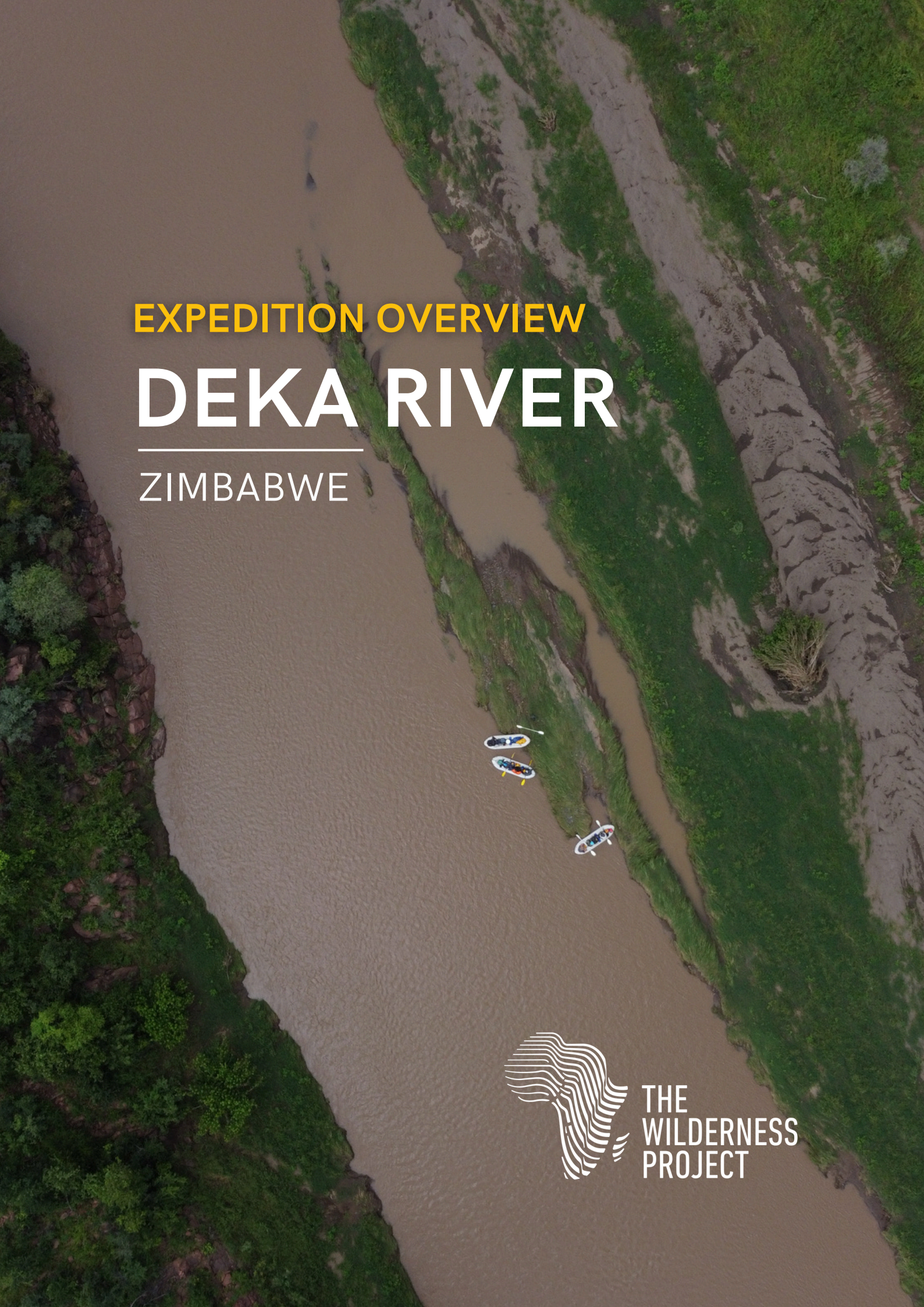


EXPEDITION OVERVIEW

DEKA RIVER

ZIMBABWE

THE WILDERNESS PROJECT

THE WILDERNESS PROJECT

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 to establish 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 enable information-sharing, provide invaluable guidance, and grant permissions wherever we work. For their continued support, we thank the Zimbabwe Parks and Wildlife Management Authority, African Parks, and the Wild Bird Trust. Finally, we thank the communities along the Deka River, who allowed us safe passage.

WILD BIRD TRUST

PARKS AND WILDLIFE MANAGEMENT AUTHORITY · ZIMBABWE · IN HARMONY WITH NATURE

CONTENTS

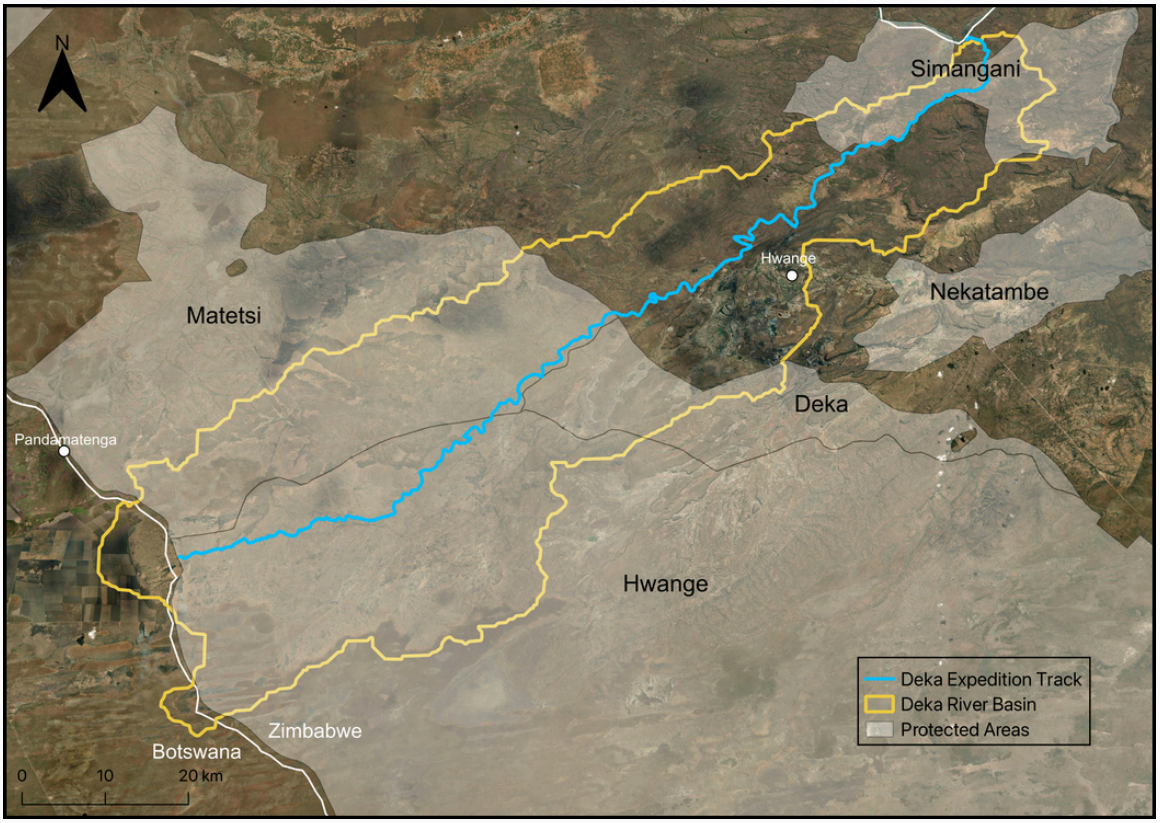
INTRODUCTION

The Deka River — a key tributary of the Zambezi — lies in Matabeleland North in Zimbabwe. It is a seasonal river that originates within the protected expanse of Hwange National Park, approximately 80 km southwest of Hwange Town[1]. Here, it begins as a narrow channel weaving through mopane woodlands and savanna grasslands. From these remote uplands, the river winds in a northeast direction, passing through the town of Hwange and several rural settlements before eventually merging with the Zambezi River near the Zambian border[2]. As one of Matabeleland North's major rivers — and the principal watercourse in Hwange District — it forms a vital lifeline for over 73,000 people living in adjacent villages[1,2].

