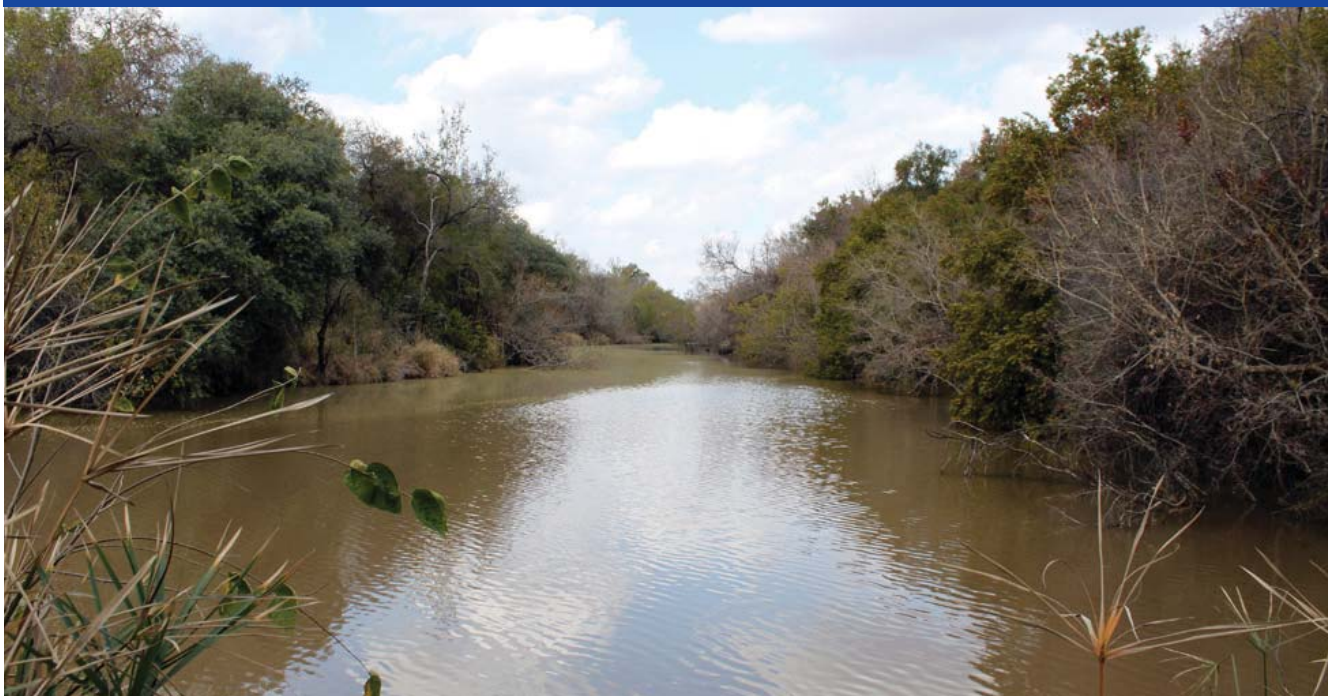
WATER ECOSYSTEMS

Free-flowing rivers and their importance to people, economies and nature: Prioritisation and targeted interventions to maintain ecological integrity

Chantel Petersen, Heidi van Deventer, Lindie Smith-Adao and Jeanne Nel from the CSIR report on initiatives to conserve South Africa's last free-flowing rivers.



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Free-flowing rivers (FFRs) are river systems that have remained connected from source to sea (longitudinally within the channel), latitudinally (connected to floodplains), and vertically (surface-groundwater interaction), allowing for functional biodiversity. Few countries still have FFRs, allowing for connectivity where ecosystem services and functions such as the movement and exchange of water, energy, material, and species within the river system and surrounding floodplains occur, assist with resilience to climate change and anthropogenic impacts and food security among others.

Free-flowing rivers are threatened by instream obstructions such as dams and weirs, pollution, and climate change. A global study by Grill et al. (2019) showed that less than 50% of rivers remain free-flowing, and most of these occur in remote regions of the world, and on the African continent, only 47% of large rivers are still free-flowing.

