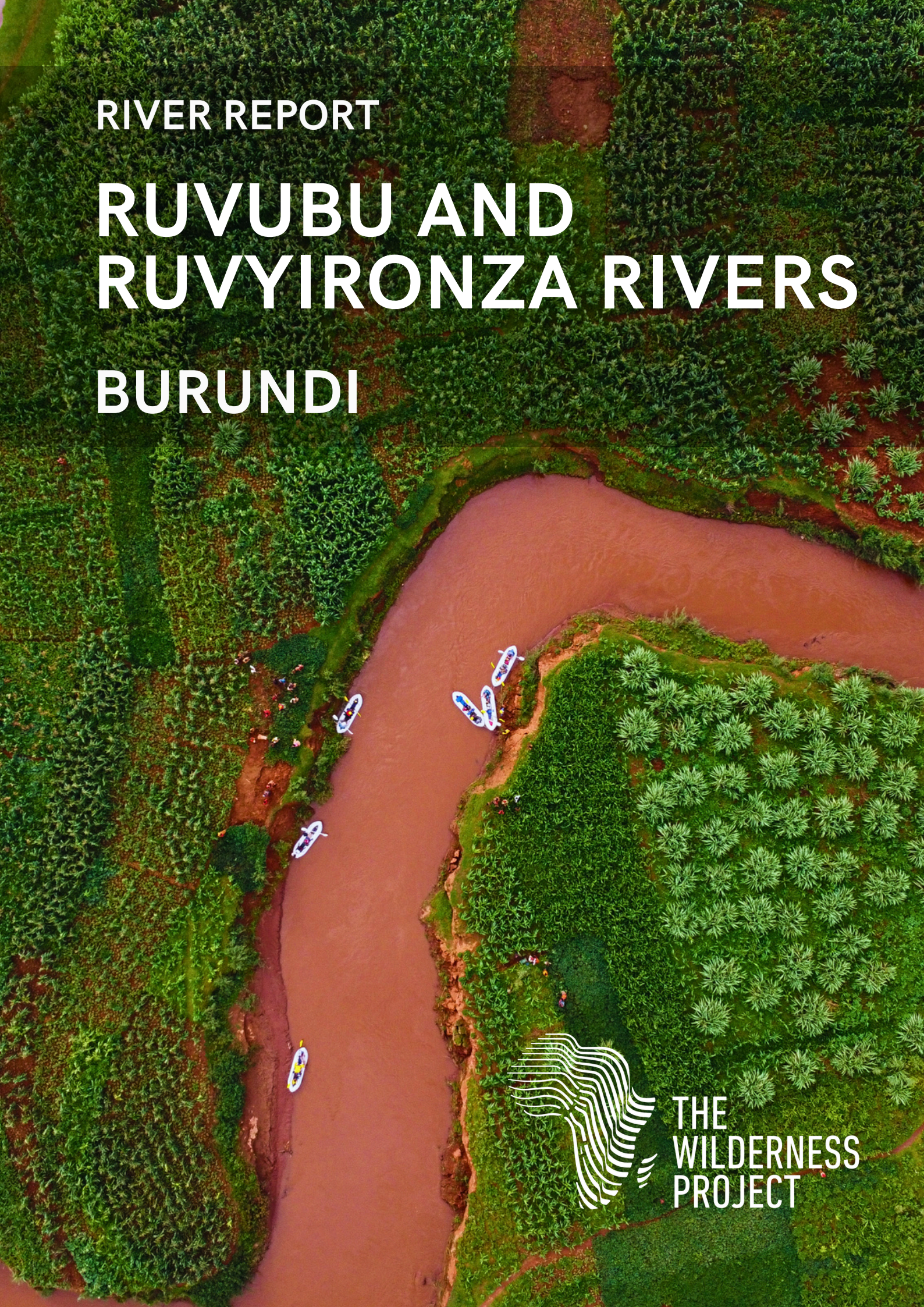
RIVER REPORT

RUVUBU AND RUVYIRONZA RIVERS

BURUNDI



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

ACKNOWLEDGEMENTS

This work would be impossible without the collaboration of our various partners who enable information-sharing, provide invaluable guidance, and grant permissions wherever we work. For their continued support, we thank the Ruvubu National Park (Office Burundais pour la Protection de l'Environnement), Université du Burundi, and the Wild Bird Trust. Finally, we thank the communities along the Ruvyironza and Ruvubu Rivers, who allowed us safe passage.

WILD BIRD TRUST

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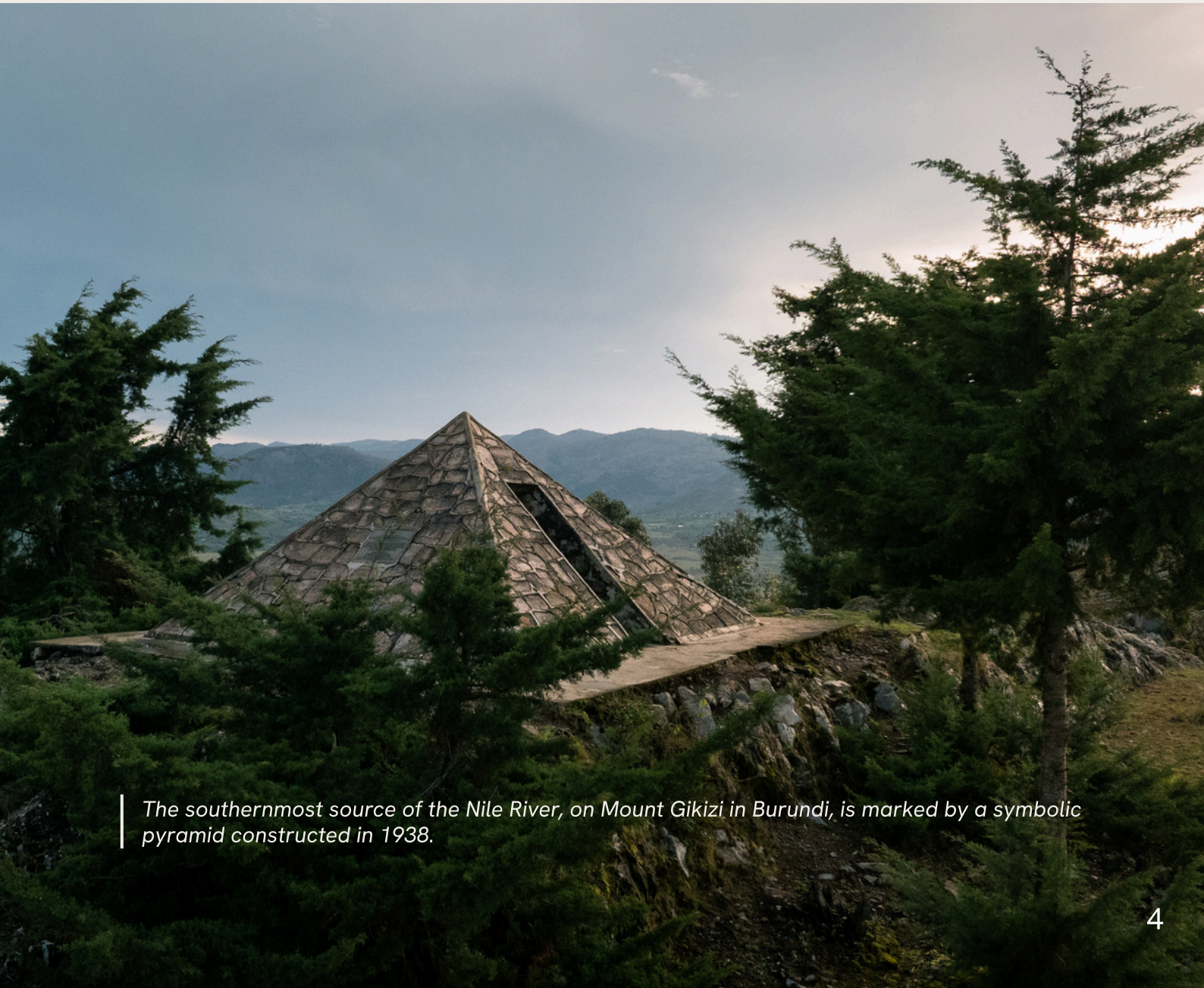
CONTENTS

INTRODUCTION

Burundi lies in the heart of Africa, over 900 km from the nearest coastline. The country is divided by a 2,600 m high mountain range known as the Congo-Nile massif. Within the peaks of these mountains lies the southernmost source of the Nile River. To the west of this range lies Lake Tanganyika — the world's second-largest freshwater lake by volume — forming a border with the Democratic Republic of Congo (DRC). To the east and northeast, the escarpment descends towards Tanzania and Rwanda.

