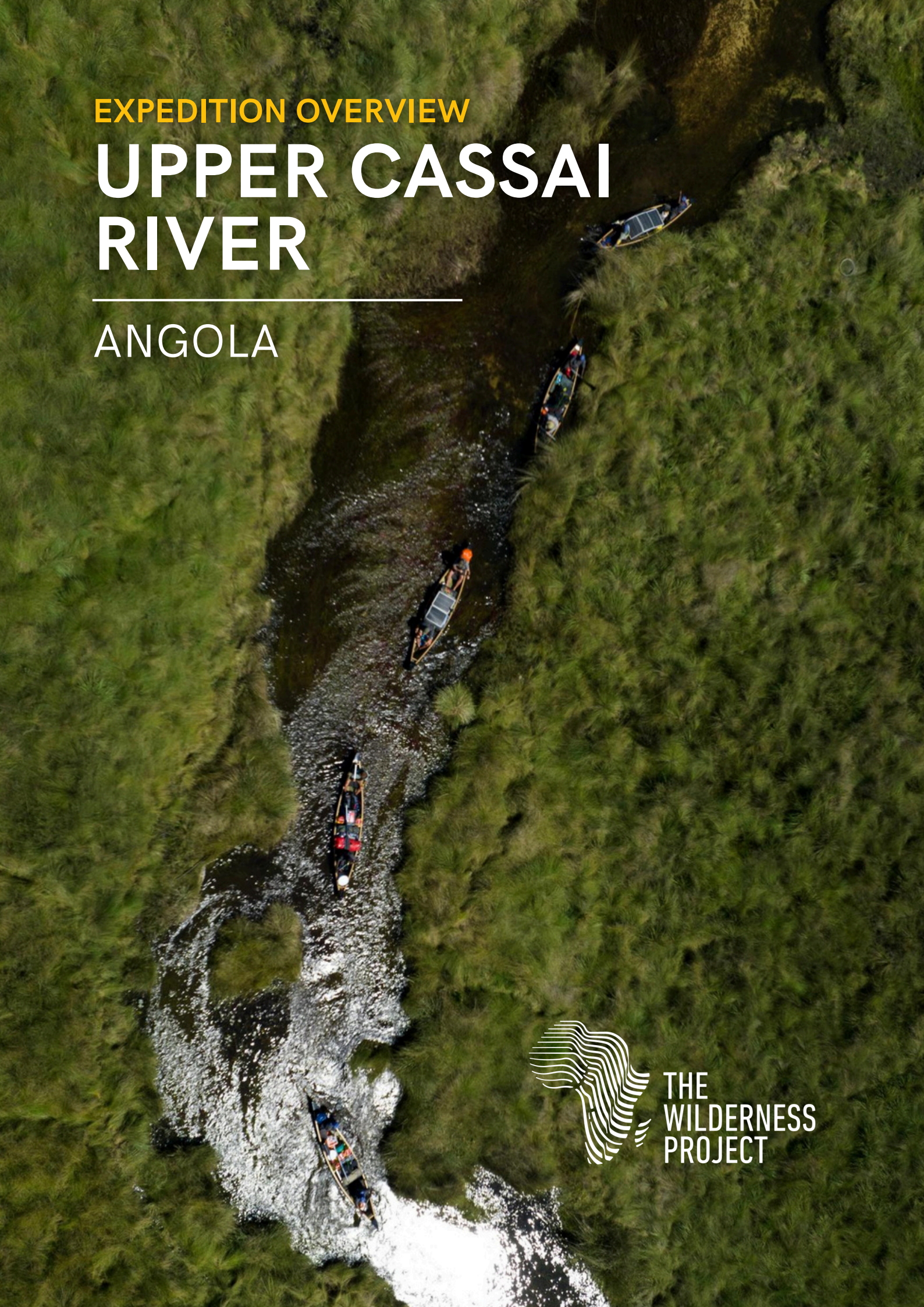
EXPEDITION OVERVIEW

UPPER CASSAI RIVER

ANGOLA



THE WILDERNESS PROJECT

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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 the establishment of detailed hydrological and ecological baselines of the largely undocumented sources and watersheds of Africa's greatest river basins — the Zambezi, Congo, Nile, Chad, and Okavango.

ACKNOWLEDGEMENTS

The successful implementation of our research transects is made possible through the commitment and collaboration of our institutional partners, whose support provides essential river access, research permissions, logistical facilitation, and critical local expertise. We express our sincere appreciation to the Government of Angola, Fundação Lisima and the Wild Bird Trust.

FUNDAÇÃO LISIMA

GOVERNO DE ANGOLA
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INTRODUCTION

The Cassai River (also known as the Kasai) is one of Central Africa's major freshwater systems and the largest Angolan tributary of the Congo River. Originating in the Angolan highlands, its headwaters now fall within Lisima Lya Mwono ("Source of Life"), Angola's first Ramsar Wetland of International Importance. From this source region, the Cassai flows northward for more than 2 000 km before joining the Congo River near Kwamouth in the Democratic Republic of Congo (DRC).

