Ecological principles involving the use of fire in grassland and grassy woodland

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Summary: In grassland and woodland, grasses in particular, can become overgrown, and inhibit the successful regeneration of other plant species. Fire plays an important role in the removal of overgrowth, and providing opportunities for other species to grow and regenerate.

For many years it was difficult to get burns undertaken in grasslands and woodlands to enhance biodiversity (as opposed for biomass control for wildfire mitigation), but recent work by scientists have provided excellent data to show fires are extremely beneficial in encouraging a diversity of species to regenerate.

Broad principles have been developed, that include the importance of burning in small patches and ensuring burns are low intensity and do not burn into trees, but little is known about optimal frequency, and the impacts on plant and animal species that have become rare, or impacts on weed species.

Much is to be gained by better understanding and utilising Indigenous fire management practices for both cultural and ecological outcomes.

What natural landscapes occur in Majura Valley?

1928 (Mildenhall photo collection): from Mt Pleasant, overlooking Duntroon Note the lack of naturally occurring trees in the valley and the wider spaced trees on the lower slopes, blending into forest on the hills on the eastern side of the valley. Ecologically, this landscape contains a mosaic of grassland in the cold valleys, open woodland above merging into forest on the upper slopes of the hills.

1997, showing the large area subject to wildfire on the eastern side of Majura Road. While large areas have been cultivated, extensive areas of native vegetation remain.

What is the ecological ideal state for native grasslands and grassy woodlands?

As a generalisation, the higher the diversity of habitat features and plants, the higher the diversity of fauna, and the healthier the ecosystem, in terms of resistance to detrimental effects (for example, drought, wildfire, overgrazing, disease, weeds or soil disturbance)

Regular biomass removal removes the biomass of the grasses, creating canopy gaps, keeping grass tussocks healthy and increases the growth of inter-tussock forbs, including their seed production leading to further recruitment.

Healthy, wildflower-rich woodland

Healthy Kangaroo Grass dominated grassland

How is this achieved?

In woodlands and grasslands biomass removal of particularly grasses is required to enable a diversity of plant species to regenerate. Grazing and burning and slashing can all achieve this.

Dense grass tussocks shade out spaces for other species to recruit.

Continued growth of grasses leads to shading and rotting of the bases of the plants, that may lead to the death of the plants and favouring weed establishment. The roots of these Kangaroo Grass plants easily pulled out of the ground after not having been managed for some years.

What impacts do grazing, burning and slashing have on native grassy ecosystems?

Each method of biomass reduction has advantages and disadvantages (see table next page).

The role of fire in grassy ecosystems

Burns may occur in different ways, each of which have different pathways, objectives, but may or may not have different outcomes. Frequent burning particularly of Kangaroo Grass dominated grassland is considered a key method to maintaining floristic diversity and fauna habitat.

1. Wildfire – uncontrolled, no planning, may be over very large areas, wildfires can also have good outcomes.

This fire revealed that the Grassland Earless Dragon sheltered in spider burrows during the wildfire in 1997.

Recovery after this fire was very good; fortuitously it occurred in a relatively wet period, so that a high diversity of plants regenerated and set seed. A similar wildfire during a drought may have severely impeded the recovery of plant and animal species.

Impact on targets	Burning	Livestock grazing	Eastern grey kangaroo grazing	Slashing
Impact on biomass	All or most herbaceous vegetative material removed	Selective removal of palatable grasses and wildflowers	Selective removal of palatable grasses	All erect material removed, generally trash created is retained on site
Positive effects on native species	Cooler burns remove biomass of grasses creating spaces for other species to regenerate, without impacting fauna	Regulated grazing retains a diversity of structure and inter-tussock spaces to favour retention of a diversity of species.		Opens canopy
Negative effects on native species	May result in exposed soil until regrowth occurs. Hot or too frequent burns may reduce habitat and kill plants and animals	Overgrazing may result in loss of species, especially taller, more palatable species, increased bare soil and soil compaction	Overgrazing results in increased bare soil and soil compaction (but lower than livestock grazing)	Can minimise seed maturation if too frequent; trash can advantage weeds
Effects on weed species	Can advantage or disadvantage weed species depending on season, intensity etc of burns; can be used to assist in weed control	Livestock can spread weeds from other sites. If not palatable they are likely to go to seed and recruit. Nutrients from dung (or fertiliser) advantage weed species. However, can be used to assist in weed control	Can spread weed seed in dung and sticky seeds on coats.	Trash remaining may mulch down and suppress native regeneration; weed seed is spread through machinery

Figure 1. Impacts of biomass reduction on native grassy ecosystems

2. **Fuel reduction,** to mitigate against uncontrolled wild-fire events. These aim to have ecological outcomes, but at times the requirement to reduce biomass may lead to compromise.

This burn is hot because the biomass being burnt is dense.

3. **Enhancement of ecological diversity**

The outcome for burns to enhance ecological diversity is to ensure trees are not burnt, especially the trunk and especially within the trunk, other plants are not destroyed (either killed or unable to regenerate), fauna are not impacted, either through loss of life or loss of nesting or shelter habitat by retaining unburnt patches.

