Science for Saving Species

Research findings factsheet

Project 5.1

Threatened Species Recovery Hub

National Environmental Science Programme

Better offsets for the northern quoll

Background

Biodiversity offsets are commonly used to compensate for unavoidable development impacts on species or ecosystems by creating an equivalent 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* 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 at a site level, in order to make sure that the offset completely compensates for the impact from the development. For many poorly-understood species and communities, however, important knowledge gaps exist. This makes it hard to know what type and how much offset action is needed to offset a given impact.

Figure 1: Northern quoll. Image: Nicolas Rakotopare

This project developed an approach for eliciting the knowledge of threatened species experts in a structured way, so as to guide estimates of both the benefits and the costs 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 one of these species - the northern quoll *Dasyurus hallucatus* (Figure 1).

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Decline of a once-abundant predator

The northern quoll is a medium-sized carnivorous marsupial and the smallest of the four Australian quoll species. Northern quolls were formerly distributed widely across northern Australia from Western Australia to south-east Queensland, but have declined dramatically. They are now found mainly in the Pilbara and Kimberley regions of WA, parts of the Top End of the Northern Territory (including offshore islands), and parts of coastal Queensland (Figure 2).

Northern quolls have a broad diet comprising invertebrates, small mammals, reptiles, amphibians, birds, carrion and fruit. Their decline has been associated with the spread of the introduced cane toad, which has toxins that can kill quolls when consumed. Predation by feral cats, inappropriate fire regimes and habitat loss and degradation are also contributing to northern quoll declines.

The northern quoll is now listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999*. There is a National Recovery Plan (prepared in 2010) in place for the species.

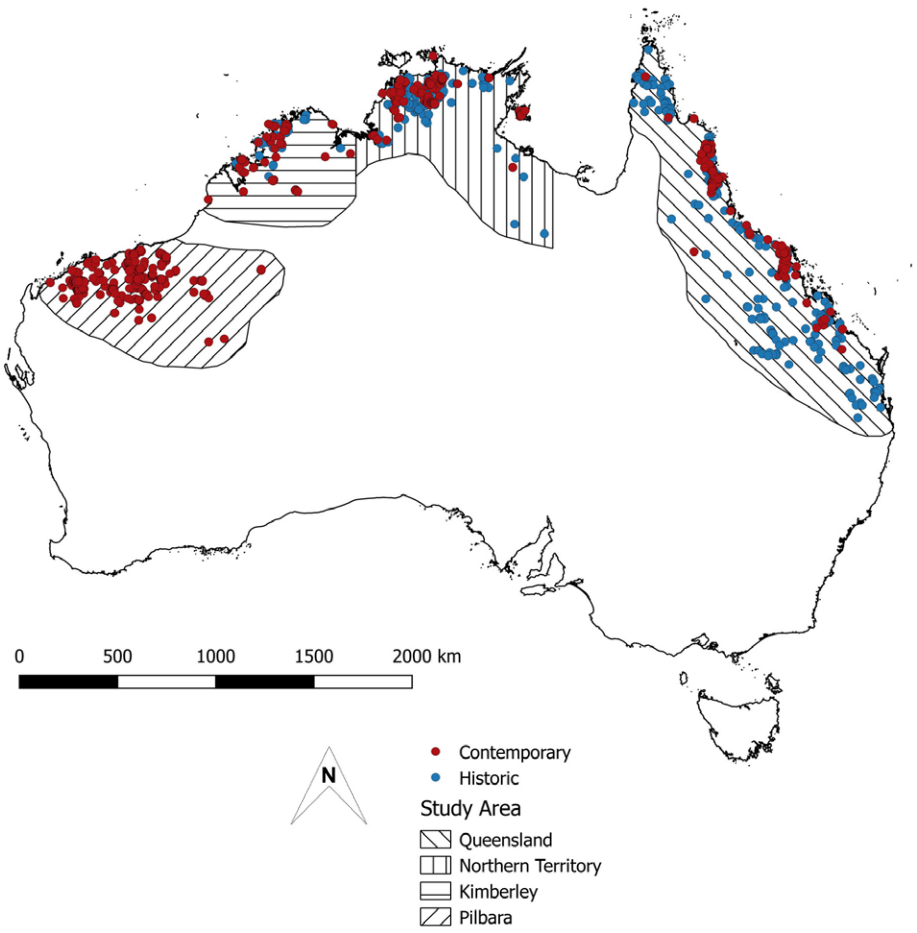


Figure 2: Distribution of the northern quoll. Blue markers represent historic presence records, and maroon markers represent contemporary presence records. Key populations are represented by varying line patterns. Map by Moore et al. 2019.