Once known for its productive fisheries and clean water, the Deka River is rapidly degrading. It’s waters are a tinged blue-green colour by pollution linked to mining activities[1]. Local communities no longer fish in the river. The water is still used for irrigating crops, and by industry, however even these uses are coming under question as the water quality continues to deteriorate. Community members in Hwange District report stomach pains and illness after drinking the water, and livestock occasionally die when herded near the river[1].

In 2017, community members began to protest against the pollution and voiced their concerns about mining and processing companies, prompting a multi-stakeholder mediation process with government, industry and civil society organisations. Thereafter, to assess the impact of coal mining on the Deka's water quality, related health risks, and mine management practices, community members — partnering with the University of Zimbabwe and Swiss Federal Institute of Technology Zurich (ETH Zurich) — collected water samples over a 1.5-year period along the Deka River, its main tributaries, and pollution sources[1]. This initiative, together with the collection of baseline data on the Deka River by TWP, will guide ongoing monitoring efforts and promote long-term, sustainable management of the river.

The shallow source pool of the Deka River (left) located northwest of Hwange National Park near the Zimbabwe-Botswana border, with the river flowing eastward from its source.



The Deka River Basin, located within the Zambezi River Basin in the northwest of Zimbabwe, lies just south of the Zambezi Gorge. Commercial farms are situated near the headwaters of the Deka River, close to the Zimbabwe-Botswana border.

THE EXPEDITION

167 km

traversed by foot and inflatable rafts

7	21	7
team members from 4 African countries	research sites established	days on expedition

The Wilderness Project (TWP) conducted a 167 km research transect along the Deka River from 25 February to 3 March 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 information, including ongoing threats to the river.

Starting at the source in the north-west of Hwange National Park, near the Zimbabwe-Botswana border, the team launched two-person inflatable rafts that were used for the expedition. The team consisted of local and international researchers, including a scientific senior ranger from Zimbabwe Parks and Wildlife, as well as expert river guides and a TWP support team

RECOMMENDATIONS

Water Quality

- Implement mitigation measures in the Runduwe and Sikabala streams to lower the levels of acid mine drainage entering the Deka River.
- Conduct regular water quality monitoring on the Runduwe and Sikalaba streams. This will help to i) assess the seasonality of mining contamination; and ii) determine the main source of contamination to the Deka River.
- In close collaboration with local authorities, policies and regulatory frameworks should be revised. These should aim at strengthening the enforcement of existing water quality standards and enhancing regulations for mine effluent discharges. This would ensure more effective protection of water resources and help to mitigate the environmental impact of mining activities.

Invasive species management

- The spread and impact of invasive species, such as Syringa (Melia azedarach) and the giant sensitive plant (Mimosa pigra) along the river should be monitored, particularly in the upper reaches of the river.
- Targeted interventions should be implemented to mitigate the spread and impact of invasive species, including mechanical removal where feasible.
- Develop and implement a coordinated invasive species management plan, integrating community-led interventions and collaboration among government, NGOs, and local stakeholders.

River Flow

- There is limited data on the hydrology of the Deka River. Flow measurements should be conducted along the Deka River to obtain a more comprehensive understanding of its seasonal hydrological dynamics.
- The seasonal discharge of Runduwe and Sikabala streams to the Deka River should be measured to determine their contribution to its overall flow.

METHODS

CONTINUOUS MONITORING

Observational survey data and 360° imagery were collected continuously along the transect. Sightings of wildlife, wetland birds, human activity, infrastructure and invasive species within 100 m of the river edge were recorded in Survey123 (ESRI) using a smartphone.

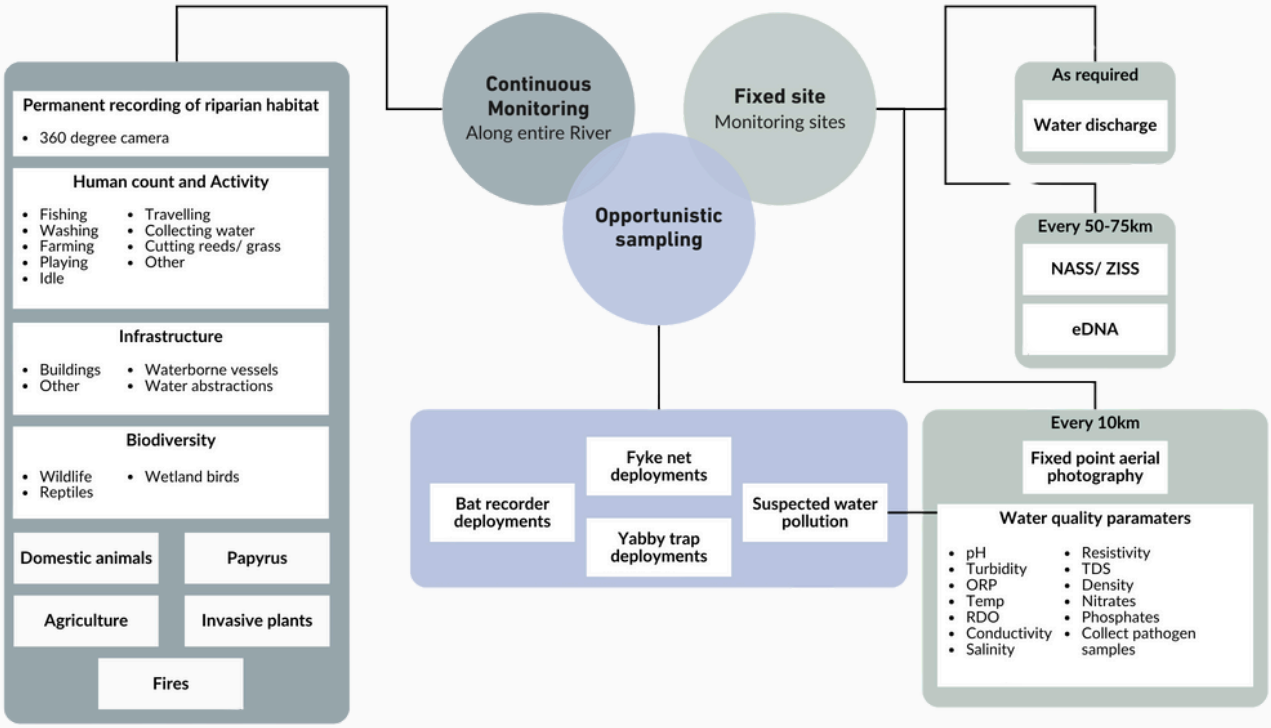
FIXED SURVEY SITES

Fixed research sites were established at regular intervals along the transect. These included drone flights, eDNA assessments, macroinvertebrate surveys, and water quality testing for a comprehensive analysis of river health.

