# ACT conservation research: the effects of kangaroo grazing on biodiversity

## Summary of recent papers

Since the ACT Kangaroo Management Plan (KMP) was published in 2010, eight studies on the effects of kangaroo grazing on biodiversity, based on work carried out in the ACT, have been published or submitted and are in review. In order to assist community understanding of kangaroos in relation to biodiversity, the directorate has summarised the papers below (Table 1). Each paper is also described individually. While this review is limited to locally derived papers, other papers based on research outside the ACT are also relevant e.g. the literature review: Foster C.N., Barton, P.S., and Lindenmeyer D.B., (2014) Effects of Large Native Herbivores on Other Animals. *Journal of Applied Ecology* **51** 929–938.

**Table 1: Summary of research on the effects of kangaroo grazing on biodiversity, based on field work in the ACT and published or in review since the publication of the KMP**

| Title of study | Year | Primary Author | Studied Taxon | Negative effect of high density of EGKs? | Recommended kangaroo density (EGK/ha) |
|---|---|---|---|---|---|
| Biomass and floristic patterns in the ground layer vegetation of box-gum grassy eucalypt woodland in Goorooyarroo and Mulligans Flat Nature Reserves, Australian Capital Territory | 2010 | Sue McIntyre | Ground-layer plants | Yes | - |
| Experimental reduction of native vertebrate grazing and addition of logs benefit beetle diversity at multiple scales | 2011 | Philip Barton | Beetles | Yes | 0.4 |
| Back to the brink – population decline of the endangered grassland earless dragon (*Tympanocryptis pinguicolla*) following its rediscovery | 2012 | Wendy Dimond | The grassland earless dragon | Yes | - |
| Bringing forward the benefits of coarse woody debris in ecosystem recovery under different levels of grazing and vegetation density | 2013 | Adrian Manning | Reptiles | Yes | 0.4 |
| Eaten Out of House and Home: Impacts of Grazing on Ground-Dwelling Reptiles in Australian Grasslands and Grassy Woodlands | 2014 | Brett Howland | Grass and Reptiles | Yes | < 0.5 |
| Restoration of eucalypt grassy woodland: effects of experimental interventions on ground-layer vegetation | 2015 | Sue McIntyre | Ground-layer plants | Yes | |
| Habitat preferences of the threatened striped legless lizard: implications for the management of grazing in grasslands. | 2015 | Brett Howland | Striped legless lizards | Yes | < 1.2 |
| Birds of a feather flock together: using trait-groups to understand the effect of macropod grazing on bird communities in grassy habitats | In review | Brett Howland | Birds | Some yes<br>Some no | varied |

Collectively the eight studies provide strong evidence that high densities of Eastern Grey Kangaroos (EGKs) can negatively impact a range of taxa in the ACT. Several studies were conducted in a way that enabled particular kangaroo densities to be recommended (advised densities between 0.4 and 1.2 EGK/ha). This range of recommendations is broadly compatible with the current practice in culled reserves which is to allow in each reserve 1.0 EGK/ha in grasslands, 0.9 EGK/ha in open woodlands, 0.5 EGK/ha in woodland and 0.1 EGK/ha in open forest or forest (see Calculation of the Number of Kangaroos to Cull). The information presented in these eight studies, and future studies, will continue to guide the future of kangaroo management activities in the ACT in accordance with the ACT Kangaroo Management Plan.

## Summary of individual papers

1. McIntyre S., Stol J., Harvey J., Nicholls A.O., Campbell M., Reid A., Manning A.D. and Lindenmayer D., 2010. **Biomass and floristic patterns in the ground layer vegetation of box-gum grassy eucalypt woodland in Goorooyarroo and Mulligans Flat Nature Reserves**, Australian Capital Territory *Cunninghamia* 11: 319–357

A grassland flora study undertaken in two nature reserves, Mulligans Flat and Goorooyarroo, established methods and reported baseline conditions for the long term grassy woodland restoration study commenced in 2007. The study included measurements of: ground layer biomass, species biomass, groundcover types and soil properties.

