The Role of Private Land Management in Malleefowl Conservation; fenced reserves, land management, monitoring and research

Laurence E. Berry, Felicity L'Hotellier, Laura Ruykys and Rodney P. Kavanagh

Australian Wildlife Conservancy, Perth, Western Australia

Abstract

Malleefowl are declining throughout their range due to a variety of threats including; altered fire regimes, habitat loss, introduced predators, feral herbivores and weeds. Private land management by NGO's such as the Australian Wildlife Conservancy (AWC) plays a major role in reducing or eliminating these threats to produce positive outcomes for Malleefowl and other threatened species. Here I discuss the four key areas where AWC is contributing to national Malleefowl conservation; monitoring, conservation fencing, land management actions and research.

AWC is applying a standardised approach to Malleefowl monitoring across its reserve network. Malleefowl breeding density (number of active mounds per unit area) is monitored using LiDAR to identify all mounds within a fixed area, revisiting these mounds each year to record status (using the NMRT methodology) and subsequently repeating LiDAR at an appropriate interval to identify any new mounds built. Results are reported as a component of our EcoHealth monitoring programs and are used to inform and refine the management regimes at each site.

The use of conservation fencing is the only proven approach to completely eradicate introduced predators from mainland reserves. AWC has successfully used conservation fencing to establish reintroduced populations of threatened critical-weight-range mammals. Here we present monitoring data from Scotia Sanctuary and Mount Gibson to demonstrate how these fenced reserves contribute to Malleefowl conservation. We show that breeding success is notably improved within fenced reserves and highlight areas for future research and monitoring.

Using examples from Scotia Sanctuary, Mt Gibson Sanctuary and Mallee Cliffs National Park, we describe how AWC's land management program will deliver positive outcomes for Malleefowl. These include introduced predator control, feral herbivore control, weed management and fire management. We discuss how integrating multiple management approaches across differing spatial and temporal scales can be used to achieve improved conservation outcomes for Malleefowl.

We conclude with a description of current AWC research programs which have relevance to Malleefowl conservation at a national scale. We also discuss AWC collaborations in other projects and future directions for our work.

Introduction

Approximately 85 million hectares of the protected area estate in Australia is managed for by non-government agencies or organisations (Metcalfe and Bui 2017). Therefore, making significant conservation gains particularly for threatened species with wide distributions is dependent not only on the effective management of public lands, but also on the effective and integrated management of private lands.

Conservation NGO's and other private groups can influence threatened species recovery through direct and indirect approaches. Direct approaches include the acquisition, protection and improvement of significant habitat, addressing key threats to species on the ground and effective monitoring of the target species. Indirect approaches may include providing leadership in threatened species conservation through engagement, sharing successful land management models through partnerships and contributing to increasing the knowledge base through research collaborations.

The Australian Wildlife Conservancy currently manages 4.65 million hectares over 27 sites across Australia with the aim of the effective conservation of all Australian animal species and the habitats in which they live. This includes four sites where Malleefowl conservation is a key management priority; Mt Gibson, WA, Yookamurra, SA, Scotia, NSW and Mallee Cliffs National Park, NSW (Figure 1).

