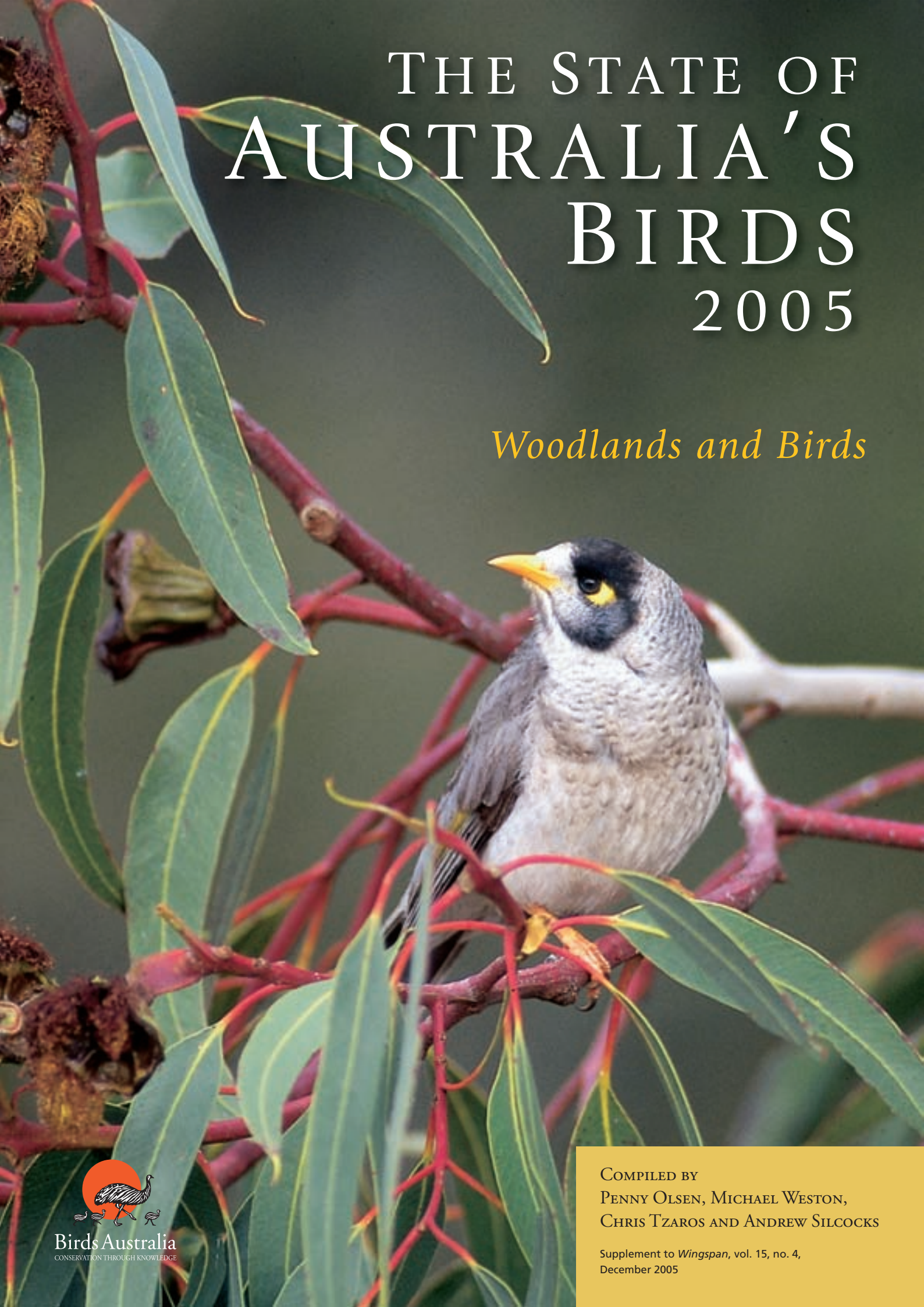


The State of Australia's Birds 2005

Woodlands and Birds

Compiled by
Penny Olsen, Michael Weston,
Chris Tzaros and Andrew Silcocks

Supplement to *Wingspan*, vol. 15, no. 4,
December 2005

Birds Australia
CONSERVATION THROUGH KNOWLEDGE

The State of Australia's Birds presents an overview of the status of Australia's birds, the major threats they face and the conservation actions needed. This third annual report focuses on woodland birds. Woodlands once covered one-third of the continent. The 'great Australian bush', with its kookaburras and magpies, is part of our national identity. Yet, in the south much of the bush has given way to agriculture. In the north, the trees may remain but savannas are degraded by livestock grazing, the effect of which is exacerbated by invasive grasses in combination with inappropriate fire regimes. It should come as no surprise that woodland plant and animal communities are the most threatened in the nation. Clearing reforms are welcome and restoration is underway, but temperate woodland remnants continue to erode and bird species losses seem probable in coming years. Across the northern woodlands, seed-eaters will continue to decline unless grazing, invasive pasture grasses and fire are better managed. In the agricultural lands the situation is critical, with cessation of incremental clearing, lessening of grazing pressure and restoration of woodlands priorities for action. This includes the return of structural and spatial diversity: trees, shrubs, litter, ground cover and other elements in a patchy mosaic. Putting the bush back into our bushlands.

'Even in countries with such deep rich soils, moist and temperate climate, and extremely favourable constitution for cropping as central and eastern Europe, it is considered by those who have studied the question that one-third of the area should be kept under forest or heath vegetation; for the drier parts of Australia one-half would not be too much.' Tepper (1896)

The Regent Honeyeater—once common across the south-east, now all but extinct in Victoria and just hanging-on in New South Wales. Photo by **Chris Tzaros**

Key Points

There is mixed news on the status of Australia's woodland birds, but it is clear that in agricultural and pastoral lands the overall situation is bleak. Some positive initiatives are underpinned by bilateral agreements between Federal and State/Territory Governments, particularly clearing controls and improvements in management strategies in the regions. However, sufficient recovery and restoration of once extensive southern woodlands are a long way off, and northern woodlands are also showing signs of widespread deterioration, with undesirable consequences for birds.

Favourable news

- The Australian Government is taking a leading role in woodland protection. In 2001 it listed Land Clearance as a Key Threatening Process under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and has since forged bilateral agreements with relevant States to end broadscale clearing of woodland.
- The EPBC Act confers greater legislative protection on Australia's woodlands, and their endangered inhabitants. Several woodland plant communities and woodland birds have been listed as threatened, highlighting their plight.
- Moves are under way to manage woodlands better, and governments are reforming their approaches to natural resource management in general. (Nonetheless, political, social and economic forces must be reconciled before these reforms are fully achievable.)
- In recent years, a regional focus has been adopted for natural resource management, which spreads the responsibility and shows promise for biodiversity management.
- There are signs that the belief that agricultural land has little conservation value is breaking down. Increasing numbers of private landowners are protecting and restoring woodlands on their properties.
- Some major initiatives, such as the Federal-State National Dryland Salinity Program, are likely to benefit both woodland birds and agriculture.
- Knowledge of woodland birds and their habitats is relatively good, but more research is needed, particularly on management and restoration actions and their effectiveness in maintaining native biota.

Unfavourable news

- One-third of Australia's woodlands and 80% of temperate woodland, the most threatened type, are cleared; less than 5% remains in some parts of southern Australia.
- The remaining vegetation is often fragmented, thinned or degraded and in need of active management to maintain it, which seldom occurs.
- Woodlands are poorly represented in reserves.
- Over one-third of Australia's landbird species are woodland dependent and at least one in five of these is threatened and in decline. In the Western Australian wheatbelt over 60% are in decline.
- Greatest bird population declines are in the agricultural areas of the south-west and south-east, where granivores and insectivores are most at risk. Across the tropical north, declines are now being detected, mainly among seed-eaters.
- Ground-feeders are significantly more likely to be declining or threatened than non-ground feeders, implicating changes to ground layer, litter and understorey as causal.
- Habitat loss is the single greatest threat to woodland birds and many other threats arise from or are exacerbated by it, such as the imbalance of Noisy Miners, predation by introduced foxes and cats, and salinity.
- For every 100 ha of southern woodland cleared an estimated 1000–2000 birds die.
- Clearing controls (e.g., legislation and bilateral agreements) do not guarantee protection of remaining woodland. Although broadscale clearing will cease late in 2006, small-scale clearing, illegal clearing and deterioration in condition of remnants will continue. Paddock trees are particularly vulnerable to attrition.
- Compliance with existing clearing regulations and incremental loss of woodlands continue to be important issues for regulators and land managers.
- Clearing regulations do not cover ground layer clearance.
- In long-cleared rural parts of southern Australia, woodlands and their birds are under continued pressure from over-grazing and intensification of farming practices.
- In the north, grazing impacts are compounded by the spread of pasture grasses and fire.
- Short funding cycles and uncertainty of funding hamper the continuity of management actions and monitoring required to effectively restore woodlands and their birds, tasks that will take at least decades.
- For some uncommon species information on their status and conservation needs is inadequate. Extinction processes are poorly understood.

Uncertain news

- With the shift to regional responsibility for natural resource planning and management, local responsibility for biodiversity has increased, but management of birds and their threats requires a cooperative effort across multiple regions.
- In agricultural landscapes, the retention of at least 30–35% of native vegetation has a high likelihood of maintaining diversity.
- Even where few trees remain, they have some value for woodland birds. However, small, isolated remnants and paddock trees do not support woodland bird populations in the long-term and without intervention the trees are doomed.
- Woodlands are meant to be 'messy', with young and old trees, dead stags, shrubs, grasses and other ground cover, logs, twigs and bark, and open grassy patches. Trees, understorey and litter not only benefit birds but improve ecosystem services that provide clean water, healthy soil, climate stability, natural control of diseases and resilience to drought.
- At least in the short-term, revegetation is a poor substitute for retention and protection of existing remnants. It is most successful when a few mature native trees remain, and plants of local provenance are used.
- There will always be some birds: woodland removal favours open-country species such as Galahs and Crested Pigeons over species in need of large tracts of intact woodland. Some woodland species are clever and adaptable and can over time learn to use new habitats and other resources.

Woodland birds to watch

- Many of the 32 woodland bird taxa (species or subspecies) listed as nationally threatened continue to decline. The status of further eight woodland taxa is such that they may meet the requirements for listing as nationally threatened: the western Victorian Pied Currawong as Critically Endangered; the Cape York Peninsula Star Finch as Endangered; and the Tasmanian Owlet-Nightjar, Tiwi Island Hooded Robin, Flinders Ranges Chestnut-rumped Heathwren, and King Island Yellow Wattlebird, Green Rosella and Black Currawong as Vulnerable.
- Other birds of concern include the Hooded Robin, Jacky Winter, White-browed and Dusky Woodswallows, White-throated Needletail, Black-chinned Honeyeater, Painted Honeyeater, Bush Stone-curlew, Grey-crowned (eastern) and White-browed (western) Babblers, Diamond Firetail, Squatter Pigeon (southern), Major Mitchell's Cockatoo, Masked Owl (southern), Barking Owl (southern), Crested Shrike-tit (western), which are still reasonably common but their populations appear to have declined substantially in recent years, especially in the south of the country.
- Active management of the Regent Honeyeater and south-eastern Red-tailed Black-Cockatoo may have halted declines, but populations are still at dangerously low levels and the honeyeater is but now all but extinct in its Victorian range. The Swift Parrot and Golden-shouldered Parrot number at most a few thousand—although greatly reduced, their populations may be stable.

Above: Brown Treecreeper, one of several woodland species declining in many agricultural regions of eastern Australia. Photo by **Tadao Shimba**

Left: '[A tree]…with a height of 20 m and a trunk diameter of 1.5 m has a bark surface area of approximately 94 square metres. A 20-year-old-tree with a trunk diameter of 20 cm and height of 15 m has a bark surface area of just 9 square metres. An animal can therefore forage as profitably on one large tree as on ten smaller trees, at the same time decreasing the risk of predation by not having to travel so often from one tree to the next.' Doug Robinson (1992). (York Gum, mid west Western Australia) Photo by **Marie Lochman, Lochman Transparencies**

Introduction

SINCE 2003 BIRDS AUSTRALIA has produced an annual *The State of Australia's Birds* (SOAB). The reports feed into Australia's State of Environment reporting. They collate and disseminate the latest information on trends in bird populations and threats to their survival, to inform Australians of the status of their birds and help bring about improved management of the land for birds and other elements of biodiversity. The reports also provide feedback to the dedicated thousands who volunteer their time and skills to monitor birds. The first SOAB (2003) was an overview of the state of the nation's birds, their major threats and progress towards improvement. The intention is to revisit the findings of that report after five years, in 2008, to assess change. The interim reports are thematic, addressing matters of national significance to birds.

In the midst of one of the most severe droughts in the nation's history, with waterways and wetlands of the south-east already suffering from inadequate environmental flows, reduced by water extraction, the theme of SOAB 2004, *Water, Wetlands and Birds* seemed timely. The report was launched in Perth by the Minister for the Environment and Heritage, Senator the Hon. Ian Campbell, and has been widely distributed. Since then there has been a little good news. The New South Wales government announced a $13 million two-year Wetland Recovery Plan to restore wetlands—with the significant but water-starved Gwydir wetlands and Macquarie Marshes as priority areas. The worrisome news is the misinformation in the media about the threat of a deadly epidemic of a potential new form of influenza, arising from bird influenza, which could result in futile destruction of wetland birds.

This year's SOAB was written as the drought broke in the south-east, promising improved conditions for birds. Trees help to buffer the land and its wildlife against drought, and this year's SOAB theme is *Woodlands and Birds*. Woodlands are Australia's most familiar landscape; at European settlement they covered 30% of the continent. Over 33% of our landbird species are primarily birds of woodlands. The first white explorers and settlers found continuous woodlands from Tamworth to Albury, on the western slopes of the great Dividing Ranges, to western Victoria and the Mount Lofty Ranges—White Box and Yellow Box, with stringybark and ironbark on the poorer slopes. In the south-east of the continent, the riverine plains were scattered with woodlands of Red Gum, Grey Box and Belah. The south-west mainland and central Tasmania also had their own unique woodlands.

Two centuries later, about 30% of woodlands nationally, and 80% of southern temperate woodlands, have been cleared, mostly for agriculture. In many of the southern remnants—often in less productive country—steep, rocky, wet or with less fertile soils—the shrubby understorey has been lost to clearing, fire, grazing, weeds or fertilisers, and the wildlife they support continues to decline. This is not simply a legacy from the past: land clearing increased from less than 400,000 ha annually in the early 1990s to over 500,000 ha in the early 2000s, mainly in Queensland. Since 2001 bilateral Federal-State agreements to halt broadscale clearing of woodlands have been reached in New South Wales, Victoria and Western Australia. In 2004, Queensland agreed to phase out broadscale clearing by late 2006, effectively ending official support for the practice in Australia, if all States uphold their responsibilities (see 'Threat from land clearing continues' p. 15).

Against this background of ever dwindling woodlands, for at least a decade there has been growing recognition that birds of temperate woodlands are among the most threatened in the country. More recently, concern has also been raised for the birds of northern savanna woodlands, where grazing, invasive pasture grasses and inadequate fire management are now recognised as the major cause of population crashes of birds, such as the Gouldian Finch.

Thirty-two woodland taxa are listed as nationally threatened under the EPBC Act. The list is growing: the Chestnut-rumped Heathwren of the Mt Lofty Ranges was added this year. In the agricultural and pastoral zones ground-feeding birds in particular are in significant decline. Overall, at least one in five woodland birds is known to be in trouble, but the proportion is suspected to be higher.

This is a very poor record, and with continued inadequate woodland management, species are likely to be lost. With the cessation of broadscale clearing by the end of 2006 the challenge will be to limit small-scale and illicit removal, repair remnants and revegetate appropriately. If the diversity of birds is to be maintained in Australia, structural diversity must be restored to woodlands by better management of livestock grazing, in particular, as well as fire and weeds. Where woodland is restored by revegetation or allowed to regenerate, declines in some species have been reversed at a local level, indicating that there is hope given sufficient, timely management action, and foresight: effective restoration will take decades.

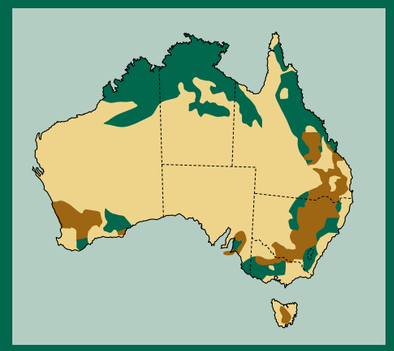
Woodlands are high priorities for addition to the protected areas system, but because most of these lands are privately owned, their management and the fate of their birds will depend on private landholders. The support of many thousands of Australians is needed to achieve the sweeping changes required.

This report begins with a national overview, followed by reports from several States and Territories, a chapter on major threats, a discussion of how much habitat is enough, and sections on restoring and improving woodlands, working with landholders, and reform. Further reading indicates the primary sources of information.

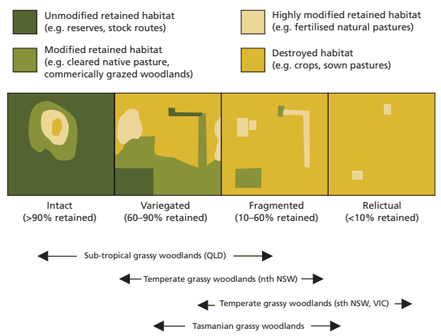
Clearing: disappearing woodlands, disappearing wildlife

Clearing of native vegetation results in the spread of dryland salinity, soil loss and erosion, deterioration of water quality, adds to the greenhouse effect, lowers productivity, and facilitates the establishment of weeds and other exotic species. Not least, clearing, mostly for agriculture, is the single greatest threat to Australia's woodland birds. It destroys habitat for birds, both immediately and in the long-term from the gradual degradation and lack of regeneration that often follows. For every 100 ha of southern woodland cleared an estimated 1000–2000 birds die, as well as many other organisms. As woodlands are cleared, tree patches become reduced in size and isolated, with associated loss of wildlife and isolation impacts on remaining populations (both ecological and genetic). In turn, without birds and other wildlife to maintain their health woodlands deteriorate further. For example, extensive insect-related tree dieback in Victoria, New South Wales and Queensland is the direct result of the loss of ecological balance between woodlands and wildlife.

But clearing didn't all occur years ago, as is commonly perceived. Since the early 1990s Australia has had one of the highest rates of land clearance in the world, concentrated in Queensland woodlands. When Queensland joins other States in cessation of broadscale clearing in 2006, the greatest threat to Australia's birds will be ameliorated. The risk remains that small-scale clearing, illegal clearing, and deterioration and lack of regeneration will eat away at the remnants. The task will be to retain, enhance and re-link what is left.



Natural distribution of grassy and shrubby eucalypt woodlands (dark green) and areas extensively cleared of native vegetation (tan). Redrawn from **McIntyre et al. (2002)**



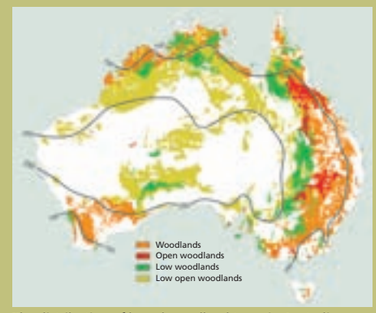
Altered woodland landscapes typically associated with agricultural lands in the various regions. Modified from **McIntyre et al. (2002)**

Varied Sittela, holding its own except where Noisy Miners are in over-abundance. Photo by **Chris Tzaros**

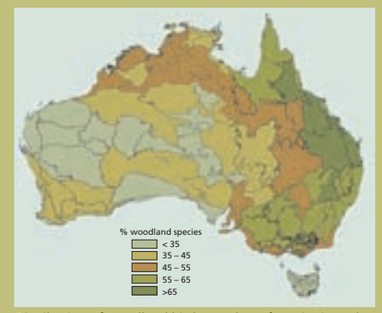
Woodlands and their birds

The simplest way to distinguish woodland from forest is by the height and spacing of trees. Trees in both woodland and forest are often 10–30 m in height, but in woodlands their crowns are deeper and do not touch. Woodlands can also be lower than 10 m in height. Many types of woodland have a tree layer, an understorey and ground cover, but there is a range of understorey and ground cover types and not all woodlands have both. Coastwards, woodlands grade into grassy forests and heaths, and inland they meet shrubland and desert.

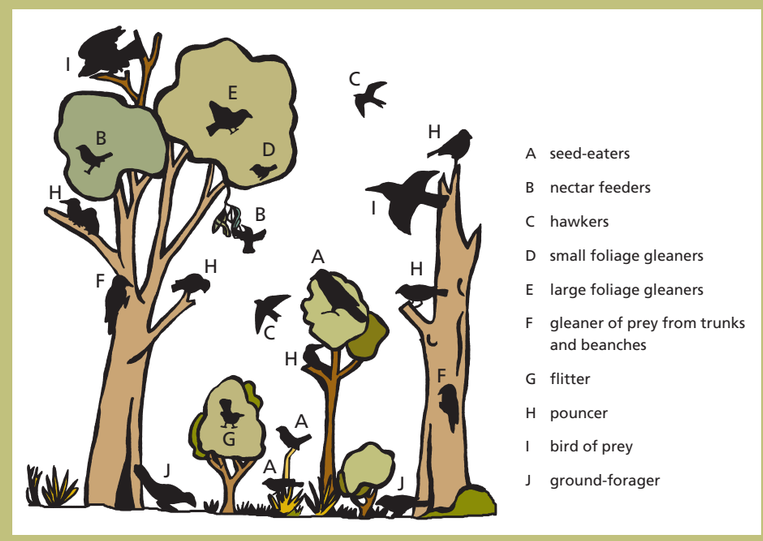
Woodland birds are those that are primarily dependent on woodland to feed and/or breed; they come in great variety (see illustration).



