

THE  
WILDERNESS  
PROJECT

EXPEDITION OVERVIEW

# LUNGA RIVER

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ZAMBIA



## ABOUT THE WILDERNESS PROJECT

By 2035, in partnership with local communities, governments, researchers and NGOs, The Wilderness Project aims to explore, study and better protect 1.2 million square kilometres of irreplaceable African wilderness. Central to this effort is establishing detailed hydrological and ecological baselines of the largely undocumented sources and watersheds of Africa's greatest river basins — Zambezi, Congo, Nile, and Okavango.

## ACKNOWLEDGEMENTS

Our research transects would be impossible without the collaboration of our partners, who provide access to the river, permissions to camp, and invaluable local perspectives. For their continued support for our work along the Lunga River, we thank Department of National Parks and Wildlife, Copperbelt University, African Parks, the Water Resources Management Authority, the University of Zambia, and the Wild Bird Trust.



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# INTRODUCTION

The Lunga River is a vital tributary of the Kafue, supplying a regular flow of clean water to one of Zambia's most economically important rivers. The Lunga originates just two kilometers from the border with the Democratic Republic of Congo (DRC), at approximately 1,400m above sea level. From here it flows through a diverse landscape of seasonal wetlands, dense miombo woodlands, and open grasslands, before joining the Kafue River.

The Lunga River maintains a relatively stable flow even during drought periods<sup>1</sup>, ensuring a consistent water supply when other sources diminish. This water supply is essential for sustaining Kafue's wetlands and supporting downstream hydropower operations. In addition, the Lunga enters the Kafue River downstream of the Copperbelt, potentially improving water quality by diluting any contamination from industrial activity along the Kafue River.

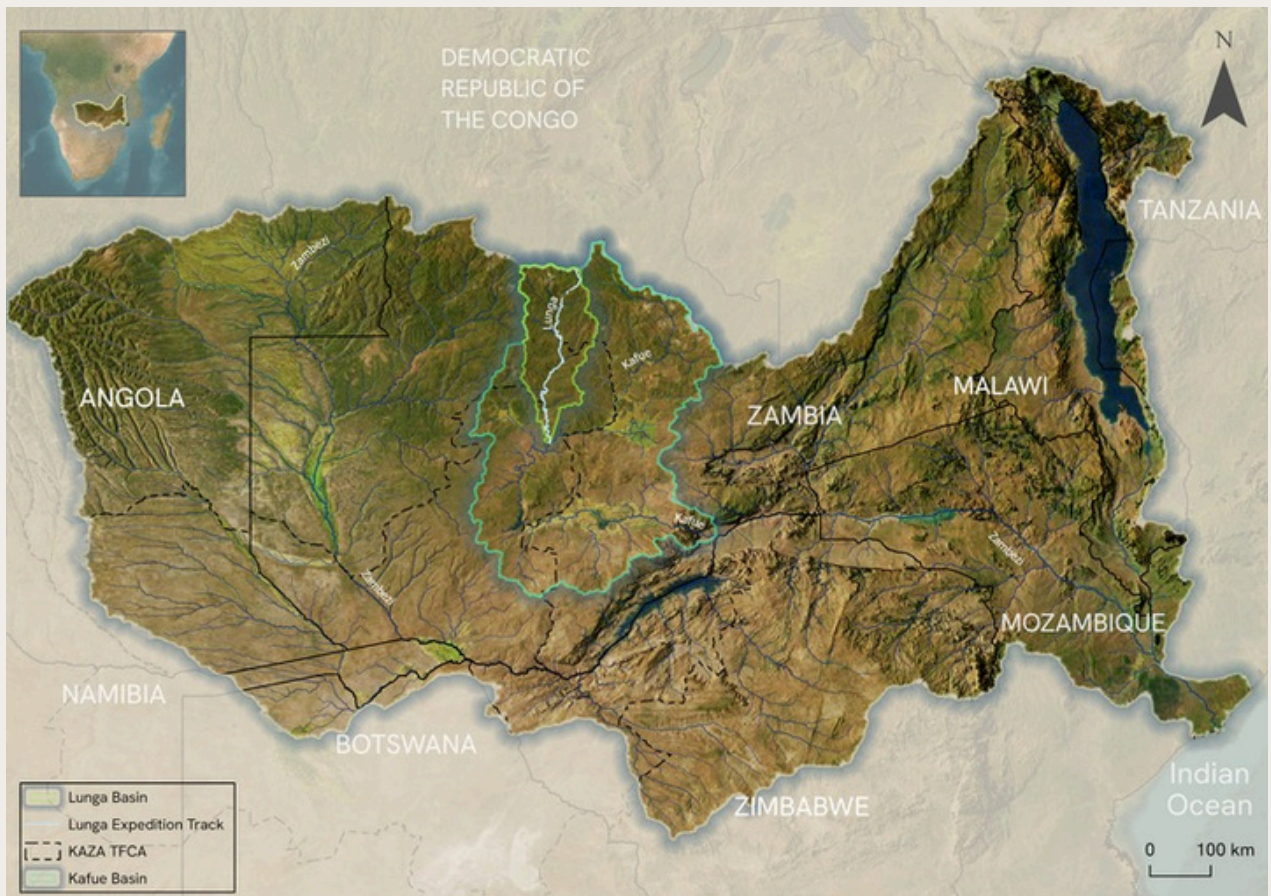
The Lunga is important to the Greater Kafue Ecosystem — a network of game management areas, including the Kafue National Park. Together, these lie at the heart of the Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA), which is the world's most extensive transboundary conservation landscape<sup>2</sup>. Within KAZA lies the world's largest contiguous population of African savanna elephants, estimated at around 230 000 individuals<sup>3</sup>.



