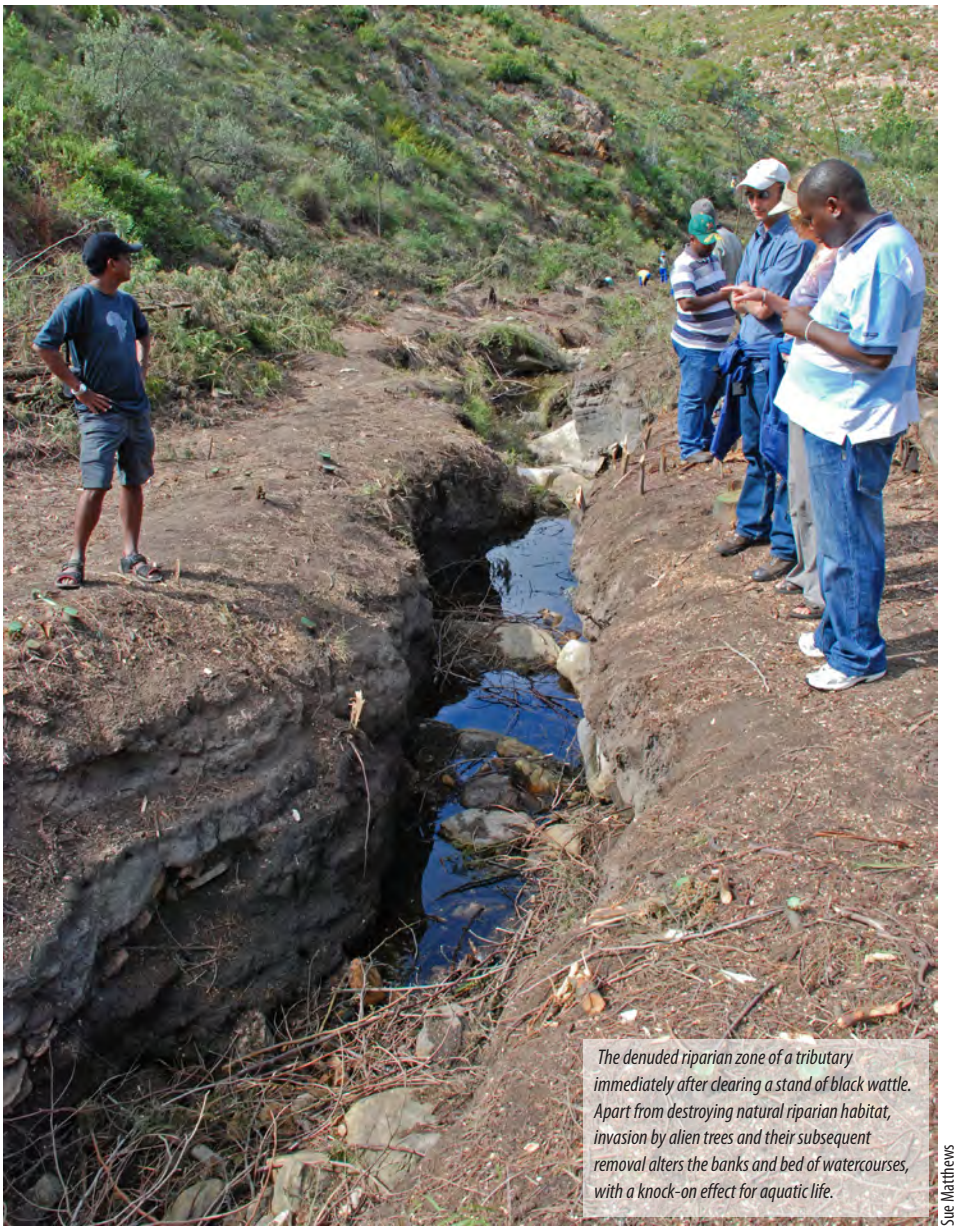
ECOLOGICAL RESTORATION – Giving back to SA's watercourses

It's been almost 20 years since the Working for Water (WfW) programme was launched in 1995, shining a spotlight on the need to safeguard South Africa's scarce water resources by clearing invasive alien vegetation from mountain catchments and watercourses. In the intervening years, the riparian zones of hundreds of kilometres of streams and rivers have been cleared with WfW and other Expanded Public Works Programme (EPWP) funding, as well as by NGOs and private individuals. But how effective are such clearing programmes in achieving ecological restoration? Sue Matthews reports.



The denuded riparian zone of a tributary immediately after clearing a stand of black wattle. Apart from destroying natural riparian habitat, invasion by alien trees and their subsequent removal alters the banks and bed of watercourses, with a knock-on effect for aquatic life.