Along its course the Cassai drains an immense catchment of nearly 890 000 km^2, drawing in major tributaries such as the Sankuru, Kwango, Kwilu, Lulua, and Fimi–Lukenie rivers [1]. Its upper reaches include peat-rich wetlands and the seasonal floodplain of Cameia National Park, which influences the river's hydrology and supports a range of riparian and aquatic species [2]. From here, the Cassai forms the boundary between Angola and the DRC and, further downstream, becomes a broad river that anchors regional trade, fisheries, and transport. Its fertile banks sustain farming and fishing communities, while its lower reaches feed into the Congo, contributing significantly to the world's second-largest river by discharge [3].

Although much of the upper Cassai remains remote and sparsely populated, Angola's ongoing investment in infrastructure and development suggests that accessibility to the river may increase in coming years. Given the Cassai's role as a hydrological and ecological link between Angola's highlands and the tropical interior of the Congo Basin, it is critical to establish a reliable baseline of its current state so that future changes can be identified and managed.

The importance of this was highlighted in 2021, when pollution originating from a tailings-pipe failure at the Catoca diamond mine in northern Angola was reported downstream in the Tshikapa and Cassai rivers within the DRC, demonstrating how basin-wide disturbances can affect people and ecosystems far downstream and reinforcing the need to document the river's natural condition while it remains largely intact [4].

The Cassai River is one of Central Africa's great freshwater arteries and the largest Angolan tributary of the Congo River.

