Australian birds could benefit from predator exclusion fencing

Jeremy Ringma1 | Megan D. Barnes2 | Michael Bode3

1School of Global, Urban and Social Studies, RMIT University, Melbourne, Victoria, Australia
2School of Biological Sciences, The University of Queensland, Brisbane, Queensland, Australia
3Science and Engineering Faculty, Mathematical Sciences, Applied and Computational Mathematics, Queensland University of Technology, Brisbane, Queensland, Australia

Abstract
The use of predator exclusion fencing is widely recognized as one of the most effective mechanisms for protecting threatened fauna from introduced or over-abundant predators. It is now used throughout the world to protect avian fauna. In Australia, where predator exclusion fencing is used extensively to protect threatened mammals, such fences for threatened avifauna are surprisingly sparse. In this perspective we demonstrate that (a) the use of predator exclusion fences for avifauna is popular in other countries with similar conservation problems, (b) a large number of Australian avian species could benefit from dedicated predator exclusion fences, and (c) despite legitimate concerns, if well designed, predator exclusion fences can pose little risk to threatened birds or are outweighed by the potential benefits. We believe wider use of predator exclusion fencing to protect Australian threatened birds could be highly beneficial and should be more regularly considered as a management action by conservation practitioners.

KEYWORDS
conservation fence, feral predator, introduced species, predation, wildlife management

1 | INTRODUCTION

Introduced cats (*Felis catus*) and foxes (*Vulpes vulpes*) are leading causes of extinction and decline in Australian wildlife (Kearney et al., 2019). Their greatest impact has been felt by mammals (Radford, Woinarski, Legge, Baseler, & Bentley, 2018), however, they have also had a massive impact on birds (Woinarski et al., 2017). Seventy-one out of Australia’s 117 listed bird species (61%) are recognized to be predated by either cats (Woinarski et al., 2017). Cats especially pose a significant threat to Australia’s birds, with evidence suggesting that they kill some 400 million birds every year (Woinarski, Murphy, et al., 2017), many of which are threatened taxa (Woinarski, Woolley, et al., 2017). For many Australian bird species, ongoing predator control is essential to prevent further declines and avoid extinction.

Australia has trialed numerous methods of predator control to combat the impact of feral predators on native birds. Predator control methods like poison baiting, trapping and shooting have had mixed success (Marlow et al., 2015), but fencing to exclude predators has high efficacy (Clayton, Pavey, Vernes, & Tighe, 2014) and is well received by the public (van Eeden, Newsome, Crowther, Dickman, & Bruskotter, 2019). Fencing is an attractive management option because it offers a consistent and highly effective control mechanism, albeit at a high initial investment (Bode, Brennan, Morris, Burrows, & Hague, 2012).
Fencing describes a structure used to restrict the movement of an agent, which may not necessarily be physical (e.g., the use of sound). Fencing can act as both an asset and a hinderance in conservation, depending on its design and intent (Hayward & Kerley, 2009). Conservation fencing—a relatively recent term, describes a fence specifically created for aiding the conservation of biodiversity. Many forms of fencing can have benefits to biodiversity, for example wildlife barrier fences near highways prevent roadkill (Clevenger, Chruszcz, & Gunson, 2001), and many fences serve to reduce the impact of wildlife on agriculture (Dickman, 2010), which consequently can abate human–wildlife conflict. Hence, the classification of true conservation fences constructed for the benefit of biodiversity as its primary objective can be ambiguous.

Here, we argue that predator exclusion fencing—a specific form of conservation fencing created to protect native fauna from introduced or overabundant predators (see Figure 1) is an underutilized, high-impact management action for the conservation of birds in Australia. Australia is a prolific builder of often massive (with several examples in excess of 8,000 ha) predator exclusion fences to protect native mammals (Legge et al., 2018; Ringma et al., 2019), but has not followed suit for birds. Despite their upfront costs, the long-term dividends of fences often make them cost-effective control methods over ecological time-scales. The conservation sector contains a diversity of organizations, values and priorities. Many of these organizations might pursue alternative conservation actions, which better reflect their values and resource limitations. Nevertheless, a wider adoption of fencing as a predator control method could make a meaningful and immediate contribution to the conservation of at-risk birds. There is a strong precedent for the use of fences, compelling reasons to believe they would be effective for birds, and many species that would benefit.