OPPORTUNISTIC SITES

Specific sites along the transect were chosen for river flow measurements, crustacean trapping, fish sampling, and bat-call recording. These data offer a deeper understanding of the biodiversity and hydrology of the river.

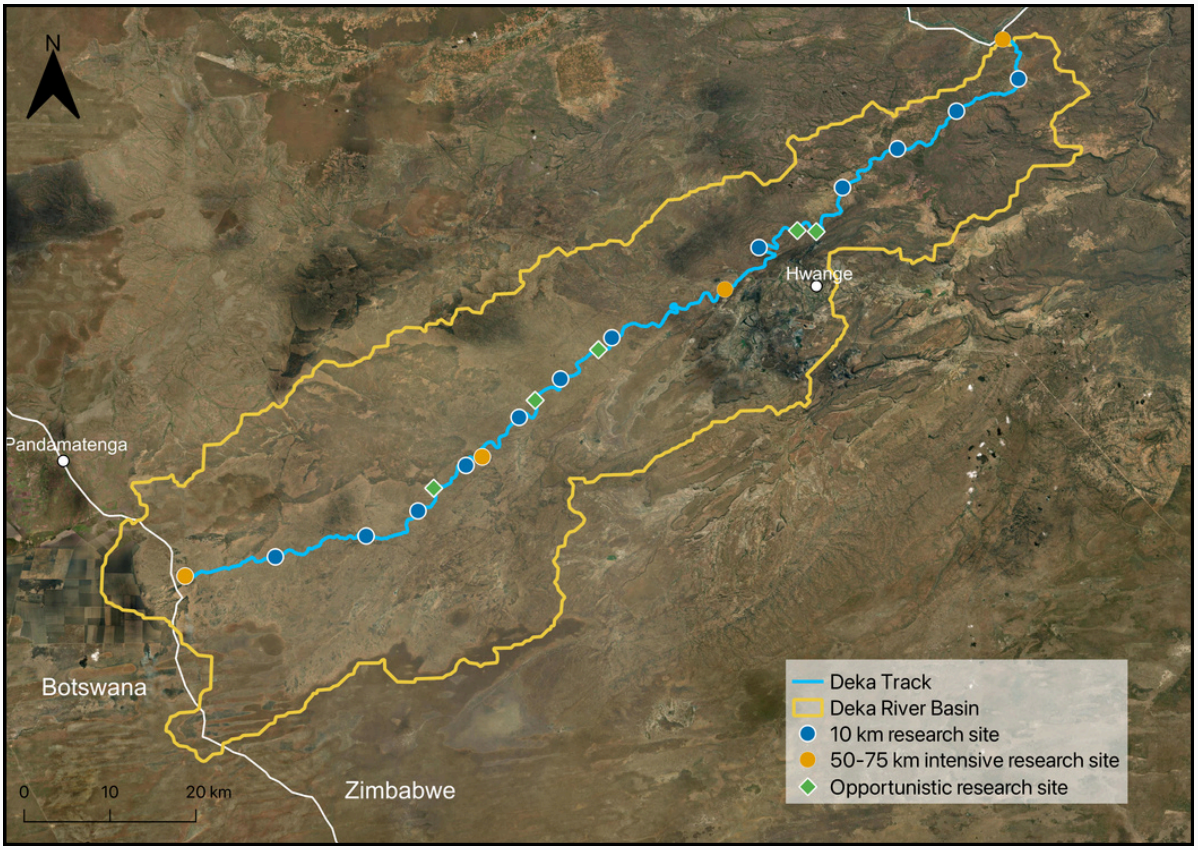
A SUMMARY OF THE DATA COLLECTED ALONG THE TRANSECT



RESEARCH SITES

17 fixed sites

29	16	660
water quality measurements	aerial drone surveys	wetland birds recorded



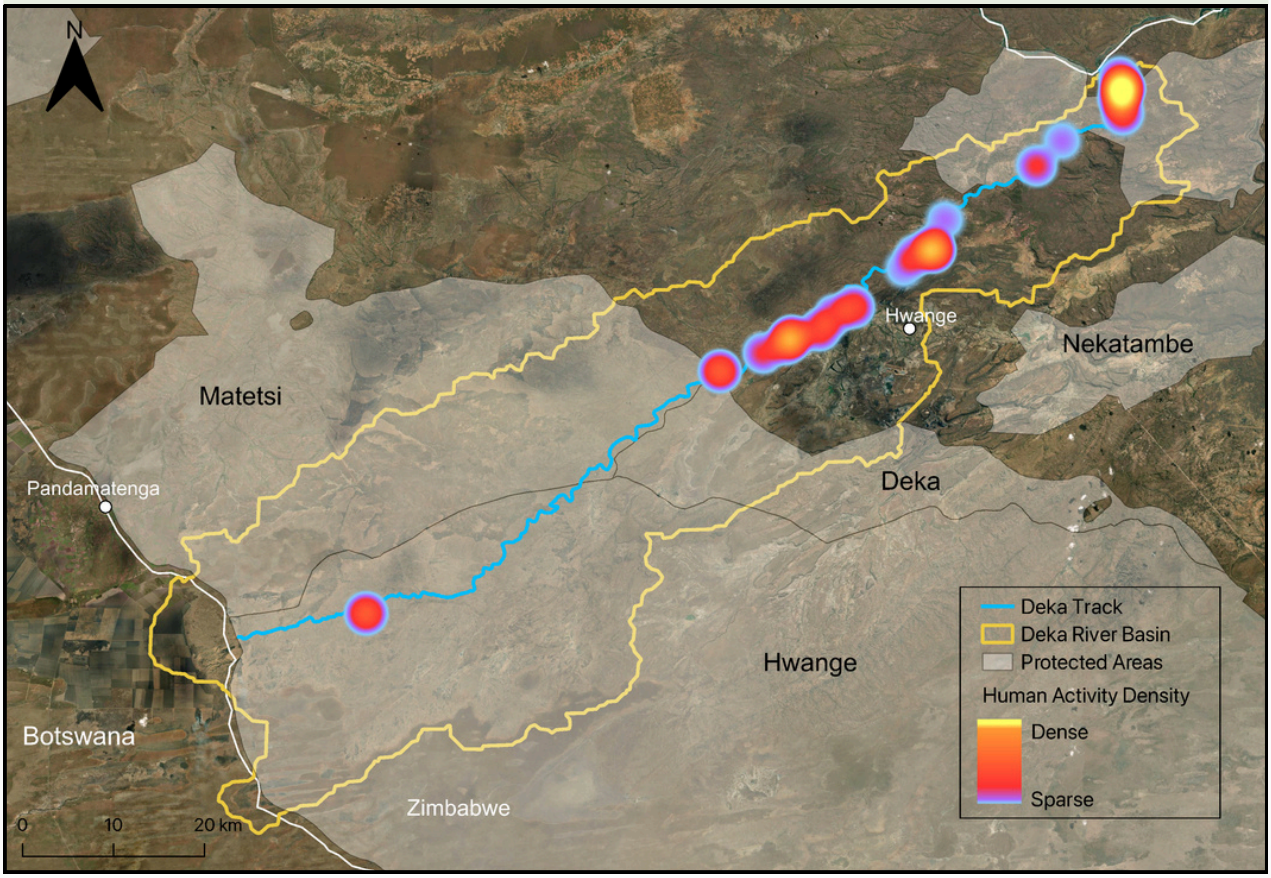
The locations of fixed and intensive research sites on the Deka River, from its source to its confluence with the Zambezi River.

