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Ecological effects of creating fuel-modified zones by chaining and burning

by Carl Gosper[1,2], Colin Yates[1] and Suzanne Prober[2]
[1]DEC Science Division, [2]CSIRO Sustainable Ecosystems, (08) 93336442
carl.gosper@dec.wa.gov.au; colin.yates@dec.wa.gov.au; suzanne.prober@csiro.au

Background

Managing fire regimes is important for both biodiversity conservation and the protection of life and property. In mallee, mallee-heath and scrub-heath communities in south-west Western Australia, discontinuous ground fuels preclude reliable fire propagation under mild conditions. In these fuels, fire propagation is usually only reliable under more extreme weather conditions when wind speeds are higher and fuel moisture contents are low. Chaining and burning is a technique for facilitating fire management in these vegetation communities, through the creation of strategically-placed 40-100 m wide fuel-modified zones along the boundaries of bushland and within large blocks of native vegetation. Vegetation is laid down to ensure a more contiguous fuel bed that facilitates burning under mild conditions. The vegetation is first dislodged using a chain, then after a period of curing, burnt. These strips constitute a very small but increasing proportion of the vegetated landscape.

Application of any management regime to the conservation estate should be underpinned by operational experiences and scientifically robust data documenting the costs and benefits to biodiversity and community assets. Research is needed to better understand the consequences for plant survival and recruitment of combining the two disturbance events (chaining and fire). We hypothesised that outcomes would vary among plant functional types (PFT) defined by disturbance response (i.e. grouping species that respond similarly to fires). PFT considered were obligate seeding species (killed by complete canopy scorch) with canopy-stored seed, sprouting species (resprout after canopy scorch) with canopy-stored seed, obligate seeding species with soil-stored seed, sprouting species with soil-stored seed and fire ephemeral herbs (complete their life cycle rapidly post-fire after germination from long-lived seed banks). In the Lake Magenta region, we compared seedling recruitment and sprouting of PFT, and the size and number of sprouting stems in mallees in mallee-heath vegetation subject to chaining and burning and burning only.

Findings

Chaining and burning affected recruitment differently from burning only, but responses varied between plant functional types:

• 90% fewer recruits of obligate seeders with canopy-stored seed were found in chained and burnt strips (burnt 1 to 17 months after chaining), and species richness of this group declined 44% (Figure 1). Desiccation of severed stems led to seed release from protective woody capsules after chaining, exposing seeds to lethal temperatures in the subsequent fire

• Little difference was detected in the abundance or species richness of sprouters (either with canopy- or soil-stored seed), between chained and burnt and solely burnt areas. Two consecutive disturbances did not affect survivorship of sprouter species

• Recruits of non-sprouter species with long-lived soil-stored seed banks, such as obligate seeding *Acacias* and fire ephemeral herbs, increased in chained and burnt strips. Fires in chained strips may have been more intense than in unchained vegetation due to drier fuel, providing a better germination stimulus for persistent soil-stored seed banks

Top: *Hakea pandanicarpa* fruits having shed seeds after chaining, but prior to burning. *Bottom*: Resprouting and flowering *Banksia rufa* after chaining and burning

Mallees sprouting after chaining and burning had similar stem sizes but fewer stems than in solely burnt vegetation (Table 1). While this effect was relatively small, other studies similarly indicate that mallees are vulnerable to repeated disturbances.

Figure 1. Effects of chaining and burning and solely burning on recruitment/resprouting of different plant functional types in mallee-heath.

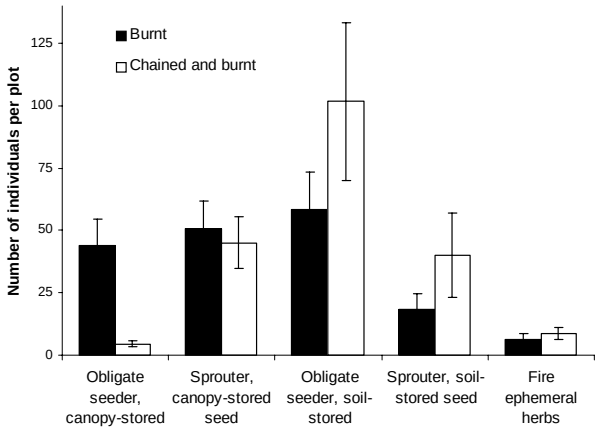

Table 1. Number of stems and mean largest stem diameter at breast height per mallee in chained and burnt and solely burnt mallee-heath.

	Burnt only	Chained and burnt	P
Number of stems	4.98 ± 0.51	3.94 ± 0.46	<0.05
Largest stem (cm)	1.43 ± 0.13	1.32 ± 0.14	NS

Top: Resprouting Tallerack (*Eucalyptus pleurocarpa*) after burning only. *Middle:* Two-year old chained and burnt strip. *Bottom*: Two-year old solely burnt patch.

Management Implications

- **Chaining and burning changes the plant community** compared to fire only, with fewer obligate seeders with canopy-stored seed and more obligate seeders with soil-stored seed.

- **The negative ecological impacts of chaining and burning narrow strips need to be weighed against the potentially broader benefits of the practice** for managing landscape fire regimes and protecting community assets. Research documenting temporal changes in fuels and in the efficacy of chained and burnt strips under a variety of fire conditions would further facilitate improved fire management.

- **Impacts could be reduced by burning as soon as possible after chaining**, to lessen seed shed in obligate seeders and subsequent seed losses in the post-chaining fire; and

- **Pre-chaining impact assessments should focus on the most vulnerable taxa:** threatened, conservation priority or narrow-range endemic obligate seeders with canopy-stored seed. Policy and decision-making criteria outlining the circumstances in which the impacts of chaining and burning outweigh the management benefits (and vice-versa) need to be developed to support operational decisions.

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Locked Bag 104, Bentley Delivery Centre, WA 6983