

The Role of the Reintroduction of Greater Bilbies (*Macrotis lagotis*) and Burrowing Bettongs (*Bettongia lesueur*) in the Ecological Restoration of an Arid Ecosystem: Foraging Diggings, Diet, and Soil Seed Banks



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Abstract

Arid Recovery, a fenced reserve free of feral predators in arid South Australia, has successfully reintroduced two critical weight range (CWR) mammals, greater bilbies (*Macrotis lagotis*) and burrowing bettongs (*Bettongia lesueur*) to facilitate the restoration of arid Australian ecosystems. This thesis evaluates the ecological roles of these reintroduced species and their relationship to ecosystem functioning and the restoration of these ecosystems.

Surveys of foraging diggings and soil seed banks, and dietary analysis were used to measure impacts of these species on three main habitats within the Reserve. The results showed that bilbies and bettongs have three major roles in ecosystem functioning: consumers, ecosystem engineers, and dispersers of seeds and fungi.

Both bilbies and bettongs were omnivorous, though their diets were distinctly different, with the bilbies focused more on invertebrates and seeds, while the bettongs consumed a greater proportion of coarser plant materials. The seed portion of the diets of both species during 2003-04 differed from a similar study three years previously, shortly after the animals had been reintroduced to Arid Recovery in 2000-01. During 2003-04, the bilbies consumed a lower proportion of seeds of species of grasses and more of forbs, while seed consumption by bettongs narrowed to be almost exclusively the seeds of shrubs.

The number of bilby and bettong diggings varied significantly both spatially and temporally, with averages of $7,530 \pm 820$ diggings ha^{-1} in Dunes, $10,560 \pm 980$ diggings ha^{-1} in Mulga, and $7,120 \pm 610$ diggings ha^{-1} in Swale. This resulted in an average of 2 to 3% disturbance of soil surface area, which is similar to or higher than reported for other Australian or overseas semi-fossorial species. The temporal variation in rates of digging was correlated with minimum daily temperatures and rainfall but not moonlight. This variation was also correlated with counts of bilby but not bettong tracks, suggesting that the temporal variability of diggings was related to levels of bilby activity.

The persistence of bilby and bettong diggings differed between the three habitat types, with the majority of the diggings in the Mulga (94%) and Swale (87%) persisting for over 12 months, while Dune diggings filled much faster, with only 15% persisting over 12 months. These diggings were shown to accumulate and bury seeds and litter, and, under some conditions, enhance germination.

The seeds of two plant species, the annual grass, *Dactyloctenium radulans*, and the shrub, *Enchylaena tomentosa*, germinated from bilby faecal pellets, and over a third of bilby faecal pellets contained fungal spores. Therefore bilbies have the potential to be dispersers of both seeds and fungi.

All three major roles of the bilbies and bettongs in ecosystem functioning (consumers, ecosystem engineers, and dispersers of seeds and fungi) have the potential to affect the flows of organic, soil and water resources, and therefore vegetation structure and overall productivity. Soil seed bank densities differed between areas with and without bilbies and bettongs. However, the heterogeneity of the system made it difficult to confidently relate these differences to any particular effects of the bilbies and bettongs.

Both bilbies and bettongs were able to locate and dig seeds buried 20 cm deep, and the caches of seed-harvester ants. Experiments showed that in areas of high digging density, 71 to 94% of seed rain accumulated and became buried in diggings. Since bilbies and bettongs have the potential to use buried seed resources, they have the potential to significantly affect soil seed banks through their consumption of seeds, redistribution of seeds through their digging activities and their interactions with other granivorous species.

This study is a first step towards understanding the roles of reintroducing CWR mammals to arid ecosystems. Possible longer term effects of these reintroductions will depend on suitable regulation of animal numbers, and climatic patterns, as restorative effects of diggings would be greatest during periods of good rainfall, whereas droughts would slow restorative processes.

Although the results of this research are unique for Arid Recovery, the principles of evaluating all major ecological roles of reintroduced species and their interactions with their environment could provide guidance for other reintroductions. These interactions are complex and would require longer-term studies over a range of conditions and locations to further understand the role of reintroducing CWR mammals to ecological restoration.

Declaration

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

I give consent to this copy of my thesis, when deposited in the University Library, being available for in all forms of media, now or hereafter known.

Signature

Date

*“When we try to pick out anything by itself,
we find it hitched to everything else in the universe”*

John Muir

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