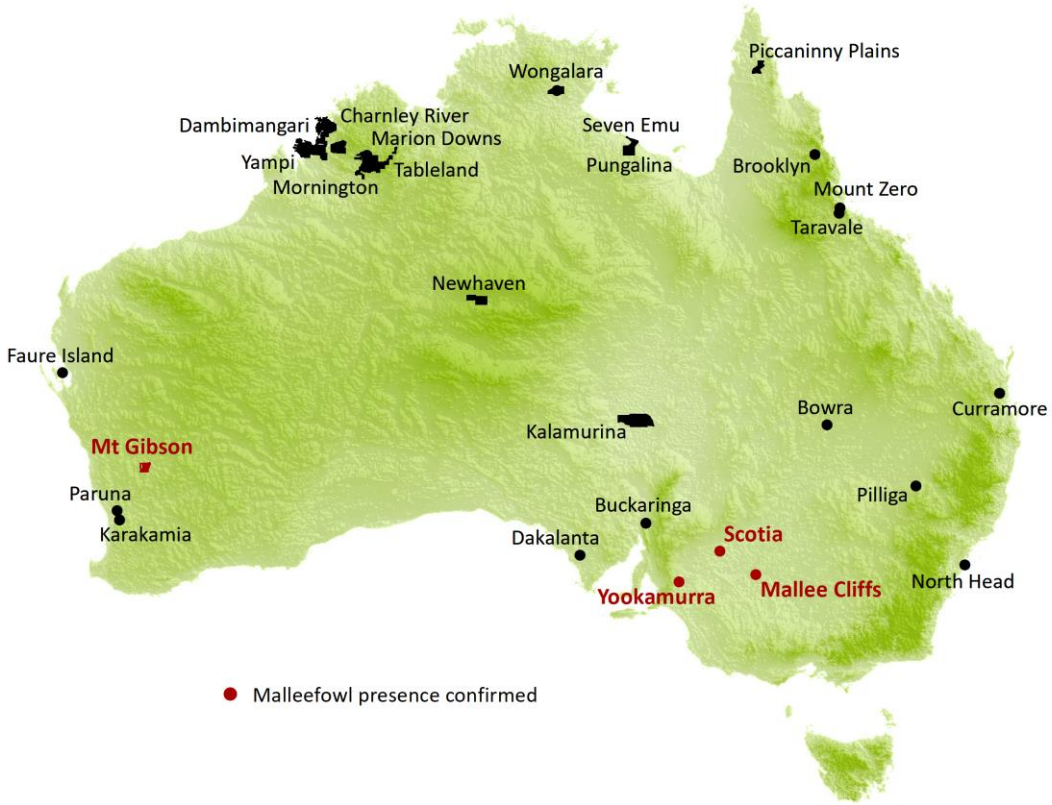

Figure 1. Locations of 27 sites currently managed by AWC. Sites where Malleefowl are actively managed are shown in red.

Across these sites AWC implements a range of conservation and land management actions to improve the status of Malleefowl and other biodiversity values. At the core of these actions is a comprehensive land management program including introduced predator control, feral herbivore control, weed management and fire management. This program is supported by detailed ecological monitoring and research programs, with the results used to refine existing actions and determine whether further interventions or alternative actions are required. Additionally, AWC is a global leader in the use of conservation fencing to create large introduced predator-free areas to benefit extant species and facilitate the reintroduction of threatened species. This conference paper describes how AWC is contributing to Malleefowl conservation in each of these areas, using examples from across our reserve network.

Monitoring

AWC implements Ecological health ('EcoHealth') monitoring programs to report on the status and trends of species, ecological processes and threats across its sanctuary network (Kanowski et al. 2018). The EcoHealth programs involve the surveillance monitoring of changes in the status of key indicators over time. Indicators to be monitored at each site are chosen using a conceptual model identifying key biodiversity assets, threatened species, ecosystem processes and environmental threats. These indicators are measured at various intervals using a range of techniques with changes in their status reported in an annual scorecard (Kavanagh et al. 2017). The monitoring program is integrated with research to identify or resolve actions required to ameliorate any negative trends (Figure 2). Malleefowl are one of 38 threatened species across this network whose population status are regularly and systematically monitored. Without this monitoring effort, changes in the status of these species on each site would be unknown.

Malleefowl are an iconic and nationally significant threatened species. At each site where Malleefowl are present, AWC implements a targeted monitoring program to track the status of the species. To date, these programs have involved the monitoring of Malleefowl mounds to establish a measure of breeding activity at each site. These programs have historically involved a range of methodologies including fixed-area plot-based surveys or visits to widely distributed sets of 'known' mounds. In recent years, AWC has adopted the National Malleefowl Recovery Team (NMRT) method for recording and reporting mound activity across these sanctuaries.

