was presumed to be part of a larger herd, migrating between Zambia and Angola in 2022 (ZCP 2024, unpublished data), represents the first documented instance of the recovery of transboundary movements. This preliminary finding provides hope that, with sufficient protection, the wildebeest migration can recover and expand into Angola.

However, the results from interviews both in Mussuma and the UWZGMA areas suggest that the migration's expansion into Angola could be hindered by significant hunting pressure in the Angolan side of the TFCA and along the borderline in both countries. Other factors pose a threat to both the existing migratory range of the wildebeest and the possibility of expansion or restoration of their historical cross-border migrations: 1) accelerated transformation of land into agriculture, overstocking and habitat degradation within the UWZGMA (Estes, 2013; Watson et al, 2022); and 2) human dominance of the water resources (lagoons and waterholes) for fishing purposes along the Angolan side of the border preventing access by migratory wildlife.

As noted by Becker et al. (2017) securing the protection of both existing and prospective dry season habitats beyond the confines of Liuwa Plain National Park is essential for the continued recovery of the integrity of this ecosystem and should be prioritised. This will increase the resilience of the ecosystem, allowing it to survive future climate shocks, and recover crucial ecosystem services, which can support the growth of sustainable natural resource-based livelihoods in what is an extremely remote and isolated area, where income generation options are currently limited.

9.5 STRENGTHENING PARTNERSHIPS AND CAPACITY ENHANCEMENT

This survey catalysed the development of strong collaborations between and among key stakeholders including the National Institute for Biodiversity and Conservation Areas (INBAC), the Moxico Provincial Office for Environment (GPAGRSC), the Zambian Carnivore Program (ZCP), the Department of National Parks and Wildlife (DNPW), African Parks (AP), and ourselves, the Cheetah Conservation Initiative (CCI). These partnerships are vital for the sustained management and ecological monitoring of the area, providing a collaborative framework that supports the overarching goals of the TFCA.

Building on this foundation, strategic initiatives have been developed to enhance future collaboration between CCI and ZCP within the Mussuma-Liuwa landscape. Notably, a joint pilot camera trap survey was conducted in Liuwa Plain National Park in late 2023. While the data collected were limited, the exercise provided valuable insights that will help refine the design of future, more comprehensive studies and contribute to a better understanding of wildlife dynamics and conservation planning. Additionally, a training exchange program has been initiated, aiming to foster mutual learning and expertise sharing between CCI and ZCP teams. This program not only strengthens the technical capacity of individuals involved but also solidifies the partnership between these entities.

A Memorandum of Understanding (MoU) was signed between CCI and the Ministry of the Environment of the Republic of Angola in 2016, which was renewed for 10 years in 2022 and specifically includes support for conservation efforts in this area. Additionally, an MoU was also signed between CCI and the provincial government of Moxico, represented by the Moxico Provincial Office for Environment (GPAGRSC), establishing a critical foundation for advancing conservation and research efforts in the Mussuma area. These agreements underscore CCI's commitment to supporting the Ministry of Environment and the Moxico Provincial Government in implementing long-term conservation and research initiatives. Central to these partnerships are the development of local capacity, providing employment opportunities, internships, and training for Angolan researchers and conservationists.

Through these collaborations, CCI has already implemented a series of training sessions focused on environmental education and land-use planning tools. These activities have included introductory training in Geographic Information Systems (GIS), which holds particular value for future spatial planning and conservation efforts. In parallel, traditional and religious leaders were engaged in tailored training activities aimed at strengthening their understanding of environmental issues and their role in promoting sustainable land stewardship.

Together, these efforts to foster partnerships and build capacity form a critical foundation for sustainable, long-term conservation in the region. By establishing a cooperative framework for managing and monitoring ecological health, they support the achievement of shared conservation goals across borders. Strengthening both human and technical capacity is essential for integrating and scaling up connectivity conservation strategies, reinforcing ecosystem resilience, and enhancing adaptive responses to climate change (Hilty et al., 2020). This approach exemplifies a holistic and sustainable conservation model—one that blends scientific research, education, and international collaboration to ensure lasting impact for both people and nature.

9.6 ADDRESSING KEY THREATS: UNCONTROLLED FIRES, HABITAT LOSS AND DEGRADATION, AND HUNTING

The threats of uncontrolled fires, habitat loss and degradation, and excessive hunting are interlinked with the socio-economic fabric of the local communities. Addressing these threats requires a community-based approach that engages local communities in the sustainable management of natural resources, including developing enforceable natural resource governance systems, and which is supported through a capacity development and training programme.

Uncontrolled fires, set indiscriminately and often without purpose or traditional oversight, have become a pervasive threat, resulting in significant ecological damage and posing serious risks to human health and food security. These fires, often exacerbated by a lack of coordinated management, can sweep through large areas, destroying habitats, endangering both people and wildlife, and annihilating crops crucial for the sustenance of local communities. Instituting community-based fire management programs can be a critical step towards mitigating this threat. Such programs would involve training local communities in effective fire prevention and control techniques and reinstating a form of communal oversight that may have been lost (or never existed). Nevertheless, given the importance of fire in these ecosystems, further long-term research is necessary to better understand its ecological role leading to the development of adaptive fire management plans across the landscape. Liuwa Plain National Park already serves as a strong example in this regard, having implemented a Fire Management Plan developed through full community consultation and incorporating traditional burning practices.

In Angola, habitat loss and degradation are driven not only by slash-and-burn agriculture—a traditional farming method that leads to extensive habitat destruction—but also by unsustainable wood exploitation. Both practices contribute significantly to the degradation of the natural environment, affecting biodiversity and the sustainability of local ecosystems. To address these dual threats, it is essential to introduce less impactful agricultural practices that increase land productivity, without expanding the land under cultivation, and to implement sustainable forestry management techniques that regulate and reduce the impact of wood exploitation.

Programs that offer training in more productive and less impactful agriculture, coupled with incentives such as seed banks and agricultural tools, could facilitate this transition and help diversify the livelihoods of the local communities, whilst enhancing food security. Similarly, sustainable forestry initiatives that include controlled logging, reforestation efforts, and the promotion of alternative energy sources to reduce the demand for firewood are crucial. These integrated management strategies will not only mitigate habitat degradation but also support the ecological integrity of the region while improving the local economic opportunities.

Unsustainable hunting, driven by both subsistence needs and commercial incentives, poses a severe threat to wildlife populations. Hunting is deeply embedded in the local culture but has escalated to unsustainable levels largely due to the influence of external forces profiting from the trade rather than benefiting the local communities themselves. This unsustainable commercial exploitation of wildlife poses serious threats to biodiversity and ecological integrity having already caused a sharp decline in wildlife populations and the local extinction of several species. Addressing this issue effectively requires not only the development of community-based wildlife management and monitoring programs but also a strong political commitment to enforce regulations that limit the influence of external exploiters. In addition, it is crucial to provide viable economic and protein alternatives to hunting that can support local livelihoods and reduce the reliance on bushmeat. Initiatives such as livestock development in the main villages—those located outside the proposed core protected area and along accessible routes such as the main road between Luena and Lumbala N'Gimbo—, sustainable agriculture and agroforestry, poultry production and eco-tourism should be designed to empower local communities.