In 2011, researchers at the CSIR, with funding from the Water Research Commission, completed the first countrywide freshwater conservation plan, the National Freshwater Ecosystems Priority (NFEPA) project, for South Africa. Free-flowing rivers were identified from the 1:500 000 DWAF (2006) spatial rivers layer, was used a basis for establishing river ecosystem types, river condition and FFRs as different spatial layers. An approach of knowledge co-production was followed where an array of researchers, decision-makers, and other stakeholders, at various levels, in the water sector were consulted as a means to validate the information portrayed. A range of different levels of relevant information through several stakeholders from diverse

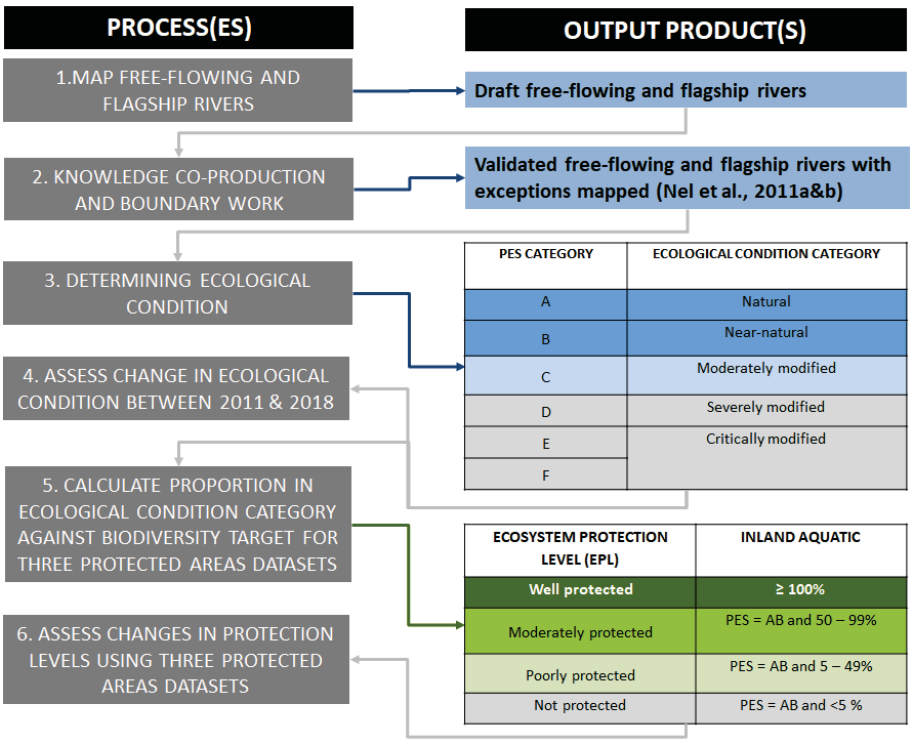
knowledge systems were applied and transformed into co-produced knowledge. The co-produced knowledge also assisted in developing criteria for the identification and selection of the 62 FFRs, including a subset of 19 priority FFRs, termed 'flagship FFRs'.

Reporting on FFRs to global biodiversity targets

The Convention on Biological Diversity (CBD) signatories agree to global targets for freshwater biodiversity and ecosystems. These include the Aichi targets for reporting by the year 2000 (CBD, 2016), and post-2020 Global Biodiversity Framework targets for 2030 (CBD, 2021). The importance of water ecosystems is also recognised in the Sustainable Development Goals (SDG), with SDG 6.6.1 monitoring changes in the extent of wetland ecosystems. (UN, 2021). The Aichi Target 11 of 2020, focused on the extent of protection afforded to water-related ecosystems (CBD, 2016). SDGs 6 and 15 monitor and report on changes in the extent of ecosystem protection, including freshwater ecosystems. Goal A of the post-2020 Global Biodiversity Framework requires reporting on targets related to changes in ecosystems' extent, connectivity, and integrity, listing twenty-one action-orientated targets to be achieved by 2030 to reach outcome-orientated goals by 2050. However, FFRs are not explicitly reported to any global targets currently. In South Africa, the protection, planning, monitoring, and assessment of changes in the ecological condition and protection status of FFRs are reported in the National Biodiversity Assessment (NBA), which is led by the South African Biodiversity Institute (SANBI) with re-evaluation occurring every five years.

The NBA 2018 reassessed the ecological and free-flowing status of the 62 rivers identified by the NFEPA project during 2011, the first countrywide freshwater conservation plan in South Africa. The ecological status was assessed using the Present Ecological State (PES) data and the FFR status was assessed for connectivity with the presence of instream dams using the dams register and the updated artificial wetlands layer (Van Deventer et al., 2019). Between 2011 and 2018, 14 FFRs lost their status as FFRs, of which ten resulted from a deterioration in ecological condition and four were due to the presence of dams in the mainstem river. However, the prioritised flagship rivers remained intact in ecological condition and longitudinal connectivity due to the adoption and championing thereof by national, provincial and local government authorities and by their inclusion in conservation planning (Van Deventer et al., 2019). This can be directly attributed to the efforts of the NFEPA project (Nel et al., 2011b; Nel et al., 2016), and the success of targeting attention and initiatives to manage these systems.

