Science for Saving Species

Research findings factsheet

Project 2.4: National Action Plan for Australia's most imperilled plants

Threatened Species Recovery Hub

National Environmental Science Programme

Conserving brigalow flora

In brief

Brigalow (*Acacia harpophylla)* forest once occupied about 14 million hectares of the fertile plains between the coast and the semi-arid interior of Queensland and New South Wales. Since the 1950s, however, it has been extensively cleared and converted to pasture and crops. Today only about 8% of the original forest is still standing, and large areas of the remainder are heavily degraded with infestations of exotic grasses.

This raises an important question: What has been lost with the brigalow forest? It is very likely that formerly common plant species have become endangered over the relatively brief period of time during which the forest was cleared without anyone having realised it. How can we identify the plant species that are likely to have been imperilled with the decimation of the brigalow forest? In seeking to answer these questions, we provide a method for using data from habitat mapping and herbarium records to identify plant species most threatened by the clearing and conversion of brigalow forest. This involves an algorithm that identifies potentially threatened plant species through associating their occurrence in brigalow forest habitat with any overlap in cleared regions of brigalow. The method has broader application, moreover, and may be used for other vegetation communities whenever records exist of species and habitat loss.

A unique country with much to lose

Brigalow forest is dominated by *Acacia harpophylla*, and forms a relatively dense canopy that prohibits dense grass growth when the forest is undisturbed, despite the forests occurring on fertile soils. These forests historically were found within a mosaic of other vegetation types, such as poplar box woodland, dry rainforest, eucalypt forest and open grasslands.

The original area of brigalow forest formed what is known as the Brigalow Belt biogeographic region, which combines two areas, a northern section which falls entirely in Queensland, from around Townsville to Rockhampton and inland past Emerald, and a southern section of almost twice the size that stretches from Rockhampton south into New South Wales and west to Charleville and Moree.

The Brigalow Belt was settled by Europeans between 1840 and 1860 and cleared for sheep and cattle. For nearly a century, the savanna woodlands around the brigalow forest provided the pasture, while the dense brigalow forest remained mostly uncleared. However, with the widespread availability of bulldozers from the 1950, clearing of brigalow forest began in earnest, subsidised by a government-funded development program. By the time legislative controls on land clearing were implemented around 2005, only about 9% of the brigalow forest remained, much of which is on public land such as road corridors, state forests and conservation reserves.

Now that the forest has been cleared, the fertile soils are supporting exotic grasses, especially buffel grass (*Cenchrus ciliaris*), and also Rhodes grass (*Chloris gayana*) and guinea grass or green panic (*Megathyrsus maximus*) in areas of higher rainfall. "These exotic grasses have resulted in a dramatic diminishment of species richness, with perennial herbs and grasses particularly vulnerable to decline. The biomass of the exotic grasses also contributes to fire risk.

Brigalow forest. Photo: Rod Fensham

The University Of Queensland AUSTRALIA

BRI QUEENSLAND HERBARIUM

What we did

Our first step was to identify the plant species that grow where the brigalow tree provides habitat. Australia's Virtual Herbarium has about 6.5 million records of plant collections available online, and most include the location where the specimen was collected. Many also provide habitat descriptions. These data date back to the first days of European exploration and settlement in the 18th century. We used the search terms 'brigalow' and 'harpophylla' in the habitat field to identify over 1000 plant species that occur alongside brigalow.

We reasoned that the stronger a plant's association with both brigalow and the Brigalow Belt biogeographic region was, the more likely it was to be in trouble. We developed a Threat Exposure Index based on:

Association with brigalow – determined by the number of records associated with brigalow relative to the total number of records for that species.

Association with Brigalow Belt biogeographic region – determined by mapping the area for which there were records for each species, and determining what proportion of this area fell within the biogeographic region.

Each of these calculations produces a fraction. Multiplying these fractions produces a percentage which represents the Threat Exposure Index. For example, a species for which half of the records were associated with brigalow, and half of the area of records falls within the biogeographic region would have a Threat Exposure Index of 25 (50% x 50% = 25%).

Our findings

The flora of the brigalow forest consists of 1059 native plant species. Of these, 56 have a Threat Exposure Index score greater than 10, and these probably include the species most threatened by the clearing of brigalow forest. Twenty of our identified 56 also occur in habitats that have not been extensively cleared, which may mean that they are more likely to persist into the future. Of the remaining 36, 11 species are almost exclusively associated with brigalow forest. Importantly, some of the plant species identified by our process had never previously been recognised as likely to be threatened. The analysis brought the parlous prospects of these species among the diminishing brigalow forest into sharp focus.