Current approaches to offsets for northern quolls

A common biodiversity offset for the northern quoll is the legal protection of land. However, this approach alone is unlikely to create a direct benefit, as the main threats (cane toads, feral cats, inappropriate fire regimes) can still impact the species.

One of the northern quoll's remaining strongholds is in the Pilbara region, where it triggers offset requirements in assessments of mining projects under the *EPBC Act 1999*. Given the lack of available information on the distribution and status of the northern quoll in this region, one component of offsets packages has been to require developers to provide a monetary contribution, calculated according to the area of native vegetation cleared for the development, towards research on the species. Current research projects supported by offset payments are examining the impact of mining on quoll populations, the benefit of rehabilitation works, and the distribution of the species in the Pilbara.

However, research alone does not achieve a direct conservation benefit for the quolls and cannot counterbalance impacts. Estimates of how alternative offset requirements may directly benefit the species by abating threatening processes are needed urgently.

Engaging experts to improve outcomes

We elicited information about the effectiveness and costs of a series of management activities (detailed in Figure 3) that may benefit northern quolls, based on expert knowledge. To do this, we first identified candidate management actions based on interviews with two key northern quoll experts. Next, we used a structured expert elicitation protocol involving three rounds of online anonymous surveys with 13 northern quoll experts, who collectively had expertise across the quoll's geographical range. Experts provided quantitative estimates of the benefits of a range of management actions at three different hypothetical offset sites which had different types of habitats, site conditions and past land management (Box 1).

To reveal the expected benefits of different potential offset actions, we asked experts to envisage the outcomes for northern quolls in each hypothetical offset site after 20 years if current management did not change ('do nothing'), and if particular management actions or combinations of actions were implemented. We then explored the costs and cost-effectiveness of these alternative strategies.

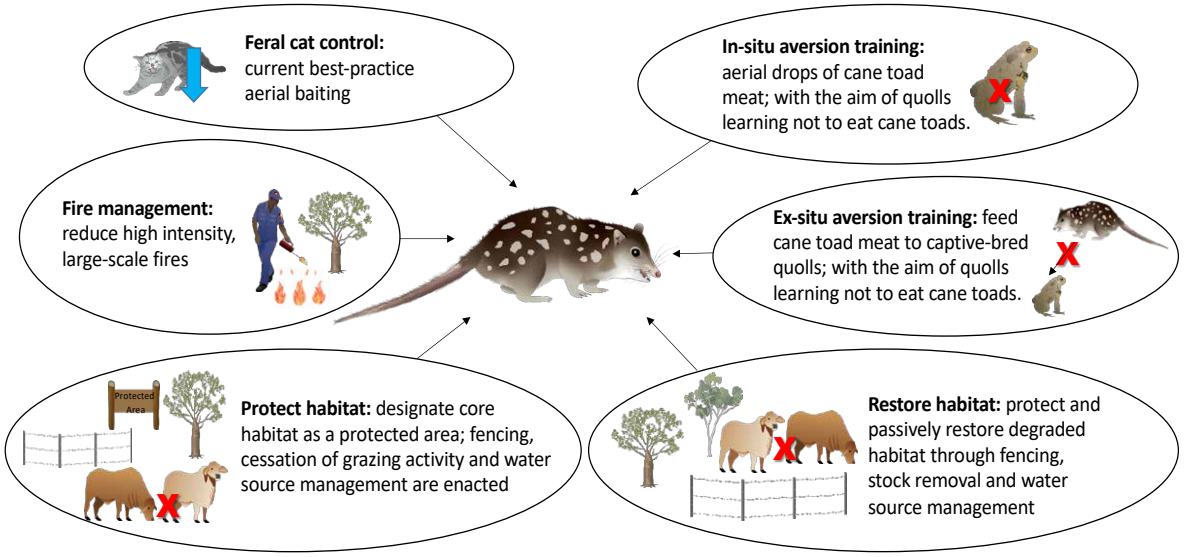
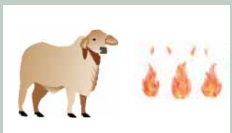


Figure 3: Potential management actions that could benefit northern quoll populations at a site level. Experts considered how these actions, alone and in different combinations, could benefit northern quolls at three different hypothetical offset sites (see Box 1).