The Ruvyironza River begins within the Ruvubu River Basin as a trickle of water flowing from the pine-covered slopes of Mount Gikizi. From this humble beginning, the Ruvyironza mixes with the Ruvubu River and travels along the Burundi–Tanzania border before it's confluence with the Akagera River. This empties into Lake Victoria, mixing with the water of countless tributaries that collectively sustain the world's longest river: the White Nile.



The southernmost source of the Nile River, on Mount Gikizi in Burundi, is marked by a symbolic pyramid constructed in 1938.

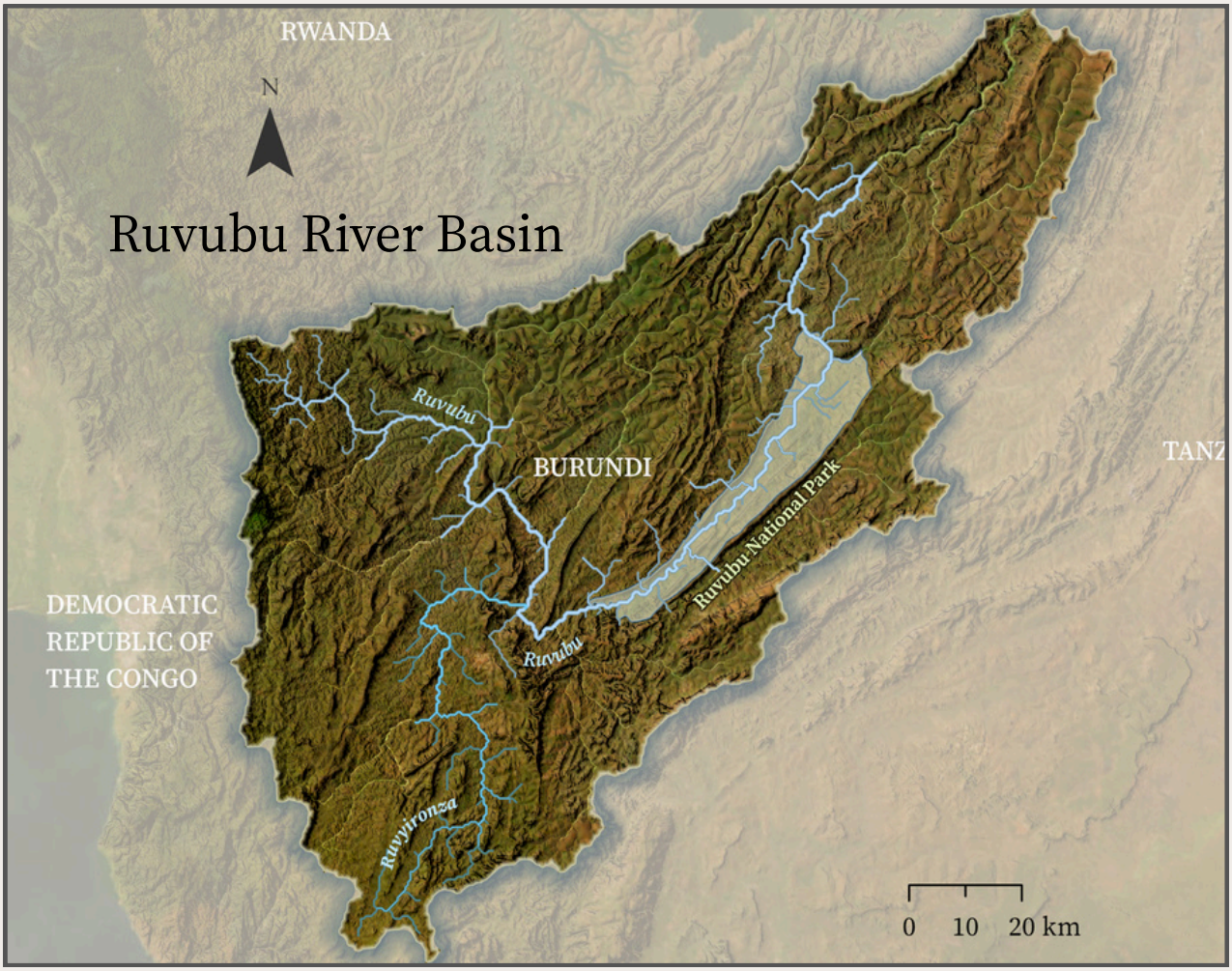
NILE RIVER BASIN

The Nile River Basin spans 3.4 million km^2, with the Ruvubu Basin representing just 12,176 km^2. Despite this, the Ruvubu Basin covers approximately 30% of Burundi.

More than 90% of Burundi's population lives in rural areas and most practice agriculture [1]. Crops are generally rain-fed, with rivers under-utilised for irrigation. This is because: i) the country has a high annual average rainfall (up to 1,800 mm in some areas); and ii) most farmers have limited access to the equipment, training or finance needed to install crop irrigation. As a result, agricultural productivity (and therefore food security) in Burundi is directly dependent on seasonal rainfall that is becoming increasingly variable and extreme under climate change conditions.

Deforestation for agriculture has isolated most of Burundi's biodiversity to the confines of the country's protected areas. The Ruvubu National Park protects a unique riparian habitat along the lower Ruvubu River, providing habitat for rare and understudied wildlife — particularly monkeys such as the endangered Ashy Red Colobus (*Piliocolobus tephrosceles*). However, wildlife populations in the park are threatened by poaching and habitat loss.

Rivers in Burundi have extreme flood pulses immediately following periods of heavy rainfall. These high flows are exacerbated by illegal clearing of riparian vegetation along rivers. In addition, widespread deforestation and extreme tillage of the surrounding mountainsides encourages overland runoff, eroding the country's fertile topsoil — particularly along steep river slopes. As a result, 64% of Burundi's land area experiences severe erosion [2]. This amounts to 38 million tons of soil annually, with an equivalent financial value of 4% of the country's GDP [3].



The Ruvubu River Basin covers approximately 30% of Burundi's land area. The basin features the Ruvyironza and Ruvubu Rivers — home to the Nile's southernmost source.