The primary source of the Lunga River. From here it flows out the top right corner into a wetland.

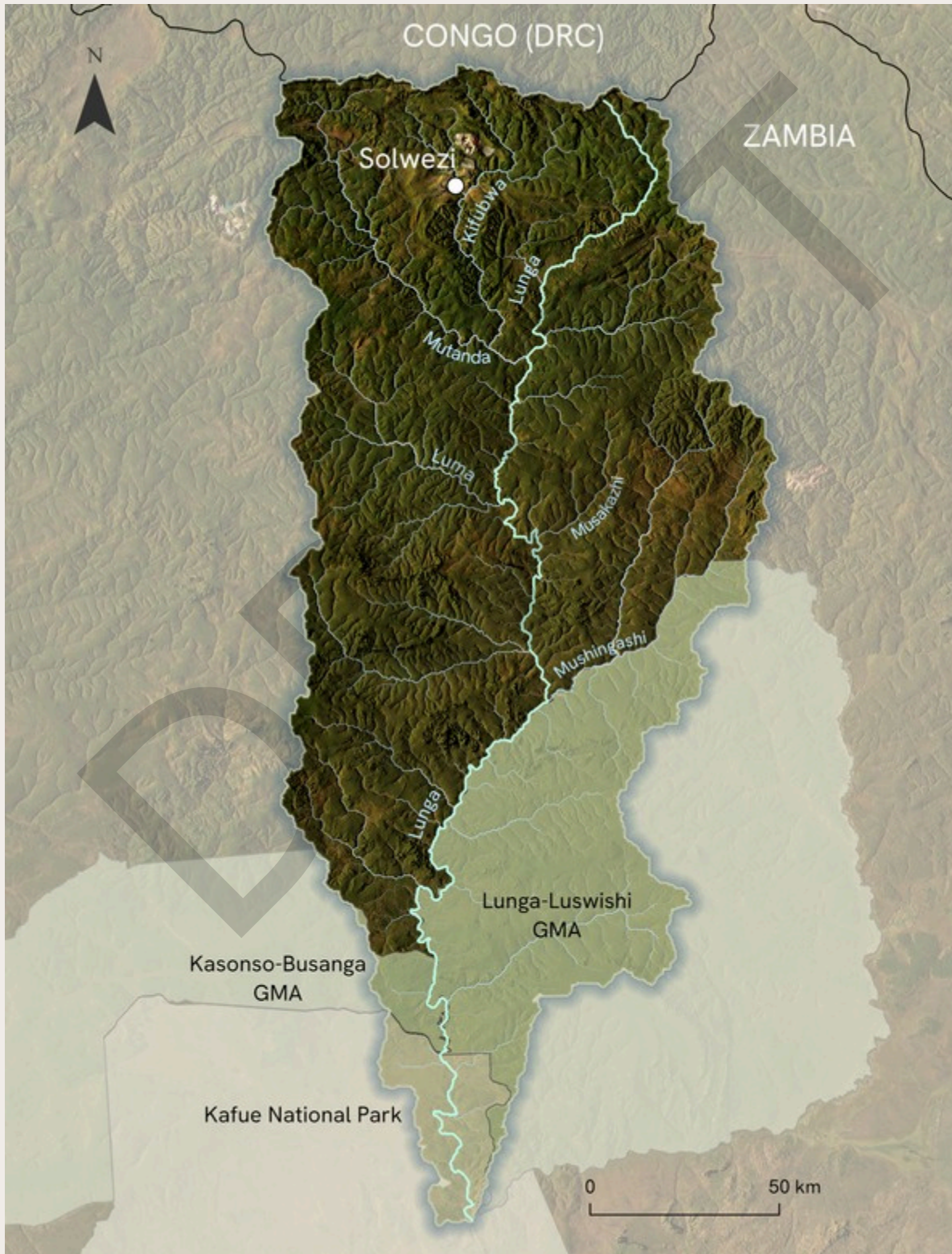
# THE ZAMBEZI BASIN

The Lunga River lies within the Zambezi Basin — southern Africa’s largest transboundary river system. More specifically, it belongs to the Kafue sub-basin, where it drains parts of Zambia’s Central and Northwestern Provinces. Its headwaters are located at the divide between the Zambezi and Congo basins



Currently, the Lunga Basin is among the least altered in the Kafue Basin and serves as a critical source of clean water for the Kafue River.

# LUNGA RIVER BASIN



The Lunga River originates along Zambia's northern border with the DRC and flows ~600 km southward through the Lunga-Luswishi GMA, Kasonso-Busanga GMA, and Kafue National Park. The Lunga Basin covers approximately 16% of the entire Kafue River Basin.

# RECOMMENDATIONS

The Lunga River has good water quality, supports healthy aquatic and riparian ecosystems, and plays a critical hydrological role within the Kafue Basin. A good example of this is from the 2024 drought, when river flows diminished across the Zambezi Basin. During this drought, the Lunga River's flow was almost equal to that of the Kafue River, highlighting the importance of the Lunga as a buffer to downstream drought impacts. To ensure that the Lunga continues to provide this essential function, among several others, a series of targeted monitoring and conservation interventions is recommended:

## PROTECTION OF THE LUNGA HEADWATERS AND RIPARIAN ZONE

The Lunga River has a comparatively lower human density than the adjacent Kafue River. However, protection of the Lunga River is limited outside of the Greater Kafue Ecosystem. This leaves the upper reaches of the river vulnerable to further mining expansion and contamination. It is recommended that the headwaters are considered for inclusion in the Water Resource Protection Areas identified by WARMA, WWF-Zambia and partners.