Sue Matthews

A number of studies have shown that removal of alien trees increases streamflow, but concern has long been expressed that indigenous riparian vegetation cannot simply 'self repair' when river banks are left in a denuded state after clearing. Indeed, an external evaluation of WfW conducted in 2003 noted: "The WfW Programme has made no provision for routine project monitoring or evaluation in relation to ecological responses to alien clearing. Even research in this regard is scant. Currently performance is measured on alien-clearing efficiency (hectares cleared) rather than on degree of vegetation recovery. Without measuring the impacts of clearing, managers have no idea whether they are using the optimal approach, degrading or improving ecological integrity."

WfW responded to this criticism, and in May 2004 provided funding for a three-year research project to assess ecosystem repair targets in alien-invaded riparian zones in the fynbos, grassland and savanna biomes, under the leadership of

Dr Patricia Holmes. At around the same time, the Water Research Commission (WRC) funded a project on riparian zone invasion in the south-western Cape, conducted by the University of Cape Town's Freshwater Research Unit. Similar projects focusing on restoration were carried out by staff and students at the DST-NRF Centre of Excellence for Invasion Biology at the University of Stellenbosch, the University of Witwatersrand's Restoration and Conservation Biology Group, and Rhodes University's Botany Department. WfW contributed funding to some of these studies.

This body of research was consolidated in a special issue of the *South African Journal of Botany*, published in July 2008, entitled 'Riparian vegetation management in landscapes invaded by alien plants: insights from South Africa'. The suite of papers concluded with a synthesis of the research findings, and guidelines for improved management of alien-invaded riparian zones.

It was recognised then that where dense stands of alien plants had excluded most indigenous vegetation, and the ecological condition of the surrounding catchment area had also been highly compromised, restoration of riparian vegetation with a similar structure and function to uninvaded sites would probably be untenable. In such cases, re-establishing a vegetation cover of non-invasive and preferably indigenous species that would be resilient to re-invasion and floods, and also provide some erosion control, was the best that could be hoped for.

In less-transformed catchments, it might be possible to restore riparian vegetation via recruitment from the soil seedbank – so-called 'passive' restoration – but a more 'active' approach involving seed-sowing and planting of seedlings and cuttings would facilitate vegetation recovery and inhibit re-invasion.

More recent research in the fynbos biome has largely supported these initial findings. Saskia Fourie was awarded her PhD in 2012 by Rhodes University for her study in acacia-infested riparian zones in the Eastern Cape, which showed that active restoration resulted in significantly higher indigenous cover after seven months, compared to passive restoration or restoring with grass. The fell-and-burn alien-clearing treatment was found to hinder passive restoration, as the high temperatures reached under burning stacks killed a large proportion of indigenous seeds, especially in the upper layers of the soil. The alien acacia seeds were more resistant to fire, and germinated faster than any indigenous species. And while grass restoration helped suppress the regeneration of the alien acacia, it did the same to indigenous species.

Sheunesu Ruwanza also assessed the effectiveness of active and passive restoration as part of his PhD through the University of Stellenbosch, awarded in 2012. Working at sites along the Western Cape's Berg River that had been heavily invaded with eucalypts, he found that there was no recruitment of indigenous species at passive restoration sites, which were instead dominated by alien herbs and grasses. At active restoration sites, germination of sowed seeds was low, but the fell-and-burn treatment yielded better results than fell-and-remove. Nevertheless, few indigenous seedlings survived the hot, dry conditions of their first summer, while cuttings failed to establish at all.

Secondary invasion by alien herbs and grasses after clearing can be attributed to nutrient enrichment of soils by previous invaders. Like many other legumes, acacias are nitrogen-fixing plants that increase levels of nitrate and nitrite in the soil, while eucalypt stands have an especially thick litter layer that releases nitrogen as it decays. Under normal circumstances these nutrients would be rapidly taken up by the alien trees, but clearing results in a sudden increase in litter and decrease in living vegetation. The resulting glut of nitrogen is thought to exclude indigenous fynbos species – adapted to nutrient-poor soils – and give alien species a competitive advantage.

A recent WRC research project by Jacobs et al., 'Identifying relationships between soil processes and biodiversity to improve restoration of riparian ecotones invaded by exotic acacias' (**Report No. 1927/1/13**), suggested that riparian soils do not accumulate nitrogen to the same extent as terrestrial soils because they are regularly flushed by floods. Nevertheless, soil nitrogen at study sites remained relatively high more than seven years after acacias had been removed.

Dana Grobler

Members of the Berg River riparian rehabilitation project team tend to young plants.

Sue Matthews

A nursery set up for a riparian restoration project in the Eastern Cape.

This clearly represents a challenge to riparian restoration, particularly since Working for Water policy for alien-clearing operations on private land has been to do follow-ups for only two years after the initial clearing, after which the landowner is expected to take responsibility for ongoing control.