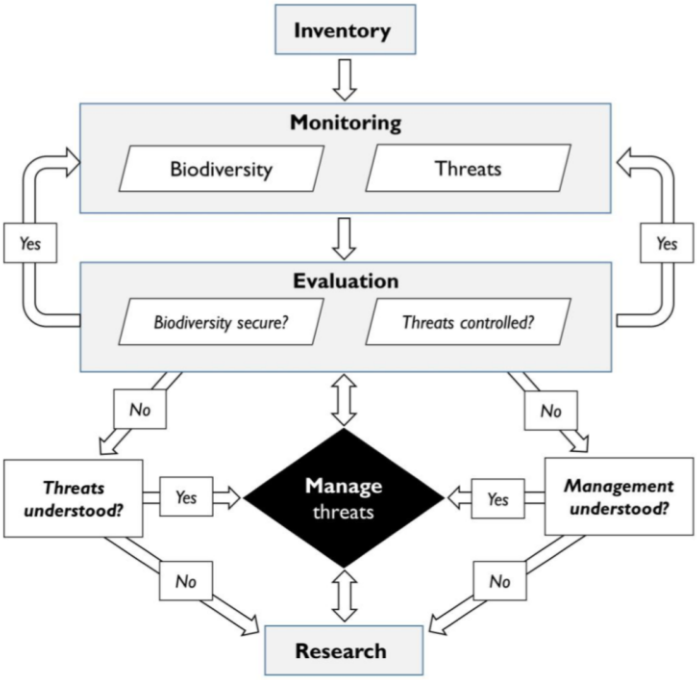

Figure 2. AWC's monitoring and research framework from (Kanowski et al. 2018),

There is a long history of Malleefowl monitoring at Scotia Sanctuary, with previous surveys conducted by various groups including Ballarat TAFE. Regular mound surveys have been conducted by AWC from 2010 onwards using a basic qualitative survey methodology to record mound activity. In 2016 the NRMT survey methodology was adopted and Scotia became designated as NMRT NSW site N11. Sixty-three known mound locations are currently monitored across Scotia Sanctuary. Mounds are checked in teams of two, with the survey generally conducted over 2-3 days with four people during October.

Of these 63 mounds, 22 are located within the 8,000 Ha introduced predator-free fenced area, with 41 located outside. This methodology did not involve searching for new mounds.

At Mt Gibson, AWC has been collaborating with the National Malleefowl Recovery Team (NMRT) to monitor mounds since 2010. Monitoring at Mt Gibson is conducted within two 1,000 Ha plots established in 2010 (Figure 3). These sites also form part of the NMRT site network as sites W27 and W28. One plot was established inside an area of proposed conservation fencing (completed in 2014) and with the other established outside. Malleefowl mounds within these plots were initially identified using chain-link ground surveys across each plot. Mounds that were identified during this survey were marked with a GPS and a post in the ground and uploaded to the NMRT database. Since then, mounds have been monitored annually by a combination of NMRT staff and volunteers and AWC staff. In 2015-16, the two 1,000 ha areas on Mt Gibson were aerially surveyed with LiDAR (light detection and ranging) and new mounds were added to the survey.

