

## Securing the threatened kowari in remote South Australia

### In brief

The kowari, *Dasyuroides byrnei*, is a carnivorous dasyurid marsupial that occurs in arid Australia. The species is currently listed as Vulnerable on the IUCN Red List. This research describes the kowari's population dynamics in what is possibly one of its last refuges, the Clifton Hills cattle station in the Sturt Stony Desert of South Australia. Our results suggest that if the trends we observed also occur elsewhere in the kowari's total range, it would be eligible for listing on the IUCN Red List as Endangered.

We make recommendations for urgent research to:

- determine the exact nature of the threats
- control predators and fence from cattle
- undertake captive breeding programs in predator-proof reserves to act as insurance populations.

### About the kowari and its habitat

The kowari is a nocturnal predator whose diet consists of invertebrates and rodents. During the day this species shelters in burrows dug into sand mounds that occur infrequently across stony gibber environments, where temperatures often exceed 40°C in summer and fall below 5°C in winter. It weighs up to 175 g (males) or 140 g (females), which highlights its vulnerability: it lies within the critical weight range (35–5500 g) that, for mammals, has been most susceptible to extinction in Australia.

Kowari populations have declined across the central Australian deserts and the species currently has a very limited distribution. Only a few populations now remain, located in arid South Australia and western Queensland. In these central deserts of Australia, the drought–wet cycles are driven principally by the El Niño Southern Oscillation, and are particularly intense.

Understanding the response of kowaris to rainfall has vital practical importance for their conservation. Large rainfalls following long droughts lead to regional-scale population explosions of rodents and their predators such as owls and diurnal raptors. However, dasyurid mammals of the kowari's size respond in a much less predictable fashion than rodents to these climatic events. Also unlike rodents, it is not clear whether dasyurids depend on dry-season refuges. Part of the reason the population dynamics of dasyurids may differ is that they are secondary consumers, feeding largely on invertebrates which themselves respond variably to drought–wet cycles. Nonetheless, some studies suggest that populations of dasyurid marsupials like the kowari do expand in response to heavy rainfall events because rodents also make up a large part of their diet.

Kowari on gibber. Photo: NathanBeerkens







Shelter sites are scarce. Photo: Robert Brandle

## Our research

We have determined the long-term population trends for two populations in the Sturt Stony Desert in arid South Australia, located on Clifton Hill Station. We tested whether the two populations have had similar or different (asynchronous) trajectories. Species with multiple populations with the same trajectories can be more susceptible to extinction than asynchronous species, because all populations will decline at once, leaving no opportunity for individuals to recolonise from adjacent populations.

Our team used long-term survey records (2000–2015) to investigate whether the kowari population currently occurs in favourable habitat and took advantage of improving climatic conditions over the period. We then assessed the extinction risk of the two Clifton Hill Station populations using advances in population viability analysis modelling techniques.

## Key threats

The kowari is at risk from the impacts of introduced predators such as cats and foxes. The risks are particularly high for the kowari from predation by feral cats. Further, grazing and trampling from stock can flatten sand mounds and degrade habitat for breeding burrows.

Drought–wet cycles are predicted to intensify with climate change. Threats from grazing animals and introduced predators are also anticipated to intensify. The open gibber habitat of the kowari provides

little cover and shelter from raptors and introduced predators, and a reduction of burrowing opportunities may increase the risk of predation. The accumulated and interacting effects of predation, grazing and predicted range declines from climate change may further amplify the risk of extinction for the kowari.

This makes it vital to understand how the kowari maintains its populations through climatic extremes and how it might persist in the future.

Kowari in Sturt Stony Desert. Photo: William La Marca







## Study methods

The location and habitat of the study, the Sturt Stony Desert, possibly one of the last refuges for the kowari in South Australia, had rainfall above the median in 2000, 2003 and 2011, and below the median in most other years between 2000–2015.

The research team surveyed animals using live-trapping techniques to measure annual population size, reproductive activity and body condition. We compared the average body condition of adults each year, using data from 2000 to 2015, by comparing body mass to head length, omitting females with pouch young (as they can channel resources into reproduction rather than bodily growth).

We collected habitat data from 25 m x 25 m plots at 200 trap locations in the two sites, which were located 30 km apart. This distance ensured independence; and no marked animals moved between the sites.

Six habitat variables were scored:

- gibber pavement
- sand mound (discrete sand rises of sandy clay loam)
- thin sand spread (no distinct form and structure)
- sand dune (deep sands generally more than one metre high)
- impermeable drainage depression (bare or pavement but with obvious algal cover from temporary flooding – includes hard pans and lake beds)
- cracking clay drainage depression (includes temporary swamps and gilgais, i.e., small ephemeral lakes).

Population viability analysis required the use of high-performance computing facilities at the University of Sydney. We accounted for the difficult nature of remote fieldwork in arid Australia by allowing the population viability analysis to include years when fieldtrips may have to be cancelled due to harsh weather conditions.

## Key findings

Regardless of climate conditions, the kowari populations in South Australia declined over the period 2000–2015. This finding was in spite of some evidence that both their body condition and rate of reproduction increased after rain.

The region where we surveyed the kowari featured favourable habitat. This leads us to suggest that the studied populations are under stress from external pressures rather than threats arising from within the species themselves. Livestock grazing and introduced predators are believed to be having the most negative effects.

The two populations of kowari showed highly similar (synchronous) trajectories. Unfortunately, this suggests an increased risk of extinction due to the low opportunity for recolonisation from adjacent populations, as they will also be declining. In fact, the results from the population viability analysis suggest that, if similar trends occur elsewhere, the species would be eligible for listing on the IUCN Red List as Endangered, with a 20% chance of extinction within the next 20 years.



## Recommendations

We recommend urgent research to better understand the exact threats to the kowari populations in South Australia. Monitoring needs to continue and be expanded to encompass other populations within the current very limited range. There is enough evidence to call for control of introduced predators and fencing from cattle of known population centres to be undertaken without delay.

The population decline in the face of these threats indicates an urgent need for captive breeding programs to be established in predator-proof reserves to act as insurance populations.



*Kowari food. Photo: Robert Brandle*



*Kowari's distinctive dark tail tuft. Photo: Cat Lynch*

## Cited material

Greenville, A.C., Brandle, R., Canty, P. and Dickman, C.R. (2018). Dynamics, habitat use and extinction risk of a carnivorous desert marsupial. *Journal of Zoology*. Forthcoming: <https://zslpublications.onlinelibrary.wiley.com/doi/abs/10.1111/jzo.12605>

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