The distribution of broad woodland types in Australia (contours show average annual rainfall isohyets). Map from Lindenmayer et al. (2005), redrawn from Johnson (2003) *Ecology: An Australian Perspective*, based on *Atlas of Australian Resources—Vegetation* (1990), prepared by **Troy Honeman and Will Smith**.



Distribution of woodland birds: number of species in each IBRA (Interim Biogeographical Regionalisation of Australia) region as a percentage of the total number of species (263), based on all recent Atlas records 1998–2005.



A typical woodland profile, with taller trees, smaller trees and shrubs forming an understorey, and ground cover. Structurally intact woodlands such as this support a diversity of birds exploiting the various foraging opportunities offered. Redrawn from **Williams and Woinarski** (1997)

The Barking Owl is declining in southern woodlands but still common across the north. **Photo by Jiri Lochman, Lochman Transparencies**

Managing for variety in woodlands on farms

For birds and production:

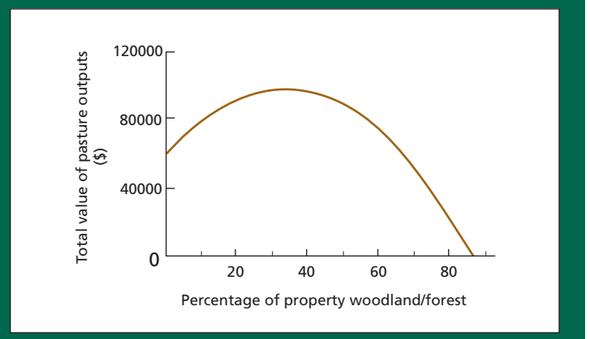
- **protect and restore woodland remnants, no matter how small. Wherever possible and appropriate, rebuild and reconnect patches (by regeneration and revegetation) to cover at least 30% of the landscape. Maximise plant variety and include locally appropriate native species (which are generally low maintenance, drought resistant and need no/little fertiliser). Allow for litter, logs and understorey.**
- **wherever possible limit agriculture to a maximum of 70% of the farm, including intensive agriculture which is best limited to 30% of the farm. Where smaller farms are involved, these percentages can be applied across the landscape of land-uses in the region.**
- **employ various combinations of stocking rate, season of grazing, season and duration of rest. If necessary exclude livestock from certain areas to allow regeneration. In general, for both production and biodiversity on pastoral lands, short intense periods of grazing followed by periods of rest are better than prolonged grazing.**
- **As much as possible, manage for the worst years—as for crops and livestock, so too for birds, which also need the good years to recover from the bad.**
- **do not plant species that are invasive, and control those that have already become weeds.**
- **manage for a mosaic of fire ages, and balance grazing, fire and local species' sensitivity to fire.**

Apart from the benefits to birds and other wildlife, healthy woodlands can stabilise the land, help manage hydrology and salinity, offer shade and shelter, anchor stream banks and filter water, enhance the environment, and improve market value and saleability. (Also see box 'Providing information: the Darling Downs land manager's guide' p. 27).

Retain at least 30% of woodland for sustainable bird populations and farm production values

'[To maintain production in grazing lands] many situations require at least 30% of the catchment to be tree-covered to stabilise or ameliorate degradation, in some cases the whole catchment would require replanting.' **Walker et al. (1998)**

While reduction of 70% of the original area of woodland obviously removes woodland bird habitat, there is evidence that retention of 30% reduces the impacts of small patch size and isolation on wildlife, particularly for mobile animals like birds, at the same time maximising pasture production. For example, Birds Australia's Birds on Farms survey of 333 southern Australian farmers, showed that, overall, for every 10% increase in tree cover across a whole farm site (50 ha area), the diversity of woodland birds increased by 7%; however, there was a similar diversity of birds on farms with 30% cover and those with 70%. Small area farms may not be able to spare a minimum of 30% to woodlands, so this proportion can be striven for at a catchment level, for example. (Also see 'How much habitat is enough' p. 18)



Some models indicate that where remnant vegetation covers 34% of a property, pasture productivity is highest. Redrawn from **Walpole** (1999)

National Overview

Birds Australia has conducted two nationwide Atlases (1977–1981 and 1998 onwards), during which thousands of volunteers monitored birds. This section presents the broad patterns and changes between Atlases, and since commencement of the second Atlas. The comparison between Atlas periods indicated a general improvement in the status of landbirds, with 85% unchanged or increased in reporting rate (see table opposite), in part because of the wetter conditions that prevailed during the second Atlas. Such gross estimates are useful but have the danger of masking change in particular areas or species, especially in a country as large and diverse—in climate, habitats and birds—as Australia.

Indeed, the overall figures do create a false impression. In total, woodland birds follow the general trends, with 13% of species decreasing (see table opposite). However, separation into feeding guilds gives a very different picture. Woodland birds that feed on the ground are markedly less secure, with 24% of species declining. Several regional studies have also identified this group as declining from loss of understorey and general habitat complexity, due to overgrazing, inappropriate fire regimes, weed invasion, clearing and firewood removal.

Because woodland grades into grassland, and many bird species use both habitats, grassland species were also analysed: more than one-third had declined significantly by the second Atlas. This finding adds weight to the evidence that ground cover change is primarily responsible for the declines.

The decreasing woodland ground feeders occur mainly in the agricultural areas of the south-west and south-east, and in pastoral country of Cape York and the Top End, but particularly in the far Top End and south-west wheatbelt (see map at right). Although it appears from this map that bird diversity has not changed between Atlases in some long cleared south-eastern regions, the expectation is that they would have increased due to the wetter conditions during the second Atlas.

Trends in the last eight years suggest that at least some woodland species are continuing to decline, eg. Zebra Finch, Jacky Winter and Dusky Woodswallow (see graph top right). Four examples show that regions of greatest change are the agricultural areas of the south-east, south-west and northern Australia (see map p. 8 lower left), as for woodland birds in general. The worst affected areas also tend to be those where the greatest amount of native vegetation has been cleared. The northern savannas have not been cleared but grazing, fire and weeds have degraded large areas (see Northern Territory report p. 9). These areas of greatest decrease in bird populations are also echoed in the distribution of threatened species (see map p. 8 lower right).

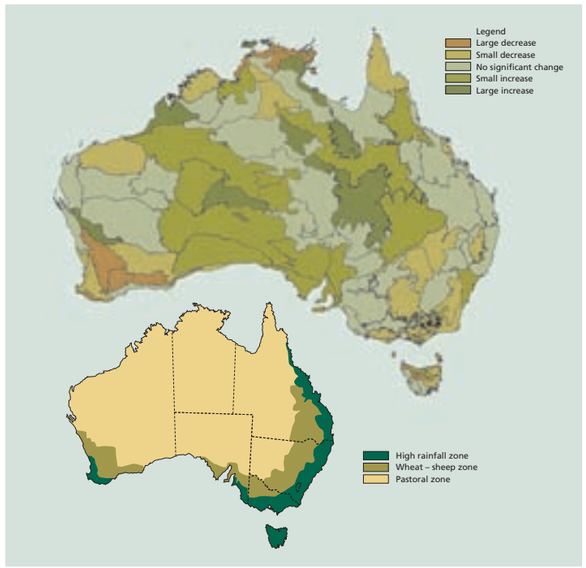
Under the Australian Government's EPBC Act, 32 woodland taxa are listed as nationally threatened; four of those are extinct (see table p. 8). The list is growing: the Mt Lofty Ranges Chestnut-rumped Heathwren was added this year, and the Tiwi Islands Hooded Robin is feared extinct. No taxon has been delisted or downlisted because its status has improved. A nationwide, expert-reviewed assessment *The Action Plan for Australian Birds* identified eight additional woodland taxa as threatened (see table p. 8). The review also identified a number of Near Threatened woodland birds; together these threatened species are concentrated in the south-west, south-east and northern agricultural-pastoral zone (see map p. 8 lower right), and on offshore islands.

When Atlas results and threatened species lists are combined it is evident that at least one in five woodland bird species is threatened or declining.

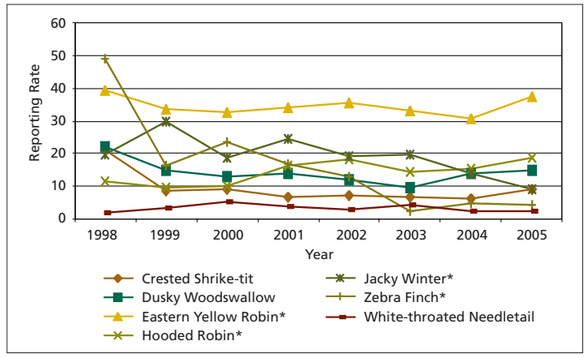
The percentage of species which declined, showed no change, or increased significantly in reporting rate[1] in a comparison between the two Atlas periods[2]: 1977–1981 and 1998–2002.

Habitat/feeding niche[3]	No. of species[4]	Decrease	No change	Increase
All woodland species	196	13%	38%	48%
Woodland ground feeders	71	24%	41%	35%
Woodland non-ground feeders	95	4%	35%	61%
All grassland species	71	37%	38%	25%
Grassland ground feeders	59	36%	36%	29%
Grassland non-ground feeders	8	13%	75%	13%
All ground feeders (woodland and grassland)	130	29%	38%	32%
All non-ground feeders (woodland and grassland)	103	5%	38%	57%
All landbirds[5]	422	15%	48%	37%

1 Reporting rate is an estimate of abundance—no. records of presence of species/no. surveys, in this case statistically adjusted for variation in survey effort and seasonality, etc. (see Barrett et al. 2003 for methodology).
2 It should be noted that each Atlas is a snapshot in time, hence any differences between them do not necessarily reflect long-term trends. Nonetheless, interpreted cautiously, with regard to other information, the comparison can be a useful indicator of change.
3 Categorised according to Silcocks et al. (2005). Some species were classed as both woodland and grassland species, and the feeding categories exclude species that feed both on and off the ground, hence the totals differ.
4 Species for which sufficient data were available for analysis. Data were corrected for variation in effort (see Barrett et al. 2003 for statistical methodology).
5 Includes a few waders and waterbirds.



Change in species richness (number of species) of woodland ground feeders in each IBRA region between two five-year Atlas periods, 1977–1981 and 1999–2004 (Atlas of Australian Birds data as in Table 1). Large decrease >-10%; small decrease -10% to -3%; no change -3% to 3%; small increase 3% to 10%; large increase >10%. The inset shows Australia's main agricultural land uses.

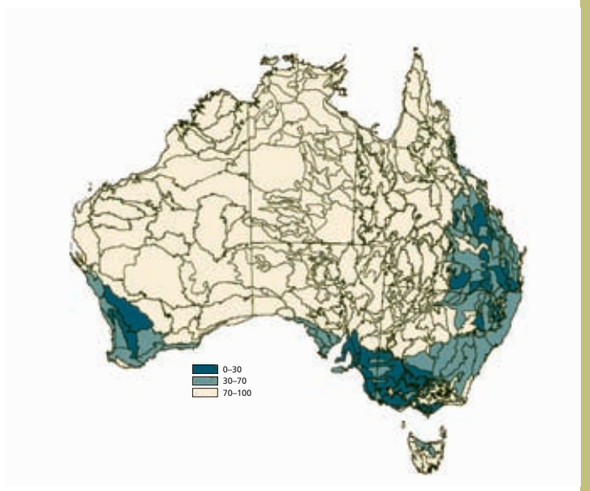


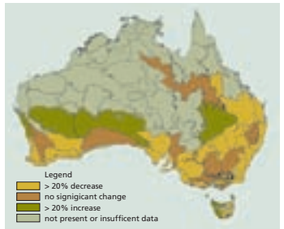
Recent trends in annual reporting rate, an estimate of abundance, based on repeated surveys in 2 ha plots with a minimum of three years' data (reporting rate = no. surveys during which that species was detected/total no. surveys x 100). All these species showed significant decreases in reporting rate between Atlases (1977–1981 and 1998–2002). An asterisk indicates species that are ground feeders, the others are non-ground feeders.

Below: The Australian Owlet-nightjar: the Tasmanian subspecies is increasingly uncommon and probably meets the requirements for listing as nationally vulnerable. It needs tree holes to roost in by day, and for nesting. Photo by **Tadao Shimba**

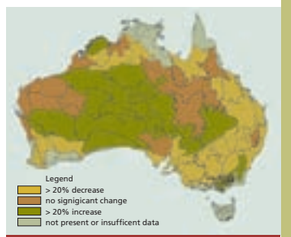
Far below: A Chestnut-rumped Heathwren—the Mt Lofty subspecies is the most recent addition to the national threatened species list, due to loss and deterioration of its woodland habitat, especially the shrubby understorey in which it lives. Photo by **Graeme Chapman**

With some two-thirds of woodlands cleared nationally, remnants like this are all that is left for woodland birds in many parts of southern Australia; but they are often too small and have lost understorey and ground cover, so that they do not support viable populations, nor do the remnants themselves persist if grazing and other degrading processes continue to prevent regeneration. Photo by **John Kleczkowski, Lochman Transparencies**

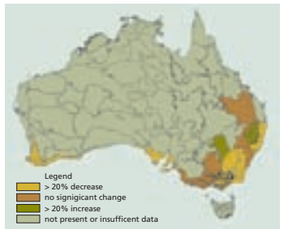




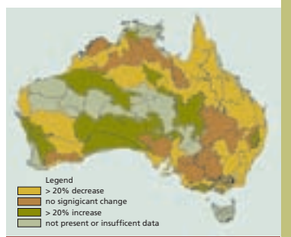
Dusky Woodswallow



Zebra Finch



Crested Shrike-tit



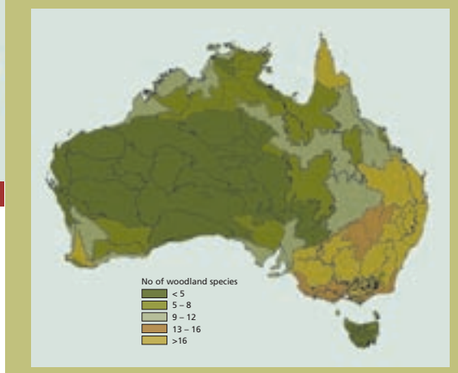
Jacky Winter

Change in reporting rate, a measure of abundance (see table p. 7), in each IBRA region in the second Atlas (1998–2002) compared with the first (1977–1981) for four declining woodland species: two non-ground feeders (a, b) and two ground feeders (c, d). In southern and eastern Australia, the areas of greatest decline tend to correspond to areas of greatest change in native vegetation cover (see map above which shows the percentage of native vegetation remaining in each IBRA region).

Woodland bird taxa (species or subspecies) listed as threatened[1] under the EPBC Act and/or according to *The Action Plan for Australian Birds 2000* (Garnett and Crowley 2000).

Taxa	EPBC Act[1]	Action Plan[1]
Emu (Tasmanian subspecies)	Ex	Ex
Kangaroo Island Emu	Ex	Ex
King Island Emu	Ex	Ex
Malleefowl	V	V
Red Goshawk	V	V
Buff-breasted Button-quail	E	E
Partridge Pigeon (western subspecies)	V	V
Partridge Pigeon (eastern subspecies)	V	NT
Squatter Pigeon (southern subspecies)	V	NT
Red-tailed Black-Cockatoo (south-eastern subspecies)	E	E
Glossy Black-Cockatoo (Kangaroo Island subspecies)	E	E
Carnaby's (Short-billed) Black-Cockatoo	E	E
Baudin's (Long-billed) Black-Cockatoo	V	NT
Western Long-billed (Muir's) Corella	V	E
Superb Parrot	V	V
Regent Parrot (eastern subspecies)	V	E
Green Rosella (King Island subspecies)	–	V
Swift Parrot	E	E
Golden-shouldered Parrot	E	E
Paradise Parrot	Ex	Ex
Masked Owl (Tiwi Islands subspecies)	V	E
Masked Owl (northern subspecies)	V	NT
Australian Owlet-nightjar (Tasmanian subspecies)	–	V
Purple-crowned Fairy-wren (western subspecies)	V	NT
Forty-spotted Pardalote	E	E
Chestnut-rumped Heathwren (Mt Lofty Ranges subspecies)	E	E
Chestnut-rumped Heathwren (Flinders Ranges subspecies)	–	V
Brown Thornbill (King Island subspecies)	E	CE
Yellow Wattlebird (King Island subspecies)	–	V
Regent Honeyeater	E	E
Helmeted Honeyeater	E	CE
Hooded Robin (Tiwi Islands subspecies)	–	V
Spotted Quail-thrush (Mt Lofty Ranges subspecies)	CE	CE
Crested Shrike-tit (northern subspecies)	V	E
Pied Currawong (western Victorian subspecies)	–	CE
Black Currawong (King Island subspecies)	–	V
Black-throated Finch (southern subspecies)	E	V
Star Finch (Cape York Peninsula subspecies)	–	E
Star Finch (southern subspecies)	E	CE
Gouldian Finch	E	E

[1]Threat categories are: Ex = Extinct; CR = Critically Endangered; E = Endangered; V = Vulnerable. The Action Plan also has an additional category Near Threatened (NT), which is included only for species listed as threatened federally but considered NT in the Action Plan.



The number of threatened woodland taxa in each IBRA region (those listed as threatened under the EPBC Act and according to Garnett and Crowley (2000), including Near Threatened taxa).

Regional Reports
Northern Territory

Woodlands remain extensive and little diminished in the Northern Territory (see table). The proportion cleared (0.9%) is low compared with that of other States/Territories, and relative to most woodlands internationally. Notwithstanding the extent of these woodlands, the conservation reserve system is limited (<4%), and provides a particularly poor representation of some woodland types. Outside the meagre reserve system, most lands are either pastoral leaseholds or Aboriginal freehold, implying that their future is heavily dependent upon the environmental understanding and concern of the landowners, and the development of conservation options, implementation of good management practices, and enhanced management capability.

Across the Northern Territory, the structure and composition of woodland formations vary substantially. Desert Oak and Mulga dominate the open woodlands in the arid centre of the continent, where River Red Gum woodlands form narrow corridors along typically dry watercourses. In the monsoonal, higher-rainfall north, woodlands and open forests co-dominated by Darwin Woollybutt and Darwin Stringybark form Australia's most extensive woodland formation, and in seasonally inundated floodplains and riparian areas various paperbark woodlands are extensive.

In the Northern Territory, bird communities and their status are as variable as this broad environmental palette, but they share are a number of characteristics:

(i) there are remarkably few exotic bird species, and these few are almost entirely restricted to urban areas;
(ii) granivorous (seed-eating) birds (such as finches, pigeons and parrots) comprise a high proportion of the bird community; and
(iii) many birds (especially honeyeaters, raptors and granivores) are highly dispersive, moving over large areas in response to seasonal or irregular variation in resources.

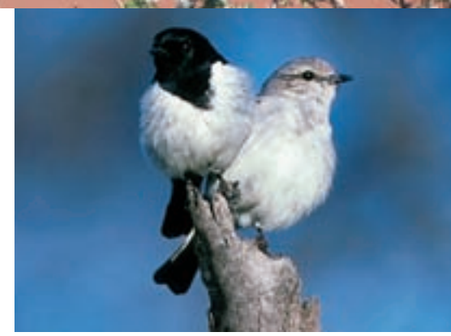
The conservation outlook for woodland birds in northern and central Australia differs from that in temperate areas. The limited amount of clearing, fragmentation and acute habitat degradation, means that many birds remain common in the northern woodlands, whereas they (or their close relatives) have suffered major declines in temperate areas. For example, Red-tailed Black-Cockatoos and Grey-crowned Babblers are common birds in Darwin and across the woodlands of northern Australia; in contrast, they are highly restricted and threatened in woodlands of south-eastern Australia.

The conservation problems for Northern Territory woodland birds are not so much conspicuous clearing and human development, but nuanced alteration of habitat caused by decadal scale changes in fire regimes, and by the almost pervasive presence of livestock, feral or otherwise. These impacts are compounded by the spread of weeds, particularly pasture grasses that have proven to be invasive. In fact, the Territory's extensive woodlands present something of a misleading veneer: most residents and visitors viewing these woodlands see the trees, but not the ecologically important changes to the other constituent pieces, particularly the understorey.

The decline of many granivorous birds in these savanna woodlands is perhaps the most recognised conservation problem in northern Australia. There are trees in these northern woodlands, but the dominant vegetation layer is often the dense, tall (typically 2–3 m) grassland layer. Each year this produces a glut of seeds—rich pickings for seed-eating birds. Seed production is typically highly seasonal, and there are few seeds available in the late Dry and early Wet season—these are lean times for most obligate seed-eating birds. During this time of natural shortage, grass species that germinate or produce seed slightly out of phase with most other species may provide the crucial difference between survival and starvation. Loss or diminution of these lean-season grass species is likely to have profound conservation impacts. It appears that such changes are already widespread, caused by combinations of grazing, invasion of exotic grass competitors, and altered fire regimes. At least a quarter of all seed-eating bird species in the northern woodlands have suffered substantial decline over the last century. These include the nationally threatened Gouldian Finch and Partridge Pigeon.