In addition to hunting, the emerging illegal trade in orchid tubers for the Zambian chikanda market represents a new cross-border pressure, highlighting the need to address plant as well as wildlife exploitation.

9.7 FISHING

Although not explored in this survey, fishing is a crucial part of the local economy, serving as the primary source of protein and income for many rural households in both countries. In Zambia, fishing is regulated by conventions that govern the fishing rights of individuals and communities (DNPW, 2016). While Angola has national fisheries regulations, it is unclear whether specific rules exist for the Mussuma area. Regardless, enforcement appears to be minimal or absent, largely due to limited institutional presence, resource constraints, and a widespread perception that fish stocks remain abundant. However, fishermen in the region have raised concerns about declining fish stocks, attributing this to challenges in utilizing sustainable fishing practices. Additionally, Zambian fishermen are reportedly exploiting the lack of law enforcement by fishing in Angolan waters.

Further research should investigate the sustainability of current fishing practices in the Mussuma region in Angola and the implementation of effective law enforcement to protect fish stocks and support local livelihoods. There is an opportunity for increased collaboration and dialogue between local communities, conservation organizations, and government authorities to reach mutually agreed perspectives on resource availability. Enhancing awareness of sustainable fishing practices and strengthening the enforcement of regulations could ensure long-term viability of fish resources, benefiting both local livelihoods and supporting sustainable delivery of ecosystem services.

Figure 123 - Fisherman in the Luena river floodplain.

9.8 THE POTENTIAL EFFECTS OF MINING IN THE EASTERN FLOODPLAINS AND THE LIUWA-MUSSUMA TFCA

The Eastern Floodplains of Angola, part of the transboundary Bulozi system, provide essential ecosystem services, including water purification, flood regulation, and critical habitat for migratory species. Within this landscape, the Mussuma region functions as a key ecological corridor, supporting biodiversity and maintaining connectivity across national borders. However, this area is increasingly under threat from expanding mining activity—particularly copper exploration. Even early-stage prospecting carries significant environmental and socio-economic risks. These threats, outlined below, pose a real danger to both the ecological integrity of the floodplains and the long-term resilience of local communities who depend on them.

Water Pollution and Sedimentation

Mining often releases heavy metals and pollutants into river systems, degrading water quality and threatening biodiversity and human health far downstream—an issue particularly sensitive in transboundary floodplains like the Bulozi. Pollution in Zambia's Copperbelt, where the Kafue River has been contaminated with cadmium, lead, and mercury, illustrates the severity of these risks (Křibek, 2023). Mining also increases erosion, contributing to sedimentation that disrupts river morphology, reduces floodplain water retention, and affects agriculture and fisheries across borders. Worldwide, metal mining affects over 479,000 km of river channels and 164,000 km² of floodplains (Macklin et al., 2023). In response to such risks, mining projects in sensitive areas like the Lower Zambezi have already been suspended (The Water Diplomat, 2023), underscoring the urgent need for stringent safeguards in the Zambezi River system.

Biodiversity and Habitat Loss

The Bulozi floodplains support diverse species and facilitate seasonal wildlife movements. Habitat fragmentation and pollution caused by mining can significantly disrupt these ecological processes. Lessons from the DRC show how extractive industries can encroach upon protected areas and lead to biodiversity collapse (Balasha & Peša, 2023).

Roads, Hunting, and Logging

Access roads constructed for prospecting often become permanent conduits for poaching and illegal logging (Kleinschroth et al, 2019; Kleinschroth & Healey, 2017). In Mussuma, similar roads built for illegal timber extraction a decade ago remain in use by bushmeat hunters (see section 3.5). A similar pattern is observed in Angola's Quiçama National Park, where oil prospecting tracks have become conduits for poaching activities (Groom et al., 2018). Restoration measures such as road decompaction and reforestation are essential to reduce long-term damage.

Increased Bushmeat Demand

Mining income may drive higher demand for bushmeat as newly monetized communities mirror urban consumption patterns. This phenomenon is well-documented across Central Africa and contributes to wildlife and resource depletion (Spira et al., 2019; Vitekere et al., 2021). Mitigation should include environmental education, alternative livelihoods, and strong community-based governance.

Livelihood and Health Risks

Communities reliant on agriculture and fishing are highly vulnerable to pollution and ecosystem degradation. In Zambia, proximity to mining has been linked to declining health indicators, particularly respiratory illnesses (Ministry of Health Zambia, EQUINET, 2018). Similar impacts in the Bulozi floodplains could worsen food insecurity and exacerbate poverty.

Human Rights Concerns

Large-scale mining has historically led to forced displacement, unsafe working conditions, and abuse in countries like the DRC (Makal, 2024). Weak legal enforcement further compounds these risks, leaving local communities exposed to exploitation.

Transboundary Management and Governance

Shared basins demand shared responsibility. Yet Angola and Zambia differ in environmental regulations and enforcement capacity. Effective management of cross-border mining impacts will require coordinated monitoring, harmonized policies, and dispute resolution frameworks to safeguard the ecological integrity of the region.

A Cautionary Case: The Copperbelt 2025 Spill

A major tailings dam failure in Zambia's Copperbelt in 2025 released highly acidic effluent (pH 1.8–2.5) into the Mwambashi and Kafue Rivers, causing massive fish die-offs, crop loss for over 200 farmers, and the shutdown of water supplies in cities like Kitwe and Kalulushi (Kamanga, 2025; Firstpost Africa, 2025). This incident highlights the urgent need for strict regulatory enforcement in ecologically sensitive areas like Mussuma. It also underscores the value of strong protected area management—African Parks' response in Kafue National Park, including water quality monitoring and early contamination detection, exemplifies how conservation can safeguard both biodiversity and communities during environmental crises (Kafuenationalparkzambia, 2025).

Balancing Risks and Opportunities

While mining in Mussuma presents clear dangers, responsible operations—if properly regulated—could support conservation and development. Environmental offsets, corporate social responsibility programs, and investments in education, healthcare, and infrastructure may offer long-term benefits. However, realizing such potential hinges on strict legal compliance, meaningful community participation, and the integration of sustainability principles into all phases of mining development.

To minimize ecological damage, mining operators must engage in continuous dialogue with environmental organizations and relevant government authorities. Such collaboration can help identify and protect critical ecological areas—particularly those essential for transboundary wildlife movements. Several key habitats within the Liuwa–Mussuma landscape must remain intact if regional connectivity and species recovery efforts are to succeed. Without proactive coordination, mining may irreversibly compromise the region's conservation value.

