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The impacts of the 2019–20 wildfires on Australian birds

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Summary

Conservation context and challenges

- There is little information on the fate of individual birds in and following fire, but those of more mobile species may have fled, with reports of forest species in suburbs and other unusual habitats in the days and months after the fire.
- Many also died, with burnt birds as large as eagles washed up on beaches. Those that survived lost food and shelter. There is also likely to have been a net loss of tree hollows used for nesting by many species; replacement will take a long time.
- Studies to date suggest that recolonisation is rapid as habitat recovers its structure, but recovery may take years and possibly decades for species associated with rainforest and other wetter habitats.
- Active management is expected to help a few species to recover, particularly through nest box erection.

Main findings

- The ranges of 180 million individual birds from more than 350 terrestrial bird taxa intersected with the 2019–20 megafires.
- The 2019–20 wildfires burnt > 25% of the range of 51 bird taxa, much of it severely; the most extreme overlap (68% of range burnt) was for the Kangaroo Island southern emu-wren (*Stipiturus malachurus halmaturinus*).
- Of the most fire-affected birds, eight were meeting the IUCN Red List criteria as threatened or Near Threatened before the fire. Another 19 were assessed as meeting the criteria directly because of the fires.
- The IUCN Red Index for all Australian birds declined by over 9% as a direct result of the fires.

- Bird communities in burnt rainforests were at lower densities after the fires and were recovering more slowly than those in adjacent burnt dry sclerophyll communities.
- Populations of the glossy black-cockatoo (*Calyptorhynchus lathami*) did better than expected in the year after fire, though may face future food shortages.

Introduction

The 2019–20 wildfires were exceptional in their extent and severity (Chapter 2). Moreover, they represent the most extreme manifestation, to date, of changes in fire severity and size that have been occurring for several decades. Ferocious fires were anticipated by research published before the fires occurred (Di Virgilio *et al*. 2019) and may be representative of a new fire regime being imposed by human-induced climate change (van Oldenborgh *et al*. 2021). Understanding the responses of birds to these exceptional fires will therefore help focus attention on those species, habitats and processes that will need greatest attention from conservation managers in coming decades, both before and after fires (Box 15.1).

For the general public, there was evidence that many birds were killed by the fire – they were found on beaches where the tidal wrack was studded with the coloured corpses of land birds that died fleeing over the sea (Fig. 15.1; Butt and McManus 2020). While some eastern bristlebirds (*Dasyornis brachypterus*) were taken into captivity from the last population known in Victoria as the fire approached (Selwood *et al*. 2022), people were mostly helpless bystanders as the fires overwhelmed attempts to slow their advance. Unlike with some mammal species (Chapter 27), few injured birds were rescued for rehabilitation after the fires and there were only very limited local efforts to provision birds with food or water (Sharrod 2020).

Box 15.1. Birds in post-fire landscapes

Bird occupation of post-fire landscapes is contingent on the functional traits of birds, the recovery capacity of affected ecosystems and the time since fire. In the first 4 months after the 2019–20 wildfires, a continent-wide investigation into bird occurrence using citizen science data concluded that 22 species had decreased, 30 species increased, and 24 species occurred at similar frequencies, although this may have been confounded by changes in detectability and dispersion following the fires (Lee *et al*. in press). Birds with smaller body sizes, smaller range sizes and specialised diets were less common after the fires. In ecosystems with little previous exposure to fire such as rainforests, there may be a much slower recovery. Surveys in Gondwanan rainforests that burnt in the 2019–20 wildfires showed that bird communities were less diverse in burnt rainforests than unburnt rainforests a year after fire (Lee *et al*. 2022). Frugivores, folivores and insectivores were less abundant in burnt rainforests, raising concerns for fire-affected rainforests that rely on seed dispersal via avian frugivores for recovery. Birds with traits and life histories that are ill-suited to post-fire recolonisation and species that are dependent on rarely burnt ecosystems may require more conservation attention in the face of a growing threat of extreme fire events.