THE EXPEDITION

660 km

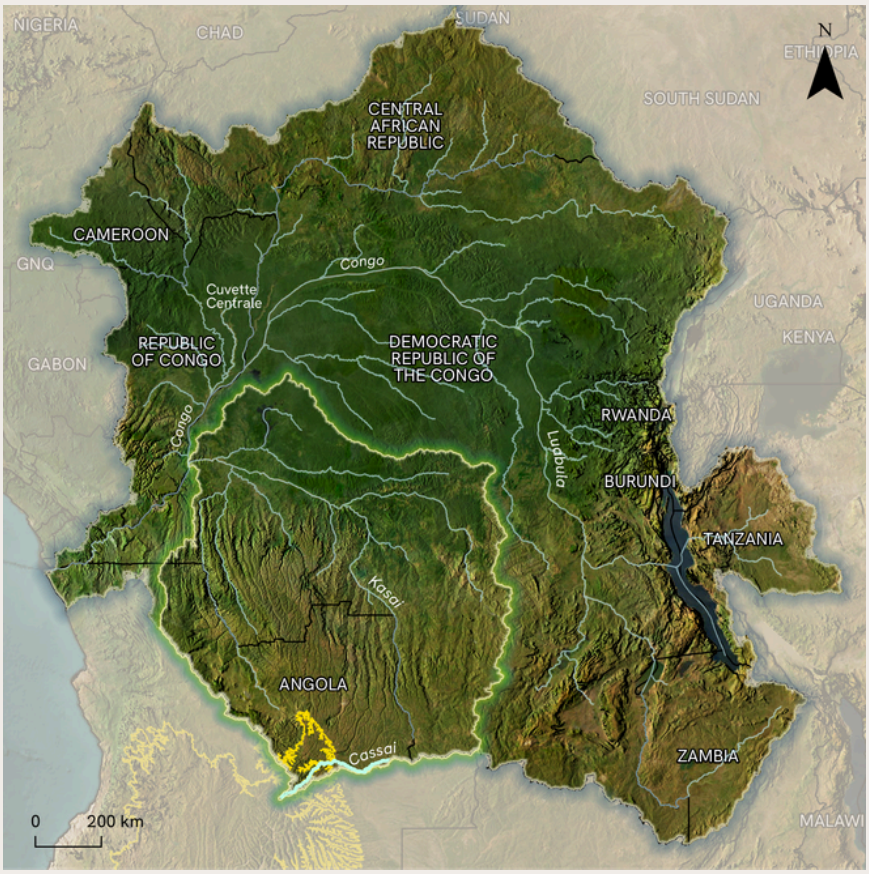
traversed by foot and canoes

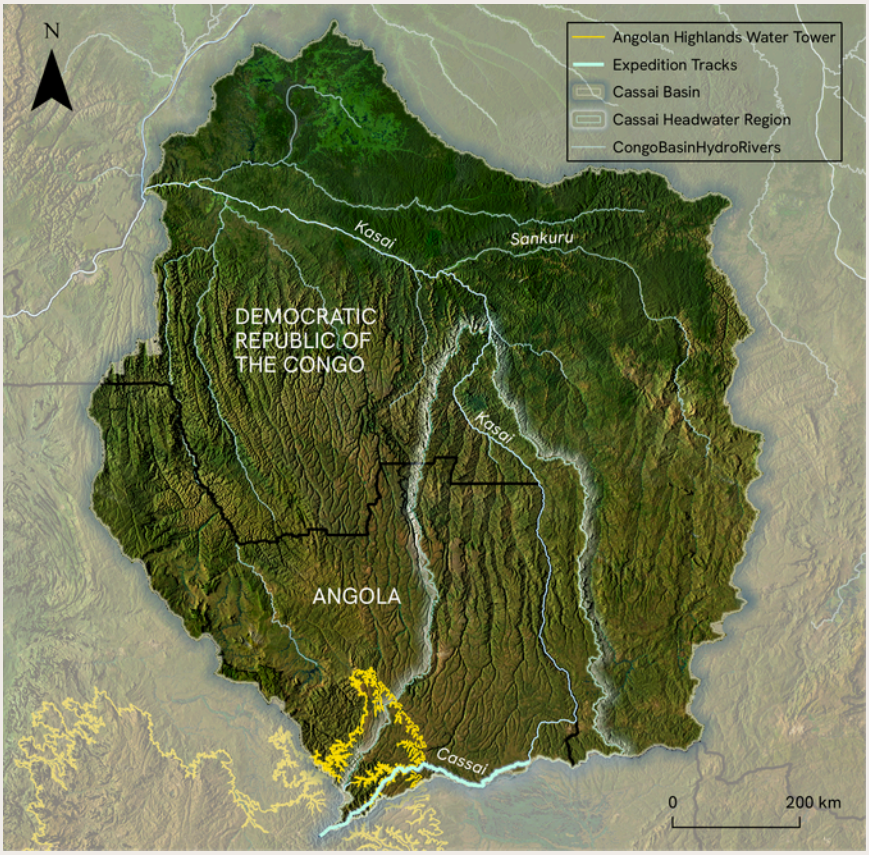
12	63	30
team members from three African countries	research sites established	days on expedition

In April 2023, The Wilderness Project (TWP) embarked on a 660 km research transect of the upper Cassai River. After reaching the river's marshland source near the town of Munhango by motorcycle, the expedition continued on foot for about 20 km before the channel became navigable by canoe. Over the next month, the team descended the upper Cassai through a succession of blockages, rapids, and waterfalls, finally reaching the Congo border where they were extracted near Cassai Sul. In 2026, the team intends to relaunch at the same point and continue downstream for another 540 km, where the river enters the Democratic Republic of Congo.

The aim of the transect was to collect baseline data on hydrology, water quality, biodiversity, and human activity. The study also identified key conservation information, including ongoing threats to the river. The 2021 pollution event on the lower Tshikapa–Cassai system demonstrated how unexpected disturbances can affect major tributaries of the Congo Basin, underscoring the importance of obtaining headwater baselines before future development or upstream land-use change alter the system. We hope that the data collected during this research survey will be a valuable resource to river managers, conservation authorities, government agencies, and anyone invested in the future of the Cassai River.

CASSAI RIVER BASIN





The Cassai River Basin spans Angola and the Democratic Republic of the Congo and forms a major sub-basin of the Congo River system. This expedition focused on the upper Cassai, documenting conditions from its headwaters in Angola's first Ramsar Wetland downstream toward the mid-basin.

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.

