Science for Saving Species

Research findings factsheet

Project 7.5

Threatened Species Recovery Hub

National Environmental Science Programme

Threats to Australia's rock-wallabies (*Petrogale* spp.) with key directions for effective monitoring

In brief

Australia has 25 species and subspecies of rock-wallaby, which are distributed irregularly across much of the continent and offshore islands. Thirteen species are threatened, but most of these are receiving little or no monitoring, and no consensus exists on the best methods to monitor them. We conducted a literature review to help identify key threats to the species; and a case study of wiliji, the West Kimberley rock-wallaby *Petrogale lateralis kimberleyensis*, to test whether estimates of rock-wallaby abundance and density can be generated from camera trap data without the need to recognise individuals. The literature review found that the key threats of predation, competition, fire and loss of genetic diversity frequently interact, and that rock-wallabies have contracted to isolated rocky range habitat since European arrival in response to exposure to new threats. Our case study demonstrated the potential for unmarked spatial capture-recapture models using camera-trap data to monitor rock-wallabies and infer their population abundance.

*A black-footed rock-wallaby (*Petrogale lateralis kimberleyensis*) or Wiliji sunning itself. Image: WWF-Australia.*

Background

Many threatened species are not monitored or, if monitored, that monitoring is suboptimal. This limitation constrains assessment of conservation management direction and efficacy, may mean that rapid declines in population are not recognised in time to remedy, and makes it more challenging to reassess conservation status. To help address this shortcoming, practical advice is required to provide effective guidelines to agencies, organisations and individuals with some interest in or responsibility for managing those threatened species. Threatened Species Recovery Hub research has provided such guidelines for some case study groups. In this example, we provide guidelines for monitoring rock-wallabies. We selected this group as an example because:

i. many rock-wallaby species are listed as threatened

ii. most species have little or no monitoring

iii. monitoring rock-wallaby species has notable challenges

iv. some commonalities in monitoring approaches are likely across species

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*LEFT: The scat of a black-footed rock-wallaby (*Petrogale lateralis kimberleyensis*). Searches for faecal pellets are a common method to monitor rock-wallabies, but generally suited to establishing presence-absence only. Image: Alexander Watson, WWF-Australia.*

Background (continued)

v. many diverse stakeholders, including Indigenous land managers, have interests in or responsibilities for managing these species, and some consistency in monitoring across these interest groups would help coordinate conservation effort and whole-of-range trend assessment.

Rock-wallabies (*Petrogale* spp.) are irregularly distributed across much of Australia and its offshore islands. There are many species, with over half classified as threatened under Australia's *Environment Protection and Biodiversity Conservation Act 1999* (13 out of 25 taxa; see Figure 1). Many rock-wallaby populations have declined severely, and most species and subspecies are experiencing ongoing declines in population size and distribution and in their conservation status. Information about population trends given in the IUCN Red List indicates that:

- no species are increasing
- only two species are considered stable
- seven species are undergoing continuing decline
- seven species have unknown trends.

Despite an explicit recognition of the need for conservation management, some species are not monitored and a consensus on the most appropriate methods for ongoing population monitoring has proven elusive.

Yimardoowarra Nyikina Mangala Rangers L-R: Jeremiah Green Albert Watson and Raymond Charles holding a female black-footed rock-wallaby ready for release at trap site on the Erskine Range. Image: Leigh-Ann Woolley, WWF-Australia.

Main aim of research

We aimed to understand the conservation issues and threats most relevant to rock-wallabies. In support of this aim, we sought to identify which monitoring programs give the most useful information about population trends, and which are most suitable for guiding better management responses.

What we did

We identified relevant literature published since 1960, including articles published as peer-reviewed papers, books and grey literature. We then classified the research into topics corresponding to:

- ecology (behaviour, diet, distribution, habitat and habitat modelling, home range, reproduction)
- conservation (conservation status, management, population estimates, recovery planning, reintroduction, threats, translocation)
- genetics (population, ecological and evolutionary genetics, systematics and taxonomy, phylogeography (i.e., historical processes explaining present genetic lineages))
- monitoring (methods for establishing presence/absence and estimating abundance).

We excluded papers that did not pertain to any of these four topics (e.g., parasitology).

We reviewed rock-wallaby monitoring programs to identify which techniques are most informative about population trends, and most suitable for guiding better management responses.

We also conducted a case study to test the ability of camera-trap data, where individual animals cannot be recognised, to generate estimates of rock-wallaby abundance and density.

LEFT: Setting up a camera trap Front to back: Yimardoowarra Nyikina Mangala Rangers Nathan Green, Jeremiah Green, Shaq Millindee, William Watson. Camera traps can be deployed for long periods, and can simultaneously collect data on rock-wallabies and co-occurring threats like the presence of introduced predators. Image: WWF-Australia.

Key findings

The literature focused mainly on ecology (145 papers) and conservation (115), with fewer papers on genetics (69) and monitoring (16). Studies focused on a single species were strongly biased towards three species: black-footed rock-wallabies (*Petrogale lateralis*, 77); brush-tailed rock-wallabies, (*P. penicillata*, 95); and yellow-footed rock-wallabies (*P. xanthopus*, 53). See Figure 2.

Key threats identified in the literature

Predation: Foxes are a primary threat to rock-wallabies in southern Australia, with clearly demonstrated impacts. Cats are also known predators of rock-wallabies and may threaten all populations other than some on cat-free islands. Both predators are responsible for low juvenile survival, which constrains recruitment.

Competition: Competition for foraging resources with introduced herbivores such as goats, rabbits, cattle, donkeys, horses and camels may threaten rock-wallabies; however, direct evidence is lacking in most cases. Competition from overabundant native macropods may also impact rock-wallabies when food is limited.

Fire: Few studies address the specific consequences of altered fire regimes for rock-wallabies. In general, rocky escarpments can interrupt the spread of bushfires and buffer rock-wallaby populations. While large-scale fires can affect rock-wallabies through direct mortality, longer-term impacts include changes to food availability and shelter.

Genetics: Effective dispersal is central to the maintenance of genetic diversity.

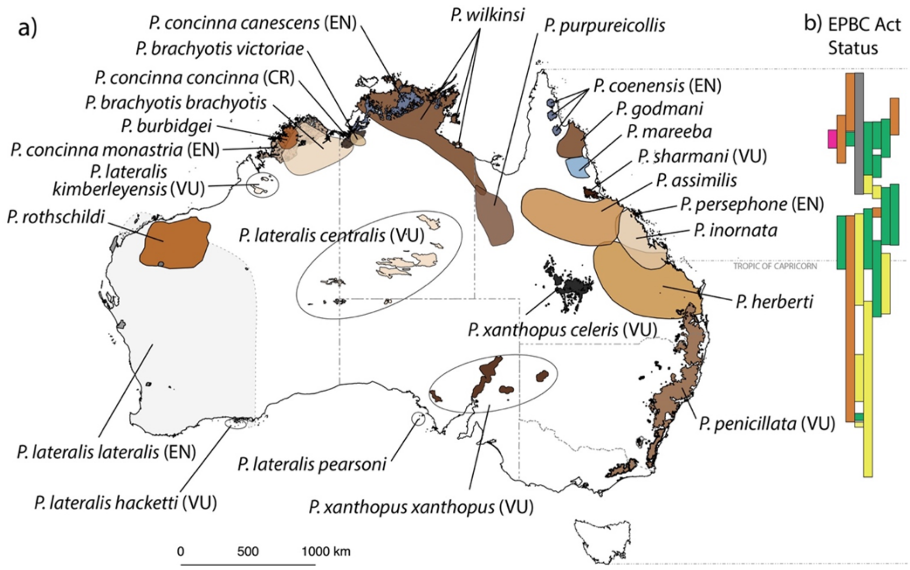

Figure 1 a) Distributional ranges of 25 Petrogale *rock-wallabies (17 species and 8 subspecies) in Australia; and b) their north–south distribution and EPBC Act conservation status. The dotted line surrounding light grey shading in the west of the map encompasses all scattered populations of* P. lateralis lateralis*. Each of the 25 bars represents the approximate latitudinal distribution of a species or subspecies. Pink = Critically Endangered, orange = Endangered, yellow = Vulnerable, green = not listed, grey = recently recognised* P. wilkinsi*.*

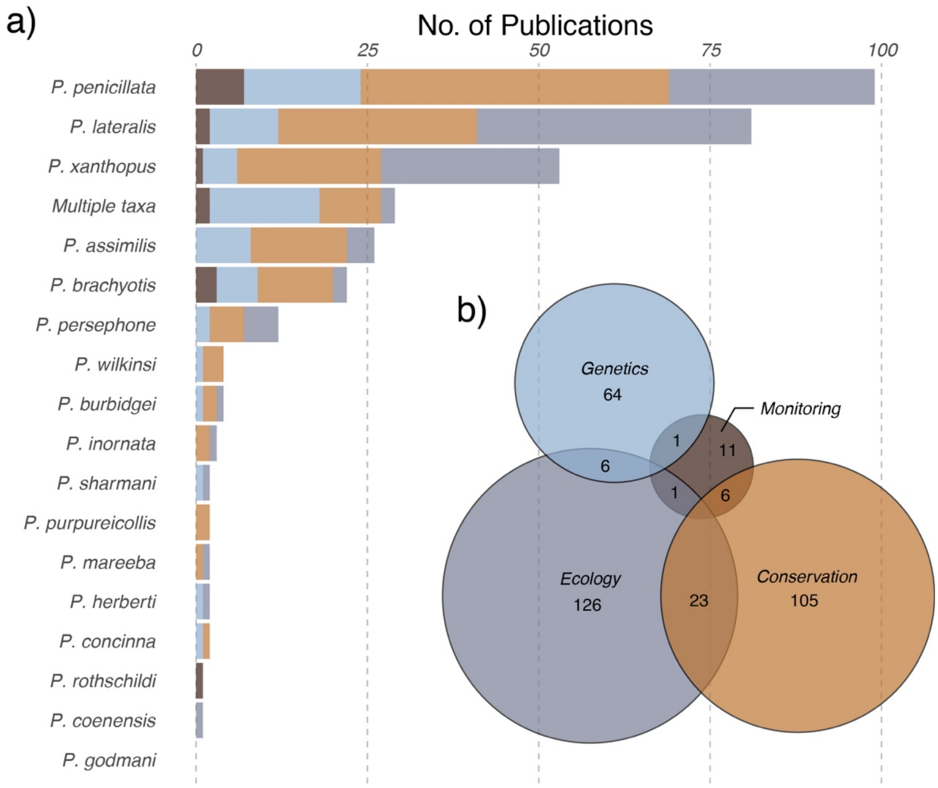

Figure 2: Rock-wallaby publications and topics of study: a) divided into the primary topics of genetics, ecology, conservation and monitoring per species; and b) Venn diagram depicting the overall research focus for literature included in the review. Circles depict primary research topics, and overlaps represent secondary topics that are shared between primary topics.

RIGHT: An adult female black-footed rock-wallaby and her joey taking shelter in a cave during the day. Image: WWF-Australia.

Key findings (continued)

Genetics (continued): While many rock-wallaby colonies are restricted to isolated rocky ranges the occasional dispersal of individuals helps to avoid the accumulation of genetic mutations that can increase extinction risk. The local extinction of colonies can reduce occasional dispersal, with implications for entire subspecies. If single colonies are long-isolated and small, such as on islands, loss of genetic diversity can be considerable.

Threats frequently interact (see Figure 3), with evidence that the contraction of rock-wallabies to rocky ranges was a result of their exposure to threats since European colonisation. Adjacent non-rocky areas are important for providing additional resources that support healthy populations.

Monitoring adequacy

A variety of rock-wallaby monitoring programs are current in Australia, but few adequately provide the range of data necessary for informed conservation.

For the 13 EPBC-listed taxa, the majority of monitoring efforts has been restricted to three species: the black-footed rock-wallaby; the brush-tailed rock-wallaby; and the yellow-footed rock-wallaby.

For most rock-wallabies, the adequacy of monitoring methods, coverage, recurrence, longevity, design quality, coordination, data availability, management linkages and demographic parameters is below the average standard for threatened mammals.

Monitoring techniques

To date, acquiring the range of monitoring data needed to adequately track rock-wallaby populations, assess threats, and allow appropriate management responses has proven difficult. Nocturnal behaviour and the preference for remote, steep and rugged terrain can mean they are difficult to observe directly. Estimates of population size and trends can therefore be extremely challenging to obtain.

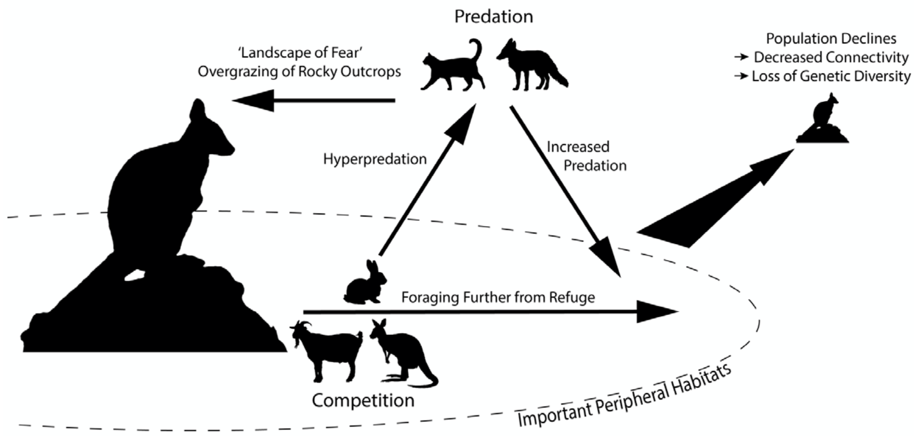

Figure 3: *Conceptual diagram of some of the interacting threats facing rock-wallabies. Introduced herbivores (rabbits) can support elevated populations of feral predators (cats and foxes). Competition (e.g., from goats, rabbits, euros) can increase the need to forage further from refuge, increasing exposure to predation. Predators can create a landscape of fear that cause rock-wallabies to remain among rocky outcrops, while predator control can lead to increased rock-wallaby numbers and overgrazing of rocky refugia.*

Our review identified direct counts, camera traps, mark-recapture, faecal pellet counts and faecal DNA analysis as methods employed to monitor rock-wallaby populations.

Direct counts of rock-wallabies generally underestimate population sizes, and variable results can hamper the ability to detect population change.

Mark-recapture methods give robust and comprehensive population data, but involve considerable effort to live-trap animals, with accompanying animal welfare considerations.

Faecal pellet counts may be suitable to determine presence/absence and, in some situations, an index of colony size. Rock-wallaby pellets are distinctive, but differentiating between co-occurring rock-wallaby species can be difficult. Regular monitoring of fixed faecal pellet plots can detect population change but requires very repetitious sampling to generate robust data.

Faecal DNA has been used successfully to monitor rock-wallabies but requires specific expertise and can be expensive. Producing consistent results can be challenging.

Camera traps offer many advantages because they can be deployed for extended periods, pose limited risk to animal welfare and can be used to infer demographic information. They can also simultaneously collect data on significant threats to rock-wallabies (e.g., presence of introduced predators and competitors).

LEFT: A camera trap set up in black-footed rock-wallaby habitat on Nyikina Mangala Country. Image: Leigh-Ann Woolley, WWF-Australia.

Key findings (continued)

Camera traps (continued): A key constraint of camera traps is that they have mostly been used to establish the presence/absence of rock-wallabies. Presence/absence monitoring across many discrete colonies will highlight distributional change, but generally these data are not suitable for following changes in the size of populations, nor for revealing demographic parameters including juvenile recruitment, survivorship or breeding success that provide insight about the stability and persistence of the population.

A black-footed rock-wallaby taking shelter in cool rocky habitat during the heat of the day in the Kimberley. Such rocky outcrops typically inhabited by rock-wallabies provide challenges for effective monitoring. Image: WWF-Australia.

Case study

Can rock-wallaby monitoring programs that use camera traps generate abundance estimates?

Until recently, calculating abundance estimates (estimating the number of individuals in a population) from camera traps has relied on individual recognition either via deliberate markings on animals, or by their natural markings. This means that in most cases individual rock-wallabies cannot be identified from camera traps.

Many rock-wallabies occur mostly on Indigenous land, with Indigenous ranger organisations often conducting rock-wallaby monitoring programs. Yimardoowarra Nyikina Mangala Rangers in collaboration with WWF have been conducting long-term surveys within the Nyikina and Mangala Native Title determination area, which contains the entire population of wiliji (West Kimberley rock-wallaby, *P. lateralis kimberleyensis*). Yimardoowarra Nyikina Mangala Rangers were seeking to extend this work by incorporating estimates of abundance into their long-term monitoring protocol.

We aimed to test whether unmarked spatial capture-recapture models could generate estimates of abundance and density from rock-wallaby monitoring programs using camera traps. Unmarked spatial capture-recapture models differ from traditional estimates of abundance by not requiring individual recognition of animals.

Using an unmarked spatial capture-recapture model, we first completed a simulation study to quantify how survey design influenced density and abundance estimates of rock-wallabies. We then applied these findings and fitted an unmarked spatial capture-recapture model for the real camera-trap data the Rangers had collected. We were able to generate a median estimate of abundance (169 individuals) and density (10.24 animals per km^2) for a subset of the survey data that had the greatest survey effort and a defined spatial extent. The Rangers feel this estimate is too high, and they are now implementing a monitoring program that uses a greater density of camera traps to gain a more accurate estimate.

Our results show unmarked spatial capture-recapture models using camera-trap data can be useful for rock-wallaby monitoring. However, the accuracy of estimates depends on the population density of rock-wallabies and can be improved by deploying denser arrays of cameras.

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Implications

Of the range of techniques employed for monitoring rock-wallabies, no method was clearly most suitable for gathering the range of data needed to accurately track populations and inform management. Successful monitoring requires a clear understanding of the purpose of the monitoring (e.g., assessing the impact of threats, maintaining genetic variation, responses to management actions such as predator control) and sufficient sampling to provide relevant data. This will likely require the deployment of multiple complementary methods.

Continued extension of automated photo processing and statistical methods to analyse camera-trap images will help advance rock-wallaby monitoring in Australia. The case study with the Yimardoowarra Nyikina Mangala Rangers demonstrates that population abundance estimates can be generated from camera-trap data when individuals cannot be identified. This greatly increases the utility of camera traps for rock-wallaby monitoring programs.

Acknowledgements

Thank you to Wade Blanchard, Mark Eldridge, Damien Giles, Sarah Legge, David Lindenmayer, David Pearson, Darren Southwell, Walalakoo Aboriginal Corporation, Alexander Watson, Darraga John Watson, John Woinarski, Leigh-Ann Woolley, and Yimardoowarra Nyikina Mangala Rangers, Darraga John Watson, Payday Butt, Raymond Charles, Vern Chuguna, Richard Cox, Quinton Fiebig, Jeremiah Green, Nathan Green, Marcus Johnson, Conan Lee, Shaquille Millindee, Tyrese Skeen, Albert Watson, Frank Watson, Kimberley Watson, William Watson, Josiah Wise for the detailed work and knowledge that underpins this factsheet.

Cited information

Lavery, T., Eldridge, M., Legge, S., Pearson, D., Southwell, D., Woinarski, J., Woolley, L., Lindenmayer, D. (2021) Threats to Australia's rock-wallabies (Petrogale spp.) with key directions for effective monitoring. *Biodiversity and Conservation* doi:10.1007/s10531-021-02315-3

Lavery, T., Watson, D. J., Yimardoowarra Nyikina Mangala Rangers, Butt, P., Charles, R., Chuguna, V., Cox, R., Fiebig, Q., Green, J., Green, N., Johnson, M., Lee, C., Millindee, S., Skeen, T., Watson, A., Watson, F., Watson, K., Watson, W., Wise, J., Blanchard, W., Eldridge, M., Giles, D., Legge, S., Pearson, D., Southwell, D., Walalakoo Aboriginal Corporation, Watson, A., Woinarski, J., Woolley, L., Lindenmayer, D. (in review) Effective monitoring of rock-wallabies: a case study of Indigenous-led surveys using camera traps.

A beautiful Kimberley sunset to top off a successful day of rock-wallaby trapping by the Yimardoowarra Nyikina Mangala Rangers L-R: Raymond Charles, Jeremiah Green, Albert Watson, and Shaquille Millindee. Image: Leigh-Ann Woolley, WWF-Australia.

Further Information

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Cite this publication as NESP Threatened Species Recovery Hub. 2021. Threats to Australia's rock-wallabies (*Petrogale* spp.) with key directions for effective monitoring. Project 7.5 Research findings factsheet.

This project is supported through funding from the Australian Government's National Environmental Science Program.