Improving ecological function in our remnants

David Duncan, Claire Moxham & Josh Dorrough (Arthur Rylah Institute for Environmental Research, DSE)

Summary

In this article we summarise results of a recent study of ecological function of 60 patches of remnant native vegetation ("remnants") in the Wimmera and Murray Mallee bioregions, the major dryland areas in Victoria's northwest. We assessed soil and vegetation characteristics assumed to contribute towards the long term survival of remnants in the agricultural landscape. The key practical messages reinforced by this study are:

- Uncontrolled livestock access is the greatest local threat to the ecological function of remnants, through prevention of regeneration and nutrient enrichment of soils.
- In the short term, remnants require longer periods without stock access to allow seedlings to germinate beyond the reach of stock.
- All remnants can add value to production as they contribute to soil stabilisation, water infiltration and nutrient cycling at higher levels than the adjacent production land.
- Most remnants show a basic level of ecological function; however small remnants which are typically highly valued by farmers for stock shelter are typically heavily degraded.
- In larger remnants, western edges appear more prone to degradation due to greater exposure to prevailing winds, which prevent soil stabilisation, and may transport weed seed, and nutrients into vegetation.
- Targeting tree planting / revegetation on the exposed windward edges may provide a buffer to the remnant from the wind.
- Conversely, efforts to expand native vegetation cover may achieve greater success on the more protected leeward side of remnants rates due to protection offered by the existing remnant.

Background

In this article, we summarise the approach and key findings from the project's first year. We undertook a survey of the current ecological status of remnant vegetation, and also examined historical photographs and interviewed farmers to establish links between the management of remnants and their condition. In the project's second year, this knowledge is being further developed to guide revegetation and restoration programs by prioritising investments for minimum cost and multiple benefits and establishing reasonable expectations about the pace of ecological recovery.

At present, there is only around 5% remnant native vegetation cover remaining in the dryland production landscapes (excluding Mallee Parks, Fig. 1). The majority of this vegetation occurs as patches of small size, mostly on private land and valued primarily for stock shelter. Not surprisingly, landholders and Catchment Management Authorities have concerns over the long term survival of these remnants and are seeking ways to increase native vegetation cover in the most efficient way possible, without threatening the viability of farm businesses.

The project 'Understanding and improving ecosystem function in the Murray Mallee and Wimmera bioregions' was developed to investigate the current status of remnant vegetation patches across the dryland cropping landscape, and determine whether they are likely to improve or decline into the future. This project will enable more strategic investment in restoration and revegetation programs and contribute to practical plans for farmers for improving the survival of their remnant vegetation in the agricultural landscape.

The phrase "ecosystem function" includes most of the values that people want from nature, including livelihood, soils, clean water, biodiversity, and healthy communities. These benefits all contribute to people's desire to live and work in a landscape. We want these services to be provided not only now but into the future, and in the face of change in climate and socio-economic trends. Consequently, ecosystem function is a quality that is hard to define and measure. From a practical perspective, we know that healthy native vegetation contributes an enormous amount to sustaining production, clean water and stable soils, and to maintaining native species in the landscape.

For these reasons we investigated the status of native vegetation to give us information about the ecological function of the land, and its ability to continue into the future under current conditions. For remnants to support a basic level of ecological function, they require fallen timber, soil crusts and perennial vegetation cover to retain resources. We focused on soil nutrients and surface characteristics, vegetation composition, structure and cover, and on the presence or absence of saplings of dominant trees and woody shrubs (recruitment). Recruitment is important in nature; if the dominant species that provide habitat for other species of plants and animals are not replacing themselves, then the benefits will cease to flow when the current generation dies out.

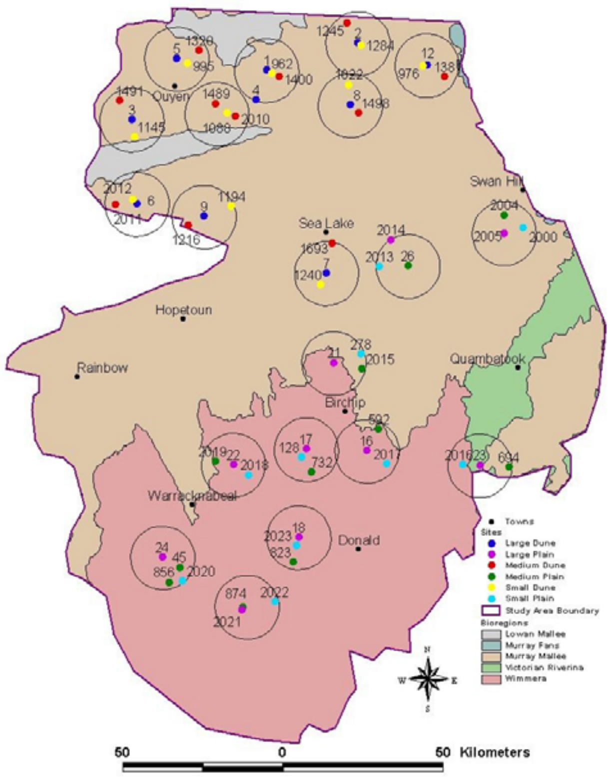

Figure 1: The project study area with surveyed remnants marked. The project focussed on the primary dryland production landscapes of the Murray Mallee and Wimmera regions, and excluded the major Mallee Parks.