McIntyre *et al*. (2010) cite the extremely high kangaroo densities in ACT reserves, being the highest reported densities of any wild kangaroo populations (higher densities were later reported from Victoria). The study indicated that biomass was consistent with high grazing pressure from the high density of EGKs. The study concluded that ACT reserves are under extremely high grazing pressure sufficient to affect soil processes and habitat. Continued high levels of grazing may inhibit soil, water and nutrient processes essential for healthy functioning of grassy woodlands.

*Box-gum grassy eucalypt woodland in Goorooyarroo*

2. Barton P.S., Manning A.D., Gibb H., Wood, J.T., Lindenmayer, D.B., and Cunningham S.A., 2011. **Experimental reduction of native vertebrate grazing and addition of logs benefit beetle diversity at multiple scales**. *Journal of Applied Ecology* **48**: 943–951.

A 16 month study, undertaken in a local nature reserve, Goorooyarroo, manipulated kangaroo grazing levels to examine the response on beetle populations. Beetles were chosen to test responses to kangaroo grazing due to their potential for rapid response to habitat change. The experiment evaluated the biodiversity effects of adding large tree trunks (at 0, 20 and 40 t/ha) and reducing kangaroo density from 2.1 to 0.4 kangaroos /ha.

The main message from the results of this study is 'management of appropriate levels of grazing is the key objective for management of plant and insect communities'. In summary, this study found heavy grazing from a high density of kangaroos poses a significant barrier to sites undergoing ecological restoration due to the reduction of pasture biomass. In addition, the study found that hardwood logs placed in clumps at a certain ratio had a positive effect on beetle diversity. The reduction in grazing was found to have a significant positive effect on both beetle abundance and diversity. The addition of logs somewhat offset the negative impact of grazing by providing refuge for beetles from the impacts of grazing. Rapid response of beetles suggests potential for a positive flow-on effect for other organisms.

This study provided quantitative guidelines for kangaroo densities for the conservation of a native taxon (i.e. beetles), with beetles more abundant and of higher diversity when there were 0.4 EGK/ha compared to areas with 2.1 EGK/ha.

3. Dimond W.J., Osborne W.S., Evans M., Gruber B., and Sarre S.D., 2012. **Back to the brink – population decline of the endangered grassland earless dragon (*Tympanocryptis pinguicolla*) following its rediscovery**. *Herpetological Conservation and Biology* **7**(2): 132-149.

A study of the Grassland Earless Dragon (GED) found the species is in danger of becoming the first recorded extinction of an Australian reptile. The GED only occurs in natural temperate grassland (NTG), an endangered ecological community. The remaining patches of this habit are so small and isolated that there is no prospect for the species to naturally recolonise areas where

*Endangered Grassland Earless Dragon in tussock*

it has died out. Other than habitat destruction and fragmentation, the key threats to the species are drought and overgrazing resulting in a failure of recruitment of young into the adult population.

Research at 23 native grassland sites in the ACT over 25 years has shown a large reduction in the population. The species is no longer detectable at three of the 10 current research sites.

4. Manning A. D., Cunningham R. B. & Lindenmayer D. B. (2013) **Bringing forward the benefits of coarse woody debris in ecosystem recovery under different levels of grazing and vegetation density**. *Biological. Conservation*. **157**, 204-14. (Full article from Biological Conservation hosted with permission from Elsevier).

This research into reptile abundance was undertaken in two endangered Yellow Box – Red Gum grassy woodland sites (Mulligans Flat and Goorooyarroo) over a four year period. As with paper 3, this study evaluated the biodiversity effects of adding large tree trunks (at 0, 20 and 40 t/ha) and reducing kangaroo density from 2.1 to 0.4 kangaroos/ha. The effect of kangaroo grazing pressure on skinks was found to be dependent on the shrub density. The greatest negative effect of high grazing pressure was on small skinks in high shrub density. The addition of large logs was estimated to be able to fast-track ecosystem restoration processes between 100 and 200 years. Aside from this benefit, the study found all areas treated with timber debris, in presence of high kangaroo grazing pressure, resulted in a small decrease in small skink abundance. Once kangaroos were excluded from the denser woodlands this proved beneficial for skinks.

The ACT Government is using the findings of this research in its management of reserves. The Woodlands Restoration Project is reintroducing 'coarse woody debris' into nature reserves in the form of large logs, mostly tree trunks salvaged from development sites.