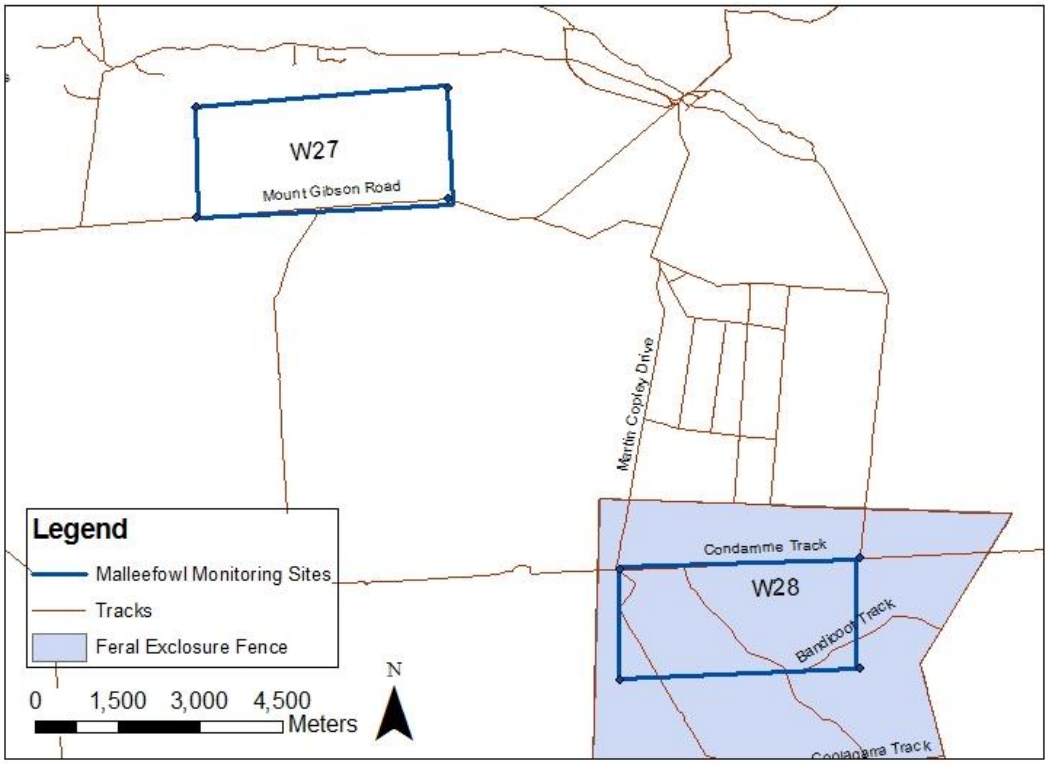

Figure 3. The two 1,000 Ha Malleefowl mound monitoring plots at Mt Gibson.

As part of a historic public-private partnership, AWC has been contributing to The National Parks and Wildlife Service (NPWS) aerial monitoring of Malleefowl mounds at Mallee Cliffs National Park since 2016 (Figure 4). These surveys have been conducted in various forms in the park by NPWS since 1989. The current methodology involves annual visits to a subset of 149 'historically most active' mounds during the breeding season. Annual assessments of these mounds have been rapidly conducted in one day using a helicopter to conduct aerial surveys of mound activity. From 2018 onwards AWC will lead monitoring of Malleefowl within Mallee Cliffs National Park using a revised methodology.

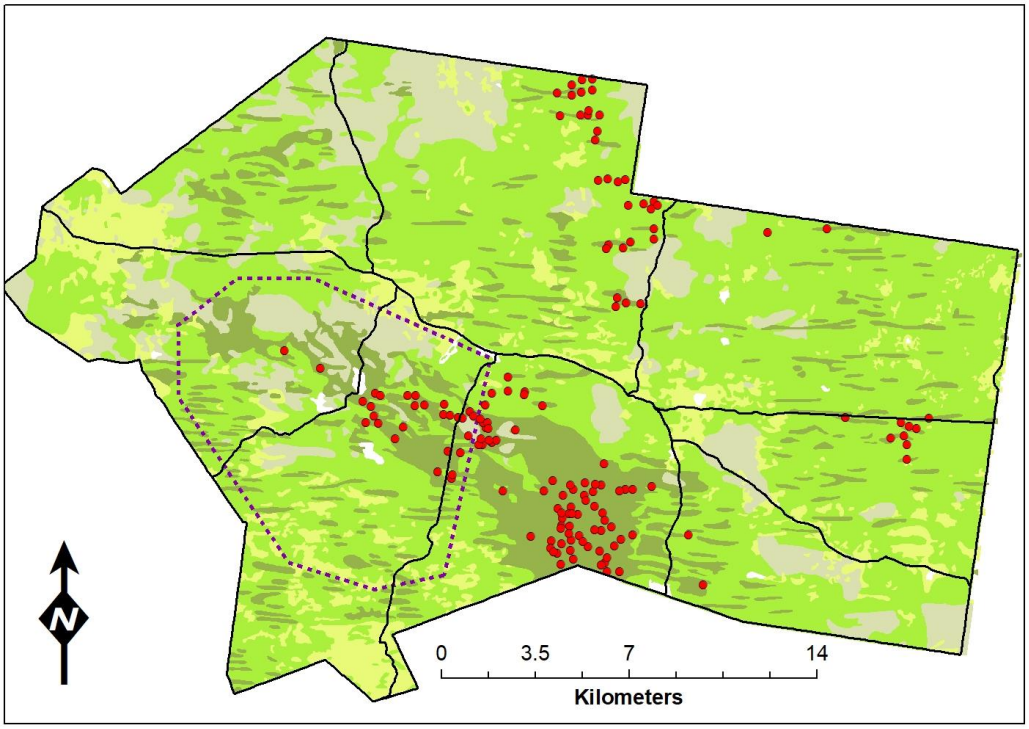

Figure 4. Locations of 149 mounds surveyed by NPWS in Mallee Cliffs National Park between 1989-2017 (data source: NPWS).