Method

60 field surveys of soil and vegetation characteristics in remnants were undertaken during winter 2005. 20 small (<3 ha), medium (5-10 ha) and large (>20 ha) remnants across a mixture of private and public land (Fig. 1). At each remnant, vegetation cover and structure, grazing intensity, and a series of indicators of soil stability, water infiltration, and nutrient cycling capacity known as Landscape Function Analysis were recorded.

Soil samples were taken from within each remnant and from the adjacent crop or pasture to examine the influence of resource transfer between the remnant and the agricultural landscape and vice versa. The data from the field survey was complemented by interviews with 35 land managers on the history, values and management of the surveyed remnants.

Results

The results confirm that most measures of ecological function (native species cover and diversity, ground layer cover of litter and logs, mosses and lichens) are higher in larger remnants in comparison to small remnants. The smaller remnants (<3 ha) were typically heavily degraded with greater weed populations and high soil nutrient enrichment, primarily as a result of stock camping. Taking available phosphorous for example, soil samples from small remnants were enriched to a similar level to adjacent crop lands (40-45 mg/kg), and up to 4-5 times higher than the interior of large patches (ca 7 mg kg, Fig. 2).

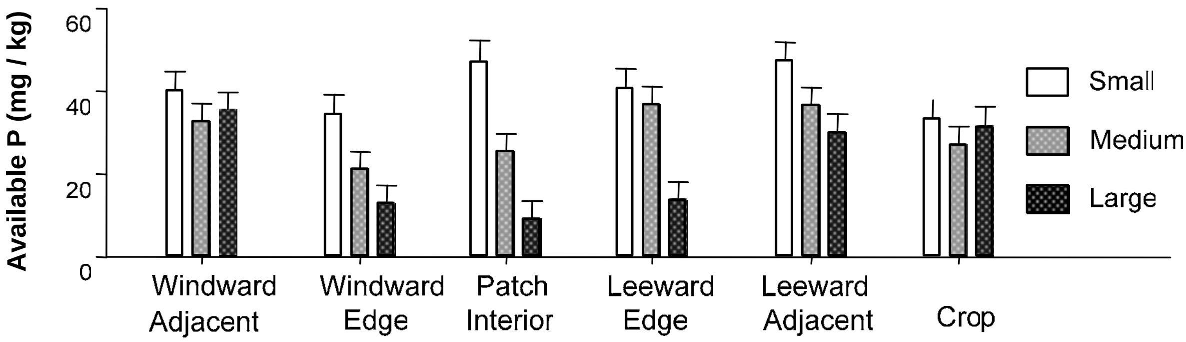

Figure 2. Average (± standard errors) available phosphorous (Colwell) by remnant size and sample location. “Adjacent” is 15 m outside remnant, “Edge” is 15 m inside fence, “Crop” is ca. 150 m east of remnant in crop/pasture.

Small remnants typically had high weed cover, very low native understorey and litter cover, and little fallen timber on the ground. Land managers reported that small and medium remnants were primarily retained for stock shelter and are still largely valued for this purpose. Given that most small remnants are still regularly used for stock shelter these results are not unexpected. Of interest is the potential of the smaller remnants to persist into the future. Very few small remnants had been without stock for more than a few years; the few that had been without sheep for 8-10 years had strongly increased native understorey cover. Further research this year will look at ecological changes in de-stocked remnants over the first 30 years of stock removal, including the incidence of native tree and shrub regeneration.

The ability to support the emergence of native seedlings and saplings of trees and shrubs is a key ecological function in itself. For successful regeneration there needs to be available seed from adult plants, and available moisture, and seedlings need to escape herbivores until they grow out of reach. Our survey of remnants found no regeneration of trees and shrubs at all in small remnants. In larger patches there was some recruitment of black box, native pine and buloke in the Wimmera, but no recruitment of Mallee eucalypts at all. Tree recruitment was observed where the remnant was primarily ungrazed, and can commonly be seen on roadsides. We, like many farmers, eagerly await the next big rains at which time we may judge what capacity for regeneration many of these remnants retain.

