

# LOCAL EXTINCTION AND DECLINE OF BIRDS IN A WOODLAND REMNANT AT INVERLEIGH, VICTORIA

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Between 1979–2000 data about the presence or absence of birds were opportunistically collected from a grassy woodland reserve on the edge of the Victorian Volcanic Plain (38°04'S, 144°03'E), Victoria. Whilst no estimates of absolute abundance were made, the observations over 20 years are representative of avifaunal change during that period. In the last three decades of the twentieth century, 22 bird species have either declined or become locally extinct in the reserve — 23 per cent of locally breeding species. These changes are important because they involve some species not known to be in decline elsewhere, and because they are occurring in a relatively large woodland remnant (1 050 ha). The opportunities for small, woodland-specialist birds to recolonize from nearby areas are extremely limited, as most nearby remnants are not connected and are generally smaller, species-poor and experiencing species loss. Many of the local extinctions are probably not naturally reversible in the current landscape.

## INTRODUCTION

Between 1979–2000, I undertook investigations into various aspects of the conservation biology and ecology of arboreal and volant mammals (possums, gliders and bats) within the Inverleigh Flora and Fauna Reserve [IFFR] (Conole and Baverstock 1985; in prep.). During that period, I opportunistically collected information relating to other fauna and flora, particularly the birds. The data are presence or absence in nature, and whilst no estimates of absolute abundance have been made, the observations from 41 visits over 20 years give an accurate picture of avifaunal change during that period.

Between 1951 and 1973, Wheeler (*circa* 1973) recorded 96 species of forest and woodland birds at IFFR. Between 1978 and 1989 I recorded 96 species of forest and woodland birds, but between 1990 and 2000 I recorded only 86 species of forest and woodland birds at IFFR. Since the baseline drawn in the early 1970s (Wheeler *circa* 1973), I have documented the local extinction of 13 bird species at Inverleigh, representing approximately 10–15 per cent of sedentary, breeding species. Another nine species (9%) have become rarer, and may become locally extinct in the near future. In total, 22 species (23%) of locally breeding species have declined — some to the point of local extinction. Although this pulse of species loss can be seen as part of a widespread extinction wave in woodland birds in south-eastern Australia (Robinson 1994; Robinson and Traill 1996; Reid 1999), some of the species are not generally thought of as part of this wider trend. By the early years of the 21st century, it seems likely that the sedentary, breeding component of the IFFR avifauna will have been reduced by up to 20 per cent in a period of about three decades after apparently being relatively stable throughout most of the 20th century.

## THE STUDY AREA

IFFR is on the eastern edge of the Victorian Volcanic Plain (38°04'S, 144°03'E), about 30 kilometres west of the large provincial city of Geelong. The reserve comprises 1 050 hectares of grassy woodland, predominantly of River Red Gum *Eucalyptus camaldulensis* and a rough-barked form of Manna Gum *E. viminalis*. IFFR has a long history of exploitation for local domestic firewood, and during the 1960s, about 10 per cent of the reserve was cleared of Manna Gum by the Forests Commission of Victoria and replanted with non-indigenous *Eucalyptus* species (mostly Sugar Gum *E. cladocalyx* and Ironbark *E. sideroxylon/tricarpa*) (Sheehan 1992). The original town common and state forest allotments were combined to make the reserve in 1988 (Sheehan 1992).

IFFR is relatively isolated, and is only very loosely connected by discontinuous, narrow strips of degraded native vegetation to the Leigh River, Barwon River and Native Hut Creek (within 1–5 km), and along similar poor quality roadsides to the Bannockburn Recreation Reserve (*circa* 300 ha) 6 kilometres to the SE. Other small and degraded remnants exist around Teesdale, just east of IFFR. Substantial areas of forest and woodland (>10 000 ha) in the Brisbane Ranges National Park, Enfield State Forest and Otway Ranges are separated from IFFR by between 20–40 kilometres of cleared agricultural land (see Fig. 1). The land clearing that led to this fragmentation and degradation took place between 50 and 100 years ago.

