31. A brief history of Malleefowl conservation and monitoring efforts in the Goonoo forest, New South Wales

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Abstract

The Goonoo forest consists of both public and private forest covering an area of around 90,000 hectares (ha). Low sandstone ridges and slopes comprising low fertile sandy loams dominate the area with a few major alluvial valleys of clays, silt, sand and gravels. Black cypress pine, ironbarks and red gums dominate the area with common understorey species that include allocasuarinas and wattles. The forest supports the most eastern population of Malleefowl remaining in Australia.

Landholder and agency interest in the local Malleefowl population sparked the beginning of a fox control program in the 1980's. The program progressively grew with the aim to control foxes in the public forest and the surrounding land within a 20 kilometre (km) buffer.

Malleefowl monitoring activities have included ad hoc breeding observations, coordinated mound searches, recording mound activity and mound observations using remote cameras. Other studies in the area have assessed the effectiveness of the fox control program. Results showed that locally fox activity can be reduced following baiting however across the landscape temporal and spatial gaps in baiting can lead to foxes not encountering baits, thus reducing the effectiveness of the program as foxes move quickly into baited areas.

In spite of these initiatives and efforts, the state of the Malleefowl population in the forest remains unclear. Limited resources inevitably reduce the effectiveness of monitoring activities and restrict the understanding of the stability, or otherwise, of the population. Monitoring activities have, however, uncovered interesting and important aspects of potential threats to the success of Malleefowl in the area, such as the observation of high levels of goanna activity detected at active mounds. Future research and the development of a more rigorous monitoring program, including targeted mound searches, is a high priority for the population and will direct more effective management actions.

The Goonoo Forest

The Goonoo is an area of public and private forest located approximately 40 km north-east of Dubbo on the central western slopes of New South Wales. The public forest covers an area of around 62,500 ha and is adjoined by a further 27,000 ha of private forest, all together surrounded by farm land. The Goonoo is the largest remnant forest in the region, with the Pilliga forest (530,000 ha) around 100 km to the north. The forest originally supplied timber for settlement needs and then became an important supplier of railway sleepers during the late 19th century. The Goonoo State Forest was dedicated in 1917 and continued to supply timber for sleepers, fencing and firewood (FCNSW 1988) prior to 2005 when the forest was gazetted National Park and State Conservation Area. The adjoining landscape comprises a forest and cleared land matrix.

Low sandstone ridges and slopes with low fertility sandy loams dominate the area while the few major alluvial valleys are comprised of clays, silt, sand and gravels. Elevation ranges from 320 m above sea level in the west where the terrain is relatively flat to 500 m to the east where the country has more defined gullies and ridges with a mean altitude of 387 m (SD = 31). The vegetation formation is classified as western slopes dry sclerophyll forest (Keith 2004) and is dominated by black cypress pine (*Callitris endlicheri*) and less commonly white cypress pine (*C. glaucophylla*), ironbarks (*Eucalyptus crebra, E. nubila* and *E. beyeriana*) and red gums (*E. dwyeri* and *E. blakelyi*) (Beckers & Binns 2000). Understorey vegetation includes *Allocasuarina diminuta*, *A. gymnanthera*, *Acacia triptera* and *Calytrix tetragona*. The forest supports one of the few populations of *Zieria ingramii*, an endangered shrub found only in central

New South Wales, from Goonoo to Cobbora forest. Long term mean annual rainfall for Dubbo is 585 mm, while mean daily temperatures range from 2.6 to 15.2 C in winter and 17.9 to 33 C in summer (http://www.bom.gov.au/climate/averages/tables/cw_065012.shtml, accessed 2007).

The Goonoo forest is important ecologically because of its isolation from areas of mallee to the west and it supports a number of species, including the Malleefowl (*Leipoa ocellata*), that are at or close to their eastern limits (Heron 1973). The NSW Fox Threat Abatement Plan (Fox TAP) lists Malleefowl in the Goonoo as a high priority threatened species for fox management (NPWS 2001). The Goonoo has been listed as one of around 12,000 Important Bird Areas across the world and identifies the need to protect and manage the isolated populations of the vulnerable Malleefowl, as well as significant numbers of the near threatened diamond firetail (*Stagonopleura guttata*) and small numbers of the vulnerable painted honeyeater (*Grantiella picta*) (BirdLife International 2014). Other species of interest in the Goonoo forest include the glossy black-cockatoo (*Calyptorhynchus lathami*), koala (*Phascolarctos cinereus*), regent honeyeater (*Anthochaera phyygia*), gilbert's whistler (*Pachycephala inornata*), turquoise parrot (*Neophema pulchella*), barking owl (*Ninox connivens*), masked owl (*Tyto novaehollandiae*), square-tailed kite (*Lophoictinia isura*), squirrel glider (*Petaurus norfolcensis*) and the eastern pygmy-possum (*Cercartetus nanus*). The bush-stone curlew (*Burhinus grallarius*), a largely sedentary bird, is found in the woodland areas surrounding the forest; this, and other species restricted to the forest, such as the pygmy-possum, are also considered susceptible to fox predation. The main threats to Malleefowl in this area include loss of habitat from clearing and fire as well as predation by foxes. Recent major fires occurred in 2004 and 2007 affecting large areas of the forest. Hazard reduction burns are carried out to minimise the large-scale threat to Malleefowl and other assets.

