

Technical note

The impact of invading alien plants on surface water resources in South Africa: A preliminary assessment

DC Le Maitre*, DB Versfeld and RA Chapman

CSIR Division of Water, Environment and Forestry Technology, PO Box 320, Stellenbosch 7599, South Africa

Abstract

The impacts of the widespread invasions by alien plants in South Africa are increasingly recognised. Most of the past concern has been about the impacts on conservation areas, other areas of natural vegetation, and on agricultural productivity. The potential impact of invading alien woody plants on water resources was known to be serious but there has been no information available to evaluate the significance of these water losses across the whole country. This paper reports on the results of a preliminary survey aimed at obtaining an overview of the extent, impacts and implications of alien plant invasions at a national and regional level for South Africa and Lesotho. Data on the extent and location of the invaded areas were obtained from a variety of sources including detailed field mapping, mainly at a 1:250 000 scale with some at 1:50 000 and 1:10 000, and generalised information on species and densities. The density class of each species in each polygon was mapped and used to derive the condensed areas (the equivalent area with a canopy cover of 100%). Each of the invading species was classified as a tall shrub, medium tree or tall tree - based on growth form and likely water use - and its biomass was estimated from a function based on vegetation age. The incremental water use (i.e. the additional water use compared with the natural vegetation) was calculated using the following equation: Water use (mm) = 0.0238 x biomass (g/m²) which was derived from catchment studies.

Alien plants, mainly trees and woody shrubs, have invaded an estimated 10.1 million ha of South Africa and Lesotho, an area larger than the province of KwaZulu-Natal. The equivalent condensed area is 1.7 million ha which is greater than the area of Gauteng Province. The Western Cape is the most heavily invaded at about a third of the total area, followed by Mpumalanga, KwaZulu-Natal and Northern Province. The catchments of the Berg and Breede Rivers are the most heavily invaded followed by the George-Tsitsikamma region, Port Elizabeth coastal region and the Drakensberg escarpment in Mpumalanga. The total **incremental** water use of invading alien plants is estimated at 3 300 million m³ of water per year, equivalent to about 75% of the virgin MAR of the Vaal River system. About a third of the estimated total water use, by volume, is accounted for by alien invaders in the Western Cape, followed by KwaZulu-Natal (17%), the Eastern Cape (17%) and Mpumalanga (14%). The greatest reduction, as a percentage of MAR, was found in the arid Northern Cape (17%), followed by the Western Cape (15%) and Gauteng (10%). For primary catchments, the greatest percentage reductions were in the Namaqualand coast (catchment F, 91%), followed by the Eastern Cape Coast (P, 42%) and the south-western Cape (G, 31%). The extent and density of the invasions and thus the impact on water resources could increase significantly in the next 5 to 10 years, resulting in the loss of much, or possibly even all, of the available water in certain catchment areas.

Alien plant control is expensive but it has been shown that control programmes are cost-effective compared with alternative water supply schemes. This preliminary assessment needs to be interpreted with caution because the results are based on a data set that contains some important uncertainties. The water-use estimates also involve some critical assumptions. Nevertheless, the scale of the invasions, the magnitudes of the impacts, and the rapid expansion we are observing are such that a national control programme is essential if the country's water resources are to be protected.

Introduction

There is increasing concern worldwide about the impacts of invading alien (exotic) plants (Drake et al., 1989; OTA, 1993; IUCN, 1997; Vitousek et al., 1996; 1997). Historically, the concerns were mainly about the impacts on human society, for example through lost agricultural production, but there is growing recognition of the impacts on biodiversity and natural systems (Clout, 1995; IUCN, 1997). Many alien plant species are categorised as serious and dangerous invaders in the USA (OTA, 1993) and losses of agricultural production alone are estimated at US\$7 bn./yr (Babbitt, 1998). New Zealand has 240 alien species recognised as invasive weeds and more than 580 000 ha of nature reserve land is threatened by invasion in the next 10 to 15 years (Owen, 1998). Various South African scientists have recognised the potential impacts of

alien invaders on indigenous vegetation (Stirton, 1978; MacDonald et al., 1986) and the ecological services that could be lost (Van Wilgen et al., 1996; Higgins et al., 1997). The potential impacts on water resources were also recognised half a century ago by Wicht (1945) and the reductions in streamflow were expected to be similar to those under pine plantations (about 350 mm per year) by Kruger (1977) and Van Wilgen et al. (1992). Modelling of the potential impacts of invading species on streamflow from fynbos catchments showed that the impacts could have severe implications for Cape Town's water supplies (Le Maitre et al., 1996). The findings of these studies were a key factor in the initiation of the *Working for Water Programme* in October 1996. This is a national programme for controlling woody invading plants which is managed by the Department of Water Affairs and Forestry (DWAF, 1997).

In January 1996 the Water Research Commission appointed the CSIR to carry out a research project on behalf of the *Working for Water Programme*. The objectives of the project were to determine the extent of invasions by alien plants, their impact on surface water resources, the costs of controlling the invaders and to

* To whom all correspondence should be addressed.

☎(021) 888-2610; fax (021) 888-2684; e-mail: dlmaitre@csir.co.za
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