



Sleeper and alert weeds: Where will they awaken as climate changes?

Dr John K. Scott, Kathryn Batchelor, Noboru Ota and Paul Yeoh

It is now scientifically accepted that Australia's climate is changing and that these changes will continue over coming decades. Some weeds previously identified as either agricultural 'sleeper weeds' or weeds on 'environmental alert'* are likely to spread as a result of these changes in climate.

CSIRO scientist Dr John K. Scott and his colleagues have used computer modelling of both plant characteristics and global climate change to predict how 41 of the nationally recognised 'environmental alert' species and agricultural 'sleeper weeds' are likely to behave as the effects of human-induced climate change become more apparent.

Sleeper and alert species

The 'sleeper' weeds are those introduced plants that are at present limited in their distribution, but have the potential to become significant weeds impacting on Australian agriculture. A second group of introduced species, at present in their early stages of establishment, but with the potential to become a significant threat to biodiversity, are identified as 'environmental alert' species.

Each of these groups of weeds might scarcely be noticed in the landscape at present. Yet as climate changes, both have the potential to become major problems in areas where they currently do not occur.

* See www.weeds.gov.au, national weed lists for more information about sleeper and alert species.



Predicting weed behaviour using computer models

Scott and his colleagues have used CLIMEX, a computer model that uses temperature and moisture parameters to develop a growth index for plants. Various stress factors were then applied to determine an Ecoclimatic Index, indicating the suitability for survival of the various species. Information from published literature was used to determine the current distribution, phenology (natural climate-related development characteristics) and physiology of each species and to determine the parameters for the models.

For some species growth chamber experiments were used to provide extra information on the plants' growth and development.

The models were then tested against known current distribution of the species, both overseas and in Australia.

The distribution of each species under various climate change scenarios was then predicted for both high and low emission scenarios for 2030 and 2070. The models used were Echam 3 and Hadley 2. The Echam 3 model includes higher rainfall, especially in northern and north-western Australia than Hadley 2: the latter also predicting hotter climates.

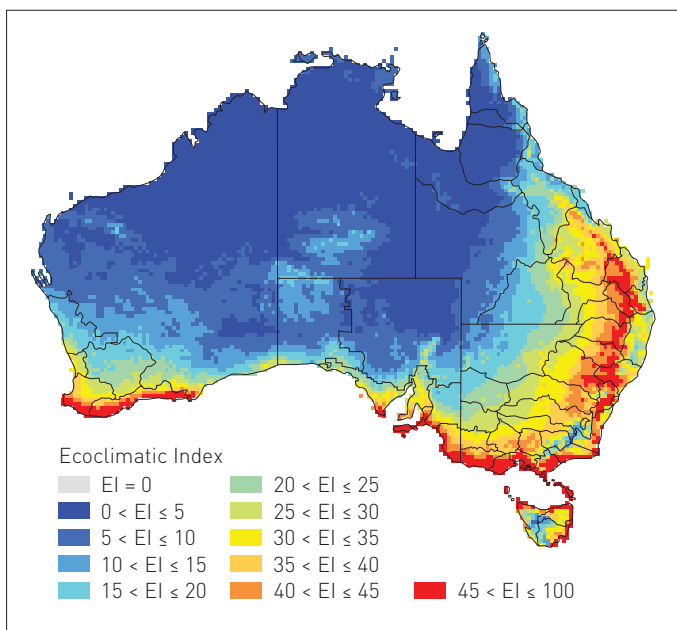


Figure 1. Average of the Ecoclimatic Indices (EIs) for 41 sleeper and alert species per quarter degree square, based on CLIMEX predictions using today's climate. Front cover and lower right: Karroo thorn. Photos D.L. Nickrent, Southern Illinois University.

Predicted shifts in weed distribution

Using either the Echam or Hadley climate model and combining it with the CLIMEX predictions of plant growth, show that the risk of environmental alert and agricultural sleeper weeds remains high in southern Australia, especially in the south-east and the south-west. Both climate models also predicted that there will be a reduced risk of establishment of these problem plants in northern Australia.

Under climate change, Scott and his colleagues predict there will be a general shift southwards for most weed species, with the shift being greatest for wet tropics species (which have the potential to move over 1000 km southward). Changes predicted for southern coastal species are much smaller, simply because they will run out of land mass on which to establish under changed climatic conditions.

Left: Yellow soldier flower (*Lachenalia reflexa*). Right: A mature White weeping broom in flower (*Retama raetam*). Photos CSIRO.



Sleeper and alert species of major concern under changed climatic conditions

Some species are predicted to show little change as a result of the impacts of climate change, while the area affected by others (including some that are currently widely distributed) will decrease.

