CITIZEN SCIENCE

State of rivers: A citizen science perspective

As part of pursuing an understanding of the water resources of southern Africa, there has been a massive increase in attempts to understand the ecological state of rivers among researchers, hydrologists, and environmentalists. Rivers continue to be the lifeblood of our environment, meaning they have a huge biological importance in our everyday lives. However, like any other natural resources rivers are subject to deterioration; hence it's important to look after them. Article by Dr Simphiwe Ngcobo, and Tanisha Curtis.

The limitations of mandated institutions to monitor the condition of river systems across South Africa has hindered the ability of annual reporting on the national state of rivers (DWS, 2021) and global commitments to reporting on Sustainable Development Goal (SDG) 6.3.2 (Stats SA, 2019). Against the backdrop of limited river health monitoring, and the importance of staying abreast of the challenges which rivers systems are facing, a current Water Research Commission (WRC)-funded project is evaluating the potential for citizen science to inform broader water resources management through the generation of a ***Citizen Science State of Rivers Report*** for 2024. Citizen practices for generating environmental data have seen a global growth in application as noted by Carlson and Cohen (2018) mentioning South Africa as one of the countries where this trend has been noted. The accessibility of citizen science tools means that individuals with limited technical training can contribute effectively to accurate data collection. Efforts are underway to enhance citizen science capabilities through dedicated research and capacity-building initiatives.

What is citizen science?
Citizen science includes the collaboration between scientific and civil societies in collecting, analysing and sharing scientific data pertaining to a particular concern or area of interest (Graham & Taylor, 2018). Citizen science has the potential to overcome challenges with data collection for a particular issue through mobilising the volunteers, who are not necessarily trained professionals in the field of concern, to collect data pertaining to an issue. Depending on the nature of the project, these volunteers may be more or less involved in the design, planning, interpretation and decision-making aspects of the study or project. Within the context of this project, citizen science approaches are being used to gather collaborators from various backgrounds to participate, engage and contribute to determining the state of rivers across South Africa, with potential participation from the community of practice in neighbouring countries.

This project aims to play a key role in promoting the use of citizen science to inform monitoring and reporting on SDG 6.3.2 which is set out to monitor the proportion of water bodies which possess good ambient water quality, based on national water quality standards (UNEP, 2018).

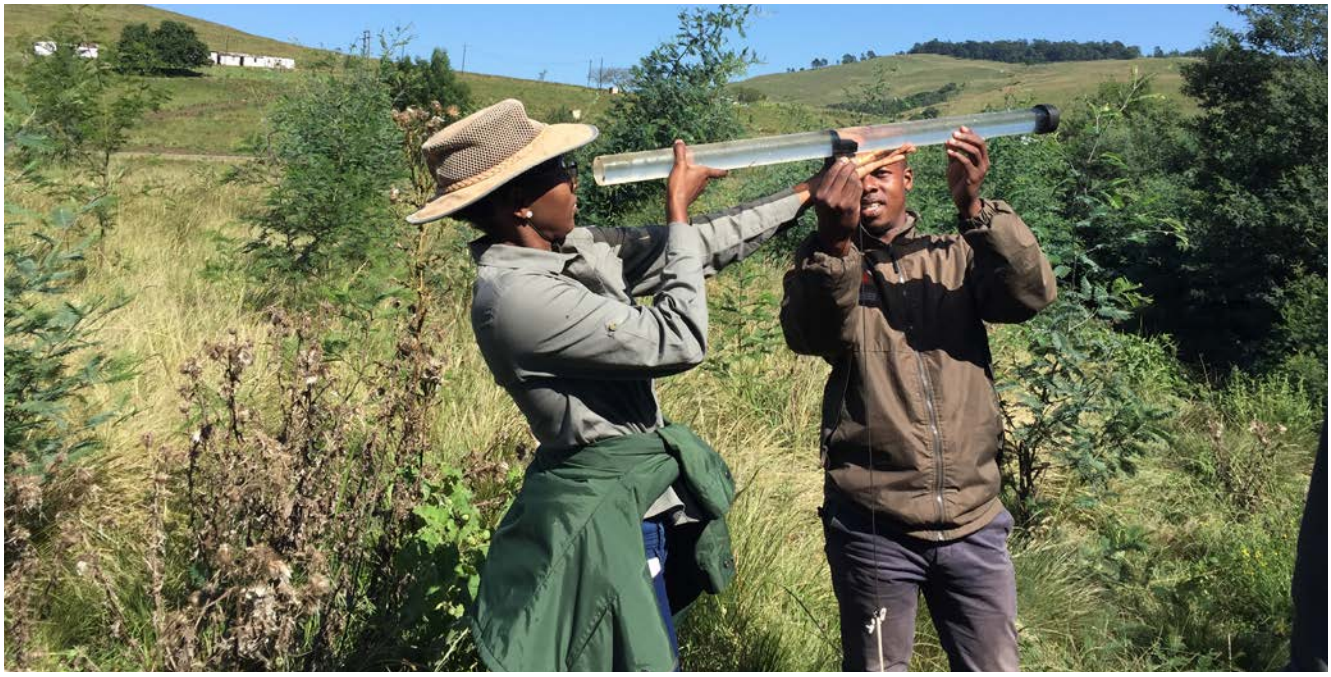
By engaging a variety of collaborators in the monitoring and reporting of river ecological conditions, it fosters a greater understanding of water quality issues and promotes sustainable water management practices among communities. This participatory approach will not only empower citizens but also provides an opportunity for policymakers with essential information to implement effective water quality management strategies, ultimately supporting the achievement of SDG 6.3.2 goals. "Our water resources are all threatened, way above 65% (NBA, 2018), due to excessive pollution, including plastics and other forms of solid waste".

