Climate change – managing the waking sleepers

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Summary Since European settlement, around 2700 exotic plants have naturalised in Australia. Around 16% of these are currently serious problems for agriculture and others are likely to emerge as major weeds. In 2003, a Bureau of Rural Sciences (BRS) study listed 144 potential sleeper weeds with significant potential agricultural impact and investigated 17 of these in detail (Cunningham *et al.* 2003). The BRS's Climatch software and the CSIRO Mk3.5 climate change dataset was used to predict the future distribution of some of the sleeper weeds identified in the BRS study (2003). The results show that large areas of Australia remain suitable for a temperate weed although it is likely it will be restricted to more southerly regions and that tropical weeds may experience a range expansion with changed climate conditions. Consequently, sleeper weeds will be a threat for decades if they are allowed to remain naturalised in the Australian landscape. Monitoring activities that show the greatest capacity to include and produce information on changing conditions will have to be used to manage sleeper weeds because they provide real-time information to help develop adaptable management plans. Community participation, supported by best practice monitoring and management methods, remains a lynchpin of successful strategies. This applies not only to weeds already identified as 'sleepers', but for other pest plants that will take advantage of future climate or land-use changes.

Keywords Sleeper weeds, climate change, adaptive management.

BACKGROUND

Weeds are a significant cost to agriculture and cause significant losses to Australian biodiversity. Strategic weed management includes the eradication of emerging weeds before they become major problems. However, to minimise management costs we need to be able to identify which naturalised species will become problems as climate and land use change. It will also be important to determine the management strategy best suited to these pest plants.

Sleeper weeds are defined as weeds that have naturalised in a region for some time but not yet begun to spread rapidly. In 2003, the Bureau of Rural Sciences (BRS) identified 117 possible sleeper weeds. After consultation with the jurisdictions, this list was refined to 17 species that could have nationally significant impacts on agriculture if allowed to spread.

A later BRS study (Cunningham *et al.* 2006) identified Uruguayan rice grass (*Piptochaetium montevidense* (Spreng.) Parodi) as a sleeper weed that was economically feasible to eradicate. The sub-alpine and alpine sleeper weed, orange hawkweed (*Hieracium aurantiacum* L.), was identified where eradication was not feasible at the time but recommended that it should be retained on appropriate weed lists. In 2009, the current status of these two weeds was reviewed within the context of the original recommended actions and future changing climate (Baker 2009). Uruguayan rice grass has been eradicated but orange hawkweed continues to expand and although its range will contract under climate change it may be able to establish at higher altitudes and remains a threat under existing climate change scenarios (Figures 1a and 1b). The author emphasised that the eradication of some naturalised plants before they become a problem (such as sleeper weeds) is more cost effective and efficient than ongoing control or containment following widespread establishment.

It is generally accepted that under climate change there will be a general shift to higher altitudes and towards the poles for most species, with the shift greatest for wet tropical species (Scott *et al.* 2008, Baker 2009). The orange hawkweed example cited above indicates that alpine and sub-alpine weeds follow this trend. A climate match for Badhara bush (*Gmelina elliptica* Sm.), which is native to Mauritius, tropical Asia and Micronesia, was also examined using the CSIRO Mk3.5 climate change dataset (Climatch 2009). This weed was selected to demonstrate the southerly shift expected to occur for tropical weeds established in Australia. The results support the premise that there will be a greater shift for wet tropical species if the climate changes predicted by the CSIRO Mk3.5 climate change model occur, with tropical weeds potentially establishing over a much greater land mass than they currently occupy (Figures 2a and 2b).

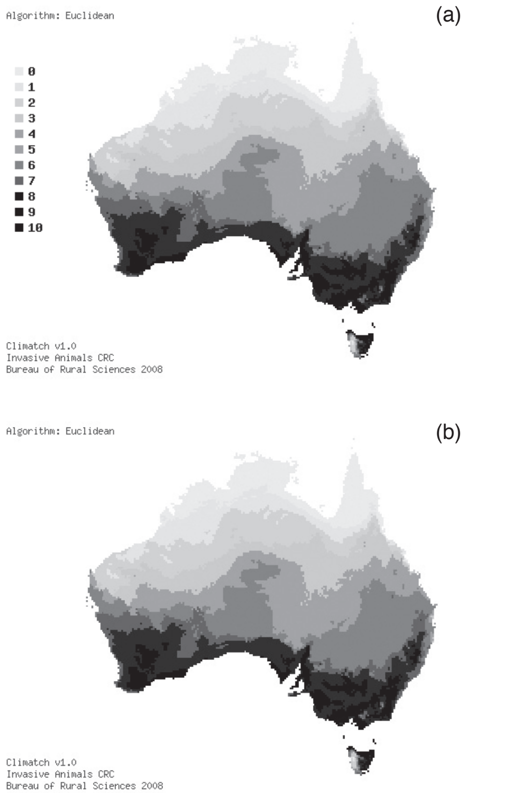

Figure 1. Climate match for *Hieracium aurantiacum* using (a) current Australian climate data and (b) the CSIRO Mk3.5 2020 dataset (Chambers *et al.* 2002). Dark colours indicate better climate match for *H. aurantiacum* (Climatch: http://adl.brs.gov.au:8080/Climatch/).