But it is not seed-eating birds alone that have conservation problems. That archetypical loser in woodland fragmentation in temperate Australia—the Hooded Robin—also appears to be in trouble in the eucalypt woodlands of northern Australia. A subspecies restricted to the Tiwi Islands off Darwin may well have become extinct recently; there have been no records for more than a decade, despite substantial search effort. At Cobourg Peninsula on the Northern Territory mainland, John Gilbert recorded Hooded Robins in 1840–1841, but none has been reported since. The problem for Hooded Robins here may be simply too much grass, which interferes with their preferred ground foraging. Historically, fine-scale burning of understorey by Aboriginal people probably allowed the development of an intricate patchwork of burnt and unburnt areas, supporting the persistence of species with specialised foraging requirements. Fortunately, the Hooded Robin remains common in some woodlands where grass cover is sparse, such as in Mulga and Lancewood woodlands. However, altered fire regimes may threaten it even in these refuges, as an increasing incidence of extensive high intensity fires eats into the extent and integrity of these woodlands.

by John Woinarski, *Department of Natural Resources, Environment and the Arts, Northern Territory*



Top: Zebra Finches are one of several seed-eaters typical of northern Australia that are declining in the savanna woodlands because of extensive groundcover changes from various combinations of grazing (by drought-hardy breeds of cattle), fire and invasive pasture grasses. Photo by **Lynn Pedler**

Above: A pair of Hooded Robins, a species which needs litter and fallen branches to hunt among. This well-known example of a declining woodland bird in southern agricultural areas is also faring poorly in the north. Photo by **Graeme Chapman**

Extent of woodlands in the Northern Territory[1]

Woodland type	Extent (km²)	% in National Parks	% in pastoral lands	% in Aboriginal lands
Eucalypt open forest	57,133	13.2	6.5	72.5
Eucalypt woodland	455,152	8.9	52.3	30.3
Melaleuca open forest	1,539	28.0	13.0	58.0
Melaleuca woodland	13,275	8.5	47.0	38.0
Acacia woodlands and open forest	75,710	0.5	85.2	12.5
Mixed-species woodlands	82,763	3.9	22.6	72.9

[1]Note that divisions between 'open forest' and 'woodlands' are somewhat indefinite. Mixed-species' woodlands are mainly dominated by *Terminalia* species. Note also that the percentages do not necessarily add to 100 because of the existence of some minor tenure types.

Rufous Treecreeper (at left) and Chestnut Quail-thrush (above) are woodland species extinct or reduced to relictual populations in a tiny handful of wheatbelt woodlands, but are faring better in extant woodlands to the east. Photos by **Graeme Chapman**

South Western Australia

Many of the temperate woodlands of Western Australia are floristically diverse and form part of Australia's only global biodiversity hotspot, the Southwest Australia Ecoregion. This species richness often translates into particularly productive systems for birds. For example, intact Wandoo woodlands support high numbers of nectarivores, insectivores and other birds. Unfortunately, 98% of Wandoo woodlands have been cleared.

Eucalypt woodlands were once widespread in southern Western Australia. They mostly occurred in a mosaic with heathlands, mallee and salt lakes, in contrast to eastern Australia, where they intermixed with forest and smaller areas of grasslands. Nevertheless, as in the east, western eucalypt woodlands often occurred on relatively fertile soils, and so were preferentially cleared for agriculture.

Across the Western Australian agricultural area there were once extensive woodlands of numerous types, with the most common dominated by large eucalypts such as York Gum, Marri, Wandoo, Salmon Gum and Gimlet; others were dominated by various species of mallee eucalypts or *Allocasuarina*. Woodlands dominated by York Gum have suffered most: it is estimated that over 97% of the more than 40,000 km^2 of York Gum woodlands have been cleared and those that remain are highly susceptible to weed invasion. Less than 25% of other woodland types is left, and in the central wheatbelt, less than 5% of all native vegetation remains.

Some bird species have benefited from the clearing and regular supply of food and water. For example, the Australian Raven and Australian Ringneck have increased in numbers in woodlands and elsewhere. The Galah, Little Corella and Crested Pigeon are among those that have colonised from more open areas to the north.

However, in the wheatbelt, extensive loss of woodlands and degradation of much of the remainder, have had dramatic and probably irreversible impacts on woodland birds, leading to declines in range and/or abundance in about two-thirds of the bird species. Most (70%) of Australia's dryland salinity is in Western Australia. More than two million hectares (about 10%) of the State's wheatbelt is affected by secondary salinisation, and the area is steadily increasing, but impacts on birds are poorly understood. Work by Denis Saunders and others suggests that, for the wheatbelt as a whole, 49% of species are declining. For the 114 woodland species, 62% are declining, with the major impact being on the passerines, of which 75% are believed to be declining.

The declines in woodland birds involve a broad cross-section of the bird fauna, including raptors, parrots, cuckoos, owls, kingfishers, treecreepers, fairy-wrens, thornbills, robins and honeyeaters. Some species remain common in areas where extensive tracts of woodlands remain but are now uncommon or regionally extinct in parts of the wheatbelt where woodlands have been reduced to relatively small remnants. Yellow-plumed Honeyeater was once the most common honeyeater in Western Australia's woodlands and mallee, but has largely disappeared from the central wheatbelt, apparently due to the loss of productive woodlands where older trees provide abundant food.

East of the wheatbelt, the situation is better, as there are extensive uncleared woodlands, although some have been subject to various degrees of grazing, timber extraction and mining. While accurate data are lacking, it is clear that these woodlands hold nationally important populations of a range of declining woodland birds, including Malleefowl and Chestnut Quail-thrush. East of the clearing line, Gilbert's Whistler, Yellow-plumed Honeyeater and Rufous Treecreeper, reduced to relictual populations in a tiny handful of wheatbelt woodlands, are still relatively common in uncleared tall eucalypt and mallee woodlands.

On the Swan Coastal Plain there were once considerable areas of woodland, often dominated by *Banksia* and *Allocasuarina* species, or by eucalypts such as Tuart, or mixtures of these. Less than 10% of Tuart woodlands remain. Historically, the Banksia woodlands were not extensively cleared, as they occurred on deep sandy soils, but in recent decades clearing of all woodland types for urban expansion and intensive agriculture has been proceeding at a rapid pace, mostly leaving only small remnants. This extreme habitat loss and fragmentation and disturbance has also led to other problems including weed infestation and 'dieback' in Tuart and Flooded Gum, and is detrimental to a range of species. As in the wheatbelt, a range of species has declined noticeably, including some once common ones such as Scarlet and Western Yellow Robin and Grey Shrike-thrush, which do not persist in small remnants. The Crested Shrike-tit, Rufous Treecreeper and Grey Currawong are now extinct, or nearly so, in woodlands on the Swan Coastal Plain. Fortunately, these species survive, and are in most cases still abundant, in the relatively extensive uncleared forests and woodlands of the nearby Darling Range.

Critical things to do for south-western Australia's woodland birds include:

- Where relictual woodlands are failing to regenerate naturally, plan for their long-term regeneration. Halt degradation in existing woodlands, by excluding grazing, controlling feral predators, prohibiting firewood removal, eliminating weeds and buffering to reduce the effect of agricultural production on natural habitats (see box 'Grazing and cleaning up' p. 15)

Raise awareness and promote revegetation to minimise effects of salinisation, promote connectivity in key areas (see box 'Restoring connectivity' p. 23) and provide for nesting hollow replacement in the long-term (see box 'Revegetation for the future' p. 23).

by Allan Burbidge, *Department of Conservation and Land Management, Western Australia,* and Cheryl Gole, *Birds Australia Western Australia and WWF-Australia*

Australian Capital Territory

The Australian Capital Territory is fortunate to have regionally significant grassy woodlands still in good condition, mainly Yellow Box and Blakely's Red Gum, including several exceptional patches of over 100 ha. This includes the largest area of its kind in public hands within the Mulligan's Flat/Goorooyarroo Nature Reserve complex, as well as woodlands remaining on rural leaseholds, particularly in the Naas Valley.

Nevertheless, around 80% of the original lowland woodlands have been lost through urban and other development, and this has resulted in a fragmented landscape, with isolated populations of nationally declining species such as Brown Treecreeper and Hooded Robin.

Urban expansion continues to threaten the Territory's iconic woodlands, and there are emerging concerns about the proposed development in the Molonglo Valley, where river corridor, woodlands, grasslands and rural grazed lands provide habitats for 13 species of birds of prey, including Wedge-tailed Eagle and Peregrine Falcon. Woodlands in the northern part of the Valley have populations of Brown Treecreeper, an ACT-listed threatened species.

Canberra Ornithologists Group conducts an ongoing Woodland Bird Monitoring Project. Analysis of data on 61 woodland birds, from 142 monitoring points at 13 locations, collected between spring 1998 and winter 2004, has revealed that:

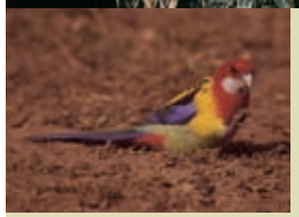
- 18 species (29%) show clear declining trends in detection rate. Some are resident species—including the Eastern Rosella, Red-rumped Parrot, Willie Wagtail, Superb Fairy-wren, Grey Currawong, and the introduced Common Starling and Common Myna, notably all ground feeders—and others are summer migrants such as the Noisy Friarbird, Dusky Woodswallow, Black-faced Cuckoo-shrike.
- 4 species (7%) show increases in detection rate; these include the Speckled Warbler, Common Bronzewing and Golden Whistler.
- 10 species (16%) have apparently stable detection rates. They include the Weebill, Rufous Whistler, Laughing Kookaburra, Crimson Rosella, Australian Magpie, Western and White-throated Gerygones, and Scarlet Robin.
- The remaining 29 species (48%) show irregular patterns of detection or indistinct trends (mostly declines). This group includes, Red Wattlebird, Grey Fantail, Pied Currawong, as well as two ACT threatened species Hooded Robin and Brown Treecreeper.

In addition to these overall trends, for a number of species short-term changes in detection rates appeared to correspond to periods of drought and/or sudden changes following the January 2003 bushfires. For example, Yellow-faced Honeyeaters, a migratory species breeding in the fire-affected ACT ranges, showed dramatic declines in the two post-fire surveys in the analysis. Continued monitoring will confirm whether the six-year declines in about one-third of woodland species, mainly ground-feeders and migrants, are persistent.

In the meantime, for the future of woodland birds in the ACT it will be important for local land managers to:

- continue to protect and manage remaining woodlands;
- maintain adequate buffers at the bush/urban interface and fire management zones outside woodland reserves, not within them;
- ensure viable connections for movement of birds and other wildlife; and
- facilitate regeneration and undertake restoration and rehabilitation; particularly at the grass/shrub/litter level, to improve structural complexity for the declining ground feeding birds.

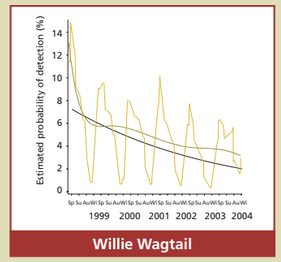
by Jenny Bounds, Alison Rowell and Ross Cunningham, *Canberra Ornithologists Group*



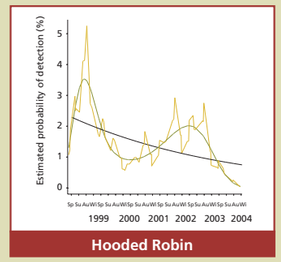
White-throated Gerygone at its bark and spider web nest built with material gleaned from woodland; its population in the ACT appears stable. Photo by **Graeme Chapman**

A surprise decliner in the Australian Capital Territory: the Eastern Rosella is one of several species that feed on the ground and are in decline due to ground cover changes. Photo by **Gunther Schmida, Lochman Transparencies**

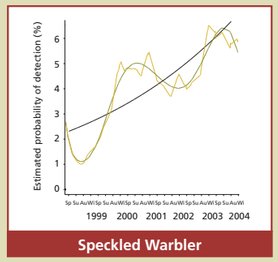
Trends in detection rates (no. surveys during which species detected/total no. surveys x 100) for five woodland bird species at 142 sites in the ACT, from spring 1998 to winter 2004. Trends are shown as: a mustard line, which is the statistically smoothed trend with a seasonal component; a green line, which is the overall smoothed trend; and a black line, which is the linear trend. The Eastern Rosella and Willie Wagtail showed a sustained decrease in detection rates; these are widespread, well-known species which have been previously assumed to be coping in a changing landscape. The Speckled Warbler increased in detection rate; this species occurred at sites with good quality or good structure shrub layer. Spring-summer migrants, the Western and White-throated Gerygones both showed indications of a slight but continued downward trend in detection rate. 147 surveys were made but not all sites were surveyed on all occasions and the trends were adjusted for unequal survey effort. The smoothed trend was determined using a regression spline, the seasonal component by a secondary harmonic, and the linear trend by linear logistic regression.



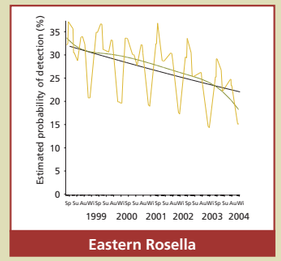
Willie Wagtail



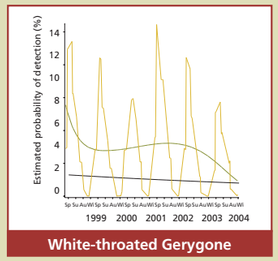
Hooded Robin



Speckled Warbler



Eastern Rosella



White-throated Gerygone

Left: The Bush Stone-curlew, declining across the south-east, nests and feeds on the ground. Loss of critical elements of their habitat, such as ground cover and litter, is extensive, and exposes them to predation. Photo by **Tadao Shimba**

Far left: The White-browed Treecreeper (eastern subspecies) is listed as Vulnerable in Victoria, where grazing and firewood collection are destroying what remains of its habitat. Photo by **Graeme Chapman**

Victoria

Birds of Victoria's woodlands face an uncertain future. Historical land clearing has been the major cause of decline of most woodland species in the State, and birds continue to suffer as a result of woodland deterioration, particularly changes to understorey shrubs and ground cover. Regent Honeyeaters once numbered in the thousands, but are now reduced to just a few birds at a handful of sites. Grey-crowned Babblers, Malleefowl and Bush Stone-curlews have experienced profound range contractions and population declines, and are largely restricted to just a few regions. Species such as the Hooded Robin and Diamond Firetail have disappeared from many districts, and are only hanging-on in others. Under State legislation, one-quarter of the 158 species of Victoria's woodland birds are listed as rare or threatened, or as a member of the threatened woodland bird community. These species may not be able to persist for much longer, unless existing threats are abated, and an attractive part of Australia's natural heritage will be lost if predicted woodland bird extinctions eventuate.

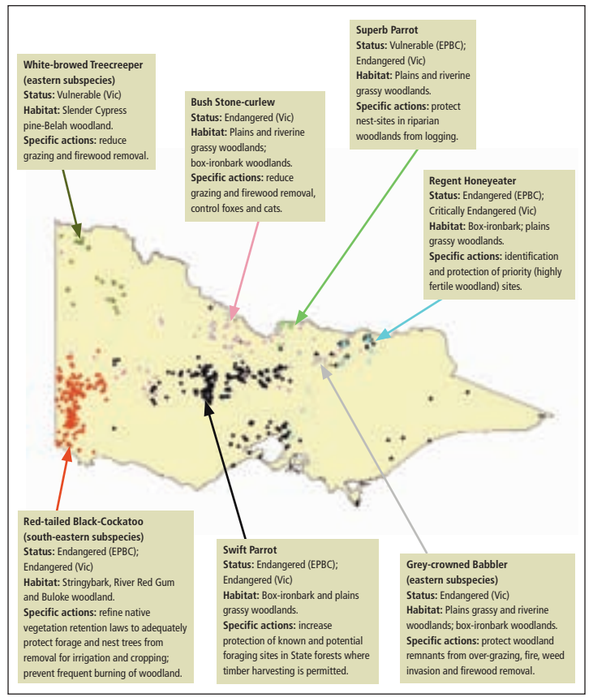
Several initiatives are underway to address the decline of birds in Victorian woodlands. An example is the recent proclamation of national parks and conservation reserves protecting 190,500 ha of box-ironbark and plains grassy woodland in central and northern Victoria—areas that would otherwise be subjected to an array of threatening processes such as timber removal, mining and over-grazing. Though these new reserves almost triple the amount of protected box-ironbark woodland on public land, the total represents under half (45%) of the present extent of this habitat on public land in the State, in an ecosystem that has already suffered an 85% loss since European settlement.

Currently, riverine grassy woodlands on public land in the north of the State are under tenure review, and there are ongoing acquisitions of high-quality private woodland remnants under the Department of Sustainability and Environment's conservation land purchase program. Over half of the most recent strategic land purchases for reservation have contained woodland vegetation, which will protect habitat for woodland birds.

There have also been refinements to legislative, policy and planning measures. Vegetation Protection Overlays under local government planning schemes and native vegetation retention controls under the State Native Vegetation Management Framework provide ongoing protection of woodland vegetation on private land, particularly at sites identified as important under the State's Biodiversity Action Planning scheme. In many woodland regions, the protection, restoration and improvement of connectivity of remnants on private land, and other on-ground activities, are supported through schemes and initiatives such as Land for Wildlife, Bush and Eco Tender and Trust for Nature.

However, despite the adoption of net gain principles, native vegetation retention laws limit but do not prevent woodland clearance, nor do they prevent ground layer disturbance. Further, the principles have yet to be implemented because the operational guidelines remain to be finalised. Approval to clear woodland patches is rarely granted, but applications to remove paddock trees are regularly authorised. In south-western Victoria, old paddock trees provide important food and nest sites for the endangered south-eastern subspecies of the Red-tailed Black-Cockatoo (see box 'Clearing of centuries-old trees threatens the south-eastern Red-tailed Black-Cockatoo'), yet many clearing approvals are granted to the developing centre-pivot irrigation industry. These woodland losses may seem insignificant in themselves but they chip away at the little that is left for Victoria's woodland birds.

by Chris Tzaros, *Birds Australia*



Distribution (Atlas of Australian Birds records 1998–2005; coloured dots), status (National EPBC Act and State FFG Act), and specific actions for selected threatened woodland birds in Victoria. The greatest need for all seven species is protection and restoration of their respective woodland habitats, including improving connectivity and the prevention of overgrazing to allow regeneration.

Tasmania

Relative to land area, Tasmania has the highest rate of native vegetation clearance in Australia. Whether for housing development, agricultural production or forestry, clearing and alteration of native vegetation pose a serious threat to the long-term survival of the State's woodland and forest birds.

Only fragments of the State's woodlands remain, felled years ago, but they continue to be cleared despite a more environmentally aware era. Removal of mature eucalypts is likely to be having an adverse impact on hollow-nesting birds. The reporting rate for the Southern Boobook, for example, has decreased markedly in the past 10 years, particularly in the south of the State (W. Wakefield pers comm.). Where mature eucalypts are retained, ground layer vegetation, logs and litter, which are perceived as a fire danger, are either cleared or burnt, leaving little or no understorey habitat. The intensification of agriculture, particularly cropping, often entails the clearing of remnant woodland or forest on farmland, or the removal of isolated paddock trees to facilitate the establishment of irrigation infrastructure. Acquisition of prime agricultural land for the establishment of plantations of Eucalypts nitens, widespread in the north-west of the State in the past decade, is now also occurring in the north-east. The impact of these activities on birds is yet to be assessed.

The status of Swift Parrot, listed under Tasmania's Threatened Species Protection Act 1995 (TSPA) and the Australian Government's EPBC Act, has worsened. This suggests that measures currently in place to ensure its survival are inadequate. Also of concern are those species currently regarded as common, but which may be adversely affected by the clearing and fragmentation of native vegetation, degradation of habitat through the incursion of weeds, and changing land use. For example, there has been a decline in reporting rates of Flame and Dusky Robins. Eastern Spinebills, Black-headed Honeyeaters and Tasmanian Scrubwrens seem unable to survive in small bush remnants (see box 'Birds disappear from remnants'). The Australian Owlet-nightjar, Shining Bronze-Cuckoo, Dusky Woodswallow, Fan-tailed Cuckoo, Brown Quail, Painted Button-quail and Spotted Quail-thrush are all being recorded less frequently.

Greater resources are needed to assess the impact of clearing and associated activities on forest and woodland birds.

by Sarah Lloyd, *Birds Tasmania*

Clockwise from top: The Painted Button-quail, Eastern Spinebill and Dusky Robin—unable to persist in woodland remnants that are too small or where understorey and ground cover are inadequate—are increasingly uncommon. Photos by **Tadao Shimba; Simon Nevill, Lochmann Transparencies; and Dave Watts, Lochman Transparencies**, respectively.