2 | AUSTRALIA SHOULD USE MORE PREDATOR EXCLUSION FENCING FOR BIRDS

Around the globe, predator exclusion fencing has been used extensively to protect birds from introduced predators. To date, over 50 fences have been erected for the protection of nesting seabirds (Cooper, 2013). Predator exclusion fences in New Zealand alone protecting more than 30 bird species behind 28 fences (Burns, Innes, & Day, 2012), 15 fences >25 ha; Innes et al., 2019), with reports of widespread recovery of forest birds and restored ecosystem function as a result of predator exclusion fencing (Bombaci, Pejchar, & Innes, 2018; Miskelly, 2018). In Europe (Mayer & Ryan, 1991) and North America (Malpas et al., 2013), game birds and waders are regularly protected using both long term fencing such as peninsula fences, and short-term fencing to opportunistically protect individual nests. These have achieved remarkable successes (Innes et al., 2012; Young et al., 2013), and when appropriately designed, result in negligible adverse effects such as strike (D. Shanahan, personal communication). Even for species particularly prone to strike, such as seabirds, the risk can be reduced through the use of high visibility tape and careful fence design (e.g., matching fence boundaries to topographic features (Swift, 2004; L. Young, personal communication).

In Australia, only a single fence has been constructed whose primary purpose is to protect a bird from introduced predators; it is at Little Desert for the ground-nesting malleefowl (Leipoa ocellata; Benshemesh, 2007). This is not to say Australian birds are not already benefiting from fences: Fences constructed for mammals provide latent protection for dozens of species, and bush stone-curlews (Burhinus magnirostris) have been translocated into some of these fence sites (Shorthouse et al., 2012). Fences to prevent stock and pigs from damaging wetlands (Doupé, Mitchell, Knott, Davis, & Lymbery, 2010; Kutt, 2017) also improve habitat quality and ecosystem level stresses on bird populations. However, targeted control of introduced predators through fencing with the primary objective of conserving bird populations in Australia is remarkably scarce, despite the potential benefits.

![Figure 1](image.png)

**Figure 1** Many forms of fencing have both positive and negative effects on biodiversity. Conservation fencing is a subset of all fencing types which relates specifically to fences constructed with the primary purpose of benefiting biodiversity. In this article, we refer mainly to predator exclusion fencing—a form of conservation fencing whose primary purpose is to create a barrier between invasive or overabundant predators and sensitive prey species.
It is not certain why predator exclusion fencing has not been more widely used to protect Australian birds. Perhaps construction costs have been thought prohibitively expensive (Norbury, Hutcheon, Reardon, & Daigneault, 2014; Scofield, Cullen, & Wang, 2011), or the perceived threat of bird strike has resulted in a tendency toward inaction or alternate intervention (e.g., due to zero-risk bias, Schneider, Streicher, Lermer, Sachs, & Frey, 2017). Yet similar concerns raised for mammals in Australia and for bird taxa have been weighed in favor of predator-exclusion fencing in other countries. Moreover, conservation fencing is commonly used in Australia to protect bird habitat from herbivory (e.g., ungulate exclusion fencing is now a common management technique in tropical wetlands, Doupé et al., 2010) and fences are frequently constructed as a boundary demarcation of protected areas, typically with little regard to bird strike risk, which arguably pose a high strike risk due to their design and visibility.

We suggest that predator exclusion fences could be used to protect a wide range of Australian bird species, particularly those vulnerable to cat and fox predation, especially either ground nesting or ground foraging taxa. For example, 109 of 162 (67%) ground nesting birds which breed in Australia have been recorded to be predated by cats (Garnett et al., 2015; Woinarski, Woolley, et al., 2017). Terrestrial species such as Golden-shouldered parrots (Psophus chrysopterygius), night parrots (Pezoporus occidentalis), ground parrots (Pezoporus flaviventris and Pezoporus wallicus), and plains wanderers (Pedionomus torquatus) all face extremely high predation from introduced predators. Many of these species currently persist in the presence of strand wire stock fencing, which is arguably less visible to birds than a mesh construction predator exclusion fence. It is our conjecture that strike risks from thoughtfully constructed fencing would likely be outweighed by the benefit of removing predators—as seen with countless other examples of predator exclusion fences made for the benefit of birds throughout the world. When in doubt, structured decision making frameworks can assist managers at deciding when the risk of bird strike outweighs the benefits predator control (Canessa, Ewen, West, McCarthy, & Walshe, 2016).