THE EXPEDITION

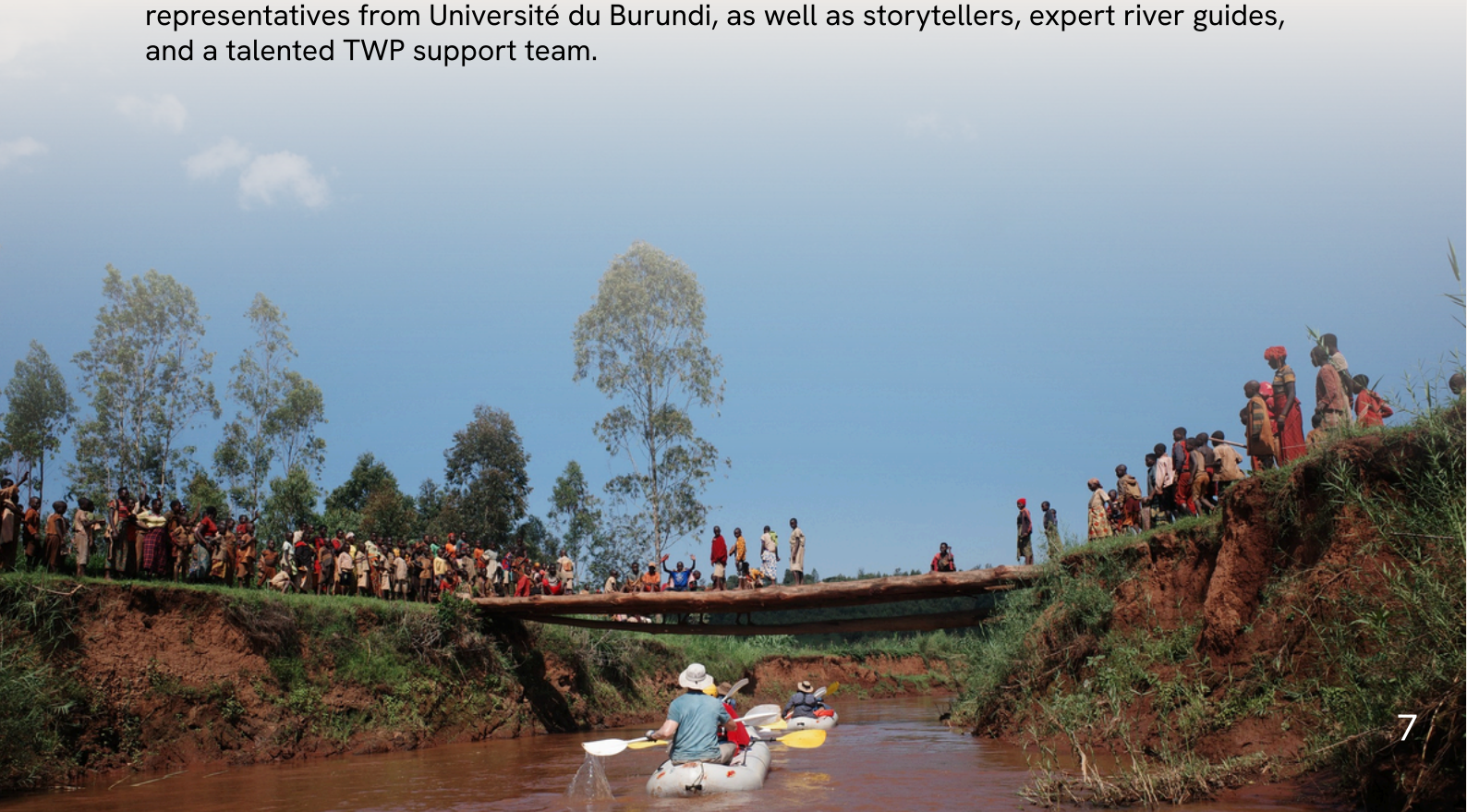
370 km

traversed by foot
and inflatable rafts

16	36	15
team members from six African countries	research sites established	days on expedition

The Wilderness Project (TWP) conducted a 370 km research transect along the Ruvubu River from 9–23 November, 2024. 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 on Mount Gikizi, the team walked the first 18 km before launching two-person inflatable rafts that were used for the remainder of the expedition. The expedition team consisted of local and international researchers, including several representatives from Université du Burundi, as well as storytellers, expert river guides, and a talented TWP support team.



KEY INSIGHTS

CATCHMENT HEALTH, EROSION AND HYDROLOGY

Key Findings

1. Clearing of riparian vegetation encourages soil erosion along the Ruvubu and Ruvyironza rivers, potentially reducing water quality and threatening ecosystem services.
2. The Ruvyironza River is a vital headwater and must be included in catchment management — it accounted for 1/3 of the Ruvubu's flow at the time of the survey.
3. Intact wetlands and clean tributaries in Ruvubu National Park and directly downstream help trap sediments and improve downstream water quality.
4. Invasive species are widespread, including black wattle, lantana, and common carp.

Recommendations

Develop a catchment-wide, community-centric management plan to address soil erosion, particularly in the upper and middle river reaches. This should include activities to:

1. Restore wetlands and riparian zones by replanting native vegetation, thereby reducing sediment runoff and stabilising river flows.
2. Protect wetlands to sustain their ecosystem services through participatory zoning and community co-management.
3. Develop targeted, community-led invasive species management interventions.

RUVUBU NATIONAL PARK: IMPERILED AND IMPORTANT

Key Findings

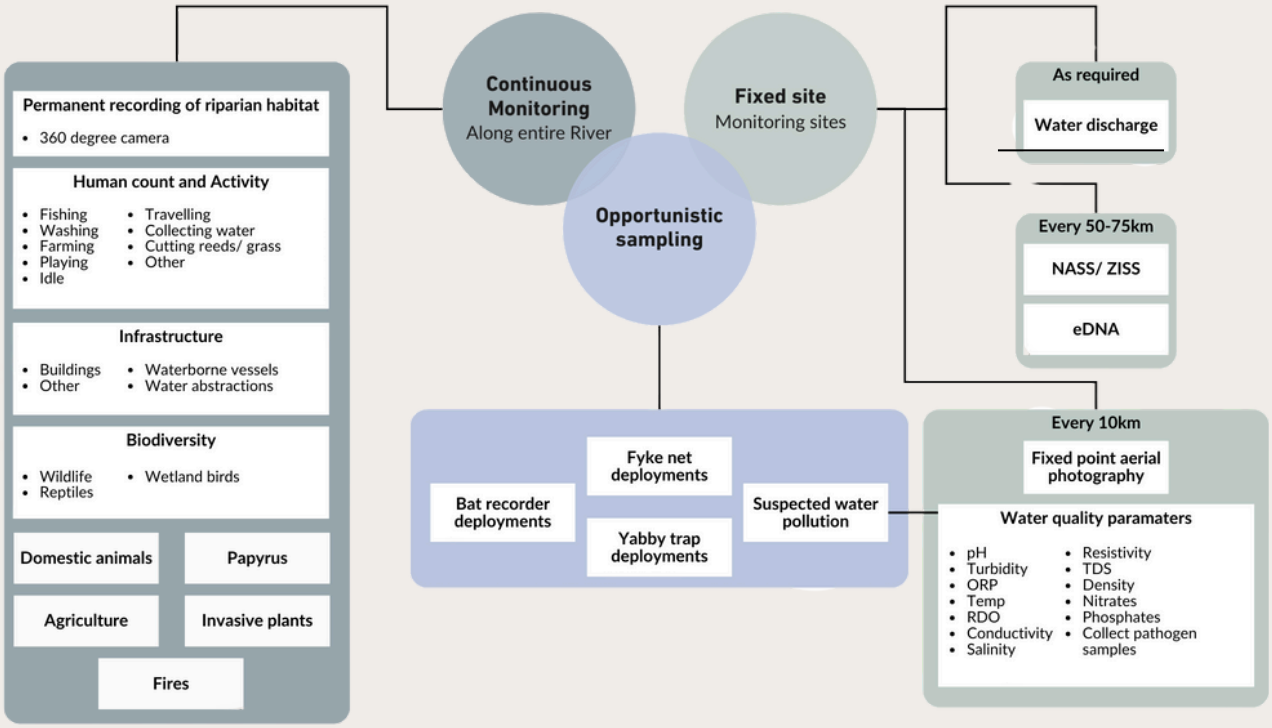
1. The Ruvubu National Park serves as a refuge for endangered and isolated wildlife populations.
2. Intact wetlands, clean tributaries and dense riparian vegetation in the park improve the water quality of the Ruvubu River.
3. We counted just 14 hippos in an isolated area of the park, suggesting that this population is small and possibly at risk of local extinction.
4. Hunting is illegal in the park; although widespread.

Recommendations

Develop a detailed park management plan that includes activities to:

1. Conduct targeted census surveys of wildlife with camera traps, acoustic sensors, and community-based tracking to guide adaptive conservation strategies.
2. Constructively engage local communities to reduce resource-use conflicts such as illegal poaching and logging in the park.
3. Increase support for the management of the Ruvubu National Park, including developing antipoaching initiatives and catalysing investment in park infrastructure.

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. Using drone imagery, eDNA sampling, macroinvertebrate surveys, and water testing, researchers revealed patterns not visible through observation alone. These sites offer a strong foundation for long-term monitoring by communities, river authorities, and NGOs involved in river stewardship.

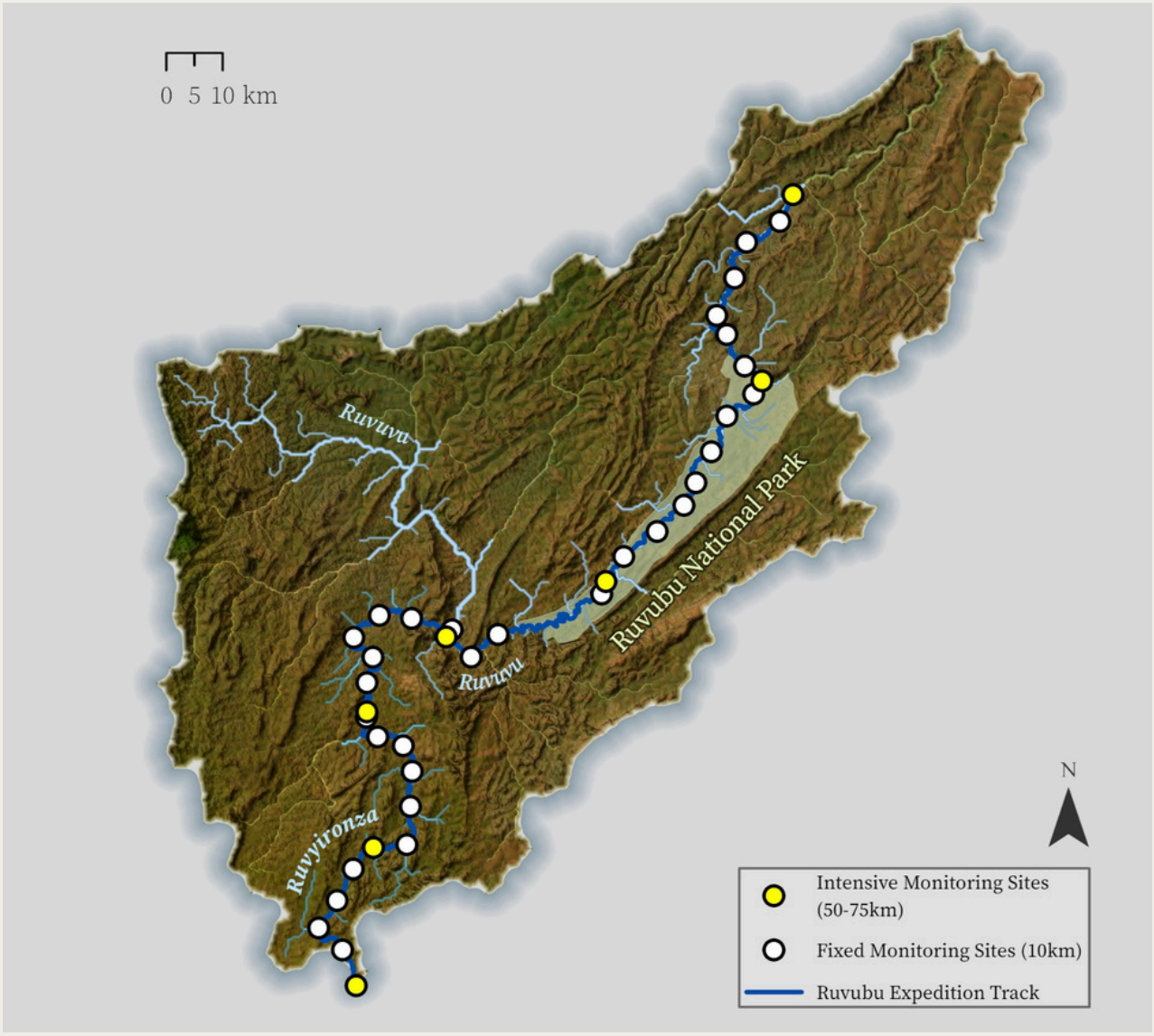
OPPORTUNISTIC SITES

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, where suitable. This approach enabled more detailed assessments of the river's hydrochemistry, hydrology, and biodiversity.

RESEARCH SITES

39 fixed sites

41	34	49
water quality measurements	aerial drone surveys	wetland bird species recorded

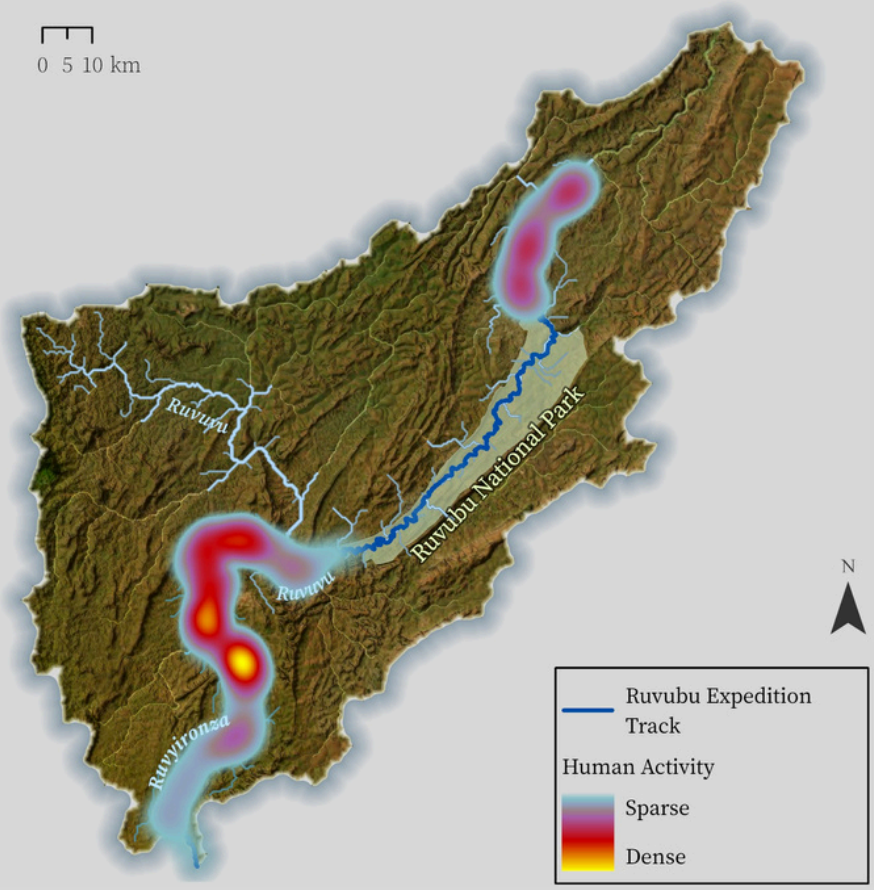


The locations of fixed and intensive research sites.

HUMAN FOOTPRINT

Burundi is the third-most densely populated country in Africa, with 501 people/km^2 [4]. Similarly, many people live along the Ruvyironza and Ruvubu Rivers — we counted a density of 20.24 people/km. This is higher than any other rivers surveyed by TWP to date.

Farming is the mainstay of local food production, with limited reliance on fisheries for food security. As a result, 23% of the people along the river were engaged in farming activities. For the first 200 km, fishing activity was sparse, averaging only 1.11 units of fishing gear and 0.31 vessels per kilometre.



Observations	/km
People/km	20.24
Fishers/km	0.20
Fishing gear/km	1.11
Vessels/km	0.31
Livestock/km	2.26

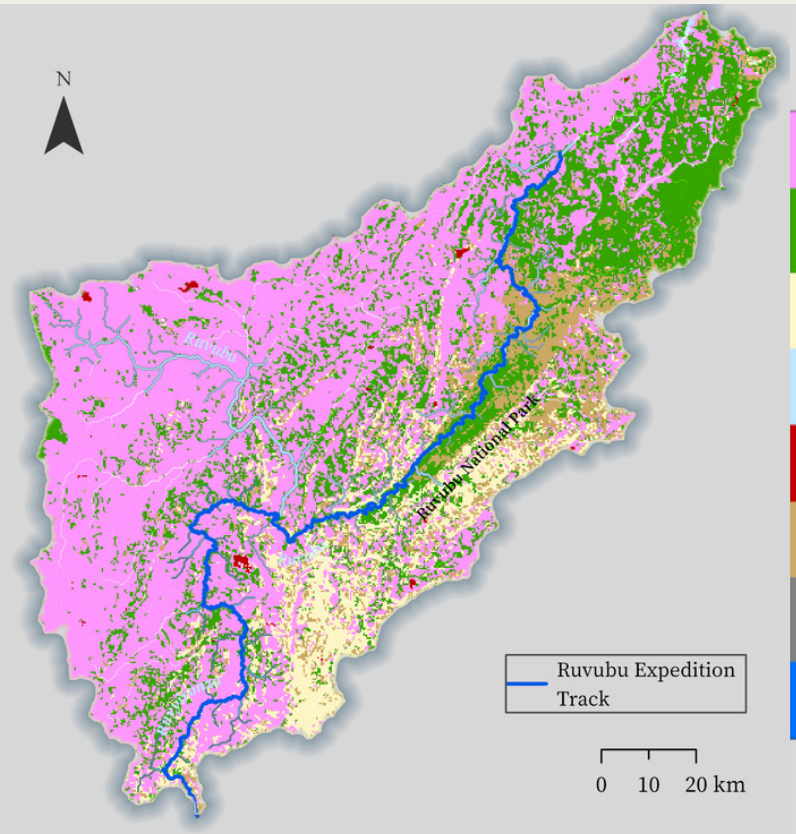
Distribution of people along the transect (left). The summary of observations (right) shows several indicators of human activity, averaged per kilometer along the transect. While not obvious from the map, poaching and illegal farming were noted within the park.

