

Scientific challenges in the field of invasive alien plant management

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Guest Editor

THIS ISSUE OF THE *SOUTH AFRICAN JOURNAL OF SCIENCE* carries papers arising from research that, in one way or another, was supported by South Africa's Working for Water programme. The papers include the keynote addresses (summarizing the state of knowledge and research in important fields) that were delivered at Working for Water's inaugural research symposium held at Kirstenbosch from 19 to 21 August 2003. A number of additional papers, based largely on research funded by the Working for Water programme, are also presented.

The Working for Water programme is a government initiative that addresses the problem of invasive alien plants. Its name captures the programme's focus on job creation in support of an important ecosystem service (the protection of water supplies threatened by invasive alien plants). The invasion of ecosystems by alien species that are knowingly or accidentally introduced to new areas is a problem of global significance. These invasions can alter the composition, structure and functioning of ecosystems and affect their capacity to deliver a range of benefits to humankind.

South Africans have long recognized the problem of invasive alien plants, and almost two decades have passed since the first detailed synthesis of the ecology and management of invasive alien species was produced in South Africa.¹ Others have followed,²⁻⁵ but these were all largely academic. More recently, the issue of alien plant invasions has taken on a new energy, fuelled by generous funding that became available for the Working for Water programme. This has taken the field into new dimensions — from academic debate to large-scale implementation. There is no doubt that South African science, and scientists, have played a pivotal role in this metamorphosis. But there are new challenges facing scientists, now that the problem is widely recognized, in that there is a large and growing expectation that science should deliver immediate, practical solutions to many management problems.

Originally, the prime argument for the establishment of the Working for Water programme was the prediction that these invasions would have severe impacts on

surface water resources.⁶ Initial funding from the South African Department of Water Affairs and Forestry, aimed at the prevention of these putative consequences, has been combined with further generous funding from the government's allocation to poverty relief. This intervention has created thousands of employment opportunities, and enhanced the lives of poor people in impoverished rural areas. The programme's perceived success in delivery has seen it grow, rapidly, from strength to strength. By the end of the 2001/02 financial year, the programme had invested R1.59 billion in clearing programmes during its first seven years of existence,⁷ making it arguably the largest environmental programme on the African continent.

Rapid growth comes at a cost. Initially, in order to focus on implementation, there was little opportunity to consolidate existing understanding regarding the ecology of invasive species, the threats that they posed to the environment, and the options for control. The nature of the funding (for poverty relief) also meant that there was a strong focus on getting most of the funds through to poor people, a new challenge for managers of alien plant control projects. However, the programme has more recently invested funds (amounting to R42 million over the past 3 years, or roughly 2.5% of the current annual programme budget) into much-needed research aimed at supporting development and implementation.

Research in this field can be rewarding. Invasions by introduced species, and landscape-scale clearing operations, provide scientists with ready-made experiments in ecology, and they can offer and have offered opportunities for expanding fundamental ecological understanding. However, the expenditure of large sums of money in a developing country that has real and immediate social and economic needs cannot be justified by such apparently esoteric goals, and scientists are being asked more pressing questions. These include whether or not the predictions of significant benefits arising from the control of invasive alien plants can be substantiated by good science, and whether or not further expenditure on research will be justified by the delivery of solutions that will significantly reduce the threat of invasive alien plants, or increase

the efficiency of their control. Funders also want to know whether or not investments in research will drive transformation in a way that will build essential and relevant scientific capacity in post-apartheid South Africa.

Past and continuing research has provided a basis on which to build. There remains a need to expand our fundamental understanding of the processes that underlie invasions and the effects that they have. Such studies are needed to underpin more holistic assessments related to the problem. Some examples are:

- The sum total of impacts (and benefits where these might exist) associated with invasive alien plants, and how these vary for different species and in different geographical areas (necessary for setting priorities);
- the means whereby the benefits that arise from costly control programmes can be expanded, for example by using the opportunity to create employment, and to exploit the plant material made available from clearing operations (necessary to decrease the costs of control);¹⁰
- the development of the means to identify species that pose serious threats at an early stage, given that new species are entering the country continuously;
- the development of arguments to justify implementation of measures to control or eradicate 'emerging' problem species (given that problems with existing, and obvious, infestations will take priority, and that the prevention of a problem is unlikely to earn political kudos for those funding it);
- the means to deal with the significant conflicts of interest that arise when invasive alien species also provide important benefits in some areas. This question relates both to the expression of objective and unbiased information based on good science, as well as to seeking solutions (for example, the propagation of sterile cultivars, or the reduction of invasive potential by introducing seed-feeding insects); and
- means for combining and integrating skills from different disciplines in order to address the problems of invasive alien plants in a holistic manner, and to develop integrated solutions. The field of resource economics, for example, needs to incorporate the contributions from ecologists, hydrologists, engineers and social scientists into economic simulations that can inform decision-makers of the full consequences of invasions and the benefits of control.