"Only the transformed behaviour of citizens can change the status quo for better as they take full advantage of empowerment and then action" said Bonani Madikizela, Research Manager at the WRC.

Collaboration is key
This project, a joint collaboration between the University of KwaZulu-Natal (UKZN) and GroundTruth, is being supported by United Nations Children's Fund (UNICEF). The potential for collaboration towards generating the ***Citizen Science State of Rivers Report 2024*** has sparked significant interest from stakeholders across South Africa and a few neighbouring countries, reflecting its compelling objectives and potential impact.

Through a strategic engagement approach, the project team has garnered the attention and involvement of a diverse array of stakeholders from various backgrounds and geographical locations. The project uses online forums as integral components for data consolidation. Online forums offer a flexible and accessible platform to create conversation around the project, such as ideas exchange which aims for a community driven approach to monitoring and improving river health. The connections made through this project are also hoped to continue into the future, encouraging the growth of a co-ordinated and connected citizen science community of practice.

Among these collaborators are academic researchers, independent citizens, South African Scoring System version 5 (SASS5) practitioners, government departments, non-profit organizations, community groups, and other relevant stakeholders, all bringing unique perspectives, expertise, and resources to this project. This diverse network of collaborators spans not only South Africa but also reaching neighbouring countries such as Namibia, Zambia and Lesotho, enriching the project with a broad range of insights and experiences. In fact, a



WRC archives

A clarity tube, used to measure water turbidity and suspended solids.

WRC archives

Assessing the aquatic health of a river systems by evaluating aquatic macroinvertebrates found in a water sample.

number of NPOs/NGOs, academic institutions, are taking up and using the citizen science tools in training students, from primary schools to post-doctoral, business and all interested community organizations and individuals. The WRC and partners are leading in the establishment of the citizen science society for southern Africa as an ultimately owner of the citizen science efforts into the future.

Through a bursary provided by the uMngeni-uThukela Water Chair of Water Resources Research and Innovation at UKZN, this project will also conceptually support a UKZN MSc Hydrology student in ***An Evaluation of the Use of Citizen Science for Water Quality Monitoring.*** The student is the lead researcher on this project, thus aspects of this project will be included and drawn upon for inclusion in the MSc thesis.

Monitoring tools used

Previous ***State of Rivers*** reports have given insight that part of the contributions that add to the poor monitoring commitment of our rivers is the lack of individual capacity and personnel for sampling as well as funds to access training courses such as SASS5, which has proven to be an effective tool for sampling in various parts of the country. Online training material on citizen science for river health monitoring have been developed (see, for example, **WRC Report No. TT 933/23**) and the project has made provision for the collaborators to freely access these materials. The suite of tools and techniques utilised under the project are as follows:

- The mini Stream Assessment Scoring System (miniSASS): a simplified version of SASS5 and accessible citizen science biomonitoring tool for assessing the water quality and health of streams and rivers. The miniSASS method involves collecting and identifying certain species of aquatic macroinvertebrates found in a water sample. These macroinvertebrates are sensitive to changes in water quality and habitat conditions, so their presence or absence can provide valuable information about the health of the stream.
- The clarity tube: used to measure water turbidity and suspended solids. It helps to determine suspended solid loads within a river and monitor these loads over time.
- The riparian health audit (RHA): serves as a citizen science instrument designed to evaluate the ecological health of rivers by assigning a score reflecting the integrity of habitat within a specified river segment, determined by assessments of factors like bank erosion, alterations in flow, and presence of alien invasive vegetation.
- Chemical testing kits: Chemical testing kits for water are commonly used to analyse the quality and safety of drinking water, as well as monitoring water quality. An example of a citizen science-based chemical testing kit is the iLab Water Testing kits available from WaterCAN, which test for chemical parameters, ***E. coli***, and coliforms. The chemical parameters tested here include nitrates, nitrite, phosphates, metals, pH, alkalinity, hardness and chlorine
- ***E. coli*** testing kits: ***E. coli*** detection kits detect the presence of ***Escherichia coli*** bacteria in water. Praecautio ***E. coli*** sampling kits indicate the quantitative results of ***E. coli*** or coliforms present in a body of water based on the colour (green for ***E. coli*** and yellow for coliforms) which an incubated sample turns over a 24-hour period.