Birds disappear from remnants

Despite Landcare and similar programs aimed at fencing and preserving bush remnants, the intensification of farming and the conversion of remnant bush to plantations of *Pinus radiata* or *Eucalyptus nitens* are eroding remnant vegetation in northern Tasmania. Of patches that remain, many are small, isolated or degrading through the incursion of weeds (especially gorse and blackberries), and less able to support viable bird populations. Several bird species seem particularly vulnerable to reduced patch size, isolation and loss of structural diversity, particularly in the understorey.

The following examples are drawn from the Birds Australia's Birds on Farms project (1996–1998) and additional surveys made in remnants on 30 properties in northwest Tasmania, and from bird surveys conducted during Land for Wildlife property assessments:

- **The endemic Tasmanian Scrubwren was absent from a number of sites despite there being suitable habitat, apparently because the remnants were too small or isolated to sustain viable populations.**
- **In the northern Midlands, the endemic Yellow-throated Honeyeater was still widespread in all the remnant vegetation surveyed, but other honeyeaters were notable by their absence. The Eastern Spinebill, for example, was not recorded in an isolated, gorse-infested, 35-ha patch of remnant bush despite good heath and banksia habitat.**
- **As recently as 1995 the Flame Robin was regarded as 'the most widespread and common of the Tasmanian robins' (Green 1995), yet surveys of 20 sites in north-west Tasmania showed that by spring 2001 and autumn 2002 they had become the least frequently recorded of all the robins. Scarlet Robins were also in low numbers, as was the endemic Dusky Robin, which Green observed was being adversely affected by 'modern methods of broad-scale farming'.**

by Sarah Lloyd, *Birds Tasmania*

Threats

Australia's woodland birds are at risk from a number of past and current threats. One in five woodland bird species is either threatened or declining nationally, but the proportion is much higher in some regions. The table summarises the major threats and their consequences. There are other threats that are certainly not unimportant, particularly introduced predators such as the fox and cat, salinity, over-grazing, inappropriate burning regimes, imbalances in native species such as Noisy Miners (in the east) and Galahs (in the west), and climate change, but these are exacerbated (in some cases caused) by the major threat, which is the loss of woodland habitats.

Fire and introduced grasses such as Gamba are the main threats to tropical woodland birds. Photo by **Dave Watts, Lochman Transparencies**

Major threats to woodland birds

Threat	Cause	Major consequences for woodland birds	Examples of affected species
Loss of woodlands and woodland trees, including paddock trees and standing dead trees	• Past selective clearing of vegetation communities, particularly on the most fertile soils • Continued removal of remnants and individual trees for farm expansion, intensification of farming, timber, firewood • Lack of regeneration due to over-grazing by livestock, inappropriate fire and water management • Decline in tree health, dieback and other deterioration from exposure, over-grazing, inappropriate fire and water management, dryland salinity, and the ecological imbalance caused by various combinations of threats	• Removes habitat, particularly the most productive woodland habitats with a number of key habitat resources, such as: – hollow-bearing trees, required by some birds for nesting, roosting and sheltering – large and mature flowering trees required by nectar and insect-feeding specialists – nutrient-rich foliage that supports abundant canopy and understorey arthropods, required by insect-feeding birds – woody debris on moist soils, needed by ground-foraging and ground-nesting birds • Reduces the area of patches to below the minimum size required by many species • Exposes fragile and specialised woodland bird communities to an array of 'edge effects' such as changed microclimate and increased contact with invasive and predatory species • Reduces connectivity and increases isolation, which limits the capacity of many species to move through a landscape, limiting opportunities for dispersal, genetic interaction and recolonisation	Bush Stone-curlew; Red-tailed Black-Cockatoo (eastern); Carnaby's Black-Cockatoo; Superb Parrot; Regent Parrot; Swift Parrot; Barking Owl; Masked Owl; Brown Treecreeper; Purple-crowned Fairy-wren; Chestnut-rumped Heathwren; Regent Honeyeater; Black-chinned Honeyeater; Painted Honeyeater; Scarlet Robin; Western Yellow Robin; Grey-crowned Babbler; White-browed Babbler; Crested Shrike-tit; Crested Bellbird
Loss of understorey—small and young trees, shrubs, grasses and herbs—logs and litter	• Clearing of understorey and ground-layer vegetation to establish introduced pasture and crops • Heavy grazing, inappropriate burning, weed invasion, raking and soil turning, and fertiliser application • Firewood collection and 'cleaning up'	• Reduces resources such as shrubs, fallen branches and leaf litter that are important to ground and understorey birds for foraging, nesting and sheltering • Limits the capacity of many species to move through a landscape (see above) • Loss and disturbance of ground-layer vegetation initiates other degrading processes such as erosion, rising groundwater and colonisation by invasive plants	Australian Bustard; Squatter Pigeon; Hooded Parrot; Turquoise Parrot; Chestnut-rumped Heathwren; Speckled Warbler; Southern Whiteface; Hooded Robin; Western Yellow Robin; Spotted Quail-thrush; Black-throated Finch; Diamond Firetail

Wandoo woodland trees in a farm matrix. The trees are valuable resources in this landscape, and Carnaby's Cockatoo breed in some of them, including the one in the foreground. However, the long-term future for remnants of this kind is bleak, as the regeneration potential is poor or non-existent in the absence of active management such as fencing to control stock access. Photo by **Eleanor Adams**

Benign neglect is killing our woodlands

The decline of remnant woodlands in Australia is a major concern as many bird species (and other animals) are dependent on them. A study of a 15-ha patch of Salmon Gum and York Gum woodland in the northern wheatbelt of Western Australia illustrates this problem. The patch was an important nesting area in the district for six species of cockatoo (in decreasing numerical order): the Galah, Red-tailed Black-Cockatoo (Western Australian wheatbelt subspecies), Western (Butler's) Corella, Little Corella (wheatbelt subspecies), Carnaby's Black-Cockatoo and Major Mitchell's Cockatoo (Carnaby's is endangered and Major Mitchell's is in decline nationally). In the northern wheatbelt, all of these are obligate tree hollow nesters.

In 1978, the condition of all trees with hollows in them was assessed. The patch was revisited in 1981, and the condition of all 682 Salmon Gums and York Gums in the remnant was noted and each was measured and photographed; this was repeated in 1997. The condition of the trees at each visit was classified as 'good', 'staghorn', 'broken top', 'dead' or 'fallen.' Over the period of the study there was a serious decline in the condition of the trees, with the percentage of Salmon Gums in the 'good' category dropping from 24% in 1981 to 16% in 1997 and York Gums from 47% to 40%. The percentage of dead or fallen trees had increased from 24% in 1981 to 35% in 1997 for Salmon Gums, and 7% to 18% for York Gums. There was no evidence of any regeneration of woodland trees since 1929, when clearing for agriculture isolated the patch and livestock were allowed to graze it.

Using data based on the rate of decline over the period from 1978 to 1997, predictions were made of the fate of the trees in the patch. By 2125 only 46 (11% of the 1981 total) Salmon Gums are expected to be alive, with only one remaining in the 'good' category. Similarly, only 16 (17%) York Gums are predicted to be alive, again with only one in the 'good' category. This deterioration of the dominant trees in the patch is characteristic of remnant native vegetation over vast areas of Australia's extensively cleared wheat-sheep regions. The future of such woodland patches is bleak, as is the future of animals dependent on them for food, breeding sites and shelter. Active management—including fencing to exclude livestock, and measures to encourage regeneration of native plant communities—is necessary to counter the present regime of benign neglect that characterises most of Australia's management of native vegetation in agricultural landscapes.

BY DENIS SAUNDERS, *Research Fellow, CSIRO Sustainable Ecosystems*

Threat from land clearing continues

Land clearing remains by far the worst threat to woodland birds. Since the early 1990s, approximately 300,000 ha or more of mature woodland habitat have been cleared annually up to this year. Over 85% of temperate woodlands have already been cleared for agriculture.

This continuing loss of woodland habitat kills at least three million birds annually. Many of these are rare, threatened or declining species, such as Barking Owl, Grey-crowned Babbler and Superb Parrot, which have already declined in range and numbers because of previous clearing of woodlands.

A range of studies has shown that local and regional extinctions tend to occur some years after clearing has stopped in a district. This is because even in heavily cleared districts, small populations of most woodland birds usually survive in the remaining woodland. However, these small pockets of woodland are not large enough to maintain viable populations of many woodland birds in the long-term (see graph below and 'How much habitat is enough?' p. 18).

This extinction trend is now highly advanced in long-cleared south-eastern and south-western Australia. Formerly common and widespread woodland species such as Yellow-plumed Honeyeater, Grey-crowned Babbler, Hooded Robin, Carnaby's Black-Cockatoo and Crested Bellbird have undergone major contractions in range and numbers. This trend will continue in future decades in the more recently cleared districts in northern New South Wales and southern and central Queensland.

On the positive side, recent advances in some States mean that clearing should be greatly reduced in future years. Queensland has been by far the greatest clearer of land nationally. Following strong campaigning by environmental groups, the Queensland Government introduced new laws in 2004 that will phase out all broadscale clearing by the end of 2006. To date these laws are being enforced and it is expected that clearing rates in Queensland will decline greatly in the next eighteen months.

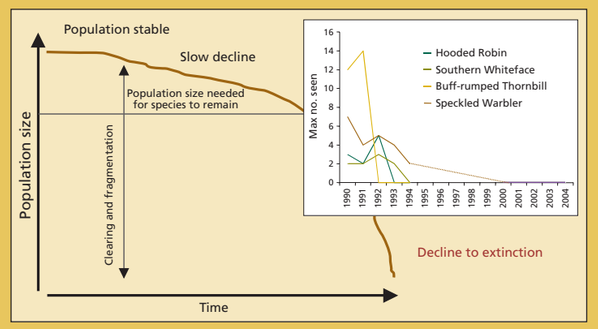
In 2003, New South Wales also announced that broadscale clearing would cease. It has unfortunately so far failed to deliver this promise. Clearing of around 60,000 and possibly up to 100,000 ha of woodland a year continues in that State, much of it illegal.

In Victoria, south-west Western Australia and South Australia, strong land clearing controls are in place, though small but significant areas of woodland continue to be cleared at times, both legally and illegally.

Revegetation efforts are accelerating in highly cleared southern States, and these are making important improvements in the quality of woodland bird habitat in some districts. However, on a national scale these improvements still remain relatively insignificant in comparison with continuing habitat destruction, with the total area of replanted woodland remaining in the low thousands of hectares per annum.

In some districts in Victoria, New South Wales and Queensland, natural regeneration of some woodland types is occurring. This is mostly restricted to foothill country, formerly grazing lands on poor soils, where grazing enterprises are now more marginal. This natural regeneration has significantly increased the area of woodland in some districts.

BY BARRY TRAILL, *Woodlands Ecologist, The Wilderness Society*



Today's clearing and fragmentation dooms some species or populations to extinction in the future. This is illustrated in the conceptual model above, which shows a hypothetical bird population and its response to clearing and fragmentation over time. Clearing may initiate and underlie the decline, but competition, for example, may become the major driver at a later stage; this cascade of processes is not well-understood. The inset is a real-life example of the loss of four species of ground-foraging birds from a small remnant in western Victoria—present in the early 1990s but locally extinct within ten years, by the time follow-up surveys were conducted in the 2000s—a process that is occurring throughout the temperate woodlands of southern Australia. The graph shows the annual average number of birds counted on regular counts 1990-1994 and 2000 onwards. Source of data: **Simon and Tristan Kennedy**

A remnant of once more extensive woodland surrounded by cropping and grazing; though they provide much needed habitat, such remnants do not support viable bird populations in the long-term. Photo by **Jiri Lochman, Lochman Transparencies**

Grazing and cleaning up

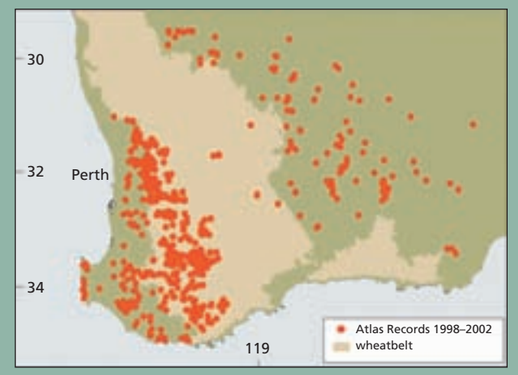
Case study: Rufous Treecreeper
Key threats – loss and degradation of habitat

The Rufous Treecreeper has declined in abundance in the agricultural regions of south-western Australia and there is evidence that its range has contracted away from the eastern half of the wheatbelt. One of the causes of this decline has been the clearing of large areas of Wandoo and Powderbark Wandoo for agriculture. Yet, even where the species persists in fragmented patches of woodland in the western half of the wheatbelt and in the forests of the Darling Range, reproductive success, juvenile survival and food availability may be compromised, not by fragmentation per se, but by declining habitat quality.

In a comparison between unfragmented habitat in the Dryandra Woodland, 160 km southeast of Perth, and a fragmented landscape in the Yilliminning agricultural district, 35 km east of Dryandra, Gary Luck found that nesting success and annual productivity were significantly lower in the fragmented landscape, as were provisioning rates to nestlings and the total amount of available insect prey. Rufous Treecreepers feed mostly on tree trunks and lower branches, and on the ground among fallen logs and leaf litter, and they build their nests in hollows in live and dead trees. It was concluded that modification of the habitat in the fragmented landscape, mainly from sheep grazing and the removal of dead trees and fallen timber, reduced the availability of food, and hence the quality of the habitat.

Repairing fragmented landscapes to ensure the persistence of native species such as the Rufous Treecreeper requires the stabilisation and reversal of current degrading processes. In woodland remnants, this includes the exclusion of stock (usually by fencing), active assistance in vegetation recovery, and the encouragement of 'untidy' farmers, who are happy to leave fallen timber on the ground and dead trees standing.

BY LESLEY AND MICHAEL BROOKER, *Western Australia*



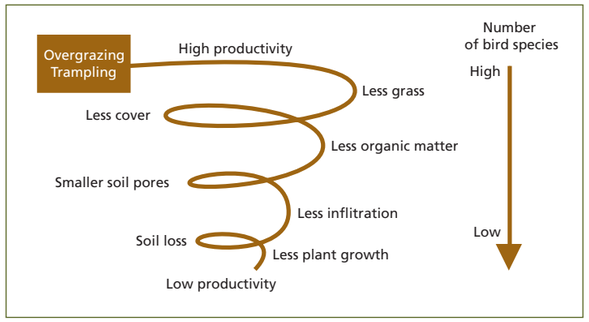
Distribution of sightings of the Rufous Treecreeper in south-western Australia from 1998–2002 (red dots) in relation to the area cleared for agriculture (yellow). The distribution of Rufous Treecreeper appears to have contracted away from the eastern wheatbelt since clearing, causing an apparent split in the population.

One of the legacies of clearing decades ago is the continuing spread of dryland salinity, which makes the land unproductive to farmers and woodland birds alike (wheatbelt of Western Australia). Photo by **Jiri Lochman, Lochman Transparencies**

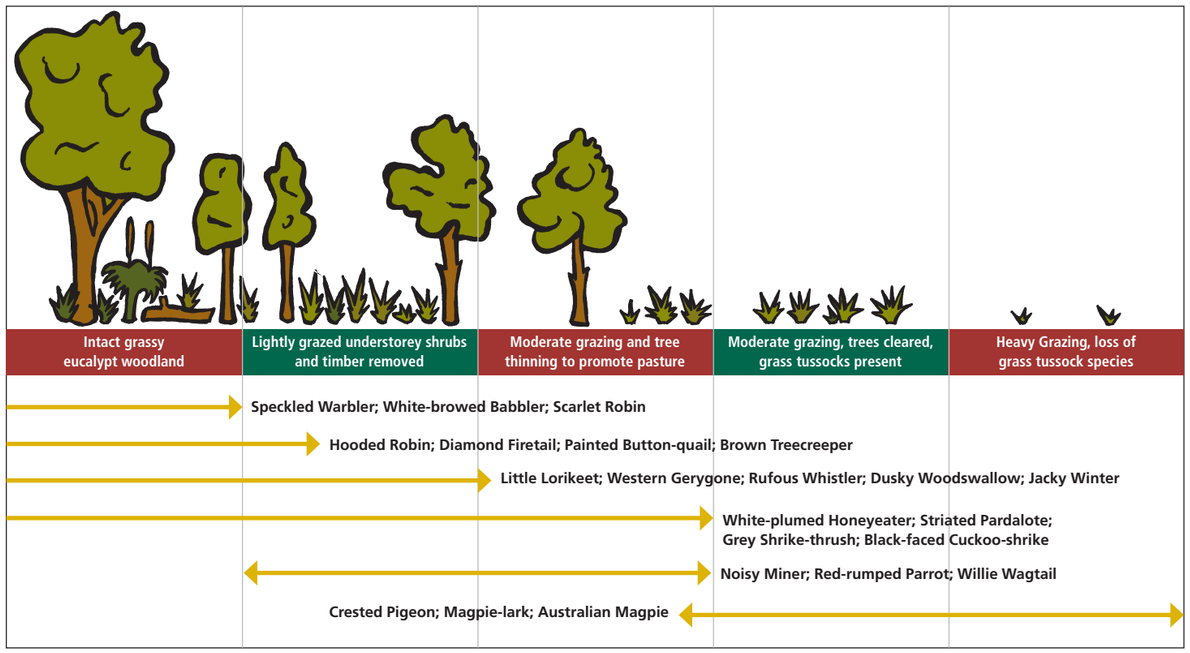
Over-grazing

Much of Australia's landcover change is due to grazing by livestock (sheep and cattle), which affects over 70% of the continent. Even where temperate woodlands have not been completely cleared, traditional forms of grazing that use set stocking rates can have significant impacts on biodiversity. A common effect of grazing is a limited amount of natural regeneration of native plants, including trees. Weed invasion is another consequence. As grazing pressure increases, native plant diversity is reduced and exotic plant species diversity and cover increase. Grazing by domestic livestock can also cause: soil compaction (and therefore reduced water infiltration into the soil); the addition of excessive amounts of nutrients to the soil; the loss of leaf litter; and, damage to remnant native trees (e.g., by rubbing and chewing). Livestock often concentrate in more productive parts of paddocks and impact areas such as watercourses (and associated riparian vegetation). Practices associated with grazing, such as chemical spraying, ploughing and the removal of woody debris, also negatively affect native birds and other wildlife. Ground feeding birds are particularly affected, due to loss of food resources—change in plant species, and reduced seed set and invertebrate diversity—and cover.

BY DAVID LINDENMAYER, *Centre for Resource and Environmental Studies, The Australian National University, Canberra*



In grassy woodlands subject to continued over-grazing, the diversity of woodland understorey and ground birds declines, as does farm productivity. Based on McIntyre et al. (2002), Birds Australia's Birds on Farms survey, **Maron and Lill 2005**



As grassy temperate woodlands are altered by grazing, clearing and cleaning up, bird communities change from a variety of types that use woodland and its edge to a few open country species. Modified from **Recher et al.** (1986)

Overgrazing removes ground cover and litter and has longer term impacts by preventing regeneration, leaving birds dependent on these resources bereft. Photo by **Chris Tzaros**

Intensification of agriculture

Although the area of Australia under intensive agriculture is small relative to grazing use, it is increasing, with implications for birds (Also see the box 'Clearing of centuries-old trees' below). For example, Birds Australia's Birds on Farms survey of 333 southern farmers revealed that there were 29% fewer understorey-dependent bird species in wheat/sheep landscapes, relative to sheep grazing landscapes. Also, there were 21% fewer understorey-dependent bird species in landscapes where cereal cropping occurred, relative to sheep grazing landscapes. Studies recommend that intensive agriculture is limited to 30% of farm area, wherever possible.

Clearing of centuries-old trees

Case study: south-eastern Red-tailed Black-Cockatoo
Key threat – habitat loss

The south-eastern Red-tailed Black-Cockatoo is one of Australia's most endangered woodland birds—only about 1000 individuals remain. This unique subspecies, chosen as the mascot for the 2006 Commonwealth Games, occurs only in south-western Victoria and far south-eastern South Australia.

The loss of suitable tree hollows for nesting, especially in dead, farmland Red Gums, has the potential to be a major future threat, but food availability appears currently to be limiting the cockatoo's population size. Unlike other Red-tailed Black-Cockatoos, this subspecies feeds only on the seeds of three tree species: Brown and Desert Stringybarks, and Buloke.

Only around 40% of the cockatoo's stringybark habitat remains, and Buloke woodlands have been reduced to about 3% of their original extent. No particular patch provides food year-round; Buloke produces fruit in summer and autumn, and stringybarks in any one area only fruit every 2–4 years. Importantly, stringybarks do not fruit optimally until about ten years after a wildfire or controlled burn. All remaining feeding habitat, right across the bird's range, is therefore of critical importance.

Yet, despite State and Federal legislation, feeding habitat is still being cleared. Most remaining Buloke feeding habitat occurs as scattered trees in paddocks, susceptible to pressures of cattle grazing and cropping. Hundreds of trees each year are either burned down in stubble fires or legally cleared to install centre-pivot irrigation systems. These large pivots need to be moved every few years, usually requiring the removal of more trees.

In the 15 years to 1997, an average 26% of Bulokes were lost from paddocks in five focal areas within the cockatoo's range. Unfortunately, replanting will not offset these losses for a long time—the slow-growing Buloke takes about 100 years to reach a size that the cockatoos will forage in, and the preferred trees are probably over 300 years old.