## ONGOING WATER MONITORING SITES

Ongoing hydrological monitoring is essential for tracking seasonal flow patterns, understanding drought resilience, and detecting potential sources of contamination. Suggested sites for monitoring include:

- Lunga-Kafue confluence: Flow measurement across seasons at the confluence is particularly important for determining the long-term hydrological contribution of the Lunga River to the Kafue.
- Mutanda-Lunga Confluence: To monitor water quality downstream of the Kifubwa River, which flows past the expanding Kansanshi Mine. This site would provide early detection of potential mining-related impacts before they reach protected areas.
- Upstream of Kafue National Park: To understand whether the quality of water entering the national park has been affected by upstream pollution, and whether any pollution events have been sufficiently diluted by the time the water reaches the park.

## IN-DEPTH FISH SAMPLING

The Lunga's ichthyofauna remains poorly documented. An in-depth fish sampling effort is needed, particularly in the upper reaches of the river. This should aim to:

- Catalogue species diversity, including any endemic or undescribed taxa.
- Provide baseline data for future ecological assessments.
- Inform conservation planning and possible red-listing of at-risk species

# RECOMMENDATIONS

## INVASIVE REDCLAW CONTROL

Redclaw crayfish (*Cherax quadricarinatus*) were recorded approximately 100 km upstream of the Lunga-Kafue confluence. If left unmanaged, this invasion will likely cause severe ecological disruption. To address this immediate threat:

- An intensive survey should be launched beginning ~50 km upstream of the current invasion front, progressing downstream to determine the full extent of spread. The use of underwater remote cameras, combined with targeted trapping, offers a high probability of detecting populations that may otherwise go unnoticed. A spatial map should be developed and updated continuously to guide adaptive management.

## INVASIVE PLANT CONTROL

Several invasive plant species were recorded along the upper Lunga River, all in the early stages of invasion. These included water lettuce (*Pistia stratiotes*), castor oil bush (*Ricinus communis*), and Mexican sunflower (*Tithonia diversifolia*). While current prevalence and impact appear limited, their early presence offers a critical window for intervention:

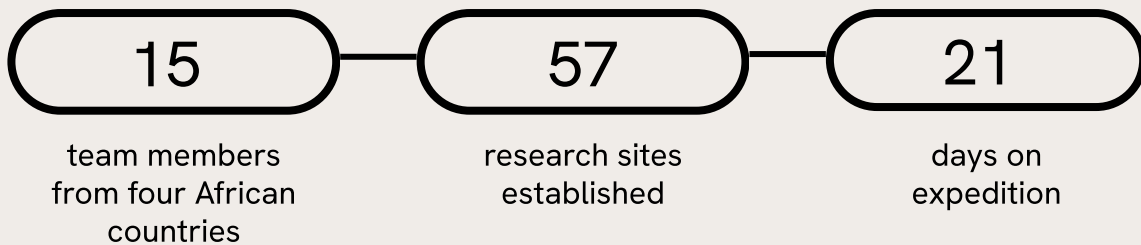
- Eradicate invasive species while still in early stages to prevent establishment and long-term ecological impact.
- Introduce the tiny water lettuce weevil (*Neohydronomus affinis*) as a biological control agent to suppress *Pistia stratiotes* before it spreads widely.
- Strengthen monitoring and prevention efforts to detect new invasions quickly and avoid further introductions.

# THE EXPEDITION

568 km



traversed by foot  
and canoe



The Wilderness Project (TWP) conducted a 568 km research transect along the Lunga River from 1 - 21 May 2025. The aim was to collect baseline data on hydrology, water quality, biodiversity, and human activity to inform future monitoring and support sustainable river management. The study also identified key conservation insights, including ongoing threats to the river.

Starting at the source, the team walked the first 75 km before launching canoes that were used for the remainder of the expedition. The expedition team consisted of African researchers, storytellers, expert river guides, and a land support team.



# METHODS

## CONTINUOUS MONITORING

During the transect, teams collected continuous survey data and 360° imagery. Each team included an observer and a recorder. Observers scanned the river and both banks — up to 100 m from the edge — identifying features such as land use, infrastructure, biodiversity, and signs of disturbance. Recorders logged observations in real time using the Survey123 (ESRI) app on a smartphone, ensuring spatially referenced data across diverse indicators.



## FIXED SURVEY SITES

Fixed survey sites were established at regular intervals to capture detailed information on water quality, biodiversity, and land use. These sites offer a strong foundation for long-term monitoring by communities, river authorities, and NGOs involved in river stewardship.

- *Every 10km:* using drone imagery and water analysis, researchers revealed patterns not visible through observation alone.
- *Every 50-75km:* eDNA sampling, macroinvertebrate surveys, and further testing provide a foundation of river health and biodiversity.



## OPPORTUNISTIC SITES

To complement continuous observations, researchers conducted targeted sampling at selected sites along the transect. Leveraging local river conditions and insights from visual surveys, they deployed overnight bat recorders, set traps for freshwater fish and crustaceans, collected water samples, and measured river discharge. This approach enabled more detailed assessments of the river's hydrochemistry, hydrology, and biodiversity.



# RESEARCH SITES

57 fixed sites

61

water quality  
measurements

59

aerial drone  
surveys

63

wetland bird  
species recorded



| The locations of 49 fixed and 8 intensive research sites.

# HUMAN FOOTPRINT

The Lunga River exhibited a low population density of just 8 people/10 km, with minimal infrastructure along its banks. These findings indicate that the river is sparsely inhabited compared to others in the Zambezi Basin (see comparison in table below).

