Conserving Kyloriny/ Western Ground Parrot:

Structured Decision Making to plan the next steps for conservation of a Critically Endangered parrot

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This report may be cited as:
Parker KA, Comer S, Berryman A, Burbidge AH, Martin A, Black J, Blight L, Boulton J, Bradfield K, Colbung, B, Colbung D, Colbung S, Cowen S, Douglas T, Eades E, Ferguson A, Gibson L, Gibson Vega A, Hansom K, Harrison N, Hartly P, Harvey R, Jones H, Knapp L, Marwick J, Page M, Ricci M, Richards J, Rypalksi A, Utber D, Van Helden B, Vaughan-Higgins R, Wettin P, Woods J, Armstrong DP. (2026). Conserving Kyloriny/Western Ground Parrot: Structured Decision Making to plan the next steps for conservation of a Critically Endangered Parrot. Perth: Department of Biodiversity, Conservation and Attractions. 65 p.

Cover: Kyloriny / Western Ground Parrot. *Photo: Brent Barrett, DBCA.*

We acknowledge the First Nations custodians of Australia, and their enduring connection to the land, waters and community, and to the country on which we live and work with Kyloriny – *Pezoporus flaviventris* – Western Ground Parrot: the Wudjari, Ngatjumay Menang, Piblemen, Wadandi, and Koreng, and the many Noongar people on whose land Kyloriny is no longer found. We pay our respects to Elders past, present and emerging.

This report contains Indigenous Cultural and Intellectual Property which extends to depictions of country, language, stories and the art of the Menang/Merningar and Wudjari Aboriginal people.

Kyloriny – original artwork by Michael Cummings, Menang
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Contents

Executive summary

The Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) (hereinafter Kyloriny) is an enigmatic parrot endemic to Western Australia. The global population has declined drastically in the last 200 years and now consists of c. 180 birds, including one remnant wild population at Cape Arid National Park and the adjoining Nuytsland Nature Reserve (c. 150 birds), one small, reintroduced population at east of Albany (c. 25 birds max) and a few birds in captivity at the Perth Zoo (6 birds). Kyloriny are at a high risk of extinction because of substantial habitat decline, with introduced mammalian predators and altered fire regimes known to be important threat processes. Global climate change also threatens long-term habitat quality. Lack of continuous funding, operational capacity, and knowledge about basic biology make management challenging. Kyloriny are also particularly difficult to catch and monitor. Consequently, the species is listed as 'Critically Endangered' by both the Western Australian and Commonwealth Governments, and recovery actions are considered high priority. To identify the best conservation management options for Kyloriny recovery, the Department of Biodiversity, Conservation and Attractions (DBCA) initiated a structured decision-making (SDM) process in 2024.

As part of the SDM process, a working group was formed consisting of representatives from Department of Biodiversity, Conservation and Attractions, Binalup Aboriginal Corporation, Southern Aboriginal Corporation, Wagyl Kaip Southern Noongar Corporation, Esperance Tjaltjraak Native Title Aboriginal Corporation, BirdLife Australia, South West Natural Resource Management, South Coast Natural Resource Management and the Friends of the Western Ground Parrot.

Over a two-day workshop the working group articulated five fundamental objectives and 11 potential management alternatives (sets of actions). The fundamental objectives included:

- maximising the persistence of Kyloriny;
- minimising costs;
- maximising Noongar-led caring for country to maintain and enhance Noongar connection with Kyloriny;
- maximising community engagement with Kyloriny conservation;
- and maximising ecosystem health as a result of Kyloriny management.

In addition, maintaining and enhancing respectful partnerships is a process objective that overlays all Kyloriny science and management. Components of the potential management alternatives included improving Noongar engagement and partnerships across all science and management, conservation translocations (reintroductions and reinforcements), captive management, intensified introduced predator control, fire management and monitoring, resource provision to improve survival and productivity of Kyloriny (e.g., provision of water, supplemental food and nest protection), restoration and revegetation of Kyloriny habitat, new applied research for improving management, education, and partnerships with the community. The consequences of each alternative in relation to each fundamental objective were then predicted using a variety of modelling techniques and expert elicitations, while explicitly accounting for uncertainty. Once the consequences had been predicted, the working group was able to navigate this decision landscape explicitly and transparently using a variety of qualitative and quantitative decision-analytic tools to identify the best options for Kyloriny conservation.

The working group identified that a combination of reintroductions from Cape Arid National Park to two new unfenced sites and reinforcement of the translocated population at Waychinicup National Park were key management actions, with the Translocate + option preferred by the majority of participants. Complementing these actions is a desire to invest in aggressive learning, which includes use of innovative and new methods to manage wild birds and achieve successful breeding in the captive population. Aggressive learning strategies also included improved management of introduced predators, increased use of AI for acoustic monitoring, use of novel techniques to find nests and building capacity in the captive population. Aggressive learning was identified as an important key to underpin future management of

Kyloriny, and when combined with reintroductions and reinforcements has potential to significantly improve the conservation outcomes for Kyloriny.

Resilience of the last remaining wild population of Kyloriny is particularly important with the risk to the species through potential introduction of Highly Pathogenic Avian Influenza (HPAI), which was not a consideration during the workshops (Vaughan-Higgins and Burbidge, 2025) but has now been detected on the south coast of Western Australia. Establishing new populations, alongside increased Noongar engagement, monitoring, fire and introduced predator management, education, partnerships and people management were considered to provide the best outcome for Kyloriny recovery across the multiple objectives. Therefore, these components will be applied in a stepwise manner with the different representatives of the working group once adequate funding has been obtained.

The SDM outputs are advisory and will be used to co-design decisions for the conservation of Kyloriny. The SDM process provided an inclusive environment for participants and facilitated a rational and transparent recommendation for Kyloriny recovery, despite competing objectives, differing value judgements and uncertainty.

1. Background

The **Kyloriny**, or Western Ground Parrot (*Pezoporus flaviventris*) (hereinafter Kyloriny) is an enigmatic parrot endemic to Western Australia. It is a slim, medium sized bird (80-108 grams) with short, rounded wings and a rich green plumage mottled black and yellow. Kyloriny typically occupy moderately dense heathlands and are rarely seen because they generally walk through their dense feeding and nesting habitats (Burbidge et al., 2016). Kyloriny is the Merningar name for the parrot, and appropriate for use across Menang country. Dr Lynette Knapp has shared the Merningar story of Kyloriny. The Kyloriny, which is generally a lower scrubland bird, was known to call the rain. '*Kyl*' – in reference to the boomerang or the trail of the mystical rainbow which appears after the rains; '*lor*' – in reference to 'lore' as in the practices and traditions of Merningar peoples; and '*iny* '– as in the reference to something being embedded within it/part of it. Note: Some may also refer to the name as in reference to the sound it makes. This is generally true for most Aboriginal bird names. If this is correct, then the true pronunciation of Kyloriny in line with its sound should be – *Killyorin*y.[1]

European records indicate that at the time of colonisation Kyloriny occurred on the south coast of Western Australia from Cape Leeuwin through to Cape Arid, and there are also records from as far north as Dongara and Perth, inland to about 200 km (Fig. 1). Their former abundance is unknown, but the global population has declined drastically in the last 200 years and now consists of c. 180 birds with a c. 66% reduction in occupancy since 1900 (Fig. 2). In the past 25 years the Area of Occupancy of the species has declined from approximately 370km^2 in 2000 to approximately 200km^2 in 2023. Therefore, the Kyloriny is now at a high risk of extinction because of substantial habitat loss, with introduced mammalian predators, especially cats, and altered fire regimes, known to be additional important threat processes (Burbidge *et al.* 2016; Comer *et al*. 2020). Global climate change also threatens long term habitat security. A lack of continuous funding, operational capacity, and knowledge about basic biology make management challenging. Kyloriny are also particularly difficult to catch and monitor. Consequently, Kyloriny are listed as 'Critically Endangered' by both the Western Australian and Commonwealth Governments, and recovery actions are considered high priority.

The Kyloriny still faces several significant threats. While the initial agents of decline, especially introduced mammalian predators and habitat loss, are partially understood, the global population remains very small, including just one remnant population at Cape Arid National Park and the adjoining Nuytsland Nature Reserve (c. 150 birds), one small, reintroduced population at a site east of Albany (c. 25 birds) and a few birds in captivity at the Perth Zoo (6 birds). The translocated population is not yet established; in spite of evidence of breeding in 2023, only a small number of birds were translocated to this site and numbers remain low. In addition, at the time of the workshops there had still not been successful breeding of Kyloriny in captivity. The ongoing impacts of inbreeding depression, and the loss of genetic diversity through genetic drift, are often cited as major risks to small populations. However, small populations are subject to multiple threats, many of which act in concert, so all threats must be considered when designing and implementing recovery programmes (Caughley 1994). These threats include demographic and environmental stochasticity (e.g., fluctuating sex ratios, increased predation by introduced mammalian predators, fire, the emergence of a novel pathogen, extreme weather events) alongside inbreeding depression and genetic drift.

A fundamental objective that is common to nearly all recovery programmes is to increase the number of individuals and populations of a threatened species. This has been a long-standing objective for Kyloriny, specifically by protecting habitat through introduced mammal predator control, fire management, by establishing additional populations through translocation, and through *ex situ* captive management (Department of Parks and Wildlife, 2014). However, there have been no explicit population models to

[1] Merningar language is currently being reinvigorated, and it is a language that does not use 'ing' as it should be pronounced as 'iny' with the 'y' written as superscript to ensure correct pronunciation. This is referenced in Nyungar Anew with Carl von Brandenstein (1988, p13)

guide management and opinions varied as to priorities for future actions. For Kyloriny, establishing new populations, conducting translocations and augmenting the small captive population was confounded by the low numbers of birds in the wild, but also imperative given the risk of having a single wild population. Efforts to establish a second wild population commenced between 2021 and 2023, with initial survival and some evidence of breeding. However, only a small number of birds were translocated and further augmentation is needed to establish this population. Therefore, to optimise use of the available data, and the broad breadth of Kyloriny expertise, DBCA applied a structured decision-making (SDM) process (e.g. Ewen, Canessa, et al. 2023) to identify the best management options for Kyloriny recovery.

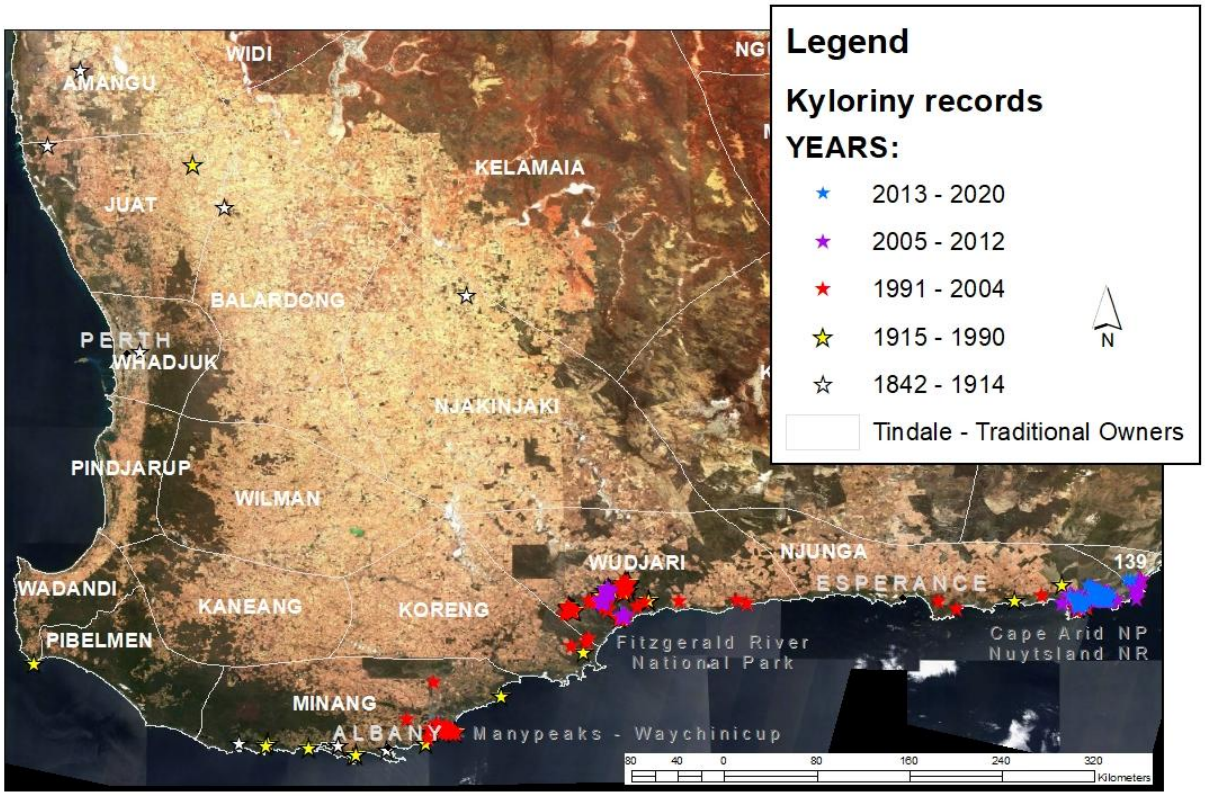


Fig. 1. Kyloriny / Western Ground Parrot *Pezoporus flaviventris* records since European colonisation, showing Tindale First Nations genealogies and spelling, and south coast populations referred to (Tindale, 1974).

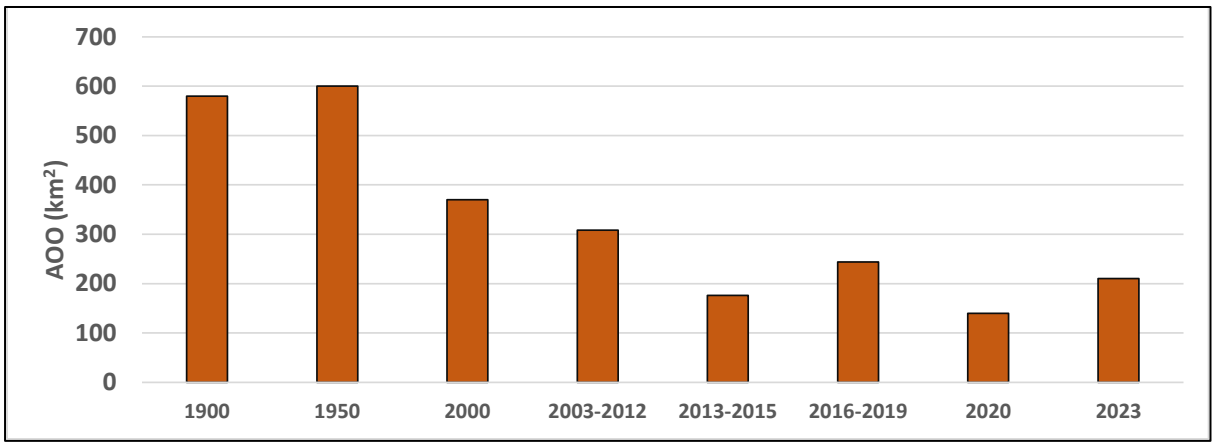


Fig. 2. Estimated Area of Occupancy for Kyloriny / Western Ground Parrot *Pezoporus flaviventris* 1900 - 2023 (S. Comer et al., unpubl.).

2. Structured decision making and species recovery

Species recovery programmes present conservation managers with formidable challenges as they typically involve multiple objectives, values and attitudes, a need or desire to implement novel techniques or intensive management (e.g., translocation and introduced predator control), and considerable uncertainty. These attributes create risks and trade-offs, as managers are required to make decisions with few data and limited resources – and poor decisions can mean the loss of populations or even entire species. Consequently, these species recovery programmes are ideal candidates for the application of decision-analytic methods (Maguire et al. 1987), although this approach has only recently gained momentum (Moore and Runge 2012; Converse et al. 2013; Ewen et al. 2014; Panfylova et al. 2019; Canessa et al. 2020; Ferrière et al. 2021; McMurdo Hamilton, Canessa, Clarke, et al. 2021; McMurdo Hamilton, Canessa, Makan, et al. 2021; Fischer et al. 2022; Ewen et al. 2023; Parlato et al. 2024).

The aim of SDM is to facilitate transparent, iterative and values-based processes that identify the best options for management while balancing multiple objectives (Gregory et al. 2012). The values focus means that the optimal choice will depend on the values of **all** stakeholders, e.g., First Nations representatives, community members, industry representatives, and conservation scientists and managers. The SDM process can be divided into seven stages (Fig. 3):

1. Clarifying the decision context (Done here through a 'goal statement')
2. Articulating the fundamental objectives
3. Identifying potential management alternatives
4. Predicting and modelling the consequences of management alternatives
5. Weighing the trade-offs associated with different management alternatives
6. Identifying the best management option
7. Implementing the best management option.

A feedback loop can be incorporated to update existing models based on monitoring, facilitating learning and adaptive management following the initial identification of the best option (Nichols and Armstrong 2012; Converse et al. 2013). Ultimately, the focus of SDM on values-led decision making enables effective working relationships among stakeholders (Maguire and Boiney 1994; Redford et al. 2011).

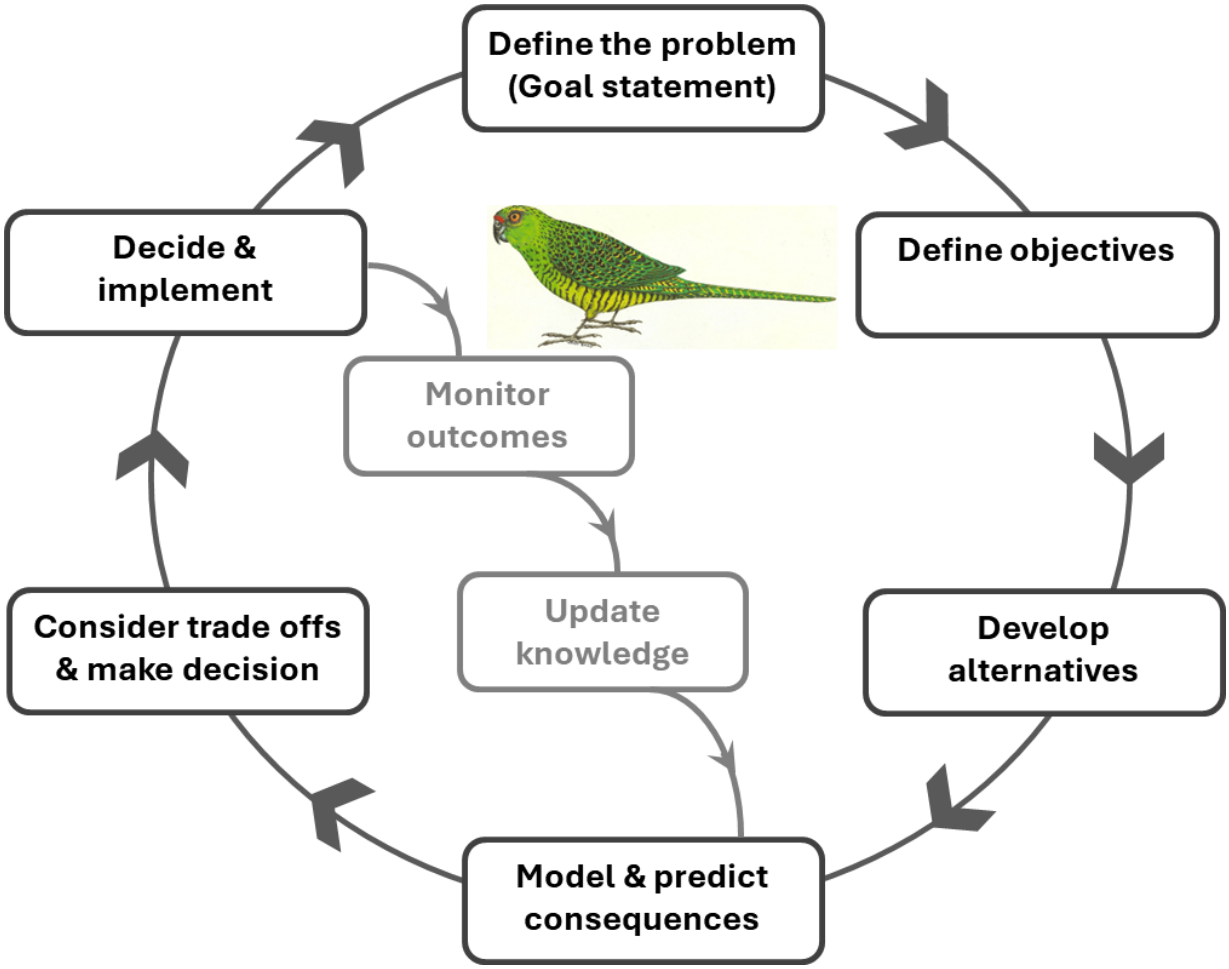


Fig. 3. The seven steps in the structured decision-making cycle, adapted from Gregory et al. (2012) and IUCN Conservation Translocation Specialist Group training material. The monitoring loop allows adaptive management, whereby following implementation the consequences and recommendations might be revised. (Kyloriny graphic: Wendy Binks)

3. Methodology

In conjunction with DBCA South Coast Region staff and the South Coast Threatened Birds Recovery Team, who oversee Kyloriny recovery, the facilitators brought together a working group for the Kyloriny SDM process. Following initial scoping of a SDM process for Kyloriny, the working group progressed through the SDM process from January 2024 to June 2025. This included frequent and ongoing communication between the facilitators and the working group (in person and online), an online questionnaire for Kyloriny recovery partners (Appendix 1), a 2-day in person meeting with all participants at the DBCA Albany office in June 2024 (Appendix 2), and two half-day online meetings with all participants in February 2025 (Appendix 3). The process taken and the outcome of each of the seven steps in the SDM process are detailed in the following sections, and a timeline for the entire process is presented in Fig. 4.

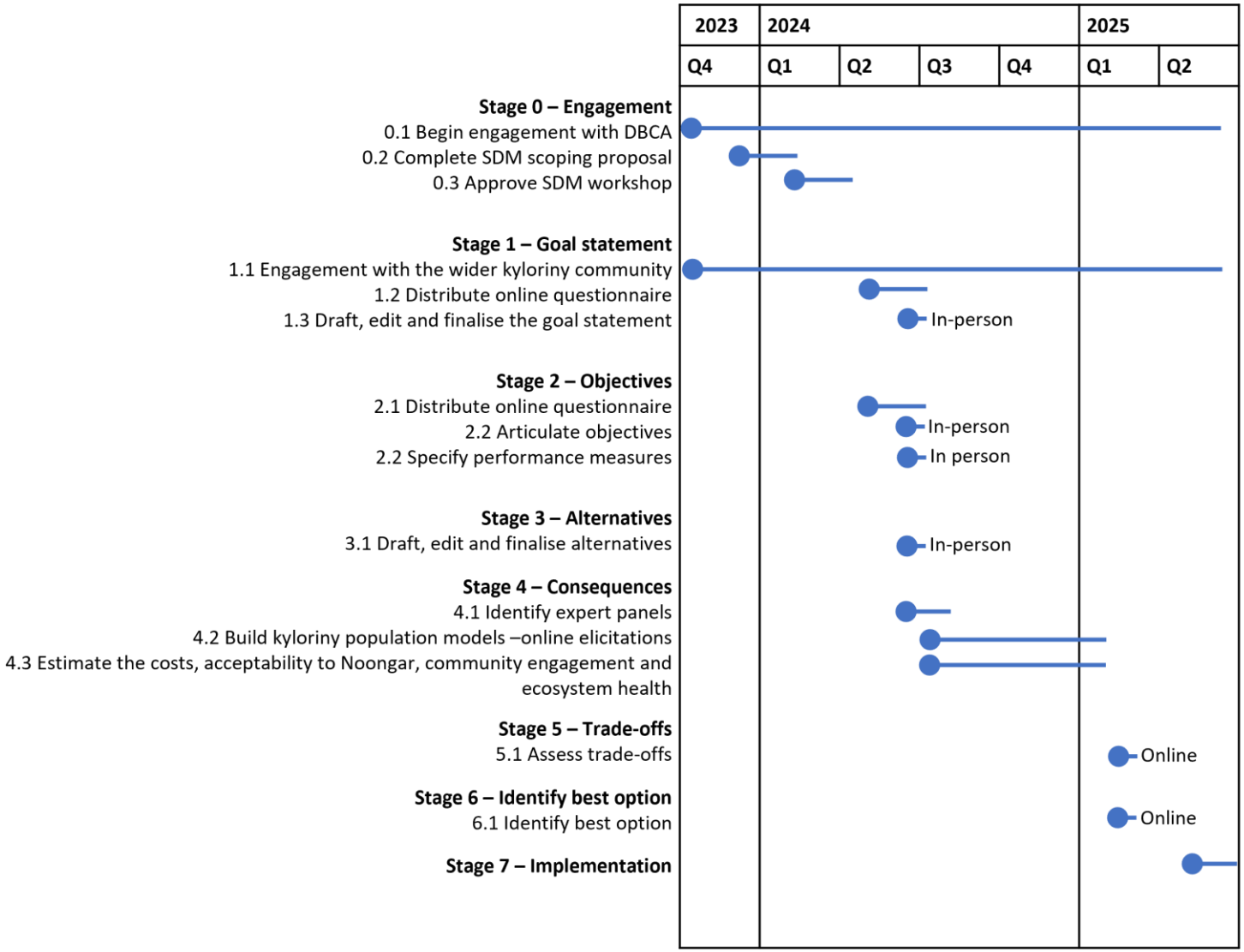


Fig. 4. Timeline for the Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) structured decision-making (SDM) process for recovery planning showing the key steps of the SDM cycle and quarter in which they were implemented each year (see Fig. 3).

4. Goal statement

Step 1 of the SDM process

The conservation goal statement highlights the focus and scope of the decision problem, describes why it has arisen, and identifies the decision-makers, as well as the time frame and legal framework within which a decision must be made (IUCN Conservation Translocation Specialist Group training material adapted from Gregory et al. 2012 and Hemming et al. 2022). It may include seven core elements.

1. **Trigger:** Why does a decision need to be made? Why does it matter?
2. **Action:** What actions need to be taken?
3. **Constraints:** What are the constraints (legal, financial, political) on taking the stated action(s)? Are these perceived or real?
4. **Class or type of problem:** How many objectives are there? Do they conflict? What is the level of uncertainty?
5. **Decision-maker:** Who has the power to make the final decision?
6. **Frequency and timing:** How often do decisions need to be made? Are other, related decisions needed?
7. **Scope:** How broad or complicated is the decision?

4.1 Process

The conservation goal statement was initially drafted by the facilitators based on responses gathered through an online questionnaire sent to all participants prior to the in-person workshop (Appendix 1). The working group then edited the goal statement during the workshop to ensure that it was fit for purpose. The initial edits were completed in a dedicated session on the first day of the in-person workshop in June 2024, after which the goal statement was revisited at the beginning of the following day, and then again during the online workshops in February 2025. Minor, but critical, edits were made throughout.

4.2 Outcome

The current version of the goal statement is:

"The Kyloriny is a Critically Endangered (state and federal) enigmatic parrot endemic to Western Australia. The global population has declined drastically in the last 200 years and now consists of c. 180 birds, including one remaining natural population (c. 150 birds), one small, reintroduced population (c. 25 birds) and a few birds in captivity (6 birds). Kyloriny are at a high risk of extinction because of substantial habitat decline, with introduced mammalian predators and altered fire regimes known to be important threat processes. Global climate change also threatens long term habitat security. Lack of continuous funding, operational capacity, and knowledge about basic biology complicate management. Kyloriny are also particularly difficult to catch and monitor. The critical decision is deciding what combination of recovery actions will ensure Kyloriny expand beyond their current range and increase in abundance. Options include improved habitat management, reinforcement translocations, reintroductions, and *ex situ* management. Targeted learning could improve ability to locate birds and knowledge of basic biology that will inform management. Maintaining and enhancing Noongar connections with Kyloriny is also fundamentally important, as is maximising the impact of Kyloriny management for other native species, increasing the public profile of Kyloriny and minimising cost.

Balancing multiple fundamental objectives and the uncertainty surrounding the outcomes of management alternatives will influence choices. Careful, inclusive and transparent consideration will allow decision-makers to support future Kyloriny recovery. The decision-makers are Noongar descendants, from South -West Noongar and traditional Country (Menang/Merningar, Wudjari, Gnadju, and DBCA, with guidance from the South Coast Threatened Birds Recovery Team and in partnership with Friends of the Western Ground Parrot, South Coast NRM and BirdLife Australia. They consider it imperative that conservation effort for Kyloriny intensifies from 2024."

5. Objectives

Step 2 of the SDM process

SDM recognises that the 'best' decision is that which best achieves the objectives of the participants. Therefore, the 'best' strategy cannot be defined unless the underlying objectives are clear. SDM recognises at least three types of objectives.

1. **Fundamental:** These objectives reflect the group's core values or end goals and are useful for comparing and choosing between a range of possible management strategies.
2. **Means:** These objectives are important for highlighting ways of achieving the fundamental objectives.
3. **Process:** These objectives state the desired approach to the decision-making process.

Articulating fundamental objectives is crucial to SDM (Gregory et al. 2012; Hemming et al. 2022). Each fundamental objective should be expressed as a statement that captures the underlying value and includes a verb indicating the desired direction of change (e.g. minimise/maximise). It is critical that means objectives are separated from fundamental objectives, as focusing on a means objective risks judging alternatives incorrectly (e.g. double counting a value). A fundamental objective cannot be 'optimised', as optimisation (or efficiency) indicates that several fundamental objectives are being combined, which leads to hidden value judgments about what is 'optimal'. Fundamental objectives should be separate, allowing the decision to be approached rationally.

Each objective requires one or more performance measures to provide a metric by which to predict and compare the expected outcomes of alternatives. Performance measures can be direct, indirect proxies or constructed scales.

5.1 Process

The Kyloriny working group articulated their fundamental objectives for Kyloriny recovery using the following systematic approach.

1. Before the in-person workshop, an online questionnaire was sent to all participants (see Appendix 1).
2. During the workshop, each participant started out by individually listing their aspirations and concerns (their values) for Kyloriny recovery.
3. Together, the working group combined similar objectives until a final set of objectives was agreed upon.
4. During this process, the facilitators compared the fundamental objectives identified by the working group with the responses to the online questionnaire. They found that these did not differ much, so there was no further discussion of the online questionnaire responses.
5. The working group then jointly identified appropriate performance measures for each objective.

5.2 Outcome

The working group identified five fundamental objectives and associated performance measures for Kyloriny recovery planning (Table 1). An additional process objective is that respectful partnerships overlay all Kyloriny science and management. Predicting the future is notoriously difficult, so to keep model predictions realistic and useful, 10 years was chosen as the time horizon.

Table 1. Fundamental objectives and their associated performance measures for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) recovery planning.

FUNDAMENTAL OBJECTIVE	**PERFORMANCE MEASURES**
Maximise persistence	Number of Kyloriny in 10 years Number of Kyloriny populations in 10 years Probability of Kyloriny extinction in 10 years
Minimise costs	Annual cost in Australian dollars
Noongar-led caring for country to maintain and enhance/reinforce Noongar connection with Kyloriny	Input from Elders in all phases, and engagement of Rangers in all aspects of delivery[1]
Maximise community engagement	Number of volunteer hours (DBCA) Number of Friends of the Western Ground Parrot Donations to Friends of the Western Ground Parrot Number of communications per annum (all partners)
Maximise ecosystem health	Number of hectares managed for Kyloriny Number of threatened vertebrate species that benefit from Kyloriny management Number of Priority/Conservation Dependent/Other Specially Protected/Migratory vertebrate species that benefit from Kyloriny management (updated 8 August 2023) - available at https://www.dbca.wa.gov.au/management/threatened-species-and-communities/nominations-listing)

[1] *Caveats around acceptable consultation include: the acceptability of various scenarios requires input on a case-by-case basis; Are translocations within understood 'historical range'? Foster collaboration and communication between First Nations groups including Elders and Aboriginal Rangers from the source and translocation site; Co-design - engagement of First Nations groups in site selection, preparation of translocation proposals and implementation of translocations. Translocations to captive institutions may be in range, but sending adults into captivity out of country is not ideal – where possible harvest eggs, or first year birds. Communication between Elders from different language groups. Welcome to Country for translocated animals.*

Conservation of Kyloriny will be led by Indigenous knowledge systems and Western science, with cultural safety and consent built into future recovery planning and implementation of actions'

6. Alternative management strategies

Step 3 of the SDM process

Once the fundamental objectives have been established, it is possible to define and evaluate alternative management strategies that could achieve these. This step often includes the identification of threats to populations. Given the complexity of most species recovery programmes, these alternative strategies will typically involve combinations of actions. The same actions can appear as components of more than one alternative.

6.1 Process

The alternative management strategies for Kyloriny recovery planning were identified using the following process.

1. The working group divided into four sub-groups and identified management actions for Kyloriny. These included broad ideas and categories of actions, along with specific management actions.
2. Each sub-group then presented and discussed their ideas with the main working group. Common themes among groups were identified and listed together.
3. The common ideas, themes and actions were then extensively discussed and debated, ultimately resulting in the creation of 11 alternative management strategies consisting of different combinations and intensities of management actions. One of the 11 alternatives was the status quo.

6.2 Outcome

The 11 alternative management strategies proposed for Kyloriny recovery are summarised below and in Table 2, and fully specified in Appendix 4. Each alternative includes strategies common to all options, such as Noongar engagement, fire management, and introduced predator management, but at varying intensity. Some strategies also contain unique approaches not included in other strategies, such as reinforcement translocations and reintroductions to new sites. At the time of the workshops there had not been successful fledging of Kyloriny in captivity and as such these alternatives were developed without the potential of captive breeding being realised.

Baseline (not included in the strategy or consequences tables)

Baseline is the standard Department of Biodiversity, Conservation and Attractions (DBCA) management of conservation estate. This was the level of conservation management for Kyloriny prior to 2010 and includes only the standard delivery of Western Shield fox baiting, no additional introduced predator management and no specific intervention for Kyloriny if they were threatened by bushfire, beyond the standard departmental consideration of conservation values when planning bushfire response and mitigation.

Status quo

This is the current level of management for Kyloriny, which includes fire management and some externally funded support for additional introduced predator management to complement DBCA's Western Shield aerial and ground baiting. This option does not include reinforcements of the translocated population at Waychinicup-Manypeaks.

It includes:

- Additional introduced predator control at Cape Arid National Park (CANP) and Waychinicup - Manypeaks (WMP) area including cat baiting, introduced predator trapping, and Felixer Grooming Traps.
- Monitoring of introduced predators and native species to evaluate the effectiveness of introduced predator control methods.
- Additional fire mitigation to protect Kyloriny habitat in CANP and WMP, including prescribed burning, and establishment and/or maintenance of low fuel slashed buffers.
- Additional bushfire suppression strategies aimed at minimising the impact of bushfires on Kyloriny habitat, including additional ground crews, and potential for aerial suppression.
- Monitoring Kyloriny (CANP, WMP).
- Captive management continued at current level at Perth Zoo (6 birds).
- No reinforcement of WMP.
- Some Noongar engagement.

Reinforcement A

This option includes all management covered by status quo, with the addition of wild-to-wild reinforcement translocations from Cape Arid National Park to Waychinicup-Manypeaks (**modelled at 12 birds estimated pa for up to three years)**. The need for reinforcement translocations and the number of birds required will be informed by monitoring. Only one translocation might be needed, depending on survival and population growth at Waychinicup-Manypeaks.

This strategy includes **Status Quo** plus:

- Wild-to-wild reinforcement translocation from CANP to WMP.
- Increased Noongar engagement.

Reinforcement B

This option is the same as Reinforcement A but with additional birds captured for the captive management program **(modelled at 3 pairs per annum for one year** with a minimum of 2 additional females), increased engagement with Noongar, and increased learning because of the intensified captive management program.

This strategy includes **Status Quo** and **Reinforcement A** plus:

- 6 birds translocated from CANP to the captive program at Perth Zoo (increased learning).
- Increased Noongar engagement.

Kaboonga

Kaboonga is the most intense alternative. It includes all the strategies under Status Quo, Reinforcement A and Reinforcement B but increases the intensity by a factor of 2-4 for most strategies. It has intensive captive management including removing and hand raising the first clutch (forced double clutching), but less intensive than Captive +++, so aims to produce 40 viable offspring per year (compared to 60 for Captive+++). This will require **18 birds being captured from the wild for the captive rearing programme (6 birds per year for three years).** Similar to Captive +++, success of the strategy relies on Perth Zoo being able to breed Kyloriny in captivity (successful breeding is yet to be achieved). This strategy also includes intensive revegetation to expand the quantity of Kyloriny habitat around existing populations.

This option is completely unconstrained by availability of resources (staff and funding) and includes reinforcement, reintroduction, intensive captive management and enhanced predator and fire management. The additional resources put into managing the wild population (CANP) means that birds can be sourced from this area for both reinforcement and new translocations.

This strategy **includes Status Quo** plus:

- Management increased two- to four-fold (CANP, WMP, 2 new reintroduction sites).
- Reinforcement translocation from CANP and captive population to WMP.
- 18 birds translocated from CANP to the captive program at Perth Zoo.
- Captive breeding (*noting that successful breeding in captivity had not been achieved when the workshops were held*).
- Increased Noongar engagement, partnerships, education, monitoring and people management.
- Revegetation/restoration.
- Reintroductions from the captive population at Perth Zoo (assuming successful breeding) to two new reintroduction sites. This will likely require a soft release strategy.

Captive +++

Captive +++ has the primary focus on intensive captive breeding and less focus on *in situ* management. This will require taking more birds into captivity (**10 pairs required, 20 birds in total**), with an aim to double clutch and produce c.6 offspring per female per year for a total of ~60 offspring per year. This approach is highly interventionist, including disease management, artificial insemination, incubation, hand-raising, Eastern Ground Parrot surrogates, proposed multiple facilities, new sites and new partnerships. No wild-to-wild translocations under this strategy. More intensive captive management under this strategy. Any translocations will be from captive-sourced birds.

This strategy includes **Status Quo** plus:

- No wild-to-wild translocations.
- Addition of 20 birds (even sex ratio) to the captive program.
- Intensive captive management (double clutching, hand raising, use of surrogates, artificial insemination, disease management/biosecurity, multiple facilities, new sites and new partnerships).
- Aims to produce 60 chicks per year (noting that successful breeding in captivity is yet to be achieved).
- Reintroductions from the captive population (assuming successful breeding) to two new reintroduction sites. This will likely require a soft release strategy.

Reintroductions

This alternative focuses on establishing new wild populations at two different sites over a 10 year period with **36 founders for each** site. This includes increased introduced predator and fire management, increased Noongar engagement, education, partnerships, learning, monitoring and people management relative to Status Quo, Reinforcement A and Reinforcement B. Captive management will remain at the level of Status Quo

This strategy includes **Status Quo** plus:

- Increased fire and introduced predator management at CANP and WMP.
- Increased fire and introduced predator management at two new release sites (both prior to translocation and following release); at least two years of increased management will be required at each site to reduce threats before releases take place.
- Wild-to-wild reintroduction translocations from CANP to two new sites.
- Monitoring of translocated Kyloriny at the two new sites (both intensive post-release monitoring and long-term monitoring).
- Increased Noongar engagement, education, partnerships, learning, monitoring and people management.

Translocate+

This alternative is the same as **Reintroductions**, with the addition of a reinforcement translocation **(12 birds pa for up to three years)** to Waychinicup-Manypeaks.

Reintroductions plus:

- Reinforcement translocations from CANP to WMP.

Small fence

This alternative includes translocation **(maximum 10 individuals)** to a small, fenced site (<400ha with at least 100ha of Kyloriny habitat), that would require ongoing supportive management (feeding, water, refuges)**.** Dispersal and fence collisions are a risk with this alternative. Noongar engagement, education, partnerships, learning and people management would be increased under this alternative but other management would stay at the same level as Status Quo.

A small fenced enclosure would need to be constructed, and introduced predators removed from within the enclosure, unless the existing Normans enclosure is used (this enclosure is near Manypeaks and has a small amount of suitable Kyloriny habitat). Ongoing fence maintenance will be required.

This strategy includes **Status Quo** plus:

- Small fence (Normans enclosure?).
- 10 birds from CANP to the small fenced site.
- Resource provisioning.
- Increased Noongar engagement, education, partnerships and learning.

Large fence

This alternative includes translocation to a 5000ha plus fenced site with at least 25% of the area high quality Kyloriny habitat. This alternative would not consider fencing the existing Cape Arid/Nuytsland population. Management effort will largely be the same as the **Reintroductions** alternative but with additional resource provisioning and only one translocation site (large fenced site).

A large fenced enclosure would need to be constructed, and predators removed from within the enclosure, requiring additional management of introduced predators in the establishment phase. Ongoing fence maintenance will be required.

This strategy includes **Status Quo** plus:

- Large fence.
- Introduced predator removal within fenced area.
- 36 birds from CANP to the large fenced site.
- Resource provisioning.
- Increased Noongar engagement, education, partnerships, learning and monitoring.

Wild only

This alternative would focus solely on the wild populations by abandoning the captive program, reinforcing Waychinicup-Manypeaks with wild-to-wild translocations (**12 birds estimated pa over three years),** increasing Noongar engagement relative to Status Quo, maintaining predator management, fire management, people management and monitoring at the same level, and decreasing education.

Status Quo plus:

- Increased Noongar engagement.
- Reinforcement translocation from CANP to WMP.
- The captive programme at Perth Zoo is abandoned (unlike Status Quo).

Aggressive learning

This alternative includes all management listed for **Reinforcement A**, as well as intensified learning and monitoring effort focussing on new and innovative methods. These may include Artificial Intelligence for acoustic monitoring, use of dogs to find nests, drones to find nests, genetic analysis, etc. Provided nests

can be found, eggs would be sourced from the wild for the captive program. Cameras would be placed on nests to improve understanding of predator impact/timing on breeding, and to assess breeding success. This strategy also includes aggressive learning from the captives, which may include trialling new techniques and cutting-edge technology to achieve successful breeding.

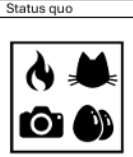
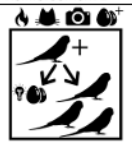
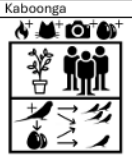
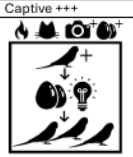
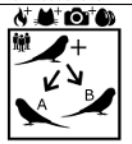
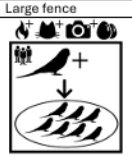
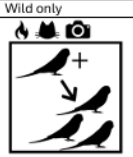
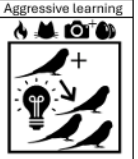
This strategy has the potential to improve vital rates, with much greater capacity to apply learning to management. The cost will be relatively high, and there is potential uncertainty about whether the new learnings will result in population growth.

As already outlined in Reinforcement A, the wild-to-wild reinforcement translocations from Cape Arid National Park to Waychinicup-Manypeaks are **modelled at 12 birds estimated pa for up to three years**. The need for reinforcement translocations will be linked to monitoring. Only one might be needed, depending on survival and population growth at Waychinicup-Manypeaks.

This strategy includes **Status Quo** plus:

- Reinforcement translocation from CANP to WMP.
- Increased Noongar engagement.
- New and innovative methods to learn more about Kyloriny ecology, and to increase our ability to detect and monitor Kyloriny.
- Potential addition of birds to the captive management program, preferably sourced from eggs taken from the wild (provided nests can be found).
- Intensified learning to optimise fire and introduced predator management.
- Trialling new techniques and cutting-edge technology to achieve successful breeding in captivity.
- Applying all new learning to improve and refine management practices.

Table 2. Strategy table showing a summary of alternative management options for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) recovery planning, indicating the key differences in their component actions and how they compare with the status quo. The number of ticks indicates the intensity of a component action, with a larger number representing a higher intensity. See Appendix 4 for a full description of each management option.

	Status quo	Reinforcement A	Reinforcement B	Kaboonga	Captive +++	Reintroductions	Translocate +	Small fence	Large fence	Wild only	Aggressive learning
											
Ex-situ management	✔✔	✔✔	✔✔✔	✔✔✔✔	✔✔✔✔	✔✔	✔✔	✔✔	✔✔		✔✔✔
Translocation (*reinforcements*)		✔	✔	✔	✔		✔			✔	✔
Translocation (*reintroductions*)				✔✔	✔✔	✔✔	✔✔	✔	✔		
Introduced predator management	✔✔	✔✔	✔✔	✔✔✔✔	✔✔	✔✔✔	✔✔✔	✔✔	✔✔✔	✔✔	✔✔
Fire management	✔✔	✔✔	✔✔	✔✔✔✔	✔✔	✔✔✔	✔✔✔	✔✔	✔✔✔	✔✔	✔✔
Noongar engagement (*two-way, science and management*)	✔✔	✔✔✔	✔✔✔	✔✔✔✔	✔✔	✔✔✔	✔✔✔	✔✔✔	✔✔✔	✔✔✔	✔✔✔
Education	✔✔	✔✔	✔✔	✔✔✔	✔✔	✔✔✔	✔✔✔	✔✔✔	✔✔✔	✔	✔✔
Partnerships	✔✔	✔✔	✔✔	✔✔✔	✔✔✔	✔✔✔	✔✔✔	✔✔	✔✔	✔✔	✔✔
New learning	✔✔	✔✔	✔✔✔	✔✔	✔✔✔	✔✔✔	✔✔✔	✔✔	✔✔	✔✔	✔✔✔✔
Monitoring	✔✔	✔✔	✔✔	✔✔✔	✔✔✔	✔✔✔	✔✔✔	✔✔	✔✔✔	✔✔	✔✔✔✔
Resource provision (*supplementary feeding, water provision, nest protection*)								✔	✔		
People management	✔	✔	✔	✔✔✔	✔	✔✔	✔✔	✔✔	✔✔	✔	✔
Revegetation/ restoration				✔✔✔							

7. Consequences

Step 4 of the SDM process

Alternatives can be compared according to their expected outcomes (or consequences) for the different objectives, which are in turn quantified using performance measures. These outcomes can be estimated from a model of the system, which is informed by available empirical data (e.g. from monitoring), data from similar systems as a surrogate, or expert judgement. When expert judgement is required, assessments should be obtained using best-practice protocols that include uncertainty (Martin et al. 2012; Hemming et al. 2018).

7.1 Process

The consequences of each alternative for each objective were estimated by participants with expert knowledge on the estimated consequences (e.g. the Noongar engagement and maximise Kyloriny persistence objectives) between the in-person and online workshops. Participants used a range of tools to estimate consequences, including population models, expert elicitations and existing data. The steps taken to estimate each consequence are detailed below.

7.1.1 Maximising Kyloriny persistence

1. Six participants with expertise on Kyloriny population ecology were posed with 10 questions (Appendix 5) for eliciting the structure of a model that would be parameterised to predict the numbers of individuals and populations after 10 years under each management alternative.
2. Based on the model developed in step 1 (Appendix 6), the experts then estimated the current number of individuals, the rate of annual population change at low density, the maximum number of individuals (i.e., carrying capacity), and the annual probability of an uncontrolled fire under each management alternative. They first generated these parameters for the existing populations (Cape Arid National Park, Waychinicup-Manypeaks, Perth Zoo), and then for the potential new populations (two unfenced sites, one large fenced site and one small fenced site). They also separately estimated the proportion of wild and captive-reared individuals lost following translocations. These elicited values included maximum and minimum plausible values as well as each expert's best estimate, so they could be captured as BetaPERT distributions (Appendix 7) used in a quantitative population model to project population trajectories over 10 years while accounting for uncertainty. Expert elicitation of the current number of individuals in the last remaining population was estimated to be around 200 birds (95% credible interval 128 – 294).
3. The working group did not decide on specific translocation sites, but rather estimated parameters based on sites that were broadly similar to those initially assessed in the workshop. This was because selecting translocation sites is complex and site availability was uncertain at the time. Ultimately, a final decision on translocation sites might require a separate decision-making process incorporating expert elicitation for the sites available for translocation.

7.1.2 Minimising costs

1. Participants used existing costings for staff (i.e. full-time equivalents [FTEs]), operational costs (management costs/vehicle/travel), logistics and equipment (e.g. predator fencing, monitoring tools) to produce an estimate of the annual cost of each alternative.

7.1.3 Noongar-led caring for country to maintain and enhance/reinforce Noongar connection with Kyloriny

1. Noongar Elders and Rangers were workshop participants and talked through the objectives, management alternatives and predicted consequences for Kyloriny recovery.
2. Noongar Elders and Rangers then talked and decided which management alternatives were considered acceptable, not acceptable, or partially acceptable, while stating that all work is subject to ongoing discussion on a case-by-case basis. Follow-up conversations with Menang Elders and Ranger Coordinators confirmed the summary provided here, but also the need for ongoing conversations and engagement with other First Nations elders (Wudjari and Ngadju) are needed. Translocations are more acceptable within the understood 'historical range' which includes a significant area across South West WA, and require collaboration and communication between First Nations groups, including Elders and Aboriginal Rangers from the source and translocation site, engagement in site selection, preparation of translocation proposals and implementation of translocations. Cultural safety needs to be considered in all aspects of delivery along with communication between Elders from different language groups, and cultural welcome to country for translocated animals.

7.1.4 Maximising community engagement

1. Workshop participants from Friends of the Western Ground Parrot (FOWGP), BirdLife Australia, and DBCA, and also the Albany Bird Group who were not able to be present at the workshop, estimated the number of volunteer hours, number of FOWGP members, communications (e.g. talks, events, reports, scientific papers) and donations per annum for each alternative. It should be noted that the performance measures for community engagement were estimates used for demonstrating the relative outcomes from alternative strategies, and did not include the capacity of relevant parties to deliver.

7.1.5 Maximising ecosystem health

1. Participants from the DBCA's South Coast Region produced an estimate of the total hectares that would be managed (e.g. introduced predator control, fire, biosecurity, monitoring) for Kyloriny conservation under each management alternative.
2. They then listed the number of other threatened vertebrate species (WA Biodiversity Conservation Act) and the number of priority, conservation dependent, migratory, and species otherwise in need of special protection, that might also benefit from Kyloriny conservation management. This included up to 23 threatened species and 28 priority, conservation dependent, migratory, and species otherwise in need of special protection, depending on the site selected.
3. These data were then presented as estimates for each management alternative in the consequence table.

7.2 Outcome

The management alternatives were predicted to perform differently in relation to the various objectives. The parameter values were relatively consistent among experts for most management options, so we generally considered the average score to reflect the belief of the group. However, different experts gave contrasting estimates for the growth of the zoo population under the Kaboonga and Captive+++ options (see Table 2 for description of management options). Therefore, for these two options the average

parameter estimates across all experts are shown along with the individual estimates for the most pessimistic and the most optimistic expert (Fig. 5b, Fig. 5c, Fig 5d, Fig. 5e and Table 3).

The Kaboonga option performed the best after 10 years of management when considering maximising the number of Kyloriny (Fig. 5b, Fig. 5c and Table 3) and the number of Kyloriny populations (Fig. 5c, Fig. 6 and Table 3). The Kaboonga and Captive+++ options performed the best after 10 years of management when considering minimising the probability of Kyloriny extinction in 10 years (Fig. 5b, Fig. 5c, Fig 5d, Fig. 5e, Fig.7 and Table 3). However, these options would be the most expensive (Fig. 8) and are only partially acceptable to Noongar (Table 3).

The Wild Only option performs the best when minimising cost. However, this option was predicted to return the least Kyloriny and Kyloriny populations after 10 years of management (Fig. 5g, Fig. 6 and Table 3) and predicted to have the highest probability of Kyloriny extinction (Fig. 7 and Table 3).

The Status Quo, Reinforcement A, Reintroductions, Translocate+ and Wild Only options are acceptable to Noongar. Of the remaining options some may be acceptable, subject to ongoing discussion, whereas others have some aspects that are acceptable (Table 3).

Under the community engagement objective the Translocate+ option performs the best when considering the number of volunteer hours per annum (Fig. 9 and Table 3), the Kaboonga option when considering additional FOWGP members (Fig. 10 and Table 3), Reinforcement B, Kaboonga, Reintroductions, Translocate+ and Large Fence when considering communications per annum from all partners (Fig. 11 and Table 3) and Captive+++ when considering donations to FOWGP (Fig. 12 and Table 3).

Kaboonga, Reintroductions and Translocate+ options perform the best when considering maximising the number of hectares protected (Fig. 13 and Table 3), the number of other threatened vertebrate species (WA Biodiversity Conservation Act) and the number of priority, conservation-dependent, migratory, and species otherwise in need of special protection protected because of Kyloriny conservation management (Fig. 14 and Table 3).

A full comparison of the consequences for each of the alternatives can be found in the consequence table (Table 3).

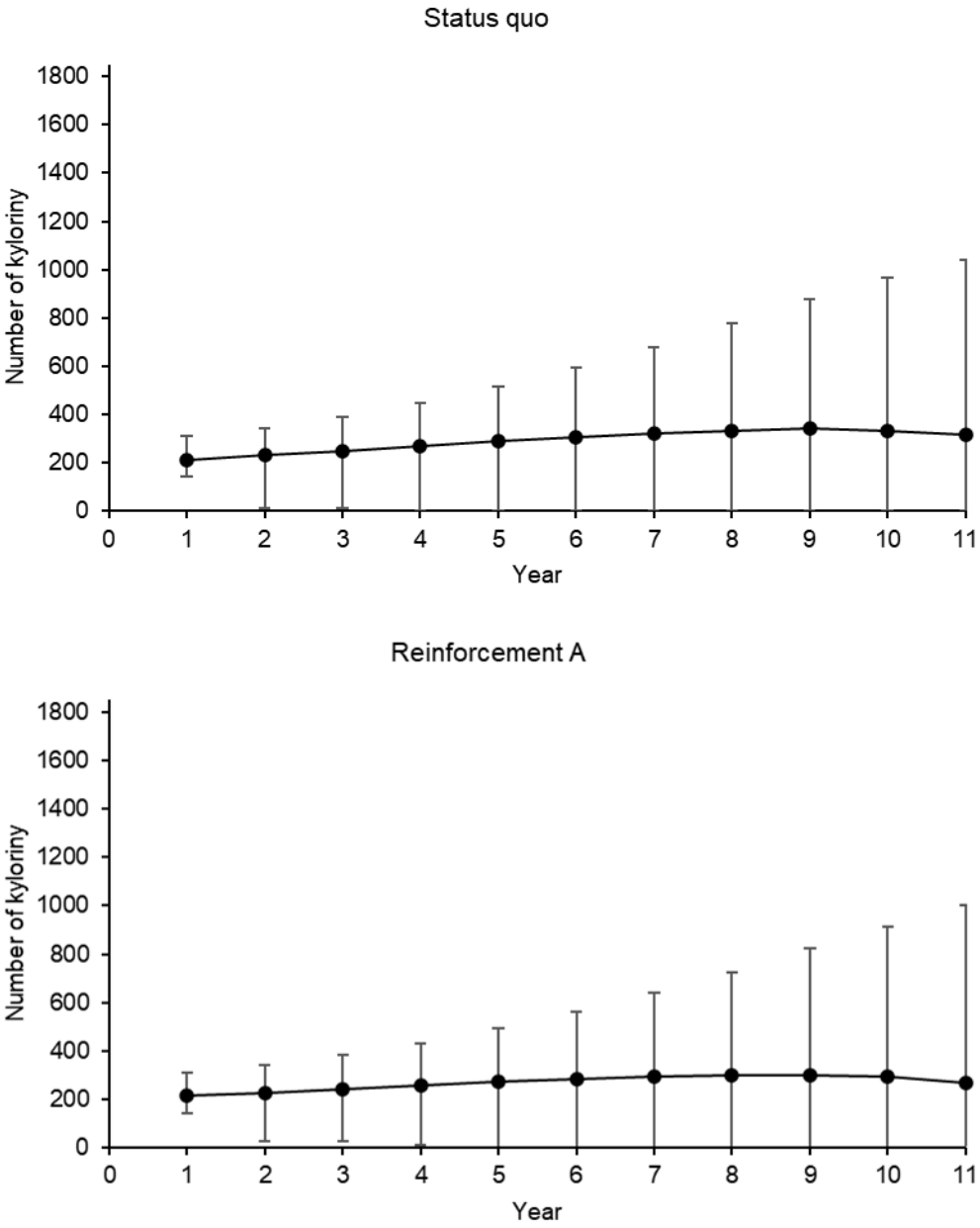


Fig. 5a. Predicted population projections for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) under the Status Quo and Reinforcement A management alternatives. Dots represent medians and the vertical bars indicate 95% credible intervals.

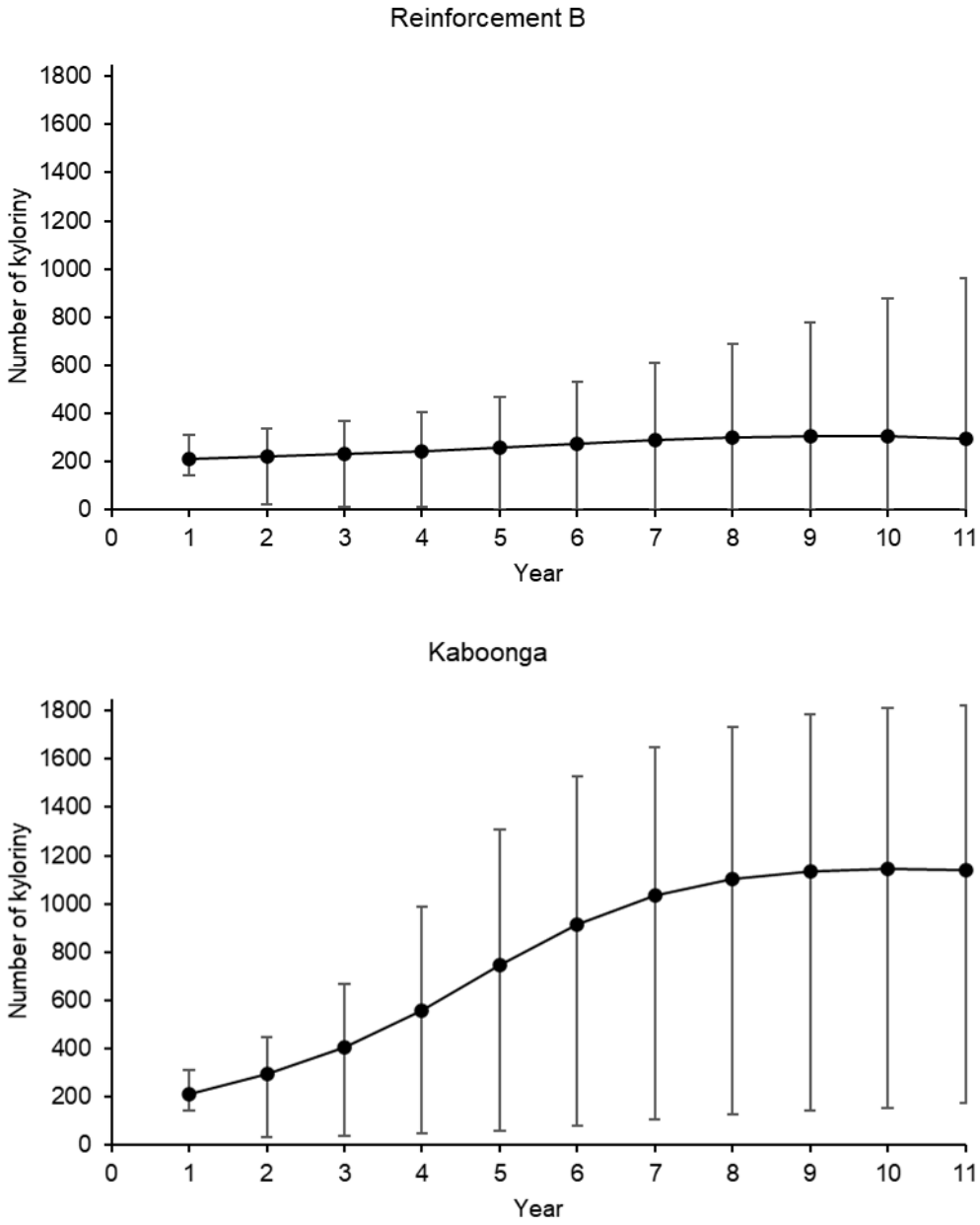


Fig. 5b. Predicted population projections for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) under the Reinforcement B and Kaboonga management alternatives. Dots represent medians and vertical bars indicate 95% credible intervals.

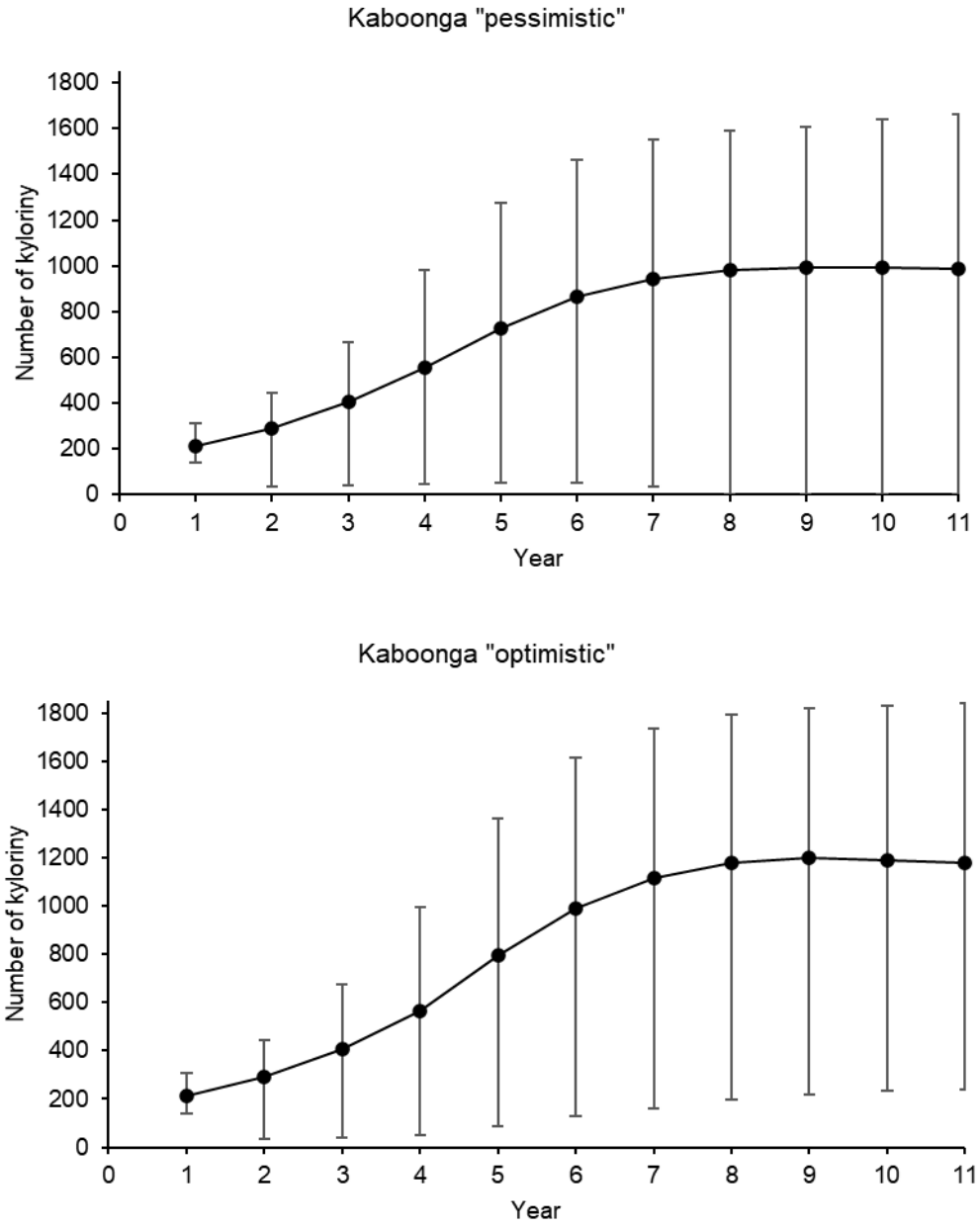


Fig. 5c. Predicted population projections for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) under Kaboonga "pessimistic" and Kaboonga "optimistic". Lines represent medians and the bars indicate 95% credible intervals.

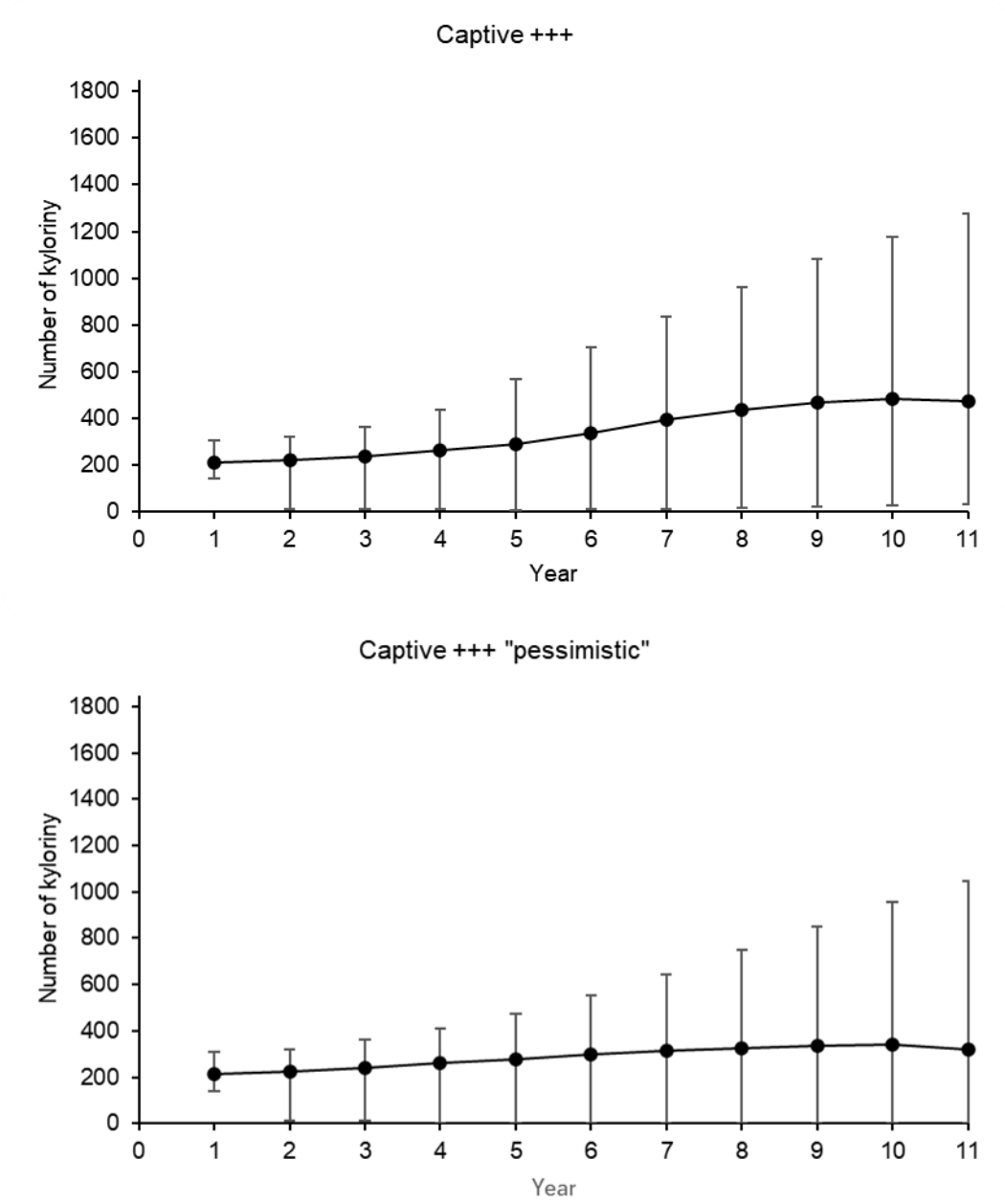


Fig. 5d. Predicted population projections for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) under the Captive +++ and Captive +++ "pessimistic" management alternatives. Dots represent medians and vertical bars indicate 95% credible intervals.

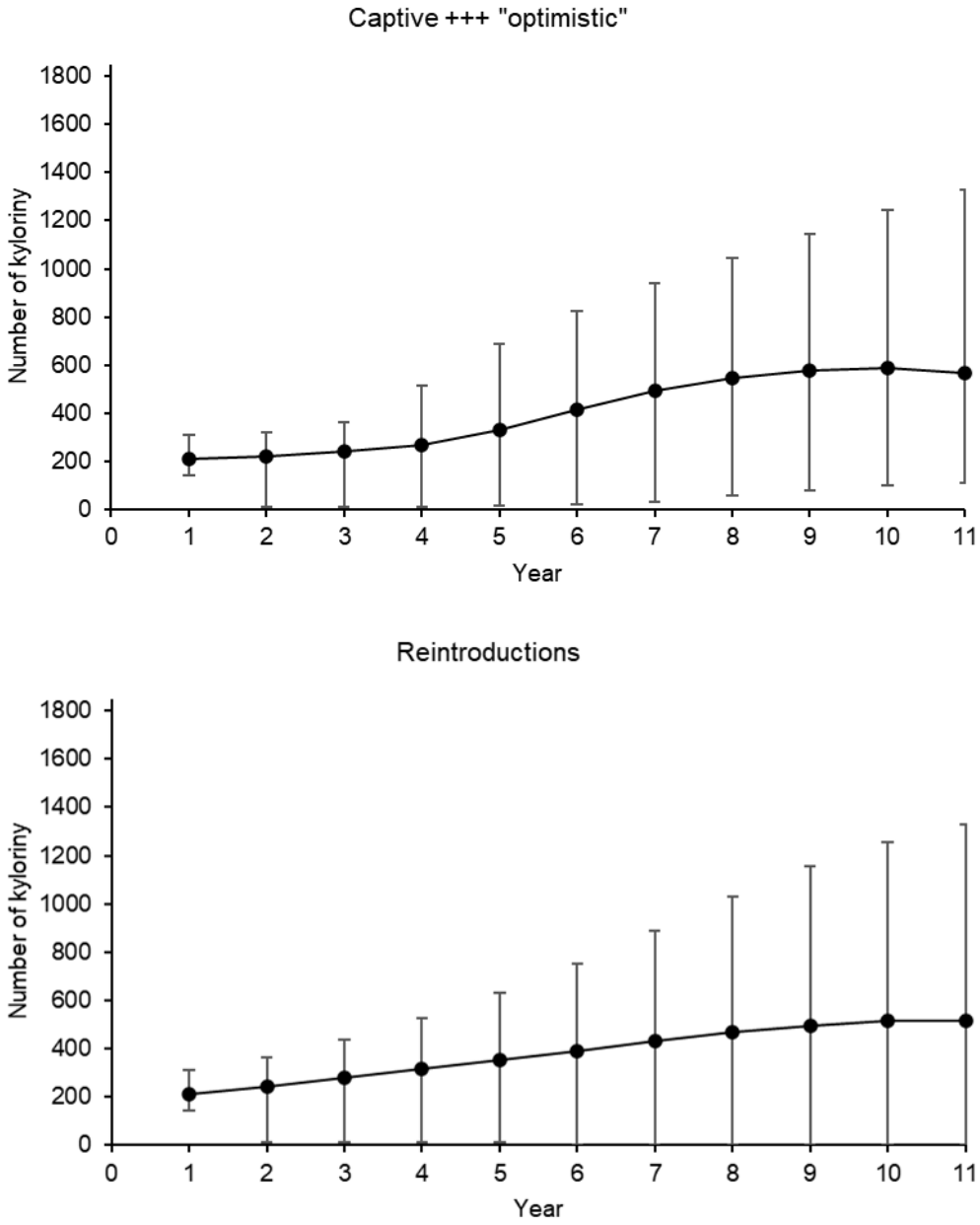


Fig. 5e. Predicted population projections for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) under the Captive +++ "optimistic" and Reintroductions management alternatives. Dots represent medians and vertical bars indicate 95% credible intervals.

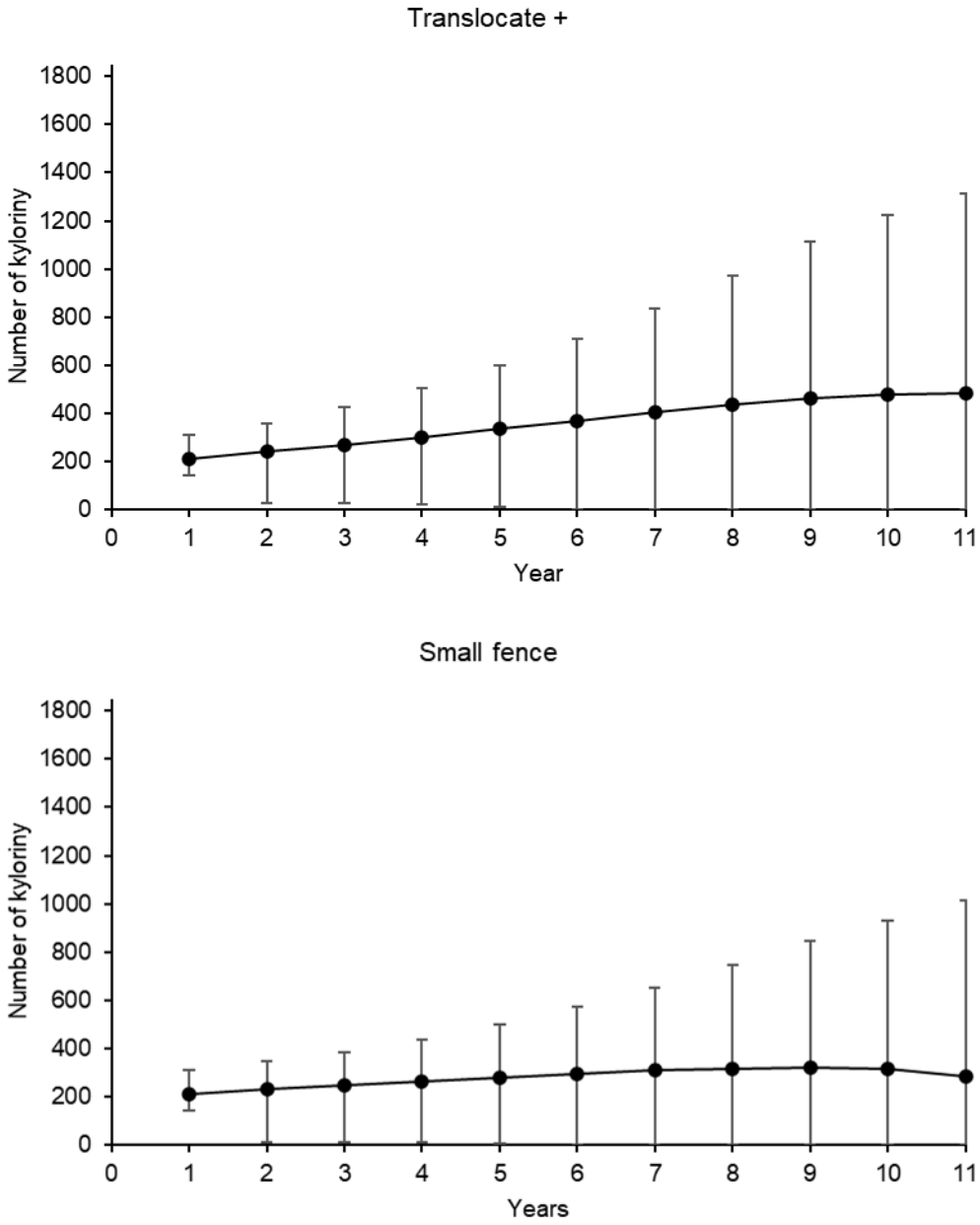


Fig. 5f. Predicted population projections for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) under the Translocate + and Small Fence management alternatives. Dots represent medians and the vertical bars indicate 95% credible intervals.

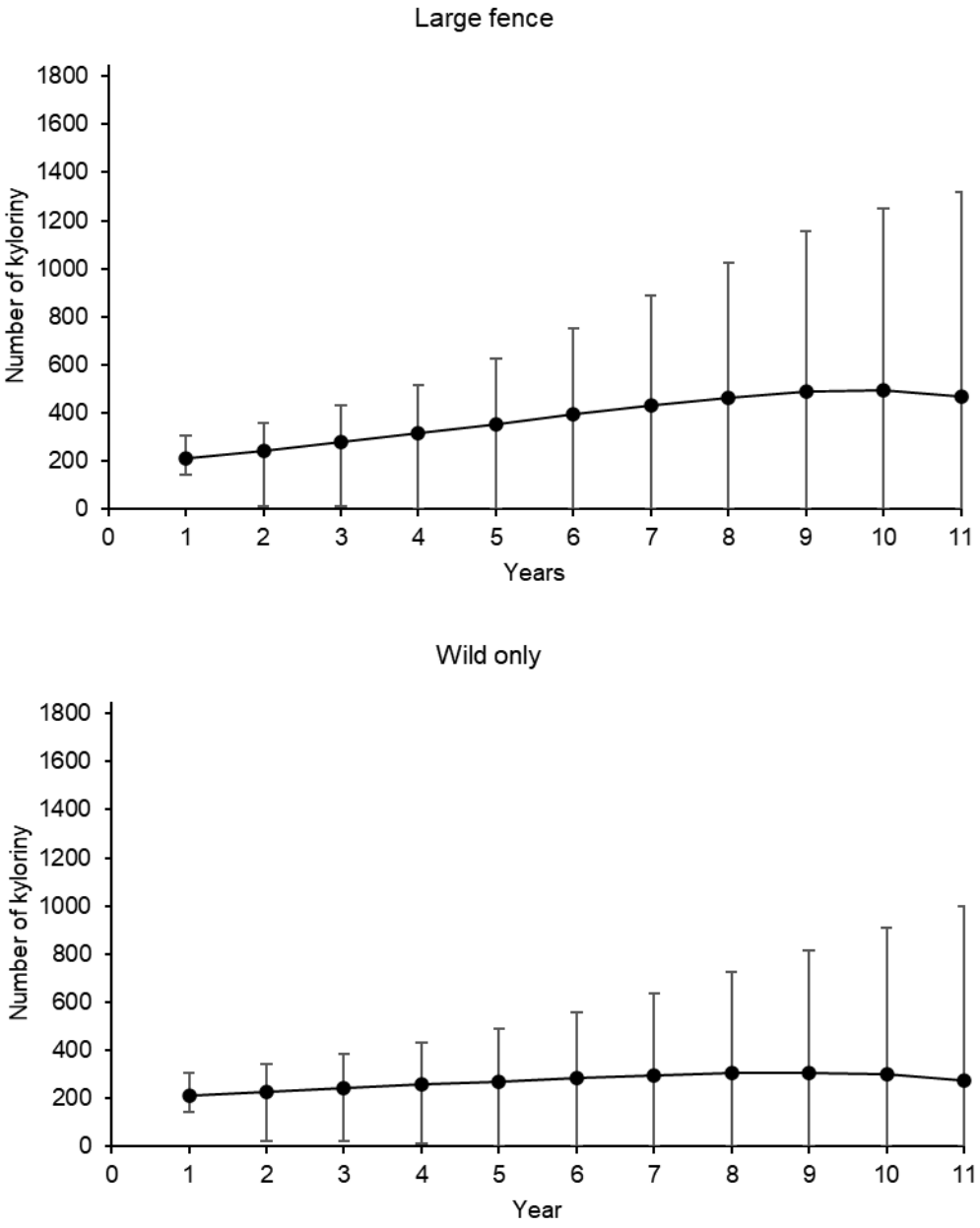


Fig. 5g. Predicted population projections for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) under Large Fence and Wild Only management alternatives. Dots represent medians and the vertical bars indicate 95% credible intervals.

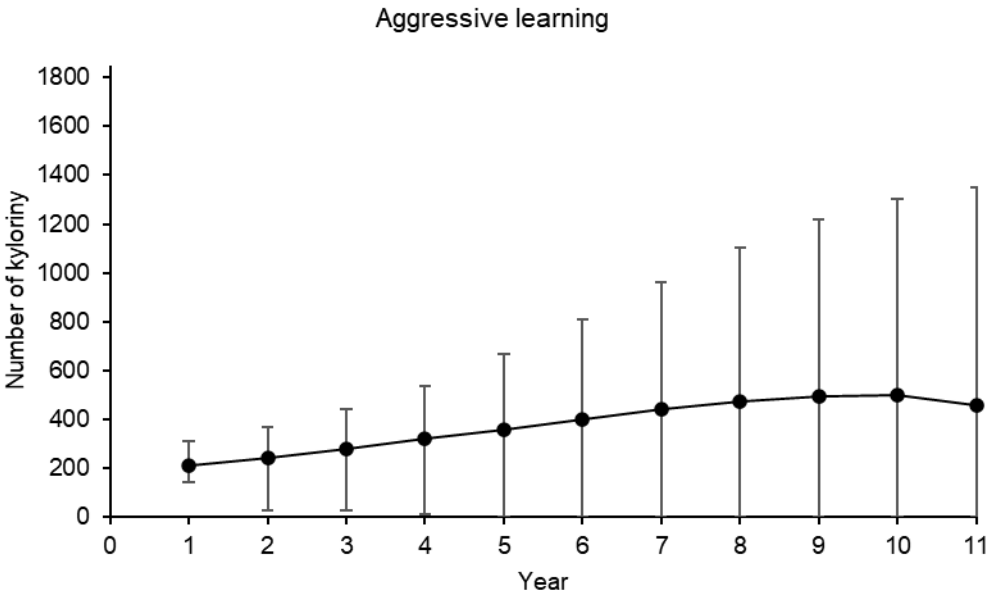


Fig. 5h. Predicted population projections for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) under the Aggressive Learning management alternative. The dots represent medians and the vertical bars indicate 95% credible intervals.

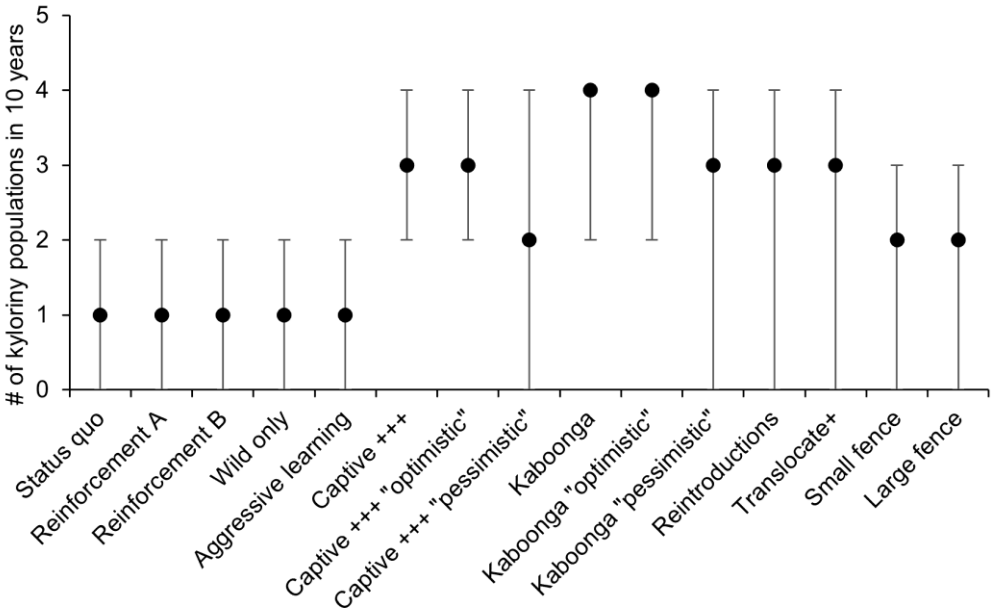


Fig. 6. Predicted number of Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) populations after 10 years under 11 different management alternatives, with "pessimistic" and "optimistic" predictions included for Kaboonga and Captive+++. The filled black circles represent the median number of populations and the vertical bars indicate 95% credible intervals.

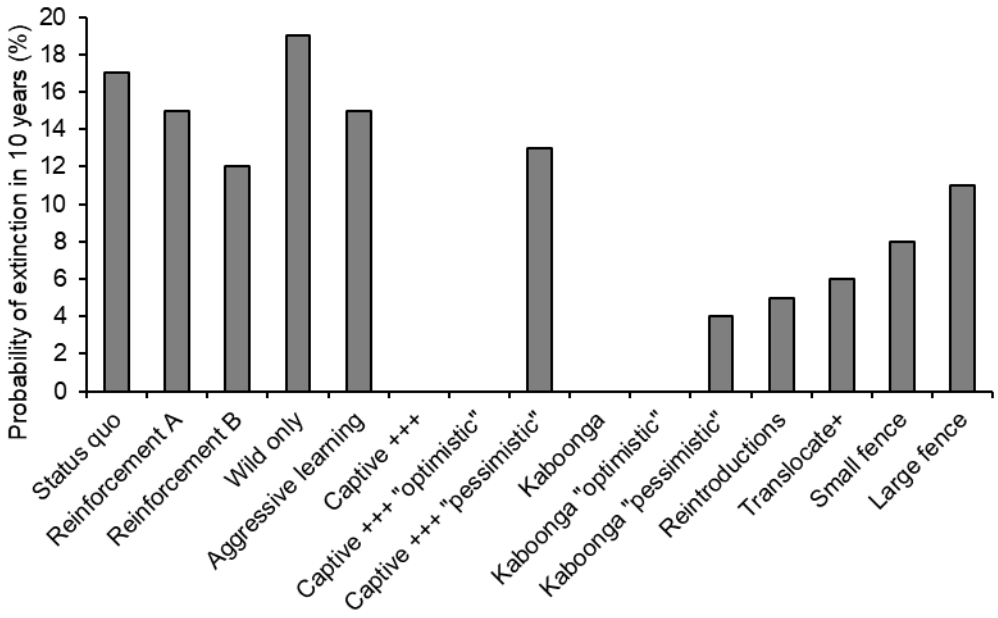


Fig. 7. The probability of Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) extinction after 10 years under 11 different management alternatives, with "pessimistic" and "optimistic" predictions included for Kaboonga and Captive+++.

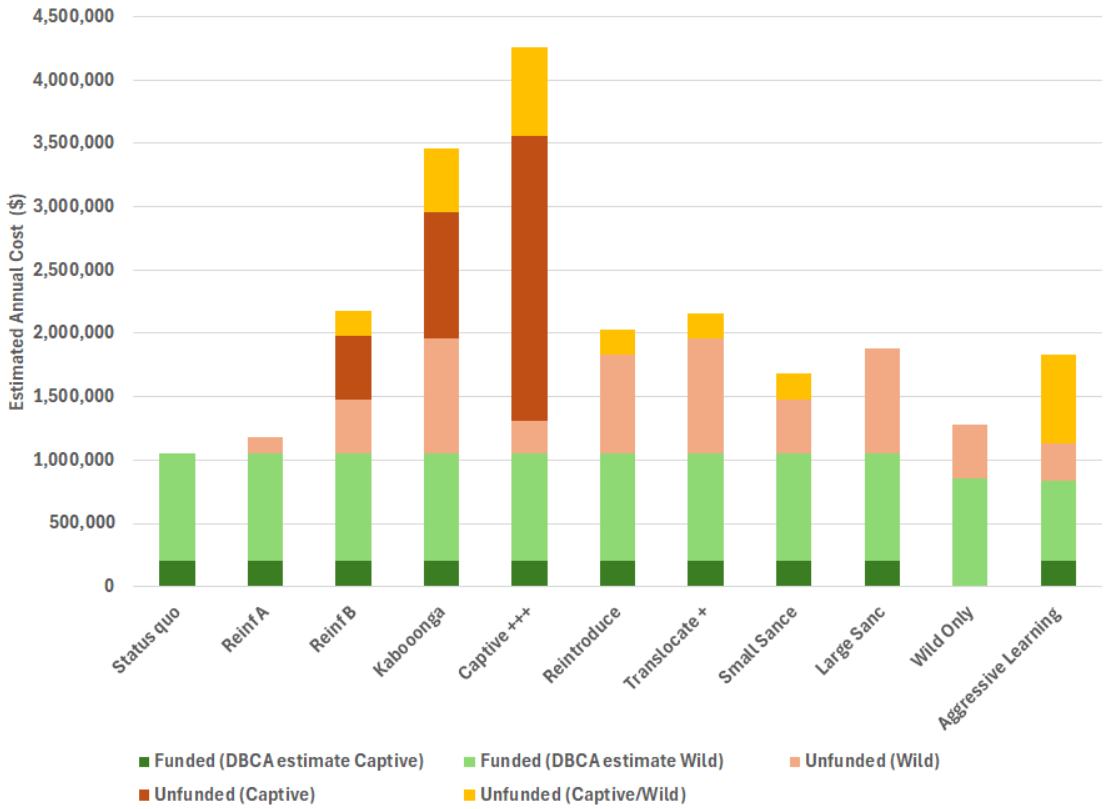


Fig. 8. The indicative cost per annum of Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) conservation management under 11 different management alternatives, with estimates of existing DBCA commitment and funds required to implement each alternative.

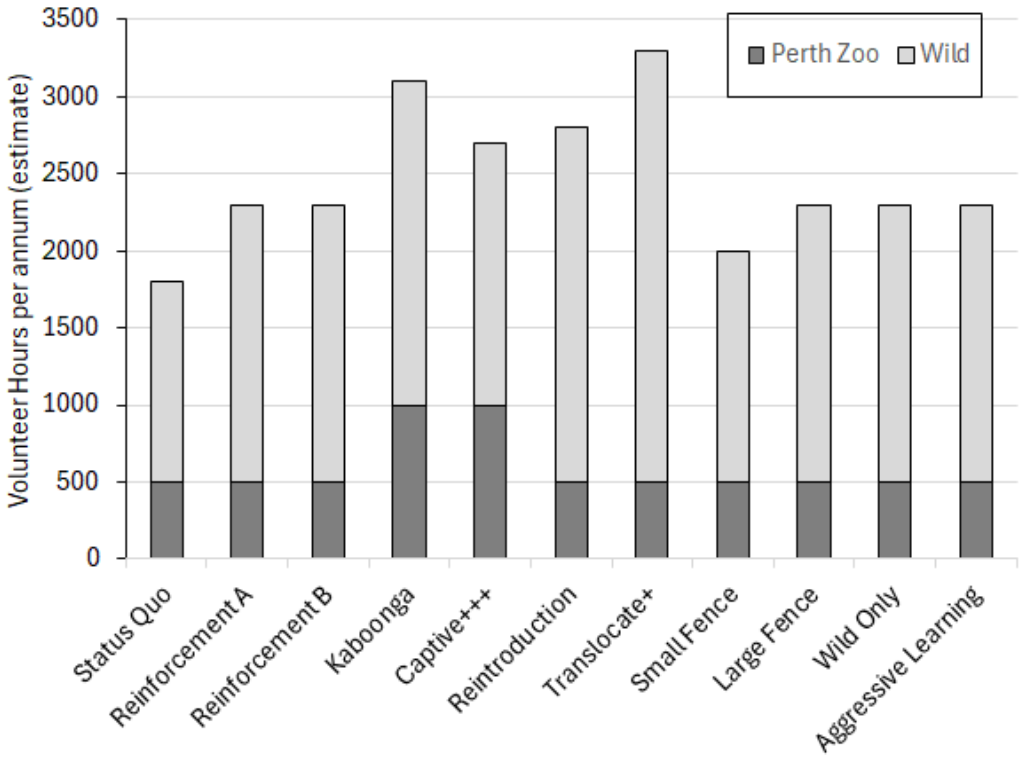


Fig. 9. Estimates of hours contributed by volunteers per annum under 11 different management alternatives for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) conservation management.

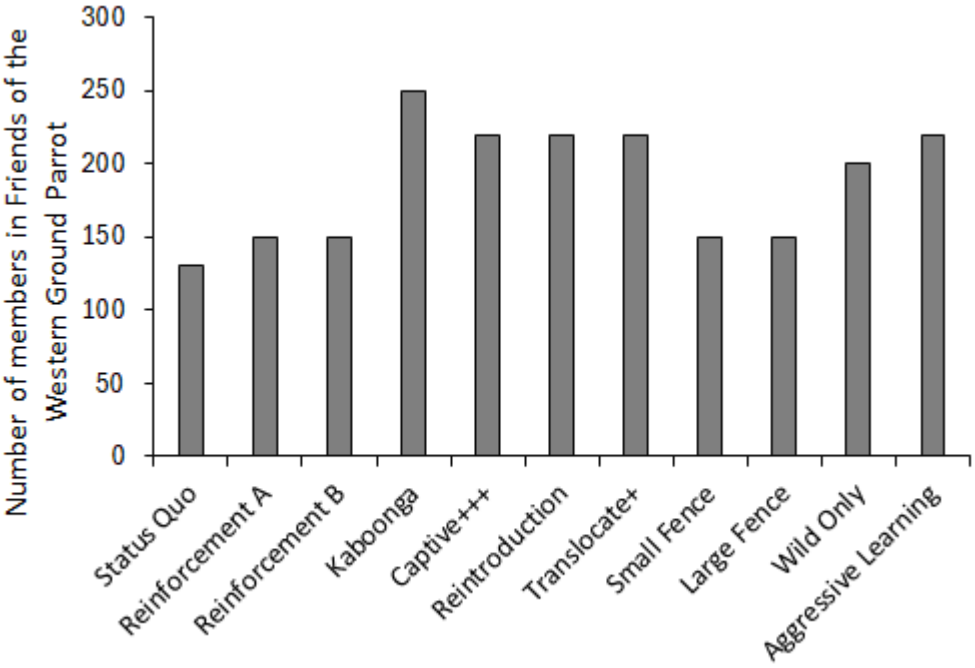


Fig. 10. Estimated number of members in Friends of the Western Ground Parrot under 11 different management alternatives for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) conservation management.

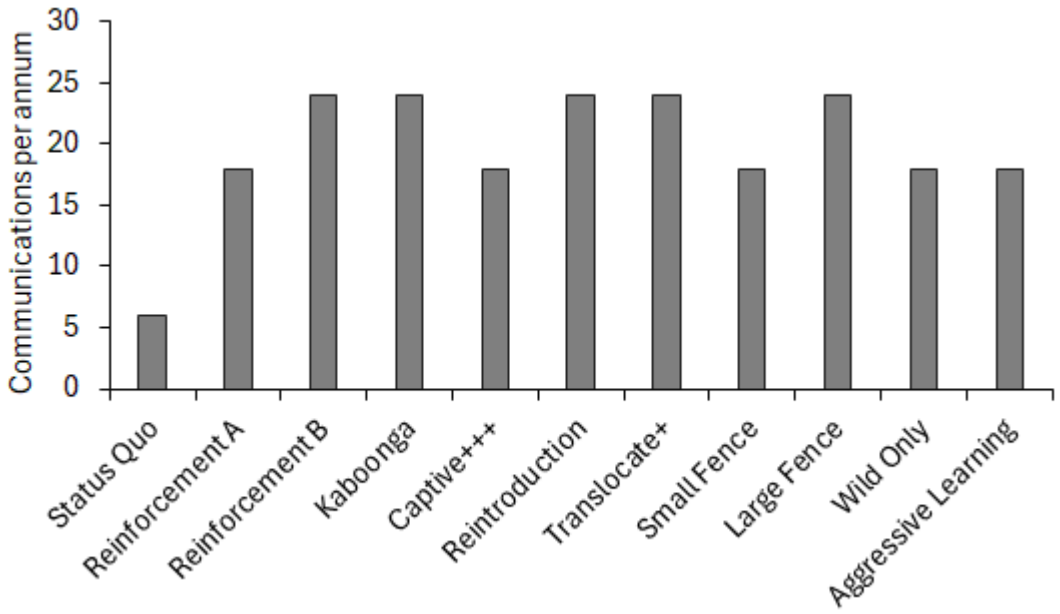


Fig. 11. Communications (e.g. public talks and meetings, reports, scientific papers) estimated per annum from all partners under 11 different management alternatives for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) conservation management.

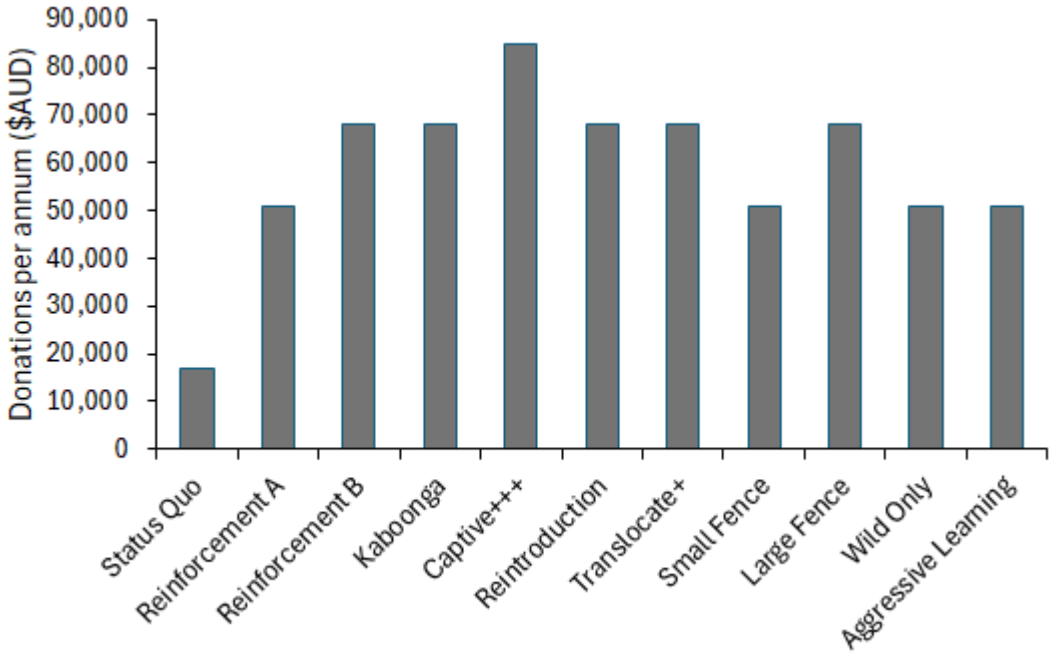


Fig. 12. Estimates of donations ($AUD) per annum from all partners under 11 different management alternatives for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) conservation management.

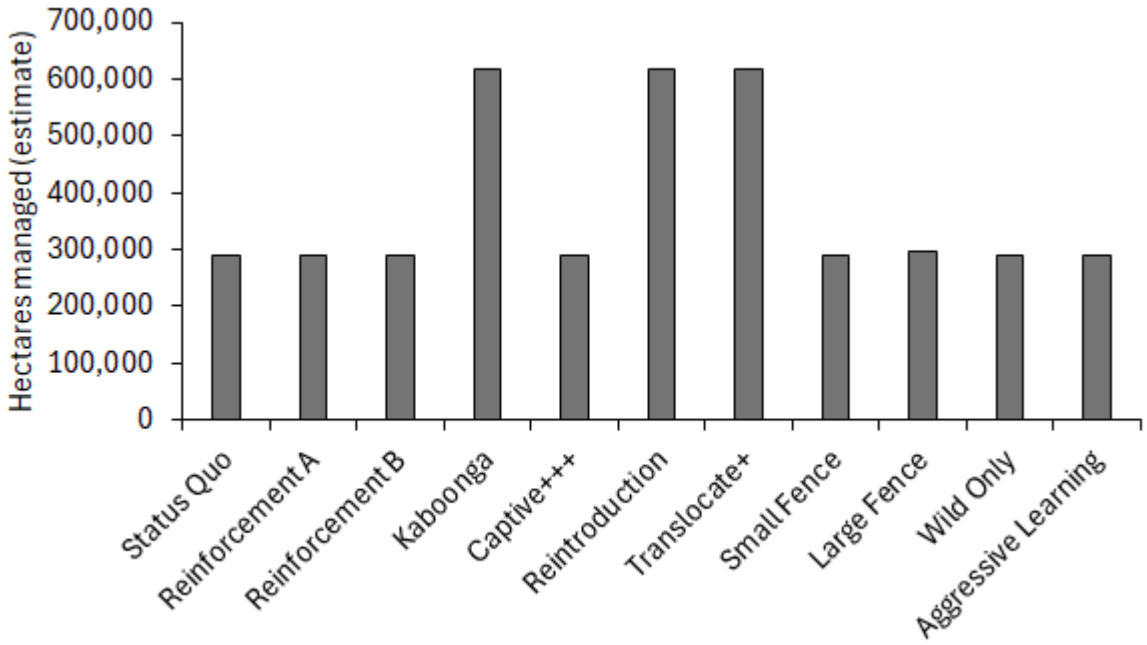


Fig. 13. Hectares managed under 11 different management alternatives for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) conservation management.

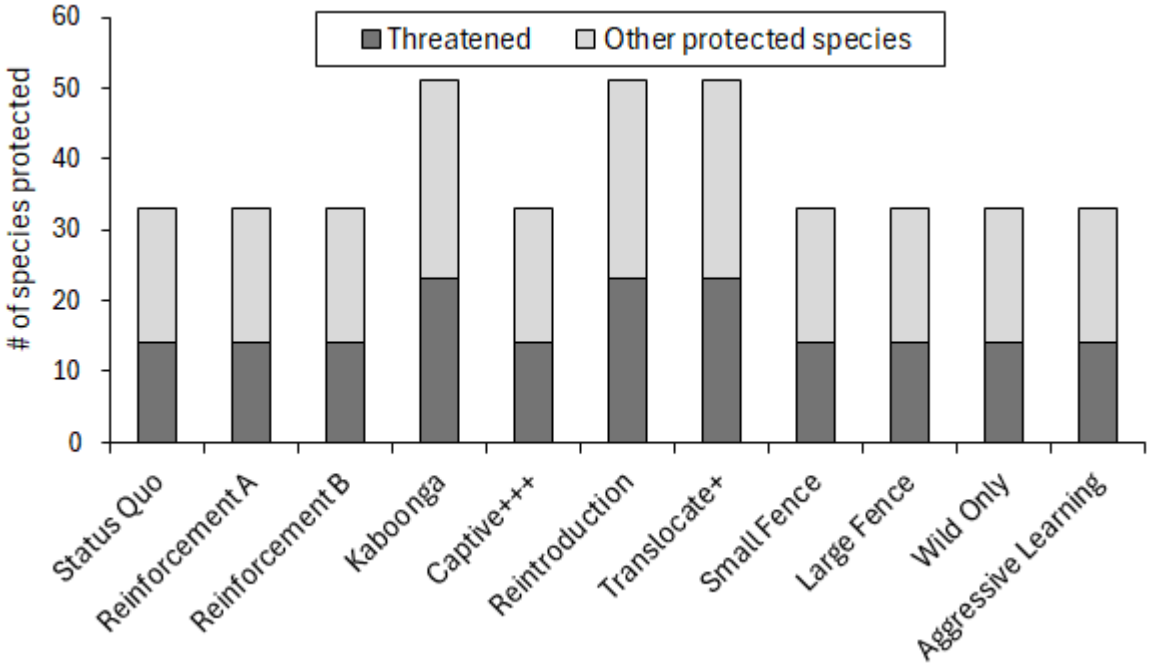


Fig. 14. Additional listed species (threatened and other protected species) protected under 11 different management alternatives for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) conservation management.

Table 3. Consequence table for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) management under each alternative. For the total numbers of Kyloriny and Kyloriny populations in the wild, the values shown are means and 95% credible intervals based on population modelling. Values for other objectives are point estimates based on expert consensus. Performance of each management objective for Noongar was determined by Elders and Rangers. The best-performing alternative for each objective is highlighted in yellow. Optimistic and pessimistic predictions are only applicable to the maximising persistence objectives.

Objective	Performance measure	Status quo	Reinforce A	Reinforce B	Kaboonga	Kaboonga pessimistic	Kaboonga optimistic	Captive +++	Captive +++ pessimistic	Captive +++ optimistic	Reintros	Trans +	Small fence	Large fence	Wild only	Aggressive learning
Max persistence	# Kyloriny in 10 yrs	330 (0-1042)	318 (0-1000)	310 (0-960)	1023 (181-1816)	860 (0-1661)	1053 (239-1838)	552 (67-1263	343 (0-1044)	622 (566-1329))	497 (0-1331)	490 (0-1315)	318 (0-1013)	465 (0-1318)	316 (0-996)	486 (0-1352)
	# Kyloriny popns in 10 yrs	1 (0-2)	1 (0-2)	1 (0-2)	4 (2-4)	3 (0-4)	4 (2-4)	3 (2-4)	2 (0-4)	3 (2-4)	3 (0-4)	3 (0-4)	2 (0-3)	2 (0-3)	1 (0-2)	1 (0-2)
	Probability of extinction in 10 years (%)	17	15	12	0	4	0	0	13	0	5	6	8	11	19	15
Min $$$	$$$ cost pa	1,320,000	1,450,000	2,000,000	3,750,000			4,500,000			2,260,000	2,360,000	1,650,000	1,850,000	1,254,000	1,800,000
Noongar-led caring for country	Acceptable?**	Acceptable **	Acceptable **	Some aspects acceptable **	Some aspects acceptable **			Some aspects acceptable **			Acceptable **	Acceptable **	May be acceptable **	May be acceptable **	Acceptable **	Some aspects acceptable **
Max community engagement	# vol hrs (average p.a.) (DBCA)	1300 +PZ 500	1800 +PZ 500	1800 +PZ 500	2100 +PZ 1000			1700 +PZ >1000			2300 +PZ 500	2800 +PZ 500	1500 +PZ 500	1800 +PZ 500	1800 +PZ 500	1800 +PZ 500
	# FOWGP members	130	150	150	250			220			220	220	150	150	200	220
	Communications (p.a. all partners)	6	18	24	24			18			24	24	18	24	18	18
	Donations (FoWGP)	$17,000	$51,000	$68,000	$68,000			$85,000			$68,000	$68,000	$51,000	$68,000	$51,000	$51,000
Max ecosystem health	# hectares managed	290,000	290,000	290,000	619,000			290,000			619,000	619,000	290,000	297,200	290,000	290,000
	# vertebrate spp. benefit (Threatened) ***	14	14	14	23			14			23	23	14	14	14	14
	# vertebrate spp. benefit (Priority/CD/ OS/Migratory)	19	19	19	28			19			28	28	19	19	19	19

*** Caveats of acceptable consultation: acceptability of various scenarios requires input on a case by case basis. Are translocations within understood 'historical range'?; Foster collaboration and communication between First Nations groups including Elders and Aboriginal Rangers from the source and translocation site; Co-design - engagement of TOs in site selection, preparation of translocation proposal and implementation of translocation . Translocations to zoo may be in range, but sending adults into captivity out of country not ideal – harvest eggs, or first year birds if preferred. Cultural safety needs to be considered in all aspects of delivery. Communication between Elders from different language groups. Welcome to country for translocated animals.*

**** Species benefitting - CANP and WMP are included for all strategies, Reintroduction Sites 1 and 2 have been calculated using CLG (Cape Le Grand NP) and FRNP (Fitzgerald River NP) as release sites, Kaboonga and Captive +++ also use CLG and FRNP as release sites, Small fence is assumed to be the Normans enclosure (within the WMP area), and Large fence has been calculated using NW (Nuyts Wilderness) as the site*

8. Trade-offs and identifying the best option

Steps 5 & 6 of the SDM process

The best strategy is the one that is believed to best meet the objectives. For single-objective decisions, it is easy to choose the strategy that provides the best outcome. However, when faced with multiple objectives, it is important that all the alternatives are carefully considered, particularly when there are conflicting objectives so trade-offs are required. The final selection of a management strategy may be affected by the uncertainty that surrounds the estimated outcomes of the candidate strategies. SDM provides several tools to account for uncertainty and trade-offs, which can improve transparency and provide decision-makers with a more complete assessment of the problem.

8.1 Process

The working group used the consequence table (Table 3) to examine trade-offs between maximising the persistence of Kyloriny, minimising costs, maximising Noongar-led caring for country to maintain and enhance/reinforce Noongar connection with Kyloriny, maximising community engagement with Kyloriny and maximising ecosystem health. The specific process involved examining the consequence table in a rational manner and, if possible, simplifying it by removing dominated options, accounting for uncertainty, facilitating deliberation and identifying the best option for Kyloriny management as follows:

1. Upon completion of the consequence table, the working group first voted anonymously on the management alternatives that were a) acceptable to them and b) their single preferred management alternative.
2. The working group then examined the consequence table for alternatives that were either considered unacceptable or were outperformed across all objectives by other alternatives.
3. The outcome of the first round of voting was then extensively discussed followed by a second round of anonymous voting on the management alternatives that were a) acceptable to them and b) their single preferred management alternative.
4. This was followed by further discussion within the working group and then two rounds of anonymously ranking the remaining alternatives from their most preferred to their least preferred management option. The ranks were then summed for each alternative, with the most preferred alternative receiving the lowest value and the least preferred the highest value.

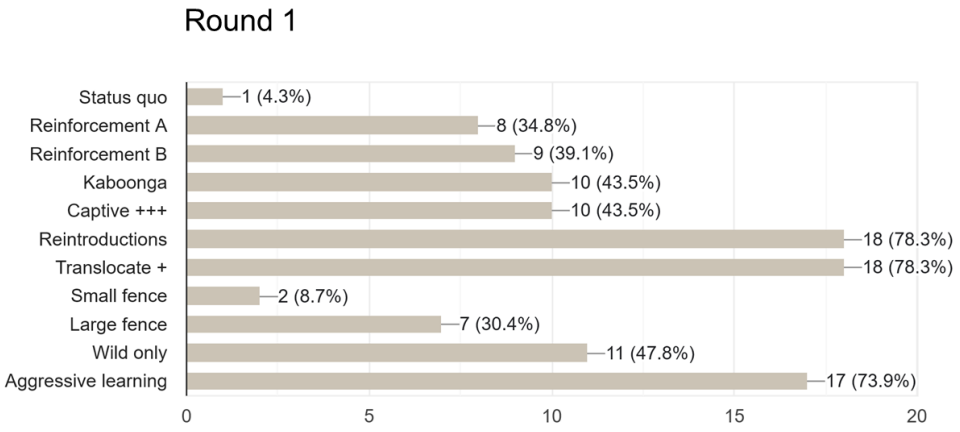
8.2 Outcome

There was extensive discussion about the various alternatives and their performance as indicated by the consequence table. No single option was unanimously rejected as unacceptable by 23 participants in the first round of simple voting (Fig. 15). When workshop participants individually considered which alternative was the best 35% (n = 8) chose the Translocate+ option, 22% (n = 5) chose Reintroductions and 22% chose Aggressive Learning. All other options each received less than 9% (n ≤ 2) support (Fig. 16).

The second round of voting was completed by 22 participants following discussion about the first-round results. Again, no single option was rejected as unacceptable (Fig. 15). When individually considering which alternative was the best, 59% (n = 13) chose the Translocate+ option and 23% (n = 5) chose the Aggressive Learning. Support for all other options was less than 9% each (n ≤ 2) (Fig. 16). The working group also decided that no single option was clearly dominated by any other option.

There was further extensive discussion following the two rounds of simple voting. The working group then anonymously ranked the management alternatives from their most to least preferred. Consistent with the two rounds of simple voting, Translocate+ was the most preferred option with Aggressive Learning also supported as the second preferred option. Support for the various options remained essentially the same after discussion and the final ranking round (Table 4). Consequently, and following discussion, the working group recommends a combination of the Translocate + option supported by Aggressive Learning to the final decision-makers as this represents the best option for Kyloriny conservation management. The incorporation of the Aggressive Learning option was discussed, and is included as the recommendation as it is an important potential means to advance the effectiveness of Kyloriny conservation management. In particular, this provides for novel research to improve monitoring, build the potential of the captive population, and potentially enable more translocations. The cost of a combination of these two options would be less than the combined cost of Translocate + and Aggressive Learning as there is overlap between the two alternatives (Table 3).

All the preferred options included increased partnerships with Noongar and an increased community connection with Kyloriny conservation. Six of the seven highest preferred alternatives all included reinforcement translocations of the Kyloriny population at Waychinicup (Reintroductions did not include reinforcement of Waychinicup). Three of the six most preferred include translocations to new sites, and three of the four most preferred included an increase in the amount of land managed for Kyloriny, particularly through increased introduced predator control and fire management. There was much less support for the status quo, a singular focus on the existing two wild populations, intensive captive rearing or fenced sanctuaries for Kyloriny conservation (Fig. 15, Fig. 16, Table 4).



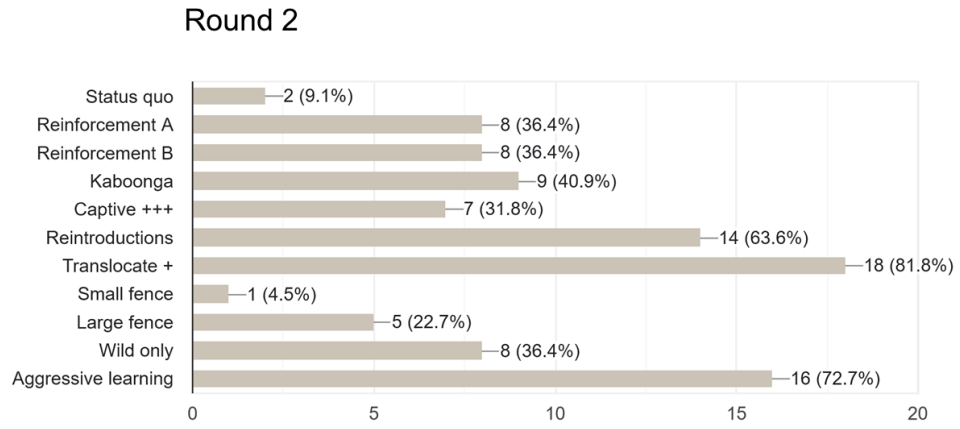
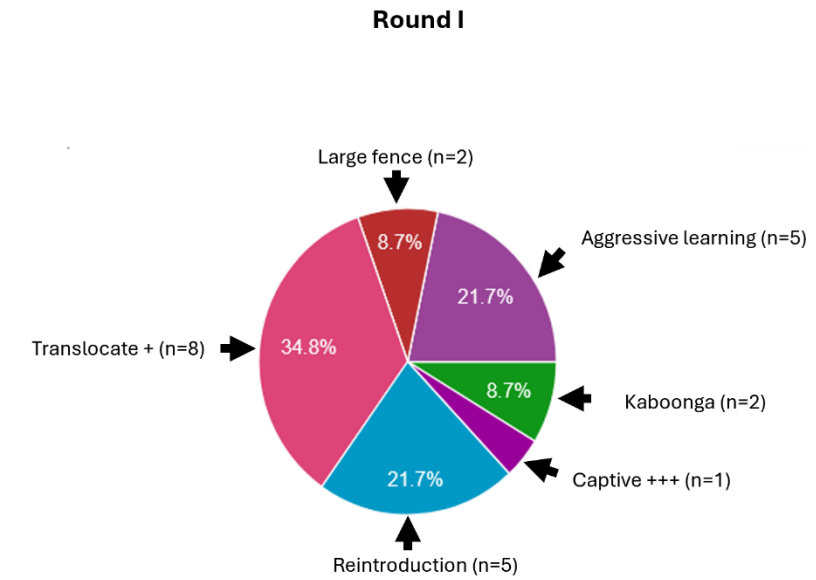


Fig. 15. Management alternatives that are considered acceptable to each individual workshop participant in two rounds of anonymous voting.



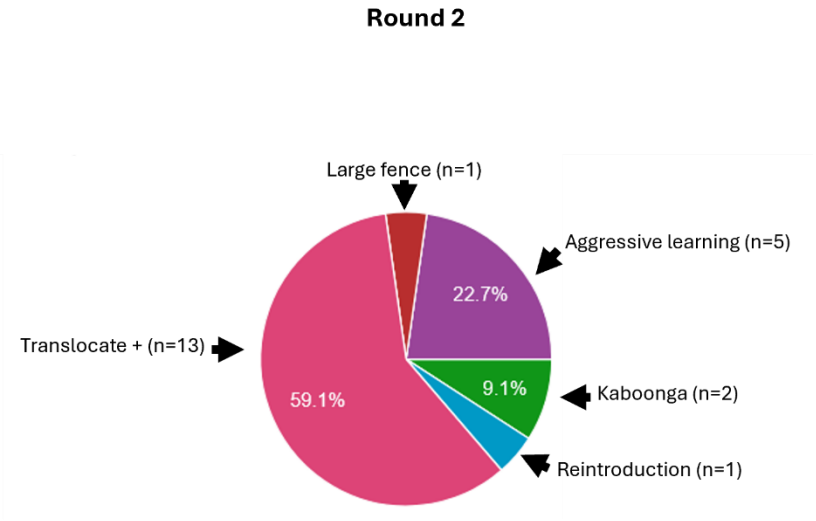


Fig. 16. The single management alternative that was considered the best for each individual workshop participant in two rounds of anonymous voting.

Table 4. Round 1 (left) and round 2 (right) anonymised individual rankings of preferred management alternatives for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) conservation management. The management alternatives are listed from the most preferred (Translocate +) to least preferred (Small fence).

ROUND 1												
MANAGEMENT ALTERNATIVES												
		Translocate +	**Aggressive learning**	**Reinforcement B**	**Reintroductions**	**Reinforcement A**	**Kaboonga**	**Wild only**	**Captive+++**	**Large fence**	**Status quo**	**Small fence**
PARTICIPANTS	**Sum**	50	73	89	90	91	93	121	128	136	154	163
	P1	4	5	3	1	7	6	8	2	9	11	10
	P2	2	6	1	3	7	5	9	4	10	8	11
	P3	1	3	2	9	5	4	8	11	6	10	7
	P4	6	2	10	8	9	5	1	11	3	7	4
	P5	1	3	5	2	6	7	8	4	10	9	11
	P6	1	6	4	8	2	5	10	11	3	7	9
	P7	2	4	6	3	1	5	7	10	8	11	9
	P8	1	2	7	9	4	3	5	10	8	6	11
	P9	8	3	1	2	7	4	9	6	10	5	11
	P10	4	2	5	7	1	6	3	8	9	11	10
	P11	3	2	8	1	5	9	11	4	6	10	7
	P12	1	4	7	6	5	2	3	11	9	8	10
	P13	1	5	2	4	3	7	8	6	10	9	11
	P14	1	8	7	3	2	6	5	4	10	9	11
	P15	11	9	10	4	8	7	6	3	5	2	1
	P16	1	3	5	6	8	2	10	7	4	11	9
	P17	1	4	2	8	3	7	5	9	6	11	10
	P18	1	2	4	6	8	3	5	7	10	9	11
	P19	-	-	-	-	-	-	-	-	-	-	-
	P20	-	-	-	-	-	-	-	-	-	-	-
	P21	-	-	-	-	-	-	-	-	-	-	-
	P22	-	-	-	-	-	-	-	-	-	-	-
	P23	-	-	-	-	-	-	-	-	-	-	-

ROUND 2												
MANAGEMENT ALTERNATIVES												
		Translocate +	**Aggressive learning**	**Reintroductions**	**Kaboonga**	**Reinforcement B**	**Reinforcement A**	**Wild only**	**Captive+++**	**Large fence**	**Status quo**	**Small fence**
PARTICIPANTS	**Sum**	43	94	103	104	122	132	150	162	168	215	225
	P1	1	4	3	8	2	7	5	9	6	10	11
	P2	4	5	7	1	3	6	9	2	8	10	11
	P3	2	8	7	3	1	4	9	6	10	5	11
	P4	1	3	4	8	2	5	6	9	7	11	10
	P5	1	2	8	5	4	3	6	7	10	9	11
	P6	2	3	5	4	1	6	7	8	10	9	11
	P7	1	3	8	2	4	6	9	5	10	7	11
	P8	1	3	5	7	2	4	8	11	6	10	9
	P9	6	2	9	10	8	7	1	11	3	5	4
	P10	3	2	5	1	7	9	11	4	6	10	8
	P11	1	3	5	6	7	2	4	11	8	9	10
	P12	1	8	2	3	7	6	5	4	10	9	11
	P13	4	2	1	7	5	6	3	8	9	11	10
	P14	1	2	4	9	7	3	5	10	8	6	11
	P15	1	4	5	2	3	7	8	6	9	10	11
	P16	1	2	8	5	4	3	9	7	6	11	10
	P17	1	4	2	9	3	6	7	11	5	8	10
	P18	1	10	2	4	5	6	9	3	8	11	7
	P19	1	6	2	3	9	5	7	8	4	10	11
	P20	1	3	2	4	10	8	7	6	5	11	9
	P21	2	7	3	1	10	9	6	4	5	11	8
	P22	2	6	3	1	9	8	4	5	7	11	10
	P23	4	2	3	1	9	6	5	7	8	11	10

9. Implementation

Step 7 of the SDM process

The final step in the SDM process is to identify mechanisms for the implementation of the recommendation, including ongoing monitoring to check outcomes with respect to predictions so that new information can be incorporated into future decisions.

After arriving at their final recommendation, the working group immediately set about planning implementation of the Translocate+ management alternative. The most urgent priorities were considered to be reinforcing the recently reintroduced population at Waychinicup-Manypeaks, identifying and commencing the establishment of two new populations, and increasing engagement with Noongar groups. Aggressive Learning was also considered as an important management alternative for many of the workshop participants, with learning and monitoring efforts increased to focus on innovative methods to support and enhance Kyloriny conservation. These have potential to add to the capacity of Perth Zoo to provide birds for translocations (Perth Zoo 2023) and also increase monitoring and management effectiveness for the wild population.

The following progress has been made to date:

- Reinforcement of the Waychinicup-Manypeaks translocated population requires a new translocation proposal, and an application for funding the preparation of this has been secured, with a draft proposal to be prepared in 2026.
- Several potential translocation sites were identified through previous translocation planning work processes, and these will require further ground truthing and assessment for future translocations.
- Perth Zoo have prepared an ex-situ conservation report, which outlines the strategies that will be used to maximise the value of the captive population to Kyloriny conservation.
- Perth Zoo have prepared an H5 High Pathogenicity Avian Influenza response plan to ensure preparedness activities and mitigation responses are appropriate for Kyloriny.
- In December 2025 Perth Zoo celebrated the first ever Kyloriny chick hatched in captivity to survive and progress to the vital milestone of leaving the nest.
- A PhD has commenced looking at improving monitoring capacity through development of machine learning models and understanding of the vocal repertoire of Kyloriny.
- Interviews with First Nations groups have commenced in partnership with the University of Western Australia, and will build on the SDM process and ensure co-design principles are incorporated to recovery of Kyloriny, monitoring and future translocations.
- Monitoring of the wild population at Cape Arid National Park and the adjoining Nuytsland Nature Reserve continues, and will be used to assess the suitability of this population as a source for further translocations and identify suitable areas from which to capture birds.
- Monitoring of the translocated population at Waychinicup-Manypeaks is also ongoing and will be used to inform how many more birds are required for reinforcement.
- Integrated management of introduced predators continues at both source and translocation sites.
- Fire management of Kyloriny habitat continues, with DBCA Albany and Esperance Districts incorporating management of occupied habitat and the translocation site into operational fire management programs.
- Community Engagement continues via the Friends of the Western Ground Parrot Facebook page, and since the workshop Friends of the WGP Newsletters, DBCA media releases, and DBCA presentations at Conferences.

10. Acknowledgements

Making good decisions is hard work but all participants in the Kyloriny SDM process kindly and patiently provided their time, energy, knowledge and insights, both inside and outside the workshops, sometimes on a voluntary basis. Thanks to Lester Coyne for sharing his knowledge with workshop attendees on the field day, and to Rangers from Southern Aboriginal Corporation, Binalup, Wagyl Kaip Southern Noongar and Esperance Tjaltjraak for participating in the workshops. The workshops were funded by DBCA, South Coast NRM, BirdLife Australia and the Friends of the Western Ground Parrot and we are grateful for their support. We are also immensely grateful for the participation of Elders and Aboriginal Ranger teams in this process and guiding outcomes.

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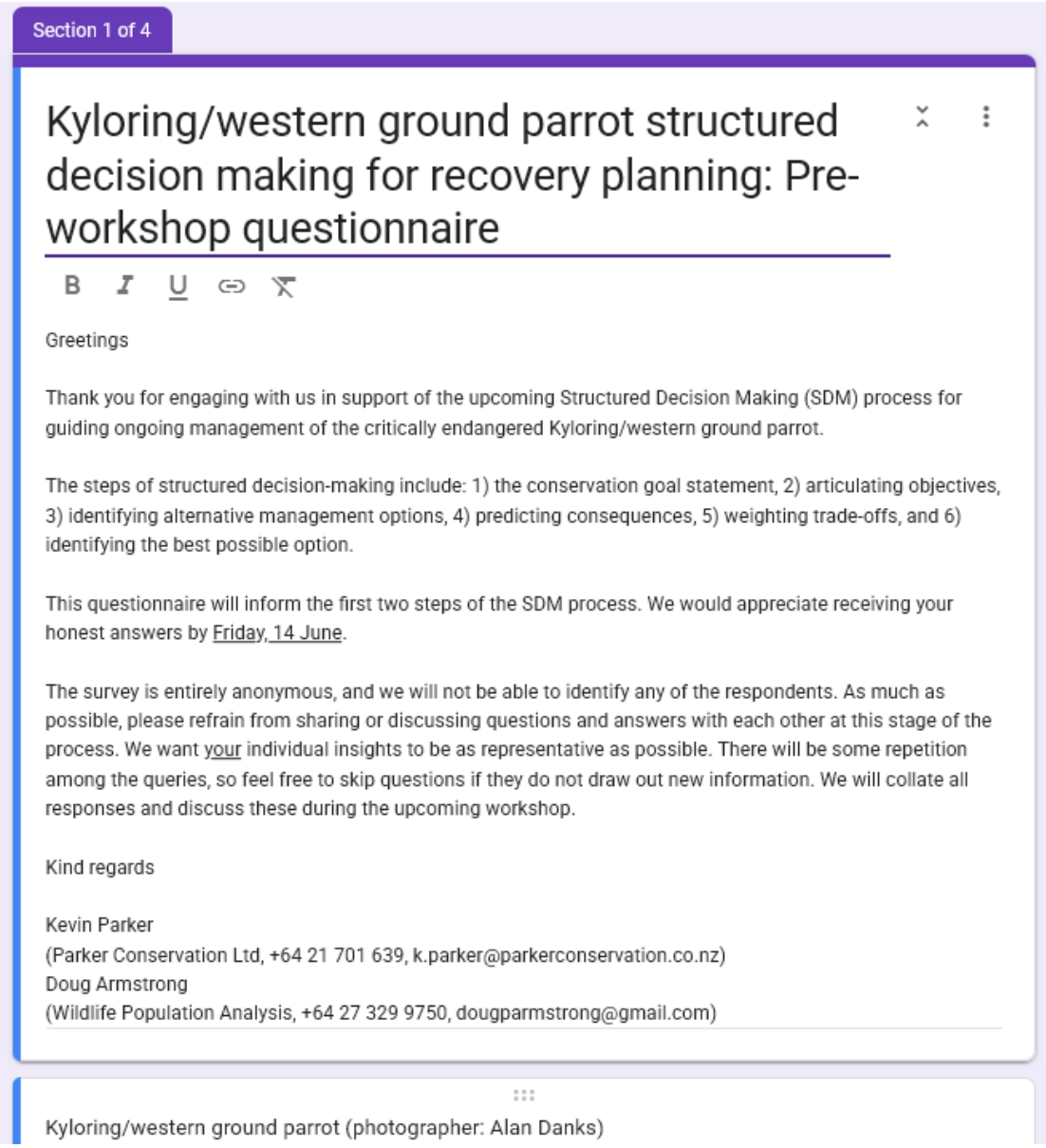
Appendix 1

Questionnaire

The following Google Forms questionnaire was sent to participants prior to the June 2024 structured decision-making workshop at the Albany DBCA offices, WA. The responses to the questionnaire were used for the initial draft of the conservation goal statement.



Section 1 of 4

Kyloring/western ground parrot structured decision making for recovery planning: Pre-workshop questionnaire

Greetings

Thank you for engaging with us in support of the upcoming Structured Decision Making (SDM) process for guiding ongoing management of the critically endangered Kyloring/western ground parrot.

The steps of structured decision-making include: 1) the conservation goal statement, 2) articulating objectives, 3) identifying alternative management options, 4) predicting consequences, 5) weighting trade-offs, and 6) identifying the best possible option.

This questionnaire will inform the first two steps of the SDM process. We would appreciate receiving your honest answers by Friday, 14 June.

The survey is entirely anonymous, and we will not be able to identify any of the respondents. As much as possible, please refrain from sharing or discussing questions and answers with each other at this stage of the process. We want your individual insights to be as representative as possible. There will be some repetition among the queries, so feel free to skip questions if they do not draw out new information. We will collate all responses and discuss these during the upcoming workshop.

Kind regards

Kevin Parker
(Parker Conservation Ltd, +64 21 701 639, k.parker@parkerconservation.co.nz)
Doug Armstrong
(Wildlife Population Analysis, +64 27 329 9750, dougparmstrong@gmail.com)

Kyloring/western ground parrot (photographer: Alan Danks)

Section 2 of 4

Conservation goal statement

These questions will help start our conversation regarding the context (scope and bounds) of Kyloring management and recovery.

Why is there a need for Kyloring management and recovery?

Long answer text

What is the exact decision that needs to be made?

Long answer text

What is the conservation goal?

Long answer text

What is the scale of the decision (e.g., are we limited to management within existing populations)?

Long answer text

By when does a decision about Kyloring management need to be made?

Long answer text

What are the constraints for Kyloring management (e.g. biological, cultural, spiritual, legal, financial, economic, others)?

Long answer text

Who are the important decision makers, in your view, that need to support the identified management options?

Long answer text

After section 2 Continue to next section

Section 3 of 4

Articulating objectives

These questions will help start a conversation regarding the objectives (what do we really care about?) for Kyloring management.

What do you hope that Kyloring management will achieve?

Long answer text

What are the challenges for Kyloring management?

Long answer text

What would be the worst outcome for you?

Long answer text

What do you want to avoid when deciding on management options?

Long answer text

Beyond the recovery of the Kyloring, what additional factors influence your choices?

Long answer text

After section 3 Continue to next section

Section 4 of 4

Additional comments

Description (optional)

Do you have any additional comments or questions for us to consider prior to the workshop?

Long answer text

Appendix 2

Structured decision-making June 2024 in-person workshop details

KYLORINY / WESTERN GROUND PARROT –STRUCTURED DECISION-MAKING SCHEDULE

Date: 27-28 of June 2024

Location: DBCA's Albany office, 120 Albany Highway, Albany

Facilitators:

1. Kevin Parker (Parker Conservation Ltd)
2. Doug Armstrong (Wildlife Population Analysis)

Workshop participants:

1. Abby Berryman (Technical Officer, South Coast Region, DBCA)
2. Abby Martin (Conservation Officer, South Coast Region, DBCA)
3. Allan Burbidge (Principal Research Scientist, Animal Science, DBCA)
4. Aline Gibson Vega (WA South Coast Threatened Birds Project Support, BirdLife Australia)
5. Arthur Ferguson (Supervisor Zoology (Australian Fauna), Perth Zoo, DBCA)
6. Bronte Van Helden (Ecologist, South Coast NRM) *only available intermittently
7. Bryan Colbung (Binalup Aboriginal Corporation)
8. Daniel Colbung (Southern Aboriginal Corporation)
9. Deon Utber (Conservation Leader, South Coast Region, DBCA)
10. Errol Eades (Binalup Aboriginal Corporation)
11. Henry Jones (Southern Aboriginal Corporation)
12. Jason Bolton (Binalup Aboriginal Corporation)
13. Justin Black (Esperance District Manager, DBCA)
14. Jacqui Richards (Senior Conservation Zoologist, Species and Communities Program, DBCA)
15. Jon Marwick (Southern Aboriginal Corporation)
16. Jyrin Woods (Southern Aboriginal Corporation)
17. Kay Bradfield (Conservation Programs and Population Planning, Perth Zoo, DBCA)
18. Larry Blight (Wagyl Kaip Representative)
19. Lesley Gibson (Animal Science Program Leader, DBCA)
20. Lynette Knapp (Merningar Elder, University of Western Australia)
21. Manda Page (CEO Southwest NRM)
22. Paul Wettin (Chair, Friends of the Western Ground Parrot)
23. Peter Hartley (Regional Manager, South Coast Region, DBCA)
24. Tegan Douglas (Black Cockatoo Program Manager, BirdLife Australia)
25. Rebecca Vaughan-Higgins (Veterinary Services Manager, Perth Zoo, DBCA)
26. Sarah Comer (Regional Ecologist, South Coast Region, DBCA)
27. Saul Cowen (Research Scientist, Animal Science, DBCA)
28. Shawn Colbung (Binalup Aboriginal Corporation)

Workshop observers:

1. Ruth Harvey (Species and Communities Program Leader, DBCA)
2. Tash Harrison (Animal Science, DBCA)

3.

Thursday 27 June 2024			
Time	**Duration**	**Activity**	**Tasks**
08:00-09:00	60 min	*Welcome to country followed by general introductions*	
09:00-09:45	45 min	An introduction to structured decision-making	Doug to present
09:45-10:05	20 mins	Background on Kyloriny and Kyloriny management	Sarah Comer
10:05-10:45	40 min	Goal statement	Kevin & Doug to facilitate
10:45-11:15	30 min	*Morning tea*	
11:15-12:30	75 min	Objectives and values	Kevin & Doug to facilitate
12:30-13:30	60 min	*Lunch*	
13:30-14:30	60 min	Objectives and values	Kevin & Doug to facilitate
14:30-15:30	60 min	Alternatives (individually & break-out groups)	Kevin & Doug to facilitate
15:30-16:00	30 min	*Afternoon tea*	
16:00-17:15	75 min	Alternatives (jointly)	Kevin & Doug to facilitate
17:15-17:30	15 min	Review of the day and the plan for the next day	Kevin & Doug to facilitate

Friday 28 June 2024			
Time	**Duration**	**Activity**	**Tasks**
08:00-08:30	30 min	Review of the goal statement	Kevin & Doug to facilitate
08:30-09:30	60 min	Review of objectives and values	Kevin & Doug to facilitate
09:30-10:30	60 min	Review of alternatives	Kevin & Doug to facilitate
10:30-11:00	30 min	*Morning tea*	
11:00-11:30	30 min	Consequence table as a framework	Kevin & Doug to facilitate
11:30-12:30	60 min	Populating the consequence table? (Decide on working/expert groups?)	Kevin & Doug to facilitate
12:30-13:30	60 min	*Lunch*	
13:30-15:00	90 min	Populating the consequence table? (Decide on working/expert groups?)	Kevin & Doug to facilitate
15:00-15:30	30 min	*Afternoon tea*	
15:30-16:30	60 min	Populating the consequence table? (Decide on working/expert groups?)	Kevin & Doug to facilitate
16:30-17:30	60 min	What next, final comments, closing…	Kevin & Doug to facilitate

Appendix 3

Structured decision-making February 2025 online and in-person workshop details

Draft agenda for the second Kyloriny structured decision-making workshop

Location: Online and DBCA's Albany office, 120 Albany Highway, Albany

When: 20 and 21 of February 2025

Time: 08:00-12:00 each day

Participants:
Abby Berryman (DBCA South Coast Region)
Abby Martin (DBCA South Coast Region)
Aline Gibson Vega (BirdLife Australia)
Allan Burbidge (DBCA BCS)
Annette Rypalski (Odonata/Esperance Tjaltjraak Native Title Aboriginal Corporation)
Bronte Van Helden (South Coast NRM)
Deon Utber (Conservation Leader, South Coast Region, DBCA)
Jacqui Richards (Senior Conservation Zoologist, DBCA)
Justin Black (Esperance District Manager, DBCA)
Jon Marwick (Southern Aboriginal Corporation)
Jyrin Woods (Southern Aboriginal Corporation)
Karl Hansom (Aboriginal Engagement Coordinator – Wagyl Kaip Southern Noongar)
Kay Bradfield (DBCA Perth Zoo)
Lesley Gibson (Animals Science Program Leader, DBCA)
Matt Ricci (DBCA, Perth Zoo)
Paul Wettin (Friends of the Western Ground Parrot)
Rebecca Vaughan-Higgins (DBCA Perth Zoo)
Sarah Comer (Regional Ecologist, South Coast Region, DBCA)
Saul Cowen (Research Scientist, Animal Science, DBCA)
Shawn Colbung (Binalup Aboriginal Ranger Corporation)
Tash Harrison (Animal Science, DBCA)
Tegan Douglas (BirdLife Australia)

(apologies – Kath Schell, Larry Blight, Ruth Harvey, Manda Page, Lynette Knapp, Peter Hartley)

Facilitators:
- Doug Armstrong (Wildlife Population Analysis)
- Kevin Parker (Parker Conservation Ltd)

Analysts:
- Lead analyst: Doug Armstrong (Wildlife Population Analysis)
- Support: Sarah Comer (Regional Ecologist, South Coast Region, DBCA), Allan Burbidge (Principal Research Scientist, DBCA), Abby Berryman (Technical Officer, South Coast Region, DBCA), Abby Martin (Operations Officer, South Coast Region DBCA)
- Support: Kevin Parker (Parker Conservation Ltd)

Thursday 20 February 0800-1200

Time	Duration	Activity	Tasks
08:00-08:15	15 min	Introductions	Kevin and Sarah
08:15-08:30	15 min	Kyloriny and structured decision-making refresher	Kevin and Sarah
08:30-10:00	90 min	Review of: - Goal statement - Objectives and performance measures - Alternatives	Kevin and Doug to facilitate
10:00-10:15	15 min	*Morning tea*	
10:15-11:45	90 min	Show full consequence table and discuss as a group Any changes required?	Doug and Kevin to facilitate
11:45-1200	15 min	Two quick voting rounds: - Acceptable alternatives? - Best alternative?	Doug and Kevin to facilitate
12:00		*Finish*	

Friday 21 February 0800-1200

Time	Duration	Activity	Tasks
0800-0830	30 min	Discuss outcome of quick voting	Doug and Kevin to facilitate
08:30-09:00	30 min	Simplify consequence table: - Remove objectives? - Remove dominating alternatives? - Hard constraints?	Doug and Kevin to facilitate
09:00-09:30	30 min	Repeat two quick voting rounds: - Acceptable alternatives? - Best alternatives?	Kevin to facilitate, Doug to run numbers
09:30-10:00	30 min	Rank alternatives from most preferred to least preferred	Kevin to facilitate, Doug to run numbers
10:00-10:15	15 min	*Morning tea*	
10:15-10:45	30 min	Discuss ranking and rounds of voting	Doug and Kevin to facilitate
10:45-11:00	15 min	Group recommendation	Doug and Kevin to facilitate
11:00-11:45	45 min	Next steps: - Create timeline? - Assign tasks?	Doug and Kevin to facilitate
11:45-12:00	15 min	Closing remarks, final review, and comments	Doug and Kevin to facilitate
12:00		*Finish*	

Appendix 4

Fully specified management alternatives developed at the workshops for Kyloriny / Western Ground Parrot (*Pezoporus flaviventris*) conservation management.

Baseline (not included in the strategy or consequences tables)

Baseline is the standard Department of Biodiversity, Conservation and Attractions (DBCA) management of conservation estate. This was the level of conservation management for Kyloriny prior to 2010 and includes only the standard delivery of Western Shield fox baiting, no additional introduced predator management and no specific intervention for Kyloriny if they were threatened by bushfire, beyond the standard departmental consideration of conservation values when planning bushfire response and mitigation.

Status quo

This is the current level of management for Kyloriny, which includes fire management and some externally funded support for additional introduced predator management to complement DBCA's Western Shield aerial and ground baiting. This option does not include reinforcements of the translocated population at Waychinicup-Manypeaks.

It includes:

- Additional introduced predator control at Cape Arid National Park (CANP) and Waychinicup - Manypeaks area including cat baiting, introduced predator trapping, and Felixer Grooming Traps.
- Monitoring of introduced predators and native species to evaluate the effectiveness of control methods.
- Additional fire mitigation to protect Kyloriny habitat in CANP and WMP, including prescribed burning, and establishment and/or maintenance of low fuel slashed buffers.
- Additional bushfire suppression strategies aimed at minimising the impact of bushfires on Kyloriny habitat, including additional ground crews, and potential for aerial suppression.
- Monitoring Kyloriny (CANP, WMP).
- Captive management continued at current level at Perth Zoo (6 birds in 2024). Noting that a female chick was born in late 2025.
- No reinforcement of WMP.
- Some Noongar engagement.

Reinforcement A

This option includes all management covered by status quo, with the addition of wild-to-wild reinforcement translocations from Cape Arid National Park to Waychinicup-Manypeaks (**modelled at 12 birds estimated pa for up to three years)**. The need for reinforcement translocations and the number of birds required will be informed by monitoring. Only one translocation might be needed, depending on survival and population growth at Waychinicup-Manypeaks.

This strategy includes **Status Quo** plus:

- Wild-to-wild reinforcement translocation from CANP to WMP.
- Increased Noongar engagement.

Year	Source	Destination	No. of birds
1	CANP	WMP (reinforcement)	12
2	CANP	WMP (reinforcement)	12 (if required)
3	CANP	WMP (reinforcement)	12 (if required)

Reinforcement B

This option is the same as Reinforcement A but with additional birds captured for the captive management program **(modelled at 3 pairs per annum for one year** with a minimum of 2 additional females), increased engagement with Noongar, and increased learning because of the intensified captive management program.

This includes **Status Quo** and **Reinforcement A** plus:

- 6 birds translocated from CANP to the captive program at Perth Zoo (increased learning).
- Increased Noongar engagement.

Year of translocation	Source	Destination	No. of birds
1	CANP	WMP (reinforcement)	12
		Captive	6 (even sex ratio)
2	CANP	WMP (reinforcement)	12 (if required)
3	CANP	WMP (reinforcement)	12 (if required)

Kaboonga

Kaboonga is the most intense alternative. It includes all the strategies under Status Quo, Reinforcement A and Reinforcement B but increases the intensity by a factor of 2-4 for most strategies. It has intensive captive management including removing and hand raising the first clutch (forced double clutching), but less intensive than Captive +++, so aims to produce 40 viable offspring per year (compared to 60 for Captive+++). This will require **18 birds being captured from the wild for the captive rearing programme (6 birds per year for three years).** Similar to Captive +++, success of the strategy relies on Perth Zoo being able to breed Kyloriny in captivity (successful breeding is yet to be achieved). This strategy also includes intensive revegetation to expand the quantity of Kyloriny habitat around existing populations.

This option is completely unconstrained by availability of resources (staff and funding) and includes reinforcement, reintroduction, intensive captive management and enhanced predator and fire management. The additional resources put into managing the wild population (CANP) means that birds can be sourced from this area for both reinforcement and new translocations.

Status Quo plus:

- Management increased two- to four-fold (CANP, WMP, 2 new reintroduction sites).
- Reinforcement translocation from CANP and captive populations to WMP.
- 18 birds translocated from CANP to the captive program at Perth Zoo.
- Captive breeding (*noting that successful breeding in captivity is yet to be achieved*).
- Increased Noongar engagement, partnerships, education, monitoring and people management.
- Revegetation/restoration.
- Reintroductions from the captive population at Perth Zoo (assuming successful breeding) to two new reintroduction sites. This will likely require a soft release strategy.

Year of translocation	Source	Destination	No. of birds
1	CANP	WMP (reinforcement)	12
		Captive	6 (even sex ratio)
2	CANP	WMP (reinforcement)	12 (if required)
		Captive	6 (even sex ratio)
3	CANP	WMP (reinforcement)	12 (if required)
		Captive	6 (even sex ratio)
??? (multiple years) Captive bred birds to commence being released	Captive	WMP (reinforcement)	Dependent on number of captive birds
		Site 1	
		Site 2	

once captive facility reaches carrying capacity			produced (aiming for 40 per year)

Captive +++

Captive +++ has the primary focus on intensive captive breeding and less focus on *in situ* management. This will require taking more birds into captivity (**10 pairs required, 20 birds in total**), with an aim to double clutch and produce c.6 offspring per female per year for a total of ~60 per year. This approach is highly interventionist, including disease management, artificial insemination, incubation, hand-raising, Eastern Ground Parrot surrogates, proposed multiple facilities, new sites and new partnerships. No wild-to-wild translocations under this strategy. More intensive captive management under this strategy. Any translocations will be from captive-sourced birds.

This strategy includes **Status Quo** plus:

- No wild-to-wild translocations.
- Addition of 20 birds (even sex ratio) to the captive program.
- Intensive captive management (double clutching, hand raising, use of surrogates, artificial insemination, disease management/biosecurity, multiple facilities, new sites and new partnerships).
- Aims to produce 60 chicks per year (noting that successful breeding in captivity is yet to be achieved).
- