

The economic evaluation is based on the 2005–06 cost of implementation, which we have assumed to be constant over the five years of the TAP. But the actual costs may vary over the years. The process for monitoring the TAP includes measuring the actual costs, thus the actual expenditures can be determined in future and the analysis can be repeated as a standard *ex post* assessment. Irrespective of these uncertainties, the Threat Abatement Plan appears to be a cost-effective strategy for protecting biodiversity and a sound investment. Given that this is the first such strategy for a weed species in Australia, such strategies should therefore be considered for other weed species that pose significant threats to biodiversity because they deliver weed control targeted at biodiversity conservation in a cost effective manner.

Acknowledgments

We are grateful to our colleagues in the Department of Environment and Climate Change for collection of the data, and to the CRC for Australian Weed Management for continuing financial support that enabled the underlying theoretical work. The approach to modelling the flow of environmental services, as Equations (2) to (6) and Figure 1, was developed as part of Project 1.2.8 of the CRC for Australian

Weeds Management (Hester *et al.* 2006). We acknowledge the assistance of Dr Brian van Wilgen, of CSIR Stellenbosch, South Africa, and Professor Dave Richardson of the Centre for Excellence for Invasive Biology, University of Stellenbosch, South Africa, for their helpful comments on early stages of this work. We acknowledge additional assistance provided by Galia Khusnutdinova, and we would also like to thank those attending the seminar at Department of Primary Industry Research Station, Frankston, Victoria, November 29th 2005, for their helpful comments on the theoretical work.

References

DEC (2006). 'NSW Threat Abatement Plan – invasion of plant communities by *Chrysanthemoides monilifera* (bitou bush and bone seed)'. (NSW Department of Environment and Conservation, Hurstville).

Downey, P.O. (2007 – in press). Determination and management of alien plant impacts on biodiversity: examples from New South Wales, Australia. In 'Plant invasions: human perception, ecological impacts and management', eds B. Tokarska-Guzik, J. Brock, G. Brundu, L. Child, C. Daehler, and P. Pyšek. (Backhuys Publishers, Leiden).

Hester, S.M., Sinden, J.A. and Cacho, O.J. (2006). Weed invasions in natural environments: towards a framework for estimating the cost of changes in the output of ecosystem services, Working Paper Series in Agricultural and Resource Economics, No. 2006-7 (University of New England, Armidale).

Palisade Corporation (2002). @RISK, risk analysis and simulation add-in for Microsoft Excel. (Newfield, New York).

Sinden, J., Jones, R., Hester, S., Odom, D., Kalisch, C., James, R., Cacho, O. and Griffith, G. (2005). The economic impact of weeds in Australia. *Plant Protection Quarterly* 20, 25-32.

Sinden, J. and Griffith, G. (2007). Combining economic and ecological arguments to value the environmental gains from control of 35 weeds in Australia. *Ecological Economics* 61, 396-408.

Sinden, J.A. and Thampapillai, D.J. (1999). 'Introduction to benefit-cost analysis'. (Longman, Melbourne).

van Wilgen, B.W., de Wit, M.P., Anderson, H.J., Le Maitre, D.C., Kotze, L.M., Ndala, S., Brown, B. and Rapholo, M.B. (2004). Costs and benefits of biological control of invasive alien plants: case studies from South Africa. *South African Journal of Science* 100, 113-22.

Projecting the impact of climate change on bitou bush and boneseed distributions in Australia

Rachael V. Gallagher^A, Linda J. Beaumont^A, Paul O. Downey^B, Lesley Hughes^A and Michelle R. Leishman^A

^ADepartment of Biological Sciences, Macquarie University, North Ryde, New South Wales 2109, Australia.

^BParks and Wildlife Division, NSW Department of Environment and Climate Change, Hurstville, New South Wales 2220, Australia.

Summary

Global climate change will have significant implications for the management of invasive species in Australia and throughout the world. Changes to temperature and precipitation regimes may influence the fecundity, recruitment and competitive ability of invasive species leading to expansions or contractions of species distributions. Using point localities derived from the Global Biodiversity Information Facility (GBIF), and NSW National Parks and Wildlife Service survey data we have

modelled projections of the potential future bioclimatic ranges of the widespread weeds bitou bush (*Chrysanthemoides monilifera* subsp. *rotundata* (DC.) Norl.) and boneseed (*Chrysanthemoides monilifera* subsp. *monilifera* (L.) Norl.) within Australia. Uncertainty exists in estimates of future climate, due to differences in projections derived from alternate climate models. Also, the severity of climate change will depend on emissions scenarios that will be influenced by human population levels, socio-economic conditions and

technological changes. To address some of the uncertainty surrounding future climate, we projected species distributions onto scenarios derived from two climate models (CSIRO MK2 and NCAR) and two emissions scenarios (A1f and B1) for the year 2030. Through investigating the potential for climate change to alter the distribution of bitou bush and boneseed, managers can make informed decisions when developing strategies with a long term perspective.