## METHODS

Though birds were of secondary interest in some of the 41 trips to IFFR, a consistent approach to surveying was taken. I either walked over large parts of the reserve on each trip, or drove between multiple locations and walked around at each. A record was kept of all bird species seen or heard. Records were entered into a BirdInfo database (Intelligent Birding, Canberra, Australia) and analysed for species occurrence by year from 1979–2000.

Taxonomy follows Christidis and Boles (1994) for species, Schodde and Mason (1997) for non-passerine and Schodde and Mason (1999) for passerine sub-species (or 'ultrataxa'). The subspecies is noted if more than one subspecies occurs in Victoria. This approach was used to ensure that the most accurate taxonomic units were used when discussing local extinctions.

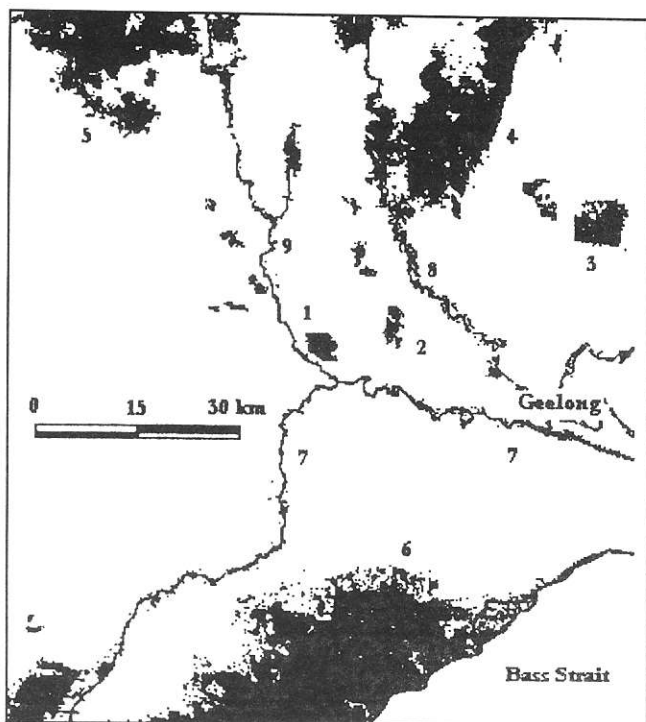


Figure 1. Map of main vegetation remnants and blocks west of Geelong, Victoria. 1 = Inverleigh FFR; 2 = Bannockburn Reserve; 3 = You Yangs Regional Park; 4 = Brisbane Ranges; 5 = Enfield State Forest; 6 = Otway Ranges; 7 = Barwon River; 8 = Moorabool River; 9 = Leigh River.

## RESULTS

Between 1979 and 2000 I recorded 124 species of birds in the IFFR. A substantial component of these 124 (about 25%) are casual visitors or vagrants, or only visit during particular climatic conditions (e.g. waterbirds during flooding episodes associated with *La Nina* conditions).

Since about 1973, 13 species have become locally extinct (Bush Stone-curlew *Burhinus grallarius*, Barking Owl *Ninox connivens*, Grey-crowned Babbler *Pomatostomus temporalis*, Scarlet Robin *Petroica multicolor boodang*, Hooded Robin *Melanodryas cucullata cucullata*, Speckled Warbler *Pyrrholaemus sagittatus*, Brown Thornbill *Acanthiza pusilla pusilla*, Buff-rumped Thornbill *Acanthiza reguloides reguloides*, White-browed Scrubwren *Sericornis frontalis frontalis*, White-throated Treecreeper *Cormobates leucophaea*, Brown Treecreeper *C. picumnus*, Eastern Spinebill *Acanthorhynchus tenuirostris tenuirostris*, Grey Butcherbird *Cracticus torquatus torquatus*); five of those since 1980 (Scarlet Robin, Brown Thornbill, White-browed Scrubwren, Brown Treecreeper, White-throated Treecreeper). A further nine species have declined markedly (Sacred Kingfisher *Todirhamphus sanctus*, Fan-tailed Cuckoo *Cacomantis flabelliformis*, Horsfield's Bronze-Cuckoo *Chrysococcyx basalus*, Shining Bronze-Cuckoo *C. lucidus plagosus*, Jacky Winter *Microeca fascians fascians*, Yellow Thornbill *Acanthiza nana modesta*, Varied Sittella *Daphoenositta chrysoptera chrysoptera*, Diamond Firetail *Stagonopleura guttata*, White-winged Chough *Corcorax melanorhamphus melanorhamphus*); see Table 1.