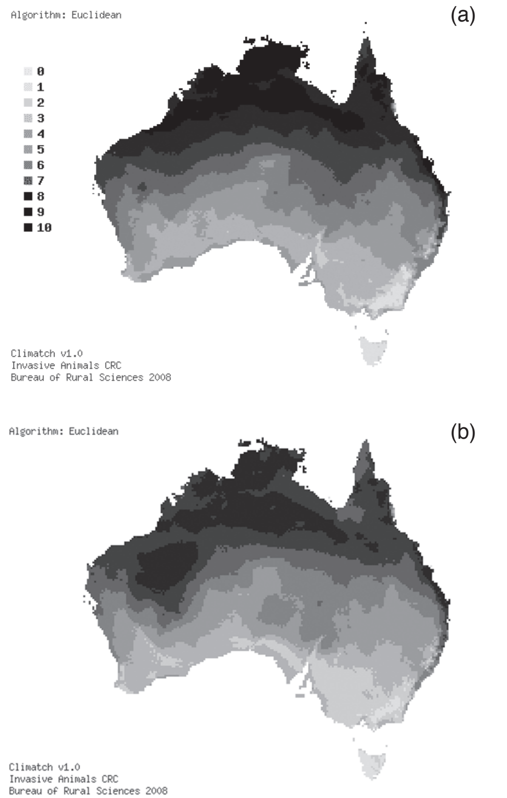

Figure 2. Climate match for *Gmelina elliptica* using (a) current Australian climate data and (b) the CSIRO Mk3.5 2020 dataset (Chambers *et al*. 2002). Darker colours indicate better climate match for *G. elliptica*. (Climatch: http://adl.brs.gov.au:8080/Climatch/).

DISCUSSION

The purpose of this work was to review some proactive steps that could assist governments and land mangers to manage sleeper weeds that will be advantaged by climate and land use change.

Habitat suitability for plants identified as potential weeds can be modelled at a landscape scale under current climate and using various climate change models when the current distribution is known (e.g. Baker 2009, Scott *et al.* 2008). Similarly, predictions on dispersal and establishment are possible when information on reproduction, dispersal method and seed bank longevity is available.

Such modelling provides opportunities to explore the interactions between invasive species and climate change, identify areas where climate change policies could negatively affect invasive species management and identify areas where policies could benefit from synergies between climate change and invasive species management.

Existing weed management skills, together with our understanding about the predicted displacement of weed species under climate change, will assist the development of management strategies for each species. To do this we must: use proactive benefit:cost analyses to assess the relative merits of time-limited eradication attempts versus containment and/or ongoing management versus the ‘do nothing’ option; be alert to the appearance of new plants where they have not been detected before; and act early where infestations are confirmed. This can be supported by developing collaborative management and research programs and encouraging effective mechanisms for organisation and communication.

Monitoring activities that show the greatest capacity to include information on changing conditions, and future revisions to management plans are likely to be the easiest avenue to ensure responsive management activities. Community participation, supported by best practice monitoring and management methods, remains a key to successful strategies.

Community participation in pest monitoring is already occurring, but motivators for participation can vary considerably. For example, the main motivators for volunteering in pest monitoring appear to be passion for protecting Australia's unique biodiversity and ecological understanding (de Chazal *et al.* 2009). These authors also found that coordination and two-way information flow between government representatives and volunteers is an important part of maintaining engagement and suggest that to facilitate this, local community groups will need coordinating networks in which both volunteers and government officials participate.

One potential area for enhancing monitoring systems with the flexibility to include and produce information on changing conditions is the development of web-based weed mapping. These systems are increasing in sophistication and, combined with community capacity to use the technology, could make significant contributions to the production of real-time maps to support current knowledge of weed distributions and densities.

Such systems could be linked to programs like Weed Warriors (2010), which encourages local schools, community groups and land management agencies to 'plan, act and evaluate' through mapping weed infestations. Combining such activities with web-based weed mapping provides options for enhancing information flow, both to policy makers and to the community and could be used to develop responsive plans for managing new weed detections.

This applies not only to weeds already identified as 'sleepers', but for those that will take advantage of future climate or land-use changes.

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