The effects of fire frequency on ant (Hymenoptera: Formicidae) communities in open eucalyptus forest in north-east Victoria.

Jonathon Peter Thompson, Honours, La Trobe University

MAJOR FINDINGS AND OUTCOMES

Fire frequencies and intensities are expected to increase into the future due to the associated effects of global warming such as temperature increases (Brereton *et al.* 1995), litter load increases (Howden and Gorman 1999), and increases in evaporation and decreases in winter rainfall leading to less available surface freshwater (Wentz *et al.* 1997). The recent wildfires that occurred in 2003 and 2009 across Victoria presented the opportunity to examine the effects of different fire frequencies on ant communities. The results provide some insight into probable changes in ant communities associated with increased fire frequency.

The research was conducted in the Stanley State Forest, 10 km south of Beechworth, Victoria in open eucalyptus forest. Multiple sampling methods were used including pitfall trapping, litter extractions, quadrat counts, light trapping and malaise trapping. The final two methods were designed to sample alates. A number of methods were used as a combination of techniques is usually best to accurately document community diversity (Agosti *et al.* 2000) and certain sampling methods have been found to favour certain species-groups (Andersen 1991b; Greenslade and Greenslade 1971). This study has shown that Stanley State Forest supports quite a diverse ant community with 62 species recorded. Arboreal species were missing from the data set due to a lack of arboreal sampling methods. However, it is unlikely that many species were missing from the voucher collection due to this lack of sampling (*pers. comm. Steve Shattuck).*

Differences in ant diversity between sites proved useful in assessing the effects of fire histories on ant assemblages. Species level data can be difficult to interpret due to the variable disturbance response of individual species (Hoffmann and Andersen 2003). However, it did provide useful information in the context of the current study. Significant differences in diversity and richness were detected between sites with different fire histories. These differences between sites were not the same as initially predicted. The long unburnt site and double burnt (03 & 09) sites were dominated by single dominant species from the genera *Iridomyrmex* and *Anonychomyrma* respectively. This dominance was a major factor leading to lower diversity within these sites. On the other hand, the two singly burnt sites (burnt only in 2003 and burnt only in 2009) were more species diverse than the other two sites.

Functional group analysis was also conduted to identify fire related trends. Functional groups recognise the ecological rather than the taxonomic affinity of species and have been shown to be useful to study the response of ant communities to environmental stress and disturbance (Andersen 1991a; Andersen 1995; Andersen 1997; Jackson and Fox 1996; Majer 1983). Functional groups did not show any obvious trends that could be related to fire history. It was expected that highly competitive, numerous, and aggressive species (Dominant Dolichoderinae) and species favoured by disturbance (Opportunists) would dominate the burnt sites, especially the site burnt twice by wildfire. It was also expected that the unburnt site would have a higher diversity of species and not be dominated by a single or a few species, the composition consisting of species from the Cryptic and Cold Climate Specialists functional groups. This was not the case for the current study with the unburnt site being dominated by a few species. The current study demonstrated that functional groups do not always follow predictable patterns and therefore their use may be problematic in these dry open forests.

It was concluded that the intermediate disturbance hypothesis may best explain the trends in ant assemblages associated with fire. It proposes that communities that are more diverse are not in a state of equilibrium but if no disturbance occurs for long periods of time then the community will progress toward a low-diversity equilibrium community (Connell 1978). This is likely due to mortality favouring superior competitors in the latter state and diversity levels being maintained in the lesser disturbed areas by niche diversification (Connell 1978). This could be occurring in the current research with both extremes of the hypothesis being represented. That is, the double burnt (03 & 09) site could be too frequently burnt, leading to low species diversity due to few species being able to colonize during the brief periods between disturbances; in the long unburnt site infrequent wildfire may be leading to low species diversity due to dominance by competitively superior species (Townsend *et al.* 1997).

SIGNIFICANCE TO ADAPTING AND PROTECTING AUSTRALIAS TERRESTRIAL BIODIVIERSITY

This research highlights the importance of thorough and appropriate fire management in the future as fire frequency and intensity is predicted to increase with global warming. More research and monitoring must be conducted urgently on the effects of fire frequency and intensity on a range of ecological systems. It is also critically important to reduce the incidence of high intensity wildfire. Fuel reduction burning is the most important tool that managers have at their disposal to do this. However, it is also important to burn the forest in a patchy manner to maintain a mosaic of fire histories. To enable mangers to properly deal with the increase in fire frequency and intensity it is important for governments to provide appropriate resources to allow effective fire management to occur.

FURTHER RESEARCH SUGGESTIONS

The results of the current study suggest that the increase in wildfire frequency that is predicted with global warming will have negative effects on ant communities in similar forest habitats; if intense burns occur too frequently then it is likely to result in a reduction in species diversity and richness. It is important to maintain appropriate and thorough monitoring into the future to deal with these possible increases in fire frequency and intensity. Future studies should be conducted that are long term (more temporal replication across multiple seasons and years), which should better identify the relationships between fire and global warming, and the subsequent effects on ant communities. As a commonly used indicator group, changes in the ants may reflect what is happening more generally in the wider invertebrate communities. Studies should be conducted in various vegetation habitats (e.g. tropical rainforest, arid zones, savannas) to determine if ant communities associated with these vegetation types are affected in different ways.

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