In grouping the species which have either exhibited marked decline or become locally extinct since about 1970, some patterns are evident (see Tables 2 and 3):

- All the selected species are primarily insectivorous.
- The largest grouping is one of species that forage predominantly on the ground or in structures very close to the ground (Scarlet Robin, Hooded Robin, White-browed Scrubwren, Speckled Warbler, Brown Thornbill, Buff-rumped Thornbill, Brown Treecreeper, Eastern Spinebill, White-winged Chough, Grey Butcherbird).
- Another grouping requires dead, standing or fallen wood as a foraging substrate or perch from which to forage (Scarlet Robin, Hooded Robin, Brown Treecreeper, White-throated Treecreeper, Varied Sittella).
- All are breeding, sedentary species susceptible to exotic predators in a landscape island (e.g. Black Rat *Rattus rattus*, Fox *Vulpes vulpes*, Cat *Felis catus*), or to major changes in habitat structure and floristics.
- There does not appear to be any universality with respect to positioning or type of nest. Some of the species in decline nest on or near the ground, which may implicate floristic/structural change in the habitat for those species, and/or susceptibility to exotic predators.

## DISCUSSION

The White-throated Treecreeper and Brown Treecreeper are broadly sympatric in open forest and woodland in the north and west of the City of Greater Geelong and adjacent areas. Pescott (1983) records both species at Batesford, You Yangs, Inverleigh and the Brisbane Ranges, to which can be added open-forest and woodland remnants near Bannockburn (Conole, unpubl. data; Baverstock and McCarthy 2000). Both species occur widely and appear secure in the You Yangs Regional Park, Brisbane Ranges National Park and contiguous Steiglitz Historic Park, but have undergone an observable but unmeasured decline at the Bannockburn Reserve and IFFR (Conole, pers. obs.). Both treecreepers had apparently become virtually extinct (down to two-three birds or less) at Bannockburn and Inverleigh by about 1990 (last Brown Treecreeper record at IFFR in 1988; last White-throated Treecreeper record at IFFR in 1991). Two or three White-throated Treecreepers remain at Bannockburn, and were last seen during 2000 (Baverstock and McCarthy 2000).

At face value, much of the woodland at IFFR still looks to be suitable for treecreepers. The reasons for their decline and extinction are unclear, but both species were already quite rare in the woodland when I first started visiting in 1979. Estimates of abundance of White-throated and Brown Treecreepers from New South Wales and elsewhere in Victoria vary between 0.03–0.60 birds/hectare and 0.03–2.00 birds/hectare respectively (Bourke 1949; Schrader 1956; Marchant 1979; Bell 1980; Ford and Bell 1980; Reilly in Blakers *et al.* 1984). On this basis it is reasonable to expect that the 1 050 hectares at IFFR might once have supported between up to 500 individuals of each treecreeper species. No data are available to confirm that numbers were ever this high, or if so when. Walters *et al.*

TABLE 1

Birds of changed status in the Inverleigh Flora and Fauna Reserve. Definitions modified from Pescott (1983): E = locally extinct; R = rare (few recorded and would only be found by systematic searching); U = uncommon (unusual, can be seen if time is spent searching, but not common); C = common (can usually be seen by the average observer); V = vagrant (beyond their normal range); L = localized (only found in localized habitat patches in reserve).