5. Howland B., Stojanovic D., Gordon I. J., Manning A. D., Fletcher D. & Lindenmayer D. B. (2014) **Eaten Out of House and Home: Impacts of Grazing on Ground-Dwelling Reptiles in Australian Grasslands and Grassy Woodlands**. *PLoS ONE* **9**, e105966.

A study investigated the effect of kangaroo grazing on reptiles at 18 grassland and grassy woodland sites in the ACT, NSW and Victoria. Ground-dwelling reptiles were chosen to test the effects of grazing, as reptiles are known to be sensitive to changes in grass structure. The sites were grazed primarily by EGKs, covered a range of kangaroo densities (from 0.3 EGK/ha to over 3.0 EGK/ha) and had relatively intact vegetation.

The study found that sites with higher kangaroo densities had less grass than sites with lower kangaroo density. There was a greater abundance of reptiles and a greater number of reptile species in areas with high grass structure and low kangaroo numbers. No species of reptile was more common in areas with low grass structure and high kangaroo numbers. However, not all species favoured the same amount of grass. Legless lizards were more common in areas with moderate grass, whereas the Eastern Three-toed Skink was more common in areas with high grass. The authors concluded that the best outcome for the conservation of reptiles would be to maintain a mix of moderate and high grass structure within reserves and prevent the formation of low grass structure found under high kangaroo numbers.

The results of this study provide two lines of evidence supporting the current approach for setting kangaroo

*Olive Legless Lizard (Delma inornata)*

carrying capacity in reserves (see Calculation of the Number of Kangaroos to Cull). First, the authors tentatively suggest that kangaroo densities less than 0.5 animals/ha could benefit a range of reptiles. This is similar to the current practice in culled reserves to allow in each reserve 1.0 EGK/ha where grasslands occur, 0.9 EGK/ha for open woodland, 0.5 EGK/ha for woodland and 0.1 EGK/ha for open forest or forest. Second, the study established that carrying capacity (i.e. number of kangaroos that can be supported) is less in wooded habitats than grasslands, likely due to negative effect of trees on grass growth. This reinforces the need to maintain different numbers of kangaroo in different habitats as allowed for in the current practice described in Calculation of the Number of Kangaroos to Cull.

6. McIntyre S., Cunningham R. B., Donnelly C. F., Manning A. D. (2015) **Restoration of eucalypt grassy woodland: effects of experimental interventions on ground-layer vegetation**. *Australian Journal of Botany* **62**, 570–579.

This study investigated changes in ground-layer vegetation at Mulligans Flat and Goorooyarroo Nature Reserves in the ACT. The study recorded change in ground-layer plants (i.e. plant biomass, plant species diversity, ground-cover attributes and life-form) from 2007 to 2011 in relation to the following experimental interventions: (1) reduced kangaroo density, (2) addition of coarse woody debris and (3) fire (a single burn).

The authors found that reducing kangaroo density doubled total biomass in one reserve, but had no effect on exotic plant biomass, species counts or ground cover attributes. Coarse woody debris also promoted biomass, particularly exotic annual forbs, as well as plant diversity in one of the reserves. The single burn reduced biomass, but changed little else. They found that the greatest driver of change regardless of treatment was the end of drought conditions in 2009 and several years of good rainfall. This increase in rainfall appears to have resulted in biomass increasing by 67% (mostly owing to the growth of perennial native grasses), overall native species counts increasing by 18%, and exotic species declining by 20% over this four year period. They suggest that strategic management of grazing pressure, use of fire where biomass has accumulated and placement of coarse woody debris in areas of persistent erosion will contribute to improvements in soil and vegetation condition, and gains in biodiversity in the future.

This longer term study has shown the overriding role of climate in driving plant production in these temperate reserves, but importantly has shown that management of grazing pressure, addition of woody debris and fire can all be used to increase recovery. These are regarded as key components in ecological restoration.

7. Howland B., Stojanovic D., Gordon I. J., Stirenmann I., Fletcher D., Snape M. & Lindenmayer B. D. (2015) **Habitat preferences of the threatened striped legless lizard: implications for the management of grazing in grasslands**. In review.