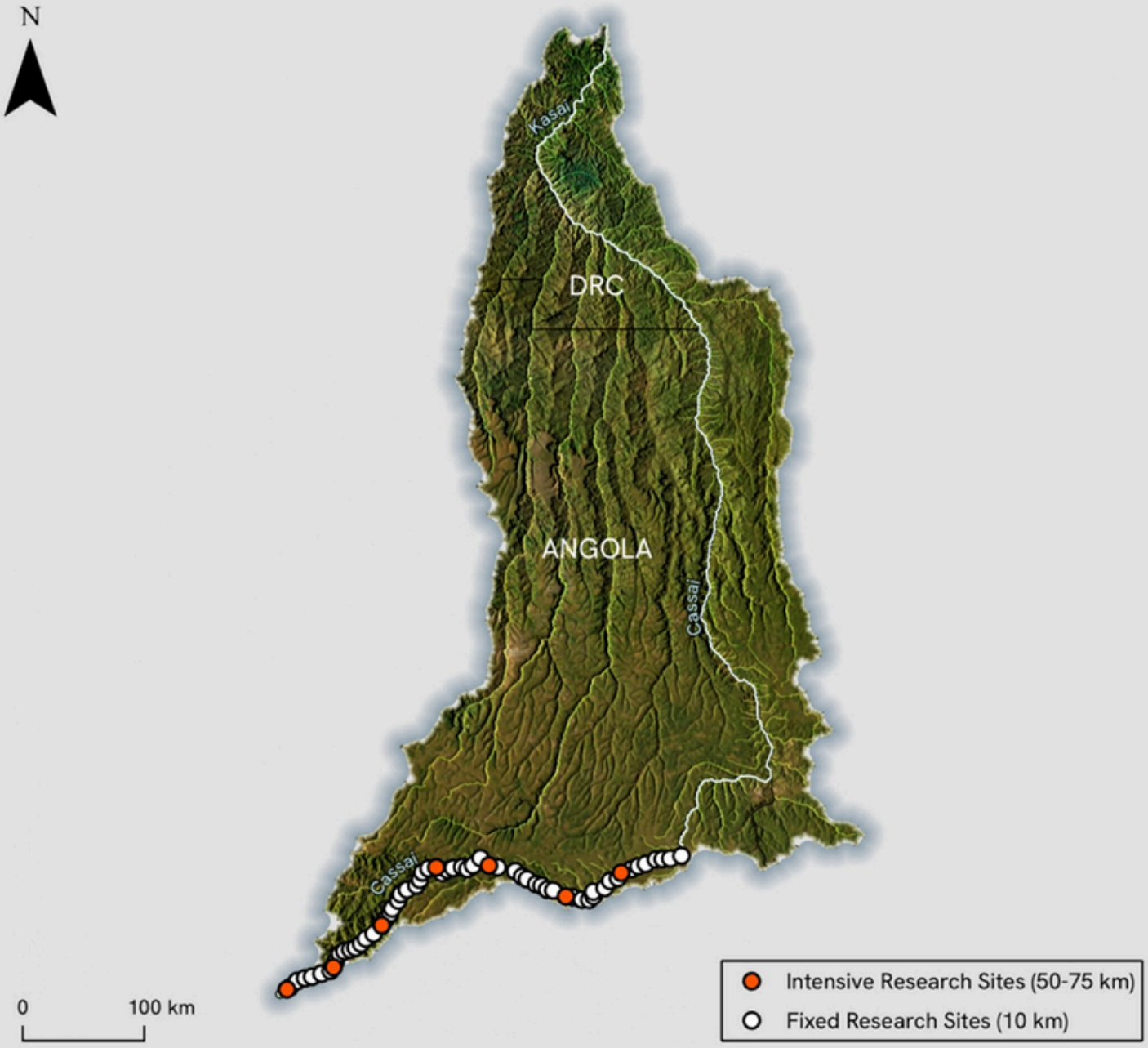
OPPORTUNISTIC SITES

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

63 sites

3.58 Tb	2 102	57
bat recordings taken	birds observed	freshwater fish specimen recorded



The locations of fixed and intensive research sites.

HUMAN FOOTPRINT

The upper Cassai River flows through one of the least populated and most remote landscapes in the Congo Basin. Scattered rural communities depend on its waters for drinking, washing, and small-scale agriculture and fisheries. Establishing a baseline of human activity along this river is critical for future conservation and development planning, as it helps identify where interventions can both strengthen community livelihoods and maintain the ecological balance of the Cassai system. Monitoring changes in settlement, land use, and resource use over time will be key to understanding how this landscape evolves as infrastructure and access slowly expand across Angola.

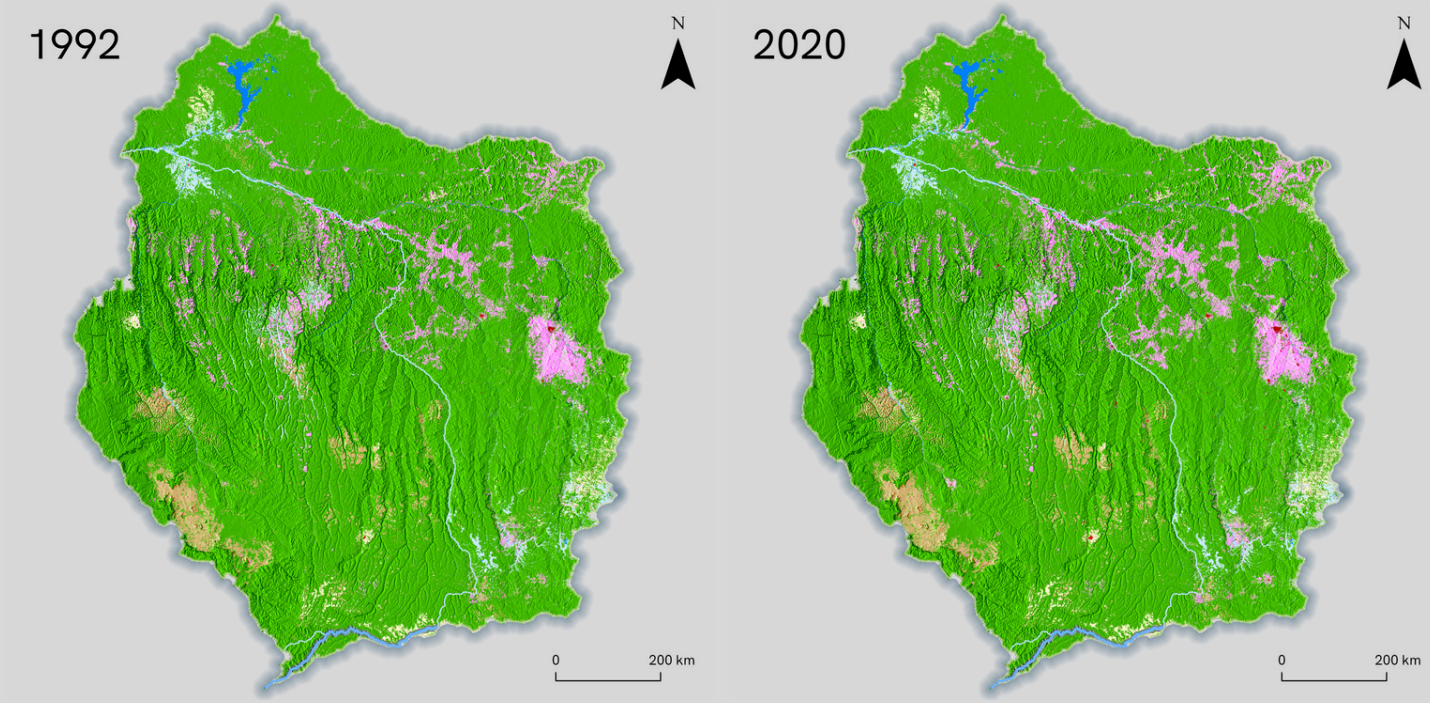
Human presence along the Cassai River is among the lowest ever recorded by The Wilderness Project, with an average of only 0.3 people per kilometre of river. Most observations occurred near the river's source, close to the road between Luena and Camacupa, while long stretches downstream were largely uninhabited. This sparse human density reflects the remoteness of Angola's interior highlands and the limited accessibility that has historically constrained settlement and intensive land use. A Google Buildings analysis supports these field findings, showing an exceptionally low density of built infrastructure across the Cassai Basin. Together, these results highlight a landscape with minimal permanent settlement and limited development footprint.