9.9 ENGAGING COMMUNITIES IN CONSERVATION EFFORTS

The long-term success of the transfrontier conservation area depends significantly on the active participation and support of local communities. Inclusive conservation programs must provide clear, tangible responsibilities and benefits to these communities, fostering their active engagement in sustainable conservation efforts and natural resource governance systems. Benefits could range from employment in conservation projects, such as wildlife monitoring roles, to partnerships for sustainable economies based on local wild products. Further opportunities include roles in eco-tourism, such as employment in the hospitality sector or as tour guides, as well as enhanced access to training programs, like conservation-focused educational programs and capacity building through professional and academic training.

However, participation alone is not enough. Governance structures that enable communities to shape and lead conservation processes are essential. Adaptive community co-management systems offer a promising model in this regard. These systems emphasize iterative learning, power-sharing, and the integration of local and scientific knowledge, thereby improving the resilience of conservation strategies in complex and dynamic environments. Drawing from principles outlined by Butler et al. (2021), such approaches promote flexibility, trust, and cross-scale collaboration. They are particularly suited for managing the uncertainties and socio-political complexities that arise in transboundary conservation initiatives. Establishing "bridging organizations" or facilitation teams—independent and trusted by all

Figure 124 - CCI and the Moxico Provincial Office for Environment engaging community leaders in conservation education, Lutembo. 2024.

stakeholders—can help coordinate these efforts, broker knowledge, and mediate potential conflicts. This ensures that governance is not only inclusive but adaptive to shifting ecological and social realities.

The conservation of migratory species presents unique challenges, as these species regularly cross national and community boundaries. Indigenous territories, community-conserved areas, and other effective area-based conservation measures (OECMs) are vital for maintaining migratory routes, but effective coordination among stakeholders is crucial. Strengthening local expertise and conservation practices through structured transboundary support can enhance these efforts. When communities take the lead, successful strategies can spread naturally, reinforcing sustainable practices across regions. Facilitating interactions between community representatives fosters collective action to address key threats to migratory species. However, uncertainties around ownership, sustainable use, and benefit-sharing can complicate community-led conservation, particularly given the risk of over-exploitation in a 'tragedy of the commons' scenario. International NGOs and transboundary conservation programs play a key role in ensuring community engagement along migration routes, promoting cooperation, and facilitating knowledge exchange. Moreover, they help ensure that conservation efforts equitably distribute costs and benefits across all communities along a species' migratory range, sustaining long-term engagement (CMS, 2024).

Education and awareness campaigns are equally important in fostering a conservation ethic among local populations. These initiatives should emphasize the ecological and economic benefits of wildlife conservation, underscoring the interconnected nature of migratory species and the necessity of regional cooperation. Encouraging sustainable practices requires ensuring that the broader community gains tangible economic benefits that outweigh short-term incentives for unsustainable activities (Gosling & Capellini, 2013; Cooney et al., 2017). By integrating conservation education with economic opportunities, communities can be more effectively engaged in long-term species protection efforts.

The remoteness of the area, limited infrastructure, and the relatively nascent stage of Angola's tourism industry may pose significant challenges in the short term. These factors suggest that opportunities such as ecotourism might be more feasible as long-term goals, requiring careful planning, investment, and gradual development to fully realize their potential. In the meantime, non-consumptive use approaches like carbon credits can provide alternative incentives for conservation while avoiding over-exploitation. Carbon credit programs, in particular, offer financial benefits to communities by preserving forests and other critical habitats that support migratory species. Successful models exist and could be adapted to local contexts, offering sustainable economic opportunities while reinforcing conservation efforts.

Additionally, these initiatives can help restore and enhance the status of traditional leadership, which may have been undermined during periods of armed conflict. Strengthening community governance is key to ensuring the sustainable management of conservation areas, particularly when dealing with species that require transboundary cooperation. By addressing both the socio-economic and ecological complexities of migratory species conservation, these strategies can contribute to a more resilient and effective conservation governance framework.

9.10 COMMUNITY BASED NATURAL RESOURCE MANAGEMENT AND SUSTAINABLE FINANCE.

Community-based natural resource management (CBNRM) has been effective in Southern Africa, particularly in Namibia, Botswana, and Zimbabwe (Child, 2019; Roe et al., 2009). This model integrates socio-economic development with conservation by empowering local communities to manage and benefit from natural resources. It typically involves devolving management rights, providing economic incentives, and generating income through activities like wildlife tourism and trophy hunting while promoting sustainable resource use. Community-Based Wildlife Management (CBWM) builds on this approach, encompassing both consumptive and non-consumptive resource use, including traditional subsistence practices, sustainable timber harvesting, and the conservation of culturally significant species. By fostering collective governance, CBWM aligns with common property resource theory (Agrawal, 2001), which emphasizes locally managed systems to prevent resource depletion and ensure long-term sustainability.

The Mussuma area in Angola presents an opportunity to adapt CBNRM, but several challenges must be addressed. The legal framework, institutional structures, and social organization require targeted development—such as clear legal recognition of community land and resource rights, the establishment of accountable local governance bodies, and the strengthening of community cohesion and participatory decision-making processes—to effectively support community conservation initiatives. While initial efforts should focus on community-based conservation—where communities participate in externally designed programs—the vision for the future is to transition toward community-led conservation, in which local communities are the primary decision-makers and leaders of conservation efforts. This shift requires strong and inclusive governance structures, local capacity building, and equitable benefit-sharing mechanisms to ensure that conservation is fully owned and directed by communities.

Wildlife populations in the Mussuma area are currently low, necessitating significant recovery efforts before considering income-generating activities like trophy hunting or general wildlife tourism. However, ecotourism could begin to develop from a low base in the short term, particularly through niche markets like birdwatching, which require less visible large mammal fauna. The area's floodplains and wetland ecosystems support diverse and unique birdlife, offering an early opportunity to stimulate small-scale tourism. Additionally, balancing conservation with sustainable hunting requires careful management to avoid societal confusion, particularly where bushmeat reduction efforts coincide with trophy hunting promotion. Ensuring that conservation policies are equitable, inclusive, and aligned with local rights and needs, as emphasized in international agreements like the Kunming-Montreal Framework (Targets 5, 9, and 22) and the UN Declaration on the Rights of Indigenous Peoples, will be critical (Zuther et al., 2024).

Tourism is unlikely to become a major income source in the near future due to the area's remoteness, limited accessibility, and lower wildlife diversity compared to other regional protected areas. Instead, alternative sustainable income sources should be prioritized, including carbon credits from forest regeneration, fire reduction, and peatland protection. Other viable opportunities in the Angolan context include community-based sustainable timber harvesting and processing (e.g., sawmills and carpentries), agroforestry, conservation agriculture, and small-scale enterprises like honey production, wild fruit processing, artisanal crafts, and other conservation-friendly businesses.