HUMAN FOOTPRINT

The Hwange District has an estimated population of more than 73,000 people[3]. The Deka River flows through several rural settlements, including Zwabo Mukuyu, Mashala, Shashachunda, Kasibo, and Mwemba. For these communities, the river provides a critical source of livelihood — particularly fishing, which is the primary activity, and livestock rearing[1].

Human presence along the river was scarce at the time of the survey, with a recorded density of just 4 people/10 km. Most individuals were located outside protected areas. Although fishing remains the principal livelihood activity, fishing density along the river is low. This is largely attributed to a decline in fish populations, which many locals associate with increasing mining-related water pollution[2]. Meanwhile, livestock rearing is widely practiced along the river, particularly in areas where human activity is more concentrated.

Indicators of Human Activity					
People/10 km	Fishers/10 km	Fishing gear/10 km	Vessels/ 10 km	Livestock/ 10 km	Riparian cropland (% of transect)
4	2	1	< 1	15	< 1

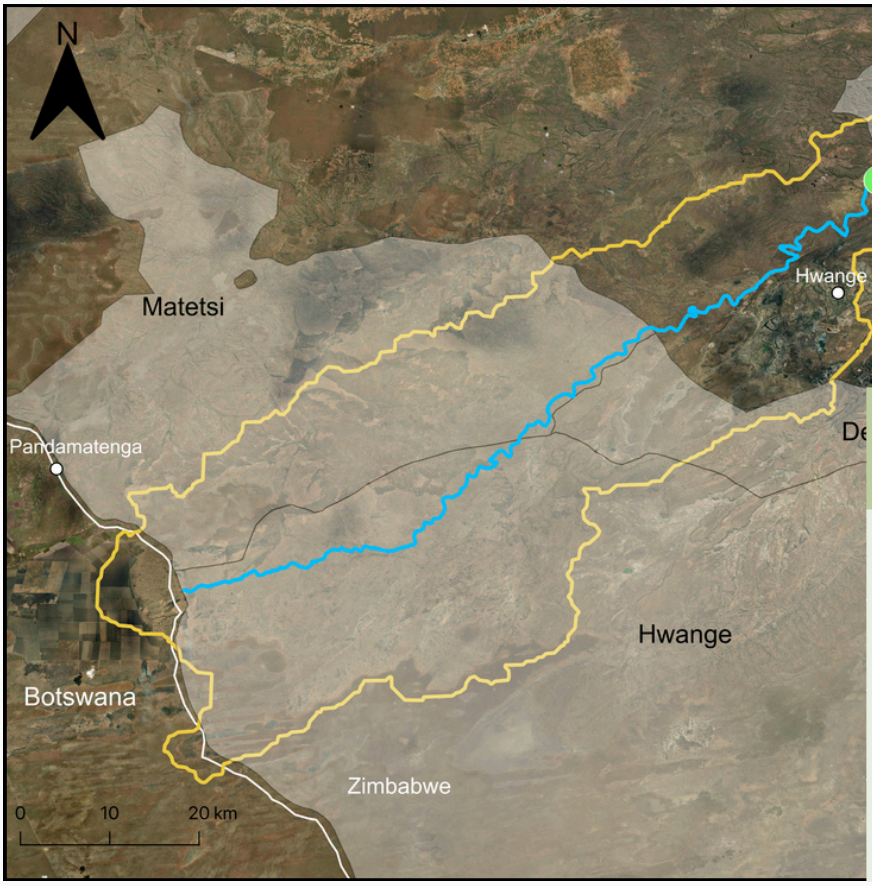


Distribution of human footprint along the river transect. People were mainly concentrated near Hwange Town.

AGRICULTURE

Rain-fed agricultural production is one of the main sources of livelihood for rural communities in Hwange District[4]. Farming in Hwange follows a semi-extensive, mixed-cropping system that incorporates both small livestock and cattle, alongside the dry-land cultivation of crops such as maize, groundnuts, sorghum, cowpeas and pearl millet[2]. With most crops being rain-fed, agricultural production in the region is particularly susceptible to climate change impacts. The area has already experienced frequent and severe droughts in recent years[5], which may lead to a decline in agricultural yields.

Minimal crop agriculture is present along the river, representing less than 1% of the distance along the riverbank. Maize, the most commonly observed crop along the Deka River, mirrors national trends where it is also the dominant staple crop grown by most rural households. Other crops observed include sorghum, bananas, and vegetables. Crops and livestock were only observed outside of protected areas. Approximately 60% of the river flows through protected areas, where land use is restricted, preventing agricultural expansion and further minimising agricultural pressure along the river. In addition, reduced rainfall, poor soil fertility in communal areas, limited access to markets and insecure land tenure further constrains agricultural productivity[4].



Crop Type	Distance along riverbank (m)[1]
Maize	200
Vegetables	100
Bananas	50
Sorghum	40

Distance of agriculture along the riverbank, mainly located near Hwange Town.

BIODIVERSITY

The first 58 km of the Deka River flows through the north-western section of Hwange National Park, the oldest national park in Zimbabwe. Spanning 14,650 km^2, it is the largest national park in the country[6]. Forming part of the Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA), the park is an important conservation area, and is considered a key biodiversity area of international significance.

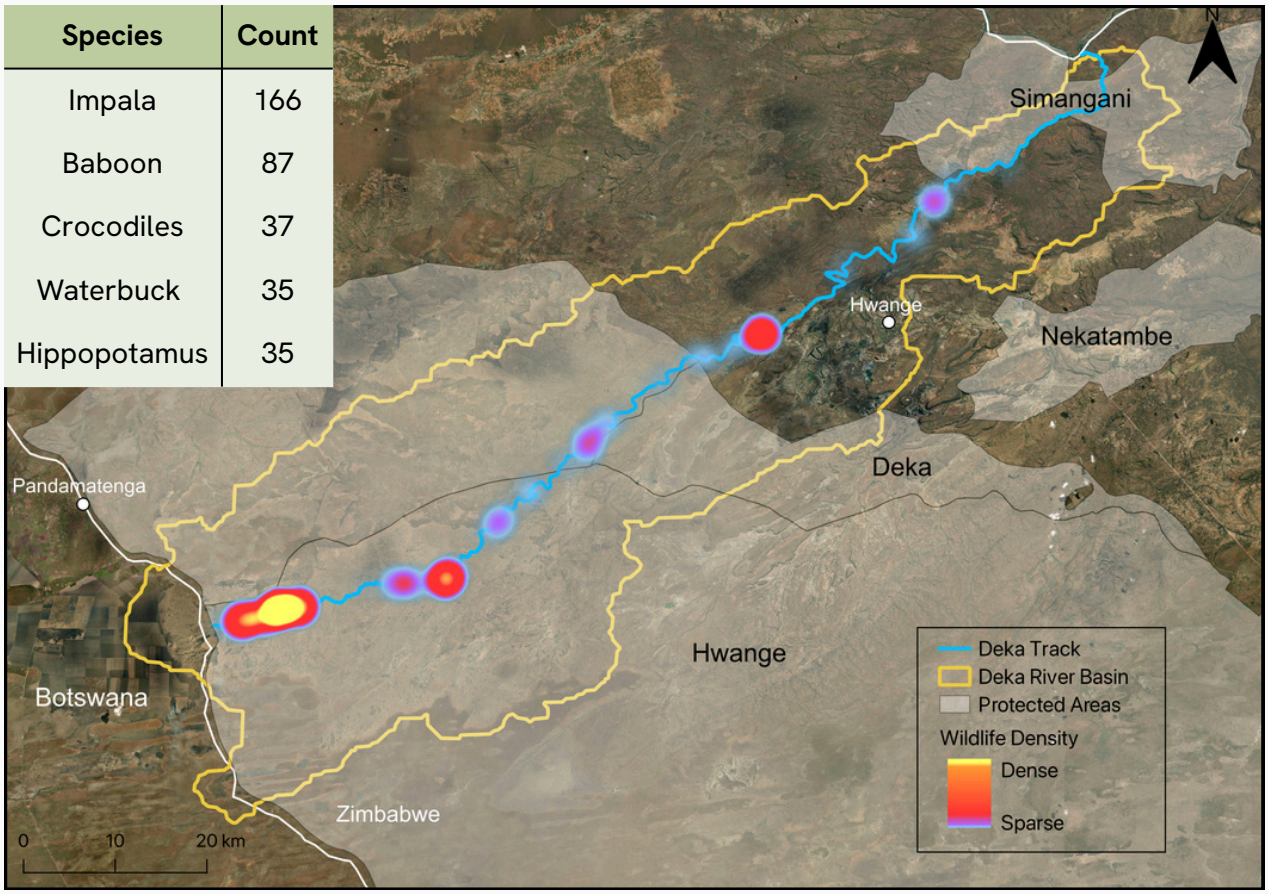
The predominant vegetation in the park includes Baikaeae plurijua woodland and Terminalia scrub, along with mopane and patchy distributions of savannahs and edaphic grasslands[7]. There is no perennial river system in the park, with animals mostly reliant on artificially pumped pans, particularly during the dry season[8,9]. In addition, elephants create craters to access subsurface water in the dry river beds and dambos[10]. The artificially fed pans provide a key water source during the late dry season for wildlife in the park, which support's the country's largest elephant population[7] — with ~40,000 elephants[11] — making it a critical stronghold for species in Zimbabwe.

