Nigeria

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MONITORING WATER QUALITY IN NIGERIA BY TRACKING SILVER CATFISH PATHWAYS IN RIVER SYSTEMS

Researchers in Nigeria are working with artisanal fisherfolk to tag and recapture fish, as a way to understand sources of pollutants and predict their potential spread.

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The Cross River estuary straddling Nigeria's border with Cameroon provides eclectic impressions of Africa's most populous nation. Sultry tropical rainforests blend into expansive mangrove swamps and farmlands that run along the coastline.

The region's unique habitats provide sanctuary and breeding grounds for an astonishing range of terrestrial and marine life.

Fed by several large rivers, it is also an important trade route for ships, while the estuarine and river waters provide rich pickings for artisanal fisherfolk.

Yet, like many parts of Nigeria's coastline, habitats in the Cross River system are under siege from a range of human-driven threats. These dangers include climate change, rapid uncontrolled urbanisation, oil palm plantations, untreated pollution from farms, sewage, deforestation, industrial developments, and gas and oil prospecting. But when fisherfolk in the region reported that numbers of silver catfish, *Chrysichthys nigrodigitatus*, had begun to dwindle, scientists realised they needed to fill in key gaps in knowledge of the fish's behaviour to better understand why.

MAPPING THE SILVER CATFISH'S MIGRATION

"Silver catfish are a very important species for artisanal fisherfolk in the Cross River region, and form a key part of the diet of local people," says Daniel Ama-Abasi, Professor of Fisheries and Aquaculture at the University of Calabar. "Their populations are threatened by a host of different problems, including pollution, habitat destruction, and climate change. Yet we know surprisingly little about the movements of these valuable fish species.

"We wanted to better understand their migratory routes to see if there was something we could do to promote their conservation."

Estuaries are aquatic environments where sea water mixes with freshwater, and where the influence of the ocean waves, tides, seasons, and river flows create a highly dynamic environment. This ever changing estuarine environment means that organisms need to be able to rapidly adapt to changes in salinity. Some animals such as salmon are anadromous, which are species that migrate from the marine environment to freshwater for spawning, indicating that they have physical abilities to survive both saline and freshwater environments. Many aquatic species, however, cannot tolerate large changes in salinity and react by shifting locations depending on aspects such as tides, water levels, and seasons.

Most of the three-thousand or so known species of catfish in the world are part of the latter group. And most of these live in freshwater. But a small number of catfish have evolved to reside in saltwater or the brackish (mix of fresh and sea) waters found in estuaries. Ama-Abasi explains that silver catfish were believed by many to reside mostly in such brackish waters. But the fish's migration patterns were largely uncharacterised by scientists, so his team set out to track the movements of the fish to find out more.

"We turned to an observation technique called 'tag- recapture', which involves tagging a small proportion of the silver catfish population found in the Cross River and its estuary,"Ama-Abasi explains. "Between January and July 2017, we worked with local communities to place small, yet distinctive markers on nearly 1000 catfish at various sites.

"We set out to try and understand how far the fish move, how much time they spend in the river compared to the estuary bay, and how big their populations are."

To recover the fish, the researchers relied on support from fishers, who received a financial reward for every tagged catfish found and reported. "We coordinated the research together with local community leaders, who expressed a strong desire to be involved in the project," Ama-Abasi explains.

"They supported us in direct communication with the fishing community as well as the distribution of flyers, which contained information about our project and the phone numbers of researchers, who they could contact if they spotted one of our distinctive tags amongst their catch."

The team also studied other key environmental variables such as the salinity and turbidity of surface water. "We monitored the fish for three years," Ama-Abasi says. "Whenever fisherfolk spotted a tagged fish, they would take a photo and call us, and a member of our team would go out to meet them. Silver catfish are a valuable delicacy in these parts, and when we came to the boats fishers were often surprised to see us return the catfish to the water. But gaining their understanding and support was essential – they are the ones doing the monitoring."

More than 60 of the tagged fish were recaptured by the end of the project, and Ama-Abasi explains that his team's research suggests that rather than residing mostly in brackish waters, silver catfish prefer freshwater environments. "Silver catfish appear to enter into the wider estuary when salinity is reduced, for instance during times of river flooding," he explains. "We

have debunked a widely-held misconception that they breed in the freshwater and return to their saline habitat. In reality they spend most of their lives living in freshwater systems such as rivers, including spawning activity."

Knowing this could have significant implications for conservation efforts. "For example it can help us to understand the potential impacts of climate change and environmental threats on their populations," says Ama-Abasi. "We can now work together with local communities and authorities on strategies to preserve their habitats as best we can. We can also try to mimic this environment in a controlled setting and help boost their populations through aquaculture initiatives. This could help to ensure food security for local communities."

FISHING FOR DATA

The work is also opening up wider possibilities for monitoring pollution in the region. "Oil and gas exploitation forms more than four-fifths of Nigeria's exports and in the wider Niger Delta region oil prospecting has frequently resulted in horrific damage to the environment and the lives and livelihoods of local people," says Francis Emile Asuquo, a Professor of Chemical Oceanography at the University of Calabar.

"Pollution from oil spills or high concentrations of heavy metals entering waters from land can cause major problems for plants and animals in the estuarine environment and also have huge implications for human health," says Asuquo, who has spent more than four decades studying water quality in the region, including leading assessments of dredging activities on river flow, the impacts of unregulated urban waste from upstream cities, and the effects of various oil spills on marine life.

"Pollutants such as hydrocarbons or heavy metals draining into the estuary via rivers can accumulate in living tissues. By learning where silver catfish, and other tagged species, have been and how the waters are impacting their biology, it is possible to track the source of pollutants and to even predict the extent of its spread.

We can do this, for instance, by observing a smaller subset of fish with radio tags and then monitoring the presence of polyaromatic hydrocarbons and heavy metals such as arsenic, mercury, chromium, and lead present in the fish's tissues."

Asuquo explains that research teams – and the communities supporting them – must also deal with other factors, such as funding challenges and even the threat of piracy and kidnappings when carrying out studies. "It is crucial that we continue this vital work: estuaries and the rivers that feed into them nurture astonishing biodiversity and a wonderfully dynamic environment," he says. "But they are also attractive places for coastal development. Human-driven impacts can destroy vital habitats, reduce the resilience of nature to buffer the effects of erosion, floods, and storms, and undermine other vital services they provide to humankind. These contributions include carbon storage such as in the ocean waters and mangroves, and nurturing immense fisheries that are a vital source of food for people.

"That is why it is so important to monitor what is happening: ocean observations can help researchers to understand the sources of pollution, and support authorities in doing something about it.

Because our observations have taken place over many decades, it enables us to better understand fluctuations in water quality in the estuary and the extent of pollution in comparison to normal, pristine conditions. And with this knowledge we have the chance to tackle the problem and ensure our coastline and its biodiversity is better protected for future generations."

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Written by Adam Gristwood

With thanks to Prof Francis Asuquo and Prof Daniel Ama-Abasi (University of Calabar, Nigeria) for contributions, including images.