Effective governance, transparency, and strong community-based organizations have been key to successful CBNRM and CBWM programs in Southern Africa. For Angola, adaptation will require ensuring that local communities are both stewards and beneficiaries of conservation. Recognizing indigenous and local rights in conservation policies, as outlined in global human rights frameworks, will be essential in fostering long-term commitment to conservation efforts.

By implementing these strategies, Angola can establish a financial model that integrates conservation with community development, with Mussuma serving as a blueprint for replication across the country. Community-based organizations should be prioritized as key drivers, reinforcing collective governance and sustainable resource management to prevent open-access depletion (Roe & Booker, 2019) while creating viable livelihood opportunities. Aligning conservation efforts with community needs will ensure sustainable development and the protection of Angola's natural heritage.

9.11 NAMING

Naming is more than a nominal designation; it reflects the community's identity and engagement with the conservation efforts. As such, further consultations are necessary to ensure that the chosen name for any new or expanded conservation areas resonates with and is embraced by local communities, thereby fostering a deeper connection and commitment to the conservation objectives.

At the time of selecting a name for the area, the name Mussuma was chosen by the assessment team (PPF, 2009). However, Mussuma specifically refers to the comuna in the southern part of the proposed area, including the forested region and the river. The population residing in the floodplains in the central and northern side of the area do not recognise this name. The entire floodplain, stretching from the Lungué-Vungo River to the Luanguinga river, is known as Mboela, a name that is accepted by the Regedor (traditional leader) and the communities. Further consultations should be conducted with the local communities to select a name that is universally recognized and accepted.

To reflect these distinctions and foster inclusivity, a dual naming approach could be adopted: Mussuma for the forested region and Mboela for the floodplains. For the broader conservation complex, including Cameia National Park, the name "Chanas do Leste de Angola," which translates to "Angolan Eastern Floodplains," could be used, as this is how the area is commonly known within the country.

Ultimately, the final decision on names must emerge from collaborative consultations with local communities. This ensures that the chosen names are culturally meaningful, widely accepted, and integral to fostering a shared commitment to conservation efforts.

9.12 PRELIMINARY ZONATION, WILDLIFE CORRIDORS AND CONSERVATION PRIORITIES

Wildlife connectivity is a well-established strategy for promoting the dispersal of plants and animals between habitats. They enhance genetic diversity for resilient populations and provide essential migration routes in response to climate change (DeFries et al., 2023). The Liuwa-Mussuma Transfrontier Conservation Area presents an exceptional opportunity to strengthen wildlife connectivity between Angola and Zambia.

Figure 125 - A view of the Mussuma landscape.

Designating the Mussuma Conservation Area in Angola, within its originally proposed boundaries (see Figure 127), as a core conservation zone with the highest level of protection is critical. Without this designation, connectivity with Liuwa Plain would be severely compromised. However, the region's relatively intact habitats and low human population density present a rare opportunity to expand beyond these initial boundaries. This expansion would secure vital links not only with Liuwa but also with Angola's Cameia National Park to the north, Mavinga National Park to the south, and the western Moxico wilderness to the west.

An expanded conservation area would significantly enhance the ecological integrity of the broader landscape, making a profound contribution to biodiversity conservation in southern Africa. Wide-ranging species like cheetahs and African wild dogs require far more space than the proposed Mussuma core area can provide to sustain viable populations. A larger protected area would address these needs while also attracting increased investment from the conservation sector, boosting the feasibility and long-term success of the initiative.

In summary, we recommend formally designating the proposed conservation area outlined in 2002 (Sectors A, B, C, D, and E, as shown in Figure 127) as the core conservation area, encompassing approximately 5,288 km², with priority given to implementing a participatory land-use planning in this region first. Simultaneously, the connectivity areas (Sectors G, H and I) should also be formally declared as protected. These connectivity areas, like the core conservation area, will require participatory land-use planning to safeguard and restore connectivity while accommodating sustainable human development.

Given the importance of these connectivity areas for wildlife movement and ecosystem integrity, they can be recognized as Other Effective Area-Based Conservation Measures - OECMs (IUCN-WCPA, 2019). In November 2018, this approach was formally acknowledged when the Parties to the Convention on Biological Diversity (CBD) adopted at the 14th Conference of the Parties a definition of OECMs, along with guiding principles and criteria for their identification (CBD/COP/DEC/14/8). According to Decision 14/8, an OECM is:

A geographically defined area other than a Protected Area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the in situ conservation of biodiversity with associated ecosystem functions and services and, where applicable, cultural, spiritual, socio–economic, and other locally relevant values.

Unlike protected areas, which must have a primary conservation objective, OECMs may be managed for multiple purposes while still delivering effective biodiversity conservation. They provide an opportunity to recognize long-term conservation efforts occurring outside designated protected areas under various governance and management regimes. These may include indigenous and local community-led initiatives, private sector engagement, and government-managed areas, all contributing to broader conservation goals.

As a signatory to the Convention on Biological Diversity (CBD), Angola has committed to advancing global biodiversity targets, including the expansion of protected and conserved areas in line with international frameworks such as the Kunming-Montreal Global Biodiversity Framework (GBF) and the Aichi Biodiversity Targets. By formally recognizing and designating at least some of these connectivity areas as OECMs, Angola would not only contribute to its national biodiversity strategy but also enhance its standing in global conservation efforts. This designation would:

- Support Angola's commitments under the CBD by increasing the coverage of conserved areas beyond formally protected zones.
- Help meet the global target of protecting at least 30% of land and inland waters by 2030 ("30x30" goal), contributing with approximately 3% of the Angolan inland national territory.
- Strengthen Angola's ecological networks by ensuring habitat connectivity for wildlife corridors, which are essential for species movement and genetic diversity.
- Promote international recognition of Angola's conservation efforts, potentially attracting funding and technical support from global conservation programs.
- Facilitate the integration of sustainable land-use planning, balancing conservation goals with local community needs and economic development.

Altogether, the broader conservation area proposed for the Angolan side could span approximately 45,000 km², as delineated in Figure 127. It is important to note that much of Moxico Province remains understudied, with very low human density and most of its habitats in good or recoverable condition. This presents a remarkable opportunity for large-scale conservation and connectivity efforts that could turn the province among the most important strongholds for wildlife in the continent. To fully realize this potential, regular assessments and adaptive, dynamic policies will be crucial as new research insights and conservation achievements continue to emerge.

Based on the above, a preliminary proposal of zonation is presented below which encompasses 15 conservation sectors, six of which are located in Zambia. Each sector includes detailed descriptions outlining its boundaries and intended purposes and has been designated with specific protection patterns and uses, strategically developed to ensure wildlife corridors.

Additional surveys would be needed once the final extent of the TFCA is decided.

> This zonation proposal is based entirely on the results and observations gathered during the surveys concerning this report and is intended as a preliminary guiding suggestion. It is not fixed and must be revised and adjusted based on further insights and feedback. To ensure its validity and effectiveness, extensive consultation with relevant government authorities, local communities, and other stakeholders operating in the area will be essential.