Species	Assessment of status	
	Pescott (1983)	Conole 2000
Emu <i>Dromaius novaehollandiae</i>	—	E
Australian Bustard <i>Ardeotis australis</i>	E	E
Bush Stone-curlew <i>Burhinus grallarius</i>	R	E
Purple-crowned Lorikeet <i>Glossopsitta porphyrocephala</i>	U	C
Swift Parrot <i>Lathamus discolor</i>	R	V
Barking Owl <i>Ninox connivens</i>	—	E
Masked Owl <i>Tyto novaehollandiae novaehollandiae</i>	—	R
White-backed Swallow <i>Cheramoeca leucosternus</i>	—	V
Sacred Kingfisher <i>Todirhamphus sanctus</i>	C	U
Fan-tailed Cuckoo <i>Cacomantis flabelliformis</i>	C	U
Horsfield's Bronze-Cuckoo <i>Chrysococcyx basalis</i>	C	U
Shining Bronze-Cuckoo <i>Chrysococcyx lucidus plagosus</i>	C	U
Bassian Thrush <i>Zoothera lunulata lunulata</i>	R	V
Scarlet Robin <i>Petroica multicolor boodang</i>	C	E
Hooded Robin <i>Melanodryas cucullata cucullata</i>	R	E
Jacky Winter <i>Microeca fascians fascians</i>	U	R
Satin Flycatcher <i>Myiagra cyanoleuca</i>	U	V
Rufous Songlark <i>Cinchorhamphus matthewsi</i>	U	R
White-browed Scrubwren <i>Sericornis frontalis frontalis</i>	C	E
Speckled Warbler <i>Pyrholaemus sagittatus</i>	R	E
Weebill <i>Smicromis brevirostris brevirostris</i>	U	V
Yellow Thornbill <i>Acanthiza nana modesta</i>	U	R
Brown Thornbill <i>Acanthiza pusilla pusilla</i>	C	E
Buff-rumped Thornbill <i>Acanthiza reguloides reguloides</i>	C	E
Southern Whiteface <i>Aphelocephala leucopsis leucopsis</i>	R	V
White-throated Treecreeper <i>Cormobates leucophaeus leucophaeus</i>	C	E
Brown Treecreeper <i>Climacteris picumnus victoriae</i>	U	E
Varied Sittella <i>Daphoenositta chrysoptera chrysoptera</i>	U	R
White-eared Honeyeater <i>Lichenostomus leucotis leucotis</i>	U	L
Yellow-tufted Honeyeater <i>Lichenostomus melanops meltoni</i>	—	V
Fuscous Honeyeater <i>Lichenostomus fuscus fuscus</i>	R	U
Crescent Honeyeater <i>Phylidonyris pyrrhoptera pyrrhoptera</i>	—	V
Eastern Spinebill <i>Acanthorhynchus tenuirostris tenuirostris</i>	U	E
*Common Mynah <i>Acridotheres tristis tristis</i>	—	U
White-winged Chough <i>Corcorax melanorhamphus melanorhamphus</i>	C	U
Grey Butcherbird <i>Cracticus torquatus torquatus</i>	R	E
Grey Currawong <i>Strepera versicolor versicolor</i>	U	V
Diamond Firetail <i>Stagonopleura guttata</i>	U	R

TABLE 2

Breeding resident species of changed status tabulated according to their principal foraging mode, substrate and height distribution of foraging (based on Recher *et al.* 1985; Ford *et al.* 1986; Conole, pers. obs.).

