

► Project *brief*

Thünen Institute of Fisheries Ecology

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Assessing the biodiversity of eels of Tanzania - Promoting sustainable fisheries through environmental monitoring and capacity building (BIOEELS)

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- **Fish biodiversity in two Tanzanian rivers was studied with special focus on anguillid eel species.**
- **The presence of three eel species was documented, with different distributions along the rivers.**
- **Equally important, the project aimed at gaining information on socio-cultural and economic importance of artisanal river fisheries.**

Background and Objective

Diadromous freshwater eels represent important components of the tropical estuarine and coastal fish fauna. They are traditionally fished in many coastal regions and are therefore an important source of food and income. However, worldwide many populations are in decline, mostly due to anthropogenic impacts. The risks for population declines are particularly strong for the freshwater eels of the genus *Anguilla* due to their extraordinary and complex lifecycle.

Four species of the genus *Anguilla* are known to exist in Eastern Africa: *Anguilla bengalensis*, *A. bicolor*, *A. marmorata* and *A. mossambica*. However, knowledge about their distribution and basic biological parameters is scarce, in particular for Tanzania and neighbouring countries.

But eels are not just an important component of freshwater fish biodiversity. They can be regarded as suitable indicators for the health of riverine and coastal ecosystems. These habitats are under considerable pressure in Tanzania and will be even more in the future in view of the expected human population growth. In order to assess the ecological status of Tanzanian coastal rivers and to be able to specifically designate priority areas for protection, the BIOEELS project had four main goals:

- Biodiversity assessment for specific eel habitats and documentation of the biology and ecology of anguilliform eels in selected riverine and coastal aquatic systems
- Reconstruct the dynamics of abundance and catch trends of eels to assess the impacts of fishing on the eel stocks
- Evaluation of social-cultural and economic factors affecting the sustainability of the eel fishery
- Knowledge transfer and capacity building for the protection of biodiversity and sustainable use

The main task of the Thünen Institute was to tackle all aspects of biodiversity assessment and learn more about the biology of east African freshwater eels. The socio-economic, fisheries` and socio-cultural aspects were mainly dealt with by the Tanzanian project partners.

The project, which was funded by the *Gesellschaft für Internationale Zusammenarbeit* (GIZ) in the MeerWissen program, focused on the lower stretches of the most important coastal rivers in Tanzania, namely the Rufiji in the Rufiji district and the Pangani in the Tanga region.

Approach

The project was planned in close cooperation with the Tanzanian partners in the [co-design approach](#), including also local fishers, whose catches were regularly analysed in several field work campaigns in the years 2021 and 2022.

Morphological species identification of the catch composition in the field was accompanied by subsequent genetic barcoding for more than 300 specimens. Several biological samples of the different eel species were taken for laboratory analyses at the Thünen Institute, including otoliths for age determination, gonad samples for histological analyses of maturation status and samples for contaminant analyses (mercury in the muscle, PAH-metabolites in the bile). For a small number of eels, a first attempt was made to study their oceanic spawning migration by using pop-up satellite archival transmitters (PSAT).

Together with the biological sampling, the project aimed at gaining novel information on the socio-cultural and economic importance of riverine fisheries in some representative communities along the two rivers, including value chain information on eel fishing, processing and trade. For this purpose, 9 community workshops and 5 focus group discussions (8 – 12 persons per FGD) were organised to raise awareness of the local communities for environmental and fisheries issues. In turn, a total of 179 interviews in the fishing communities were conducted to gain information about local knowledge on the fish communities and observed trends in the fishery.

A further goal of the project consisted of the training of enumerators in the use of the eCAS mobile application for online documentation of fishery yields.