Malleefowl observations in the Goonoo

The first published report of Malleefowl occurring in the Dubbo area was in 1954 when the Breelong forest, which then adjoined the Goonoo forest was mentioned in Griffiths NSW survey of Malleefowl (Korn 1989). Additional reports were published by Sharland (1966), Heron (1973) and Morris (see Korn 1989) where his survey in 1984 estimated a maximum of 12 breeding pairs. Korn (1989) suggests, following his investigations over the six years prior to 1989 that many more pairs than this estimate breed in the forest or its immediate surrounds. Korn (1986) also noted a Malleefowl attacked by a Brown Goshawk, and made other observations using a hide installed at a mound in the Goonoo forest. These early observations and those of many others since inspired actions to protect the Malleefowl in the area.

Goonoo Fox Control Project

Landholder and government agency interest in the local Malleefowl population sparked the beginning of a fox control program in the 1980's. The program progressively grew with the aim to control foxes in the public forest and the surrounding private land within a 20 km buffer. The then Rural Lands Protection Board (RLPB, now Local Land Services), Forests NSW (FNSW) and National Parks (NPWS) staff together with a group of landholders met to plan fox control operations in autumn and winter.

Members of this coordinators group had specific roles and tasks to ensure the programs implementation was successful. RLPB was responsible for media releases, preparing and distributing newsletters and facilitating coordinator meetings. FNSW and NPWS notified neighbours, attended coordinators meetings, distributed baits and monitored bait stations. Private landholders notified neighbours, organised bait distribution meetings, "sold the program" to the community and provided feedback. To encourage and maintain participation of stakeholders, bait distribution meetings on the landholder coordinators' properties would also include guest speakers on current issues from experts such as the district vet, rural fire service or the local weeds council.

Bigfoot Walk through

A Malleefowl conservation program known as the "Goonoo Lands Bigfoot Project" operated between 2004 and 2007 with the aim of monitoring the Malleefowl population. The program was coordinated by a community representative with assistance and guidance from FNSW, RLPB and NPWS staff and the local community. Monitoring included periodic visits to Malleefowl mounds that were known to have been recently active. In 2004, 107 agency staff and volunteers walked strategically through forest compartments (2.8% of the Goonoo forest area) and successfully carried out searches for unknown

mounds. An additional 53 mounds were located at varying stages, the majority inactive. This collaborative approach (Invasive Animal CRC 2012) to protect both natural and agricultural assets, with its high level of stakeholder interest, has and continues to, provide a good foundation for research, and a number of projects have been carried out with the support of the program

Goonoo research

Fox range area - Between 2005 and 2007 13 foxes were radio-tracked using VHF and GPS collars in the southern half of the Goonoo. The results were somewhat surprising with foxes across larger areas than expected. Mean VHF and GPS range areas were 836 ha (range 172.8 – 1817.7 ha, n=9) and 6096 ha (range 3947.2 – 9217.6 ha, n=3) respectively (Towerton 2014). Range areas were larger than other VHF tracked foxes in Australia and around the world, while GPS collared foxes were considerably larger in comparison. Foxes were tracked for short periods only as they succumbed to poison baits as well as the difficulty in tracking VHF collared foxes onto private property and obtaining signals from within densely forested areas. We thus suggested that the VHF collared range areas are underestimated. GPS collars allowed us to examine fox movements at a fine scale, with individual foxes displaying preferences for forest and cleared areas. We also examined movements during a typical "baiting window", which at the time was around two weeks, and found that only a proportion of the entire range area might be visited during that time. This has implications for bait density and placement.

Fox bait uptake – Information routinely collected on bait-take at pre-defined stations throughout the forest between 2000 and 2005 found that there was no consistent decline in relative fox abundance but instead increases in the index occurred in successive checks within most operations (Towerton 2014). Spatial analyses of checks within control operations showed that consecutive baits were removed at more than 70% of bait stations that were visited by foxes. Temporal analyses found that within an operation, successive bait-takes occurred at around 20% of stations and, across all operations, hot spots of activity were identified. This suggests that the small baiting window in standard baiting operations may not be effective in reducing the activity of foxes across the landscape. It is likely that a large proportion of baits were being cached during each operation. Fox activity was assessed before and after four operations using sand plots, and on two occasions in spring 2005 and autumn 2006, a significant reduction in activity was observed, however, although not significant, the following two operations saw slight increases.