Fig. 15.1. Burnt birds, here a rainbow lorikeet (*Trichoglossus haematodus*), washed up on Mallacoota beaches after the 2019–20 megafires. (Photo: Justin McManus/*The Age*)

Fire is not infrequent in the habitat of many of the bird species affected by the recent fires (Clarke 2020). Even rainforest, usually a fire refuge, sometimes burns, judging from the presence of emergent eucalypts that can only have recruited after fires in the distant past (Bowman *et al*. 2013). For heathland, and the birds that depend on it, fires can prevent a transition to more woody habitats (Loyn 1997). However, despite a capacity among Australian birds to 'cope' with fire, the 2019–20 fires were exceptional, and we need to understand their impacts (Clarke 2020) in order to predict whether the inevitable fires of the near future will lead to long-term declines or if bird populations are sufficiently resilient to persist even if the fire regime changes.

In this chapter, we summarise the impacts of the 2019–20 fires on birds. To do so we build on information from earlier studies of the responses of birds to fire in southern Australia, present results from expert elicitation and preliminary findings since the fires, and summarise the impact of the recent fires on extinction risk. We conclude with recommendations on the management likely to benefit birds in the face of the increasingly hostile fire environment anticipated as the climate heats up (Herold *et al*. 2018) and droughts intensify (Evans *et al*. 2017).

Key findings

Overviews of the impacts of the 2019–20 wildfires on Australian birds were derived from three sources. First van Eeden *et al*. (2020) (see also Chapter 12) estimated that ~180 million birds were present in burnt areas at the time of the fires, the density estimates being derived from over 100 000 standardised surveys extracted from BirdLife Australia's Birdata database and stratified by vegetation type and bioregion. The proportion of these birds that died is unknown.

Initial intersections of distribution maps of bird taxa with maps of the areas burnt in the 2019–20 wildfires identified 378 bird taxa as having been affected (Ward *et al*. 2020). Subsequently, Legge *et al*. (in press) refined and extended this analysis, identifying 51 taxa with > 25% of their range burnt by the fires, including all 16 taxa endemic to Kangaroo Island. The taxon with the highest proportion burnt was the Kangaroo Island southern emu-wren, of which 68% of the modelled distribution was burnt.

The third measure of the fires' impact was on the IUCN Red List status (IUCN 2012) of Australian birds. In August 2020, 6 months after the fires, the status of all 1285 Australian bird taxa was assessed using the IUCN Red List criteria (Garnett and Baker 2021). Of 51 bird taxa with ≥ 25% of their ranges burnt, eight had met the criteria as threatened or Near Threatened in 2011 (Garnett *et al*. 2011). The fires resulted in all but two of these meeting the criteria for listing at a higher threat level in 2020 (Kangaroo Island glossy black-cockatoo (*Calyptorhynchus lathami halmaturinus*) and western ground parrot (*Pezoporus wallicus flaviventris*) were already highly threatened). An additional 19 taxa were deemed to meet the IUCN Red List criteria as threatened in 2020 as a result of the fire. Twelve birds with 5–24% of their habitat burnt also met the IUCN Red List criteria as threatened or Near Threatened in 2020 (Garnett and Baker 2021), but for none of them did the fires contribute significantly to their extinction risk.

The Red List status can also be used to calculate changes to the Red List Index (RLI; Butchart *et al*. 2007), a measure of the conservation status and its change across a group of species. The RLI (which ranges from 1 if all taxa are Least Concern to 0 if all taxa are Extinct) for all Australian birds was 0.894 at the end of 2020. Had the fires in 2019–20 not occurred the RLI would have been 0.902, meaning the fires caused a 7.2% decline in the national Red List Index based on an analysis of the 973 taxa living in terrestrial habitats (so excluding seabirds, shorebirds and mangrove taxa). For the 51 taxa with ≥ 25% of their ranges burnt, the RLI fell by over 21.2% from 2001–2020, from 0.957 to 0.753 (Fig. 15.2). In