AGRICULTURE

Most Burundians work in the agricultural sector, and farmlands cover 85% of the country [5]. The vast majority of this land (up to 80%) is used to produce food for household consumption, while a smaller fraction (5–7%) is for commercial production [6]. Subsistence food production, predominantly of maize and beans, forms the cornerstone of food security in the country.

Agriculture covers almost 60% of land within the Ruvubu Basin. Much of this agriculture lies within fertile valleys and floodplains of the Ruvyironza and Ruvubu Rivers. Up to 70% of the banks along these rivers are cultivated. Whilst these farmlands are the primary source of food security for local communities, they also destabilise the riverbanks, thereby encouraging soil erosion.

Crop Type	Distance along riverbank (m)[1]
Maize	190,460
Bananas	40,130
Cassava	40,010
Groundnuts	7,510
Sorghum	5,845



LULC Class	Ruvubu 2020 (km²)
Agriculture	6,727
Forest and Woodland	2,820
Grassland	1,172
Wetland	18
Settlement	27
Shrubland	1,032
Bare/ sparse vegetation	0
Water	1
Total	11,798

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

SOIL EROSION

An estimated 38 million tonnes of topsoil is eroded in Burundi each year, costing the country roughly $120 million annually — equivalent to 4% of national GDP [7]. The riparian zone of the Ruvubu River catchment experiences severe soil erosion during periods of heavy rainfall. This is linked to:

- The cultivation of wetlands and river margins;
- Extreme deforestation of valley slopes; and
- High-tillage agriculture.

Eroded topsoil contaminates the Ruvubu River, resulting in extreme turbidity[1] levels that are harmful to aquatic life (the maximum recorded on the transect was over 5,000 NTU). In addition, topsoil erosion reduces soil fertility, with potential impacts on crop yields and food security. Erosion is likely to rise under climate change conditions, which include an increase in extreme rainy days of up to 90% by 2100 [8].

Severe riverbank erosion along a maize field contributes to increased sediment load in the adjacent water body. The exposed soil profile highlights the vulnerability of riparian agricultural zones to erosion, which in turn drives turbidity and downstream sedimentation issues.

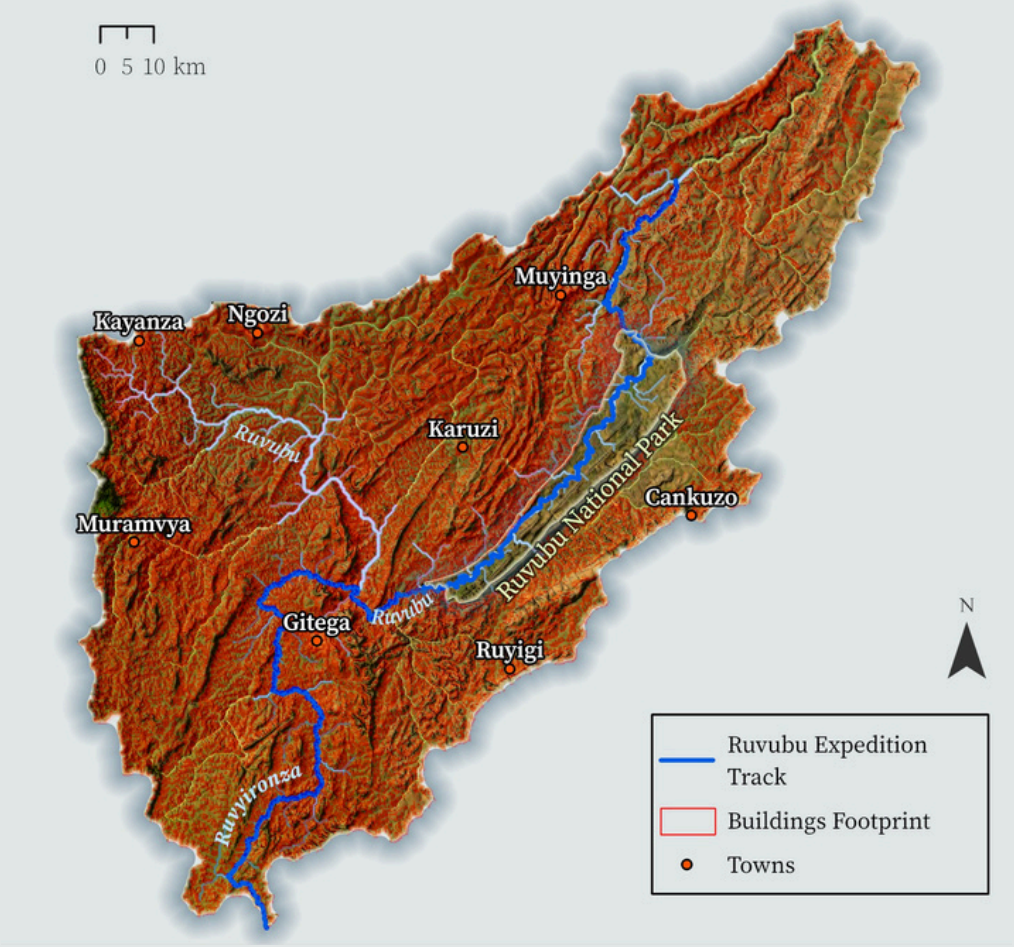
1. Turbidity is a measure of water clarity, indicating the presence of suspended particles like silt, algae, or organic matter that scatter light and reduce visibility.

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 [9]. 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.

Burundi has a high density of buildings that are evenly dispersed across the landscape. Along the Ruvubu River, building density is slightly lower. This may be because of unstable riverbanks and valley slopes that increase the likelihood of landslides, thereby deterring settlement construction.

Building density within 4 km of the river	Building density within the Ruvubu Basin
65 buildings/km^2	73 buildings/km^2