The Deka River also flows through the Deka and Matetsi Safari Areas, which are hunting areas. Together with Hwange National Park, these areas create a protected area network with little development along the river in these sections, explaining the prominence of wildlife in this region.

Hwange National Park and surrounding protected areas support a rich diversity of wildlife, including large mammals, various antelope species, predators, and small mammals. This biodiversity is evident in the animal counts recorded along the transect, where 440 animals representing 13 species were observed. Impalas were the most numerous, followed by baboons. Crocodiles, primarily spotted near rapids and waterfalls, were also common. Other frequently recorded species included waterbucks and hippos, with 35 individuals of each noted.

Few animals were recorded outside of protected areas, with only occasional sightings of species such as vervet monkeys. This is consistent with wetland bird distribution along the river, indicating the absence of wildlife in these areas may be attributed to landscape fragmentation, likely due to coal mining and processing which has led to considerable land degradation in Hwange and surrounds[12]. In addition, bushmeat hunting, while prohibited under Zimbabwean law without a permit, is common even in unprotected zones where it serves as a source of subsistence[10]. Poaching remains a significant conservation challenge across Zimbabwe's protected and unprotected areas, and it is not uncommon in Hwange District[4]. In Hwange National Park, in particular, poaching of elephants for their tusks is a persistent threat[10], with the most significant incident being the mass poisoning of ~300 elephants in 2013[8]. Although large-scale poisonings have not been recorded since, smaller poaching incidents continue to occur.

Species	Count
Impala	166
Baboon	87
Crocodiles	37
Waterbuck	35
Hippopotamus	35



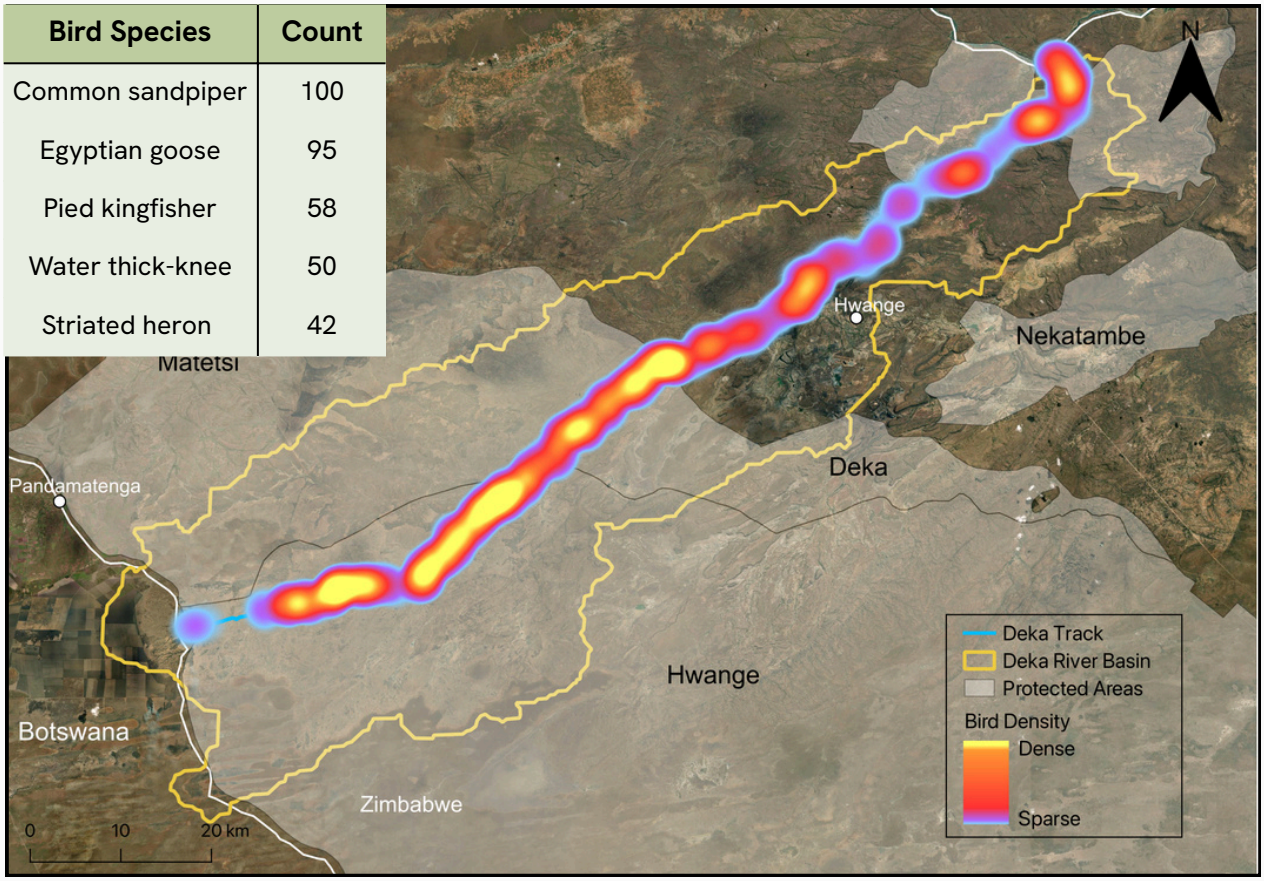
Wildlife distribution along the transect, highlighting a significant concentration within Hwange National Park.

