Science for Saving Species

Research findings factsheet

Project 1.2.1.3

Threatened Species Recovery Hub

National Environmental Science Programme

Beyond pattern to process: Current themes and future directions for the conservation of woodland birds through restoration plantings

In brief

Temperate woodlands once covered an extensive area of southern Australia; however, up to 95% of their cover has been cleared for agriculture since European arrival. Scattered remnants persist, but they are vulnerable to threatening processes, and Australia's rate of land clearing remains among the highest in the world.

With an ongoing loss of habitat, restoration plantings are a critical conservation strategy for woodland birds and other fauna. However, many revegetation programs are being implemented without sufficient knowledge as to the habitat requirements of the species they should be supporting. This study reviewed literature, made predictions based on it, and identified knowledge gaps for future research.

Some restoration plantings may attract birds but not provide adequate breeding habitat and resources; this is known as an ecological trap. As many Australian woodland birds are long-lived, with a lifespan of 10 to 20 years, there may be a time lag before the effects of an ecological trap become apparent. It is therefore important to assess whether woodland birds are able to successfully breed in restoration plantings.

It is important to monitor progress towards ecological restoration targets; however, we found that pattern-based metrics such as presence/abundance and species richness may mask issues such as whether restoration plantings are acting as ecological traps. We recommend conducting more "process-oriented" rather than only "pattern-focused" research to assess the success of restoration plantings as a conservation strategy.

Hooded robin's nest. Photo: Donna Belder

Background

Converting land to agriculture is a leading cause globally of habitat loss and altered ecosystem processes, and therefore loss of biodiversity. Restoration plantings are an increasingly common strategy to address habitat loss in fragmented agricultural landscapes.

Changes in attitude towards land management throughout the 1980s and 1990s led to small-scale revegetation programs and, later, larger-scale government-initiated programs. Many early plantings were implemented without a well-defined wildlife conservation plan, but have nonetheless in some cases been occupied by woodland birds and other fauna. With ongoing large-scale revegetation programs such as the 20 Million Trees Program underway to improve the extent, connectivity and condition of native vegetation, extensive areas of temperate woodland restoration plantings are being added to the landscape every year.

However, there has been only very limited work done to measure or monitor the capacity of restoration plantings to support breeding populations of native species, and their usefulness as a conservation tool is debated. This study focuses on the response of woodland birds to revegetation in Australian

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Background (continued)

temperate woodlands. Woodland birds are known to respond in a range of ways to revegetation with areas that can support birds having particular attributes such as being located in gullies, being wider (than narrower), containing attributes such as large old trees, being linked with other areas of native vegetation (such as other plantings) and being subject to limited grazing pressure. There have also been studies which have quantified relationships between the occurrence of particular species and the attributes of plantings (like the presence of an intact leaf litter layer and mid-storey vegetation). However, there is still much to learn about the long-term responses of this assemblage of birds to revegetated woodlands, especially whether such places are suitable for birds to successfully reproduce. As a result, there are currently no optimisation strategies to guide restoration programs to ensure that they support breeding populations of woodland birds.

Weebill. Photo: Donna Belder

Superb fairy-wren. Photo: Donna Belder

What we did

In response to these problems, we conducted a detailed review and synthesis of literature on threatened species assemblages, so that current knowledge could be consolidated and knowledge gaps identified for future research. There has been limited research on these topics internationally, and almost none in Australian temperate woodland systems, although we drew upon a long-term (approximately 20-year) study led by David Lindenmayer on responses of woodland birds and other fauna to restoration plantings and woodland remnants on farms in the South West Slopes region of New South Wales.

Our focus was on Australian temperate woodlands, which once covered an extensive area of southern Australia but have been reduced by up to 95% over the past 150 years as a result of land clearing for agriculture. We reviewed literature, made predictions and identified knowledge gaps for future research. We moved beyond the scope of previous reviews of the value of revegetated areas and replantings for bird assembles as determined by studies of species occurrence patterns, that is, whether species had simply been detected in revegetated areas. To extend our knowledge, we reviewed the scientific literature on how restoration plantings might influence the long-term survival and persistence of woodland bird communities in fragmented agricultural landscapes. This included an assessment of studies that have documented breeding success in restoration plantings.

To identify relevant literature, we searched publication databases and citation lists for examples of work on patterns of occurrence but also studies of breeding success in revegetated or restored areas.

Prior research and future directions

Most prior research in Australia focused on the potential suitability of habitats in restoration plantings such as presence/abundance and species richness of birds in revegetated areas. That is, they have examined the pattern of occurrence rather than the ecological mechanisms (like breeding success) that can underpin such patterns. "Pattern-based" studies have been employed to investigate the effects of habitat loss, fragmentation and degradation on declining woodland bird species. More direct measures of habitat suitability or population persistence, such as breeding success, have rarely been used in Australia.

Further, we consider that setting measurable goals for restoration is crucial, and it underpins how we define long-term success in a restoration context. This should include assessing the capacity of restoration plantings to support breeding populations. However, this has rarely been measured in restoration monitoring projects and should become a standard part of restoration programs in the future. One of the best metrics for quantifying breeding success is to determine how many bird species are attempting to breed and how many young are successfully fledged to independence. Gathering data on such metrics is demanding and time-consuming but nevertheless important for assessing the

Table 1. Future research directions. Summary of past and present research on birds in fragmented agricultural landscapes and landscapes undergoing habitat restoration, with recommended future research directions.