A study of the habitat preferences of a threatened reptile species, the Striped Legless Lizard *Delma impar*, was conducted over two years at six ACT grassland reserves. Study sites were selected to cover a range of kangaroo densities (1.2 kangaroo/ha - 5 kangaroo per/ha), a range of grassland sizes (10 – 200ha) and contain a mix of native and introduced grasses. The study was initiated in 2012 by the ACT Government as part of a long-term investigation of kangaroo grazing impacts on biodiversity. The Striped Legless Lizard is a good indicator species for the effects of grazing, as this species relies on grass structure for shelter from predators, for food and to regulate its body temperature. High levels of grazing are known to negatively affect this species as high grazing removes grass structure. However, some level of grazing is considered important, as it promotes the formation of a mix of short and tall grass which this species is thought to prefer.

This study found that the Striped Legless Lizard can occupy even small and degraded grasslands provided there is sufficient grass and high kangaroo numbers are avoided. The authors recommended that to ensure the ongoing conservation of this threatened

*Striped Legless Lizard*

*Eastern Grey Kangaroos loafing in the sun*

reptile, kangaroo numbers should be limited to less than 1.2 kangaroos/ha, but with some level of grazing maintained to promote the mix of short and tall grass that the Striped Legless Lizard prefers. Although the study was conducted in grasslands grazed by kangaroos in the ACT, the results have implication for management of grazing outside the ACT and for both native and domestic herbivores. The recommendations made in this study for the conservation of the Striped Legless Lizard are likely to benefit a range of grassland species, e.g. the endangered Grassland Earless Dragon.

The Striped Legless Lizard will likely benefit from the current practice in culled reserves to allow in each reserve 1.0 EGK/ha where grassland occurs, 0.9 EGK/ha for open woodland, 0.5 EGK/ha for woodland and 0.1 EGK/ha for open forest or forest (see Calculation of the Number of Kangaroos to Cull).

8. Howland B., Stojanovic D., Gordon I. J., Radford J., & Lindenmayer B. D. (2015) **Birds of a feather flock together: using trait-groups to understand the effect of macropod grazing on bird communities in grassy habitats**. In review.

In this study the effect of kangaroo grazing on birds was investigated at 18 grassland and grassy *Eucalyptus* woodland properties from across the ACT, NSW and Victoria. With over 300 species of bird recorded in the ACT alone, it is not feasible to investigate the effects of grazing on all individual species. Instead the study used a trait-based approach, grouping birds based on shared life-history traits likely to be affected by grazing. These groups were large ground-foraging, small ground-foraging, aerial insectivorous, and ground-nesting/concealment species. The study evaluated effects of kangaroo grazing on these four trait groups by studying the birds in 18 sites that provided a gradient in kangaroo density.

The authors found that birds that utilised the grassy layer for food and relied on early detection of predators were more common under high grazing intensity, whereas birds that nested on the ground and relied on grass for concealment from predation, and birds that fed on invertebrates above the grass layer (i.e. aerial insectivore) were both more common under low grazing intensities. Large bodied (> 250g) ground-foraging birds (e.g. galah, sulphur-crested cockatoo, white-winged chough) were most common at very high grazing intensities and appear to benefit from a very open grass layer. Small ground-foraging species (e.g. crested pigeon, magpie-lark, red-rumped parrot, superb fairy-wren) were most common at moderate to high grazing intensity and declined at very high and low grazing intensities. This study concluded that a mix of low and high grazing intensities will be important in promoting a diverse bird assemblage. The authors suggest that the duration of very high grazing events should be limited to prevent simplification of habitat and loss of food items.

*Sulphur Crested Cockatoo*

## Related topics

- The ACT Kangaroo Management Plan explains all ACT Government policies on kangaroos.
- Calculation of the Number of Kangaroos to Cull sets out the current formula for calculating how many kangaroos to leave in each culled reserve, and explains how kangaroo populations are counted. It is expected that the formula will be revised as new research information is obtained.
- Independent scientific review of ACT kangaroo counting methods and cull calculations. A review in 2014 by Kurahaupo Consulting found that the methods and advice are appropriate.

## For more information

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