Box 1: Hypothetical offset sites and benefit indicator

Management actions are likely to confer different amounts of benefit to northern quolls at different types of sites. We therefore asked experts to compare the relative benefits of management actions (Figure 3) at three different hypothetical offset sites, each 200,000 ha in size:

Site 1. Current quoll habitat, no cane toads: A large cattle property with low grazing pressure, no cane toads, and minimal human disturbance where ten female quolls were trapped in the most recent trapping year.



Site 2. Degraded, potential quoll habitat: A grazing property with substantial disturbance from grazing and fires but no cane toads, where no quolls are currently found, located adjacent to quoll habitat.

Site 3. Current quoll habitat with cane toads: same as site 1, but cane toads have recently arrived.

To estimate the benefits of different management actions, a suitable benefit indicator was required. The benefit indicator needs to be able to be readily measured and monitored at the site level, and be highly likely to relate to the viability of the species. For the northern quoll, the benefit indicator that experts were asked to use *the number of female quolls trapped in 200 trap nights*, a standard survey method for the species, assuming average climatic conditions.

Effective offsetting for northern quolls

On average, experts believed that the number of female quolls trapped would not change over 20 years in the 'do nothing' (or baseline) scenario at the site that was current quoll habitat without cane toads, nor would any quolls move into the degraded potential habitat in the absence of management interventions (Figure 4). For the hypothetical offset site where toads were present, experts indicated quolls would decline over the 20-year period if no management occurred (from 10 to 1.3 female quolls trapped from the standard trapping effort, on average).

The most beneficial management actions for northern quolls at all three hypothetical offset sites included a combination of habitat protection, feral cat control and fire management (Figure 4).

However, at a degraded site with potential quoll habitat, it was thought that passive habitat restoration was also required to achieve the greatest benefit for quolls. To achieve the most benefit at a site with current quoll habitat where cane toads recently arrived, experts believed that in-situ aversion training or ex-situ aversion training combined with introduction of captive bred quolls was also needed.

Experts believed that protection of habitat alone would not provide a substantial conservation benefit for northern quolls, with active land management practices having higher conservation benefits. Further, experts estimated that once cane toads are present, even with protection, cat control, fire management, captive breeding and ex-situ aversion training, the number of quolls in 20 years would still decline. These results highlight the severe threat posed by cane toads, and suggest uncertainty about the long-term retention of cane toad aversion behaviour following training.

It is important to note the large uncertainty bounds in the experts' benefit estimates, which should be accounted for by incorporating large precautionary buffers when developing offsets (i.e., increasing the amount of offset action required). Experts noted that quolls are effective at dispersing into suitable habitat, and quoll numbers could steadily increase at a site where key threats were well-managed. In addition, some experts noted that cat control may be more effective at reducing cat numbers in the degraded site (compared to current habitat) as cats would have fewer places to take cover.

