

Environmental DNA can enable conservation of Tanzanian freshwater fish

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Across East Africa, rivers are critical for fish production, provision of drinking water and ensuring sustainability of agriculture. Rivers are also valuable wildlife habitats, and the communities of freshwater fish within them provide an excellent indication of overall ecosystem health.

About the research

Freshwater fish communities are subject to land use changes, pollution, climate change, overharvesting, flow modifications and infrastructure development such as dam construction.

It is important to have a detailed understanding of the species diversity present to assess the impact of future environmental change on species of commercial and conservation importance.

River fishes can be difficult to survey and map using nets and traps, so we trialled a newly developed “environmental DNA” (eDNA) approach.

We sampled trace DNA in the water and comparing the DNA present to a “barcode” reference library of DNA from fish species in the region.

Our results revealed habitat use patterns of over 65 species, including species of commercial and conservation importance, as well as species not previously known to science.

Our analyses focussed on the Rufiji River basin, the largest river system in Tanzania, and home to a rich diversity of fish species. Many of these species are important for artisanal fisheries.

Despite much of the Rufiji River basin being in areas where biodiversity is protected, species are potentially vulnerable to habitat modification, climate change and invasive species.

Freshwater fish for sale, caught from the Ruaha River at Kidatu in Tanzania. **Image credit:** George Turner.

Policy recommendations

- Environmental DNA-based methods have capacity to inform Environmental Impact Assessments

Future agricultural or infrastructural developments require robust biodiversity assessments, and environmental DNA-based methods can help by providing information on the habitat use patterns of rare, migratory and commercially-important species.

- Invest in the skills and infrastructure to enable environmental DNA-based methods in ecosystem monitoring.

Biodiversity surveys using eDNA-based methods will increase in importance in the next decade. Once field and laboratory skills are developed, and analytical infrastructure is in place, eDNA biodiversity surveys can take place rapidly without the need for expert field identification skills.

- Develop a national reference collection of Tanzanian fishes

Effective implementation of eDNA research for Tanzanian fishes will require a national reference collection of preserved and DNA-sequenced specimens all species.



Key findings

We looked at the distribution and diversity of fishes in the Rufiji River Basin, which includes the ecologically important Rufiji, Kilombero and Great Ruaha Rivers.

Using environmental DNA, we can identify the core distributions of freshwater fish species, including those that are difficult to sample using nets and traps. Species mapped using the environment DNA ranged from small mountain catfishes, commercially important tilapia and rarely-sampled lampeye killifishes.

Our results show how environmental DNA-based methods can inform Environmental Impact Assessments. For example, our analyses show an unexpected importance of mountain streams for eel species that migrate into freshwater from the sea, and will be affected by dam construction downstream.

A major limitation to our environmental DNA-based work has been the absence of a comprehensive DNA barcode reference library for all Tanzanian fishes.



Filtering environmental DNA from water samples taken from the Rufiji River in Tanzania. **Image credit:** Asilatu Shechonge

What is environmental DNA?

Animals and plants shed DNA into their environment through natural biological processes. This DNA can be collected from water, soil or the air, and when purified the sample is ready for analysis. We can sequence this DNA and compare the sequences to those in a reference library to identify the species that are present. The amount of DNA belonging to a species can be a good indicator of how abundant the species is in the environment.

Further information

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