Monitoring programs based on repeat visits to a fixed set of known mounds may not accurately represent Malleefowl activity at a site since they do not account for the construction of new mounds between survey years. Fixed-mound surveys are based on consideration of activity at spatially discreet mounds, rather than on measures of activity within an area, from which inferences of breeding density can be inferred. Given recent technological advancements, detailed identification of the locations of potential Malleefowl mounds within landscapes are now possible using LiDAR (Light Detection and Ranging) imaging. This approach has been successfully used to inform monitoring programs at various locations nationally including at Mt. Gibson. AWC is now moving towards a uniform approach to monitoring Malleefowl across its sanctuary network. This revised approach is based on the following broad steps;

1) The use of LiDAR to identify possible mound locations within each property, followed by ground truthing.
2) The establishment of fixed-area plots in areas of high mound activity for continued annual monitoring.
3) The stratification of these plots inside and outside of existing or planned introduced predator-free areas.
4) Annual monitoring of Malleefowl breeding activity within these plots using the NRMT methodology.
5) The repeat capture of LiDAR imagery to update new mounds at an appropriately determined interval (~5 – 10 years).

The Influence of conservation fences on Malleefowl breeding success

The use of conservation fencing is the only proven approach to completely eradicate introduced predators on the Australian mainland (Dickman 2012). Three of the four AWC sites currently managed for Malleefowl include areas where introduced predators have been eradicated and excluded using

conservation fencing. Within these areas the potential impacts of introduced predators and feral herbivores on the extant Malleefowl populations are reduced. These areas also enable the subsequent reintroduction of threatened Australian mammals and their ecosystem functions. The largest of these fenced areas on the Australian mainland is at Scotia Sanctuary (8,000 Ha), where 5 regionally-extinct mammal species have been successful reintroduced over the last decade. The most recent fenced area was completed at Mt Gibson (7,800 Ha) in 2014 and now supports reintroduced populations of 8 threatened mammal species; the largest successful multi-species reintroduction project achieved on a single site in Australia. A 9,600 Ha fenced area is also in development in partnership with the New South Wales National Parks and Wildlife Service at Mallee Cliffs National Park, where 10 locally extinct mammals will be reintroduced.

Malleefowl mound activity has been consistently higher within the fenced area at Mt. Gibson following the complete eradication of introduced predators in 2015 (Figure 5). In 2016, we recorded the highest number of active mounds (n=9) within the fenced area since monitoring began in 2010. This initial result suggests that fenced reserves free of introduced predators and feral herbivores may have a positive influence on Malleefowl breeding success. These results are also supported by monitoring results at Scotia Sanctuary, where mound activity has been substantially higher within the fenced area than outside since 2013 (Figure 6). These fenced areas may play an important long-term role in protecting genetically-distinct insurance populations of Malleefowl across its range. In addition, if Malleefowl are able to reach sufficiently high numbers within these fenced reserves, then these populations may be able to act as sources for translocation to other areas.