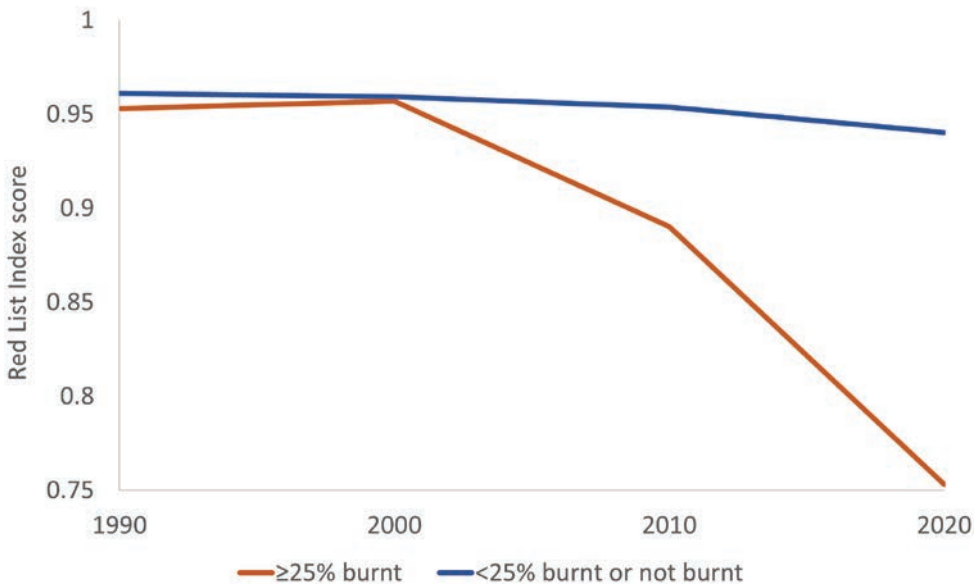

Fig. 15.2. Red List Index for Australian bird taxa from terrestrial habitat for which ≥ 25% of the habitat burnt in 2019–20 (51 taxa) and all other taxa (931 taxa).

contrast, the RLI for the remaining 922 Australian bird taxa living in terrestrial habitats fell by just 1.2% to 0.940 over the same period.

For the 26 taxa that moved to a higher extinction risk category because of the fires (Garnett and Baker 2021), the numbers killed by fire can be estimated. Based on estimates of population size of each taxon before the fires derived from range and density measures, and of mortality during them based on fire extent and severity, an estimated 1.53 million individuals of these taxa died, ~45% of their combined populations before the fires occurred (Table 15.1). Expert elicitation was also used to estimate the mortality immediately after the fire for 12 of the same taxa (Legge *et al*. in press). Assuming the same starting populations, the experts estimated 160 600 died, compared with 164 600 when calculated from Garnett and Baker (2021) for the same 12 taxa. The experts also considered that, across a wider group of 24 birds of concern, declines would continue from immediately after fire (18.5%) to 1 year after fire (24.1%), with only a slight recovery to 17.6% below pre-fire population a decade (or three generations) after the fire (Legge *et al*. in press).

Table 15.1. Estimated mortality of birds for which the IUCN Red List status was affected by the 2019–20 fires (status and data from Garnett and Baker (2021) unless indicated).

Taxon	Status post-fire	No. estimated to have died	% decline of estimated pre-fire population
Kangaroo Island glossy black-cockatoo (*Calyptorhynchus lathami halmaturinus*)*	Endangered	25	9.1
South-eastern glossy black-cockatoo (*Calyptorhynchus l. lathami*)	Vulnerable	400	5.1
Gang-gang cockatoo (*Callocephalon fimbriatum*)	Vulnerable	3000	10.7
Kangaroo Island crimson rosella (*Platycercus elegans melanopterus*)	Vulnerable	104 000	34.6
Western ground parrot (*Pezoporus wallicus flaviventris*)	Critically Endangered	40	28.6
Eastern ground parrot (*Pezoporus w. wallicus*)	Near Threatened	6700	15.2
Southern rufous scrub-bird (*Atrichornis rufescens ferrieri*)	Endangered	1500	28.3
Northern rufous scrub-bird (*Atrichornis r. rufescens*)	Endangered	500	15.9
Kangaroo Island superb fairy-wren (*Malurus cyaneus ashbyi*)	Endangered	269 000	53.1
Kangaroo Island southern emu-wren (*Stipiturus malachurus halmaturinus*)	Endangered	73 000	59.3
Kangaroo Island New Holland honeyeater (*Phylidonyris novaehollandiae campbelli*)	Vulnerable	334 000	46.0
Kangaroo Island brown-headed honeyeater (*Melithreptus brevirostris magnirostris*)	Endangered	47 000	48.2
Kangaroo Island white-eared honeyeater (*Nesoptilotis leucotis thomasi*)	Endangered	27 000	54.0