Two reviews published in this issue have noted that the Working for Water programme's activities provide extraordinary opportunities for innovative experi-

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mentation and research.^{11,12} The range of ecosystems in which clearing projects are located, and the scale of operations, combine to offer opportunities that are rarely found anywhere else. We have not yet fully capitalized on these prospects, and this remains a largely unexploited opportunity for scientists.

There are also issues of research capacity that have to be addressed, urgently. The bulk of research funding from Working for Water (50% over the past 3 years) has been directed at biological control. In South Africa, biological control has been practised since 1910, and the country's biological-control scientists form a relatively small, united and committed community. They have conducted collaborative research over the past 30 years, and have an impressive track record, with many weeds having been effectively brought under control. A recent study⁸ indicated that the economic returns from biological control research (in terms of environmental impacts prevented), compared to the costs of research, ranged from 34:1 to 4333:1. These returns on investment are phenomenal, and the achievements of South Africa's biological-control scientists have not gone unnoticed.

The National Science and Technology Forum, in its science and technology awards for 2001, acknowledged the Weeds Research Division of the Agricultural Research Council's Plant Protection Research Institute as the organization that made the greatest contribution to science, engineering and technology over the last 10 years in South Africa — a significant achievement in the face of stiff competition. The Weeds Research Division has staff and facilities that represent an asset of strategic national importance, and one that is delivering hundreds of rands of benefits for every rand spent on research. Recent developments at the Agricultural Research Council have seen this capacity coming under growing threat, as the council does not have the capacity to maintain the facilities and staff, and to make use of significant business opportu-

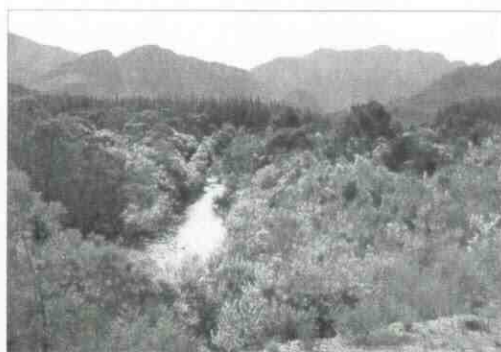
nities. It is in the national interest to ensure that these trends are reversed.

The Working for Water programme has been the subject of a recent comprehensive review. While the conclusions of this review are not yet available, preliminary findings were reported at the research symposium.⁹ The programme's achievements were seen as significant in the context of the lack of an enabling legal and institutional environment for the management of invasive alien species. The programme's rationale was seen to be sound from ecological, social and economic perspectives. However, the reviewers were of the opinion that improved accountability through the clarification of mandate, effective partnerships with government, and more efficient institutional arrangements were urgently required. The way in which the programme addresses these issues will be crucial for it to be able to build on its early and remarkable successes.

The existence of the Working for Water programme is due to the vision and hard work of many people. Political involvement was necessary for the creation of the programme, and the vision, leadership and support of the previous minister of Water Affairs and Forestry, Kader Asmal, was vital in this regard. His successor (Ronnie Kasrils), and the ministers of Environmental Affairs and Tourism (Valli Moosa) and of Agriculture and Land Affairs (Thoko Didiza) have continued to provide essential support for the programme. Guy Preston, the programme leader, has, for over 8 years, provided the leadership and tireless perseverance necessary for the programme to succeed. A foundation of research was an essential part of the programme's success. In this regard, Christo Marais (Working for Water's manager of scientific services), and his staff (Ahmed Khan, Mthembeni Khumalo, Nceba Ngcobo and Pumla Ndaba) are thanked for their unstinting support. My colleague Dave Richardson has provided valuable assistance in the conceptualization of this review issue. There is no doubt that the Working for

Water programme has, through its funding of relevant research, created the stimulus for continued achievements in this field by South African scientists.

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Before and after: Invasive pines and Australian wattles along the Wemmershoek River in 1985 (left), and the same site following clearing by the Working for Water programme, taken in 2003. Such clearing operations are known to reduce water use by alien plants, and contribute to the conservation of water resources. The development of effective methods for the repair of such ecosystems is one of the many scientific challenges facing the programme. Photographs: D.M. Richardson.

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