The Red-tailed Black-Cockatoo Recovery Team, hosted by Birds Australia, is working with land managers to reduce the amount of stringybark woodland affected by fuel-reduction burns, through careful planning and low-intensity burning regimes, and many keen farmers are replanting and protecting habitat with the assistance of government and non-government organisations. However, the short- to medium-term survival of our Commonwealth Games mascot will depend on the cessation of incremental habitat clearing.

Fence posts cut from box woodland are just another incremental loss to an already depleted woodland. Photo by **Chris Tzaros**

An excess of Noisy Miners: a sign of ecological imbalance in degraded and fragmented woodlands

The Noisy Miner is a well-known bird of woodlands, parks and gardens, where garrulous groups aggressively exclude all but a few other bird species from their territories. The reduction in extent, fragmentation and degradation of eastern Australia's woodlands have created ideal habitat conditions for the miner, and as a result the species has become a major contributor to the population declines exhibited by many woodland bird species.

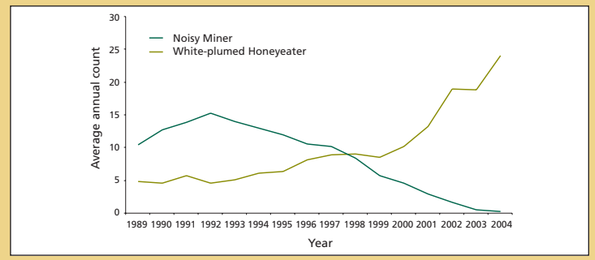
A native honeyeater, the Noisy Miner occurs throughout most of eastern Australia. In recent years its presence in remnant woodland has increased, while species richness and density of other birds, particularly smaller-bodied woodland species has decreased (for example, see graph). The miner excludes many other species, particularly insect-eating birds (which help to maintain tree health), leading to further deterioration of remnants. In a La Trobe University experiment, removals of miners from remnant patches of woodland resulted in substantial recovery of other avifauna: in one case, the number of small insectivore species increased 270%.

The habitats preferred by the miner include open country with scattered eucalypts, and woodland remnants and edges, especially where the shrub layer has been grazed away. Yet even in some large contiguous woodlands and forests, such as those of the Brigalow Belt of southern Queensland where large areas of ironbark and Spotted Gum vegetation remain on the less fertile soils of the Great Divide, Noisy Miners are abundant. Preliminary research again implicates loss of the shrub layer, but points to too frequent or intensive burning as the cause in these areas.

Not all degraded woodland types that lack a shrub layer are dominated by the miner. The Buloke woodlands of the Victorian Wimmera are highly fragmented and most are heavily grazed and invaded by weedy grasses. Yet, they are home to a rich assemblage of woodland species, such as Hooded Robin, Varied Sittella and Brown Treecreeper—and, notably, not the Noisy Miner. However, where Buloke woodlands contain as few as five eucalypts per hectare they are far more likely to support Noisy Miner colonies—and to have an avifauna dominated by larger-bodied open-country species. This has important implications for the plant species mix used in revegetation projects.

It is critical to understand variation in Noisy Miner habitat relationships across eastern Australia, so appropriate habitat restoration practices can be identified to reduce the miner's domination of woodland avifaunas.

BY MARTINE MARON, *University of Southern Queensland*



At Gardiner's Creek, Bennettswood, a woodland fragment in eastern suburban Melbourne, numbers of the aggressive Noisy Miner have increased, while those of other aggressive but smaller species such as the White-plumed Honeyeater have plummeted. Source: **John M. Peter**

How Much Habitat is Enough? Keeping Woodland Birds in Rural Landscapes

What happens to bird communities as woodland and forest habitats are lost from rural landscapes? How does the extent and configuration of the remnant native vegetation, and the type of surrounding land uses affect the avifauna? What is an appropriate goal for maintaining birds in these environments?

To address these types of issues, birds were surveyed in 24 northern Victorian 'landscapes', each 10 km by 10 km in size. These landscape study units were selected to represent a gradient in tree cover (as a surrogate for woodland habitat) from 2–60%. Half the landscapes represented situations in which woodland remnants were aggregated into one or a few larger blocks, and in the others remnants more dispersed across the landscape (see illustration at right). These landscapes are typical of the sheep-wheat belt of southern Australia, within the 450–650 mm rainfall zone, and having native vegetation generally dominated by 'box' eucalypts (e.g., Grey Box, White Box, Yellow Box) with River Red Gum along the watercourses. Birds were surveyed at ten sites in each landscape, with two surveys in each of the breeding and non-breeding seasons within a 12-month period. Survey sites were located in different types of wooded vegetation: streamside strips, roadside vegetation, scattered trees, small blocks (< 40 ha) and large blocks (> 40 ha).

The first important finding was the richness of bird species occurring in these rural landscapes: a total of 156 landbirds was detected from all surveys, including many threatened species such as the Superb Parrot, Bush Stone-curlew and Swift Parrot. The number of woodland-dependent birds ranged from 12–53 species per landscape and clearly decreased as the total amount of tree cover decreased. Tree cover was by far the most influential factor affecting species richness of woodland birds (explaining 55% of the variation) with smaller but significant amounts of variation contributed by geographic location of the landscape, the range in elevation and average patch shape.

Further insights were gained by closer analysis of the relationship between tree cover and species richness of woodland birds. As total tree cover declined, the decrease in species richness was not a consistent proportional decline: rather, there was a disproportionately rapid loss of species in landscapes with low proportion of tree cover. The best fitting models all pointed to a threshold at around 10% tree cover (see species richness graph opposite). In landscapes cleared below this level the woodland bird community 'crashes' as species after species disappears.

What does this 10% threshold in species richness mean for conservation planning in rural landscapes? Certainly, it does not represent a suitable goal or target for conservation, but the point at which major change or collapse occurs in the woodland bird community. For many species, this is the end point of a process of decline that began at higher levels of tree cover (see graphs lower right). Above this point, species may be present in a landscape but their populations are not viable for long-term survival. Clearly, we need to set goals well on the 'safe' side of this threshold.

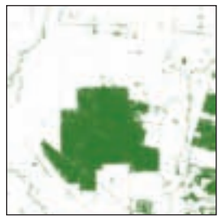
There is no simple or single answer to the question 'how much habitat is enough?' It depends on the type of rural landscape that Australians wish to leave for future generations, and the number of extinctions deemed acceptable. After examining responses of individual species and comparing likely outcomes for different scenarios of tree cover (see box 'Planning for the future'), indications are that a mix of land-uses comprising approximately 30–35% native vegetation and 65–70% agricultural production has a high likelihood of retaining diverse and resilient woodland communities in temperate rural landscapes.

However, several caveats are in order. First, several rare and threatened species were recorded, but at only a handful of the survey sites—too few to allow analysis of their distribution. It may well be that they are much more sensitive to habitat loss. Second, factors other than the amount of habitat are also important: at individual sites the quality of habitat influences the presence of species, and predators, disturbance processes and other factors can also be influential. Third, studies such as this are a 'snapshot' of the avifauna at a point in time: time-lags in the response of woodland birds to landscape change will almost certainly occur. Last, whereas great benefits will be gained by restoration of rural landscapes in heavily modified regions of southern Australia, this does not replace the central role of dedicated conservation reserves.

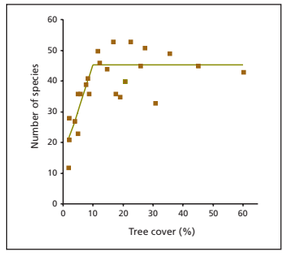
by Andrew Bennett and Jim Radford,
School of Ecology and Environment, Deakin University

Left: Willie Wagtails are one of the few birds able to hang on in highly fragmented landscapes, in scattered trees, and remnants along roadsides and creeks.
Photo by **Dave Watts, Lochman Transparencies**

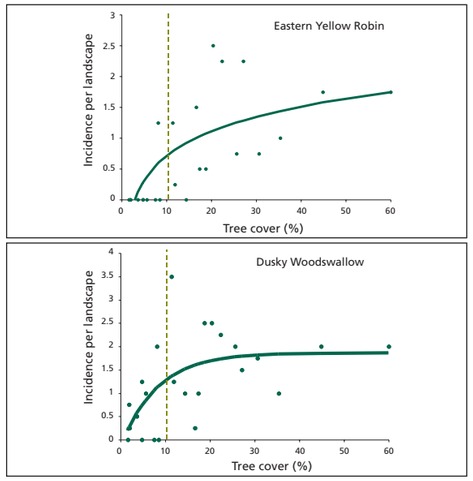
Above: Dusky Woodswallows are declining nationally and need landscapes where about one-fifth or more remains wooded.
Photo by **Bill Belson, Lochman Transparencies**



Woodland cover is similar (19–20%) in these study landscapes in northern Victoria, but they display different configurations: a) aggregated and b) dispersed through the landscape



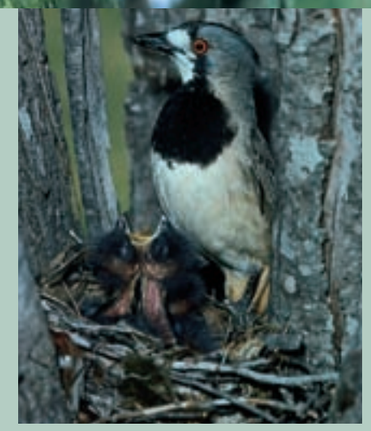
The relationship between species richness of woodland birds and tree cover, showing a marked loss of species below 10% tree cover



Predicted pattern of decline in the incidence of Eastern Yellow Robin (a) and Dusky Woodswallow (b) with increasing loss of tree cover in rural landscapes in northern Victoria. The Eastern Yellow Robin begins disappearing from the landscape when 60% or less of the tree cover remains, and the Dusky Woodswallow begins to decrease when tree cover is about 20% or less. Note that the process of population decline for these species commences well before the 10% threshold at which species richness shows marked change (see Radford et al. 2005 for methodology)

Above: A White-browed Babbler in a Cherry Ballart (Native Cherry) in Victoria; the species can persist where 10–15% of woodland remains, but need litter and shrubby ground cover to forage among. Photo by **Tadao Shimba**

Right: The Crested Bellbird needs larger areas of woodland to persist. Photo by **Graeme Chapman**



Planning for the future

A major challenge is to determine how much native vegetation is required for woodland birds to thrive in rural landscapes. There is no universal answer because different species prosper in different environments: the type and arrangement of native vegetation in the landscape, as well as land use, landform, climate and biogeography all influence species composition. Perhaps the question to ask is 'what will happen to the avifauna in *this* landscape if it is managed in *this* way?'

Scenario A **Imagine a rural landscape with less than 5% native vegetation cover. This highly modified landscape is likely to be dominated by farmland species (e.g., Australian Magpie, Galah, Crested Pigeon) with 'woodland-associated' birds (e.g., Eastern Rosella, Willie Wagtail, Laughing Kookaburra) persisting along roadsides and creeks, in small remnants and among scattered trees. A few woodland species may be relatively widespread (e.g., Musk Lorikeet, Grey Shrike-thrush), but most occur only in dwindling numbers in small pockets of suitable habitat (e.g., Grey Fantail, Weebill). However, this landscape will not be able to support viable populations of most woodland species.**

Scenario B **Now consider a landscape with 10–15% native vegetation cover. The prospects for native birds are brighter. Woodland-dependent species are more likely to occur here: species such as the Brown Treecreeper, Crested Shrike-tit and Black-chinned Honeyeater may be prevalent. The abundance of patch edges and diversity of patch sizes creates a varied landscape, one favoured by edge-dwellers such as the Jacky Winter and Mistletoebird. Some habitat-sensitive species, such as the Hooded Robin and White-browed Babbler, occur in small populations. This landscape is likely to support a relatively high diversity of woodland bird species, but not necessarily in large enough populations to ensure their future viability. However, this scenario serves as a useful intermediate goal for restoration of very low-cover landscapes.**

Scenario C **Finally, picture a landscape with 30–35% native vegetation cover. This landscape is relatively healthy, supporting a diversity of resilient populations more capable of withstanding environmental fluctuations. Woodland-dependent species are likely to outnumber farmland and woodland-associated species. Many species that are uncommon in lower-cover landscapes (e.g., Eastern Yellow Robin, Gilbert's Whistler, Swift Parrot) occur in greater numbers in landscapes like this, greatly improving their chance of long-term survival. Large blocks of habitat are a key feature of these landscapes, and their integrity must be preserved from degrading land-uses or fragmentation into smaller blocks. It is only in these large blocks that area-sensitive species, such as the Crested Bellbird, Speckled Warbler and Australian Owlet-nightjar, are able to persist.**

by Jim Radford and Andrew Bennett,
School of Ecology and Environment, Deakin University

Spotted Quail-thrush: extinct in the Mt Lofty Ranges because of clearing and changes to ground cover, and declining nationally. Photo by **Tadao Shimba**

Size matters: remnants and revegetation

Broadacre clearance was legally halted in South Australia in the 1980s. Nevertheless, in the Mt Lofty Ranges (MLR) removal of native woodlands has been concentrated in good quality agricultural land, leaving only 2% of these high quality woodlands. This has had important effects on the birds that depend on these systems.

Based on the amount of woodland habitat that remains in the MLR, species-area predictions suggest that between 35 and 50 species will become regionally extinct in the absence of large-scale restoration. Of the original 120 species present in the MLR, nine have already become regionally extinct (e.g., the Swift Parrot, Glossy Black-Cockatoo and Spotted Quail-thrush—all endangered nationally), with a further 60 continuing to decline in abundance and/or distribution (e.g., the nationally endangered Chestnut-rumped Heathwren).

These changes can combine to result in further woodland deterioration. For example, the removal of high quality habitat has meant the loss of those woodland types that predominantly produce flowers in summer and autumn. As a result, the nectarivorous honeyeaters decline during these seasons, with inadequate food resources to maintain their populations. In turn, these depressed populations are unable to provide the pollination services required by those plants, found in poorer quality habitats, that flower in winter and spring. Low plant recruitment leads to poorer food resources for honeyeaters, which leads to even lower plant recruitment.

The primary solution to this problem is the re-instatement of woodland habitats, particularly those of high quality. However, current revegetation efforts in the MLR are generally inadequate. At the landscape scale, patches of revegetation are small (often less than 1 ha; see graphs), linear in shape, and located on poor quality land, both within individual farms, and across the region. Such efforts do little to restore those high quality habitats that have suffered from the highest losses. Based on the minimum home ranges for many declining species (see table), patch sizes of reinstated woodlands need to be 20–100 ha at a minimum. Access to large, continuous patches of good quality land is thus critical for the restoration of woodland avifauna, but also poses a social challenge, as this land also provides the best agricultural return.

Within individual patches of revegetation, reinstated woodlands rarely mimic their remnant counterparts. For practical ease of planting, trees tend to be planted in rows, and at relatively high densities. In addition, the total number of tree species planted tends to be much lower than the diversity found in remnants. Because of the limited time-frame over which many revegetation projects occur, trees in revegetation also tend to have a similar age structure, only excepted by isolated remnant trees that happened to occur in the area prior to revegetation. All of these sub-patch issues are likely to produce woodland that is very different, both in structure and floristics, from the woodlands that would have once inhabited the region.

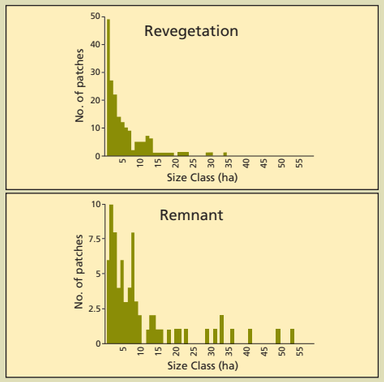
But does it matter to the birds? There is still a lot of research to be done, but certain features, critical to the success of some bird species, can be missing from revegetation as a result of planting density. For example, ground-foraging insectivores like the Hooded Robin and Scarlet Robin show strong preferences for foraging over a mixture of bare ground and leaf litter, pouncing from low, dead lateral branches. Where trees are planted at high densities, they fail to develop lateral branches—resembling poplars in shape—and are unlikely to be useful to these birds.

Nevertheless, there is some evidence that larger patches of more open woodland revegetation can be attractive to many of the declining species. In the 1970s, South Australia embarked on a revegetation program to ameliorate environmental conditions in the Monarto area as the first step in establishing a satellite city on the eastern flanks of the MLR. Plans for the city were scrapped in the early 1980s but not before some 1,680 ha of farmland had been planted with a suite of Australian trees and shrubs, many from other parts of Australia. Twenty-five years later the woodland systems that have established are used to some extent by at least 70 species, including many of the species declining over the MLR, such as Hooded Robins and Rufous Whistlers.

Conservation of woodland avifauna in the MLR, therefore, consists of two stages, both of which are critical for success. First, reinstatement of appropriately structured woodlands, in large patches and on good quality land, needs to be initiated as soon as possible. Such reinstatement needs to be long-term (and funded as such), and flexible, with ongoing management to produce woodlands with structural and floristic diversity that are also self-sustaining. If done well, these woodlands should provide suitable habitat for many of the currently declining avifauna within 30–100 years of initiation, longer if hollows need to form. At the same time, remnant woodlands must be managed in such a way that they conserve and incorporate those habitat features required by declining bird species and deal with other threats on the small remnant populations, so that there are birds available to colonise the reinstated woodlands once they become suitable. Only through good research, and execution of both of these stages, can the future of the woodland avifauna of the MLR look anything less than grim.

There is a glimmer of hope that remedial works will be in time to prevent regional extinctions. The recently State and Federally accredited Natural Resource Management plan for the MLR sets a challenging target of re-establishing all of the former vegetation associations of the region to 30% of their pre-European cover, with an initial focus on the disproportionately cleared systems. To this end several programs have begun in the last three years. SA Water is currently removing grazing and re-establishing woodlands on a series of patches, 50–100 ha in area around Mt Bold Reservoir, and Elizabeth Law-Smith has generously donated Para Woodlands, 300 ha of grazing and cropping land, to the State with annual financial support until 2032 to put back the woodland systems that once clothed this area. These are fine starts but still small relative to what is needed.

BY DAVID C PATON AND DANIEL J ROGERS,
School of Earth and Environmental Science, University of Adelaide



The size distribution of revegetated patches and remnant patches of woodland, in the Tungkillo region of the Mt Lofty Ranges, South Australia (after Harris 1999, cited in Paton et al. 2004). 174 patches of revegetation and 76 patches of remnant vegetation were assessed.

Home range size (based on minimum convex polygon) and longest known movements of some declining woodland bird species. Data based on banding summaries, density estimates and home range measurements of individually marked birds (see references in Paton et al. 2004).

Species	Home range for a pair (ha)	Longest movement (km)
Restless Flycatcher	10–100	2
Scarlet Robin	3–50	72
Hooded Robin	10–100	2
Jacky Winter	10–20	0
Crested Shrike-tit	5–20	10
Rufous Whistler	2–20	10
Brown Thornbill	1–5	9
Yellow-rumped Thornbill	2–20	37
Yellow Thornbill	5–20	2
Varied Sittella	20	0
Diamond Firetail	2–20	5

Left: A Striated Pardalote, one of many species dependent on tree holes for nesting. Photo by **Graeme Chapman**

Above: Nectar-feeders such as the Blue-faced Honeyeater need healthy stands of a variety of flowering species to support them all year. Photo by **Tadao Shimba**

Restoration

'Ecological restoration is the process of restoring one or more valued processes or attributes of a landscape'. Davis and Slobodkin (2004)

Australia is on the cusp of a new age, with an end to broadscale land clearing and the beginning of widespread community-based landscape restoration. Australians are rolling up their sleeves and volunteering their time, land and expertise to help reinstate native habitats, many of which are woodlands. One hundred and fifty years of damage and neglect will not be undone overnight—it will be a long, slow and arduous process, which will involve learning new and better ways. If it is ultimately to succeed, the effort will require an ongoing and long-term commitment from government, industry and the community.

Birds stand to benefit greatly from habitat restoration and are commonly used as a focus or flagship for revegetation initiatives. For example, planting projects in the Capertee Valley, New South Wales, are designed and promoted around the restoration of habitat for the threatened Regent Honeyeater. The Grey-crowned Babbler is a flagship for efforts to retain roadside vegetation in Victoria, and was the impetus for the production of detailed maps of roadside vegetation which are used by local Councils, road and fire authorities to avoid damaging important habitat.

Retention, regeneration and revegetation

The three 'Rs', retention, regeneration and revegetation all play a role in restoration, often in concert. Carefully planned efforts, such as those which increase patch size and improve habitat connectivity, are crucial for the provision of adequate woodland bird habitat now and into the future.

Retention is the protection of existing remnant habitat, even single trees. Protection of remnants is of primary importance because they are generally thought to have higher habitat values than regenerated or revegetated areas and probably cannot be recreated in all their complexity, at least in the shorter term. It has been estimated that from the viewpoint of a foraging animal, a 300-year-old Grey Box represents about the same value to birds as ten 20-year-old trees.

Remnant vegetation can also provide seed stock and a source of birds to recolonise restored areas, and act as a skeleton from which to rebuild. Retention is needed in all land tenures, and often involves managing threats to remnant vegetation, such as clearing, fire, grazing, invasive weeds and firewood collection.