WETLAND BIRDS

Wetland birds are powerful indicators of environmental change, especially in river systems where their presence often reflects the availability of wetland habitat. By regularly monitoring bird populations, we can detect early ecological shifts and identify emerging conservation priorities. However, wetland bird monitoring is limited in southern Africa, even within protected areas.

Wetland-associated birds were predominantly distributed in protected areas, with a noticeable decline observed outside these areas. Hwange National Park is classified as an International Bird Area, supporting a diverse range of bird species, with more than 400 species recorded in the park[6,8]. This is reflected in the number of wetland birds recorded along the transect — 660 birds belonging to 45 species. However, several bird species were only observed within protected areas, including lapwings, thick-knees, vultures, widowbirds, crakes, and jacanas. Here, wetlands formed by dams and pans provide ideal habitats that sustains this rich avian biodiversity.

Bird Species	Count
Common sandpiper	100
Egyptian goose	95
Pied kingfisher	58
Water thick-knee	50
Striated heron	42



Distribution of wetland-associated birds along the river transect. Most birds were distributed in protected areas.

INVASIVE SPECIES

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[13]. In addition, AIPs can reduce water quality by increasing evaporation rates and reducing stream flow and dilution capacity[14]. The continuous monitoring of AIPs allows for early detection of threats to riverine ecosystems.

Several alien invasive plants were recorded along the Deka River transect. Syringa (Melia azedarach) was concentrated near the river's source, where it has already formed dense stands. Small patches of red water fern (Azolla filiculoides) were observed within Hwange National Park, while a single patch of the giant sensitive tree (Mimosa pigra) was found near the confluence with the Zambezi River.

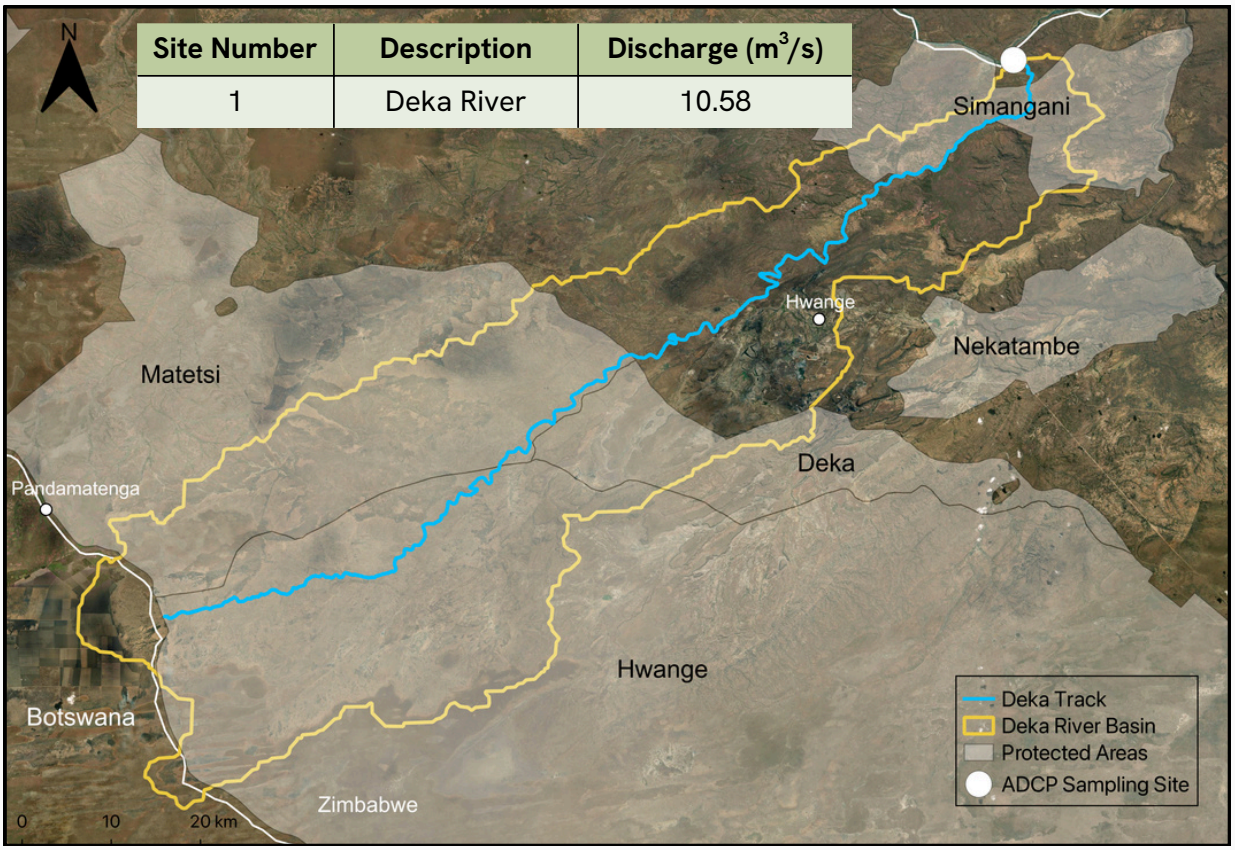
These invasive species pose serious ecological risks by outcompeting native vegetation and disrupting ecosystem balance. Syringa can alter surface water runoff in landscape and riparian zones, affecting both terrestrial and aquatic systems[15]. The red water fern is especially problematic in areas like Hwange National Park, where it can blanket water surfaces and disrupt aquatic ecosystems and degrade habitat quality for native species[16]. Mimosa pigra is highly invasive, forming dense thickets that can hinder access to water and alter the hydrological regime of the river[17]. Prompt control measures such as mechanical removal or biological control agents, supported by regular monitoring and coordinated management efforts are essential to limit their spread and prevent long-term ecological impacts.

*The invasive syringa (*Melia azedarach*) at the source of the Deka River.*

RIVER FLOW

The rivers in Zimbabwe exhibit high inter-annual and seasonal variability, with most flowing only during the wet season, except for those on the Eastern Highlands[18]. The Deka River is seasonal, flowing primarily from January to May[19]. During the dry season, it is reduced to a series of intermittent pools[11]. The Deka is fed by several tributaries, of which the Runduwe and Sikabala streams are the main contributors to its flow. The Runduwe Stream joins the Deka River near its midpoint[2], while the Sikabala enters the river a few metres downstream of a small dam[1].

Water discharge of the Deka River was collected at a single site, near its confluence with the Zambezi River. A discharge of 10.58 m^3/s was recorded. This was much higher than the flow of the Gwayi River (1.03 m^3/s) but lower than Shangani River (20.51 m^3/s), as measured in February 2025. Given that the region received 50-100 mm of rainfall during the expedition, it indicates that the Deka River had moderate flow conditions. However, additional discharge measurements along the river are needed to better assess its flow regime. The flow of the Deka, coupled with its seasonal variability, may be reduced by climate change impacts, as the region has experienced more frequent and severe drought conditions in recent years[5]. This is particularly concerning, given the river's importance to surrounding communities and the ecosystems it supports.



River discharge measurement sites along the transect, measured near its confluence with the Zambezi River.

MINING IMPACTS

The Deka River, a lifeline for many communities in western Zimbabwe, has come under increasing environmental and public health pressure from industrial and mining operations in Hwange District. As the Hwange region contains extensive coal reserves, coal mining has been the main economic activity since the early 1900s[1], underpinning the local economy despite its significant environmental impacts. As of 2023, there were about nine coal-mining and processing entities operating within the Deka catchment[18].

