Science for Saving Species

Research findings factsheet

Project 5.1

Threatened Species Recovery Hub

National Environmental Science Programme

Better offsets for Brigalow Belt reptiles

Background

Biodiversity offsets are commonly used to compensate for unavoidable development impacts on species or ecosystems by creating a benefit for the same species or ecosystem elsewhere. In Australia, offsets are routinely prescribed as conditions of approval for proposed development that will impact threatened species or ecological communities listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), or under state and territory laws.

For offsets to work as intended, we need to be able to quantify how much benefit an offset action will provide for a species or ecosystem, so that we can make sure that the offset completely compensates for the development impact. For many poorly-understood species and ecological communities, however, important knowledge gaps exist making it hard to know what type of, and how much, offset action is needed to offset a given impact.

This project developed an approach for eliciting the knowledge of threatened species experts in a structured way, so as to guide estimates of the benefits of alternative offset approaches. Although it doesn't replace field-based studies, it can guide decision-makers in basing offset decisions on the best available information at the time, and help identify how much uncertainty there is about the effectiveness of particular offset actions. We tested the approach using several case study species that commonly trigger offset requirements, and for which developing appropriate offset proposals is considered challenging. Here, we describe the approach and findings for a suite of threatened reptiles that occur in the Brigalow Belt bioregion of eastern Australia.

Golden-tailed gecko. Image: Melissa Bruton

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The Brigalow Belt bioregion

The Brigalow Belt bioregion is one of Australia's most significant and imperilled biodiversity hotspots. The bioregion extends from northern Queensland to Narrabri in NSW (Figure 1), but since European colonisation, 90% of brigalow woodlands have been cleared, as have extensive areas of other woodland types in the bioregion.

The most significant threats to Brigalow Belt reptiles are habitat loss, degradation and fragmentation, both historical and current. Conversion of Brigalow Belt woodlands is ongoing, for agricultural, mining and coal seam gas extraction activities. Reptiles are particularly sensitive to habitat loss and degradation as they have limited ability to disperse, or may have morphological specialisations for particular substrate types, relatively small home-range sizes and thermoregulatory constraints.

Other key threats to reptiles in the Brigalow Belt include the impacts of inappropriate fire regimes, intensive grazing, compaction of ground layer and underground shelter sites (by cattle and pigs), predation (by cats and foxes), invasive weeds or pasture grasses (particularly buffel grass), hydrological changes and climate change. Brigalow Belt reptiles are also threatened by inappropriate roadside management practices, and the removal of woody debris and rocks.

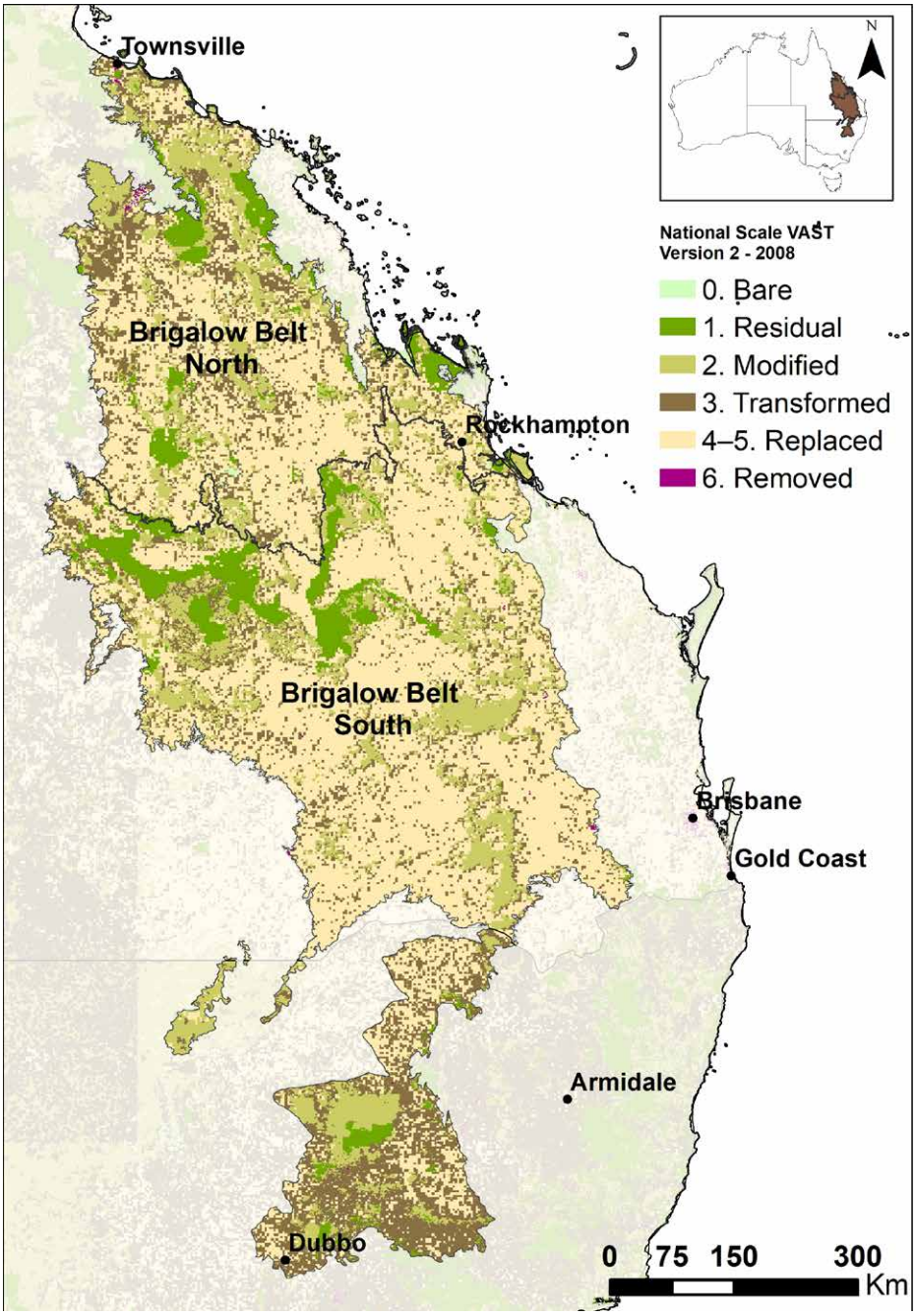


Figure 1: Location of the Brigalow Belt, showing vegetation condition.

The Brigalow Belt bioregion

There are sixteen species of reptile species that occur in the Brigalow Belt in this study (see Figure 2 and Table 1).

Small skinks

a. Mount Cooper striped lerista (Steve Wilson)
b. Brigalow scaly-foot (Steve Wilson)

Roma earless dragon (Steve Wilson)

Small snakes

a. ornamental snake (Steve Wilson)
b. Dunmall's snake (Melissa Bruton)
c. grey snake (Melissa Bruton)

Golden-tailed gecko (Melissa Bruton)

Yakka skink (Melissa Bruton)

Common death adder (Melissa Bruton)

Woma (Melissa Bruton)

Figure 2: Some of the threatened Brigalow Belt reptiles considered in this expert elicitation process (for complete list, refer to Table 1).

Table 1: The threatened reptiles in the Brigalow Belt we considered in the expert elicitation.

'Grouping' for expert elicitation process	Species name	Distribution	Status (national and state)
Small skinks and scaly foot	Allan's lerista or Retro slider *Lerista allanae*	Endemic to the Brigalow Belt bioregion, only known from undulating soil plains, which have been extensively modified for cropping and mining developments	National : Endangered Queensland: Endangered
	Capricorn ctenotus *Ctenotus capricorni*	Restricted to Queensland	National: Not listed Queensland: Near threatened
	Vine-thicket fine-lined slider *Lerista cinerea*	Restricted to Queensland	National: Not listed Queensland: Vulnerable
	Mount Cooper striped lerista *Lerista vittata*	Restricted to Queensland	National: Vulnerable Queensland: Vulnerable
	Five clawed work-skink, Long-legged worm-skink *Anomalopus mackayi*	Core range in Brigalow Belt bioregion, Queensland	National: Vulnerable Queensland: Endangered NSW: Endangered
	Brigalow scaly-foot *Paradelma orientalis*	Restricted to Queensland	National: Vulnerable Queensland: Least concern
	Collared delma *Delma torquata*	Core range in Brigalow Belt bioregion	National: Vulnerable Queensland: Vulnerable
Earless dragon	Roma earless dragon *Tympanocryptis wilsoni*	Occurs in native grasslands on sloping terrains, very little known about its ecology	National: Not listed Queensland: Vulnerable
Yakka skink	Yakka skink *Egernia rugosa*	Endemic to Queensland	National: Vulnerable Queensland: Vulnerable
Small snakes	Ornamental snake *Denisonia maculata*	Core range in Brigalow Belt, Queensland	National: Vulnerable Queensland: Vulnerable
	Grey snake *Hemiaspis damelii*		National: Not listed Queensland: Endangered NSW: Not listed
	Dunmall's snake *Furina dunmalli*		National: Vulnerable Queensland: Vulnerable
Golden-tailed gecko	Golden-tailed gecko *Strophurus taenicauda*	Endemic to Queensland	National: Vulnerable Queensland: Near threatened
Common death adder	Common death adder *Acanthophis antarcticus*	Broad distribution in Australia, substantial declines in Brigalow Belt	National: Not listed Queensland: Vulnerable NSW: Not listed
Woma	Woma *Aspidites ramsayi*	Broad distribution in Australia, range contractions in recent decades	National: Not listed Queensland: near threatened NSW: Not listed

Note: the Darling Downs dragon was not included in this expert elicitation process due to its highly specialised habitat requirements.

Current approaches to offsets for Brigalow Belt reptiles

A common biodiversity offset action for Brigalow Belt reptiles is land acquisition. However, this is challenging for three key reasons. First, remaining Brigalow woodlands are highly fragmented, existing mainly as small patches, linear strips along roads and fence lines, and regrowth areas, so finding suitable sites for land acquisition is exceptionally difficult in this habitat type. Second, the Brigalow Belt region has undergone such extensive modification that the specific habitat requirements for several reptile species are poorly known. Finally, the extent to which typical management actions benefit the different reptiles is not well understood, and benefits of general habitat management are often assumed to apply uniformly across species.

Engaging experts to improve offset strategies

We elicited information about the effectiveness of a series of management actions that may benefit Brigalow Belt reptiles (Figure 3), based on expert knowledge. To do this, we first identified candidate management actions based on interviews with two key Brigalow Belt reptile experts. Next, we used a structured expert elicitation protocol involving two rounds of online anonymous surveys with 13 Brigalow Belt reptile experts. Experts provided quantitative estimates of the benefits for a range of management actions at four hypothetical offset sites which had different types of environments, site conditions and past land management (Box 1).

We asked experts to envisage the outcomes for Brigalow Belt reptiles in two hypothetical 200 ha offset sites after 20 years if current management did not change ('do nothing'), and if particular management actions, or combinations of these actions, were implemented. Experts were also asked to envisage the outcomes for Roma earless dragons in two hypothetical 10 ha offset sites.

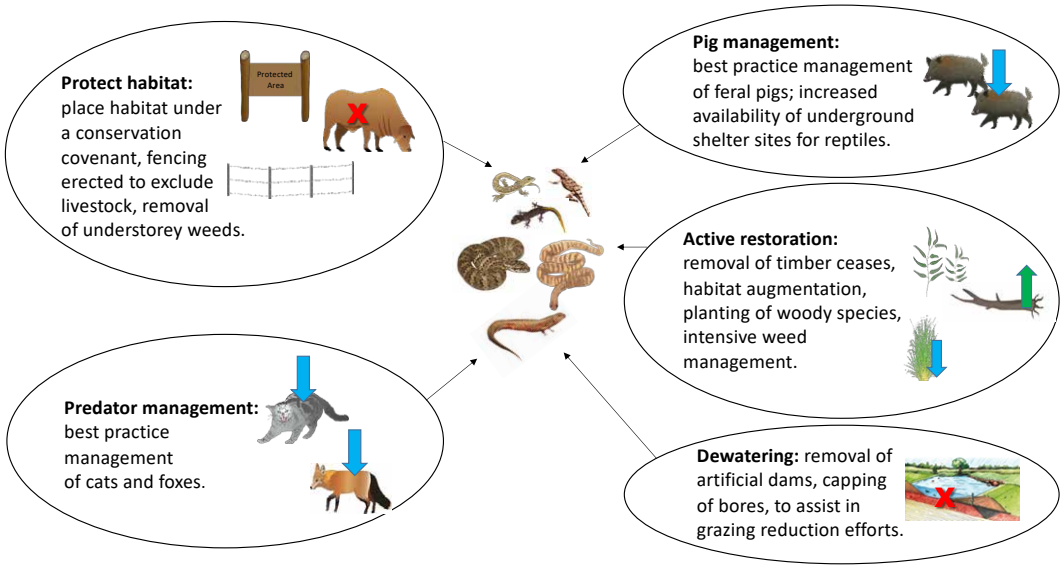


Figure 3: Potential management actions that could benefit Brigalow Belt reptile populations. Experts considered how these actions, alone and in different combinations, might benefit Brigalow Belt reptiles at two different hypothetical offset sites.

Box 1: Hypothetical offset sites and benefit indicator

Management actions are likely to differ in their benefit to Brigalow Belt reptiles at different types of sites. We therefore asked experts to compare the relative benefits of management actions (Figure 3) at two different hypothetical offset sites, each 200 ha in size (for all reptiles except the Roma earless dragon):

Site 1. High-quality reptile habitat: A 200 ha patch of habitat on a large cattle property which has relatively intact vegetation and few invasive grasses and is rarely grazed by livestock. Brigalow Belt reptiles are present in numbers expected for an intact site (specified in the starting conditions).

Site 2. Moderate-quality reptile habitat: A 200 ha patch of habitat on a large cattle property with moderate grazing pressure, and some removal of timber for firewood and fencing. Brigalow Belt reptiles are present in lower numbers than in Site 1 (specified in the starting conditions). The Roma earless dragon typically occurs in grassland patches, and such patches that remain are very small. For this species, the descriptions of the hypothetical offset sites (3 and 4) were the same, but they were only 10 ha in size.

To estimate the benefits of different management actions, a suitable benefit indicator was required. The benefit indicator needs to be able to be can readily measured and monitored at the site level, as well as reflect the viability of the species. Experts were asked to use *the number of individuals of each reptile group estimated to occur at the site* as the benefit indicator. All population estimates for this process are assumed to be based on an appropriate amount of survey effort during a hypothetical monitoring program at the site, using suitable survey techniques.

Effective offsetting for Brigalow Belt reptiles

On average, the experts believed that the 'do nothing' options would result in a slight to moderate decrease in all species over the 20-year period, particularly for small skinks and scaly foot (20% decrease), yakka skink (25% decrease) and the Roma earless dragon (25% decrease). Protection of habitat alone was also believed to result in a decrease in all species. A key reason for this was presence or likely invasion of buffel grass (*Cenchrus ciliaris*), a 'transformer' weed which can alter entire ecosystems through alteration of fire regimes and competition with native plants. Buffel grass control requires very intensive management over a long time period (>20 years).

While most of the offset actions were thought likely to result in some improvement relative to this baseline scenario the uncertainty around these estimated benefits was high (Figure 4-6). For some species, experts thought it might only be possible, at best, to slow the rate of decline, rather than stopping it altogether.

In most cases, experts thought there was a chance that the action might achieve no benefit at all, relative to the counterfactual scenario.

At hypothetical site 1 with high-quality reptile habitat, experts estimated controlling foxes and feral cats gave greater benefits (up to 9% increase for small skinks and scaly-foot); simply protecting a site though a conservation covenant, with exclusion fencing and removal of understorey weeds was thought to have no benefits (up to 15 % decrease in small snakes). Experts thought that the yakka skink, small skinks and scaly foot and small snakes would benefit the most from predator control (compared to other groups), because these species are readily eaten by foxes and cats.

At the moderate quality site, the combination of active restoration, control of feral predators (foxes and cats) and control of feral pigs was believed to yield the greatest benefit for most species. These actions resulted in the greatest increase from the baseline scenario with no management. The increase in benefit from predator control was more pronounced for snakes than lizards. Experts thought that the main benefit from dewatering (removal of dams and bores) was that it would contribute to keeping predator numbers down, so there was no additional effect of this action compared to scenarios that included predator control. Experts noted that restoration of habitats in the Brigalow Belt bioregion is an important action that warrants more dedicated attention, since most of the original vegetation has been lost due to land clearing. Experts thought two of the small snakes, grey and ornamental snakes, would be more likely to benefit from pig control than other groups.

For the Roma earless dragon, experts believed that actively managing predators (cats and foxes) at a relatively intact site was a more effective approach than restoring and managing threats in degraded habitat (Figure 6).

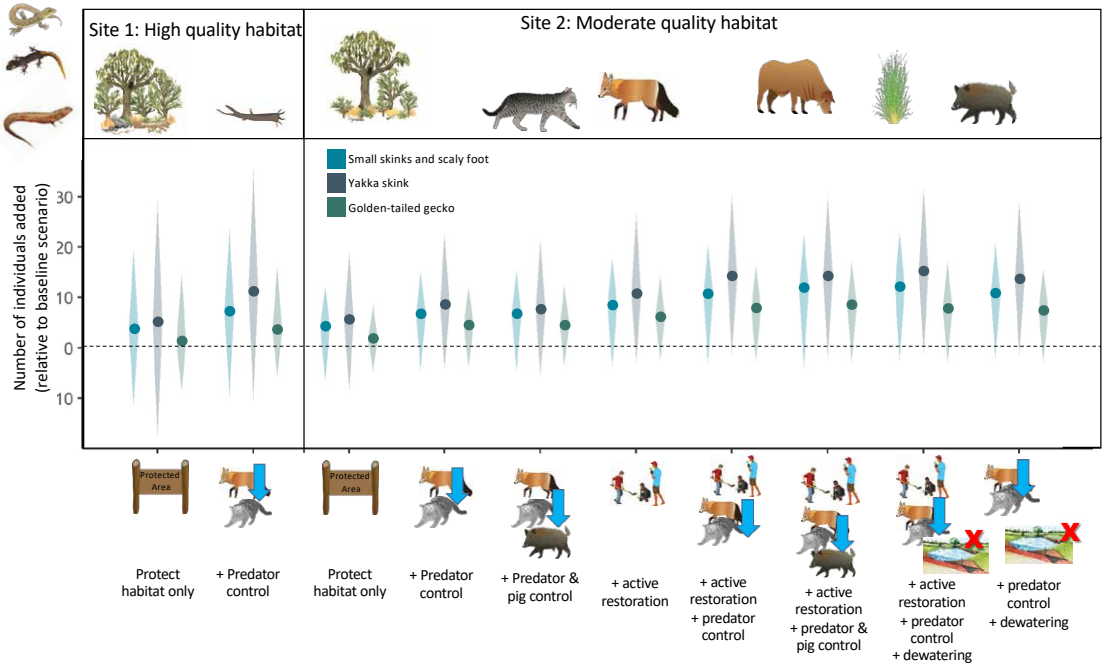


Figure 4: Results of expert elicitation for lizards (small skinks and scaly foot, yakka skink and golden-tailed gecko), showing the estimated difference in the number of individuals likely to be present after 20 years of different management scenarios, relative to a baseline scenario with no management ('do nothing'). The circle at the widest point in the diamond shows the aggregated 'best guess' estimated increase. Diamonds capture the range of estimates based on 90% confidence intervals for the expert estimates.

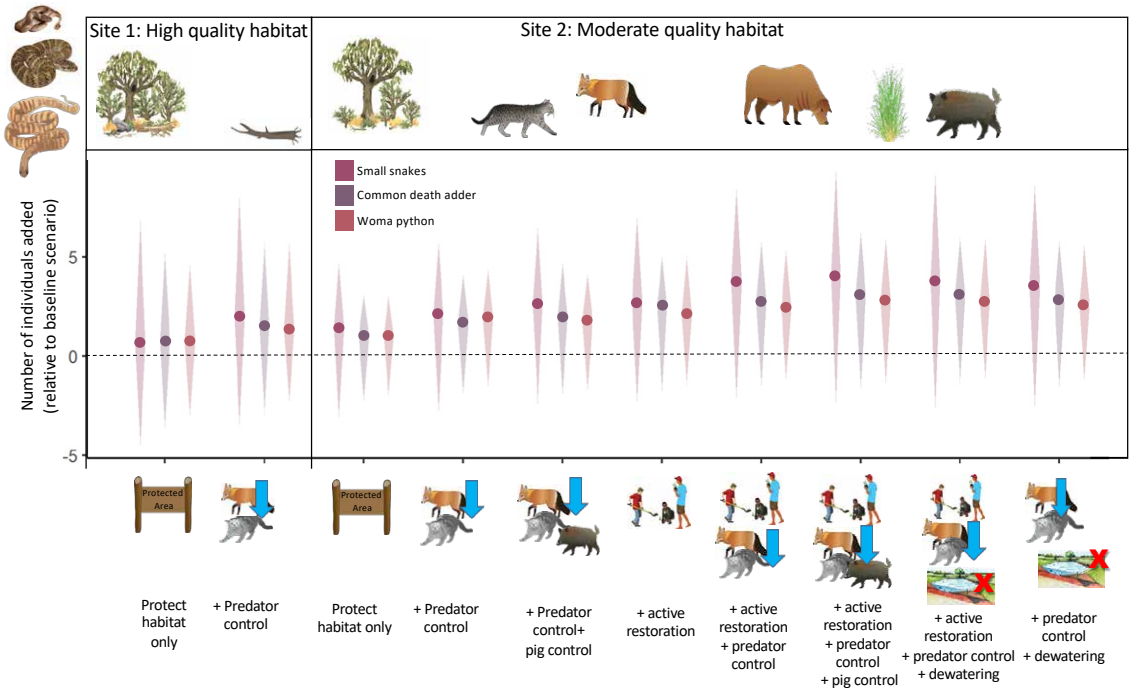
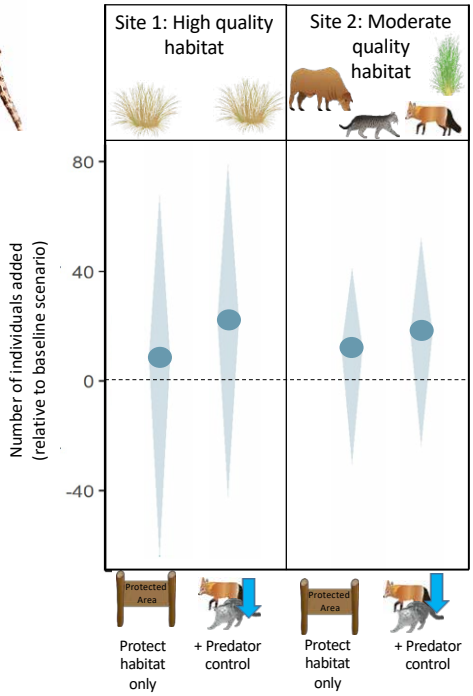


Figure 5. Results of expert elicitation for snakes (small snakes, common death adder and woma), showing the difference in the number of individuals likely to be present after 20 years under different management scenarios, relative to a baseline scenario with no management ('do nothing'). The circle at the widest point in the diamond shows the aggregated 'best guess' estimated increase. Diamonds capture the range of estimates based on 90% confidence intervals for the expert estimates.

RIGHT: Figure 6: Results of expert elicitation for the Roma earless dragon, showing the difference in the number of individuals likely to be present after 20 years under different management scenarios, relative to a baseline scenario with no management ('do nothing'). The circle at the widest point in the diamond shows the aggregated 'best guess' estimated increase. Diamonds capture the range of estimates based on 90% confidence intervals for the expert estimates.



- *Brigalow trees and forest. Image: Don Butler*

Implications of the research

Biodiversity offsets must only occur after all previous steps in the mitigation hierarchy have been considered, especially for species like Brigalow Belt reptiles where the benefits of offsets are highly uncertain. The design of better biodiversity offsets for threatened species will remain an ongoing challenge for policy makers, particularly for species where the relative contribution of key threats are poorly known, or for which limited quality habitat remains. A well-designed biodiversity offset is one that is based on the principles of the IUCN policy, and incorporates:

- Current ecological knowledge (action plans, recovery plans, management plans, peer reviewed literature, where available) and
- Full consideration of cumulative impacts (geographically and over time).

Expert elicitation is not a perfect tool or solution for addressing issues with biodiversity offsets in Australia. It does not replace the urgent need for empirical studies to evaluate and improve on-ground management approaches. Instead, it provides a relatively quick, inexpensive and repeatable method of obtaining current and best available knowledge in a way that reduces bias, and in a form that is useful to inform decision making on biodiversity offsets.

Brigalow Belt woodlands continue to be threatened by ongoing incremental loss associated with mining and infrastructure development as well as clearing for agriculture. For particular habitats, like brigalow woodland itself or the fertile grasslands of the region, there are major challenges in finding and securing biodiversity offset sites of suitable size and condition. Threatening processes operate at a landscape scale, and small, fragmented populations are vulnerable to local extirpation. Hence, offsetting on a site-by-site basis yields highly uncertain outcomes for Brigalow Belt reptiles. For some species, such as the death adder, experts thought it would be at best possible to slow the rate of population decline for the species in the Brigalow Belt, rather than halting it altogether.

'Grouping' of species may have benefits in expediting expert elicitation. However, it is important to use logical and ecologically sound categories for the groups, ensuring that species within a group are likely to respond similarly to a given intervention. Poorly-thought-through grouping can mask different responses of species of conservation concern. Future research should identify species of substantial conservation concern and undertake separate expert elicitation processes for these.

Experts strongly emphasised that the most important action to arrest the decline of threatened Brigalow Belt reptiles is to protect remaining stands of woodland and grassland, and implement active and ongoing management of threats (pasture grasses, cats and foxes) in these areas. Most remaining habitat is on private land, so landholders will require support to manage these patches. They also recognised the importance of providing support and incentives to private landholders to restore moderate-quality habitats, in combination with active and ongoing management of key threats.

Results from this expert elicitation process suggest:

- Best practice management of feral cats and feral foxes is necessary for the best outcomes in already high-quality sites;
- Different offset actions are predicted to have a greater benefit to different groups of species; e.g., feral pig management for small snakes;
- Livestock grazing should be excluded from biodiversity offset sites for small skinks and scaly-foot, yakka skinks, small snakes, and the Roma earless dragon.
- Buffel grass should be controlled selectively but intensively, without disturbing or damaging the soil structure or microrelief, or relying on simply grazing down the sward;
- Active habitat restoration for Brigalow Belt reptiles in combination with predator control was thought to yield the best results in medium-quality habitat, as long as the species of concern still occurs there;
- The benefits of management actions were believed to be contingent on the same actions being applied in adjoining sites because of decreasing effects of fragmentation or increasing connection to make larger contiguous areas;
- Experts thought that there were negligible opportunities for developing suitable biodiversity offsets for two species: one from the small skinks and scaly foot group, Allan's lerista, and the Darling Downs earless dragon, which was not included in this process.

Further reading

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Brigalow scaly-foot. Image: Steve Wilson

Authors

Martine Maron/UQ; Helen Mayfield/UQ; Tida Nou/UQ; Christy Davies/UQ; Eric Vanderduys/CSIRO; Geoffrey C. Smith /QLD Department of Environment and Science; Melissa Bruton/Australian Wildlife Conservancy/University of Queensland; Matthew Greenlees/Macquarie University; Conrad Hoskin/James Cook University; Andrew Amey/ Queensland Museum; Chris Sanderson/QLD Department of Environment and Science; Steve Wilson/independent consultant; Melanie Venz/QLD Department of Environment and Science; Jane Melville/Museums Victoria/Monash University; Michael Mathieson/QLD Department of Environment and Science; Teresa Eyre/QLD Department of Environment and Science; Daniel Ferguson/QLD Department of Environment and Science; Stephen Peck/ QLD Department of Environment and Science

Graphics

Graphics were kindly provided by the NESP Northern Australia Environmental Resources Hub, Zoe Stone, Kim Kraeer, Lucy Van Essen-Fishman and Diana Kleine (Integration and Application Network Library). Many thanks to Melissa Bruton and Steve Wilson for photographs.

Brigalow forest. Image: Rod Fensham

Further Information

Professor Martine Maron - m.maron@uq.edu.au

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National Environmental Science Programme

Cite this publication as Maron, M., Mayfield, H., Nou, T., et al. 2021. Better offsets for Brigalow Belt reptiles. NESP Threatened Species Recovery Project 5.1. Research findings factsheet, Threatened Species Recovery Hub, Brisbane.

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