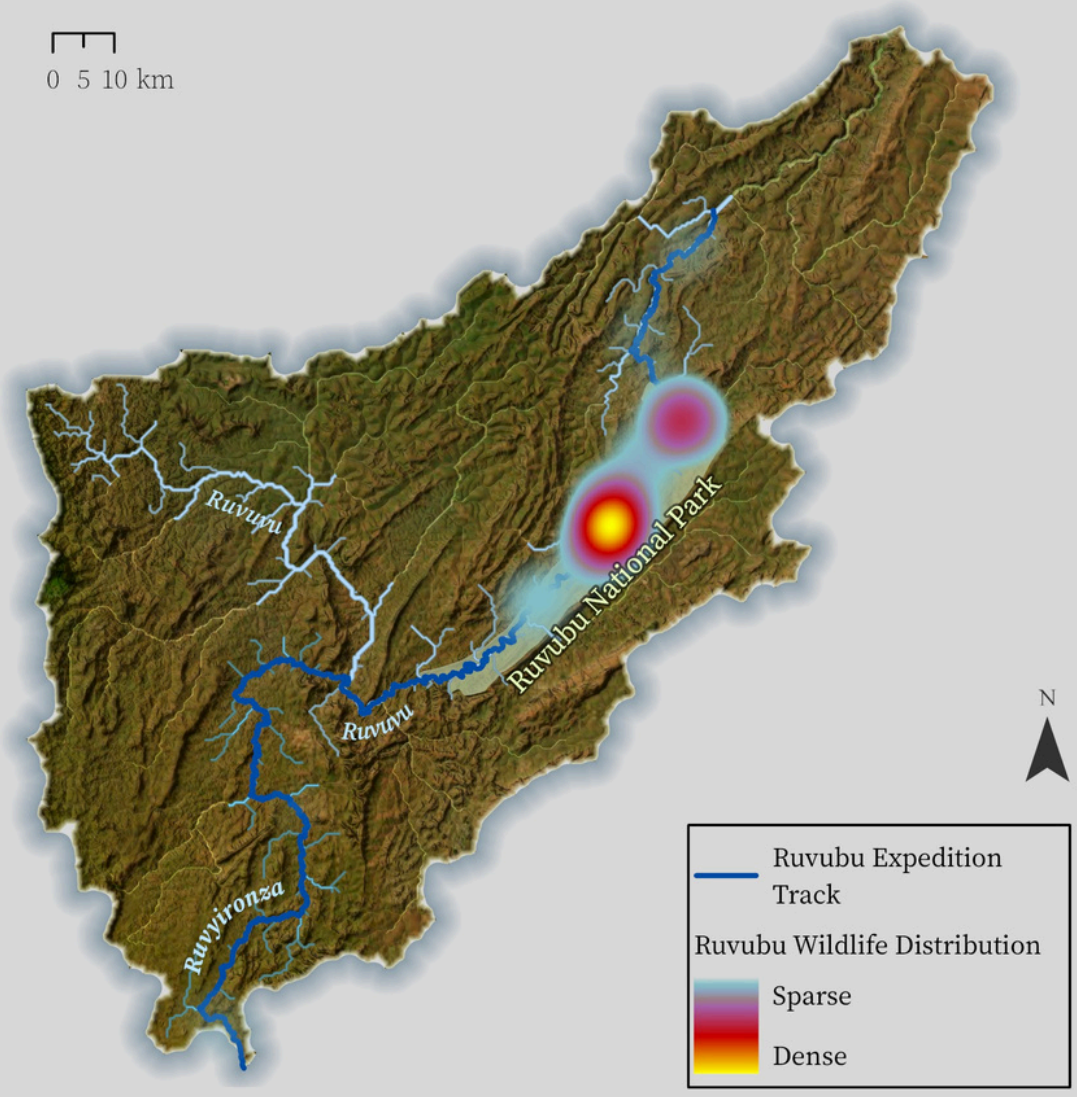


The distribution of buildings within the Ruvubu Basin

BIODIVERSITY

Burundi is home to an estimated 597 bird species, 203 mammalian species, 89 species of reptile, 49 species of amphibians, and over 300 species of fish, with 90 species recorded in the country's rivers [9,10]. Just a few of these were detected on the survey, largely because sampling was limited to the river transect and did not include reptiles or amphibians. The vast majority of biodiversity was concentrated within Ruvubu National Park and its surrounding wetland habitats. Outside of the national park, deforestation and land-clearing for agriculture have reduced indigenous biodiversity to a few isolated patches along the river.

Within Ruvubu National Park	Outside of Ruvubu National Park
1.86 wildlife/km	0.04 wildlife/km



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

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 1,033 wetland-associated birds, spanning 44 species, were recorded along the transect. Their distribution was markedly uneven, with the greatest abundance and diversity found downstream of Ruvubu National Park. Here, expansive floodplains and seasonal wetlands create ideal conditions for a wide range of waterbirds. In contrast, upstream areas, characterised by intensive agriculture,
supported far fewer birds.

The 10 most common wetland bird species along the transect:

Bird Species	Count
White-faced Whistling Duck	227
Common Sandpiper	166
Black-crowned Night Heron	123
Collared Pratincole	89
Malachite Kingfisher	41
Pied Kingfisher	34
Hadada Ibis	30
Black-headed Heron	20
Spur-winged Goose	18
Grey Heron	18

RUVUBU NATIONAL PARK

The Ruvubu National Park is one of the last remaining intact ecosystems in Burundi. The park encompasses several important habitats that border the lower Ruvubu River for approximately 100 km. These include wetland floodplains with spring-fed lakes, dense riparian montane forests and mixed miombo woodlands in open savannahs along the valley hillsides. Together, these habitats are home to 95% of the wildlife that we counted along the Ruvubu River transect.

Though historical data is limited, it is believed that the Ruvubu National Park was once home to a substantial hippopotamus population. this is suggested by its name — ‘Ruvubu’ means hippopotamus in the local language of Kirundi. However, only 14 individuals were recorded on this survey. This small population faces several threats that may drive local extirpation, including habitat degradation, human-wildlife conflict, and poaching.

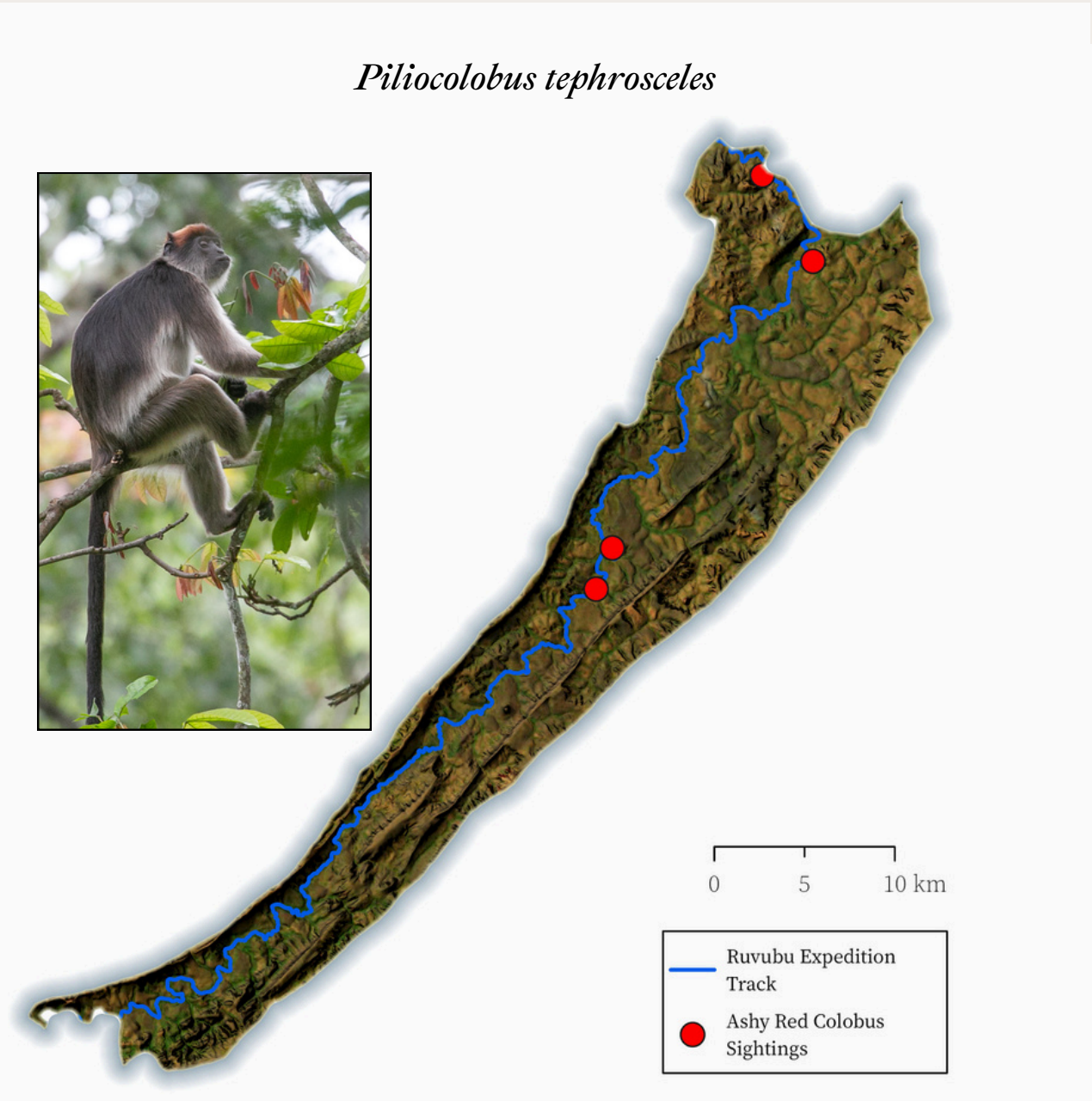
The wetlands, tributaries and forests of the Ruvubu National Park improve the water quality of the Ruvubu River. However, the park area is small, and the ecosystem services provided are insufficient to completely mitigate the impacts of upstream degradation, particularly following periods of heavy rainfall. As a result, sustainable management of degraded upstream landscapes is vital to improve water quality in the Ruvubu River.