Subsistence agriculture, charcoal production and beekeeping were common livelihood activities within the riparian zone. A total of 267 beehives were recorded — many of which were made of bark and suspended in woodlands. Fishing was less common than the nearby Kafue River, possibly a function of access, remoteness, or seasonal variations in river use that were not captured during the survey period.

Charcoal production was indicated by several kilns and charcoal stockpiles in forested areas. In Zambia, charcoal production accounts for approximately 65% of annual woodland loss and up to 30% of the country's total deforestation (~300,000 ha per year)<sup>4,5</sup>.



Observations	Lunga River	Zambezi Basin Average
People/10 km	8	46
Fishers/10 km	<1	4
Fishing gear/10 km	7	20
Vessels/10 km	7	23
Livestock/10 km	<1	35

*Distribution of people along the transect (left). The summary of observations (right) shows several indicators of human activity, averaged per 10 km along the transect. Note the low levels of human interaction along the Lunga River compared to the rest of the Zambezi Basin.*

# BUILDING ANALYSIS

Google's Open Buildings dataset is a global mapping resource that uses high-resolution satellite imagery to identify and outline individual building footprints<sup>6</sup>. By mapping the location and density of buildings, the data provides a landscape-wide view of human activity. This perspective allows for consistent, basin-scale analyses that help to identify areas of potential environmental impact.

The Lunga River, with a building density of just 2 buildings/km<sup>2</sup>, remains relatively underdeveloped compared to other major river systems in Zambia — for example, the Kafue River averages 24 buildings/km<sup>2</sup> (within a 4 km buffer of the river). This low development density is largely due to the fact that approximately 60% of the Lunga flows through protected areas where infrastructure expansion is restricted. Near its headwaters, close to the mining town of Solwezi, building density is notably higher and land use is dominated by mining.



## Building density within the Lunga Basin



7 buildings/km<sup>2</sup>

## Building density within 4 km of the river



2 buildings/km<sup>2</sup>

## Building density within the Zambezi Basin



20 buildings/km<sup>2</sup>

*The distribution of buildings within the Lunga Basin.*

# WETLAND BIRDS

Birds are among the most responsive indicators of habitat availability. Wetland birds in particular depend on healthy, intact wetlands to forage, breed, and roost, making them sensitive to habitat degradation. Continuous monitoring of birds can reveal early warning signs of environmental degradation and help to identify critical nesting and foraging areas that require conservation attention.

A total of 1,383 wetland-associated birds, representing 63 species, were recorded along the transect. Bird presence was continuous, highlighting the Lunga River's importance as habitat. The widespread occurrence of half-collared kingfishers and African finfoots suggests relatively intact riparian vegetation and a largely undisturbed river system.

*The 10 most common wetland bird species along the transect:*

Bird Species	Count
African pied wagtail	198
White-fronted bee-eater	163
Western cattle egret	123
Pied kingfisher	71
Striated heron	68
Hadada ibis	57
Half-collared kingfisher	54
Reed cormorant	50
Hamerkop	47
Cape wagtail	45



*A Bohm's bee-eater in the riparian vegetation of the Lunga River*

# WILDLIFE

The Lunga River supports a rich diversity of wildlife, including elephants, Kinda baboons, puku, crocodiles, and hippos. During this survey, 621 individual animals from 13 species were recorded, with hippos comprising nearly 50% of these (N = 285). Most wildlife sightings occurred within protected areas, where expansive zones of intact habitat extend well beyond the river corridor and provide critical refuge. Outside these areas, although the riparian vegetation remains largely intact and the river continues to function as an ecological corridor, the surrounding terrestrial landscape is more fragmented. Habitat quality declines beyond the river margin, limiting terrestrial wildlife presence to scattered pockets and underscoring the importance of protected areas in sustaining broader ecosystem integrity.

Outside Protected Areas	Inside Game Management Areas	Inside Kafue National Park
<1 animal / 10 km	10 animals / 10 km	50 animals / 10 km



Wildlife distribution along the transect, highlighting a significant concentration within Kafue National Park