Regeneration is the process of allowing woodland vegetation to regrow naturally and it usually involves elimination of grazing pressure, for example by fencing out livestock. The existing seed stock then germinates and grows, or suckers establish, resulting in the replacement of cleared or degraded vegetation.

Revegetation is the planting or seeding of native vegetation to replace cleared, or enhance degraded, vegetation. Revegetation has been one of the foci of government efforts to restore landscape health in Australia, and has attracted significant investment from Government. The value of revegetation to birds has been the source of ongoing debate, but a number of general principles have emerged, increasing the value of revegetation for conservation:

- Revegetation needs to be carefully planned. Planning guidelines outlining many useful general principles are available from various agencies and groups and, while these are generally regionally specific, coverage is increasing. Setting clear objectives and incorporating the ecological requirements of target species into the plans are essential ingredients for bird friendly plantings. Long-term monitoring and learning from experience are also keys to success.
- Opportunistic revegetation for purposes such as windbreaks does not necessarily translate into valuable bird habitat.
- Larger revegetation sites are likely to support more bird species, and wider strips are better than narrow strips.
- The value of revegetation varies according to the planting pattern (patches are generally better than strips) and the context in the landscape (e.g., well connected revegetation is better than isolated revegetation).
- Indigenous vegetation, preferably of local provenance, should be used. Some plant nurseries operate exclusively for threatened birds, such as the nursery dedicated to providing plant stock for recovery efforts for the Helmeted Honeyeater.
- The value of revegetation to birds increases with the time since planting (but most revegetation is still less than 30 years old).
- The method of revegetation (planting tube stock or direct seeding) does not appear to affect the value of the site to birds, though direct seeding is cheaper when that is an option.
- The value of revegetation depends on the structure of the resultant vegetation. Planting or otherwise restoring understorey components such as shrubs increases structural complexity and bird diversity.
- Ground-layer vegetation, such as native grasses and herbs, is often ignored in revegetation efforts because methods for its establishment are more difficult, expensive and time-consuming than planting or seeding trees or shrubs. However, this layer is important for many birds.
- The value of revegetation might vary regionally. For example, according to data from Birds Australia Atlas, the Yellow-faced Honeyeater was most likely to be recorded in rehabilitated areas over other land uses in temperate coastal areas, but this trend was not evident elsewhere.
- Revegetation is not necessarily appropriate in areas, such as grasslands, originally devoid of tall vegetation.

In the short term, revegetation is no substitute for the retention of existing remnant vegetation. Rather, it contributes to a longer term solution—an investment in the future. Nonetheless, for some species,

The Yellow-faced Honeyeater, declining in parts of its range, is one of several species to use young revegetation, especially in temperate coastal areas. Like many birds it likes to drink, and riparian woodlands offer prime habitat. Photo by **Graeme Chapman**

rehabilitation efforts such as revegetation and controls on grazing appear to be successful to at least some extent (e.g., see box 'Revegetation brings woodland birds back'). More research is needed to establish the long-term value of restored patches and landscapes, refine current techniques and develop more efficient methods of restoration.

Restoring understorey and ground litter

Fencing to control grazing is a major tool for the maintenance and restoration of understorey and the litter layer, though understorey plants may be planted or regenerate themselves. Retention of litter means that firewood collection, grazing and the urge to 'clean-up' woodlands need to be managed thoughtfully. Despite the relative importance of the litter layer to a large proportion of the woodland bird fauna, it is often the last component of the woodland structure to return following revegetation. While uncommon, artificial re-establishment of a litter layer to woodlands has occurred at a few sites. One landowner near Bendigo, Victoria, used a crane to lift fallen timber from outside a woodland remnant into the remnant. Another landholder at Euroa, Victoria, took material from ecological thinning operations and redistributed it through the woodland to provide a litter layer.

Reinstating tree holes

Hollows are a precious resource in Australian woodlands—over a third of Australia's woodland birds depend on hollows for nesting or shelter. Birds Australia Atlas 2-ha habitat sites with hollows contained on average more hollow-nesting bird species (2.0 species per survey) than sites with no or few hollows (1.2 species per survey). Generally, older trees contain hollows, and a reliable supply of hollows depends on enough mature or dead standing trees being present at any one time.

It has been estimated that trees may take at least 100 years to form a useful hollow and 200 years or more for the formation of a hollow large enough for a cockatoo or owl, so that even ageing revegetation or regeneration may not provide the hollows needed by many species.

In woodlands where hollows are scarce, tree holes can be enhanced and repaired (see box 'Engaging the community: repairing tree hollows') and nest boxes installed. Nest boxes have been provided for particular species, for example, the Turquoise Parrot and Red-tailed Black-Cockatoo. Some replanting projects have provided nest boxes in the replanted areas. One example is the Lurg Hills Restoration Project, in north-central Victoria, where over 150 nest boxes have been installed and are being used by species such as White-throated Treecreepers, Eastern Rosellas, Striated Pardalotes and Laughing Kookaburras. However, nest boxes are only temporary substitutes for natural hollow-bearing trees. Boxes can also be taken over by introduced birds and feral bees, so they require regular maintenance.

Revegetation brings woodland birds back

At the end of the Decade of Landcare in the 1990s, Greening Australia ACT & SE NSW was pondering the countless hours and dollars involved in revegetation efforts in their region, and asking the question 'Are we making a difference?' One of the oft-repeated reasons for tree planting was creation of habitat for native wildlife, but there was little information from which to assess whether this was an outcome.

So Greening Australia launched its own research project. Birds were chosen as the focus because they are well-studied, easily observed, high up the food chain, and charismatic. In addition, Greening Australia worked largely in woodlands in the ACT and south-east NSW, and the decline of woodland birds was becoming widely documented. Did birds inhabit native revegetation, and if so, which species? And what features of revegetation were best for birds?

The 'Birdwatch' project was conducted during 2000–2001. As with many large-scale bird surveys, the bulk of the fieldwork was carried out by dedicated volunteers. In this case the Canberra Ornithologists Group formed the backbone of the project, which over an 18-month period carried out 415 surveys on 132 sites across a region from Braidwood to Boorowa. The survey sites included remnant woodlands, open paddocks, and a large number of revegetated sites of various sizes and ages.

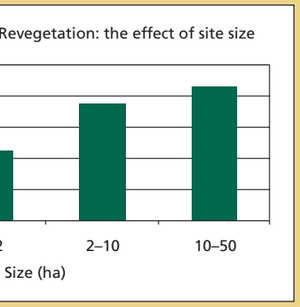
One hundred and nine bird species were found to use the revegetated sites. The 20 most commonly recorded species were all native (see table), and predominantly small insectivorous birds, which although common across the region are often not found in the typical grazed woodland remnant.

Encouragingly, some of the larger more aggressive native species such as the Noisy Miner and Pied Currawong were recorded infrequently. Particularly exciting was the finding of threatened woodland species in revegetation, including the Hooded Robin, Speckled Warbler and Diamond Firetail.

Analysis of revegetation site characteristics showed that the older the revegetation and the larger the site (or wider the windbreak), the more woodland bird species were recorded. For example, the larger a revegetation site, the more likely it was that a Rufous Whistler was recorded. Rufous Whistlers were found in 40% of all sites less than 1 ha in area, but more than 80% of all sites of 10–50 ha (see graph).

The results of 'Birdwatch' have been incorporated into Greening Australia's guidelines for revegetation in the region. They provide much inspiration and hope to farmers, Landcarers and birdwatchers.

Nicki Taws, *Greening Australia ACT & SE NSW*



The Rufous Whistler is disappearing from southern woodland remnants because it needs large patches of woodland to persist. It will use patches of revegetation, especially where the area exceeds 10 ha. Photo by **Graeme Chapman**

The birds most commonly found at revegetation sites in the Braidwood-Boroowa region of New South Wales

Species	Frequency (% of surveys)
Superb Fairy-wren	75
Yellow-rumped Thornbill	47
Crimson Rosella	41
Grey Fantail	35
Brown Thornbill	33
Australian Magpie	32
Yellow Thornbill	23
Willie Wagtail	22
Rufous Whistler	22
White-plumed Honeyeater	22
Grey Shrike-thrush	20
Eastern Rosella	17
Striated Pardalote	16
White-eared Honeyeater	14
Yellow-faced Honeyeater	12
Silvereye	12
Striated Thornbill	12
Buff-rumped Thornbill	12
White-browed Scrubwren	11
Common Bronzewing	10

Left: Blue-breasted Fairy-wren. Photo by **Graeme Chapman**

Far left: In this large windbreak (40 m x 1200 m) near Binalong, New South Wales, 32 species of woodland birds have been recorded, including species thought to be declining in many areas—the Scarlet Robin, Red-capped Robin and Speckled Warbler. Photo by **Nicki Taws**

A Carnaby's Cockatoo (also know as the Short-billed Cockatoo) nesting in a repaired chimney. Photo by **John Lauri**

Revegetation for the future

Case study: Carnaby's Black-Cockatoo
Key threats – loss and degradation of habitat

Western Australia's Carnaby's Black-Cockatoo is extinct in approximately one third of its former range across the woodlands of the wheatbelt of Western Australia. The cockatoo breeds in woodlands and spends the non-breeding period in coastal and near-coastal areas in the south and south-west of the State. In both areas, it feeds in Kwongan heath rich in proteaceous plant species such as *Banksia*, *Grevillea*, *Hakea* and *Dryandra*, seed from introduced trees such as pines and weeds such as Wild Radish and Corkscrew. It breeds in the large hollows of eucalypts, generally of woodland tree species such as Salmon Gum and Wandoo.

The degree to which the species is limited by loss of nesting hollows is not clear, but the cockatoo has disappeared from areas where feeding habitat and breeding habitat are not sufficiently close together to allow for efficient foraging by males feeding females and developing chicks. Poaching and competition for nesting hollows are also threats.

Vegetation clearing in the wheatbelt has virtually ceased, but loss of habitat for the cockatoo continues through deterioration of remnants. The planting of future nesting trees, and replacement of lost understorey and nearby Kwongan heath is underway, but its effectiveness is so far untested. Revegetation programs and subsequent monitoring will require significant efforts and resources for many years to come.

by Cheryl Gole, *Birds Australia Western Australia and WWF-Australia*

Restoring connectivity

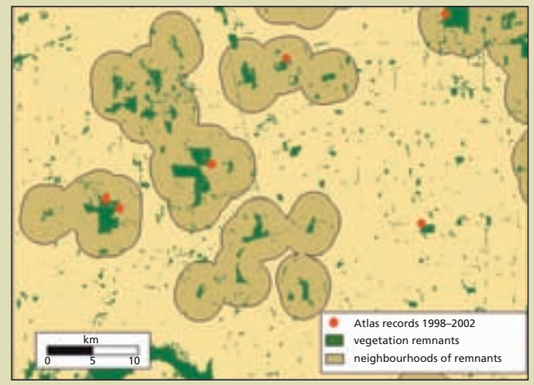
Case study: Blue-breasted Fairy-wren Key threat – loss of habitat connectivity

Blue-breasted Fairy-wrens are cryptic, hard-to-find birds that rarely move far from the shelter of shrubs in the understorey. A study of 666 individually colour-banded wrens in the Western Australian wheatbelt near Wyalkatchem showed that, even though dispersing birds may move as far as 9 km (straight line distance) or 14 km (distance via corridors), they rarely crossed gaps in the vegetation of more than 60 m.

Reproductive success was actually higher in small remnants than in the larger ones. This was due to higher rates of nest predation and parasitism in the larger remnants. On the other hand, survival was poorest in the small remnants. When vegetation remnants in the study area were divided into 'neighbourhoods' based on how well the remnants were connected to one another via corridor vegetation, it was found that about 14% more potential dispersers were lost from the poorly-connected areas than from a core 'well-connected' neighbourhood. This shows that dispersal between remnants can be a highly dangerous undertaking for some birds. So dangerous, in fact, that it could lead to local extinction in a poorly connected neighbourhood.

These findings highlight the importance of looking at the big picture when planning the restoration of habitat in fragmented landscapes. In many cases, the connectivity of the landscape (i.e., the connectedness of remnants) and the total amount of habitat in a region may be more important than the actual size of individual remnants. Clearly, it will be more cost-effective and conservation-effective to employ short corridors within habitat neighbourhoods (clusters of remnants), even though the remnants may be extremely small, than to tackle long corridors between highly isolated remnants.

by Lesley and Michael Brooker, *Western Australia*



It is more cost and conservation-effective to implement short corridor plantings within habitat neighbourhoods (brown) than to embark on risky long corridors that may be ineffective.
The Atlas records shown are sites where Blue-breasted fairy-wrens were present during one or more surveys. The habitat neighbourhoods indicate groups of remnants in close proximity, where the total amount of vegetation in the whole neighbourhood exceeds some pre-determined value (see Brooker and Brooker 2003).

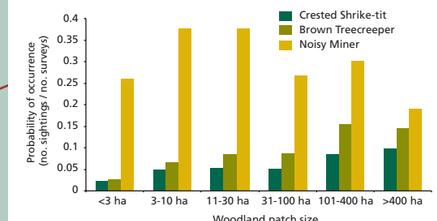
Enhancing agricultural landscapes for birds

The aerial photo shows a typical landscape in what was once contiguous woodland, now partly cleared and fragmented, mostly for agriculture. The insets show examples of factors enhancing birds' occurrence in agricultural landscapes. Graphs are based on data from Atlas habitat forms and 2-ha surveys, and show reporting rates on the vertical axes (see Barrett et al. 2002 for methodology), unless otherwise stated; the results are generally applicable, but regional variation may occur.

Logs

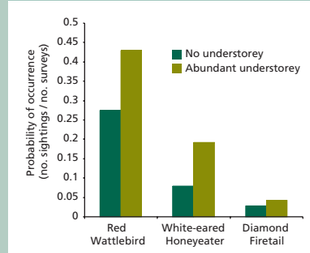
Logs provide habitat for ground-dwelling and ground-foraging species, such as the Speckled Warbler, Brown Treecreeper and White-winged Chough.

Larger Remnants



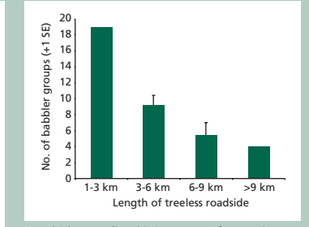
The larger the remnant, the more species it is likely to contain, but even small remnants provide habitat for some birds. Declining species such as the Crested Shrike-tit and the Brown Treecreeper occur more reliably in large woodland patches; other more common species, such as the Noisy Miner, are common in all remnant sizes surveyed.

Understorey



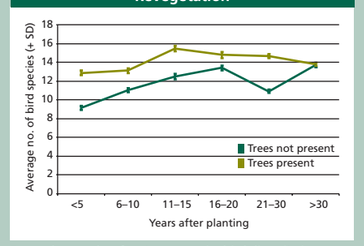
Understorey provides habitat for a variety of woodland species, including the Red Wattlebird and White-eared Honeyeater, which are much more common where understorey is present. On the otherhand, open-ground foraging granivores, such as the Diamond Firetail, are less affected by loss of understorey.

Roadside Remnants



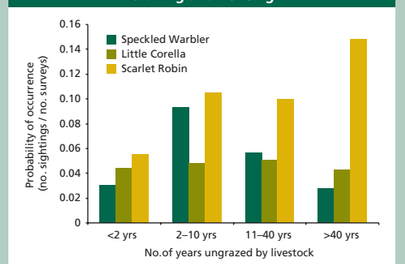
Roadside woodland is important for species such as the Grey-crowned Babblers in northern Victoria; the babblers would otherwise be locally extinct. Data from **Doug Robinson**

Revegetation



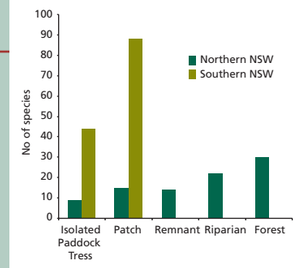
Even where only a few trees remain, bird diversity is higher than where all have been removed. Revegetation can increase bird diversity at both types of site. Following planting, sites where they were a few trees still present when revegetation was carried out gained between one and three species. At sites from which all trees had been cleared, bird diversity increased by up to 5 species following tree planting, but it took over 30 years to reach the level of diversity of sites where some original trees remained.

Grazing and Fencing



Some species are sensitive to the effects of grazing. The Scarlet Robin occurs more frequently in long-ungrazed areas; the intermediate years after removal of grazing suit the Speckled Warbler; whereas the Little Corella is more-or-less indiscriminate. Hence, a mosaic of low impact grazing regimes, including exclusion by fencing, is safest for the maintenance of a variety of birds.

Paddock Trees



Even single paddock trees have value for wildlife, exemplified by two studies that are not directly comparable: (blue bars) the number of bird species commonly recorded in paddock trees, in comparison with trees in other contexts, in northern NSW; (red bars) total number of bird species in southern NSW recorded at isolated trees and patches. Note that riparian vegetation supports a relatively rich array of species. **Adapted from Law et al. (2000) and Fischer and Lindenmayer (2002), respectively**

Play the remnants game and learn how to better manage remnants for birds: http://www.birdsaustralia.com.au/remnants/remnants.html

The Speckled Warbler favours larger remnants with high structural diversity, where it nests and forages on or close to the ground. Feared to be one of many declining woodland birds, it seems to be more adaptable than some and holding its own in at least some regions. Photo by **Tadao Shimba**

Research: guiding better management of birds in temperate woodlands

Major research efforts are required to determine how best to conserve woodlands birds and integrate their conservation needs with the predominant types of land use in woodland landscapes (particularly livestock grazing and cropping).

Two large-scale 'natural experimental' studies have been examining relationships between vertebrate biota (including birds) and temperate woodland and other vegetation types in southern New South Wales. One is taking place in the Nanangroe region close to Gundagai, and the other spans nearly 200 sites located between Albury and Gundagai (south-north) and Temora and Tumbarumba (west-east). Some important new insights for on-farm bird conservation are emerging from these studies.

- **Even small (0.5 ha) patches of remnant 'old growth' woodland can contain significant numbers of native bird species, particularly where the highly aggressive Noisy Miner is absent or in low numbers. These patches also can act as significant stepping-stones facilitating the movement of many bird species across semi-cleared grazing landscapes.**
- **Old growth woodland, coppice regrowth woodland, natural woodland regeneration and replanted woodland areas function as markedly different habitats—each supporting a different assemblage of woodland bird taxa. Therefore, farms with a suite of different habitat types will typically support a richer bird fauna than farms with few kinds of native vegetation cover. For example, farms that support both old growth woodland and replanted areas will typically have five more bird species than farms where only old growth occurs and replanted areas are absent.**
- **Replanted areas can be important habitats for a range of woodland birds, including several species such as the Flame Robin, Scarlet Robin, Speckled Warbler and Hooded Robin, which are known to be declining. Size and shape of plantings appear to have a significant influence on the occurrence of these and other species.**
- **Conditions in the surrounding landscape can have profound impact on the occurrence of some species of birds in particular patches of woodland. For example, when woodland remnants are surrounded by maturing stands of plantation pine many traditional woodland bird taxa (e.g., Brown Treecreeper) decline and are replaced by species more typical of forest environments (e.g., Golden Whistler). The habitat attributes of these woodland patches embedded in plantation, such as the amount of leaf litter, logs and shrub cover, also appear to influence bird assemblages.**

The results of these and other studies will be important in the future for improving the effectiveness of vegetation management practices and increasing the biodiversity values of revegetation efforts in Australia's temperate woodland landscapes.

David Lindenmayer, Ross Cunningham, Mason Crane, Damian Michael, Christopher McGregor and Rebecca Montague-Drake, ***Centre for Resource and Environmental Studies, The Australian National University, Canberra***

Victorian open woodland with grass-trees. Photo by **Chris Tzaros**

Well-designed plantations can provide habitat for woodland (and forest) birds

The primary aim of plantations is the production of large quantities of wood and paper. However, plantations offer opportunities for bird conservation, and there are at least four reasons why this is important:

- **the plantation estate in Australia is set to reach three million hectares by 2020, most of it in semi-cleared agricultural land;**
- **through the application of ecologically appropriate management strategies, many (although certainly not all) bird species can be conserved in plantation-dominated landscapes;**
- **populations of some bird species may play a major role in key ecosystem processes. For example, native insectivorous birds might reduce the risk of pest problems in plantations; and**
- **the conservation of species may be important to the certification of plantations as being managed in an ecologically sustainable way.**

The key conclusions from the body of bird research conducted in Australian conifer and eucalypt plantations are as follows:

- **Plantations are not 'biological deserts' for birds, as has often been claimed. However, many bird species rarely or never occur in plantations and plantation bird assemblages are species-poor compared with native forest and woodland.**
- **Native bird diversity will often be higher in plantations than in extensively cleared grazing land. While this may be an advantage for forest taxa, woodland or open-country species may be disadvantaged by such landscape changes.**
- **Many species of native birds can use patches of remnant native vegetation within plantations, and the presence of patches boosts bird diversity significantly above that typical of plantation monocultures.**
- **The retention of biological legacies, such as windrows of logs from cleared trees, prunings and other slash after thinning, and scattered paddock trees and patches of eucalypt regrowth within the plantation, significantly boosts bird diversity.**
- **Bird occurrence in plantations and in native eucalypt remnants within plantations is significantly influenced by the size, shape and spatial arrangement of remnant native forest and woodland. Larger patches, and those that are wide, support more species than small, linear remnants. However, even relatively small patches (including individual paddock trees) can be useful for some bird species.**
- **Isolated stands of plantation trees support significantly fewer species of birds, and lower abundances of those species, than stands of plantation trees adjacent to patches of remnant native vegetation.**

Management practices in plantations that conserve some elements of the natural biota include:

(a) stand-thinning in pines, to support greater bird species richness;
(b) maintaining and/or restoring patches of remnant vegetation (especially in riparian areas where harvesting is precluded);
(c) ensuring that plantation landscapes do not become monocultures, by maintaining a diversity of landscape elements such as dams, easements and native vegetation patches; and
(d) limiting the loss of significant biological legacies.

