Science for Saving Species

Research findings factsheet

Project 4.1.7

Threatened Species Recovery Hub

National Environmental Science Programme

More than just diggers: Quenda and woylie disperse viable seed

In brief

Many Australian mammals eat seeds. This may influence seed survival, germination or dispersal and have implications for ecosystem health and environmental restoration; however, seed consumption and dispersal by Australian mammals has been little studied.

We conducted an experiment using two seed-eating digging mammals, quenda and woylies, which were formerly far more widespread but are restricted to south-west Western Australia. We measured the duration and effect of digestion by these animals on the survival and germination rates of seeds of three native plant species.

Forty-two percent of seeds consumed survived and were viable after gut passage. Germination capacity varied across plant species and which animal they were consumed by, being variously higher, lower or unchanged compared to a control of undigested seeds.

Mean gut passage times were 14 hours for quenda and 24 hours for woylies but some seeds were retained for 48 hours, indicating that these species can play a role in seed dispersal.

Reintroducing these mammals to habitat where they once occurred could help restoration efforts through the dispersal of native plants, but their ability to disperse exotic plant species should also be considered. Wild-to-wild translocations of quenda and woylies should consider the potential for seed transfer between source and receiving sites.

Background

Animal–seed interactions are important for how vegetation communities are structured across a diverse range of ecosystems worldwide. When an animal eats seeds, it may result in either predation (when the seed is destroyed) or dispersal (when the seed remains viable). Consequently, it can be either detrimental or beneficial for plants.

The dispersal of plant seeds via ingestion by a vertebrate animal may be advantageous to plants in several ways. First, seeds may be dispersed further from the parent and sibling plants than by other forms of seed dispersal, thus reducing competition with them. Second, when seeds are deposited in the scats (poos) of animals, the scats may provide moisture and nutrients that help the seed germinate. Finally, when animals consume seeds it may help to break seed dormancy.

Many Australian mammals consume seeds as an important part of their diet. Australian mammals are typically considered to be seed predators that play an insignificant role in seed dispersal. However, very few studies have investigated seed dispersal by Australian mammals.

LEFT: Quenda. Image: Leonie Valentine

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Native Animal Rescue

Background (continued)

This study looked at the influence on seeds of digestion by two digging mammals:

Woylies are classified as Critically Endangered by the IUCN and listed as Endangered under the EPBC Act. They were once found across much of Australian mainland but are now restricted to a few places in south-west Western Australia and reserves to where they have been translocated.

Quenda are classified as a Priority 4 (Species of Conservation Concern) under the *Western Australian Wildlife Conservation Act 1950*. Quenda have declined within their range in south-western Australia, and in abundance since European arrival.

Research aims

We looked at the influence of digestion by two digging mammal species, quenda and woylies on the germination of native seeds. In particular, we investigated:

1. How long do quenda and woylies take to pass seeds through their digestive systems?
2. Is the germination capacity of seeds retrieved from the scats of quenda and woylies lower or higher than that of uneaten seeds?

What we did

We conducted an experiment in 2019 using two female adult quenda and a male and female adult woylie held in captivity at Native Animal Rescue, Malaga, Western Australia, along with laboratory seed work conducted at Kings Park Science, Department of Biodiversity, Conservation and Attractions.

We selected one species each from the native Australian genera *Acacia, Dodonaea* and *Gastrolobium* as their seeds germinate only after exposure to high temperatures or after scarification (softening or weakening of the seed), and prior research suggests that this capacity for germination is increased by passage through the gut of animals, although the effect of consumption by marsupials on dormancy remained unknown.

The three plant species we chose were raspberry jam wattle (*Acacia acuminata*), sticky hop bush (*Dodonaea viscosa*) and York Road poison (*Gastrolobium calycinum*; named for its 1080 levels which are lethal to non-native animals).

We determined the viability of seeds from the three native plant species by using digital X-ray imagery. Only viable seeds were used in the experiment.

We then fed 50 viable seeds of each plant species to woylie and quenda housed in individual captive enclosures at Native Animal Rescue.

At the beginning of the experiment, we mixed the seeds into each animals' usual feed for one feeding session (see Figure 1). We collected scats from each animal's enclosure three times daily for four consecutive days to discover how long it took for the animals to pass the seeds.

Figure 1: Viable seed from three native plant species was mixed into the captive animals' feed for one feeding session. Image: Gabrielle Beca.

Figure 2: Gabrielle Beca sorting scats in the laboratory. Image: Gabrielle Beca

Figure 3: Germinated seeds in a petri dish. Image: Bryony Palmer

We placed all scats in paper bags and dried them for six days, before examining them for seeds (see Figure 2). We removed whole seeds, sorted them by species and dried them. Then we retested the viability of the retrieved seeds using the same digital X-ray method.

Finally, we conducted a laboratory germination trial on retrieved seeds and control seeds (viable seeds that were not fed to animals). We sowed all of the retrieved seeds and 25 control seeds of each species onto petri dishes and counted the number of germinating seeds for four weeks. (See Figure 3.)

Key findings

Our key finding was that quenda and woylies are capable of being both seed predators and seed dispersers.

The animals consumed most of the seeds presented to them (mean 71%; range 35–97%), and many of the consumed seeds were damaged or destroyed. We frequently found seed fragments, that could not be identified to species and were therefore discarded, in the scats. Overall, less than half of the consumed seeds were retrieved whole, with or without the elaiosome (fleshy, nutritious attachment to the seed), but the rate of recovery varied greatly between individuals.

The peak excretion (54% of seeds) for quenda was between 4 and 11.5 hours. For woylies, the peak excretion (59% of seeds) was between 19.5 and 24 hours.

(See Figure 4.) The mean time for gut passage was similar to the time of peak excretion for both species: 14 ± 3 hours for quenda and 24 ± 2 hours for woylies.

Of the seeds retrieved from quenda scats, 100% percent of raspberry jam wattle, 96% of sticky hop bush and 97% of York Road poison seeds were viable (97% overall).

Of the seeds retrieved from woylies scats, 100% of sticky hop bush, 87% of York Road poison and 80% of raspberry jam wattle seeds (88% overall) remained viable.

Germination of all three species of plant occurred in both control and ingested seeds.

No significant difference showed between the germination capacity of raspberry jam wattle seeds ingested by quendas or woylies and the controls.

Germination capacity of the sticky hop bush seeds that were ingested by quenda was 25% lower compared to the controls, but there was no difference between the seeds that were ingested by woylies and the control seeds.

Germination capacity of the York Road poison seeds that were ingested by quenda was 50% higher than the control seeds, but seeds consumed by woylies had a significantly lower germination capacity than the control seeds.

Our study shows that viable seeds, capable of germinating under laboratory conditions, are deposited in the scats of quenda and woylies. However, only 42% of the consumed seeds were retrieved whole from the scats, suggesting that quenda and woylies may act as seed predators.