Among the candidate species is a tree in the genus *Denhamia* that is only known from a single specimen. Another is a white-flowered species in the genus *Aneilema*. It's allied to the weed known as wandering jew, though the white-flowered *Aneilema* stands upright and has only rarely been sighted. There is also a mistletoe, *Viscum bancroftii*, with the appearance of twigs parasitising another mistletoe, *Amyema quandang*, that in turn parasitises the brigalow tree itself.

Solanum is a prominent genus in our list of imperilled species of brigalow forest, leading to four of these bush tomato species being targeted for detailed on-ground surveys to accurately determine their fate in the face of the decimation of the brigalow forest habitat.

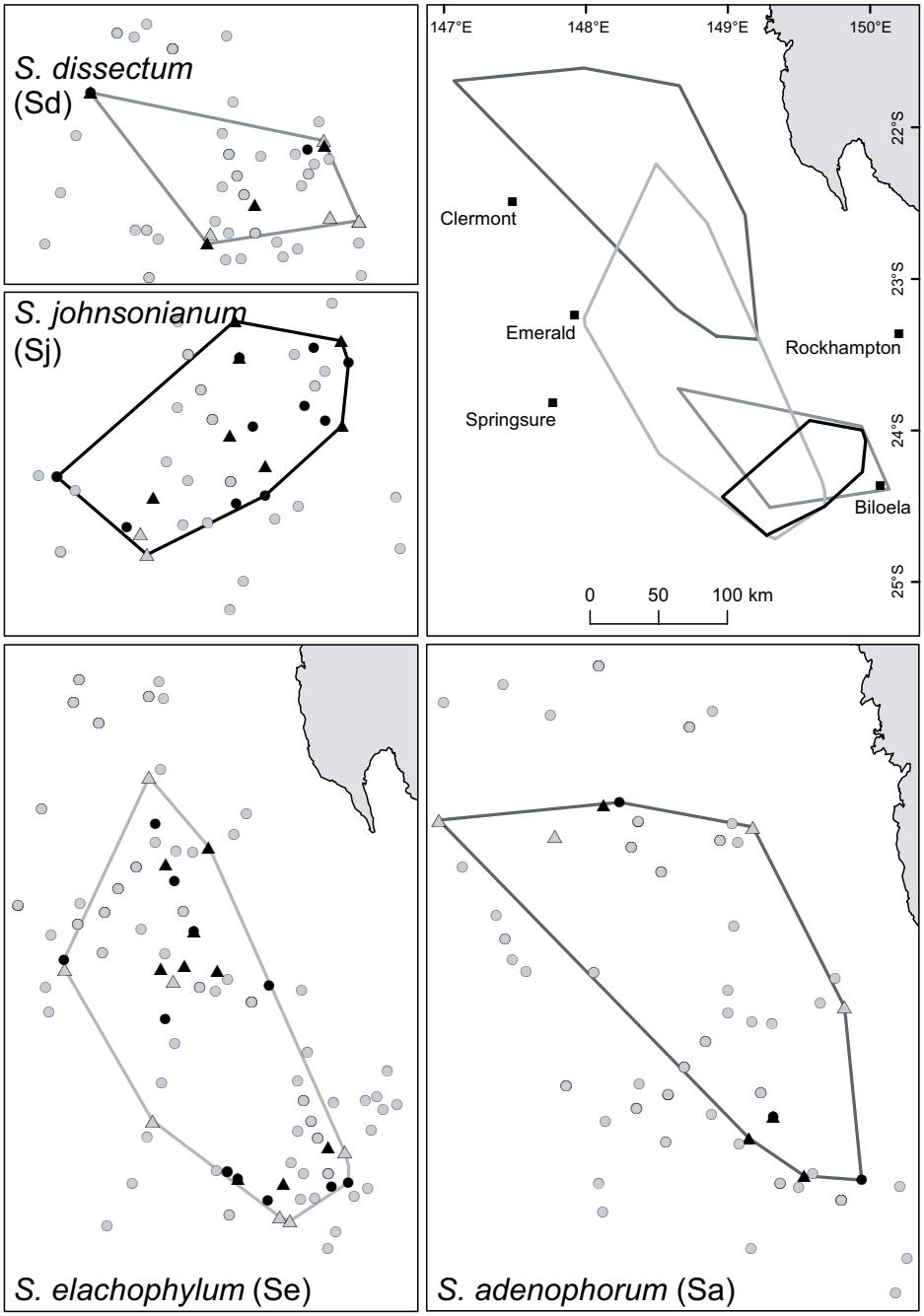
RIGHT: Four species of Solanum that were surveyed and assessed using IUCN Red Listing criteria; ***S. adenophorum*** *(top),* ***S. dissectum*** *(second from top),* ***S. elachophyllum*** *(third from top),* ***S. johnsonianum*** *(bottom).* ***S. adenophorum*** *was assessed as Vulnerable,* ***S. dissectum*** *Critically Endangered,* ***S. elachophyllum*** *Vulnerable and* ***S. johnsonianum*** *Critically Endangered.*