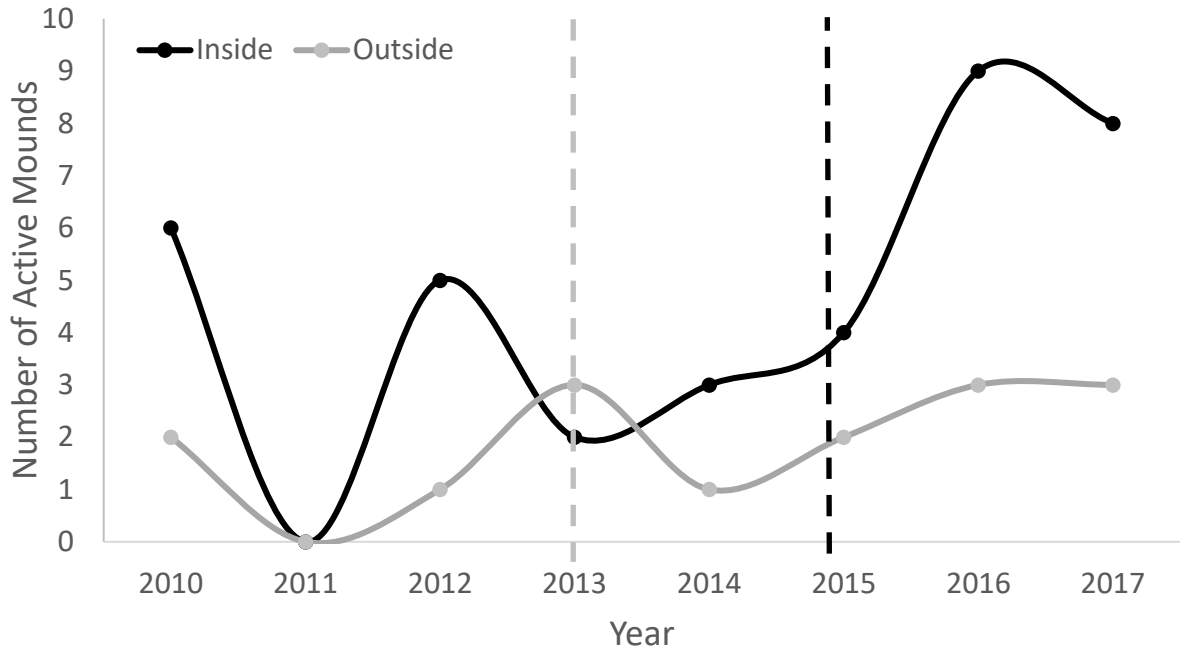

Figure 5. Differences in Malleefowl mound activity inside and outside of the introduced predator-free fenced area at Mt. Gibson Wildlife Sanctuary, WA. Fence construction began in 2013 (grey dashed line). Introduced predator eradication within the fenced area was completed and translocation of threatened mammals commenced in 2015 (black dashed line).

The results from Mt. Gibson and Scotia also provide clear examples of the benefits of long-term monitoring to conservation and land management decision-making. Whilst mound activity at Mt. Gibson has been consistently higher within the fenced area following completion, the data also show two periods prior to commencement of the fencing project where this area supported higher

Malleefowl breeding density, in 2010 and 2012. This suggests that the area selected for fence construction may present generally higher quality habitat than the exterior plot. However, the exterior plot did present higher mound activity in 2013. Further monitoring will reveal whether this plot-based comparison is representative of changes in population or whether differences between years are subject to the influences of other variables. Similarly, data from Scotia suggests that the monitoring of a fixed set of mounds outside the fence, where Malleefowl may be subject to greater predation or competition pressures and more likely to build new mounds in more suitable areas, may not be a suitable monitoring approach. The lack of Malleefowl breeding activity outside the fence at Scotia has triggered AWC to investigate the use of alternative monitoring approaches. To establish if Malleefowl breeding success is limited beyond the fence, or if these results are attributable to the monitoring methodology, Malleefowl monitoring at Scotia will move towards a plot-based approach informed by LiDAR in 2019. These examples demonstrate that whilst monitoring data of this nature requires careful interpretation, it does provide a basis for management decisions and can be used to trigger alternative actions.