Figure 126 – Grey crowned cranes in Liuwa Plain National Park.

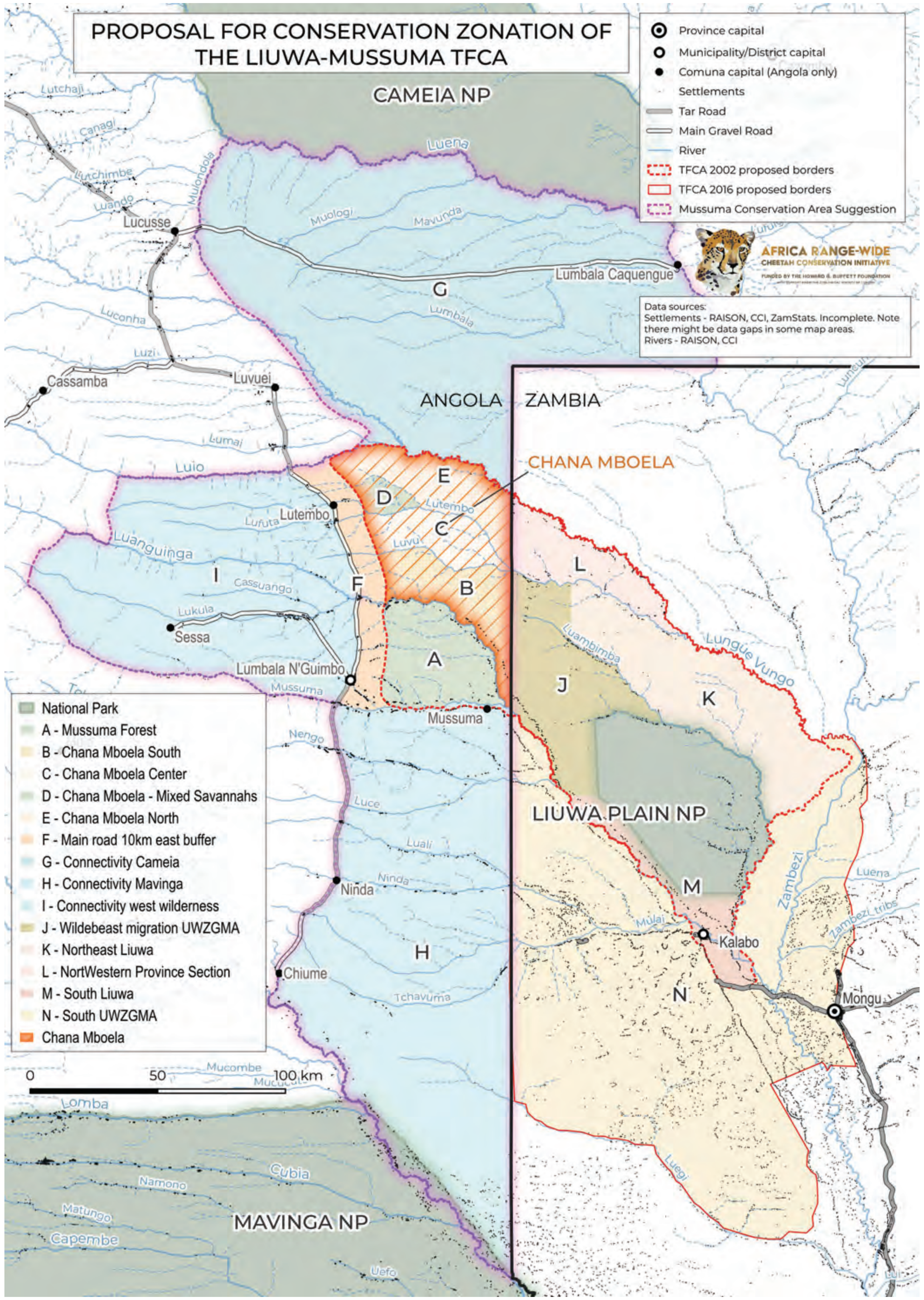


Figure 127 – Proposal for conservation zonation of the LMTFCA and surrounding connectivity areas.

ANGOLA SECTORS

Sector A: Mussuma Forest - Forested area in the Mussuma comuna ~1,570 km^2

This area constitutes one-third of the 2002 proposed 'Mussuma Conservation Area' in Angola and is naturally bordered by the Luanguinga and Mussuma rivers. Its primary objective should be to rehabilitate the dense miombo- *Cryptosepalum* forest, which has suffered significant degradation due to illegal rosewood exploitation and subsequent issues such as uncontrolled fires and increased hunting facilitated by improved access. This forest habitat is crucial for several species, particularly the leopard, which is likely to be extinct in the Zambian side of the TFCA and significantly diminished in Angola. It is also one of the most densely populated areas, with settlements along the margins of both the Mussuma and Luanguinga rivers. A forest restoration project should be planned for the immediate future. This area could be interesting for the establishment of a community forest reserve.

Sector B: Chana Mboela South - Wildebeest migration corridor ~1,270 km^2

This area is naturally demarcated by the Luvu and Luanguinga rivers and creates a direct link with Liuwa Plain National Park via sector H in Zambia. The purpose of this area is securing connectivity and restoring the historical wildebeest migration route. Additionally, it represents a critical zone for large carnivores' dispersal from Liuwa Plain NP (see Figure 127). Together with Sector C and E, this region constitutes the core conservation area and merits the highest level of protection, particularly if there is an increase in the level of protection of the UWZGMA. There is a risk that poaching could intensify in the unprotected Angolan landscapes, similar to previous patterns observed elsewhere. For example, when African Parks assumed management of Kafue National Park, poaching within the park decreased but surged in the surrounding GMAs (Kafue NP AP Manager pers. comm.). This underscores the urgent need for robust protection measures in these regions.

However, a mixed-use protection level should be implemented along a strip by the Luanguinga River, which is strongly populated by humans. Additionally, the management of water resources inside this sector is crucial, as some species, like the roan antelope, are highly water-dependent and currently face threats from competition for water resources with cattle and fishing activities.

Sector C: Chana Mboela Center - Calupa/Luengo: Pristine and largely inhabited floodplain ~826 km^2

Naturally bordered by the Lutembo and Luvu rivers, access to this area is limited to canoe entry from the east, where the two rivers meet, or by foot from the west. The challenging access results in a very low population density (at the time of the survey, approximately 100 people in a single village on the eastern corner at the Luvu River margin), contributing to its largely pristine condition with minimal human impact. This area, together with Sector B and E, constitutes a core conservation zone and should be granted the highest level of protection, as it is a critical site for wildlife recovery and has the potential to serve as a sanctuary.