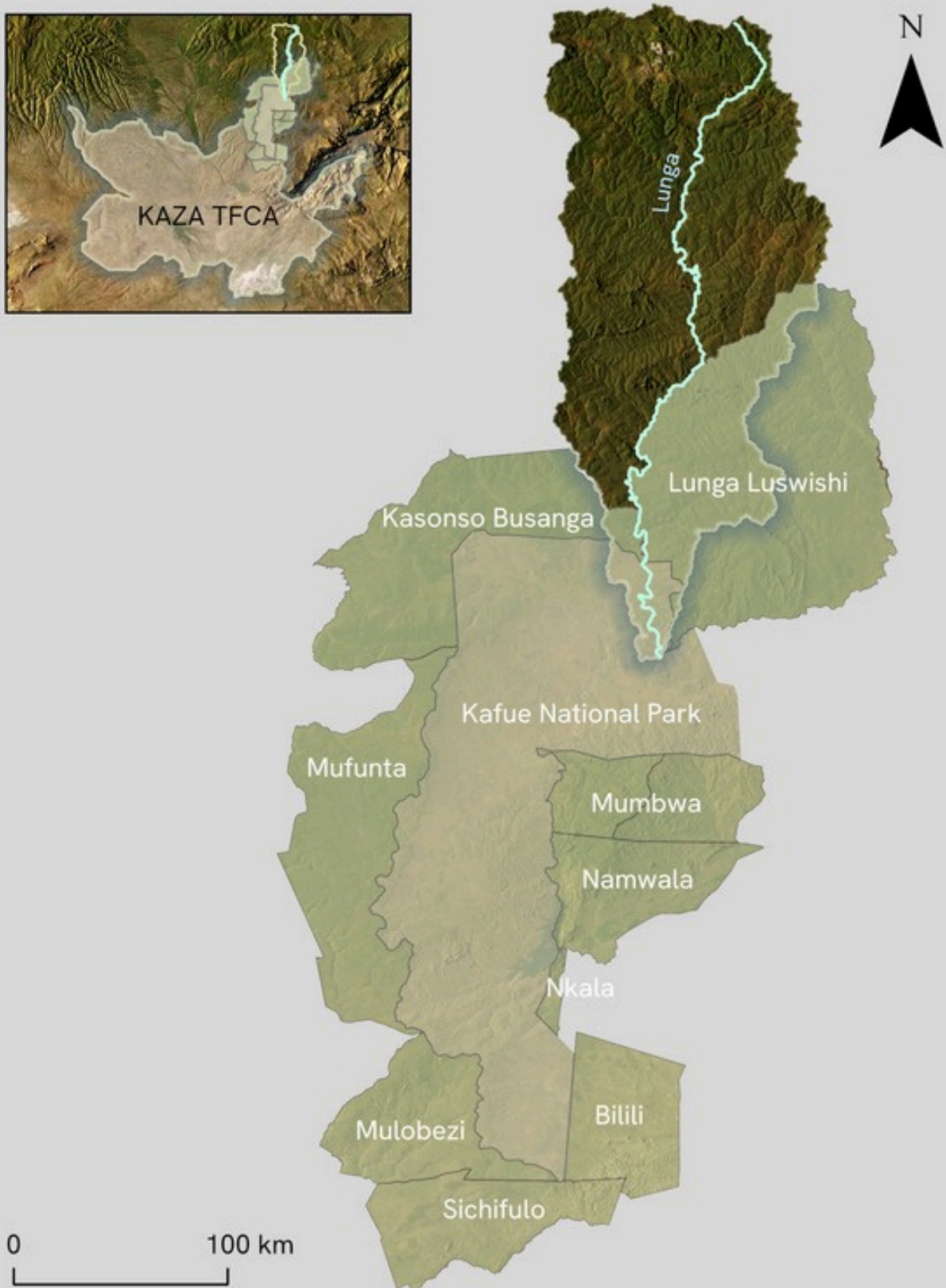
# GREATER KAFUE ECOSYSTEM

Approximately 50% of the Lunga River flows through the Greater Kafue Ecosystem, particularly Lunga-Luswishi Game Management Area (GMA), Kasonso Busanga GMA, and Kafue National Park. At 66,000 km<sup>2</sup>, the GKE is one of the largest contiguous protected landscapes in Africa and the largest in Zambia. Its expansive reach and ecological connectivity make it a stronghold for biodiversity conservation in Zambia, offering refuge to a large number of species and acting as a critical corridor for seasonal wildlife movements.

During the expedition, 96% of all recorded wildlife observations occurred within the GKE. Notably, keystone species such as hippopotamus and elephants, along with endangered birds like vultures, were observed exclusively within this protected landscape. The ecological value of the Lunga River is closely tied to the integrity of the surrounding conservation matrix. Without the safeguarding role of these protected areas, both biodiversity richness and the natural regulation of ecological dynamics would be significantly diminished.



# GREATER KAFUE ECOSYSTEM



Approximately half of the Lunga River flows through the Greater Kafue Ecosystem, which forms the northernmost extension of the Kavango Zambezi Transfrontier Conservation Area (KAZA TFCA)

# FISH SAMPLING

Fish sampling is essential for understanding fish diversity, monitoring ecosystem health, and informing sustainable fisheries management. These approaches help to understand species composition, detect the presence of diseases, and assess the impacts of environmental pressures like overfishing and habitat loss.

To sample fish diversity, a fyke net was set overnight at 16 sites along the Lunga River. Additional sampling was carried out opportunistically using a dip net and hook and line. Specimens were identified in the field, with photographs and vouchers collected for verification and future study.

A potentially undescribed fish species, referred to as Slender kneria (*Kneria* sp. 'Upper Zambezi'), was recorded in the upper reaches of the Lunga River. This detection highlights the need for further study in this area. The ichthyofaunal diversity of the Lunga should be thoroughly sampled to determine species composition and potential endemism. Documenting and describing such species is essential — not only for taxonomic clarity, but also for guiding conservation priorities, particularly given the growing threats from invasive species and disease outbreaks.

Several fish were observed with external lesions consistent with symptoms of EUS. However, this would need to be confirmed with targeted sampling and laboratory analysis. The disease is caused by a pathogenic water mould, *Aphanomyces invadans*, and has been previously reported in the Kafue, first documented in 2010<sup>7</sup>. EUS can cause high levels of mortality among wild and cultured fish populations, disrupt local food webs, and threaten livelihoods that depend on fisheries. Its spread poses a significant risk to aquatic biodiversity and ecosystem function<sup>7</sup>.



Setting the fyke net along the Lunga river bank. A fyke net has a funnel-shape, tapering from its entrance to the end.

# INVASIVE CRAYFISH

Invasive redclaw crayfish (*Cherax quadricarinatus*), are widespread in the Zambezi Basin (for more information on their distribution, see the World of Crayfish Map)<sup>10</sup>. Redclaw crayfish were introduced into the Kafue River in 2001 following an escape from a fish farm near the Kafue Flats. Their presence has significantly impacted traditional fisheries<sup>11,12</sup>, increasing processing costs as fishers must sort through damaged catches and frequently repair or replace torn nets. Frequent entanglement also forces them to abandon nets, contributing to ghost fishing. On average, the damage caused by a single invasive crayfish translates to an annual fishery loss of \$6.15 (176.88 ZMW) in the Kafue River<sup>13,14</sup>.