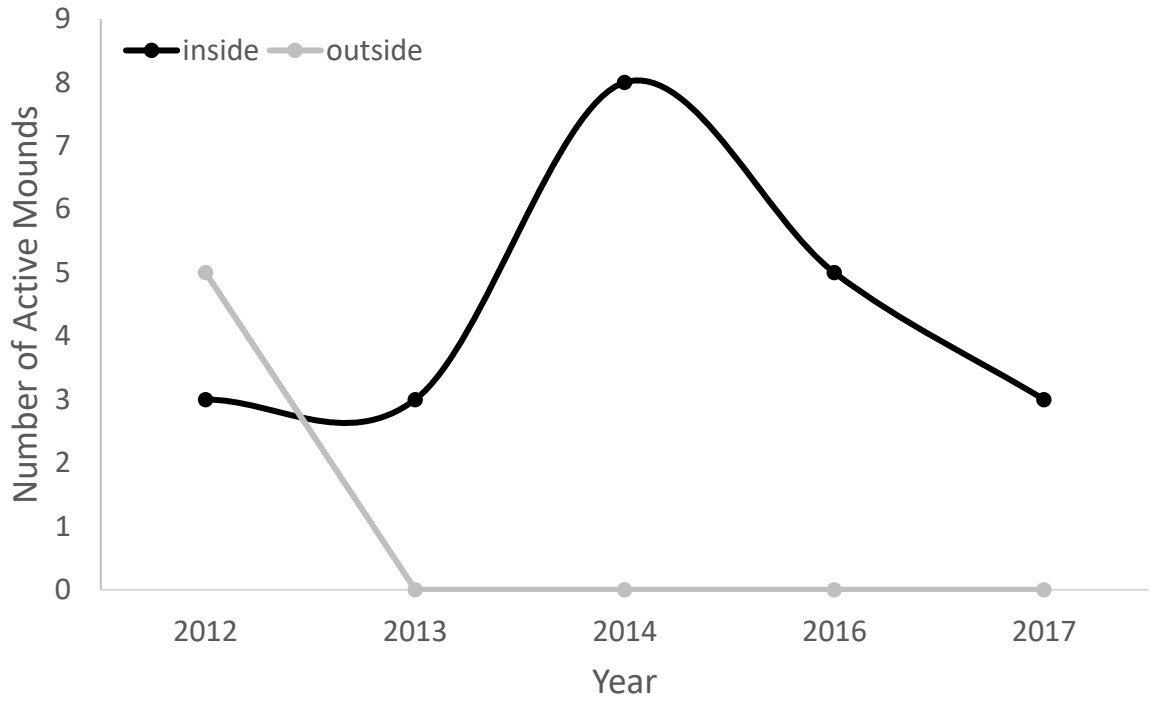

Figure 6. Differences in Malleefowl mound activity inside and outside of the introduced predator-free fenced area at Scotia Wildlife Sanctuary.

Land management for Malleefowl

Across its sanctuary network, AWC conducts large-scale land management programs aimed at improving biodiversity outcomes by reducing key threats. These programs have a focus on introduced predator control, feral herbivore control, fire management and weed management. Gains in each of these areas may result in improved outcomes for Malleefowl conservation.

A multi-faceted introduced predator control program is currently underway at Mallee Cliffs National Park. The park is a stronghold for Malleefowl in NSW and has a history of Malleefowl monitoring and research back to 1989. The AWC predator control program builds upon the previous baiting program established by NPWS in 2014 with the following elements; 1) the use of 37 km of conservation fencing to completely eradicate introduced predators from a 9,600 Ha area of the park, 2) 113 canid pest

ejectors (CPEs) placed 1.5 km apart along the internal road network of the park, 3) 115 fresh meat bait stations at 1.5 km intervals, alternating between the CPE stations, 4) a regular shooting program targeting foxes and cats, 5) a targeted cat trapping program centred on activity hot-spots identified by the monitoring program, 6) the institution of a 5 km buffer around the park within which adjacent land owners are encouraged to carry out regular fox baiting and shooting. Without the use of multiple concurrent methods, it may not be possible to produce and maintain sufficient declines in introduced predator population numbers and their functional roles within the park.

In 2017/18, the AWC baiting program at Mallee Cliffs National Park achieved an average 31.2% fresh bait take with 270 baits taken from 863 deployed. In addition to this, 108 of the 113 CPE's were triggered. These results suggest that the baiting program may have removed up to 378 individual foxes from the landscape. However, due to potential non-target takes, caching behaviour or undigested baits, actual kill rates may be lower. The consistent bait-take rate throughout the year suggests that whilst the program may be successfully removing resident foxes, the immigration of naive foxes from the surrounding landscape is sufficiently high to maintain a consistent fox population size on site. In following years, the program will advance the additional use of shooting, trapping and buffer management, with the monitoring program used to evaluate any potential gains.

In addition to predator control, a range of other land management activities of potential benefit to Malleefowl take place on AWC managed land. In 2017/18, 338 goats were removed from Mallee Cliffs National Park, using a contract musterer. Several sections of the boundary fencing were also upgraded to reduce goat and livestock incursions into the park. In addition, 430 km of road edges and 77 hectares of the park were treated for weed infestations. As Mallee Cliffs National Park has not experienced large fires since 1977, local fire management seeks to maintain the existing mosaic and preserve large areas of intact old-growth Mallee, which is an under-represented age class within the Mallee estate at the national scale. Small strip burns located along the boundary and along roads at strategic locations are used to provide additional support to firefighting operations in the event of a large conflagration.