Wader and waterfowl species in Europe and North America are frequently protected by fences (Malpas et al., 2013; Mayer & Ryan, 1991), these birds’ nest and forage in predictable areas, meaning that both targeted fencing of nest sites, or landscape-scale fences could improve survival during vulnerable life-stages. For example, 32 of 45 (71%) Charadriiformes and nine out of 12 (75%) Procellariiformes are recognized to be predated by cats (Garnett et al., 2015; Woinarski, Woolley, et al., 2017). Fences could be used to assist seabirds and waders such as fairy tern (Stena nereis), little penguins (Eudyptula minor) and hooded plovers (Thinornis cucullatus) which breed on the Australian mainland, and are in decline due to predation. High tide wader roosts and other critical habitats, many of which are often managed with poison baiting could similarly receive a higher level of protection through fencing. For this application, small scale fencing provides unparalleled protection while being the most cost-efficient predator control option (Norbury et al., 2014). Similarly, the plains wanderer is recognized to be threatened by foxes, yet fencing of known habitat to exclude foxes is not even identified as a potential action in the recovery plan (Department of Environment, 2015). Instead broadscale baiting across complex tenure is proposed, which is likely to carry higher costs for lower gains (particularly given recolonization rates of foxes in agricultural landscapes; Gentle, Saunders, & Dickman, 2007), and the risk of perverse outcomes from trophic cascade responses (i.e., potential increase in cat abundance; Marlow et al., 2015).

The benefits of predator exclusion fencing to conserve threatened birds outweigh the costs. With a growing body of evidence in support of fencing as a conservation action and worsening conservation crisis, the costs of continuing to ignore the benefits of fencing for birds are too great to continue being overlooked.

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ORCID

Jeremy Ringma https://orcid.org/0000-0003-0704-5212

REFERENCES

Benshmesh, J. (2007). National recovery plan for malleefowl. South Australia: Department for Environment and Heritage.

Bode, M., Brennan, K. E., Morris, K., Burrows, N., & Hague, N. (2012). Choosing cost-effective locations for conservation fences in the local landscape. Wildlife Research, 39, 192–201.

Bombaci, S., Pejchar, L., & Innes, J. (2018). Fenced sanctuaries deliver conservation benefits for most common and threatened native Island birds in New Zealand. Ecosphere, 9, e02497.

Burns, B., Innes, J., & Day, T. (2012). The use and potential of pest-proof fencing for ecosystem restoration and fauna conservation in New Zealand. In Fencing for conservation (pp. 65–90). New York, NY: Springer.

Canessa, S., Ewen, J. G., West, M., McCarthy, M. A., & Walshe, T. V. (2016). Stochastic dominance to account for uncertainty and risk in conservation decisions. Conservation Letters, 9, 260–266.

Clayton, J. A., Pavéy, C. R., Vernes, K., & Tighe, M. (2014). Review and analysis of Australian macropod translocations 1969–2006. Mammal Review, 44, 109–123.
Clevenger, A. P., Chruszcz, B., & Gunson, K. E. (2001). Highway mitigation fencing reduces wildlife-vehicle collisions. Wildlife Society Bulletin, 29, 646–653.

Cooper, J. (2013). Predator-proof-fences-are-helping-to-protect-procellariiform-seabirds-including-acap-listed-albatrosses-and-petrels. ACAP, Hobart. Retrieved from https://www.acap.aq/en/component/content/article/60-news-archive-section/2013-news-archive/1359-predator-proof-fences-are-helping-to-protect-procellariiform-seabirds-including-acap-listed-albatrosses-and-petrels

Department of Environment. (2015). Draft national recovery plan for the Plains-wanderer (Pedionomus torquatus). Retrieved from https://www.environment.gov.au/system/files/resources/99912ff3-3221-4a4e-bd46-cda9c86108e0/files/draft-national-recovery-plan-plains-wanderer.pdf

Dickman, A. J. (2010). Complexities of conflict: The importance of considering social factors for effectively resolving human-wildlife conflict. Animal Conservation, 13, 458–466.

Doupé, R. G., Mitchell, J., Knott, M. J., Davis, A. M., & Dickman, A. J. (2010). Efficacy of exclusion fencing to protect ephemeral floodplain lagoon habitats from feral pigs (Sus scrofa). Wetlands Ecology and Management, 18, 69–78.

Garnett, S. T., Duursma, D. E., Ehmk, G., Guay, P. J., Stewart, A., Szabo, J. K., ... Duson, G. (2015). Biological, ecological, conservation and legal information for all species and subspecies of Australian bird. Scientific Data, 2, 150061.

Gentle, M. N., Saunders, G. R., & Dickman, C. R. (2007). Poisoning mitigation fencing reduces wildlife-vehicle collisions. Journal of the Royal Society of New Zealand, 36, 1–13.

Innes, J., Fitzgerald, N., Binny, R., Byrom, A., Pech, R., Watts, C., ... Burns, B. (2019). New Zealand ecosanctuaries: Types, attributes and outcomes. Journal of the Royal Society of New Zealand, 49, 1–24.

Innes, J., Lee, W. G., Burns, B., Campbell-Hunt, C., Watts, C., Phipps, H., & Stephens, T. (2012). Role of predator-proof fences in restoring New Zealand’s biodiversity: A response to Scofield et al. (2011). New Zealand Journal of Ecology, 36, 1.

