Climate Resilient Restoration of Box Gum Woodlands

December 2014

Box Gum Woodlands were once widespread across south-eastern Australia. Today they occupy less than 10% of their original extent and are listed as an endangered plant community. Local communities are interested in restoring these important ecological areas.

This research looked at novel ways to improve and restore the resilience of Box Gum Woodlands to a drying climate. We examined ways to enhance soil biophysical condition, especially its capacity to capture and store limited rainfall.

Soil condition in different woodland degradation states

We examined physical and biological properties of soil in Box Gum Woodlands across central NSW, in sites that reflected a range of different degradation conditions, and compared these with high quality reference sites.

A high quality reference site

Degraded ground-layer states included those known from earlier work to be depleted in soil carbon and nitrogen, to states dominated by exotic annuals and known to be enriched in nutrients.

A site in a depleted state

The most striking trends were for the depleted ground-layer states dominated by grasses such as Spear Grass (*Austrostipa scabra*), short Wallaby grasses (*Rytidosperma* spp.) and Wire grasses (*Aristida* spp). These had lower ground cover, organic carbon, clay content, micro-invertebrate abundance and microbial activity, and had slower water infiltration and greater topsoil compaction (indicating poor aeration) than sites in reference condition. Overall this led to a >25% reduction in the water holding capacity of the soil.

Enriched sites had higher levels of carbon than sites in reference condition, but compaction, clay content, water holding capacity, and biological activity were similar to sites in reference condition.

Interventions to increase soil condition and water holding capacity

To improve the soil condition (soil carbon, soil biological activity and soil moisture holding capacity) in depleted sites we trialled five treatments at three sites, these were:

- aerating soil using a drum rolling spike aerator (to reduce compaction)
- adding biochar using the aerator (to introduce carbon and microhabitat)
- adding mulch (to protect soil surfaces and introduce carbon)
- sowing native Red Grass *Bothriochloa macra* (to increase carbon)
- adding phosphorus (addition of 'super' - phosphate is a common practice on these soils)

Drum rolling spike aerator

Mulch and Biochar

After two years of treatment we observed lower compaction, softer soil surfaces (at one site), higher infiltration, occasionally higher soil moisture, and higher soil carbon and higher pH.

Native forb cover and superior establishment of the large-seeded forb, Bulbine Lily (*Bulbine bulbosa*) after hand sowing were also observed.

The addition of mulch also improved the rate and diversity of metabolic activity by the microbial community and increased the abundance of collembola (springtails). Mulch also inhibited germination of small seeded forbs.

Future monitoring will determine whether the benefits reflect one-off increments or transitions that will facilitate ongoing improvement towards reference condition (Figure 1).

Mulch from chipped eucalypts

While these effects are a substantial improvement over the degraded starting point, comparison with reference sites suggests the effect achieved so far are, on average, around 25% of that required for restoration to reference conditions. Further monitoring may determine if the benefits continue to accrue as biochar and mulch become better incorporated in the soil.

Phosphorus

Phosphorus addition had predominantly negative effects from a woodland restoration perspective. Total biomass marginally increased but this was mostly due to increases in exotic annuals, resulting in lower native grass cover. Measures of microbiological rates were also lower, although abundance of mites was higher.

Native Red Grass and aeration

There are few significant effects for Red Grass plots or for aeration at this stage. As Red Grass plants were still small and not fully established, effects may still become evident over longer time frames

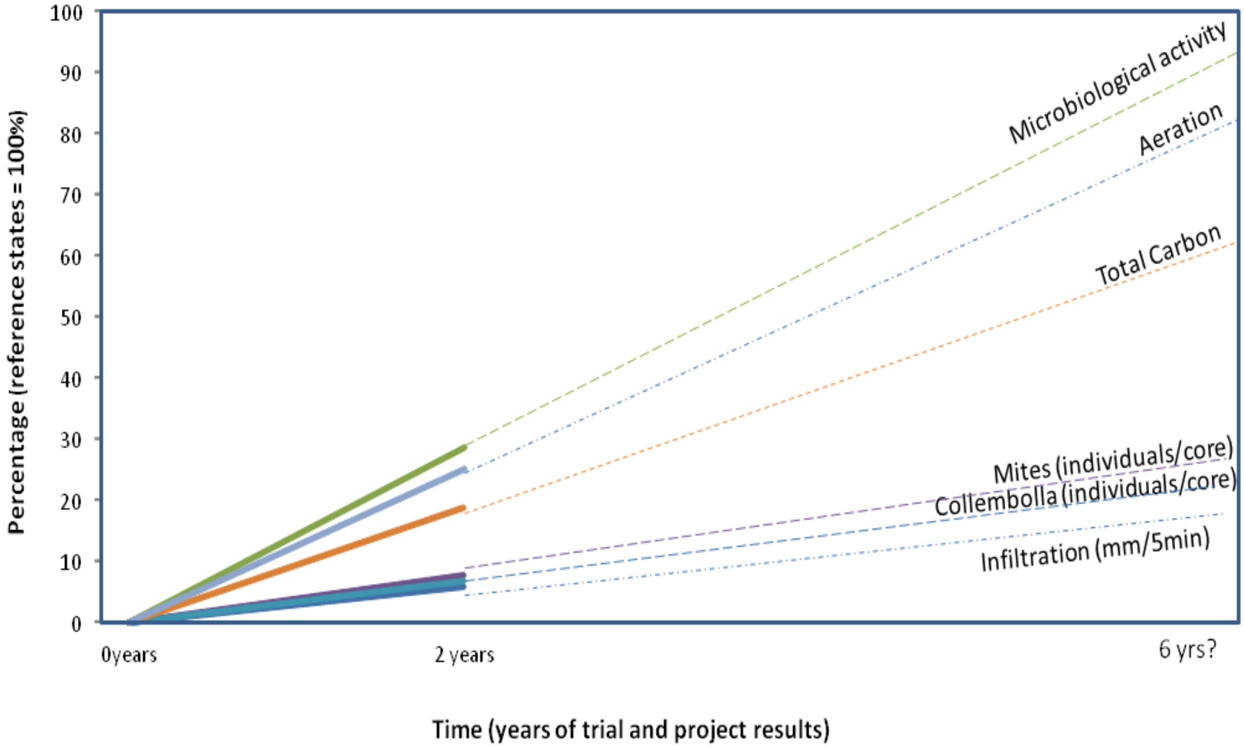

Figure 1. On average the soil improvements in 2 years took the sites 25% closer to the reference conditions, but responsiveness varied from 28% to 6%. The solid lines show the results measured at 2 years with the dotted lines showing the potential projected outcomes at 6 years if improvements continue at the initial rate.

Partners

This project is part of the Communities in Landscapes project led by Landcare NSW and funded under the Australian Government program Caring for Our Country. Partners include: CSIRO; Landcare NSW; Grassy Box Gum Woodlands Conservation Management Network; NSW Office of Environment and Heritage; Industry & Investment; Capital Region Greening Australia's Florabank; University of Sydney; STIPA Native Grasses Association Inc; NSW Department of Primary Industries

References

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CONTACT US

t 1300 363 400
+61 3 9545 2176
e enquiries@csiro.au
w www.csiro.au

FOR FURTHER INFORMATION

Ecosystems & Biodiversity Knowledge Systems
Suzanne Prober
t +61 8 9333 6789
e suzanne.prober@csiro.au
w www.csiro.au/landnandwater