Research and future directions

As an iconic Australian threatened species, AWC is invested in improving the status of Malleefowl across its range. Through engaging in partnerships with government organisations, such as our partnership with NPWS in NSW, AWC is working to promote its model of intensive land management informed by ecological monitoring into other government and non-government agencies and organisation. In addition, AWC is able to use its position and resourcing to contribute to Malleefowl conservation more broadly. For example, through collaboration and joint funding arrangements with partners including NSW Office of Environment and Heritage (OEH), AWC is working to capture LiDAR data across a large area of the 'Scotia Mallee' region in far South-western NSW. These data will form a substantial piece of conservation infrastructure that will re-define and provide confidence in our current understanding of Malleefowl populations in the region.

A core component of AWC's adaptive management framework is to use research to identify required actions where the threats or management actions required to address a decline in species, as established by the monitoring program, are poorly understood. One example of research collaborations is AWC's involvement in the Malleefowl adaptive management project. This is a national project managed by the University of Melbourne and the NRMT that involves determining whether or not predator control positively influences Malleefowl abundance. AWC is currently

proposing to contribute six sites to this project, with one inside and one outside of the fenced areas at Scotia and Mt. Gibson and two at Mallee Cliffs National Park.

At each site, AWC has developed a Research Strategy which outlines key projects required to address known gaps in ecological or management knowledge at the site. As an iconic threatened species at the site, the Research Strategy for Mallee Cliffs National park identifies three key areas relating to Malleefowl that require further research (Kavanagh et al. 2018); 1) revision of monitoring methodologies, 2) mound use and breeding success in the absence of introduced predators, 3) dispersal and habitat use. Results of these research programs will provide confidence in conservation management actions for this species.

The use of conservation fencing at AWC sites presents an opportunity to examine Malleefowl response to the absence of introduced predators and feral herbivores. In addition, these areas provide the opportunity to observe Malleefowl response to the re-wildling of ecosystem functions lost from the local extinction of a range of critical-weight-range digging mammals (Figure 7). Given that current data suggest that fenced areas may have a positive impact on Malleefowl breeding success, future research projects will use the opportunities presented by these fenced areas to identify key ecological relationships and management responses which may be employed beyond-the-fence to increase population resilience and generate further positive conservation gains.

Figure 7. Active Malleefowl mound within the proposed introduced predator-free fenced area at Mallee Cliffs National Park, 2017.

Acknowledgements

We would like to acknowledge the contribution of AWC's supporters and volunteers, without who this work would not be possible. We would also like to acknowledge our key partners in this work, the

NMRT, NPWS and the WA, SA and NSW governments. In particular, we would like to thank and Marc Irvine from OEH. We would also like to acknowledge the contribution of many other AWC staff to our Malleefowl work including Michael Smith, David Roshier, Helen Crisp and John Kanowski.

References

Dickman, C. R. 2012. Fences or ferals? Benefits and costs of conservation fencing in Australia. Pages 43-63 Fencing for conservation. Springer.

Kanowski, J., L. Joseph, R. Kavanagh, and A. Fleming. 2018. Designing a monitoring framework for Australian Wildlife Conservancy, a national conservation organisation. Monitoring Threatened Species and Ecological Communities:239.

Kavanagh, R., L. E. Berry, V. Leo, L. Joseph, J. Kanowski, and A. Fleming. 2017. Ecological Health Monitoring Framework: Mallee Cliffs National Park. Australian Wildlife Conservancy, Perth, WA.

Kavanagh, R., L. E. Berry, V. Leo, J. Kanowski, and A. Fleming. 2018. Research Strategy: Mallee Cliffs. Australian Wildlife Conservancy, Perth, WA.

Metcalfe, D. J., and E. N. Bui. 2017. Australia state of the environment 2016: land, independent report to the Australian Government Minister for the Environment and Energy. Australian Government Department of the Environment and Energy, Canberra.