Key area	Early work – conclusions	Recent work – conclusions	Future research directions
Distribution and abundance	(i) Woodland bird species, including species of conservation concern, occupy restoration plantings (ii) Restoration plantings and remnant sites support different bird communities	Restoration plantings may not act as habitat refuges for woodland birds, including species of conservation concern	Factors influencing habitat selection by woodland birds in fragmented agricultural landscapes
Population dynamics	Importance of understanding interactions between habitat selection and habitat quality	Understanding factors that influence colonisation of high-quality sites can inform management decisions	Quantifying habitat quality in restoration plantings; identifying potential ecological trap mechanisms in revegetated landscapes
Resources	Food resource availability lower in smaller than in larger woodland fragments	Restoration plantings may take decades to develop habitat features of remnant sites, such as nest hollows	Resource availability (food and nesting sites) in restoration plantings
	Beetle assemblage composition closely linked to microhabitat variables e.g. fallen logs	Beetle assemblages may show either positive or neutral responses to habitat restoration	Responses of invertebrate prey of woodland birds to restoration
Breeding success	Nest failures in plantings is mostly due to predation	Little evidence of successful breeding in restoration plantings	Quantifying nest success in restoration plantings, identifying causes of success/ failure
Species interactions	Conflicting results; nest predation may be same in small and large fragments, or increased by edge-effects in small fragments	Intense nest predation likely cause of decline for woodland bird species of conservation concern	Quantifying nest predation, identifying primary nest predators in restoration plantings
	Work in North American shows that brood parasitism by brown-headed cowbirds (Molothrus ater) is lower in restored than in remnant landscapes	Horsfield's bronze-cuckoo (*Chrysococcyx basalis*) may be dependent on large habitat fragments	Brood parasitism in temperate woodland restoration plantings
	Noisy miner disrupts and excludes small insectivorous birds from habitat patches in fragmented landscapes	Noisy miner main driver of bird distribution patterns in fragmented woodlands, prevents restoration plantings acting as habitat refuges	Effects of noisy miner removal on landscape-level bird species distribution patterns and restoration planting occupancy

Cited material

This factsheet summarises findings from the following paper:
Belder, D. J., Pierson, J. C., Ikin, K., and Lindenmayer, D. B. (2018). Beyond pattern to process: Current themes and future directions for the conservation of woodland birds through restoration plantings. *Wildlife Research* 45, 473–489. doi:10.1071/WR17156

Further information

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Prior research and future directions (continued)

effectiveness (or otherwise) of restoration programs designed to promote the recovery of biodiversity in degraded agricultural landscapes.

Previous research has discovered that some woodland bird species, including species of conservation concern, will readily occupy restoration plantings. Indeed, some of these species may even prefer to use plantings over remnant woodland. However, the occurrence of species in plantings may not mean that they can persist in the long term in such places, nor breed successfully in them. Indeed, restored habitats, including restoration plantings, have the potential to become "ecological traps" for bird populations. Ecological traps occur when individuals colonise sites that are of inferior habitat quality or they are occupied by predators that cause reduced breeding success. If restoration plantings act as ecological traps, then population declines may be worsened rather than reversed by the extensive planting of native vegetation.

Our review revealed that metrics associated with the occurrence of species, rather than metrics for long-term survival and breeding success may mask key issues such as whether restoration plantings are acting as ecological traps. As many Australian woodland birds are long-lived, with a lifespan of 10 to 20 years common among them, there may be a time lag before the effects of a potential ecological trap mechanism become apparent. It is therefore important to assess whether woodland birds are able to breed successfully in restoration plantings. Our synthesis of information looked at factors that may influence breeding success in restoration plantings. From this synthesis, we developed a set of future research questions based on early and recent work in key areas. These are provided in a table of future research directions – see Table 1.

Recommendations

Our results and recommendations will be relevant to researchers in the field of conservation biology and land managers or project managers seeking to assess the success of conservation projects. They may be applied by focusing future research on the questions of interest that we highlight, and by using population-oriented metrics when assessing conservation success.

To prevent and reverse the ongoing decline of Australia's woodland birds, and to re-establish endangered habitat in highly fragmented agricultural landscapes, it is vital that temperate woodland restoration efforts continue and increase over the coming years. However, to ensure that restoration plantings are both an ecologically effective and cost-effective biodiversity conservation strategy, it is also essential for their design and management to be informed by effective scientific research.

We emphasise that researchers should undertake more "process-oriented" rather than "pattern-focused" research to assess the success of restoration plantings as a conservation strategy. To the best of our knowledge, all past studies that have provided information to help guide future restoration efforts in Australia have been based on pattern data. Developing a comprehensive understanding of the ecology of woodland birds in revegetated landscapes is fundamental to devising knowledge-based solutions to reverse species decline, and a necessary key step is to move beyond pattern data towards quantifying population responses of birds to habitat restoration.

We recommend that future research on restoration plantings focus on the areas of interest and knowledge gaps identified in our review and summarised in Table 1, with an emphasis on exploring factors at the landscape and patch scale that are likely to contribute to restoration planting acting as ecological traps.

Finally, a more thorough approach to monitoring restored habitats is required to determine their ability to support breeding populations of woodland birds. Crucially, the capacity to accurately evaluate the success of restoration plantings in achieving intended conservation goals underpins effective utilisation of conservation resources, as well as ecologically sound environmental management.

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