In addition to the citizen science tools previously mentioned, there exists a variety of other tools and methods that can be used. These additional resources contribute to the diverse range of approaches within the realm of citizen science, offering further opportunities for data collection. For example:

- Dragonfly biodiversity index: The Dragonfly Biodiversity Index is a tool used to gauge ecosystem health by assessing the diversity and abundance of dragonfly species. Dragonflies are sensitive to environmental changes, making them useful indicators. By monitoring their populations, scientists can determine the condition of freshwater habitats and guide conservation efforts.
- The Transparency Velocity Head Rod (also referred to as the velocity plank): This tool is used to measure parameters, such as the depth and width of a river, which can be used to determine the velocity and the discharge of a river.
- Mini-WET Health: This technique evaluates wetland health by utilising indicators derived from geomorphology, hydrology, and vegetation characteristics.

All these tools have been identified as effective tools for citizens to monitor their environment and can supplement the data observed concerning the condition of local water resources.

Long-term monitoring

Questions have been raised about the long-term sustainability plan to keep the interest in water quality monitoring alive; there is already an ambition to continue monitoring beyond this project's timeframe. Financial constraints have contributed to a lack of widespread and continuous monitoring (DWS, 2021). Citizen science responds to overcome this obstacle through exploring low-cost river health monitoring options. This includes the creation of a low-cost miniSASS kit; for example, using ice cream containers to collect macroinvertebrates and also budget-friendly nets to promote the accessibility of citizen science practices.

South Africa has been declared a water-scarce country (Crookes ***et al.,*** 2018), which should be alarming for every citizen, including its neighbouring countries, since water is a shared resource. This project called for all citizens to take action for their rivers by monitoring the health of that system. This has been strongly encouraged to assist in capacitating citizens to better understand the state of river systems, and prompt all to reflect on their impact on these systems. This monitoring will also contribute to telling the story of the ecological conditions of rivers from a citizen science perspective. However, citizens are encouraged to keep using these techniques beyond the duration of this project to inform themselves and their communities, and to stay abreast, adapt and be resilient to the condition of their local river systems. Be sure to keep an eye out for the ***2024 Citizen Science State of Rivers*** report!

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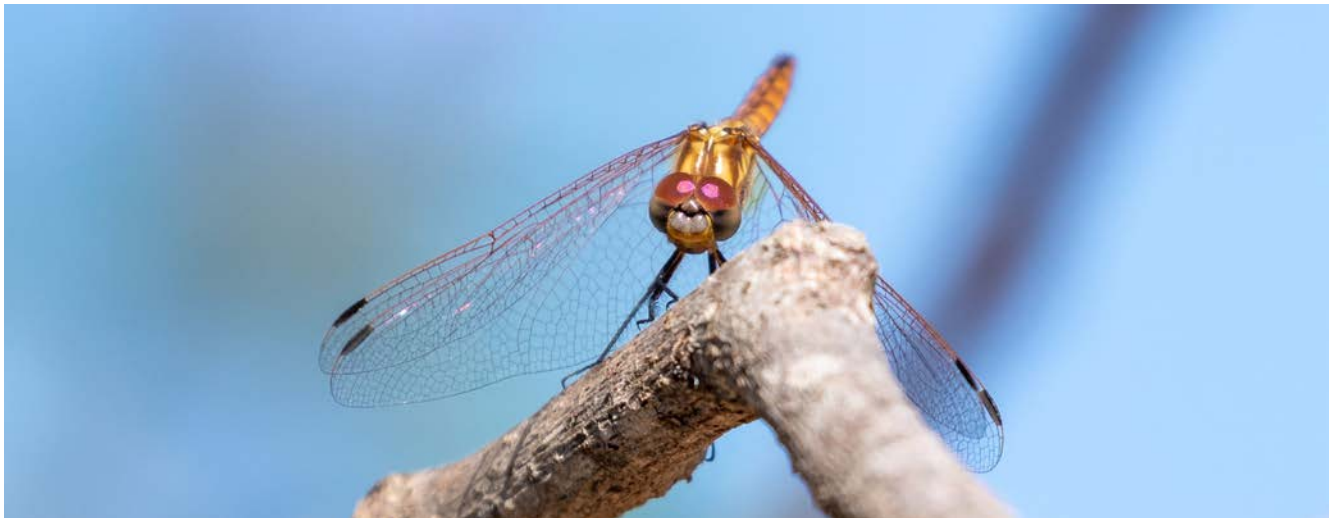

Dragonflies are sensitive to environmental changes, making them useful indicators.