Species	Foraging			Status change
	Mode	Substrate	Height distribution	
Scarlet Robin	Pounce	Ground	<0.2m	Locally extinct
Hooded Robin	Pounce	Ground	<0.2m	Locally extinct
Jacky Winter	Sally	Air	2.0–10.0 m	Decreased abundance
White-browed Scrubwren	Glean	Ground	<0.2 m	Locally extinct
Speckled Warbler	Glean	Ground	<0.2 m	Locally extinct
Yellow Thornbill	Glean	Foliage	4.0–10.0 m	Decreased abundance
Brown Thornbill	Glean	Foliage	0.2–4.0 m	Locally extinct
Buff-rumped Thornbill	Glean	Ground	<0.2 m	Locally extinct
White-throated Treecreeper	Glean	Bark	4.0–10.0 m	Locally extinct
Brown Treecreeper	Glean	Ground/Bark	<0.2 m	Locally extinct
Varied Sittella	Glean	Bark	4.0–15.0 m	Decreased abundance
Eastern Spinebill	Glean	Nectar	0.2–4.0 m	Locally extinct
White-winged Chough	Probe	Ground	<0.2 m	Decreased abundance
Grey Butcherbird	Pounce	Ground	<0.2 m	Locally extinct
Diamond Firetail	Glean	Ground	<0.2 m	Decreased abundance

TABLE 3

Breeding resident species of changed status tabulated with nesting substrate and height (based on Beruldsen 1980).

Species	Nest		Status change
	Substrate	Height	
Scarlet Robin	Bark/fork/spout	1–20 m	Locally extinct
Hooded Robin	Spout/stump/fork	<3 m	Locally extinct
Jacky Winter	Dead branch	2.0–12.0 m	Decreased abundance
White-browed Scrubwren	Shrub	<1 m	Locally extinct
Speckled Warbler	Ground	<0.1 m	Locally extinct
Yellow Thornbill	Foliage	3–10 m	Decreased abundance
Brown Thornbill	Shrub	<1 m	Locally extinct
Buff-rumped Thornbill	Bark/shrub/ground	<1 m	Locally extinct
White-throated Treecreeper	Hollow	4–20 m	Locally extinct
Brown Treecreeper	Hollow	1–12 m	Locally extinct
Varied Sittella	Dead wood	10–25 m	Decreased abundance
Eastern Spinebill	Shrub	3–10 m	Locally extinct
White-winged Chough	Branch	<13 m	Decreased abundance
Grey Butcherbird	Fork	<5 m	Locally extinct
Diamond Firetail	Shrub	<5 m	Decreased abundance

(1999) have found that some remnants in New South Wales contain male Brown Treecreepers but no females. It is possible that once populations reach low enough levels, the dispersal of females out of the remnant is enough to tip the balance to local extinction.

Wheeler (*circa* 1973) and Pescott (1983) list the Scarlet Robin as common at Inverleigh, but I regard it as locally extinct and have not recorded it there since 1979. The most recent record from Bannockburn is 1988 (Conole, pers. obs.; Baverstock and McCarthy 2000).

Wheeler (*circa* 1973) and Pescott (1983) list the Hooded Robin as rare at Inverleigh, but I regard it as now locally extinct and have not recorded it there. Emison *et al.* (1987) consider the Hooded Robin a winter visitor to coastal areas in Victoria, but this is inaccurate as the species was a breeding resident in various parts of the Geelong area such as the You Yangs, Batesford and Brisbane Ranges into the late 1980s (Conole 1981, pers. obs.; Pescott 1983). It has declined markedly in the Geelong area since then and probably only survives now at one or two locations at the You Yangs and Brisbane Ranges (Pescott 1983; Jessop *et al.* 1988; Conole, pers. obs.). It is one of a suite of species that are declining across southeastern Australia (Robinson 1994). Hooded Robins have probably suffered from the degradation of habitat structure robbing them of suitable foraging perches, display and nest sites, with a concomitant loss of prey availability. Boles (1988) and Sullivan (1993) refer to the Hooded Robin's predilection for 'untidy' dry woodlands with ample dead, fallen timber and stumps.

The White-browed Scrubwren, Brown Thornbill and White-eared Honeyeater *Lichenostomus leucotis leucotis* once had localized distributions within the IFFR. Pescott (1983) describes the scrubwren as common, and the thornbill and the honeyeater as uncommon, but this is no longer true. These species were locally abundant within a 5–6 hectare patch of Austral Bracken *Pteridium esculentum* in Manna Gum woodland, but the scrubwren and thornbill are now locally extinct (last records 1988 and 1989 respectively), and the White-eared Honeyeater has proliferated to become abundant throughout the Manna Gum/Kangaroo Thorn *Acacia paradoxa* parts of the reserve.