Sector D: Liambuca-Cauiana: inhabited Mixed Floodplains and forest ~250 km^2

The area is encompassed by the Cauiana and Lutembo rivers and features a balanced mixture of dense miombo/*Cryptosepalum* forests, open savanna and floodplains. It has no human population, and little habitat degradation and is only 10km from the Lutembo village. This area could be an ideal setting for a community-based natural resource management and conservation programme.

Sector E: Chana Mboela North - Sacaliata: The roan antelope floodplain and fringe forests ~1,300 km^2

The area is naturally defined by the Lungué-Vungo and Lutembo rivers and directly connects with sector L in Zambia, and is mostly comprised by extensive floodplain, savanna and fringe forests. Is home to the (relatively) strongest population of roan antelope, and their forests were the only areas where leopards were captured on camera traps, underscoring the need for high protection status. Slash-and-burn agriculture activities, initially closer to main road or Lutembo, are shifting eastward and significantly impacting the forest habitat. Like Sector B, a mixed-use protection strategy should be considered at least in some areas along the Lungué-Vungo strip where the human residents concentrate. The rest of the area should receive a higher level of protection.

Of notable importance is the **Lutembo River on the Angolan side**. Along more than 70 km where it divides section C and D/E it has no human population settled on its margins, providing a unique opportunity for habitat preservation. Nevertheless, smuggling and immigration routes between Zambia and Angola were detected and reported along the northern margin.

The area referred to as Chana Mboela (sectors B, C, D and E) forms the essential bridge between the Zambian and Angolan sides of the Liuwa-Mussuma Transfrontier Conservation Area. Without the preservation of this corridor, the TFCA loses both its ecological function and its core justification for existence. **This area must be granted the highest level of legal protection—ideally as a Strict Nature Reserve.** This status is essential to shield the area from mining, oil exploration, and other incompatible land uses that pose a direct threat to its ecological value and long-term viability.

Sector F: 10 km buffer zone between the core conservation area and the main road - largest human settlements – Mixed use – 1,190 km^2

This area experiences significant human impact due to its proximity to the main tar road, larger towns, villages, and agricultural developments. Despite these pressures, it retains substantial conservation value and plays a key role in maintaining connectivity with the western wilderness area. As such, it could be considered a transitional buffer zone for mixed-use activities, bridging the gap before reaching the core conservation areas to the east.

Sector G: Connectivity between Mussuma and Cameia National Park – Large inhabited floodplain ~16,250 km^2

This vast floodplain, situated between the Luena and Lungué-Vungo rivers and aligned in Figure 127 east-west with the limits of the Bulozi floodplains, plays a critical role in maintaining and restoring connectivity between Mussuma and Cameia National Park, and consequently, between Cameia and Liuwa Plain NP. Its significance is underscored by the fact that it was the only area where both lechwe and wattled crane were observed during our survey. Human density here is very low, especially in comparison to the Zambian side, with populations primarily concentrated along the road leading from Lucusse to Lumbala Caquengue. It is important to prioritize extending protection to this area, after safeguarding sectors A, B, C, D, and E.

Sector H: Connectivity between Mussuma and Mavinga through Ninda and Chiume ~13,800 km^2

The area extending south from Mussuma to the banks of the Cuando River features a diverse landscape, including floodplains, savanna, and dense forests. Human populations are primarily concentrated along the main rivers, particularly in the northern part of the region. As in similar areas, this region likely experiences habitat degradation and a decline in wildlife. Nevertheless, it presents a valuable opportunity to connect Mussuma with the southern conservation zones, such as Mavinga and Luengue Luiana National Parks. A survey would be needed to assess the current status of its wildlife populations, especially in the southern section.

Sector I: Connectivity between Mussuma & the 'western Moxico wilderness area'. ~8,560 km²

Restoring wildlife populations in the Mussuma area could yield mutual benefits through connectivity not only with Liuwa Plain National Park but also with the wilderness area of western Moxico. Recent surveys in this wilderness area (NGOWP, 2018) have identified significant remaining populations of wildlife, including all five large carnivores: lion, cheetah, hyena, wild dog, and leopard. Facilitating wildlife dispersal across this vast landscape could enhance genetic diversity and contribute to the overall ecological health of the species involved. Achieving this connectivity could also extend benefits to the southeastern part of Angola, specifically the Luengue-Luiana and Mavinga National Parks, as these areas are naturally linked without significant human-created barriers.

ZAMBIA SECTORS

Liuwa Plain National Park: Core TFCA conservation area ~3360 km²

As a long-standing, well-protected conservation area, Liuwa Plain will play a central role in the TFCA, serving as the main source of wildlife populations for the region.

Sector J: Wildebeest migration UWZGMA – Core connectivity with Angola ~2,470 km²

This area, mostly located between the Angolan border, Liuwa Plain NP, the Lutembo, Luambimba and Luanguinga rivers. At certain times the area contains nearly the entire Liuwa wildebeest population on their winter range and is the area of most activity by the associated carnivores (Matt Becker, pers. comm.). It merits a high level of protection and concentrated conservation efforts, focusing on habitat restoration and poaching reduction to safeguard and facilitate the reestablishment of the wildebeest migration. Mitigating human-carnivore conflicts should also be a central aspect of the conservation programme in this sector, as it also represents carnivore's main dispersal route to Angola.

Sector K: Northeast Liuwa UWZGMA ~3,480 km²

Although less critical for connectivity, it represents an important opportunity for community conservation, facing similar challenges as in sector H.

Sectors L: Northwestern Province Section - Connectivity with sector E. ~1,240 km²

Although it is directly connected to Sector E in Angola, the area is inaccessible by land from the Zambian side due to the absence of bridges over the Lutembo or Lungué-Vungo Rivers. While this area was not surveyed for the current report, it remains a critical zone for ecological connectivity with Angola. Given the relatively better wildlife status on the Angolan side, it could also represent the most ecologically intact part of the Zambian component of the Transfrontier Conservation Area, despite the significantly higher human population compared to the Angolan side. A wildlife status survey is necessary to assess its current condition.

Sector M: South of Liuwa Plain NP~1,060 km²

Area not surveyed under the scope of this report. It should be carefully considered due to its higher human population density and the encompassing of the Luanguinga River floodplain, of special relevance for waterlogged habitat dependant species such as lechwe and sitatunga. The area was frequented by wild dogs in the past for hunting during the winter (reedbuck, lechwe), with denning reported (Matt Becker, pers. comm.).

Sector N: UZGMA LMTFCA extension 2016 ~16,600 km²

Included in the LMTFCA border proposal of 2016 by DNPW, it encompasses part of the Upper West Zambezi GMA south of Liuwa Plain NP. This area was not surveyed under the scope of this report. It presents the higher human population density in the area and its habitats and wildlife are probably highly impacted, which can pose significant challenges for wildlife and ecosystem restoration.

9.13 WILDLIFE RECOVERY

Wildlife abundance and diversity in the study area—on both the Angolan and Zambian sides—have been severely impacted by human activities, primarily hunting, habitat degradation, and competition with livestock. Reducing these pressures could pave the way for a rapid, natural recovery of wildlife, particularly given the proximity of a well-protected source population in Liuwa Plain National Park.

Smaller antelope species such as common duikers, oribis, and steenboks are expected to rebound quickly with effective protection. Larger herbivores like zebras and wildebeests may also resume their historical migration routes across the Angolan landscape. Conversely, species currently more common on the Angolan side—such as porcupines, aardvarks, and blue duikers—could potentially expand their range into Zambia as habitat conditions improve. This process of natural recolonization will depend heavily on the sustained reduction of human pressures and the restoration of suitable habitats.

The roan antelope, the only large antelope persisting across both sides of the study area, is locally critically endangered. Its populations remain extremely low, particularly in the southern Angolan floodplains and the UWZGMA. As such, it must be prioritized for targeted recovery efforts.

To further enhance biodiversity, species reintroductions may be considered once baseline protection is secured. Lechwe, tsessebe, buffalo, and eland—whose populations remain relatively low even within Liuwa Plain NP—could be reintroduced to help restore ecological balance and improve system resilience.

Large carnivores such as lions, hyenas, cheetahs, and wild dogs may naturally recolonize areas outside Liuwa Plain NP if prey populations recover and human pressures decline. The Zambian side may also benefit from the potential return of leopards, supported by remnant populations in Angola.

However, further ecological studies are essential to assess habitat suitability and carrying capacity for different species. Addressing the root causes of wildlife decline is critical for lasting recovery. With effective conservation strategies, the area holds significant potential to support a thriving diversity of both small and large species. Combined with strategic reintroductions and natural recolonization by large carnivores, this landscape could become a cornerstone of regional biodiversity conservation in Southern Africa.

Figure 128 – Lion population is recovering in Liuwa Plain National Park.

Figure 129 – Reintroduced African wild dogs in Liuwa Plain National Park.

9.14 FUTURE CONSERVATION AREA AND TFCA

In Zambia, the Liuwa–Mussuma Transfrontier Conservation Area includes Liuwa Plain National Park as its core, well-protected conservation area, along with the Upper West Zambezi Game Management Area (UWZGMA), which encompasses most of the TFCA's remaining Zambian extent. While the UWZGMA is already designated, it requires a robust management and ecological recovery strategy to fulfil its conservation potential.

In contrast, Angola currently lacks formal conservation areas within the TFCA boundary. Establishing such areas will be essential to realizing the transboundary vision, but this process must take into account Angola's specific socio-political, legal, and ecological context.

Key factors that must be addressed include:

1. Size of the Conservation Area: Larger conservation areas can be more complex to manage and protect, particularly in Angola, where addressing basic needs remains a priority. However, the region offers a remarkable opportunity to advance conservation efforts in Southern Africa, especially for wide-ranging species. While the immediate focus should be on securing the core conservation area of Mussuma, which is critical for maintaining connectivity with Liuwa Plain, CCI strongly supports the formal declaration of a much larger area, including community managed OECMs. This broader designation would not only safeguard ecological integrity and species sustainability over the long term but also lay the groundwork for a more comprehensive and impactful conservation strategy.

2. Geographical Challenges: The proposed area for this ecological corridor is highly fragmented by floodplains and rivers, creating natural barriers that hinder accessibility and pose significant challenges for day-to-day management, monitoring, and law enforcement. For example, accessing Sector E from Sector B (see Figure 127) by car requires a minimum of 8 hours due to the lack of direct routes and poor road conditions, especially during the rainy season. These logistical constraints mean that patrolling, responding to illegal activities, or coordinating conservation activities can be extremely time-consuming and costly. To address these challenges, a pragmatic and realistic approach is essential—this could include establishing strategically placed ranger posts or field stations within each sector, engaging local communities as part of decentralized monitoring networks or community-based ranger programs, and improving key access routes where possible to enhance connectivity and response times.

3. Community Engagement and Partnerships: Focusing conservation efforts initially on smaller scale key conservation areas with active community involvement could be a practical starting point. In Angola this approach should prioritize the Mussuma core area (sectors A, B, C, D, and E in Figure 127), while laying the foundation for a larger connected landscape. Collaborating with stakeholders experienced in conservation, capacity building, and funding can support the development of the necessary infrastructure and skills. Over time, the goal should be to expand efforts to the broader area.

Although the establishment of one or more formal conservation areas on the Angolan side should be prioritized, this should not be an impediment to the protection of the wider area. Community conservation programs should kick off in parallel to the work of the formal conservation area declaration. This way, when declared, any new conservation area will find an already a well-documented recovering landscape engaged with effective natural resource governance systems, ingredients that could make a great start for the official protected area and TFCA.

Given the presence of human population in most of the Angolan area of interest, the future protected area does not necessarily need to fall under a single conservation category. Different levels of protection could be assigned to the different sections depending on the conservation priorities and strategies defined. See section 9.12 for further details.

In order to fulfil the future TFCA agreement, following the MoU signature between Angola and Zambia, detailed planning and stakeholder consultations should occur to define the boundaries and management strategies of the TFCA. It's also crucial to secure sustainable funding sources and develop a comprehensive management plan that includes biodiversity conservation, community engagement, and human development. Additionally, legislative support will be needed to recognize and enforce the TFCA, ensuring that the agreement has the necessary legal backing to be effectively implemented.

10. RECOMMENDATIONS

Below, we outline a series of broad, high-level recommendations for short-term and long-term actions that are essential to ensure wildlife conservation and promote sustainable socioeconomic development. Additionally, we present research priorities to support these objectives.

The short-term actions primarily focus on community engagement, awareness, and data gathering, which provide the groundwork for more sustainable and effective longer-term actions. The long-term recommendation regarding connectivity highlights the importance of broader conservation efforts and partnerships beyond Liuwa Plain National Park.

10.1 SHORT-TERM CONSERVATION RECOMMENDATIONS

Humanitarian Mine Action
Non-technical surveys and mine clearance should be prioritized in areas targeted for early conservation action. These efforts are essential to ensure safe access for rangers, ecological monitoring, and community engagement. Without them, key short-term activities—such as patrols, land-use planning, and education—cannot proceed effectively or securely.

Establish a Base Camp and Aviation Strip
Set up essential infrastructure to facilitate logistics and rapid access for conservation and development activities.

Conduct Public Consultations for Conservation Area Establishment
Gather local input to ensure long-term support and address community concerns.

Launch a Community Wildlife Monitoring Initiative
Engage communities in monitoring wildlife to foster ownership and build local conservation capacity. This initiative will also generate data relevant for corridor identification and species recovery.

Foster Human-Wildlife Coexistence
Develop participatory models to help communities adapt to recovering wildlife, particularly large carnivore populations (Durant et al., 2022).