Furthermore, subsequent to the NBA 2018, work on the FFRs was extended to assess the success of the Protected Area Expansion Strategy (RSA, 2010). The protection levels of free-flowing and flagship rivers were quantified according to the percentage of river length occurring in formally National Protected Areas (NPAs). This included the NPA Geographical Information Systems (GIS) spatial layers of 2008, 2018, and the Protected Areas Expansion Strategy (NPAES) and the projected protected areas by 2024 (Figure 2). The results were published a scientific publication entitled "Incorporating free-flowing rivers into global biodiversity targets: Prioritisation and targeted interventions to maintain ecological integrity" (Petersen et al., 2023). Adequate conservation of rivers is often assumed when occurring in protected areas without taking cognisance of river connectivity (i.e. longitudinal, lateral, vertical and temporal linkages) or catchment disturbances. Results from Petersen et al. (2023) showed that the inclusion of FFRs in future NPAES plans (2016 and 2024) increased the



Flow diagram of the methods followed to achieve the ecological condition categories and protection levels for free-flowing rivers. Biotic response attributes of a river relative to the natural ecological condition drive present Ecological State (PES) categories.

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A dolomitic eye of the Groot Marico River which pours crystal clear, pristine waters into the start of the river. This is the only free flowing river left in the arid region of the country and the North West Province.

representation of freshwater ecosystems throughout all ecoregions and increased the protection level to 59% in a well-protected category. In addition, the study proposed that the loss of the extent of FFRs in a natural and largely natural ecological condition be reported to SDG 6; whereas changes in the connectivity of FFRs be included in the post-2020 Global Biodiversity Framework targets; and lastly, changes in protection levels of FFRs reported to SDG 15.1.2 (Petersen et al., 2023). Currently rivers are not reported under any SDG.

A comparison between the free-flowing rivers of the NFEPA project, as updated and used in the NBA 2018, showed a marked difference to that of the global mapping of FFRs by Grill et al. (2019) (Figure 4). The global assessment mapped a total extent of 225 192 km of FFRs for South Africa in comparison to the most recent NBA 2018 which mapped 164 018 km extent of FFRs (Figure 4b). The global study showed a 27% more in extent of FFRs than the extent used to apply in South Africa's countrywide scale assessments.

When the global free-flowing rivers are also considered for change detection and reporting to the global targets, one of the major concerns are in the representation of pressures at a global scale. The global dataset showed extensive extent of FFRs, because it was automatically derived in GIS from a digital elevation model, and mapped the presence of FFRs, irrespective of the flow, hydrological period or damming in the tributaries of these systems. In contrast, the South African dataset showed a selection and prioritisation of <100 FFRs, which offers a more feasible means of monitoring, prioritisation and management at a countrywide scale. Priority was given to permanent and seasonal mainstems and tributaries in South Africa, because these systems experience high anthropogenic pressure and showed a larger degree of transformation, compared to the arid ephemeral systems.

Implementation and uptake

The Petersen et al, (2023) was published at an opportune time as the 15th meeting of the Conference of the Parties to the UN Convention on Biological Diversity met over a two-week summit during 7-19 December 2022 in Montreal, Canada. According to the GEO BON (Group on Earth Observations Biodiversity Observation Network) and FWBON (Freshwater Biodiversity Observation Network) (2022) science brief for COP15, inland waters are not explicitly included in Targets 1 and 3 of the post-2020 Global Biodiversity Framework. The published paper was included in the South African delegation to COP15 and was, therefore, pertinent to the efforts to achieve the goals of the

post-2020 Global Biodiversity Framework.

The WWF currently spearheads the Iconic Free-Flowing Initiative, which promotes the free-flowing nature of rivers by strengthening policies and promoting laws to protect such rivers, prevents the building of dams that would negatively affect humans and wildlife depending such rivers. It will assist local leaders to develop sustainable energy plans limiting the need for hydropower and assist in reconnecting rivers by removal of dams together with other restoration projects and initiatives (https://www.worldwildlife.org/pages/free-flowing-rivers). Furthermore, awareness was also created with the development of an augmented reality free-flowing river app available for download on a mobile device (https://www.worldwildlife.org/pages/explore-wwf-free-rivers-a-new-augmented-reality-app). This app puts an entire landscape in your hands. You can immerse yourself in its incredible virtual world, where you'll meet the people and wildlife that live there. Through this in-depth, interactive storytelling experience, you can learn how wildlife, people and entire landscapes depend on healthy, flowing rivers. You can for example dam the river to see what happens, and then try a sustainable energy mix that keeps the river connected but still satisfies growing energy demands.

Explore WWF Free Rivers, a new augmented reality app (After https://www.worldwildlife.org/pages/explore-wwf-free-rivers-a-new-augmented-reality-app).

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