Taxon	Status post-fire	No. estimated to have died	% decline of estimated pre-fire population
Kangaroo Island little wattlebird (*Anthochaera chrysoptera halmaturina*)	Vulnerable	9500	47.5
Kangaroo Island red wattlebird (*Anthochaera carunculata clelandi*	Vulnerable	48 000	38.8
Kangaroo Island purple-gaped honeyeater (*Lichenostomus cratitius cratitius*)	Vulnerable	62 000	35.9
Lowland pilotbird (*Pycnoptilus floccosus sandlandi*)	Vulnerable	77 000	23.2
Upland pilotbird (*Pycnoptilus f. floccosus*)	Vulnerable	11 000	25.2
Kangaroo Island shy heathwren (*Calamanthus cautus halmaturina*)	Vulnerable	2000	47.9
Southern yellow-throated scrubwren (*Sericornis citreogularis citreogularis*)	Near Threatened	160 000	20.8
Kangaroo Island spotted scrubwren (*Sericornis frontalis ashbyi*)	Endangered	187 000	51.9
Kangaroo Island striated thornbill (*Acanthiza lineata whitei*)	Vulnerable	120 000	47.0
Kangaroo Island brown thornbill (*Acanthiza pusilla zietzi*)	Endangered	124 000	65.1
Kangaroo Island western whipbird (*Psophodes nigrogularis lashmari*)	Endangered	13 000	51.6
Kangaroo Island grey currawong (*Strepera versicolor halmaturina*)	Vulnerable	27 000	41.3
Western Bassian thrush (*Zoothera lunulata halmaturina*)	Endangered	4100	58.7
Total		**1 530 000**	**45.1**

* Estimated loss from Southern Rivers flock (Berris *et al.* 2020)

Finally, we assessed the current threat from fire, relative to other threats, to Australia's birds. Using the approach of Garnett *et al.* (2019) on the data assembled in Garnett and Baker (2021), an increase in the frequency, scale or intensity of fire constitutes a threat to 88 of all 221 threatened and Near Threatened Australian bird taxa. This fire threat makes up 15.6% of the total threat burden to Australian birds, sitting between the closely associated 'Increased frequency or length of droughts' (16.3%) and 'Rising temperatures and heat waves' (12.3%) as the most important threats to Australian avifauna.

For some taxa, such as the regent honeyeater (*Anthochaera phrygia*), losses may have been underestimated because their distribution is so poorly known (Crates *et al.* 2022). For others, better than expected survival surprised observers (see the case studies for Kangaroo Island glossy black-cockatoo and western whipbird (*Psophodes nigrogularis lashmari*) (Box 15.2), eastern ground parrot (*Pezoporus wallicus wallicus*) and eastern bristlebird (Box 15.3)). There are two lessons apparent from such studies. One is that monitoring needs to occur for at least several years after fires to place the immediate response post-fire in context. For example, the glossy black-cockatoos on Kangaroo

Island survived fire far better than expected, breeding successfully even in badly burnt areas in the first few months post-fire. However, a more recent survey (November 2021) suggests that the inexperienced young birds may not have survived well and the population may have declined. The second lesson is that each species responds to fire differently. Thus, the bristlebirds, whipbirds and ground parrots that survived the fire in unburnt refuges were able to make use of regenerating vegetation within 12 months post-fire, whereas southern emu-wren (*Stipiturus malachurus halmaturinus*), white-eared honeyeater (*Nesoptilotis leucotis thomasi*) and Bassian thrush (*Zoothera lunulata halmaturina*) still had populations well below pre-fire estimates after the same period. In all areas, drought-breaking rains soon after the fires may have had a major influence on the rate of recovery.

Box 15.2. Response of Kangaroo Island birds to catastrophic fire

Woodland bird community

The majority of bird taxa severely affected by the 2019–20 wildfire were endemic taxa from Kangaroo Island. On 3 January 2020, almost the entire area of the island's largest remaining wooded habitat, in Flinders Chase, was incinerated with a blaze of unprecedented ferocity. Most birds in the fire ground probably died. However, surveys immediately after the fire found survivors in tiny remnant patches that had somehow escaped being burnt, including highly fire-sensitive species like the western whipbird and southern emu-wren (Boulton *et al.* 2020). Six surveys since have all confirmed the importance of these unburnt patches. Eighteen months after the fire, whipbirds were defending territories over 2 km from the nearest unburnt vegetation and shy heathwrens (*Calamanthus cautus halmaturina*) had become widespread. However, the recovering vegetation did not yet have enough complexity for emu-wrens, which persisted only in unburnt vegetation, and some species that prefer taller, moister vegetation were also still very scarce (Boulton and Gates 2021). The lessons are that recovery can be surprisingly fast, but that there are major differences among species depending on how quickly habitat structure recovers.