Participatory Planning and Mapping

- **Chiefdom Mapping:** Identify traditional boundaries collaboratively to strengthen local governance and support spatial planning for conservation.
- **Zonation Mapping:** Designate areas for core conservation, buffer zones, and resource use through joint mapping.
- **Land Use Planning:** Align conservation corridors with community development goals.

Coordinate Bilateral Monitoring and Training Programs
Develop cross-border collaborations to standardize wildlife monitoring and expand training for conservation staff.

Map and Regulate Lagoon Use in Angola
Ensure sustainable use of wetlands critical to species like wildebeest and roan antelope.

Assess Viability of Community-Led Income Generation
Explore and support the development of:

- Climate-smart agriculture
- Market access for local products
- Community-based tourism
- Carbon credits via forest management
- Sustainable timber and agroforestry models

Establish a Formal Conservation Area within Mussuma
Secure legal status and institutional support for conservation activities in Mussuma.

Advance TFCA Development through Government Engagement
Coordinate meetings between Angola and Zambia to move from TFCA concept to formal cooperation under an MoU.

10.2 LONG-TERM CONSERVATION RECOMMENDATIONS

Advance the TFCA from Emergence to Established
Negotiate and sign bilateral treaties to solidify joint conservation commitments.

Ensure Connectivity with Cameia and Mavinga National Parks as well as Western Moxico
Establish corridors that support regional wildlife movement and genetic diversity.

Implement Community-Based Natural Resource Management (CBNRM)
Apply sustainable income models to empower communities in conservation and improve livelihoods.

Secure Community Land Tenure
Build on initiatives like the *Minha Terra* project to provide legal land rights that align with conservation incentives.

Support the Development of Community Wildlife Conservancies
Create locally governed conservancies to attract investment and promote wildlife stewardship.

Restore Cameia National Park
Undertake long-term ecological restoration and, if necessary, species reintroductions following IUCN best practices.

Promote Climate-Resilient Conservation
Support ecosystem-based adaptation through landscape-wide planning informed by climate impacts, water availability, and ecosystem services.

10.3 RECOMMENDED RESEARCH TOPICS

The following research topics are designed to support the actions outlined above. Many research efforts directly inform short- and long-term conservation priorities and should be developed in parallel.

A. Ecological Monitoring and Recovery

- Ecological Benchmarking and Restoration Potential
- Wildlife Movement and Corridor Mapping
- Biodiversity Inventories for Understudied Taxa
- Ecological Processes and Role of Termite Mounds

B. Landscape Management and Resilience

- Fire Regimes and Integrated Fire Management
- Climate Change Impacts and Ecosystem Services Valuation
- Sustainable Agriculture and Agroforestry
- Nature-Based Economies and Livelihood Diversification
- Wetland Dynamics, Seasonal Lagoons, and Freshwater Fisheries

C. Socio-Spatial Planning and Governance

- Socio-Spatial Land Use Transitions
- Zonation and Multi-Category Protected Area Models
- Resource Governance and Community Institutions
- Cross-border Conservation Policy Harmonisation

D. Human Dimensions and Conflict

- Human–Wildlife Conflict and Coexistence Strategies
- Youth Engagement and Environmental Education
- Historical Ecology and Memory Mapping
- Bushmeat Economies and Protein Alternatives

E. Foundational Tools and Risk Management

- Ecosystem Services Valuation and Payment for Ecosystem Services Potential
- Participatory Scenario Modelling

Figure 130 - CCI team researchers placing a camera trap within a small lagoon in the Mussuma area.

11. CONCLUSION

The Liuwa-Mussuma Transfrontier Conservation Area (LMTFCA) presents a unique and timely opportunity to create an ecologically connected and socially inclusive conservation landscape across a war-impacted region spanning Angola and Zambia. This initiative can secure cross-border connectivity for wide-ranging predators like lions and cheetahs, enable the recovery of migratory species such as wildebeest, and deliver tangible benefits to communities who are rebuilding their lives after decades of conflict and displacement.

Figure 131 - Navigating through the Liuwa-Mussuma floodplains landscape.

Anchored by Liuwa Plain National Park and extending into the Mussuma region, the LMTFCA can revive Africa's second-largest wildebeest migration and reestablish a continuous landscape for species movement, gene flow, and climate adaptation. Mussuma's floodplains and forest-savanna mosaics, part of the greater Bulozi wetland system, are critical to this vision. Yet these habitats remain vulnerable to unsustainable hunting, agricultural expansion, uncontrolled fires, and the looming pressure of large-scale mining in ecologically sensitive areas.

Despite these threats, this landscape is poised for renewal. Wildlife is already returning, and communities show strong interest in conservation, ecotourism, and local governance models. A core conservation area of 3,600 km² has been identified in the Mboela floodplain—laying the groundwork for participatory zoning and community-based natural resource management. If fully implemented, the TFCA could become one of the largest connected ecosystems in Southern Africa, linking a vast expanse of contiguous habitat and making a meaningful contribution to the global 30x30 conservation target.

Crucially, cross-border collaboration is essential to realize this vision. Coordinated anti-poaching patrols, joint monitoring programs, and harmonized land-use strategies between Angola and Zambia can reduce threats and enhance regional resilience. Capacity-building exchanges, bilateral governance mechanisms will be vital to operationalize the TFCA and harmonize its long-term management.

The principles of "strategic opportunism," as outlined by Huntley (2023), are particularly relevant to this landscape. These principles emphasize the need for flexibility, adaptive planning, and deep local engagement to address Africa's dynamic and often uncertain conservation contexts. Rather than rigid planning, the LMTFCA must be shaped through phased, inclusive processes that build on emerging opportunities and reinforce trust across communities and institutions. Adaptive management—rooted in science, traditional knowledge, and lived realities—will be key to maintaining resilience in the face of political shifts, climate variability, and evolving conservation needs.

On the Angolan side, immediate priorities include establishing a formally protected core area in Mussuma, co-developed with local communities, and ensuring that early investments in governance, wildlife monitoring, and community-based natural resource management are firmly in place. Cultural sensitivity, including around the naming of the conservation area, will be essential to securing legitimacy. Meanwhile, the UWZGMA in Zambia requires targeted ecological restoration and improved management to function as functional corridor linking Liuwa Plain with Angola.

The LMTFCA is more than a conservation project—it is a model for ecological peacebuilding, post-conflict recovery, and regional integration. With the right support, it can transform returnee villages into conservation hubs, bring back the great migrations, and inspire a new generation of stewards across the Angola–Zambia frontier.

Achieving this vision will require bold, coordinated, and sustained action—backed by strategic partnerships, enabling policies, and strong local ownership. The ecological potential is nearly intact, the political will is forming, and the communities are ready. The groundwork has been laid, and momentum is growing. Now is the time to invest in the long-term recovery of a landscape where biodiversity, people, and peace can thrive—securing a legacy of connectivity, coexistence, and conservation that endures for generations.

Figure 132 – Buffalo in Liuwa Plain National Park.

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