The effects of permanent and temporary fire refugia on the distribution of invertebrates

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Ecological disturbances like fire can affect biodiversity. Fire usually causes a heterogeneous burn of the landscape resulting in a fire mosaic. Unburnt patches may act as fire refugia and have been proposed to affect faunal persistence in a fire-prone landscape. These can differ spatially and temporally; however there is a paucity of research about how fire refugia can affect the post-fire succession of fauna. As such, I delve into understanding more about how unburnt patches can act as fire refugia and if their ability to act as refugia is dependent on their temporal properties (permanent versus temporary fire refugia). Ultimately, this thesis has the potential to increase the understanding of biodiversity conservation and improve landscape management.

I explored the following questions: (1) Do species abundance and richness differ between potential permanent and temporary fire refugia? (2) Is the response of a species to potential fire refugia related to the trophic or flight group that they belong to? This study surveyed invertebrates using sweep netting in Pinkawillinie Conservation Park and three treatments were implemented across dunes and swales: "Matrix" sites are within the most recent burn in 2005, "Temporary" sites are patches that were last burnt in 1986, and "Permanent" sites are patches were last burnt before 1986. The uninterrupted vegetation north of the 2005 fire burn was used as controls for surveys. Invertebrates were classified into morphospecies, trophic and flight groups. A Generalized Linear Model (GLM) was fitted to analyse landscape types (Matrix, Patch and Uninterrupted), age classes (burnt in 2005, burnt in 1986, burnt before 1986) and age-landscape interaction, while soil types (dune and swale) were analysed as a covariate. Vegetation variables were also measured.

There were fewer flying species in older uninterrupted sites than 26-year-old uninterrupted sites. In contrast, there were fewer Iridomyrmex sp. individuals in 26-year-old uninterrupted sites than older uninterrupted sites. However, in both cases, species abundance and richness were similar between patches of different ages. Eight morphospecies displayed responses to landscape and 15 morphospecies displayed responses to soil type. Species abundance and richness of six trait groups also differed in landscape and soil types. Vegetation was different across age, landscape and soil type.

Contrary to my expectations, the distribution of invertebrates is unlikely to differ between permanent and temporary fire refugia, and unburnt patches do not seem to act as fire refugia seven years after fire. Instead, other ecological processes may drive landscape responses. Early successional species dominated matrix sites, while species with highest abundance levels in patch sites were possibly weak competitors or prey species. The next step to understand more about the temporal properties of fire refugia is to focus on the immediate effects of fire and on other fauna. In doing so, a better picture of post-fire succession can be painted.