Fox activity remote cameras - We explored the use of remote cameras to estimate the activity of foxes and potential prey species before and after poison baiting operations (Towerton *et al.*. 2011). We placed cameras in forest and cleared areas, on tracks only, at 100 sites covering an area of ~441,500 ha during winter 2009. Thirty-six species were identified from photos. No clear effects of fox-baiting were detected on foxes or potential prey species at the landscape scale, but a trend for reduction in fox activity was observed. The number of sites occupied by foxes increased after baiting, but 12 sites occupied during the pre-baiting sample detected no foxes post-baiting, a 36% reduction in these previously occupied sites. Fifteen previously unoccupied sites detected foxes post-baiting. The sustained and new detection of foxes at sites may be due to increased movements as young males disperse and new home ranges become available following fox baiting operations. Evidence of foxes with prey was also observed, most identified as macropods. The activity of foxes in surrounding agricultural areas was higher than in forests, highlighting the difficulty in managing foxes in fragmented native forests surrounded by farmland.

Fox control effort - With a clear understanding of how important the coordinated approach is to fox control, we sought to provide a structure for collecting, storing and using the existing monitoring data more strategically (Towerton *et al.* 2013). Fox baiting effort was assessed across the landscape by mapping bait stations set on public and private land in order to identify gaps in baited areas across the Goonoo Fox Control Program area. As foxes are capable of dispersing large distances and recolonising areas rapidly after removal, the aim was to develop an approach whereby land managers could examine spatial and temporal gaps in baiting operations, which were the potential source of recolonising foxes, so that these areas could be targeted and covered in subsequent operations. Large unbaited areas were identified around the areas that were baited where the distribution of baits was clustered across the landscape. This information can then be presented at coordinators meetings allowing decisions to be made based on bait monitoring results. Collecting this information from landholders is more difficult and we suggest setting up permanent bait stations on private property that would allow at least parts of

this analysis to be carried out. Strategic planning to address spatial and temporal gaps in bait placement is likely to improve effectiveness.

Malleefowl cameras 2006 -Three remote cameras were trialled on Malleefowl mounds before they were all destroyed during a wildfire in 2006 (Towerton *et al.* 2008). A total of nine species were identified including mammals (fox, echidna, goat, swamp wallaby and dunnart), reptiles (lace and sand monitors) and birds (raven and common bronzewing). Three species of concern were identified (the fox and two goanna species) that may predate upon eggs and or young Malleefowl or adults and one species that may damage the mound (goat) potentially effecting breeding success.

Fauna cameras 2009 – Trials were carried out to explore the use of remote cameras to monitor terrestrial biodiversity, in particular Malleefowl and pygmy possums, at six sites where nine cameras were setup within a 1 km grid at each site (den Boer 2010). The sites overlaid previous fauna survey sites. This project identified 21 species, including a range of native and pest species. In comparison to the previous survey, 14 species out of a possible 31 species recorded at the selected sites were identified by the remote cameras. Unfortunately however this didn't include the Malleefowl or the eastern pygmy possum.

Malleefowl cameras 2009 – Remote cameras were used to assess activity at 15 Malleefowl mounds in the Goonoo, and found three of these to be active (Brown 2009). Species visiting mounds included red-necked wallabies, lace monitors, koala, goats, feral cats, echidnas, foxes, goats, goannas as well as the Malleefowl. Three cameras were then set at each of the three active mounds to test different camera setups and attempt to determine the breeding success, or otherwise, of the Malleefowl. Initial results found many behaviours observed such as courtship displays, mound preparation, digging holes for egg laying as well as potential predation by goannas.

Conclusions

Malleefowl monitoring activities have included ad hoc breeding observations, coordinated mound searches, recording mound activity and mound observations using remote cameras. These activities have uncovered interesting and important aspects of potential threats to the success of Malleefowl in the area, such as the observations of foxes, high levels of goanna activity detected at active mounds and the presence of goats and other species that may disturb mounds. In spite of these initiatives and efforts, the state of the Malleefowl population in the forest remains unclear. Limited resources inevitably reduces the effectiveness of monitoring activities and restricts the understanding of the stability, or otherwise, of the population.

Although the long-term public and private participation in efforts to manage fox impacts in the study region has been excellent, the evidence collected suggests that managing foxes to minimise their predation threats on native species and livestock, even with this level of support, remains problematic and its success unclear. The sparse and patchy distribution of resources available to foxes in the forest appears to promote large movements and thus unstable range areas. Any spatial and temporal gaps in baiting can lead to foxes not encountering baits, or the continuous migration of foxes into baited areas, as well as those from the surrounding unbaited areas into the buffer zone and then potentially the forest. Baiting operations were shown to be successful in that up to 75% of collared foxes succumbed to poisoning, while fox activity was reduced following some baiting operations. The mixed successes may suggest that the current approach is close to being sufficient to reduce fox activity and increase the protection of native species and livestock, but improvements need to be made for any long-term benefits to be sustained.

In concluding, Malleefowl conservation efforts can be improved in the Goonoo by a collaborative approach across all aspects of conservation management (pest control, habitat management, monitoring) through the development of a robust, long-term Management Plan. Improved planning of fox control efforts to minimise spatial and temporal gaps, benefits both Malleefowl conservation and agriculture production. Continued monitoring to improve our understanding of the threats limiting Malleefowl survival in the Goonoo will assist long-term planning and adaptive management triggered by these monitoring results.

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