	Cassai River Observations
People	0.3 / km
Fishers	0.1 / km
Riparian cropland (% of transect)	0.1 %
Buildings within 4 km of river	1 building / km^2
Building density within the Cassai Basin	7 buildings / km^2

Distribution of people observed along the transect. The upper Cassai River hosts among the lowest densities of human activity recorded to date.

Where communities do occur, their relationship with the river is direct and subsistence-based. Fishing, small-scale agriculture, and limited artisanal mining together represent the main human activities observed along the Cassai, yet their extent remains minimal. Only a handful of small fishing camps were recorded, and cultivation was confined to isolated gardens on higher terraces, covering just 0.1% of the riverbank area. Artisanal diamond workings were few and localised at the time of the survey.

Although the river corridor remains sparsely inhabited, a land-use and land-cover (LULC) analysis reveals a 159% increase in settlements in the wider region since 1992, indicating an increasing human footprint in the region. Continued monitoring will be essential to track how these broader trends influence settlement patterns and resource use along the Cassai. The observations from this transect therefore offer an important baseline for understanding one of the Congo Basin's most important tributaries and provide context for how human use may evolve as access improves over time.



	Agriculture	Forest	Grassland	Wetland	Settlement	Shrubland	Bare	Water
% change from 1992 - 2020	14%	-2%	5%	3%	159%	14%	235%	-1%

A land-use land-cover (LULC) analysis of the Cassai Basin, based on the European Space Agency's (ESA) Climate Change Initiative (CCI) Land Cover dataset. The analysis shows spatial patterns in land use and cover, offering insights into environmental dynamics and anthropogenic pressures.

