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Seedling establishment in an pyrogenic flowering species: the role of time-since-fire, litter and post-dispersal seed predation

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Seedling establishment in a pyrogenic flowering species: the role of time-since-fire, litter and post-dispersal seed predation

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Certification

I, Andrew John Denham, declare that this thesis, submitted in partial fulfilment of the requirements of the award of Master of Science (Research), in the School of Biological Sciences, University of Wollongong, is entirely my own work except where otherwise acknowledged, and has not been submitted for qualifications to any other university or institution.

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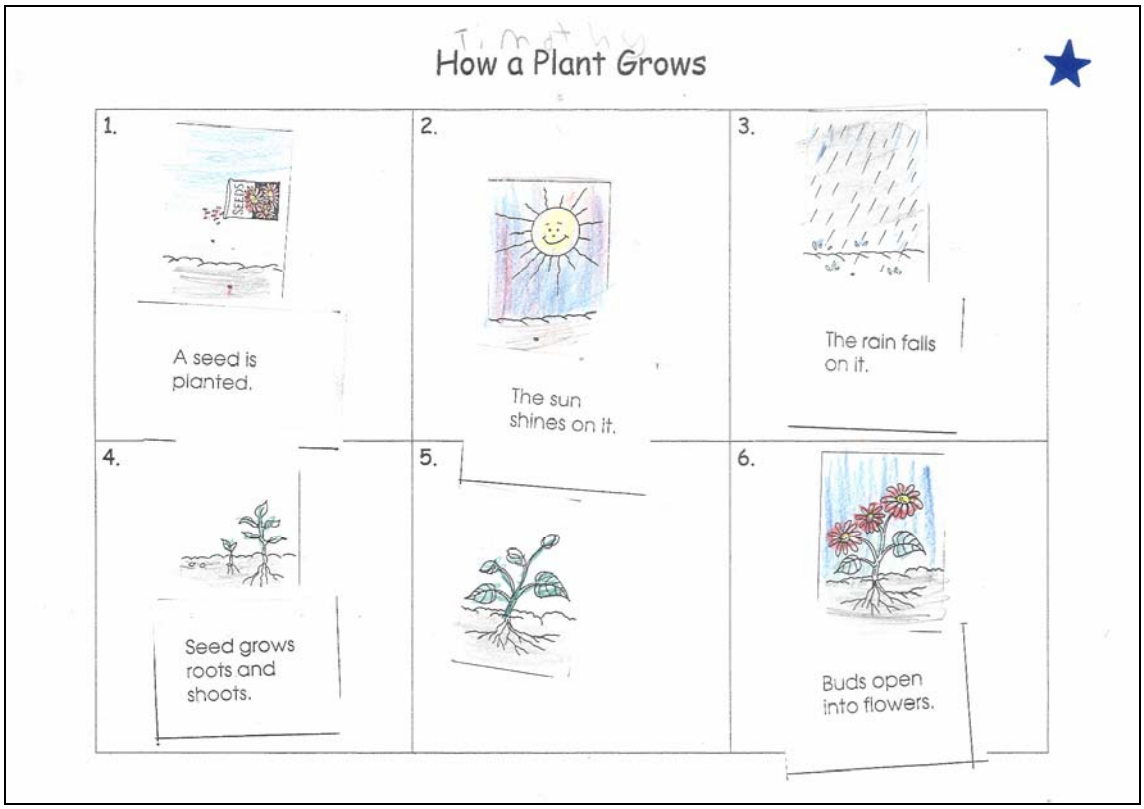

Part of the life-cycle of a plant, as illustrated by Timothy, age 6.

If only it were that simple….

Table of Contents

List of figures

List of tables

Abstract

In fire prone environments, the period immediately following fire events is perceived to provide the only opportunity for recruitment for many plant species. Resprouting shrubs do not need to recruit after every fire, because many individuals survive each fire and therefore may contribute to the population. However, without periodic recruitment, the accumulated mortality of adults both during and between fires would lead to local extinction even of these species. Most plant species establish seedlings within a year of fire from either canopy or soil seed banks. In contrast, species with pyrogenic flowering have no seeds available immediately after fire and thus have their recruitment delayed. The work of this thesis aims broadly to investigate the mechanisms by which species with delayed recruitment persist. For one of these species, *Telopea speciosissima*, I asked the following questions –

- Do seedlings establish under shade and litter and tolerate competition from existing plants, or must they establish in open spaces?
- Does post-dispersal seed predation strongly influence seedling recruitment or are its seeds less susceptible to predation than those of early post-fire recruiters? and
- Does *T. speciosissima* have particular characteristics that tie seedling establishment to the late post-fire environment or is it only its life history (constrained by its phylogeny) that prevents earlier seed release?

Telopea speciosissima is a pyrogenic flowering species – it has no seed bank, but it resprouts, flowers and sets fruit in the post-fire environment. I examined recruitment in *T. speciosissima* using two seed-addition experiments, in which I manipulated predator access, microhabitat characteristics, and time of seed arrival in relation to fire. For contrast, I included *Banksia serrata*, a resprouting canopy seed bank species with seed mass similar to in *T. speciosissima*, in one of these experiments.

In the first experiment (in sites that were 3 and 4 years post-fire), seed predation was measured by placing caches of seeds within experimental microsites. These microsites were left open or covered with 12mm mesh to exclude vertebrates. The habitat within the experimental microsites was classified according to litter and vegetation cover. It was then either left intact or the litter and vegetation were removed. Seed predation was high overall (47-80%), regardless of access to vertebrates. Predation varied among sites. Few seeds or seedlings survived to 9 months after planting. Survival

of seeds or seedlings was improved in microsites with dense vegetation and litter cover. Removing the litter and vegetation cover increased the probability of seed predation by vertebrates in the first year of the experiment, but it did not influence predation by invertebrates.

In the second experiment (in sites that were 0.5 and 2-3 years post-fire), vertebrate predators were excluded from all experimental microsites. Vegetation within experimental microsites was not modified, but the litter was modified such that half the microsites had the mean mass of the early post-fire sites, the other half the mean mass of the later post-fire sites. Here I compared seedling establishment of *T. speciosissima* with that of the canopy seed bank species, *B. serrata*. I hypothesised that seedling establishment would be linked to the timing of seed release determined by the natural history of the species, with the prediction that *B. serrata* would establish more seedlings soon after fire, while *T. speciosissima* would establish more seedlings later after fire. The litter treatment tested the hypothesis that litter mass made a significant contribution to differences between the habitats with different times since fire. Seedling establishment overall was poor (< 36% of seeds), peaking within 3 months of planting. Both species established more seedlings in late post-fire sites, but litter treatments did not influence seed survival or seedling establishment. Seeds of *T. speciosissima* suffered greater predation in early post-fire sites (69.5%) than in late post-fire sites (51.2%). Predation of *B. serrata* was lower and did not vary significantly among sites (47.3%).

Since the canopy seed bank species (*B. serrata*) may establish seedlings in early or late post-fire habitats, its recruitment opportunities are determined by the timing of seed release after fire. In contrast, the greater susceptibility of *T. speciosissima* to seed predation in early post-fire sites suggests that this may be a factor favouring delayed seed release. This provides support for the hypothesis that *T. speciosissima*, as a pyrogenic flowering species, has characteristics that favour late post-fire recruitment. The seeds and seedlings of both these species tolerate relatively high levels of vegetation and litter cover. However, for pyrogenic flowering species, effective post-fire recruitment may require the coincidence of favourable environmental conditions and low levels of seed predation.

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