Of greatest concern are species that will significantly increase their spread under changed climatic conditions. Scott and his colleagues identify *Acacia karroo* (karroo thorn), *Tipuana tipu* (rosewood or Tipuana tree) and *Bassia scoparia* (kochia) among the most important in terms of the increased area they are likely to affect. Some of the species are likely to become major problems under the current climate. These include *Acacia karroo*, *Retama raetam* (white weeping broom) and *Equisetum arvense* (common horsetail).

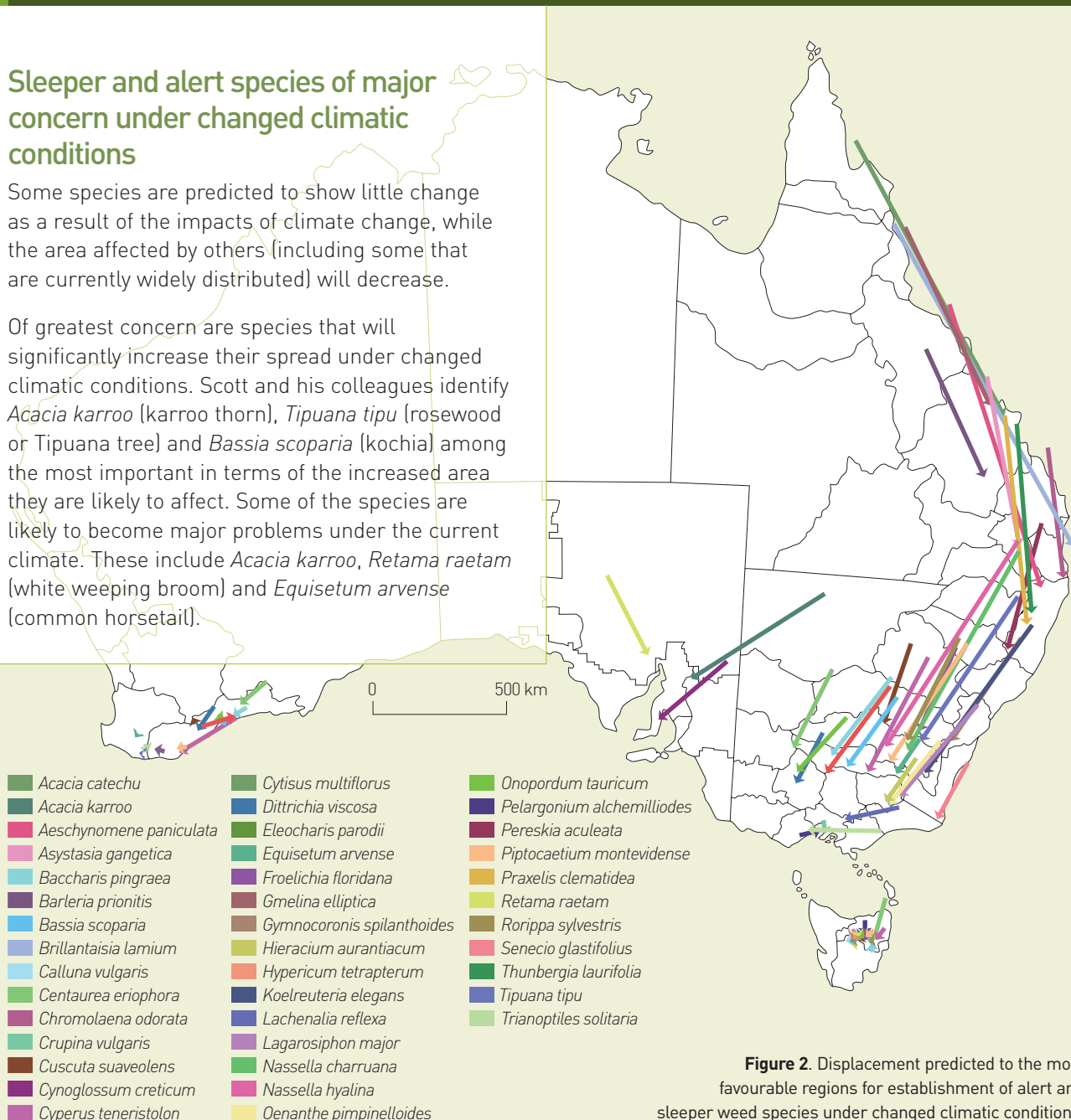


Figure 2. Displacement predicted to the most favourable regions for establishment of alert and sleeper weed species under changed climatic conditions.

Implications for NRM regions

Scott and his colleagues have analysed the threat to each of the natural resource management (NRM) regions from alert and sleeper species, under the current climatic conditions and under changed conditions predicted from the international climate models.