Redclaw crayfish were detected on the Lunga River approximately 100 km upstream from the Kafue confluence, consistent with their high densities in the Kafue River and ongoing range expansion. Although their presence in the Lunga River may not be new, this represents the first scientific documentation of the species in the system. Given their invasive potential and upstream mobility, it is likely that redclaw are widespread within the Lunga River, reinforcing the need for timely intervention.

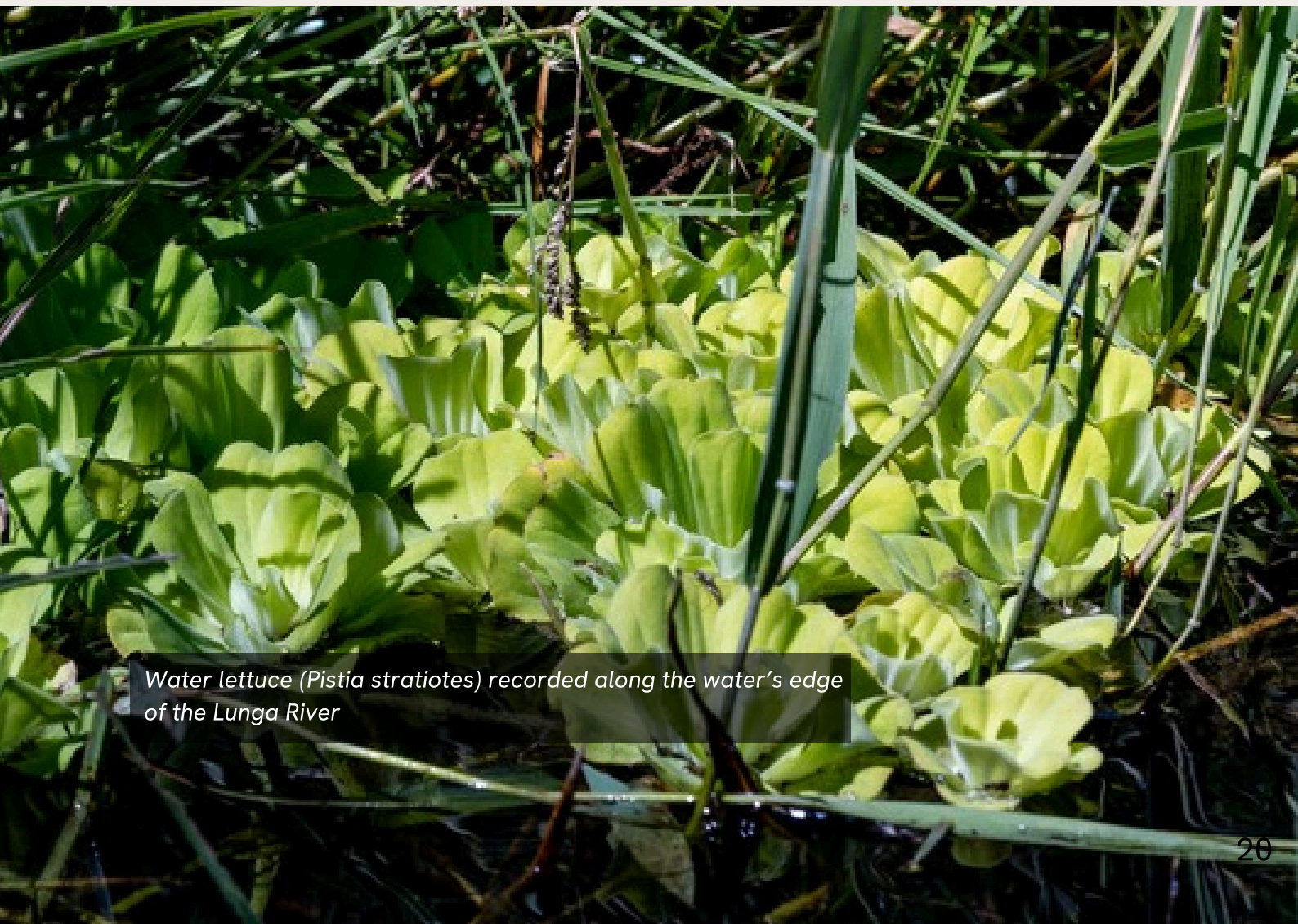


A male redclaw crayfish. All captured individuals are sexed and measured for key morphological traits, including claw size.

# INVASIVE PLANTS

Alien invasive plants (AIPs) are known to have several impacts on river systems in Africa. These include the displacement of native vegetation and changes in nutrient cycling, which have detrimental impacts on native biodiversity<sup>8</sup>. In addition, AIPs can reduce water quality by increasing evaporation rates and reducing stream flow and dilution capacity<sup>9</sup>. The continuous monitoring of AIPs allows for early detection of threats to riverine ecosystems.

Invasive plant species were prevalent throughout the upper two-thirds of the river. The most widely distributed species included water lettuce (*Pistia stratiotes*), castor oil bush (*Ricinus communis*), and Mexican sunflower (*Tithonia diversifolia*). Notably, all observed occurrences of water lettuce were confined to a 10 km stretch, where it formed dense mats along the river margins. While invasive plants were present, their prevalence appeared lower than on other river systems, and their ecological impact on the Lunga River currently appears limited. Importantly, water lettuce has not yet been recorded on the Kafue River, making early intervention critical to prevent its spread downstream. Control efforts should therefore prioritize this species, including the introduction of the water lettuce weevil (*Neohydronomus affinis*) as a proven biological control agent.