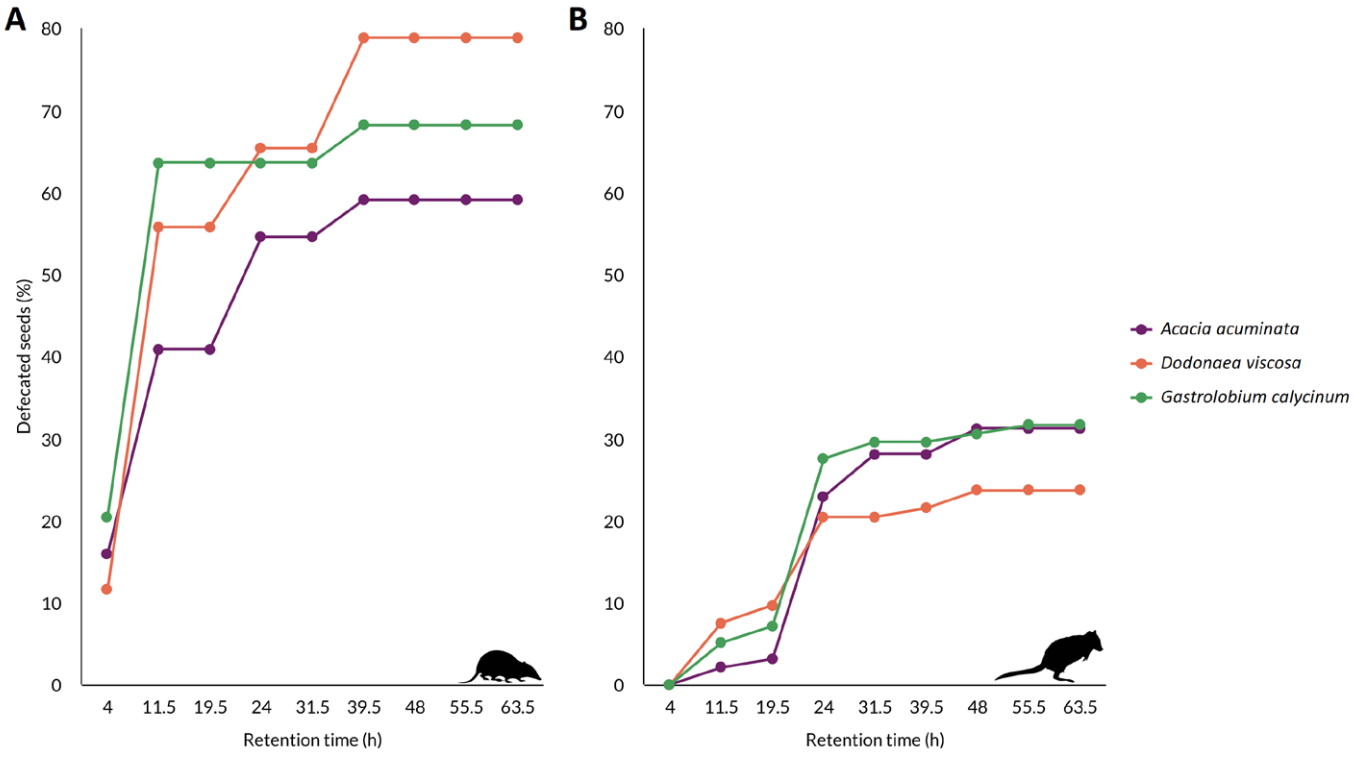

Figure 4. Relationship between the retention time (in hours) and the cumulative percentage of viable seeds of raspberry jam wattle (Acacia acuminata), sticky hop bush (Dodonaea viscosa) and York Road poison (Gastrolobium calycinum) recovered from scats of (A) quenda and (B) woylies. The experiment was continued until 103.5 h after consumption, but the last seeds were recovered from the scats at 39.5 h (quenda) and 55.5 h (woylies).

BELOW: *Woylie. Image: Arthur Chapman, CC BY 2.0 Wikimedia Commons*

Key findings (continued)

Nevertheless, the high viability and germination of some seeds retrieved from the scats indicate that these mammal species may also play a role in seed dispersal.

Although consumption by woylies or quenda improved germination capacity in only one seed species, York Road poison, being eaten can offer other advantages to seeds, such as increased dispersal distances and protection and nutrients from the scat.

While most seeds in this study were passed quickly, with excretion rates peaking at 11.5 and 24 hours for quenda and woylies, respectively, both species retained some seeds for at least 39.5 hours.

Combining the gut passage times we recorded with the home range sizes of the two mammals (quenda ~5 ha and woylies ~65 ha) indicates that quenda and woylies may be able to disperse seed over substantial distances. This could confer advantages to those seeds that remain viable after excretion, such as reduced competition with parent or sibling plants, and serve to counteract the negative impact of the mammals' seed predation on plant populations.

Implications and recommendations

These findings will be of most importance to managers conducting translocations.

Translocations of digging mammals, including woylies and quenda, are taking place throughout Australian landscapes. Reintroducing these mammals to habitat where they have been lost can help restoration efforts through the dispersal of native plants. However, it is possible that translocated woylies and quenda could also disperse exotic plant species. This requires more research.

Given the gut passage times we recorded, wild-to-wild translocations of quenda and woylies would probably see them excrete most seeds consumed before they were captured during the holding or transport stage, although some seeds could be excreted at the release site. We suggest that managers conducting wild-to-wild translocations retain scats excreted during holding and transport and dispose of them where germination cannot happen, unless dispersal of plant species from the source site is desirable. Where the source site supports exotic species that are absent at the release site, we recommend post-release monitoring for seedling recruitment of species of concern.

Cited material

Beca Gabrielle, Palmer Bryony, Valentine Leonie E., Erickson Todd E., Hobbs Richard J. 2020. Gut passage time and viability of seeds consumed by Australian marsupials. *Australian Mammalogy*. https://doi.org/10.1071/AM20063

Further Information

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