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Invertebrate Biodiversity in Urban Landscapes: Assessing Remnant Habitat and its Restoration

My research group works on a number of projects looking at the effects of urbanization on invertebrates and the ecological processes they provide. We have extended this work to a case study in western Sydney to assess invertebrate responses to replanting. This work is ongoing and is evaluating these effects in response to urbanization and how this may influence management goals and actions.

Urban remnants in the Sydney region are often of high conservation value and represent last examples of once-common vegetation. They also provide valuable opportunities for research and education and are of intrinsic value to the community for a number of reasons.

The case for using invertebrates in such work was based on the fact that they respond to fine-scale disturbance, are sensitive to impacts, are abundant and are important to the ecosystem.

Urban bushland is subjected to a number of impacts that are likely to affect invertebrates and invertebrate diversity, including:

- fragmentation – leads to area effects; edge effects and isolation,
- changes to nutrient input,
- altered disturbance regimes (fire, invasive plants etc.).

Invertebrate species in remnants

We looked at a number of different types of sites in urban bushland – small sites, edge sites and interior sites, and looked at ground dwelling invertebrates and at arboreal invertebrates.

We found that:

- there was no difference in the number of different species in small and large remnants,
- small remnants supported a fundamentally different range of species,
- parasitic wasps showed most dramatic shift in composition and this was noted for spiders and flies too,
- the different functional groups of ants were affected by fragment size – generalized myrmecines and opportunists more prominent in smaller remnants,

Examining the populations of arboreal invertebrates shows that the composition of species found in small sites was significantly different to interior sites, with the interior sites supporting significantly fewer arboreal invertebrates. It was found that there were fewer birds in small remnants. The larger numbers of birds in the interior and edge sites keep invertebrates populations lower due to predation in these sites.

Defoliation of plants by herbivorous insects was also examined. From time to time there are outbreaks of insect “pests” in urban remnants, with small sites having greater levels of defoliation than larger ones. Insect damage is commonly associated with eucalypt dieback either as a cause or consequence. Our work found that localized damage within a 10 Km radius was by a different herbivore at each of three sites. There may be a number of processes which are disrupted and result in this, including increase of herbivore invertebrate populations due to loss of predators and parasites. Learning more about these may help future management of these remnants.

Other aspects of urban invertebrate populations may also lead to understanding of the disruption of processes in urban bushland. These include Predation and Parasitism, as there are numerous working hypotheses that higher trophic levels are more susceptible to habitat fragmentation. Declines in pollinator assemblages occur, with disruptions reported in edges, fragmented habitat and disturbed habitat.

Ants as indicators of restoration success. Further work on invertebrates has been undertaken: *A study on the Effects of revegetation on ant fauna and seed removal by ants* (as part of a collaboration between NSW National Parks & Wildlife Service (David Keith) and The University of Sydney (Boris Lomov and Dieter Hochuli).

This work was carried out in western Sydney using sites in the Greening Western Sydney project. This project is being carried out in open space areas in western Sydney totalling 5400 ha, which are owned by Planning NSW (now DIPNR) The sites have been managed by Greening Australia NSW since 1992 to restore ecological communities of Cumberland Plain.

To date, around 2000 ha have been revegetated. Our examination of the ant fauna in these sites was in the context of the broader assumption that introduction of native trees and shrubs to pasture will foster regeneration of the Cumberland Plain Woodland.

Ants were used as indicators of restoration success for a variety of reasons:

- they are abundant and diverse in most habitats,

- they are ecologically important at many trophic levels and sensitive to ecological change,
- they are easy to sample and classify both taxonomically and functionally,
- they have been successfully used in restoration assessments notably in mine rehabilitation studies.

The aims of the study were to determine how revegetation changes diversity and composition of ant fauna, and to investigate whether revegetation fosters the recovery of a plant-insect interaction such as seed dispersal by ants

Four types of sites were compared:

- ungrazed Pasture – which were the Control sites,
- 4-5 Year Old Revegetated Sites,
- 8-10 Year Old Revegetated Sites,
- bush Remnant Sites, which were the reference sites.

Preliminary results revealed that:

- ant species richness increased with the restoration age,
- species richness in remnants was higher,

- ant assemblages of revegetated areas were approaching those in forest remnants, but still significantly different from them,
- species that contributed the most to the differences among the treatments were *Iridomyrmex rufoniger* group, *Pheidole* spp. and *Tetramorium turneri*

Another factor examined was seed removal and dispersal with the different stages of revegetation.

Observation showed that seed removal by ants was carried out by 13 species from 7 genera, and these were divided into regular and occasional removers.

These studies showed that:

- the rates of seed removal by ants increased with the age of restoration,
- the assemblage of regular seed removers in the pasture and revegetated sites was considerably different from the those in remnants,
- main species contributing towards this difference being *Rhytidoponera metallica*, *Tetramorium turneri* and one *Pheidole* sp.

Conclusions. Can you recreate complex entities?

- although restoration of Cumberland Plain Woodland may take decades, recovery of certain ecological processes may take place at the early stages of restoration,
- measurements of ant community structure coupled with measurements of its function could serve as useful indicators of ecosystem recovery

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