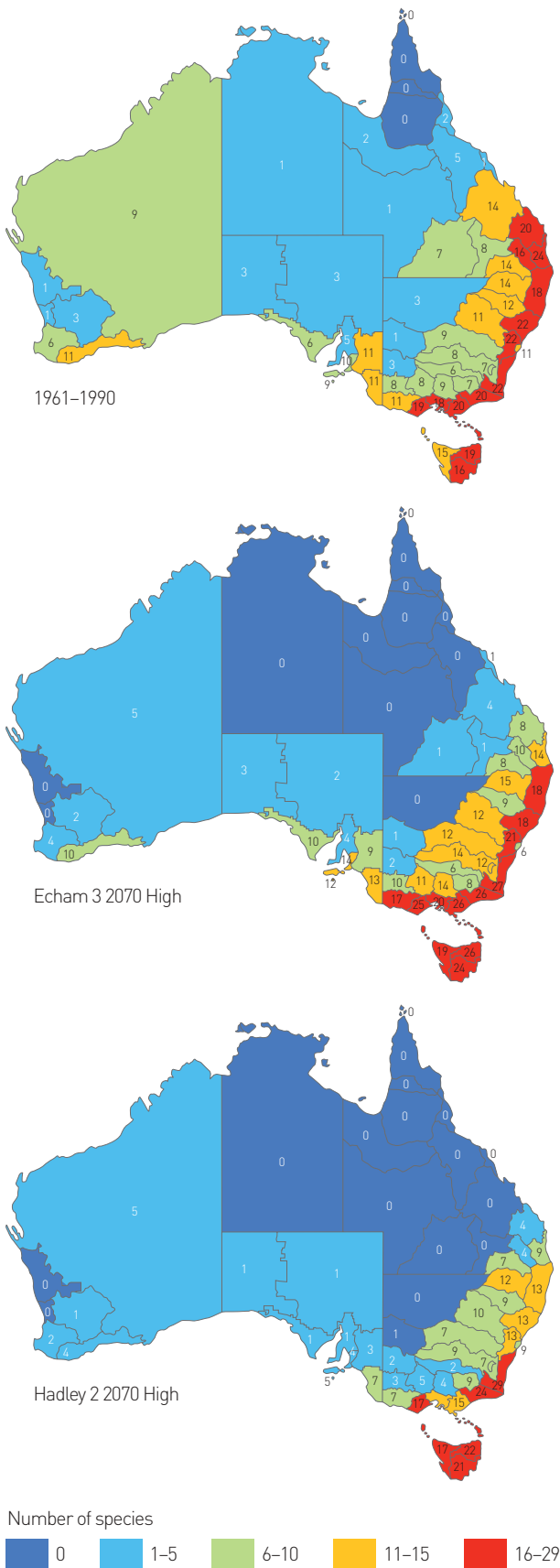
As is clear from Figure 3 (next page), NRM regions in the south-east of the continent are at greatest risk of increased numbers of sleeper and alert weeds establishing in their areas. Regions in the wheat-sheep belt of northern New South Wales to the Victoria-South Australia border are most vulnerable.

Recommendations for action

The climate modelling used in this study preceded the fourth report from the International Panel on Climate Change in 2008, and it is likely that the changes predicted are an under-estimate. This increases the importance of the recommendations that follow.

1. In order to raise awareness of the likely impacts of climate change on the spread of undesirable plants, the distribution maps developed in this project and identification photos for the key species should be made readily available on CSIRO and government websites.

Figure 3. NRM regions showing the number of sleeper and alert species with a high probability of establishment under today's climate conditions and two climate change scenarios in 2070.



- Each of the NRM regions predicted to experience increased impacts of sleeper or alert species should take appropriate action to prevent their spread within and into each region.
- Given that weeds frequently establish and spread from 'vacant spaces' in the landscape, and existing weeds are likely to move south as climate changes, a **new** set of sleeper and alert species needs to be identified for northern Australia.
- Management strategies that take account of the likely impacts of climate change should be developed for each sleeper and alert species predicted to present problems in new areas. This might include both new surveillance strategies and quarantine barriers across the north-south migration route.
- The information provided from this project should be updated using the climate predictions provided by the Independent Panel on Climate Change in its fourth report presented in 2008.

This project was conducted by Dr John K. Scott, Kathryn Batchelor, Noboru Ota and Paul Yeoh, CSIRO Entomology.

Full report: *Modelling climate change impacts on sleeper and alert weeds*. A report prepared for Land & Water Australia. CSIRO Entomology, Wembley WA. Accessible at <http://csiro.au/resources/Sleeper-Alert-Weeds.html>

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Printed on Revive Silk which is made in Australia from elemental chlorine free pulp with 65% derived from sustainable plantation forests and 35% recovered fibre. It is PEFC Certified and Australian Paper is an ISO 14001 certified mill which utilises renewable energy sources.

Published by: Land & Water Australia
Web: www.lwa.gov.au
ISBN print: 978-1-921544-51-4
ISBN electronic: 978-1-921544-52-1
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This publication can be ordered free of charge from CanPrint Communications, freecall: 1800 776 616, or e-mail: lwa@canprint.com.au and quote product code **PN22353**

Photos: Front page, D.L. Nickrent
Design: Angel Ink
Print: Paragon Printers, June 2009