Glossy black-cockatoos

The fires that incinerated most of western Kangaroo Island in January 2020, threatened to wipe out decades of conservation effort for glossy black-cockatoo (Fig. 15.3), including protecting nests from possums, providing artificial nest boxes and plantings of the species' sole food tree, the drooping she-oak (*Allocasuarina verticillata*). This effort had helped to bring the population from 150 birds in 1995 to more than 350 in 2016 (Berris *et al.* 2018).

Spatial analysis found that 54% of the drooping she-oak feeding habitat had been burnt. Nevertheless, 59% of nests the following winter breeding season were successful, higher than the long-term average, although fewer nests were recorded overall in areas that lost significant amounts of feeding habitat. A thorough census in September 2020 found over 450 individuals, many of them young of the year. Just one of the island's flocks was smaller than before the fires, by ~25 birds. However, the 2021 census recorded only 377 birds, and in some areas almost all unburnt drooping she-oak trees had been heavily foraged upon by the birds indicating that food may now be limiting. The burnt drooping she-oak woodlands could take 15 years or longer to reach

Fig. 15.3. The Kangaroo Island glossy black-cockatoo. (Photo: Karleah Berris, Kangaroo Island Landscape Board)

maturity and resume production of seed. Therefore, although direct mortality from the fires was lower than feared, indirect mortality after the fires may be occurring over several years if post-fire food shortages have reduced survival or constrained breeding (Berris and Welz 2021).

Box 15.3. Post-fire recovery of eastern bristlebirds and ground parrots at Nadgee Nature Reserve

After almost 40 years without fire, more than 90% of the heaths of Nadgee Nature Reserve in coastal southern New South Wales burnt at extreme intensity on 28 February 2020. Ten weeks after the fire, the ground cover and shrub layer were recovering rapidly and two bird species that have been the focus of management, the eastern bristlebird and ground parrot, were detected (Fig. 15.4; Oliver and Malolakis 2020). By September 2020 at least 36 eastern bristlebirds were found in small semi-burnt patches of heath and heathy woodland and drainage lines along all four heath transect sites monitored regularly, but only a few ground parrots were detected, at a single site, compared to the usual 30–50 parrots detected across four survey points. Six months later, in March 2021, the grasses and sedges on which ground parrots feed were

Fig. 15.4. Coastal heath, Nadgee Nature Reserve, 12 months after the fire had recovered to pre-fire levels. (Photo: Damon Oliver/DPIE)

flowering and seeding freely. In this survey, 25 parrots were detected at the four sites, an abundance close to the long-term average from 2004–2019 (Oliver and Malolakis 2020).

Broad context for impact and recovery

Much is already known about the response of Australian forest bird communities to fire (Woinarski and Recher 1997), with fire frequency having the most important influence on responses (Bradstock 2008). Several studies show that a regime of control burns produces little change in avifauna composition (Wooller and Calver 1988; Smith and Smith 2017; Kuchinke *et al*. 2020; Wills *et al*. 2020). However, competitive and other relationships among species can change after fire (Rainsford *et al*. 2021) and increasingly rare, long-unburnt landscapes appear to be favoured by many species that are also disadvantaged by anthropogenic processes like habitat fragmentation (Davis *et al*. 2016; Wills *et al*. 2020). Also, even single fires can be detrimental to bird communities for extended periods. Although birds can fly, heat-related mortality is still high during severe fires (Pescott 1983; Geary *et al*. 2020; McKechnie *et al*. 2021), especially for less mobile species. The loss of nests, hollows and other fire susceptible habitat can be detrimental to the recovery or recolonisation of bird species after large fires, a process hindered further by logging or habitat fragmentation (Geary *et al*. 2020; Lindenmayer and Sato 2018; Lindenmayer *et al*. 2021; Chapter 19). In mountain ash (*Eucalyptus regnans*) forest the abundance of only one species, the flame robin (*Petroica phoenicea*), was found to have recovered 10 years after the 2009 fires, with significant declines of bird species associated with tree cavities in combination with logging (Lindenmayer and Sato 2018; Lindenmayer *et al*. 2021). Other resources provided by large old trees, such as hanging bark, large-scale flowering in the canopy and undergrowth, were also affected. Diet and habitat specialisation, size and