Coal mining is associated with various contaminants, including heavy metals and industrial pollutants. The discharges from these facilities can severely compromise river health, in extreme cases rendering water quality unfit for human consumption. There is evidence that this may be the case along the Deka, where a blue-green precipitate was observed entering the Deka River from a tributary located upstream of a coal mine tailings dam.

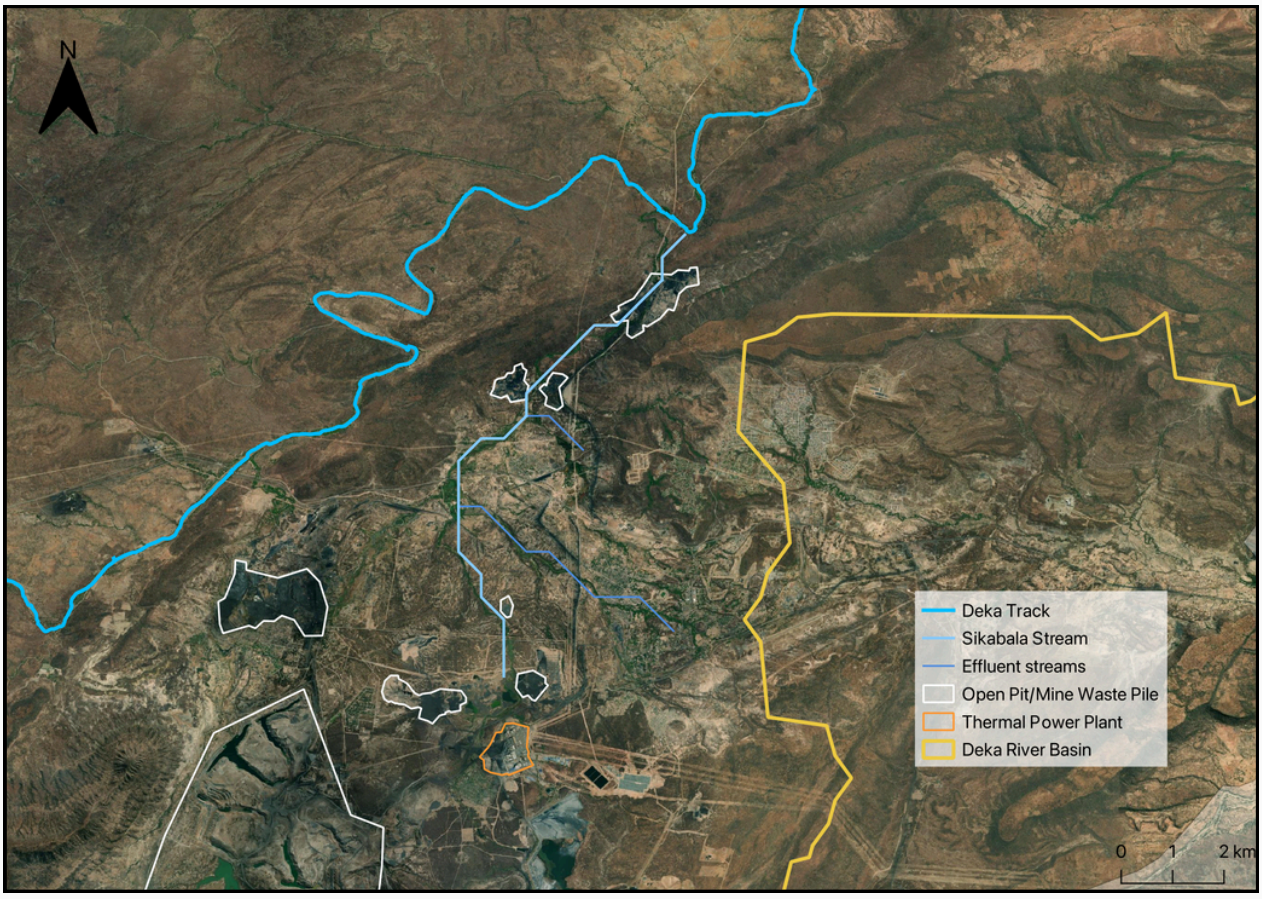
The blue-green colour of the Deka, particularly noticeable before the rainy season, could indicate a decline in water quality. This may be linked to its main tributaries, such as the Runduwe and Sikabala streams, which are known to be contaminated by acid mine drainage originating from coal effluents and underground mining sites[1,2]. This is particularly concerning for the Deka River, as it poses health risks to local communities and their livestock, and threatens the ecological integrity of the river system. However, analyses of water samples collected along the transect is needed confirm the possible source, and the extent of contamination along the Deka.

Acidic water entering from Sikabala Stream from a coal mine tailings dam (left) and alkaline water on the mainstem Deka (right) resulting in a blue precipitate.

MINING IMPACTS

The pollution of the Deka River appears to be influenced by its tributaries, particularly the Runduwe and Sikabala Streams[1,2]. However, the extent of their contribution has yet to be fully established. The Sikabala flows for ~20 km before joining the Deka River downstream of a small dam, carrying effluent from open-pit mines and abandoned underground mines[1]. During the rainy season, runoff from waste heaps, pit lake overflows, and illegal dumping intensify the discharge of acidic, metal-rich water. This makes the stream a major source of acid mine drainage (AMD) and coal residues, with visible downstream impacts, such as algal blooms and fish deaths[1].

Historical and ongoing mining activities may be exerting broader pressures on the Deka River system, which may contribute to shifts in aquatic biodiversity and compromise the river's role in sustaining local livelihoods. This highlights the importance of addressing not only direct sources of contamination, but also the cumulative and long-lasting impacts of mining on the river's ecological integrity and the communities that depend on it.



Coal mining and processing sites in the Deka River Basin, showing open-pit mines and waste piles through which Sikabala Stream and effluent streams flow before entering the Deka River.