Perhaps the most important management issue is the need to carefully control where new areas of eucalypt and conifer plantation are located and consider the conservation values of the land cover they replace. There is no justification for clearing of even small patches of woodland and other native vegetation to establish plantations.

David Lindenmayer, ***Centre for Resource and Environmental Studies, The Australian National University, Canberra***

Assessing the impact of habitat loss on woodland birds: new directions

Habitat loss, fragmentation and degradation are crucial causes of the decline and local extinction of many woodland bird species. In these landscapes, complex ecological processes can subject individuals to increased levels of stress via a loss of critical resources such as food and shelter, increased levels of competition and predation and disruption of dispersal patterns. Ultimately, survival and fecundity of individuals is reduced, and populations decline.

Evaluating the status of bird populations has traditionally involved assessment of changes in bird communities, and in population size and abundance. One limitation of this approach is that by the time a decline is detected it may be too late to take remedial action. Furthermore, while it is useful in identifying patterns of decline, this approach has a limited ability to predict which species will be adversely affected.

In response to these difficulties, a new focus is emerging that uses indices of body condition as relative indicators of the health status of populations. A variety of simple body measures can reflect underlying physiological state, and indicate an individual's ability to deal with stress. While occasional stress is a normal part of life, over a prolonged period it can be detrimental to health. Chronically high levels of stress can suppress the immune system, reduce growth and promote cell death, and ultimately reduce survival or fecundity.

A variety of measures can be used to assess stress levels. Examples include relative differences in the levels of circulating stress hormones, energy reserves such as fat and protein stores, fault bars and growth rates of feathers and blood parasite loads. Many are simple and inexpensive to measure, and so are well suited for broadscale use. Measuring stress in a range of ways can also point to the type and timing of stressors. For example, the condition of a bird's feathers is indicative of conditions experienced during the previous moult, while fat stores reflect current levels of food availability. Such comparisons have potential to profile the type of stress experienced and thus provide clues as to causes.

Considerable research has been undertaken in Australia on physiological response to stress and its effect on body function and reproduction, but it has yet to be developed as a conservation tool. Recent studies have demonstrated that birds living in smaller habitat remnants can suffer higher levels of stress than those in large tracts of habitat, and this is reflected in differences in mortality and fecundity. Thus, there is potential to identify vulnerable populations before substantial declines occur. In addition, this approach has application in identifying specific mechanisms of decline and testing the effectiveness of habitat restoration efforts because a bird's condition reflects the state of the environment in which it lives. Given the status of woodland birds, this innovative approach deserves consideration as an addition to existing techniques.

BY JANET GARDNER, *Division of Botany and Zoology, The Australian National University*

The Yellow-tufted Honeyeater, with its hanging cup nest slung in the foliage, is one of several woodland birds that feed, breed and roost among mistletoe. Photo by **Peter Merritt**

The importance of mistletoe in woodland remnants

Although mistletoe is popularly viewed as a weed that kills trees and devalues animal habitat, recent research has revealed a different story. These native parasitic plants may eventually kill some trees, but overall they actually promote biodiversity.

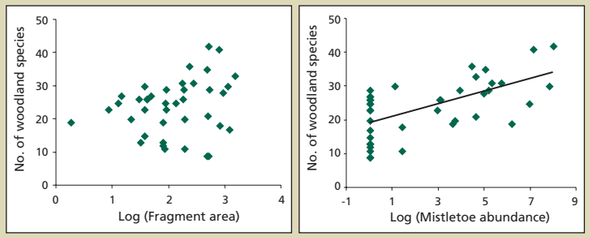
A landscape-scale removal experiment has been established near Holbrook, southern New South Wales: all mistletoe plants have been removed from 20 woodlands remnants, leaving mistletoe intact in another set of 20 remnants, as a control. Prior to mistletoe removal in 2004, 12 months of baseline data were collected (on birds, mammals and reptiles) to evaluate existing patterns of distribution and abundance across all sites.

The results show that larger woodlands generally support more species, but the relationship is weak, indicating that other factors are also involved (see graphs). Conversely, mistletoe abundance (which was not significantly influenced by woodland area) has a strongly positive effect on woodland birds—the more mistletoe a site has, the higher the bird diversity.

Determining how mistletoe influences native animals is a key goal of the continuing research at these 40 sites. Early results have suggested the direct effects (i.e., mistletoe as food, nest sites and shelter) are complemented by a suite of indirect effects on leaf-litter and nutrient availability, and through fallen branches and hollow-formation when infected branches are shed.

Unlike shrubs, hollows and coarse woody debris that are also beneficial to many woodland species, mistletoes have become more abundant in fragmented landscapes. Through a combination of fire supression, fewer leaf-eating marsupials (known to prefer mistletoe foliage) and the increased availability of water, nutrients and light in woodlands (especially associated with edge habitats), mistletoe density has increased 10–30 fold in many regions. So, while fragmentation is causing widespread declines in woodland fauna, by providing critical food and shelter in an otherwise resource-depleted ecosystem, mistletoe may be helping some woodland-dependent animals to persist.

DAVID M WATSON AND MATHEW HERRING, *Applied Ornithology Group, Institute for Land, Water and Society, Charles Sturt University*

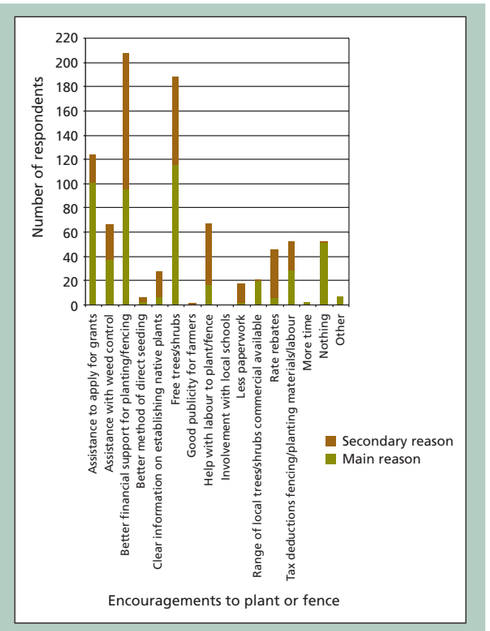


Working with Landholders

Private landholders are important to the survival of Australia's woodland birds. Because of the vast area of land managed privately, small gains in bird conservation on individual landholdings can significantly improve the state of woodland birds. But how can land managers be encouraged to balance biodiversity and productivity? Several approaches have been developed but there is no one clear process that delivers the best outcomes for birds. Even laws protecting against clearing native vegetation, which have had an overwhelmingly positive impact on biodiversity conservation, are not always constructive—for example, in some circumstances they discourage landholders from letting parts of their land temporarily regrow into woodland. Nevertheless, the last few decades has seen many positive initiatives in partnering with landholders to protect birds and other elements of biodiversity (e.g., see boxes 'Listening: the Red-tailed Black-Cockatoo landholder survey example' and 'Providing information: the Darling Downs land manager's guide').

Listening: the Red-tailed Black-Cockatoo landholder survey

In 2003, Birds Australia surveyed 500 landholders in western Victoria and eastern South Australia to hear their attitudes towards the threatened south-eastern subspecies of the Red-tailed Black-Cockatoo. The study also examined what, if any, barriers existed to action that would benefit the bird. The illustration shows which inducements and assistance landholders believed would be most effective in facilitating them to plant or fence parts of their properties for the cockatoo. One of the major areas they identified was assistance with access to grant funds. In response, in 2004–2005 Birds Australia obtained funding to run a series of farm planning workshops to help meet this need.



Providing information: the Darling Downs land manager's guide

In 2005, Birds Australia produced *Birds of the Darling Downs: A Land Manager's Guide*. The guide is an example of a user-friendly manual that suggests practical ways of enhancing farms for birds.

Guiding principles for a bird-friendly landscape in the Darling Downs

Principle	Management Options
The bigger the patch, the better, but small remnants are better than none!	• Maintain and/or re-establish large patches (10 ha or more) of native vegetation. • Protect smaller patches and strive to enlarge some.
Well-connected habitat patches assist bird movement and ensure long-term survival.	• Provide corridors and stepping-stone patches of native vegetation to improve connectivity.
Maintain, enhance or re-establish areas of complex habitat.	• Manage 10% of the property to provide core habitat. • Try to maintain habitat values in all vegetation types on the property.
Retain hollow trees and stags in a mixed age stand.	• Protect and maintain a range of old hollow-bearing trees, including dead ones. • Ensure new trees are being recruited to create mixed-age stands. • Consider providing artificial hollows if few are available.
Manage grazing and fire to minimise impacts on native woodlands.	• Adjust grazing to improve and maintain woodland health. • Manage fire to protect habitat values, as well as infrastructure and productivity values.
Control introduced predators.	• Manage introduced predators to reduce their predation on birds.

A volunteer in safety gear in the process of repairing a hollow in known Carnaby's Cockatoo breeding habitat, northern Western Australian wheatbelt. Note the use of old sheets of tin. Photo by **John Lauri**

Engaging the community: repairing tree hollows

Many of Australia's birds are obligate tree hollow nesters and others use hollows as shelter and roosting sites. In highly cleared and fragmented landscapes such as Western Australia's wheatbelt, the loss of hollow-bearing trees and an increase in bird species such as Galah that have benefited from clearing for agriculture, mean that hollows may be an increasingly limited resource.

Through direct competition with other species, hollows are effectively lost to declining species such as Carnaby's Black-Cockatoo and Major Mitchell's Cockatoo. Competition for hollows by Little and Western Corellas and Galahs is a growing problem, and hollow loss through the construction of hives by the feral European Honeybee is particularly problematic. Other competitors include Australian Shelduck and Australian Wood Duck, both of which have increased in abundance in the wheatbelt.

Hollows may also be lost as a result of tree fall, clearing, removal for firewood, storm damage, fire, collapse of the nest chamber floor and damage by poachers. While many of these are natural causes, they pose a threat in areas where hollows are not replaced as in healthy woodlands. In some areas, community groups are seeking to reverse some of these trends.

Since 2003, Birds Australia Western Australia has been working with northern agricultural region landholders to repair and maintain hollows, primarily for the use of the endangered Carnaby's Black-Cockatoo. Volunteers have repaired hollows by patching 'blow aways' and splits in trunks and branches, replacing 'mudguts' (the crumbly detritus that occurs in the base of hollows), capping very exposed hollows and removing beehives and the addled eggs of previous nesting attempts by a variety of bird species. Rusty old sheets of tin make ideal hollow patches: readily available at old dumps, they blend well with the surroundings.

This low-cost program has inspired local landholders to engage in woodlands-based conservation action. Importantly, post-repair monitoring has also shown that Carnaby's Black-Cockatoo is willing to nest in repaired hollows. This is not a long-term solution to the loss of hollows, but provides an example of how community action can provide some short-term solutions to local conservation problems.

BY CHERYL GOLE, *Birds Australia Western Australia and WWF-Australia*

Major Mitchell's Cockatoo: there are concerns that the species is declining nationally because of loss of mature woodland trees for nesting. Without active intervention many more remnants—the living dead—will disappear from the Australian landscape, and with them their dependant birds. Photo by **Peter Merritt**

Reform

Laws, policies and strategies

Natural resource management

Over the last 20 years State and Commonwealth governments have invested in regional natural resource management plans through one-off, short-term initiatives such as the Decade of Landcare (10 years), Natural Heritage Trust (NHT) Phase 1 (5 years), the National Action Plan for Salinity and Water Quality (7 years) and the NHT Phase 2 (5 years). Responsibility for planning and control of natural resource management has increasingly been handed to the community. Since 1996, over 420,000 volunteers have helped on more than 12,200 NHT-funded projects around the country, mostly in groups like Landcare. By June 2004 NHT had facilitated the rehabilitation of 789,000 ha of land: 554,000 ha of native vegetation had been fenced or protected by legal agreement; 130,000 ha rehabilitated by fencing, planting and weed control; and 104,000 ha of largely cleared land replanted (not all of it woodland). While this eight-year effort totals little more than the area of woodland cleared in any one year, and 1% of the total woodland cleared since settlement (50,000 km^2), it demonstrates a commitment to change and a strong regard for the bush by many in the community.

In partnership with the States and Territories, the Australian Government has adopted a strategic regional investment approach to natural resource management (NRM), of which biodiversity conservation and monitoring are key elements (see next section). In the last five years all jurisdictions have established NRM bodies. NRM management and reform requires long-term effort. In the south-east and south-west, protection of woodland remnants is urgent, but restoration will take decades. In these regions, many of the native mammals are extinct and the birds appear to be following suit. Without long-term commitment, southern woodlands and their fauna seem doomed.

Environmental protection

Under the Federal EPBC Act, in addition to 31 woodland bird taxa (see p. 14) listed as threatened, nine woodland types are listed as Threatened Ecological Communities—for example, Brigalow, Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions, and Grassy White Box Woodlands. Several woodland-related Threatening Processes are recognised, including the 2001 listing of Land Clearing (see box). In the case of land clearing, national listing highlighted the importance of the threat, but the Australian Government determined that the issue was best dealt with by the States. Thus, for woodland bird habitat, the State and Territory Governments, and their laws, policies and strategies, have a particularly important role to play.

There are many State, regional and local laws, policies and planning instruments that have a strong bearing on woodland bird conservation (for example, see box 'Victorian legislation and policies relating to woodland protection). All States and Territories have native vegetation retention controls, and threatened species protection laws. Another form of legal protection is covenants, which are attached to land titles and require sympathetic land management (see below). Although there are many general measures to conserve woodlands, the issue of landscape-scale regulation has been largely neglected—only two States/Territories have an overarching strategy to conserve woodland birds: Action Plan No. 27 *Woodlands for Wildlife: ACT Lowland Woodland Conservation Strategy (Nature Conservation Act 1980)* and Victoria's Draft *Action Plan for Victorian Temperate Woodland Bird Community (Flora and Fauna Guarantee Act 1988)*.

Compliance with native vegetation retention laws continues to be a problem. Some landowners resent controls on the vegetation on their land, and unauthorised clearing still occurs from time to time. Fortunately, such clearing is only rarely at a significant scale, but incremental loss through the removal of single or small groups of trees is a persistent problem for regulators, land managers and birds. Loopholes in some laws are sometimes exploited such that significant clearing can still occur. For example, regulations designed to limit clearing to 2 ha annually, can be used to clear a much greater area of 2 ha worth of trees (by excluding the inter-tree space from the clearing limit).

While overwhelmingly positive for conservation, vegetation controls can occasionally have unintended negative consequences. For example, landowners who wish to supply and harvest plantation timber may be more likely to plant exotic vegetation than native vegetation, so that clearance controls do not apply. Clearly, native vegetation retention laws need to incorporate suitable flexibility while more strongly and unambiguously protecting existing and restored woodland habitat.

National listing of woodlands and their threats

Key Threatening Processes listed under the EPBC Act relevant to woodlands and woodland birds (*indicates those for which a Threat Abatement Plan has been prepared):

- **Dieback caused by the root-rot fungus***
- **Land clearance**
- **Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases**
- **Predation by feral cats***
- **Predation by the European Red Fox***
- **Competition and land degradation by feral goats***
- **Competition and land degradation by feral rabbits***

Victorian legislation and policies relating to woodland protection

In Victoria, as elsewhere, legislative measures, polices and planning instruments relevant to woodland bird conservation are complex and diverse. They include:

- **Flora and Fauna Guarantee Act 1988.**
- **Native vegetation retention controls under the Planning and Environment Act 1987.**
- **Environmental Significance Overlays or Vegetation Protection Overlays under local government planning schemes.**
- **Victoria's Native Vegetation Management: a Framework for Action.**
- **Preparation of Native Vegetation Plans and Strategies by every Catchment Management Authority.**
- **Regional Forest Agreements and/or Forest Management Plans.**
- **Statewide Guidelines for habitat tree retention in State Forests.**
- **Victorian Firewood Strategy.**
- **Park Management Plans.**
- **Establishment of Bioregional Networks to co-ordinate and audit the conservation efforts of land management.**
- **Development of Biodiversity Action Planning process to identify and map priorities at bioregional, landscape and local scales.**
- **Advice on biodiversity under the Victoria Planning Provisions.**
- **Inclusion of some specific nature conservation objectives in some municipalities' Municipal Strategic Statements.**
- **Preparation of the Victorian Pest Framework: a Framework for Action.**
- **Preparation of the draft Victorian River Health Strategy.**
- **Completion of roadside management plans by municipalities within the temperate woodlands region.**
- **Formation of National Recovery Teams to coordinate conservation actions for some threatened woodland birds.**

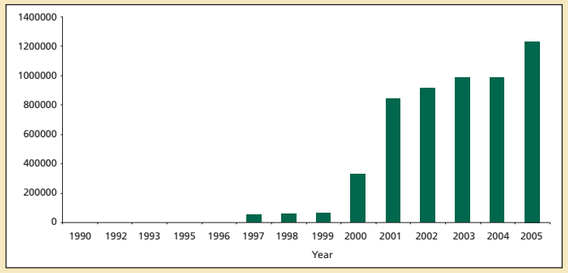
Reserves: governments and conservation organisations

All States and Territories have areas of woodland in their reserve and protected areas systems (e.g., in National Parks). However, woodlands are not well represented nationally: only 11% of extant woodlands are within conservation reserves (see table).

Area and percentage of woodland in nature conservation reserves (National Forest Inventory 2003).

	ACT	NSW	NT	Qld	SA	Tas	Vic	WA	Nationally
Area ('000 ha)	17	605	4	2594	2921	474	1412	2834	10,861
Percentage of total woodland area	77	22	0	7	33	28	58	13	11

Private reserves, those purchased or donated for nature conservation by non-government agencies, have emerged as a force for habitat conservation, largely in the last five years (see the graph). Organisations dedicated to the acquisition and management of land now own well over 1.3 million hectares, and are supported partly by government through programs such as the National Reserve Systems grants funded by the Australia Government's Natural Heritage Trust. For many organisations managing private reserves, the real challenge is not raising the capital to acquire land, but to resource the effective management of the reserves in perpetuity, to ensure that their natural and biodiversity values remain or are enhanced.



The number of hectares of nature reserve owned and managed by selected national conservation organisations (Australian Wildlife Conservancy, Australian Bush Heritage and Birds Australia) in the last 15 years. Based on reserves owned and detailed on the organisations' websites, September 2005. However, few primarily reserve woodland.

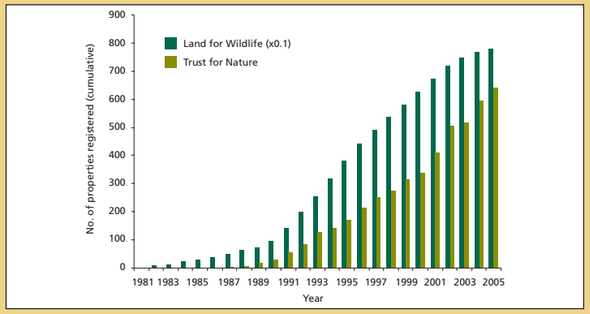
Buloke woodland, listed nationally as a Threatened Ecological Community and a vital source of food for the endangered south-eastern Red-tailed Black-Cockatoo. Photo by **Martine Maron**

Voluntary conservation on private lands

Reserves are a critical part of the effort to conserve woodland birds, but the greatest gains are to be had on the vast lands in private hands. There are many mechanisms which encourage and support biodiversity conservation on private land. Some examples include:

- **Covenanting and the use of mechanisms such as the Trust for Nature's revolving fund, where properties are purchased, covenanted and then on-sold.**
- **Grants such as the Australian Government's Envirofund (Natural Heritage Trust), which fund on-ground works, and which are available to private land holders provided they guarantee to maintain the outcome of the works for an agreed period.**
- **BushTender and similar schemes are auction-based approaches to improving management of native vegetation on private land. Under these systems, landholders competitively tender for contracts to improve their native vegetation. Successful bids are those that offer the best value for money.**
- **Land for Wildlife is an accreditation scheme which allows landholders to obtain support for appropriate on-ground works and management to provide habitats for wildlife on their property, even though the property may be managed primarily for other purposes, and to promote their property as meeting the criteria. This scheme operates throughout Australia (except for the ACT).**
- **Local Governments have a variety of conservation and environment protection schemes.**

Many of the above initiatives also provide tax incentives, rate relief, and specialist management advice to participating landowners (details are available from State/Territory and Australian Governments). Despite these encouragements, there is a need for greater government incentives for private landholders who manage their woodlands sustainably or restore them.