The ecosystem services offered by the park include:

- Tributaries contribute fresh, clear water to the Ruvubu River;
- Intact forests, woodlands and savannahs capture rainfall, letting it slowly seep into the ground and gradually feed the river with clean water; and
- Floodplains slow the flow of water, allowing sediments to settle to the riverbed.

The most common animals within the park were primates, including the Gentle Monkey (*Cercopithecus sp.,* likely several species) (N=63), and the Ashy Red Colobus (*Piliocolobus tephrosceles*) (N=76). In addition, there were several other sightings of unconfirmed primate species. All of these were restricted to the confines of Ruvubu National Park.

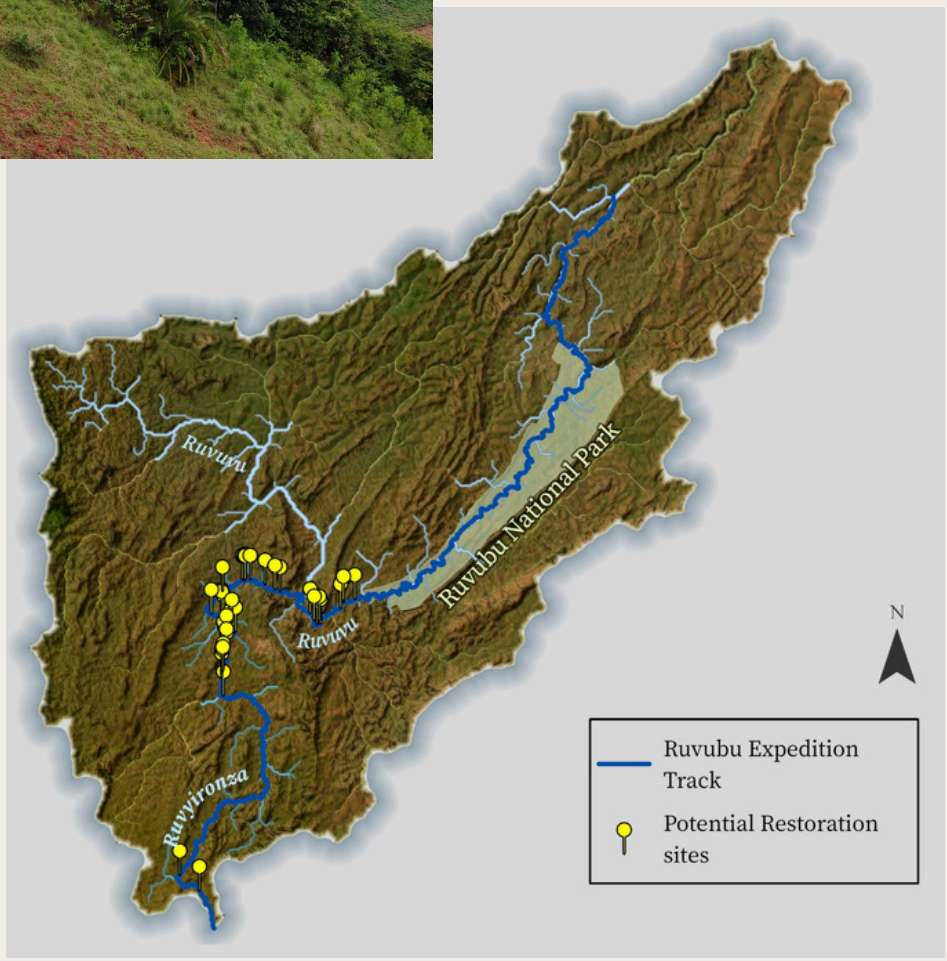
The Ashy Red Colobus is endangered, with only a few isolated populations remaining in Uganda and Tanzania [11]. Unfortunately, we were unable to capture any clear photographs of *P. tephrosceles* from the boats. Further research should be conducted to assess the size and status of the Ashy Red Colobus population within Ruvubu National Park.



Locations of the Piliocolobus tephrosceles sightings within Ruvubu National Park. Some of the troops included up to 30 individuals. Photograph of P. tephrosceles in Kibale NP, Uganda by Yvonne A. de Jong and Thomas M. Butynski, Wildsolutions.nl.

POTENTIAL RESTORATION SITES

Several isolated patches of indigenous vegetation were identified outside of the Ruvubu National Park. These were typically small (< 0.25 km^2) and located in pockets of steep river meanders or on rocky islands. Importantly, these isolated patches of indigenous vegetation were all surrounded by agriculture, and in most cases were already being cleared to plant crops. Any future catchment management efforts aimed at restoring the Ruvubu should consider including these locations as pilot sites.



Locations of potential restoration sites identified along the river transect.

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

We recorded several invasive plant species along the transect, including black wattle (*Acacia mearnsii*), lantana (*Lantana camara*), tree of heaven (*Ailanthus excelsa*), and giant sensitive tree (*Mimosa pigra*). *Lantana camara* was dominant in the upper reaches, likely due to its preference for cooler, moisture-rich environments, while *Mimosa pigra* became more prevalent downstream, possibly due to changing altitude and habitat conditions.

Non-native pine (*Pinus* spp.) and eucalyptus (*Eucalyptus* spp.) trees are widespread within Burundi. These plantations are actively managed by local communities, who use the wood for construction material and charcoal production. Non-native trees have largely replaced the extirpated indigenous forests as the primary source of fuelwood in the country.

Acacia mearnsii (left) and *Lantana camara* (right).