Discussion

This study has brought together an important data set regarding the current status and history of remnant native vegetation of the Murray Mallee and Wimmera bioregions. Although the status of the average remnant in the landscape is often poor according to a range of measures, we hold some optimism for the future.

Not all remnants will be managed for maximum ecological function. Our interviews confirmed that some will continue to be valued primarily for stock shelter and it may be of little concern if the remnant is not species-diverse. As a minimum, people are more likely to want to know that the dominant structural species in remnants, trees, tall shrubs, and perennial understorey will be able to regenerate given favourable management and rainfall.

Results indicate that most remnants in the Wimmera and Murray Mallee landscape currently have the capacity for basic ecological function whilst the current generation of trees survive. Even given the extended series of dry years, the failure of many dominant tree species to recruit in small and medium patches is of concern. Even though small remnants may remain degraded into the future, all remnants contribute to soil stabilisation, water infiltration and nutrient cycling at higher levels than the adjacent production land. Small patches (<5ha) cumulatively account for around one quarter of remaining vegetation in our landscape.

For remnants to have a basic level of ecological function, they require fallen timber, soil crusts and perennial vegetation cover to retain resources. Therefore when managing our landscape we need to take into account the following management strategies that improve the probability of regeneration and the sustainability of remnants:

1. Livestock access

Uncontrolled livestock access is the greatest local threat to regeneration of native species and ecological function of remnants. We expect that continuation of current grazing rotations would mean that the current standing crop of trees will die without replacement over the coming decades. In the short term, longer periods without stock access are necessary to allow seedlings to grow beyond the reach of browsing stock. Often times there may only be one small remnant of native vegetation available for shelter within a paddock; therefore the productivity value of remnant vegetation as shade and shelter to livestock may be important. This means both that it may be costly to keep stock out of shelter sites, but also that it will be costly to allow current shelter sites to continue to degrade. Further modelling of the economics of this situation is required.

2. Strategic controlled grazing

Once some recruitment occurs, strategic controlled grazing may provide one of the most practical means of reducing nutrient loads for the benefit of perennial native plant species. Data shows how stock grazing and camping over time can lead to nutrient enrichment, soil compaction and loss of soil crust. The greatest impact was seen in small remnants where stock remove biomass from paddocks and concentrate nutrients within native vegetation patches, where they shelter. At certain times, if stock are permitted to graze remnant vegetation *but not camp*, they may effectively act to export nutrients back out of enriched remnants into surrounding paddocks. Such management could also control weed biomass.

3. Buffer and expand remnants

Our study suggests two major strategies for buffering and expanding remnants, based on the evidence that windward western edges are more prone to degradation. Firstly, target regeneration or seek opportunities to facilitate passive[1] regeneration along the more protected leeward edges. Secondly, undertaking revegetation and tree planting on the windward edges may provide a buffer to sand and nutrients. Plantings for alternative stock shelter could also be established up-wind of remnants or located down-wind of the source of wind erosion or fertiliser drift. The problem with many buffer strips planted in recent years is that they are far too narrow to have much chance of long term survival.

Economic modelling tested the opportunity cost to landholders of removing a 50 m wide strip adjacent to a 10 ha remnant from production for revegetation or regeneration purposes. The forgone income from production was small in terms of cropping or grazing enterprise. However, further study is required to understand the shelter value of remnants for livestock in these landscapes.

The Wimmera Mallee Ecosystem Function project will be completed in June 2007. By this time we will have an excellent understanding of the health of remnant vegetation in the dryland zone, its ability to respond to removal of stock pressure, and how it should be managed to maximise the benefits that landholders gain from having remnants on their land. We will have also established a plan for monitoring change within remnants over the coming years, an adaptive experiment that landholders can implement in their remnant vegetation. A ute guide will help landholders to read their local landscape, and note subtle but ecologically important changes that results from their activities.

Acknowledgements

The Wimmera Mallee Ecosystem Function Project (2005-2007) is being undertaken by the Arthur Rylah Institute for Environmental Research (DSE) in collaboration with BCG and CSIRO Sustainable Ecosystems. This project is funded by the North Central and Mallee Catchment Management Authorities with support from DPI Our Rural Landscapes and Wimmera CMA. North Central and Mallee CMA's acknowledge the support of the Commonwealth and State Governments through the National Heritage Trust and the National Action Plan for Salinity and Water Quality. The opinions expressed in this article are those of the authors and are necessarily those of the Department of Sustainability and Environment.

[1] Passive or natural regeneration refers to allowing native species to germinate and grow unassisted, except by protection from herbivores by fencing or other management. The phrase is used to distinguish from more expensive methods of direct seeding and tubestock planting.