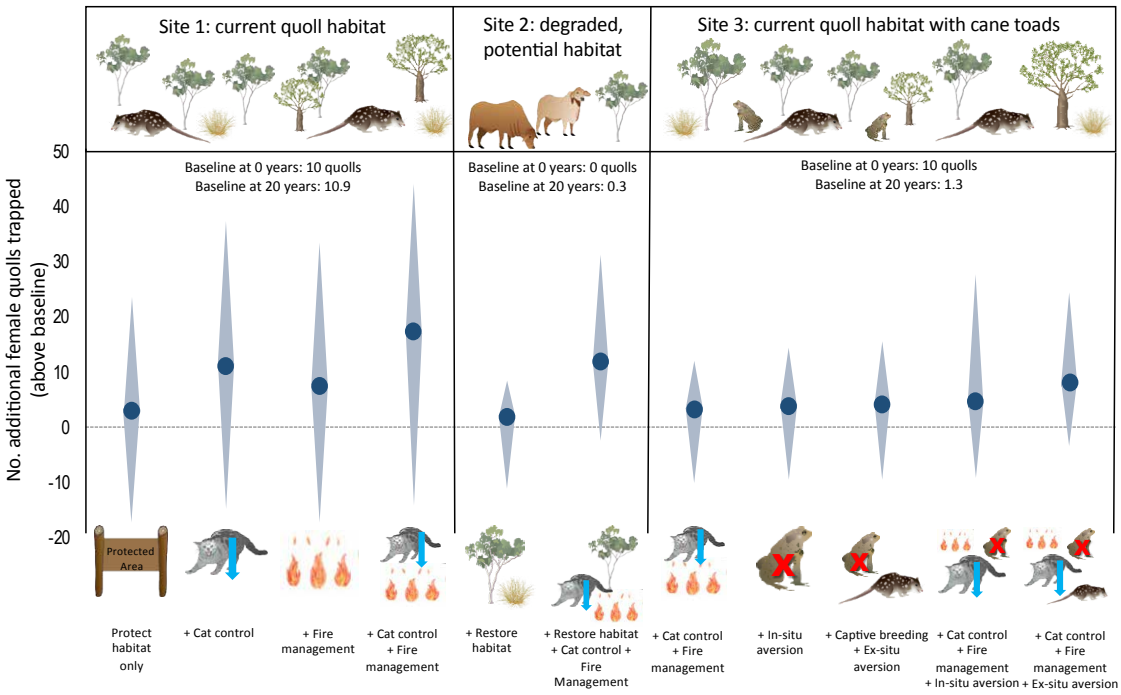


Figure 4: Results of expert elicitation showing the estimated benefit (defined as the number of female quolls trapped) of different management actions for northern quolls after 20 years, relative to a baseline scenario with no management (i.e. 'do nothing') at each of three hypothetical offset sites (see Box 1). The circle at the widest point in the diamond is the aggregated 'best guess' estimate. Diamonds capture the 90% confidence intervals around expert estimates.

Cost-effectiveness of offset actions

The cost estimates apply only to the management scenarios considered in the expert elicitation process. While our results can provide a guide for scaling up the area managed to achieve greater benefits for northern quolls (as long as other site conditions remained consistent), they cannot be used to scale down – a given fraction of the investment would be very unlikely to achieve an equivalent fraction of the estimated benefit. The cost data was collected from remote areas of northern Australia, and therefore expected to represent a relatively high cost compared to other areas.

Based on the cost data we collected from experts, the most cost-effective management options for the northern quoll were the combined actions of 'protect habitat, cat control and fire management', in existing quoll habitat (Figure 5). These actions resulted in an estimate of 17 more quolls trapped compared to the 'do nothing' scenario, and the estimated cost for protection of current habitat and implementation of fine-scale fire management and feral cat management was $4.7M/year over a 20-year period for a 200,000 ha site. This equates to an average estimated cost of $279,000 per additional female quoll detected in current quoll habitat. However, as there was such high uncertainty about the effectiveness of all actions, the maximum cost/quoll for this combined action could not be defined and may be much higher. This was because the uncertainty bounds around the estimates of benefit overlapped zero in all cases.

Habitat protection alone was not a cost-effective option. Active management in combination with protection increased the number of quolls gained per dollar spent three- to fourfold.

To achieve the greatest benefits for the least cost when cane toads were present, the combined action of habitat protection, cat and fire control, captive breeding and ex-situ aversion training was required. This was estimated to cost $626,000 per additional quoll trapped over 20 years (lower estimate = $200,000, maximum estimate = undefined). Restoring habitat alone had a very high cost per quoll, so would not be a cost-effective option, but combined with cat control, fire management and ex-situ aversion training its cost-effectiveness was more comparable to options that involved management within current quoll habitat.

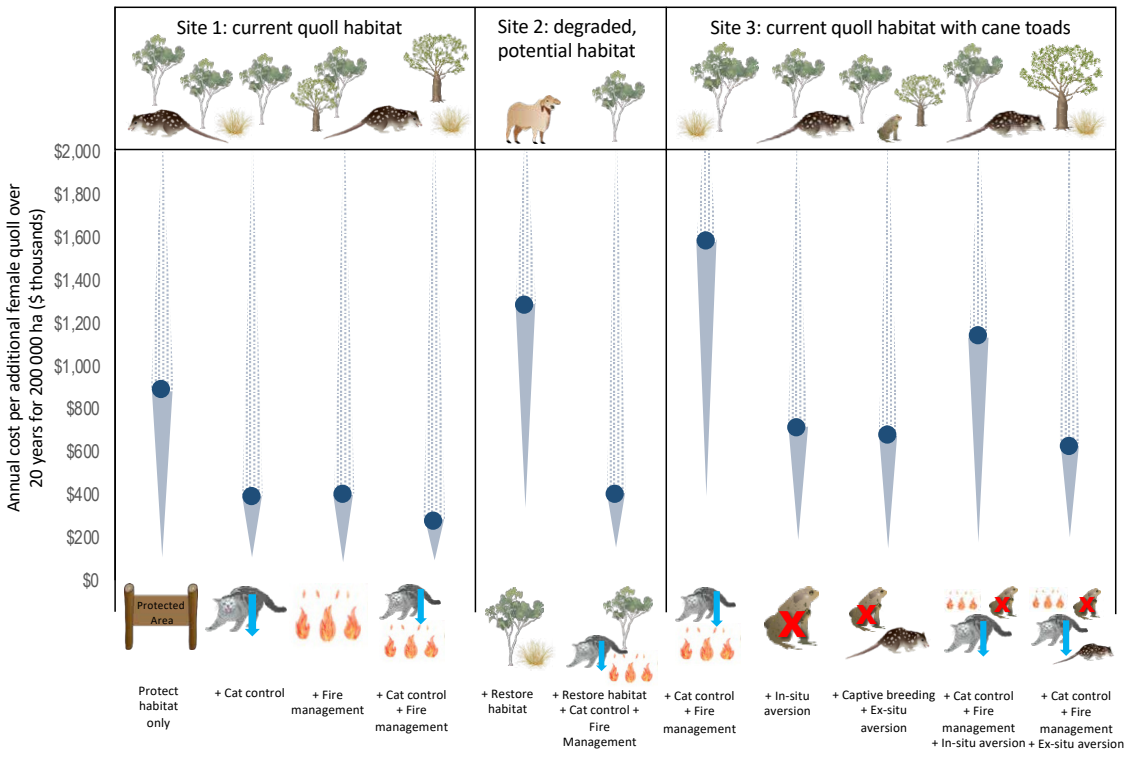


Figure 5. Cost-effectiveness of each management action implemented across 200,000ha for 20 years, presented as the average annual cost per additional female quoll trapped from standard survey effort ($000s, AUD 2019, estimated using expert elicitation). Dark blue circles show the best estimate, and the top and bottom points capture the low and high estimates of cost per female quoll trapped. Due to the fact it was possible for a benefit to be less than 0, the upper cost-effectiveness estimates are non-defined. Note: annual cost per female northern quoll trapped was obtained by dividing the total annual costs of management actions over 20 years by the number of female northern quolls experts thought could be added as a result of the management action.

Graphics

Photos and graphics were kindly provided by the NESP Northern Australia Hub, Zoë Stone, Kim Kraeer, and Lucy Van Essen-Fishman (Integration and Application Network Library),

Further Information

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Implications of research

Biodiversity offsets must only occur after all previous steps in the mitigation hierarchy have been taken. 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 best-practice principles of the IUCN offsets 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 to empirical studies to improve management, but provides a relatively quick, inexpensive and repeatable method of obtaining current, best available knowledge to inform decision making on biodiversity offsets.

Northern quolls are imperilled and in decline across their range. Current toad-free mainland strongholds for the species are likely to see cane toad invasion in the short- to medium-term. Actions to limit this invasion, or assist quolls to adapt, are likely to be important holistic management interventions, noting there is considerable uncertainty about longer-term retention of cane toad aversion training.

Results from this expert elicitation process suggest:

- Protection of habitat alone has limited conservation benefit for northern quolls, because threatening processes (such as feral cats and inappropriate fire regimes) are likely to be present; additional actions to manage key threats are needed in order to try and counterbalance impacts;
- In areas where cane toads have not yet invaded, the protection of habitat, combined with best-practice management of feral cats and fire may be the most effective and cost-effective conservation actions for the northern quoll
- in areas where cane toads have invaded, the protection of habitat, combined with best-practice management of feral cats, fire and ex-situ cane toad aversion training may be the most effective conservation actions. This suite of actions is, however, costly; and
- protection and management of key threats in current habitat is likely to be more beneficial and cost-effective than restoring degraded, potential habitat.

Results from our expert elicitation are consistent with key management actions (on the mainland) for the northern quoll listed in the Action Plan for Australian Mammals (2014), and strongly indicate that a package of management actions including feral cat control and fire management are likely to be the most cost-effective approach to biodiversity offsets for the species.

Further reading

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