The tree trunks and foliage were not burnt in this fire

Patch burns (e.g. Aboriginal culture), may involve burning off overgrowth of grasses, in very small patches that essentially put themselves out.

How do we know what to do?

To enable these outcomes, four factors are taken into account

- Frequency – how often an area is burnt: currently, conservatively 10-40 years for grassy woodland and 4-10 years in grassland;
- Intensity – how hot, which is affected by amount of biomass, dryness (curing) of the biomass, season, weather (dry/windy/damp/foggy) and time of day (affects dryness)
- Season – affects how the fire burns – too hot, not enough,
- Patch size: how much to burn, spaces for shelter of fauna

Trials by Ken Hodkinson (retired CSIRO ecologist) comparing season of burning with slashing are showing some interesting results:

	Autumn burns (every two years	Spring burns	Slashing	No management
Native species richness	Highest	Lower	Lower	Lower
Exotic species richness	Highest	Highest	Lower	Lower
Kangaroo Grass recruitment	Highest	Highest	Lower	Lower
Longer period retained of lower density of biomass	Highest	Lower	Lower	Lowest

ACT Government are undertaking trials in grassland in Jerrabomberra to determine how to undertake small patchy burns to retain habitat for grassland fauna.

Much more research is needed, and integration of Aboriginal cultural practices and their role in maintaining biodiversity and heritage.

1. Ecological understanding is that, as a generalisation, the higher the diversity of soils, habitat and plants, the higher the diversity of fauna, and the healthier the ecosystem, in terms of resistance to detrimental effects (drought, overgrazing, disease, weeds),

2. In woodlands and grasslands biomass removal of particularly grasses is required to enable a diversity of plant species to regenerate.

3. This may be achieved by burning, grazing, slashing or a combination of all.

4. Each has advantages and disadvantages; see table

5. Weed type and density is also a factor that needs to be taken into account. The majority of weeds are affected similarly to burning to native species – ie often positively at the same time that natives increase.

6. Frequent burning particularly of Kangaroo Grass dominated grassland is considered important to maintaining floristic diversity and fauna habitat.

7. Four factors are always taken into account considered for burning:

   - frequency – how often;
   - intensity – how hot, which is affected by amount of biomass, dryness (curing) of the biomass, season, weather (dry/windy/damp/foggy) and time of day (affects dryness)
   - season – affects how the fire burns – too hot, not enough
   - how much to burn: patch size, spaces for shelter of fauna

8. The general aim is to ensure trees are not burnt, especially the trunk, other plants are not destroyed (either killed or unable to regenerate) and fauna are not impacted, either loss of life or loss of nesting or shelter habitat, for example

9. There has been a slow change in attitude towards burns undertaken for ecological purposes. Prior to 2003 they were given very low priority by government, but since they have gradually increased.

10. More research is required to determine frequency, intensity, seasonality and size of patches burnt.

11. Some research is occurring in ACT, following extensive work in grasslands elsewhere, especially Victoria.

12. Excellent work by government and particularly a trial by Dr Ken Hodkinson (retired CSIRO ecologist) comparing season and other methods (slashing). Results…..

13. Burning results (Ken):

- Frequent autumn burning (every 2 years) germinates and maintains higher native plant species richness (+10 species) than spring burning, annual mowing and no management (control).
- Burning (spring or autumn) germinates more exotic plant species than the other treatments.
- Burning (spring or autumn) enlarges patches of Themeda triandra which appears to be outcompeting and replacing Chilean Needlegrass and African Lovegrass (and other exotics).
- Autumn burning has the longest hazard reduction period.

14. Restoration and fire (Ken): The GCG restoration project began autumn 2016. Thirteen sites and four treatments; autumn burning every 2 years, autumn burning every 4 years, the Canberra mow (6 times a year) and control. Into each treatment plot we have planted 5 forbs that are rare or lost from most NTG in urban Canberra. We are interested in survival and spread under each management. Sites range in native plant species richness from zero to mid-level and in landscape position (top, slope and bottom).

15. ACT Govt also undertaking monitoring at selected locations of impacts of the Bushfire Operational Plan, especially where more frequent burning than deemed ecologically correct is mandated for high fire risk areas

16. Much more notice needs to be taken to consider Indigenous cultural practices and their role in maintaining biodiversity.

Sarah Sharp is a plant ecologist, specialising in conservation management of grassy ecosystems. She worked with ACT Government for 18 years as a scientist, particularly providing advice on conservation of grasslands and grassy woodlands. She was involved in the preparation of the Strategic Action Plans for Grasslands and Woodlands, has provided input into management plans including the Bushfire Operational Plans and prepared site management plans, for example, sites managed by National Capital Authority. She was a member of the ACT Bushfire Council between 2011 and 2013, providing ecological input, and is a member of the ACT Weeds Advisory Group. Now semi-retired, she works as a volunteer with community groups (including Friends of Grasslands, Conservation Council Biodiversity Working Group and Molonglo Catchment Group) to conserve grassland and grassy woodland sites and species and to work with Parkcare groups to promote the application of quantitative and scientifically robust monitoring after management is applied. She has a strong interest in the dynamics of species and ecological communities, including the use of fire and impacts of fire on these ecosystems, and in gaining understanding and utilisation of indigenous fire management practices for both cultural and ecological outcomes.