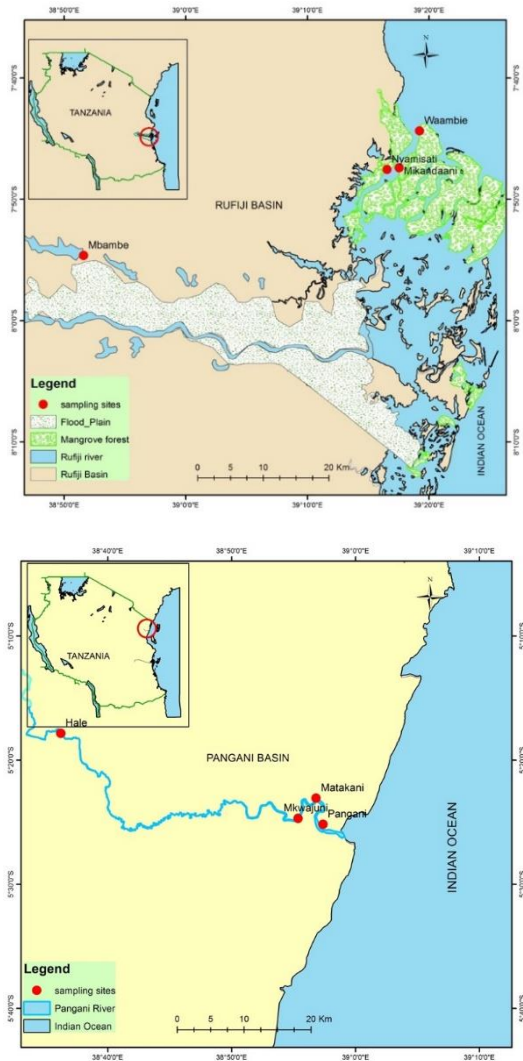


Fig. 1: Study area and sampling locations at the rivers Rufiji (upper graph) and Pangani (lower graph) in Tanzania.

Results

For the assessment of the diversity of the fish community, 70 species from 59 genera and 40 families were detected in 334 genetic samples. In some cases, morphological and genetic species determination were not in agreement. In these cases, further investigations are necessary.

During the project, the presence of *A. bicolor*, *A. bengalensis* and *A. marmorata* in the studied rivers was documented, which show a distinct distribution pattern along the rivers. Whereas *A. bicolor* was found in all sampled river sections with a clear tendency towards the lower stretches, *A. marmorata* and *A. bengalensis* were only caught upstream.

With a value of 109.3 µg/kg wet weight, the average concentration of mercury in the muscle of 42 analysed eels (*A. bicolor* and *A. bengalensis*) from different locations in the two rivers

was in an expected range and, e.g., clearly below the EU threshold for human consumption (500 µg/kg for fish, 1000 µg/kg for *Anguilla* species). No clear differences between species and locations were found. Similarly, the measurements of PAH metabolites in the bile of 21 eels did also not reveal any unexpected values (mean value for 1-Hydroxypyren 272.9 ng/ml bile) and were slightly lower than in eel samples from German rivers, but higher than in eels from Morocco.

The project also provided the very first, though only anecdotal, information about the early phase of the oceanic spawning migration of *A. bengalensis* from East Africa. Data received from one PSAT-tagged individual revealed a northward migration of roughly 300 km along the coast within one week after tagging and diel vertical migrations (DVM), which have been described also from other *Anguilla*-species. During the DVM, the eel achieved depths of more than 550 m during day and only about 65 m at night. Another eel was possibly preyed upon.

The project also revealed first information on the socio-economic importance and on the value chain of the eel fishery at the river Rufiji. Consumers of eels differ depending on eel species. Anguillid eels are locally utilized for human consumption while other anguilliform estuarine species like the giant slender moray are mostly utilized as baits for crab fisheries. The eel fishery is characterized by a short marketing chain that supports the livelihood of the communities. While the consumption preference of eels near the coast is low compared to other species due to the snake-like shape of eels, the larger growing species further inland are higher priced.

Concluding remarks

Despite some initial problems in getting started due to the outbreak of the COVID-19 pandemic, the project became a true success story with regard to capacity building, institutional partnership and north-south-cooperation. The project partners gained basic and new information on the two major coastal river ecosystems in Tanzania, for which previous information was scarce. A preliminary assessment of the spatially structured fish biodiversity in these rivers together with first scientifically proven records of three catadromous freshwater eel species gives a baseline for further more detailed studies. Together with records and descriptions of common fishing practices and other anthropogenic impacts, this information can also influence the future management of these ecologically sensitive systems. This was outlined in a final stakeholder workshop in Dar es Salaam with representatives from politics, local and regional authorities, non-governmental organizations and scientific institutions as well as the resulting Policy Brief of the project. Public outreach of the project resulted in a UDSM award recognizing the team's dedication in effectively engaging the community through innovative initiatives, and impactful communication strategies (<https://youtu.be/xG5QM6aQlZY>).

Further Information

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