Water lettuce (*Pistia stratiotes*) recorded along the water's edge of the Lunga River

# WATER QUALITY

Temperature, pH, dissolved oxygen, conductivity, and turbidity are measurable physical and chemical characteristics that reflect the water's suitability for uses such as drinking, recreation, or sustaining aquatic life. Monitoring standard water chemistry along the Lunga River supports the assessment of ecosystem health, helps detect potential pollution sources, and reveals temporal or spatial shifts in water quality.

Water quality conditions along the Lunga River generally fell within expected ranges for surface water in Zambia, suggesting a healthy freshwater system. The graph below illustrates these patterns, showing consistent values across most sites with only a few notable deviations. Where deviations occur, they tend to be localized and often reflect natural influences, such as nearby tributaries or groundwater inputs far from the main river channel.

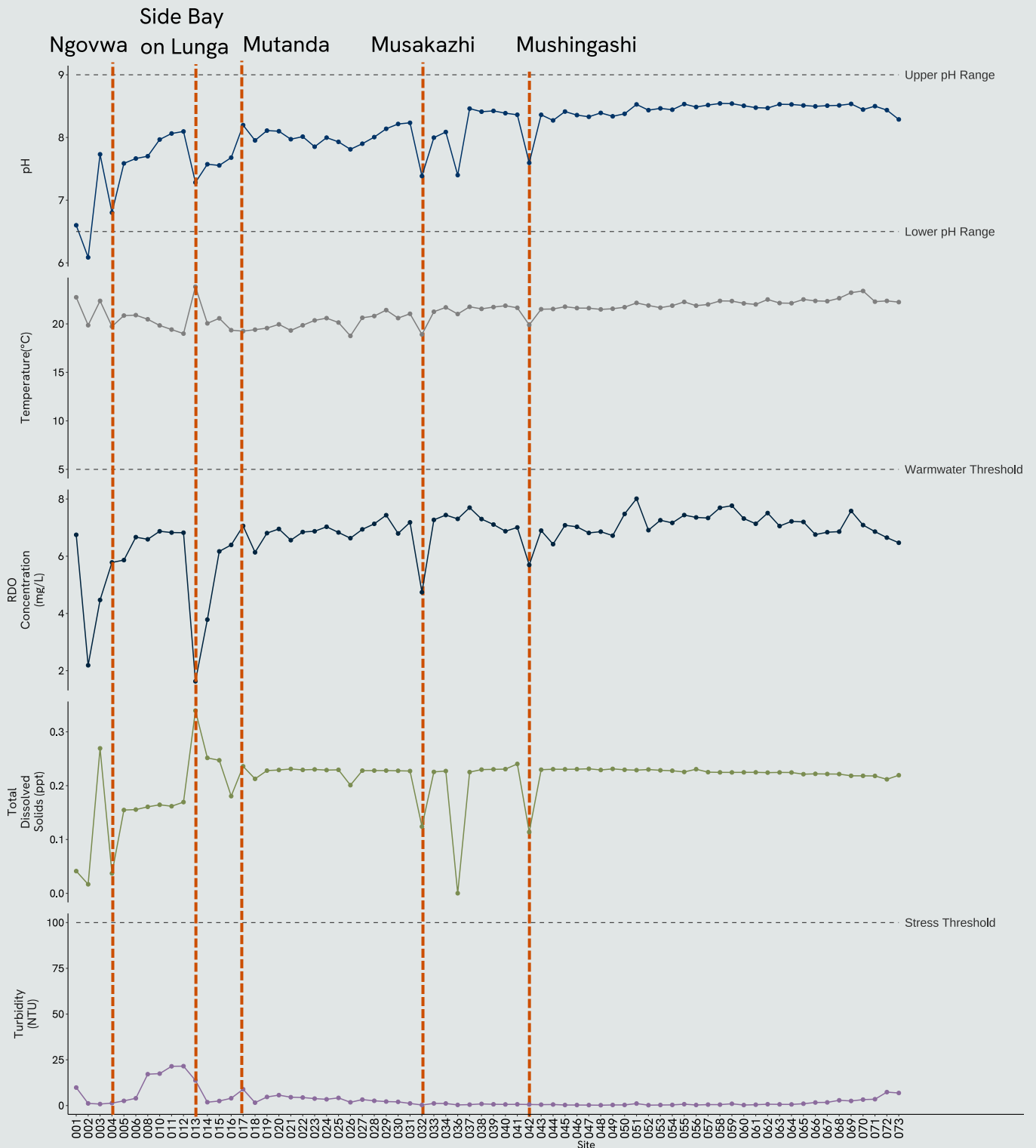
Sites 1 and 2, situated near the headwaters of the Lunga River, are both supplied by groundwater—Site 1 via a dammed spring and Site 2 via a well. Their common subsurface origin likely accounts for their similar water chemistry, characterized by low pH, low total dissolved solids, and limited oxygenation. These features reflect minimal interaction with the atmosphere and low mineral content typical of groundwater-fed systems.

Site 13, located in a stagnant side bay, showed reduced dissolved oxygen (DO), likely due to limited mixing and aeration. Sites 32 and 42, which receive inflows from the Musakazhi and Mushingashi tributaries, recorded dips in pH, DO, and total dissolved solids (TDS). These tributaries pass through heavily vegetated, slow-flowing areas where the accumulation of organic matter and reduced turbulence likely contribute to localized changes in water chemistry. While these inputs cause sharp variations at their confluences, conditions stabilize downstream and do not appear to affect the broader river system.

The Kifubwa River, which joins the Mutanda River en route to the Lunga, flows past the Kansanshi Mine— one of Zambia's largest copper mining operations. Preliminary in-situ measurements at the Mutanda-Lunga confluence showed negligible change in water quality, but laboratory analysis will determine whether heavy metals are present. Continued monitoring at this location is essential, particularly given the mine's ongoing expansion and its potential influence on downstream water conditions.