In light of the decline and local extinction of a range of host species (thornbills, scrubwrens), it comes as little surprise then that some brood parasites (Fan-tailed Cuckoo, Horsfield's Bronze-Cuckoo, Shining Bronze-Cuckoo) have also declined in abundance at IFFR. Since the early 1990s, records of these three, largely migratory cuckoos have declined in the area. Also of interest is that records of the Pallid Cuckoo *Cuculus pallidus*, a brood parasite principally of *Lichenostomus* honeyeaters, have remained constant.

The Australian Owlet-nightjar *Aegotheles cristatus* is regarded as having declined in South Australia and Victoria (Robinson 1994) but inexplicably it seems to be holding its own in this isolated remnant. Reliable estimates of abundance in IFFR are not available, but it is my opinion that owlet-nightjars are about as abundant now as they were 15–20 years ago in the reserve. Though nocturnal, this species has similar foraging habits to several of the declining diurnal birds. If predation by the Black Rat *Rattus rattus* is implicated in the decline of some diurnal birds, then perhaps owlet-nightjars avoid that predatory pressure by being active at the same time as the rats are, unlike diurnal birds that are probably killed in roosts.

The large scale removal of standing and fallen timber for firewood has probably removed a favoured gleaning substrate for species such as the treecreepers and Varied Sittella, a source of invertebrates for a range of birds, and perches for the 'pounce' foraging Scarlet Robin, Hooded Robin and Grey Butcherbird (Recher 1991). In combination with a reduction in floristic diversity of the understorey, this process has led to a simplification of the woodland structure, and a lessened availability of food resources. These are clearly important changes, and ones that could be partly reversed or mitigated. Mac Nally *et al.* (in press) have demonstrated the link between higher amounts of woody debris in woodland and greater biodiversity of birds. During the 1990s, it appears that improved management of firewood procurement by utilizing the Sugar Gum plantations may already have arrested this trend, and there is now more woody debris being allowed to accumulate in the woodland.



Overall, it could be said that a more floristically and structurally diverse shrub layer should be encouraged for avian conservation. That the middle and ground storey were once more diverse and complex is evidenced by remnant specimens of Dogwood *Cassinia aculeata* (1 plant) and *C. arcuata* (<5 plants), Snowy Mint-bush *Prostanthera nivea*, Grey Everlasting *Ozothamnus obcordatus* (<5 plants), Sweet Bursaria *Bursaria spinosa* var. *macrophylla* (<50 plants), Hop-bush *Dodonaea cuneata* (<20 plants), Prickly Tea-tree *Leptospermum continentale* (<20 plants), Tree Violet *Hymenanthera dentata* (<50 plants), etc. (Conole, unpubl. data). Some middle-storey plants have also become locally extinct, e.g. Twiggy Daisy-bush *Olearia ramulosa* (Mark Trengove, pers. comm.).

Much attention was focused on possible poaching of parrot nestlings in the reserve in 1994 (Hughes 1994), but this activity does not occur at a high enough level to act as a significant endangering process on abundant Eastern Rosellas *Platycercus eximius* and Red-rumped Parrots *Psephotus haematonotus*.

Over the 1980s and 1990s, the fox and cat were not abundant at IFFR (Conole and Baverstock 1985; pers. obs.), but this may not always have been the case. However, the Black Rat has been and remains widespread and abundant (Conole and Baverstock 1985; pers. obs.). On oceanic islands, the introduction of this species has brought about significant extinctions of birds, particularly small-medium passerines and ground feeding-nesting species (Ford 1989).