WATER QUALITY

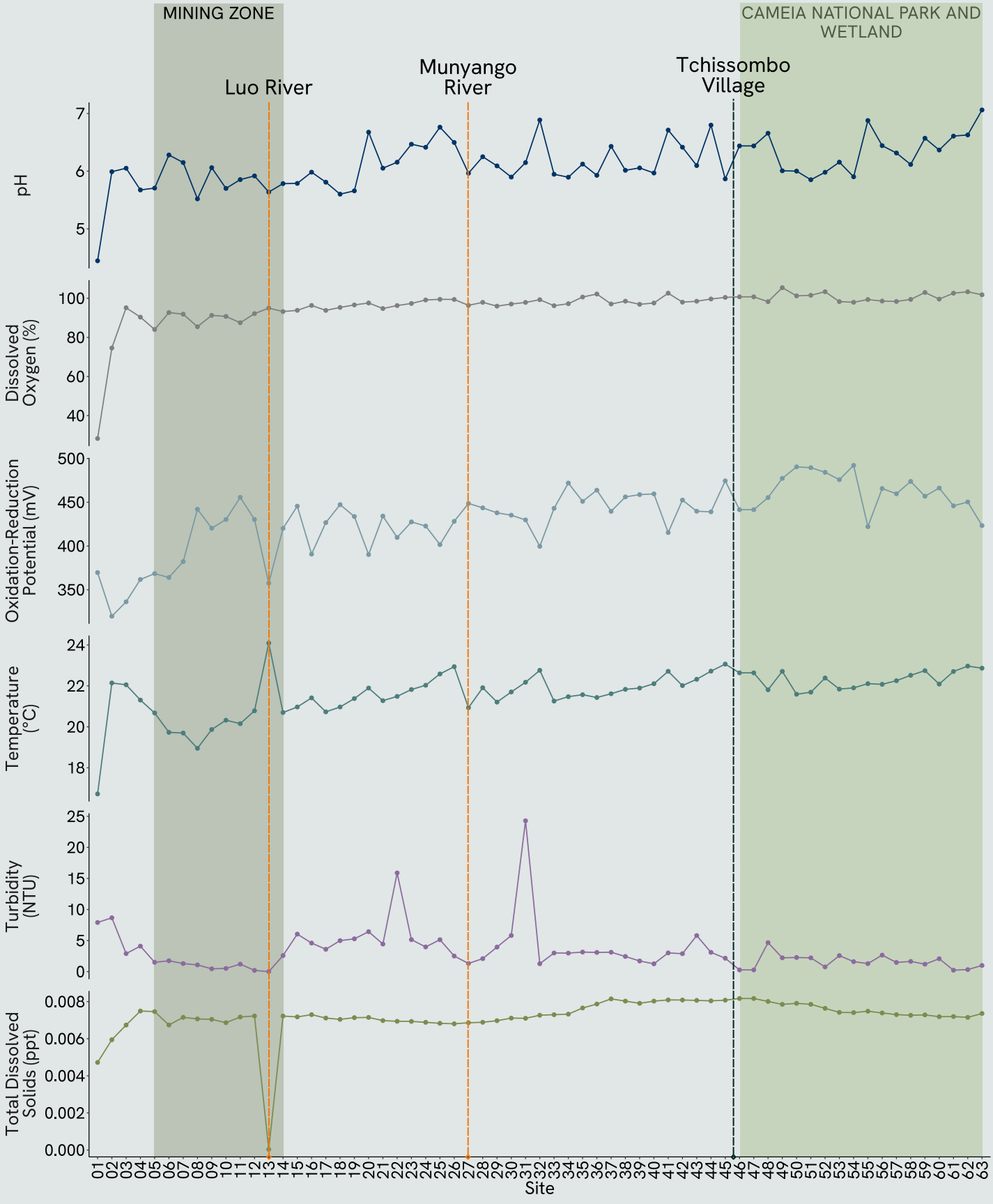
Water quality provides a fundamental measure of river health. Monitoring key chemical and physical parameters, such as pH, dissolved oxygen (DO), total dissolved solids (TDS), and turbidity, helps to assess the suitability of water for human consumption, track landscape influences, and detect any signs of pollution from mining or settlement activity. As the largest Angolan tributary of the Congo River, the Cassai also plays a major role in regulating the broader basin's freshwater chemistry and sediment transport, connecting the peaty uplands of Angola's interior to the tropical lowlands downstream.

In 2021, a tailings-pipe failure at the Angolan Catoca diamond mine resulted in reported fish mortality, illness, and the disruption of water supplies along the Tshikapa and lower Cassai rivers in the DRC [4]. Although these impacts occurred far downstream of the headwaters surveyed in this study, the event demonstrated how water quality disturbances in one part of the basin can affect communities and ecosystems over large distances, underscoring the importance of establishing clear baselines in the still-pristine upper catchment.

Across the 2023 transect, overall water quality in the upper Cassai was excellent. All measured parameters fell within internationally recognised safe limits for human consumption [5], and no anomalies were detected along the survey reach. Dissolved oxygen levels remained consistently high and total dissolved solids (TDS) values low, both indicators of clean, well-oxygenated water with minimal anthropogenic disturbance. The pH of the river was generally on the acidic side, averaging slightly below neutral — a pattern typical of peaty headwater systems. Despite this acidity, pH levels remained well within acceptable bounds for drinking water and aquatic life.

The expedition encountered eight artisanal diamond mining sites in the upper reaches, but no water quality deviations were observed in proximity to these areas. At the confluence with the Luo River, a brief fluctuation in water chemistry was observed, marked by a change in TDS and oxidation-reduction potential (ORP). This shift was transient and likely associated with attenuated flow from surrounding peatlands, which temporarily altered the water's colour and ionic composition.

The findings from the 2023 expedition provide a rare baseline for one of Central Africa's least studied river systems. They indicate a river that remains chemically pristine, buffered by intact wetlands and sparse human presence. However, as accessibility and extractive activity will likely increase in the coming years, continued monitoring will be essential to detect any emerging trends and to safeguard this key tributary's contribution to the broader Congo Basin.