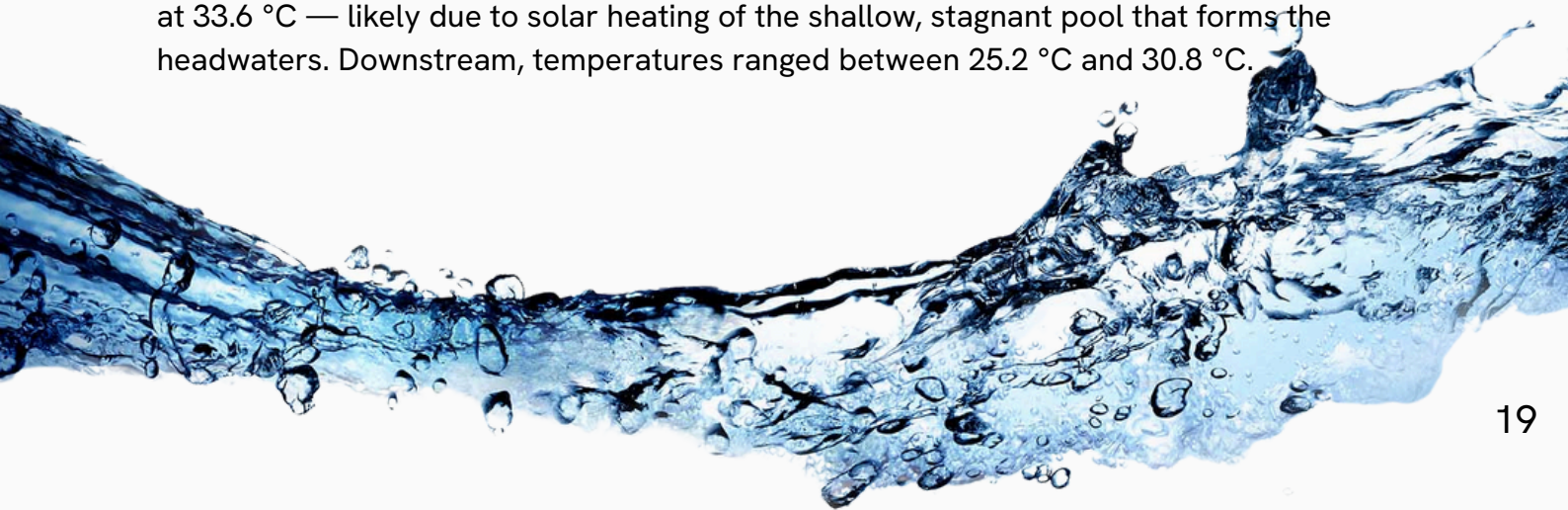
WATER QUALITY

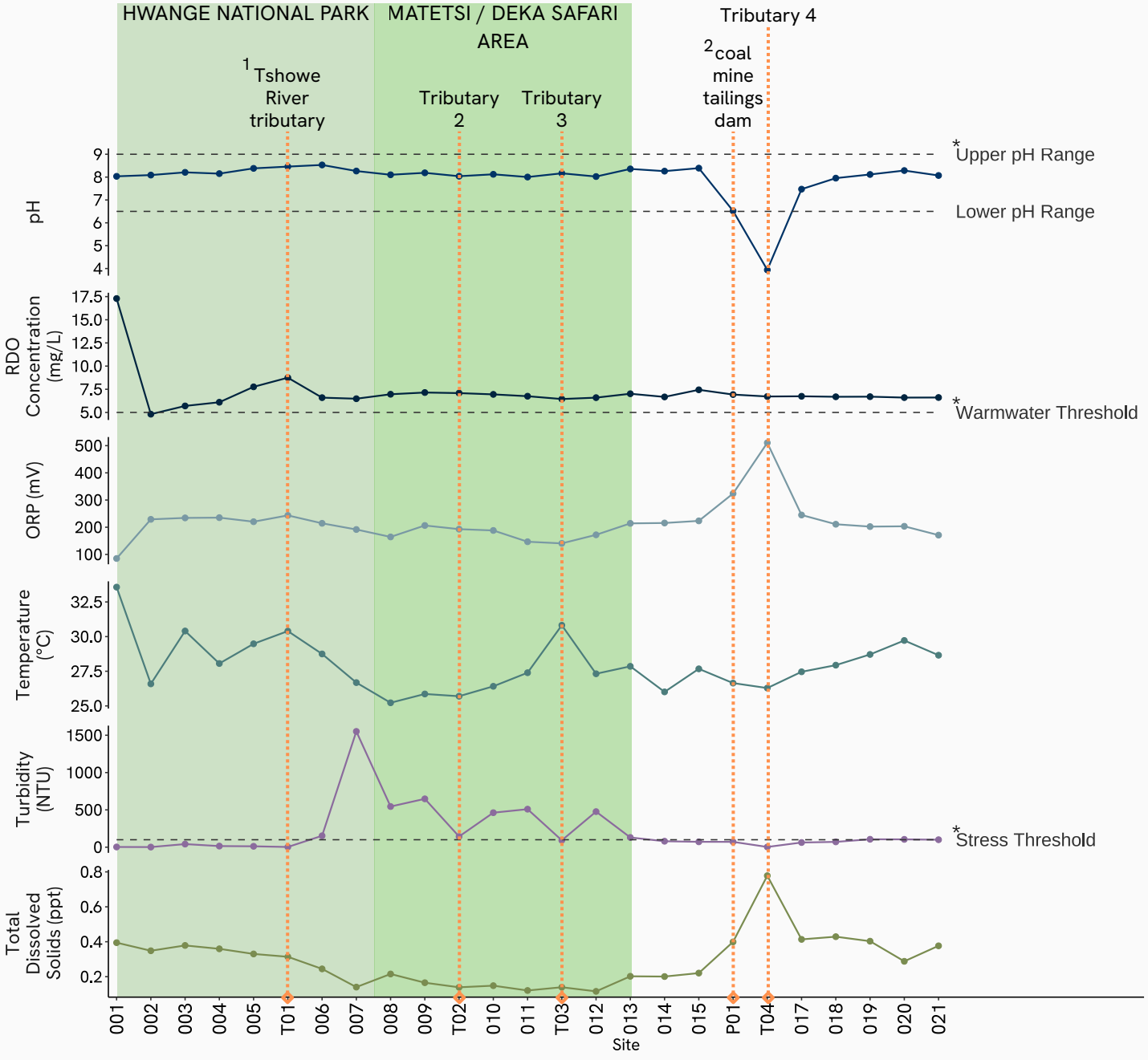
Monitoring water quality along the Deka River is essential for assessing ecosystem integrity and guiding conservation efforts. Water quality measurements can reflect local influences, such as mining. These factors have implications for aquatic biodiversity, erosion dynamics, and the long-term health of the ecosystem. In addition to measuring water quality along the Deka River, water quality was assessed at selected sites where tributaries joined the river, including a coal mining tailings dam located upstream of tributary 4 (see next page).

The Deka River exhibits varying water quality characteristics along its course, with notable chemical and physical changes influenced by natural and anthropogenic factors. From its source, the river displays generally alkaline conditions, with a pH around 8.2. However, this stability is disrupted at the confluence with the highly acidic tributary T04 (pH ~3.5), located near a coal mine tailings dam. These findings are consistent with previous studies, which showed that the Deka River generally exhibits alkaline conditions, except at its confluence with the Runduwe and Sikabala tributaries, where the pH is acidic[1,2].

At this junction, visible blue precipitate forms, likely the result of chemical reactions between the acidic inflow and alkaline river water — suggesting the introduction of acidity and mineral pollutants, potentially from mining runoff. While this points to anthropogenic influence, particularly from coal mining activities, confirmation is needed with the analyses of water samples. Following this confluence at site 17, the river's pH temporarily drops to 7.5 before gradually rising again around 8 near its entry into the Zambezi River. In parallel with pH changes, an increase in salinity, electrical conductivity, and total dissolved solids can be seen at site 17, further suggesting pollutant input.

Relative dissolved oxygen (RDO) and oxygen partial pressure (OPP) were unexpectedly high at the river's source despite the presence of algal growth, which is typically associated with oxygen production. This algal growth is likely driven by nutrient enrichment from agricultural runoff, particularly from commercial farms located near the source of the Deka River. Water temperatures were also highest at the source, peaking at 33.6 °C — likely due to solar heating of the shallow, stagnant pool that forms the headwaters. Downstream, temperatures ranged between 25.2 °C and 30.8 °C.





[1]Water quality was assessed at selected sites where significant tributaries joined the Deka River.
[2]To further investigate potentially contaminating activities, water quality was assessed at the location of the coal mining tailings dam, which was located upstream of Tributary 4.
**Water quality guidelines as outlined by the U.S. Environmental Protection Agency. 1986. Quality Criteria for Water. (EPA 440/5-86-003). Washington, DC: Office of Water Regulations and Standards. Available: https://www.epa.gov/sites/default/files/2018-10/documents/quality-criteria-water-1986.pdf.*

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