Using spatial models and a Bayesian belief network to predict risk of parkinsonia invasion at a landscape scale in northern Australia

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Summary Predicting where invasive plants will have their greatest impact will increase the speed and effectiveness of management. This includes assessing potential impacts through time and space in order to prioritise management actions before those impacts are realised. Parkinsonia (*Parkinsonia aculeata* L.) is a weed of national significance that is widespread in northern Australia, occurring from the arid interior to the wet-dry tropics and from seasonally inundated wetlands to upland habitats. Although widely distributed, it is still considered to be an emerging problem in most regions. Risks of parkinsonia invasion at the landscape scale have never been quantified.

Recent studies have demonstrated the utility of Bayesian belief networks in capturing and integrating expert knowledge and empirical data to model species' distributions and to identify the factors most likely to influence species' occurrence and abundance (e.g., Smith *et al.* 2007). We plan to develop Bayesian belief networks for predicting the risk of parkinsonia invasion at a landscape scale (10,000 ha) for the Desert Channels region of Queensland. Expert knowledge, supported by GIS data, will be used to determine the probabilistic influence of environmental, hydrological and land use variables on the risk of invasion. The predictive ability of the Bayesian model will then be validated for the Barkly Tablelands region of the Northern Territory and the Fitzroy River (West Kimberley). All three regions are primarily pastoral (cattle) and have serious problems with parkinsonia invasion, but they differ in a number of potentially important respects, including climate, soils, hydrology, topology, prevalence of fire and the size and management systems of pastoral properties.

Considerable ecological data are already available for parkinsonia, largely from long-term research sites placed in representative climatic regions and habitats across Australia (R.D. van Klinken unpublished data), and large-scale management trials conducted in northern Queensland (J. McKenzie and S. Campbell unpublished data). There is also considerable expert opinion available within each region, partly as a result of large financial investments in on-ground management over recent years.

Ecological research has already shown that parkinsonia can grow vigorously and produce copious seeds across Australia. However, thickets of sufficient size and density to cause significant economic and environmental impacts are often restricted to very specific parts of the landscape, and can be transitory (van Klinken 2006). It is anticipated that our landscape model will help identify those parts of the landscape within each region that are most at risk of invasion, and where invasion will have the greatest economic and environmental consequences. This in turn will help set national and regional objectives for management efforts, including on-ground control, biological control and implementation of strategies to limit spread.

Keywords Landscape modelling, Bayesian belief networks, plant invasions, *Parkinsonia aculeata*, predicting impacts.

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