MINING ZONE
CAMEIA NATIONAL PARK AND WETLAND
Luo River
Munyango River
Tchissombo Village
pH
Dissolved Oxygen (%)
Oxidation-Reduction Potential (mV)
Temperature (°C)
Turbidity (NTU)
Total Dissolved Solids (ppt)
Site

BIODIVERSITY

The upper stretch of the Cassai River flows through one of the least documented regions of the Congo Basin. Very little is known about its wildlife, birds, or fish, and few formal biodiversity surveys have been conducted here. Establishing a biological baseline is therefore an important first step toward understanding how these remote landscapes support freshwater and riparian species. Monitoring along such systems helps detect ecological change over time and provides the foundation for future conservation and land-use planning as development gradually expands across eastern Angola.

Wildlife sightings during the 2023 expedition were infrequent. The highest number of animals was recorded near Cameia National Park, where the seasonal wetland likely creates refuge habitat largely free from human disturbance. Within this area, the team observed seven hippos and eleven crocodiles. These numbers are relatively low compared to findings from other rivers across southern and central Africa, and these species are also known to have declined widely across Angola following decades of conflict and hunting. Their distribution suggests that the Cameia National Park and its surrounding channels do provide habitat for these important species, including permanent water, vegetation cover, and low human pressure.

The density of large wildlife observed along the upper Cassai transect shows a concentration around the Cameia National Park. Besides hippos and crocodiles, other large mammals were rarely encountered. On several occasions, the team observed an unidentified monkey species, suggesting the presence of primates in riparian woodland zones.

WETLAND BIRDS

Birds were encountered throughout the transect, offering useful insight into habitat structure along the river. Wetland-associated species were present in moderate numbers, with widowbirds, bee-eaters, storks, and kingfishers among the most frequently observed. These species are characteristic of open floodplain and riparian grassland environments and reflect the natural mix of habitats in the upper Cassai system. Bird activity was highest near Cameia National Park, where shallow, seasonally flooded areas provide foraging grounds and shelter.

The team also recorded multiple sightings of the African Finfoot (*Podica senegalensis*), a species that depends on shaded banks and undisturbed watercourses. Its occurrence along several stretches of the Cassai suggests that sections of riverbank forest remain intact and that the system still provides suitable habitat for this specialised bird.

Twelve most common bird species counted on the transect, including the endangered Bateleur and rare African Finfoot.

Species	Count
Marsh Widowbird (*Euplectes hartlaubi*)	898
Sharp-tailed Starling (*Lamprotornis acuticaudus*)	142
White-fronted Bee-eater (*Merops bullockoides*)	135
Woolly-Necked Stork (*Ciconia microscelis*)	122
Pied Kingfisher (*Ceryle rudis*)	115
Hartlaub's Babbler (*Turdoides hartlaubii*)	93
Little Bee-Eater (*Merops pusillus*)	66
Malachite Kingfisher (*Corythornis cristatus*)	43
African Stonechat (*Saxicola torquatus*)	37
Hamerkop (*Scopus umbrette*)	33
Bateleur (*Terathopius ecaudatus*)	29
African Finfoot (*Podica senegalensis*)	22

FISH

An *Amphilius* catfish, a fish well adpated for fast-flowing, rocky habitats.

The Cassai River forms part of the Congo Basin but rises near the divides separating it from the Upper Zambezi and Okavango systems. Its headwaters therefore occupy a region of potential biogeographic linkage among these basins. However, the upper Cassai has rarely been sampled, and its fish communities remain poorly documented [6].

During the 2023 expedition, the team collected 20 environmental DNA (eDNA) samples from seven sites along the transect and obtained a broad range of fish specimens to characterise the aquatic fauna of this remote headwater region. Preliminary identifications include species from the Mormyridae, Cichlidae, and Cyprinidae families — groups common to Angolan rivers with similar hydrology.

Hydrological studies describe the upper basin as relatively stable, with low sediment loads and a largely unaltered flow regime. These characteristics, together with the absence of major dams or intensive land use, suggest that aquatic habitats remain in a natural state. Confirming the full composition of the fish community will require further taxonomic work, but the material collected during this expedition represents an important reference for this part of the Congo system.

A *Cyphomyrus* sp., one of the freshwater elephantfish species famous for their unusually large brain size.

Rapids such as these are among the many aquatic habitats surveyed in the upper Cassai, where a range of conditions may support a broad diversity of fish species.

RIVER FLOW

Understanding how water moves through the Cassai is key to interpreting the wider hydrology of the Congo Basin. As the Congo's largest Angolan tributary, the Cassai plays a vital role in sustaining the region's freshwater balance, supporting communities across both Angola and the Democratic Republic of Congo (DRC). Measuring flow along this river provides a foundation for future monitoring and helps to explain how climate and landscape features influence discharge patterns, water availability, and local livelihoods throughout the basin.

The Cassai begins on Angola's Bié Plateau, where cool, wet uplands feed numerous streams that merge into the main channel. Rainfall in these southern headwaters is strongly seasonal, feeding wetland systems such as that in the Cameia National Park that hold and release water over time. As the river flows northward, the landscape opens into a broad depression and the climate shifts to more equatorial conditions that are hotter, more humid, and with a single long rainy season. This south-to-north gradient underpins a gradual but steady accumulation of flow as the river moves downstream [7, 8].