The cumulative number of properties registered under Land for Wildlife and covenanted under the Trust for Nature in Victoria, 1981–2005 (the number of Land for Wildlife properties has been scaled down by multiplying the actual number by 0.1, such that 7000 is shown as 700). Sources: **Department of Sustainability and Environment and Trust for Nature**

New Management Units for the Nation: Managing Biodiversity in Regions

The Australian Government has recently altered its natural resource management (NRM) approach to one of strategic regional investment. Regional plans and strategies are being developed which provide the framework through which communities identify NRM issues in their region, assess the relevant social, economic and biophysical pressures, develop regional NRM targets (including biodiversity targets), and identify priorities for investment and actions necessary to achieve targets. Under bilateral agreements, Federal and State/Territory funding will be channeled to regional NRM bodies (in some areas called Catchment Management Authorities) in the 57 NRM regions Australia-wide. These agencies will be at the centre of biodiversity and bird management for the foreseeable future, and they face many challenges.

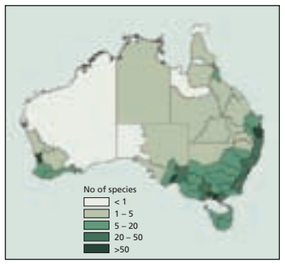
Birds Australia's role

How can Birds Australia assist NRM bodies and contribute to NRM management? Birds have a key role to play in defining biodiversity assets, indicating their condition, and monitoring change associated with management interventions or other processes. Birds Australia is working with NRM bodies to incorporate bird data and monitoring into regional plans, activities and reporting. The organisation has assisted the Wimmera Catchment Management Authority, Victoria, with their biodiversity planning and monitoring (see Case Study), and is represented on the peak body for NRM in New South Wales. In 2005, Birds Australia obtained funding through the Australian Government's Natural Heritage Trust to assist ten mostly Victorian NRM regions to develop powerful bird monitoring programs to inform their NRM.

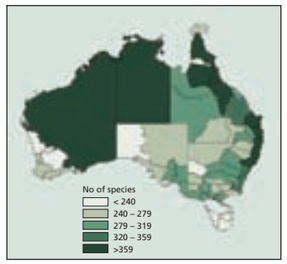
The Atlas of Australian Birds

Birds Australia has conducted two nationwide Atlases (1977–1981 and 1998 onwards), during which thousands of volunteers monitored birds. The Atlas of Australian Birds database contains a wealth of baseline information on every NRM region (see Map A). The data show that each region has a different richness of birds (see Map B) and a different number of threatened bird species. The data collection, storage and analysis systems have been developed by experts and tested over many years. The web-based extension, Birdata, allows electronic submission and feedback to Atlassers. Atlas data are frequently used in threatened species assessments, action plans and State of the Environment reporting.

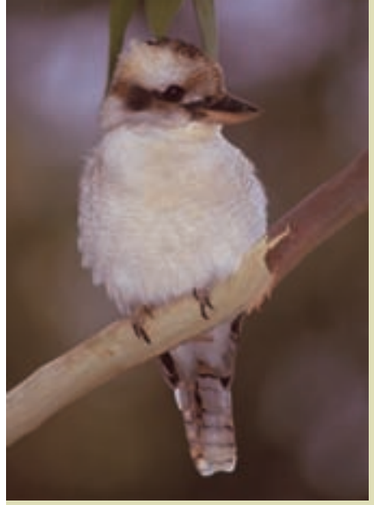
Atlas surveys are simple, healthy and enjoyable, and require only a pair of binoculars and an ability to recognise the local bird species. Not least, bird atlassing offers an engaging means for the community to monitor biodiversity and contribute to regional NRM.



Map A. The number of Atlas surveys per 10 km x 10 km grid in each Natural Resource Management region, 1998–2005.



Map B. The number of bird species in each Natural Resource Management region for which there are Atlas records, 1998–2005.



An immature Laughing Kookaburra, an iconic Australian woodland bird. Photo by **Jiri Lochman, Lochman Transparencies**

Why birds are good indicators of biodiversity

Birds are recognised internationally as useful indicators of biodiversity and the health of ecosystems. Because of the wealth of information, bird monitoring is making a major contribution to the global push to halt biodiversity loss, sitting alongside indicators of social and economic progress towards sustainable development.

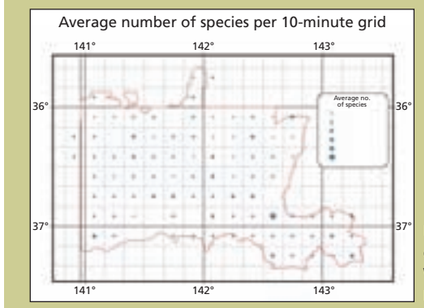
- **Birds are a major component of most ecosystems and are sensitive to many kinds of environmental disturbance.**
- **Birds' habitat requirements are likely to encompass the needs of a variety of other biota.**
- **Birds are the best-known group of animals in terms of knowledge of their ecology, abundance and distribution.**
- **Birds are attractive and birdwatching is rewarding, hence birds can help to engage the community in actively monitoring biodiversity.**
- **Birds have wide appeal—they can help to educate the public, and play a compelling role in advocacy.**

Case study: Planning and monitoring in partnership with the Wimmera Catchment Management Authority

The Wimmera Catchment Region, an area of about 30,000 km², is located in western Victoria, and contains the Wimmera River Catchment and part of the Millicent Coast Basin, extending to the South Australian border. In 2003 Birds Australia was funded by the Australian Government's Natural Heritage Trust to conduct a pilot project that investigated the application of Atlas of Australian Birds data and expertise to the regional planning process.

There were 2,247 Atlas 1 (1977–1981) and 5,413 Atlas 2 (1998 onwards) surveys from the region available for analysis. The report examined the change in birds between the Atlases. From the lists of species showing changes in reporting rate, 21 management issues/threatening processes were identified as concerns for the Wimmera Catchment Management Authority (WCMA). Lists of nationally threatened species occurring in the WCMA and their potential threats were also provided, and a number of species were highlighted as potential indicator species for monitoring purposes.

In 2004, the WCMA used the report to inform their biodiversity planning, and appointed a project officer to commence coordinating volunteers to conduct bird monitoring. Birds Australia assisted with the design of the program, in conjunction with statisticians, and was contracted to provide Atlas forms, collect, vet, process and manage the data on behalf of the WCMA. This will be an ongoing arrangement. Data collected are readily available to the CMA for measuring their performance against targets, and for adaptive management, and can also contribute to broadscale regional or national analyses.



Distribution and diversity of birds in the Wimmera Catchment Management Area

Further Reading

Andrén, H (1994) Effects of habitat fragmentation on birds and mammals in landscapes with different proportions of suitable habitat. *Oikos* 71: 355–366.

Antos, MJ & Bennett, AF (2005) How important are different types of temperate woodlands for ground-foraging birds? *Wildlife Research* 32: 557–572.

Australian Government (2004) Our Bush—Fact Sheet. http://www.nrm.gov.au/publications/our-bush/

Australian Government (2004) Our Land—Fact Sheet. http://www.nrm.gov.au/publications/our-land/

Barrett, G, Silcocks, A, Donnelly, C, Cunningham, R & Poulter, R (2002) *Australian Bird Atlas (1998-2001). Supplementary Report No. 2 – Atlas Bushcare.* Birds Australia report to the Department of Environment and Heritage.

Barrett, GW, Silcocks, AF, Barry, S, Poulter, R & Cunningham, RB (2003) *The New Atlas of Australian Birds*. Birds Australia, Melbourne.

BirdLife International (2004) *Working Together for the World's Birds and People.* BirdLife International, Cambridge.

Brooker, L & Brooker, M (2003) Local distribution, metapopulation viability and conservation of the Blue-breasted Fairy-wren in fragmented habitat in the Western Australian wheatbelt. *Emu* 103: 185–198

Davis, MA & Slobodkin, LB (2004) The science and values of restoration ecology. *Restoration Ecology* 12: 1–3.

Driscoll, D, Milkovits, G & Freudenberger, D (2000) *Impact and Use of Firewood in Australia.* CSIRO Sustainable Ecosystems, Bushcare and Environment Australia, Canberra.

Fischer, J & Lindenmayer, DB (2002) The conservation value of paddock trees for birds in a variegated landscape in southern New South Wales. 1. Species composition and site occupancy patterns. *Biodiversity and Conservation* 11: 807–832.

Ford, HA, Barrett, GB, Saunders, DA & Recher, HF (2001) Why have birds in the woodlands of southern Australia declined? *Biological Conservation* 97: 71–88.

Freudenberger, D (1999) Conservation of biodiversity in grazed landscapes: some patchy principles. Pp. 15–161 in T Barlow & R Thorburn *Balancing Conservation and Production in Grassy Landscapes*. Proc. Bushcare Grassy Landscapes Conference, Clare, South Australia, 19–21 August 1999.

Freudenberger, D (1999) *Guidelines for Enhancing Grassy Woodlands for the Vegetation Investment Project.* A report commissioned by Greening Australia ACT & SE NSW and CSIRO Wildlife and Ecology, Canberra.

Garnett, ST & Crowley, GM (2000) *The Action Plan for Australian Birds 2000*. Environment Australia, Canberra.

Gibbons, P & Boak, M (2002) The role of paddock trees for regional conservation in the agricultural landscape. *Ecological Management and Restoration* 3: 205–210.

Graetz, D, Wilson, MA & Campbell, SA (1995) *Landcover Disturbance Over the Australian Continent: A Contemporary Assessment.* Biodiversity Series No. 7. Biodiversity Unit, Department of Environment, Sport and Territories, Canberra.

Green, RH (1995) *The Fauna of Tasmania: Birds.* Potoroo Publishing, Launceston.

Grey, MJ, Clarke, MF & Loyn, RL (1998) Influence of the Noisy Miner *Manorina melanocephala* on avian diversity and abundance in remnant Grey Box woodland. Pacific Conservation Biology 4: 55–69.

Hamblin, A (2001) Land theme report. *Australia State of the Environment Report 2001.* CSIRO Publishing on behalf of the Department of the Environment and Heritage.

Hobbs, RJ & Yates, CJ (eds) (2000) T*emperate Eucalypt Woodlands in Australia: Biology, Conservation, Management and Restoration.* Surrey Beatty & Sons, Chipping Norton.

Law, BS, Chidel, M & Turner, G (2000) The use by wildlife of paddock trees in farmland. *Pacific Conservation Biology* 6: 130–143.

Lindenmayer, D, Claridge, A, Hazell, D, Michael, D, Crane, M, MacGregor, C & Cunningham, R (2003) *Wildlife on Farms: How to Conserve Native Animals.* CSIRO Publishing, Collingwood.

Lindenmayer, D, Crane, M, Michael, D & Beaton, E (2002) *Woodlands: A Disappearing Landscape.* CSIRO Publishing, Collingwood.

Luck, GW (2003) Differences in the reproductive success and survival of the Rufous Treecreeper *Climacteris rufa* between a fragmented and unfragmented landscape. *Biological Conservation* 109: 1–14.

Maron, M. (2005) Agricultural change and paddock tree loss: implications for an endangered subspecies of Red-tailed Black-Cockatoo. *Ecological Management and Restoration* 6: 207–212

Maron, M & Lill, A (2005) The influence of livestock grazing and weed invasion on habitat use by birds in grassy woodland remnants. *Biological Conservation* 124: 439–450.

McIntyre, S, McIvor, JG & Heard, KM (eds) (2002) *Managing and Conserving Grassy Woodlands.* CSIRO Publishing, Collingwood.

Moore, SA & Renton, S (2002) Remnant vegetation, landholders' values and information needs: an exploratory study in the Western Australian wheatbelt. *Ecological Management and Restoration* 3: 179–187.

National Forest Inventory (2003) *Australia's State of the Forests Report 2003.* Bureau of Rural Sciences, Canberra.

Olsen, P & Weston, M (2004) *The State of Australia's Birds 2004: Water, Wetlands and Birds.* Supplement to Wingspan 14 (4).

Olsen, P & Weston, M (2005) Fire and Birds: Fire Management for Biodiversity. Supplement to *Wingspan* 15 (3).

Olsen, P, Weston, M, Silcocks, A & Cunningham, R (2003) *The State of Australia's Birds 2003.* Supplement to *Wingspan* 13 (4).

Paton, DC, Rogers, DJ & Harris, W (2004) Birdscaping the environment: restoring the woodland systems of the Mt Lofty region, South Australia. Pp. 331–358 in D Lunney (ed.) *The Conservation of Australia's Forest Fauna.* Royal Zoological Society of NSW, Mosman.

Radford, JQ, Bennett, AF & Cheers, GJ (2005) Landscape-level thresholds of habitat cover for woodland-dependent birds. *Biological Conservation* 124: 317–337.

Recher, HF, Lunney, D & Dunn, I (1986) *A Natural Legacy: Ecology in Australia.* Pergamon Press, Sydney.

Recher, HF, Majer, JD & Ganesh, S (1996) Eucalypts, arthropods and birds: on the relationship between foliar nutrients and species richness. *Forest Ecology and Management* 85: 177–195.

Reid, JRW (1999) *Threatened and Declining Birds in the New South Wales Sheep-Wheat Belt: I. Diagnosis, Characteristics and Management.* Consultancy report prepared for the New South Wales National Parks and Wildlife Service.

Robinson, D & Traill, BJ (1996) *Conserving Woodland Birds in the Wheat and Sheep Belts of Southern Australia.* RAOU Conservation Statement No. 10. RAOU, Melbourne.

Robinson, D (1992) Old trees for wildlife. *Land for Wildlife* Note 18. Department of Natural Resources and Environment, Victoria.

Robinson, D (1993) Vale Toolern Vale: the loss of our woodland birds. *Wingspan* 9: 1.

Sattler, P & Creighton, C (2002) *Australian Terrestrial Biodiversity Assessment 2002.* National Land and Water Resources Audit, Canberra. (www.nlwra.gov.au)

Saunders, DA, Hobbs, RJ & Margules, CR (1991) Biological consequences of ecosystem fragmentation: a review. *Conservation Biology* 5: 18–32.

Saunders, DA & Ingram, JA (1995) *Birds of Southwestern Australia. An Atlas of Changes in the Distribution and Abundance of the Wheatbelt Avifauna.* Surrey Beatty & Sons, Sydney.

Saunders, DA & Ingram, JA (1998) Twenty-eight years of monitoring a breeding population of Carnaby's Cockatoo. *Pacific Conservation Biology* 4: 261–270.

Saunders, DA, Smith, GT, Ingram, JA & Forrester, RI (2003) Changes in a remnant of Salmon Gum *Eucalyptus salmonophloia* and York Gum *E. loxophleba* woodland, 1978 to 1997. Implications for woodland conservation in the wheat-sheep regions of Australia. *Biological Conservation* 110: 245–256.

Silcocks, A, Tzaros, C, Weston, M & Olsen, P (2005) *An Interim Guild Classification for Australian Woodland and Grassland Birds.* Birds Australia Supplementary Report to State of the Environment Report 2006.

Szaro, RC & Johnston, DW (eds) (1996) *Biodiversity in Managed Landscapes: Theory and Practice.* Oxford University Press, New York.

Tepper, JGO (1896) Trees and their role in nature. *Agricultural Gazette of New South Wales* 7: 29–37.

Tzaros, CL (2001) *Importance of Riparian Vegetation to Terrestrial Avifauna Along the Murray River, South-Eastern Australia.* MSc Thesis, Deakin University.

Tzaros, C (2005) *Wildlife of the Box-Ironbark Country*. CSIRO Publishing, Collingwood.

Walker, J, Dowling, T, Fitzgerald, W, Hatton, T, Mackenzie, D, Milloy, B, Nicoll, C, O'Sullivan, A & Richardson, P (1998) *Evaluating the Success of Tree Planting for Degradation Control.* Final Report of the National Landcare Project. CSIRO, Canberra.

Walpole, SC (1999) Assessment of the economic and ecological impacts of remnant vegetation on pasture productivity. *Pacific Conservation Biology* 5: 28–35.

Williams, J & Woinarski, JCZ (1997) *Eucalypt Ecology: Individuals to Ecosystems.* Cambridge University Press, Cambridge.

Wilson, K & Recher, HF (2001) Foraging ecology and habitat selection of the Yellow-plumed Honeyeater, *Lichenostomus ornatus*, in a Western Australian woodland: implications for conservation. *Emu* 101: 89–94.

Woinarski, JCZ (1993) Australian tropical savannas, their avifauna, conservation and threats. Pp. 45–63 in C Catterall (ed.) *Birds and Their Habitats: Status and Conservation in Queensland.* The Queensland Ornithological Society, Brisbane.

A structural intact box-ironbark forest in all its complexity. Photo by **Chris Tzaros**

Contents

The Painted Honeyeater, one of several declining woodland birds that feed, breed and roost among mistletoe. Photo by **Graeme Chapman**

Front cover: Coming to a woodland near you: the Noisy Miner. In eastern Australia, the prevalence of this aggressive native species, to the detriment of other woodland species, is a sign of diminishing and deteriorating woodlands. Photo by **Tadao Shimba**

Acknowledgements

Birds Australia thanks the Vera Moore Foundation and the Australian Government Department of the Environment and Heritage for their continued funding of this important series; and for assistance with funding and planning we thank Joshua Smith and Robert Cole. We are particularly grateful to the following individuals who contributed various reports and other textual material: Andrew Bennett, Jenny Bounds, Lesley and Michael Brooker, Allan Burbidge, Mason Crane, Ross Cunningham, Janet Gardner, Cheryl Gole, Matthew Herring, David Lindenmayer, Sarah Lloyd, Martine Maron, Christopher McGregor, Damian Michael, Rebecca Montague-Drake, David Paton, John Peter, Jim Radford, Daniel Rogers, Alison Rowell, Denis Saunders, Nicki Taws, Barry Traill, David Watson and John Woinarski. Simon and Tristan Kennedy contributed bird survey data and Wendy Beumer wrote the landholder report from which the graph on p. 27 is drawn. Eleanor Adams, John Lauri, Lynn Pedler, Tadao Shimba, Nicki Taws and Chris Tzaros kindly allowed free use of their photographs, and the Victorian Department of Sustainability and Environment provided the aerial photograph on the centre pages. Briana Elwood, CSIRO Publishing, arranged electronic copies of some illustrations.

These reports are overseen by the Birds Australia Research and Conservation Committee. Denis Saunders, Hugh Ford, Graeme Hamilton, Martine Maron reviewed the entire report; John Blyth, Tania Rajic and Jonathan Sparks reviewed particular sections. Sophie Knezic copy edited and guided production, and Andrea Williamson designed and laid out the report. Not least, thanks to all the volunteers who contributed to the Birds Australia Atlas, Threatened Bird Network, and other bird surveys mentioned in this report.

Birds Australia
CONSERVATION THROUGH KNOWLEDGE

Dedicated to the study, conservation and enjoyment of native birds and their habitat

Since 1901 Birds Australia (Royal Australasian Ornithologists Union) has worked for the conservation of Australasia's birds and their habitats. Its reserves and observatories protect bird habitat and offer unique research and birdwatching opportunities. As an independent, not-for-profit organisation, Birds Australia relies on the financial support of companies, trusts and foundations, and private individuals, and the involvement of thousands of volunteers in its projects.

415 Riversdale Road,
Hawthorn East, Victoria 3123
Tel: (03) 9882 2622; Fax; (03) 9882 2677;
Email: mail@birdsaustralia.com.au
Web site: www.birdsaustralia.com.au

Vera Moore Foundation

Australian Government

Funding for this report was generously provided by the Vera Moore Foundation and the Australian Government.

The views expressed in this report do not necessarily reflect those of Birds Australia or its Council, the Australian Government or the Minister for the Environment and Heritage.

Layout and design: P.A.G.E. Design
Reproduction and printing: Courtney Colour Graphics

Birds Australia welcomes new members and volunteers

The **Atlas of Australian Birds** is a long-term, nationwide, volunteer-based bird-monitoring project that welcomes new Atlasers. Contact Andrew Silcocks (03 9882 2622; a.silcocks@birdsaustralia.com.au)

The **Threatened Bird Network** links volunteers with recovery efforts for more than 25 threatened species. Contact Chris Tzaros (03 9882 2622; c.tzaros@birdsaustralia.com.au)

The **Important Bird Area** project identifies areas critical to the survival of native birds. Contact Mike Weston (03 9882 2622; m.weston@birdsaustralia.com.au)

JOIN TODAY! *By joining Birds Australia, you help Australia's wild birds and their habitats.*

Title First Name

Surname

Address

Phone ((BH)

Email

Please accept my enclosed cheque for $68 ☐ $50 (concession) ☐

$108 (family*) ☐ or $87 (family concession) ☐ payable to 'Birds Australia'

or debit my Bankcard ☐ Visa ☐ Mastercard ☐

Expiry Date / Signature

Date / /

SCIA.1

Birds Australia, 415 Riversdale Rd, Hawthorn East, Vic. 3123
Tel: (03) 9882 2622; Fax: (03) 9882 2677;
Email: mail@birdsaustralia.com.au

*Family covers two members at the same address. Membership runs for 12 months.

To comment on this report: www.birdsaustralia.com.au/soab/ For copies of previous *State of Australia's Birds* reports: www.birdsaustralia.com.au

ISSN: 1036-781