mobility all affect the ability of birds to survive in the post-fire environment, as does loss of resources in general (Loyn 1997; Lindenmayer *et al*. 2008; Franklin *et al*. 2021). Birds with a plant-based diet, such as seed and nectar, suffer the greatest initial declines (Loyn 1997) while distance from unburnt refuges can influence rate of recolonisation (Lindenmayer *et al*. 2008; Watson *et al*. 2012; Murphy *et al*. 2021). Such refuges can be critical for persistence of some species in a landscape, generally harbouring higher abundances of birds even several years after a fire and probably being the source of most recolonisation of surrounding burnt habitat (Robinson *et al*. 2014; Murphy *et al*. 2021). Such refuges are likely to come under increasing pressure as the climate changes.

There are few studies of the responses of marked birds to fire. One study reported significant population changes for 13 of 20 studied species from before to 3 years after a high-severity fire in forest near Canberra (Baker *et al*. 1997). Even relatively mild fires may kill birds either directly or after the fire as a result of food shortages. For example, only 22% of birds banded before a mild fire in a dry sclerophyll forest in south-western Australia were re-trapped over the 3 years after fire (Wooller and Calver 1988). However, none of these studies determined how individuals survive fires. Instead, accounts tend to be anecdotal, like the record of up to 20 superb lyrebirds (*Menura novaehollandiae*) sheltering from the 2019 fire beside a farm dam (Fig. 15.5; Millington 2020).

Greater understanding of individual responses to fire will improve management responses, which are currently highly limited. Expert elicitation attempting to determine the relative benefits likely to accrue after the fires from current management suggests that, for most bird taxa, little can currently be achieved with existing knowledge (Legge *et al*., unpublished data; Fig. 15.6). Much of the management is not directed specifically at reducing the risk from fires. For example, provision of nest boxes for Kangaroo Island glossy black-cockatoos is a response to a general lack of hollows on the island and also benefits the birds after fires (Berris *et al*. 2020). Similarly, decades of research and management have enabled re-establishment of eastern bristlebirds in many heaths in New South Wales from which the species had been extirpated. This reduces risk from wildfire by reducing the probability that all populations will be burnt simultaneously. However, establishing numerous subpopulations is also a sound strategy for reducing many forms of risk, not just fire, and has enabled down-listing of the taxon despite the fire risk (Bain *et al*. 2021).

Fig. 15.5. Superb lyrebirds, usually solitary, gather around a dam as fire rages in the background in a valley near Wollombi, New South Wales. (Photo: P. J. Wallis)

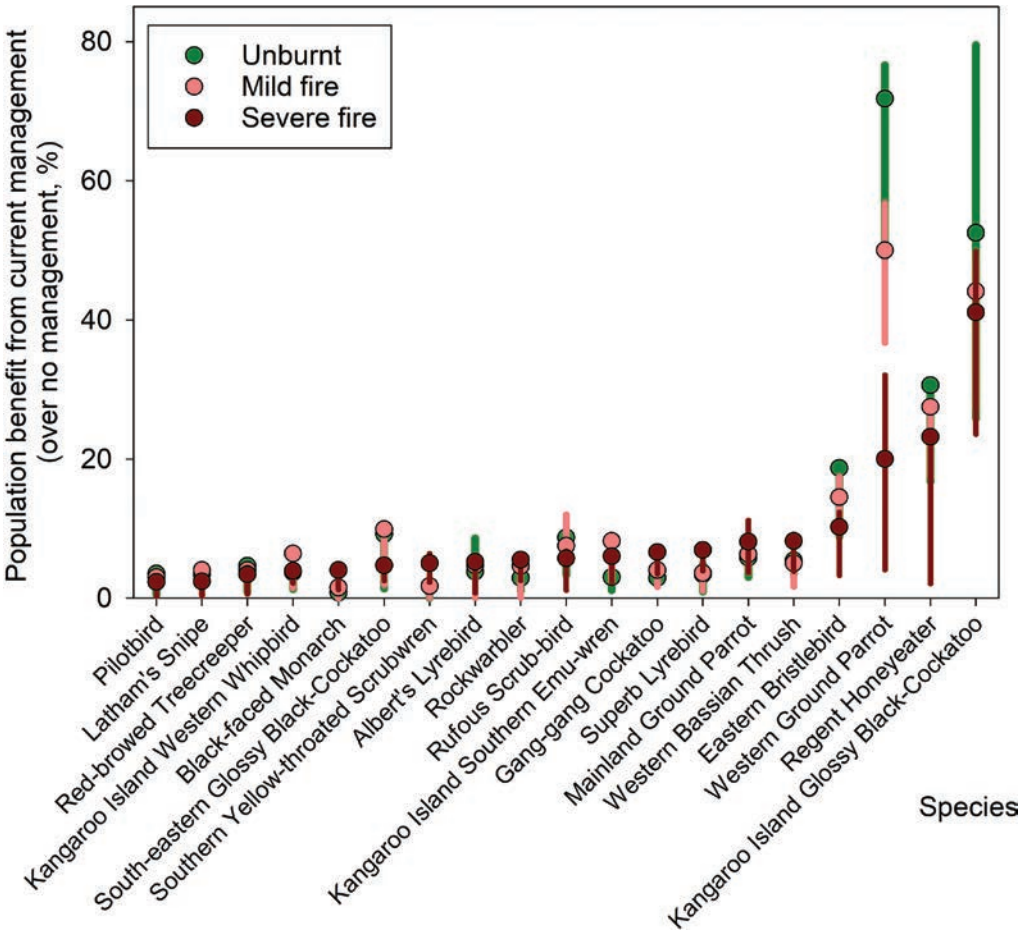

Fig. 15.6. Expert-elicited estimates of the benefits of current management, after mild and severe fire, and if there are no fires, for a selection of Australian bird taxa affected by the 2019–20 fires. The population benefit is expressed as the percentage increase in the population with current management in place, compared to a scenario without that management (Legge *et al.*, unpublished data).

Conclusion

The intense fires of 2019–20 undoubtedly killed many birds. Immediately after the fire greatest concern was for species from low, dense habitats, like eastern bristlebirds or western whipbirds, but most have returned to burnt areas as ground cover has regenerated. The tiny population of Kangaroo Island glossy black-cockatoos also attracted attention. It initially fared better than expected, but 21 months post-fire its population has declined and there is evidence of food shortages in burnt areas, so the potential for ongoing declines over the next few years remains a concern. Of greater concern are the birds of rainforests and other damp, dense habitats as these burn very infrequently, so can take much longer to recover the vegetative structure required by habitat specialists (although see Loyn 1997). Where hollows limit nesting opportunities, post-fire provision of nest boxes may accelerate recovery, although this is expensive, localised and may be species or

location specific. Otherwise, management needs to concentrate on improving landscape fire management and fire suppression, including responding more rapidly and effectively to future fires so they are neither as intense nor widespread. After extensive fire, protection of long-unburnt habitat becomes imperative as these patches become increasingly scarce in the landscape. Such places should be protected not just from wildfire but also from prescribed burning.

Recommendations

Fundamental to protection of Australian birds from extreme drought and vast uncontrollable fires will be mitigation of climate change. Without global cooperation to limit greenhouse gas emissions, the task of fire and biodiversity managers will become increasingly difficult.

In the meantime, research and management can help moderate the impacts of extensive fires on birds in these ways:

- Increase the amount and quality of monitoring to assess how birds respond to major disturbances and other threats, such as fire and changes to fire regime.
- Study how birds survive fires of different intensities using new technologies for tracking survival and mobility so landscape elements that promote survival can be conserved or provided.
- Continue existing management that reduces extinction risk, including risk from fire – the larger the population before a fire, and the more places in a landscape that are occupied, the greater the probability of persistence. Strategies can include intensive management (e.g. nest boxes), assisted migration and habitat restoration.
- Prepare contingency plans for responses to fire, identifying particularly those actions that need to be implemented quickly even if the impacts are not immediate (e.g. planting or protecting casuarinas that may not provide seed in under a decade).
- Identify long-unburnt parts of the landscape and develop and implement plans to protect them, with priority especially for the protection of large contiguous areas of long-unburnt vegetation.
- Ensure the value of important threatened bird habitat, particularly where fragmented, is recognised alongside the values for people and property.
- Plan for climate change (e.g. Molloy *et al*. 2020). Do not assume that historical frequencies of drought and fire will continue. Use modelling to estimate what is likely to occur within a feasible planning frame and adapt fire management strategies accordingly.

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