# WATER QUALITY



It's important to note that these findings represent a snapshot of water quality during the time of sampling, and conditions may shift seasonally or in response to land use changes, rainfall, or other environmental factors. While field parameters offer valuable insight into the river's condition, they cannot detect all contaminants — such as heavy metals or certain organic pollutants. To supplement this dataset, water samples from selected sites have been submitted for laboratory analysis, with results pending.

# RIVER FLOW

The Kafue River supports three hydropower stations, which account for over 55% of Zambia's total power generation<sup>15</sup>. Understanding the Lunga's flow provides valuable insight into its contribution to the reliability and resilience of downstream water and energy systems, and for guiding water resource management.

In 2024, during a basin-wide drought, the Lunga River maintained a steady flow of  $37.0\text{ m}^3/\text{s}$  at its confluence with the Kafue — similar to the Kafue's flow of  $43.1\text{ m}^3/\text{s}$ . This highlights the Lunga's role as a vital water source during dry periods, helping to sustain Kafue River flow when upstream contributions were severely diminished. By contrast, in 2025 — a year with more typical rainfall patterns — the Kafue's flow at the same location rebounded sharply to  $115.8\text{ m}^3/\text{s}$ , while the Lunga increased more modestly to  $46.6\text{ m}^3/\text{s}$ . The comparison underscores not only the severity of the 2024 drought but also the Lunga's relative hydrological stability, making it an important buffer during times of water scarcity.

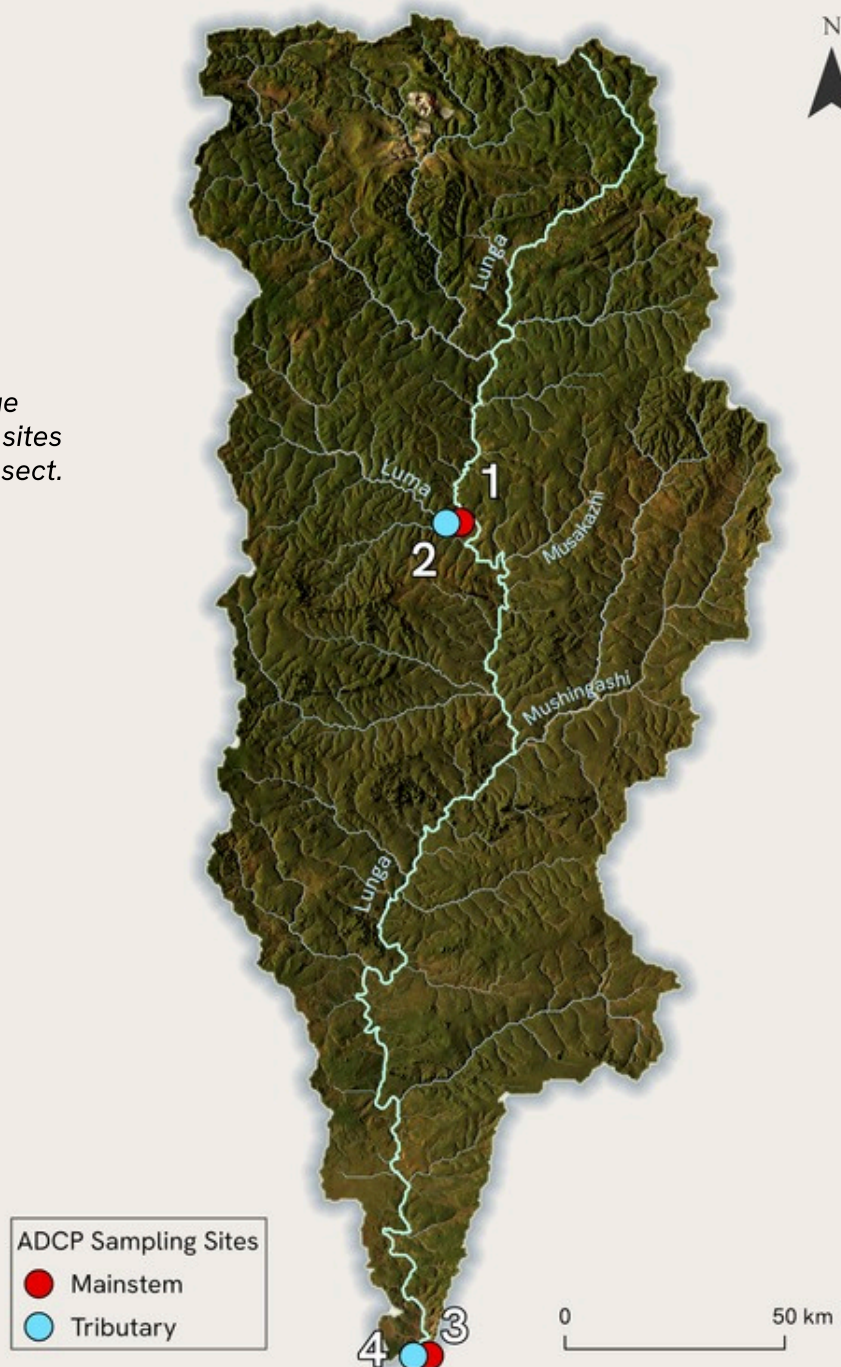


*The confluence of the Lunga (left) and Kafue (right) rivers. The difference water colours is due to variation in suspended sediments and water chemistry.*

# RIVER FLOW

Site Number	Description	Discharge (m <sup>3</sup> /s)
1	Lunga River	42
2	Luma River	1
3	Lunga River	47
4	Kafue River	116

River discharge measurement sites along the transect.



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