"Ecological restoration is a long-term commitment", says Prof Karen Esler of Stellenbosch University's Department of Conservation Ecology and Entomology. "The success stories are where there's been collective and focused attention – you need champions and dedicated groups of people that will keep on going back. Probably the way to go is to establish public-private partnerships where there are local interest groups that have a close connection to the area."

This is the approach being taken for a riparian restoration initiative on the Berg River, driven by the provincial government's Department of Environmental Affairs and Development Planning (DEADP). The project is a component of the Berg River Improvement Plan, drafted in response to concerns about the deteriorating condition of the river due to faecal and nutrient pollution from agricultural and urban sources.

A service provider, Blue Science, has been awarded a three-year contract to rehabilitate riparian areas that have been cleared of aliens by either Working for Water or Landcare. The aim is to demonstrate the benefit of re-establishing a buffer zone to improve water quality by absorption of run-off and reduction of erosion.

"So far we have five sites at Hermon, just downstream of Wellington, but with the next planting season this winter we are looking at identifying new sites in the Franschhoek and Paarl areas," says Jason Mingo, Berg River Task Manager in DEADP's pollution directorate. "Within the last year we have planted just over 22 000 plants comprising 24 species. The teams are watering these regularly, although in some cases farmers have agreed to install irrigation systems. The plants' survivability in the first year will guide us in terms of which species are more adapted to the very harsh and stark conditions that are created when you clear a section of bank of all alien vegetation."

"The reason we've focussed on this stretch of the river is that it's far removed from any natural sources that would allow for recolonisation by these types of fynbos species," he explains. "We hope to re-establish pockets of natural vegetation that will over time reseed newly cleared areas on the river."

"We've established an advisory committee to bring all the role-players and stakeholders that are involved in such activities together, to allow for effective planning and to understand who's doing what where. The idea is to identify key partners, such as local conservancies and the Biodiversity and Wine Initiative, that can help raise awareness around the reason we need these riparian buffer zones to the relevant farmers and farm managers."

Until recently, this stretch of the Berg River was lined with eucalypt and acacia trees. One of the aims of the provincial government's riparian zone rehabilitation and management project is to raise awareness among farmers of the need for riparian buffers to reduce agricultural runoff.

"The sites we're currently working on total only 2.2 km, which is a drop in the ocean in terms of the almost 300 km length of the entire system, but the vision of the Berg River Improvement Plan is to begin the process of introducing water stewardship among the various landowners, organisations and stakeholders along the river so it becomes not just a government initiative, but a partnership where we assist each other in rehabilitating the banks of the river."

Prof Esler, who serves on the advisory committee, says: "The project is an important initiative because it's bringing a whole range of different groups around the table for a common interest." She adds that this is also the motivation for a proposal to establish a South African restoration network, which would improve communication between scientists, policy makers and practitioners, and help close the 'knowing-doing' gap.

She has recently been involved in a WRC-funded research project, led by Dr Phumza Ntshotsho of the CSIR in Stellenbosch, to investigate the feasibility of establishing such a network – possibly a regional chapter of the international Society for Ecological Restoration. A workshop was held at the end of February to explore the idea. "My interest in the network is in focusing research attention and also allowing us to learn from each other, so it's not just individuals doing research here, there and everywhere, but collective learning as well."

A bibliometric analysis conducted as part of the project revealed that 141 of the 191 journal articles on restoration or rehabilitation in South Africa published since 1994 focused on terrestrial ecosystems, with only 19 and 14 articles reporting on riparian and aquatic studies respectively. About a third of the terrestrial studies related to mining, with invasive alien vegetation studies lagging well behind in second place.

John Hishin/Game Plan Media

DEADP/Western Cape government

*The fynbos star-apple or bloubessie (*Diospyros glabra*) is one of the species being planted in cleared areas along the Berg River. It is hoped that such taller shrubs will ultimately shade out the grass and improve conditions for natural groundcovers and low-growing riparian species.*

However, a recently completed WRC-funded research project by Blignaut et al., which examined the costs and benefits of eight restoration projects countrywide and assessed the potential market for ecosystem goods and services associated with restoration, found that those yielding water services had a relatively high likelihood of success as well as high payoffs. In contrast, the one mining-related restoration effort studied was considered something of a 'white elephant', as significant resources have been committed to it with proportionally little reward and a low probability of success. (For more on this WRC project, see *The Water Wheel*, November/December 2013.)

"It's obviously a big challenge to source funding for restoration projects, but we found that it is worth investing in those that are linked to some kind of water service, because South Africa is such a water-poor country," says Prof Esler, a member of the project team.

"Around the world, ecological restoration is coming to the forefront now, because we're realising that we've degraded the services that ecosystems supply to such an extent that there's a feedback to our well-being. That's not to say restoration is replacing conservation – conserving intact habitat has to happen in parallel, but it's just simply not enough." ❑