Bush tomatoes, grasses and fire

To estimate the decline of these bush tomato species, we started with herbarium records to guide our on-ground surveys and then conducted simple searches recording the area and the number of plants as we walked. We conducted these surveys in cleared habitats as well as remnant brigalow forest to avoid the untested assumption that the clearing of brigalow forest for pasture necessarily spelt the demise of the bush tomato populations.

Through hundreds of these 'walk-in-the-bush' surveys we could accurately determine the current geographic range of each species, as well as determine the faithfulness of the species to the brigalow habitat. With the help of regional ecosystem maps, completed as part of a major statewide project, defining the pre- and post-clearing distribution of the habitats, and the historical records of the herbarium records, we could also estimate the demise of the species.

As we have seen, the fragmented remnants of the brigalow forest are vulnerable to invasion by exotic pasture grasses, including buffel grass and green panic. These grasses provide fuel for fires which further degrade the fire-sensitive brigalow. This means that in addition to estimating past decline by assessing the extent of cleared forest, we were able to estimate future decline by estimating the extent of remnant forest that has been degraded by grass invasion and fire.



ABOVE: The geographic range of the four Solanum species in relation to the north-east coast of Australia (top right) and records for each species. Triangles represent historical herbarium records (grey, population not relocated during current surveys; black, population relocated during current surveys); circles represent survey searches for the current study (grey, population not located; black, population located). Some absence records from the current study have been excluded for clarity.

Brigalow trees and forest. Photo: Don Butler

Implications

Red Listing is a procedure ratified by the International Union of the Conservation of Nature to define the threat status of the world's species. To apply the criteria, it is important to identify population size and factors related to the geographic range, and to estimate the extent of past decline and likely magnitude of future decline. We have demonstrated a way to identify species threatened by rapid habitat loss, especially if the habitat is targeted for clearing and the species have a small geographical range.

The method we developed for the bush tomatoes provides a blueprint for how to estimate these factors given the uncertainties of looking into the past and the future. Past and future decline was more than 90% in all cases, and the bush tomatoes *Solanum dissectum* and *Solanum johnsonianum* were never found outside remnant brigalow forest. They are eligible as Critically Endangered using Red Listing criteria.

Next steps

While there are some remnants in conservation reserves protected by legislation, remnant brigalow continues to be cleared. Prospects for recovery of brigalow forest appear slender. What is needed now is to continue to undertake detailed assessment of plant species from the brigalow forest, and then work with the stakeholders and landholders who preside over the last vestiges of these habitats.

Management of threats within remnants is also critical, particularly the control of exotic grasses to prohibit damaging fires. Incentives to landholders to allow brigalow regrowth can also provide a start for the recovery of the former forest.

Brigalow itself can regrow from root suckers (i.e., from roots left after the initial clearing), although subsequent re-clearing of the regrowth can remove the wattle altogether.

While our study has indicated how we should focus our effort towards plants growing in brigalow forests, our approach has a much broader application. We have demonstrated how existing data, in this case herbarium collection records and vegetation mapping, and simple survey data derived from walks in the bush can be used to identify species threatened by rapid habitat loss, something that is being witnessed in many places across Australia and around the world.

Further Information

Rod Fensham
rod.fensham@qld.gov.au

Further reading

Fensham, R. J., Laffineur, B., & Silcock, J. L. (2018). In the wake of bulldozers: Identifying threatened species in a habitat decimated by rapid clearance. *Biological Conservation* 219, 28–34.

Threatened Species Recovery Hub
National Environmental Science Programme

This project is supported through funding from the Australian Government's National Environmental Science Program.