During the 2023 expedition, river flow was measured at four sites using an Acoustic Doppler Current Profiler (ADCP), including near the source marsh, the confluence with the Munyango tributary, and downstream sections approaching the Cameia National Park and its contained wetland. The ADCP, operated from a moving boat, recorded water depth and current velocity across each channel section, providing a detailed picture of how discharge builds downstream. This method follows international hydrological standards and is particularly valuable in regions where permanent gauging stations are scarce.

The results show a consistent increase in discharge downstream, from about 8 m^3/s near the source to around 50 m^3/s farther north. The Munyango tributary contributed noticeably to this rise, and the increase near the Cameia wetland suggests that this system stores and releases large volumes of water during the rainy season. Climate projections indicate that the average annual discharge across the basin may decrease substantially in coming decades, underscoring the importance of establishing reliable river flow baselines for tracking future change [7]. While these four measurements represent a small spatial and temporal snapshot, they form an important starting point for understanding the Cassai's upper hydrology and for guiding future, longer-term monitoring of this key headwater system.

Site Number	Description	Discharge (m^3/s)
1	Mainstem	8.49
2	Munyango	10.32
3	Mainstem	17.30
4	Mainstem	50.39

River discharge measurement sites along the transect, with discharge values displayed for each site.

KEY INSIGHTS

Key Insight:
The Cassai headwaters and wetlands support one of the most important, unmodified tributaries of the southern Congo Basin. Located partly within Angola's first Ramsar Wetland of International Importance, this headwater region combines high hydrological stability, good water quality, and a low human footprint, making it a strategic reference site for basin-wide conservation planning and water governance.

Recommendation:
Use the upper Cassai as a national reference site for Angola's inland water monitoring. Future work should prioritise low-cost, repeatable monitoring at key sites (e.g., Cameia Wetland, Munhango source, and Cassai Sul) and data-sharing with regional initiatives such as the Congo Basin Water Resources Research Center (CRREBaC).

Key Insight:
The 2021 pollution event on the Tshikapa–Cassai system highlighted the interconnected nature of the basin and the potential for large-scale disturbances to affect fisheries, drinking water, and human health downstream. This risk is amplified by the Cassai's role as the largest Angolan tributary of the Congo River, linking localised impacts to one of Africa's most extensive transboundary river systems. While the upper Cassai remains chemically pristine, the event demonstrated the need for clear upstream baselines and sustained monitoring to inform basin-scale and transboundary river management efforts.

Recommendation:
Strengthen transboundary information-sharing between Angola and the DRC by supporting joint hydrological and water quality monitoring programs. These programs should incorporate upstream baseline data (such as those established through this expedition) into regional management frameworks and perform further monitoring of the full river extent, to help track change, identify potential risks, and support early detection of future disturbances.

Key Insight:
The upper Cassai is among the least populated river corridors recorded by The Wilderness Project, averaging only 0.3 people per km. Human activity is limited to small-scale subsistence fishing and cultivation, with negligible land conversion.

Recommendation:
Support participatory land-use planning that recognises communities as custodians of the river. Integrate early conservation measures, such as zoning of riparian buffers and sustainable fishing agreements, into forthcoming regional infrastructure or development plans to prevent future degradation.

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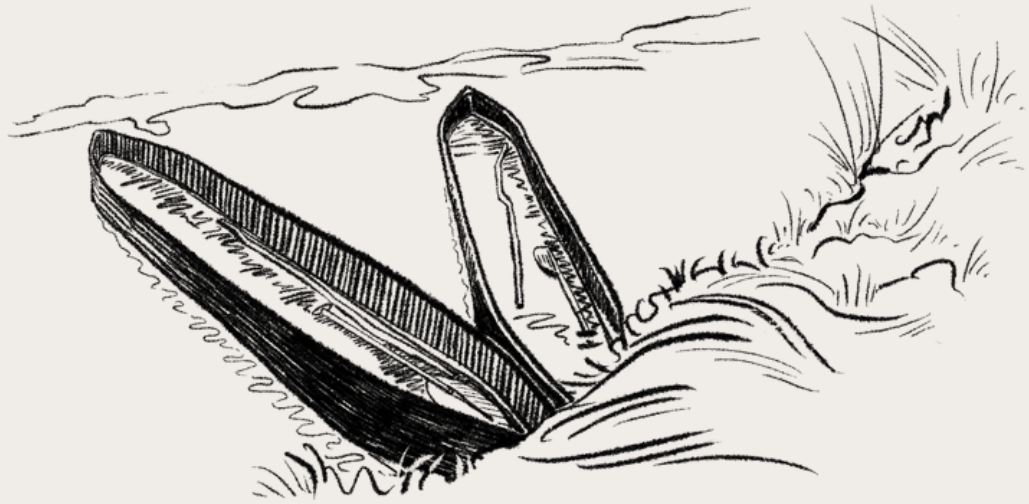


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