It is possible that the proliferation of Kangaroo Thorn *Acacia paradoxa* and exotic grasses does not provide adequate diversity and quantity of prey for a full community of insectivorous birds. Past arguments for Kangaroo Thorn's efficacy as a refuge from predators and as a nesting substrate are only partly borne out by observations. Diamond Firetail, Red-browed Finch *Neochmia temporalis* and Superb Fairy-wren *Malurus cyaneus* are the only species making major use of *A. paradoxa* for nesting at IFFR. Other species do use it for movement across the landscape, but few species forage in *A. paradoxa*. My observations during spotlight survey suggest that the Red Wattlebird *Anthochaera carunculata*, Superb Fairy-wren and Eastern Rosella use *A. paradoxa* as a night roost. With the exception of the fairy-wren though, birds tend to roost on top of the bush or on emergent branches rather than in the prickly interior.

Bennett (1993) has pointed to the poorly understood nutrient cycling processes, which may be impeded or dysfunctional in these degraded ecosystems. Bromham *et al.* (1999) found a reduction in invertebrate diversity in grassy woodland remnants grazed by stock. Overgrazing by rabbits and kangaroos may produce a similar result in remnants such as IFFR. It may now be the case that invertebrate production, particularly of terrestrial species, is not adequate to support a full community of terrestrial, insectivorous birds. Zanette *et al.* (2000) concluded that forest songbirds face declining food resources as habitat fragment size decreases.

Although it is expected that island populations will have a higher than average chance of becoming extinct, at 1 050 hectares IFFR is not a typical small remnant woodland (Ford 1989). It seems likely that another 5–10 species (e.g. Jacky Winter, Diamond Firetail, Varied Sittella, White-winged Chough) will become locally extinct there by 2010 on current trends, unless management intervention succeeds in ameliorating the threatening processes.

On a positive note, penetration of the inner areas of IFFR by 'farmland' birds has been surprisingly minimal. Some examples are Eastern Rosella, Red-rumped Parrot and Willie Wagtail *Rhipidura leucophrys*. The Noisy Miner *Manorina melanocephala*, which often invades smaller habitat islands and drives out competitors, is only present in two or three colonies on the periphery of the IFFR. Noisy Miners appear not to have penetrated the core areas even along the wide and sealed Teesdale-Inverleigh Road that bisects the IFFR into two roughly equal parts.

### Conclusion

A pattern of species loss of small, terrestrial, insectivorous birds is well entrenched at Inverleigh Flora and Fauna Reserve. This is clearly important, both because it includes both some species of wider concern and some species not generally in decline elsewhere, and because the relatively large size of IFFR (1 050 ha) has failed to confer the expected benefits of its area/size relationship in species retention. Also of concern is that this process has gathered pace in the last few decades of the 20th century, after being apparently somewhat stable for decades before that. The relative isolation of IFFR from truly large forest/woodland blocks has meant that there has been little if any species turnover, but rather a steady loss of diversity.

The opportunities for small, woodland-specialist birds to recolonize IFFR from nearby areas are extremely limited, particularly given that similar extinctions are occurring at Bannockburn (Conole, pers. obs.; Baverstock and McCarthy 2000), and most nearby remnants are smaller, species-poor and also suffering species loss. Most of the local extinctions are therefore probably not naturally reversible in the current landscape.

Extinctions of core, sedentary species since *circa* 1973 run to about 14 per cent, with a further 8 per cent declining to the point of vulnerability. Current indications are that more species will follow, which could bring the core species count at IFFR down to about 80 species of birds in 2005, from about 95 in 1973. Such species loss, or relaxation to equilibrium, is to be expected in any isolated remnant, but what has caused the process to restart ('punctuated relaxation') after a long remission is not clear. Left unmanaged this epidemic of local extinctions could amount to 20 per cent of core species between 1970 and 2005.

Measures to arrest the steady loss of bird species must be implemented as a matter of urgency. The reserve's manager, Parks Victoria, must develop a stabilization and recovery plan which attempts to deal with issues such as enhanced connectivity, continued rigorous management of firewood removal, and restoration of some nearby remnants. IFFR should be managed as a landscape element, along with other nearby remnants such as the Bannockburn

and Teesdale Recreation Reserves, and corridors along roadsides and watercourses. Once habitat values have been restored, consideration might also be given to the reintroduction of selected species.

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