WATER QUALITY

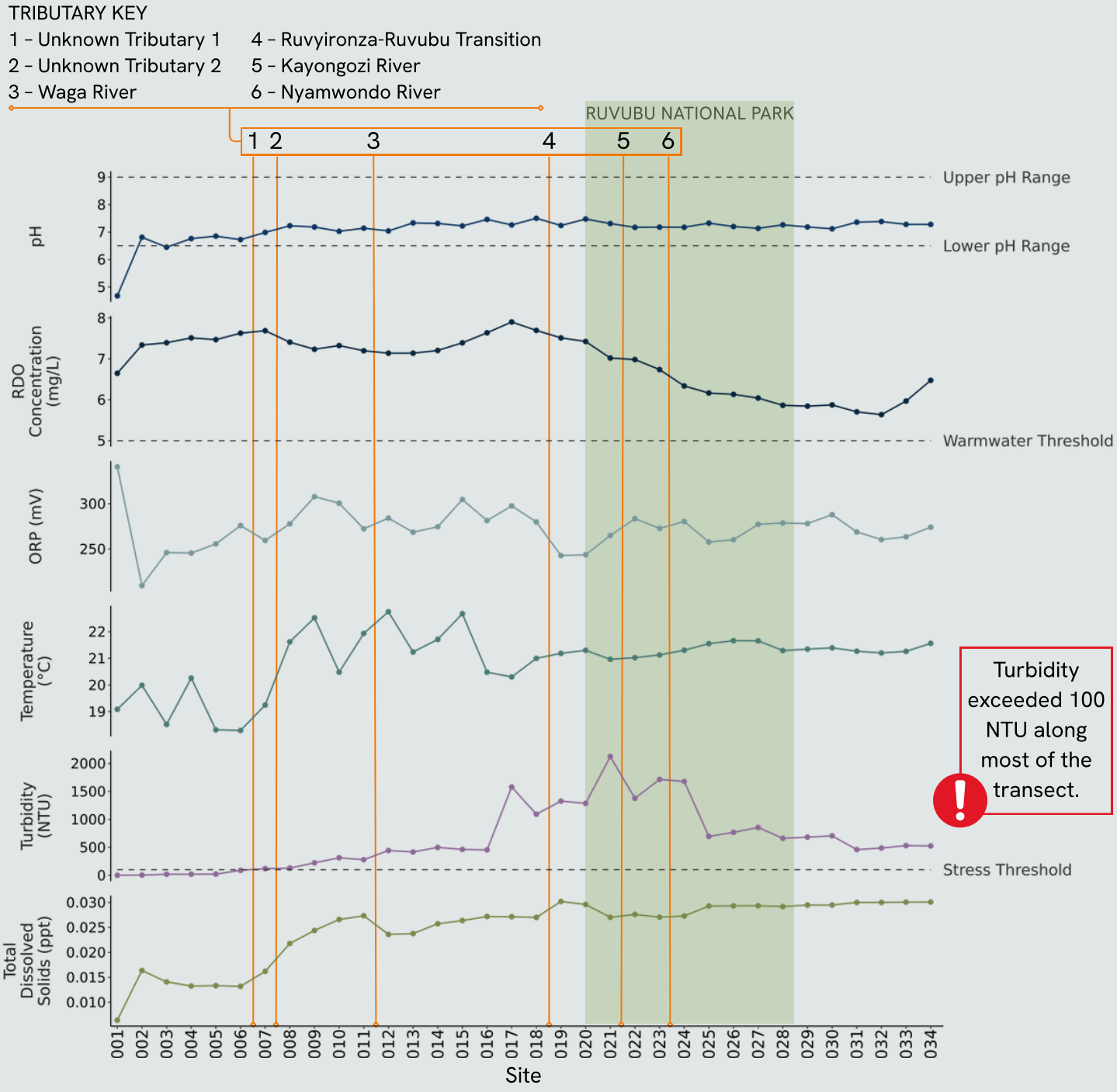
Burundi has a tropical, mountainous landscape with steep slopes, high rainfall and unstable soils. These attributes influence soil erosion and runoff dynamics, producing distinctive water quality characteristics in the country's rivers [14,15]. In the wet season, heavy rains flush sediment from hillsides, turning the water brown and murky.

Water quality in the Ruvyironza and Ruvubu Rivers is closely tied to the surrounding landscape. Near the source of the Ruvyironza River, granite rocks and non-native pine trees likely lower pH, making the water mildly acidic. As pH stabilises downstream, topsoil runoff from agriculture contributes sediments to the river that gradually increase turbidity.

In November of 2024, heavy rainfall caused the turbidity of the river to reach over 5000 NTU (with an average turbidity of over 640 NTU). Such extreme turbidity may stress aquatic organisms by impairing feeding, clogging gills, and smothering eggs, potentially influencing the composition of fish, amphibian and invertebrate communities [16].

The colour of the Ruvubu River (left) contrasts sharply with adjacent floodplain lakes in Ruvubu National Park (right). The difference is due to upstream erosion, resulting in a high sediment load in the Ruvubu River. The floodplain lakes of the Ruvubu National Park are comparatively clear because of filtration by wetland vegetation and settlement of suspended sediments.

WATER QUALITY



Note: Chemical contaminants like nitrates, fertilisers, and pesticides could not be detected using field methods, so 20 water samples were collected for lab analysis. Ongoing monitoring will be essential to track long-term trends, and support effective conservation and land-use planning along the Ruvubu River.

RIVER FLOW

Rivers in Burundi flood rapidly in response to variable and often heavy rainfall. For example, the discharge of the Ruvyironza and Waga Rivers can double in a matter of days following rainfall events [17]. Combined with extreme deforestation of the upper and middle catchment, overland runoff from heavy rainfall events often results in flash floods and landslides.

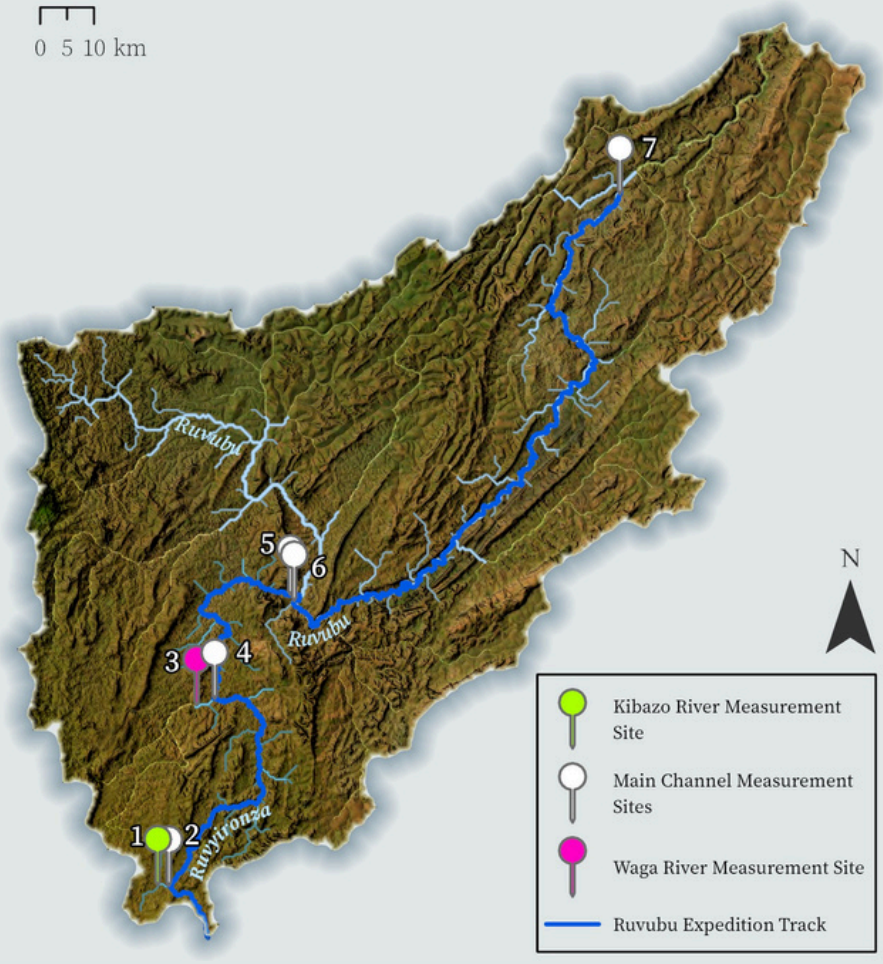
Regular and targeted monitoring of flows is essential to support the sustainable management of the Ruvubu and Ruvyironza Rivers. This information sheds light on the interplay between runoff, land-use and climate — and how these affect downstream water-users. Furthermore, flow measurements indicate the availability of water for hydropower, agriculture and domestic use.

Ariel Nigarura from Université du Burundi uses the Acoustic Doppler Current Profiler (ADCP) to measure the flow of the Waga River, a major tributary of the Ruvyironza.

Burundi experiences its rainy season in February–May, with a shorter wet season between September–November. Discharge measurements were taken in November at the end of this 'small rain' season, therefore indicating conditions of high river flow. Flow measurements were collected at seven sites. These included i) one site on the Kibazo and Waga tributaries in the upper reaches of the Ruvyironza River; ii) three sites on the Ruvyironza River; and iii) two sites on the Ruvubu River.

The Ruvyironza River and its tributaries contributed 27.6 m^3/s to the flow of the Ruvubu River, accounting for 34% of surface water flow upstream of Ruvubu National Park. Similarly, tributaries within the park contributed substantially to the flow of the Ruvubu River before it entered Tanzania. The final flow of the Ruvubu River ~2 km from the border was 134.14 m^3/s

Site Number	Description	Discharge (m^3/s)
1	Kibazo River	1.28
2	Main Stem (Ruvyironza)	1.72
3	Waga River	7.33
4	Main Stem (Ruvyironza)	7.03
5	Main Stem (Ruvyironza)	27.6
6	Main Stem (Ruvubu)	81.35
7	Main Stem (Ruvubu)	134.14



River discharge measurement sites along the transect.

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