Kearney, S. G., Carwardine, J., Reside, A. E., Fisher, D. O., Maron, M., Doherty, T. S., ... Wintle, B. A. (2019). Corrigendum to: The threats to Australia’s imperilled species and implications for a national conservation response. Pacific Conservation Biology, 25, 328–328.

Kutt, A. (2017). The fine art of fencing night parrots. Melbourne: Bush Heritage. Retrieved from https://www.bushheritage.org.au/blog/fencing-night-parrots

Legge, S., Woinarski, J. C., Burbidge, A. A., Palmer, R., Ringma, J., Radford, J. Q., ... Bentley, J. (2018). Havens for threatened Australian mammals: The contributions of fenced areas and offshore islands to the protection of mammal species susceptible to introduced predators. Wildlife Research, 45, 627–644.

Malpas, L. R., Kennerley, R. J., Hirons, G. J., Sheldon, R. D., Ausden, M., Gilbert, J. C., & Smart, J. (2013). The use of predator-exclusion fencing as a management tool improves the breeding success of waders on lowland wet grassland. Journal for Nature Conservation, 21, 37–47.

Marlow, N. J., Thomas, N. D., Williams, A. A., Macmahon, B., Lawson, J., Hitchen, Y., ... Berry, O. (2015). Cats (Felis catus) are more abundant and are the dominant predator of woylies (Betongia penicillata) after sustainedfox (Vulpes vulpes) control. Australian Journal of Zoology, 63, 18–27.

Mayer, P. M., & Ryan, M. R. (1991). Electric fences reduce mammalian predation on piping plover nests and chicks. Wildlife Society Bulletin (1973–2006), 19, 59–63.

Miskelly, C. M. (2018). Changes in the forest bird community of an urban sanctuary in response to pest mammal eradications and endemic bird reintroductions. Notornis, 65, 132–151.

Norbury, G., Hutchison, A., Reardon, J., & Daigneault, A. (2014). Pest fencing or pest trapping: A bio-economic analysis of cost-effectiveness. Austral Ecology, 39, 795–807.

Radford, J. Q., Woinarski, J. C., Legge, S., Baseler, M., Bentley, J., Burbidge, A. A., ... Gillespie, G. (2018). Degrees of population-level susceptibility of Australian terrestrial non-volant mammal species to predation by the introduced red fox (Vulpes vulpes) and feral cat (Felis catus). Wildlife Research, 45, 645–657.

Ringma, J., Legge, S., Woinarski, J., Radford, J. Q., Wintle, B., Bentley, J., ... Bode, M. (2019). Systematic planning can quickly close the protection gap in Australian mammal havens. Conservation Letters, 12, e12611.

Schneider, E., Streicher, B., Lerner, E., Sachs, R., & Frey, D. (2017). Measuring the zero-risk bias: Methodological artefact or decision-making strategy? Zeitschrift für Psychologie, 225, 31–44.

Scofield, R. P., Cullen, R., & Wang, M. (2011). Are predator-proof fences the answer to New Zealand’s terrestrial faunal biodiversity crisis? New Zealand Journal of Ecology, 35, 312–317.

Shorthouse, D. J., Iglesias, D., Jeffress, S., Lane, S., Mills, P., Woodbridge, G., ... Manning, A. D. (2012). The ‘making of’ the mulligans flat—Gooroooyarroo experimental restoration project. Ecological Management & Restoration, 13, 112–125.

Swift, R. (2004). Potential effects of ungulate exclusion fencing on displaying Hawaiian petrels (Pterodroma sandwicensis) at Hawai’i Volcanoes National Park (Master’s thesis). Oregon State University.

van Eeden, L. M., Newsome, T. M., Crowther, M. S., Dickman, C. R., & Bruskotter, J. (2019). Social identity shapes support for management of wildlife and pests. Biological Conservation, 231, 167–173.

Woinarski, J. C. Z., Murphy, B. P., Legge, S. M., Garnett, S. T., Lawes, M. J., Comer, S., ... Paton, D. (2017). How many birds are killed by cats in Australia? Biological Conservation, 214, 76–87.

Woinarski, J. C. Z., Woolley, L. A., Garnett, S. T., Legge, S. M., Murphy, B. P., Lawes, M. J., ... Nankivill, A. (2017). Compilation and traits of Australian bird species killed by cats. Biological Conservation, 216, 1–9.

Young, L. C., VanderWerf, E. A., Lohr, M. T., Miller, C. J., Titmus, A. J., Peters, D., & Wilson, L. (2013). Multi-species predator eradication within a predator-proof fence at Ka ‘ena Point, Hawai’i. Biological Invasions, 15, 2627–2638.

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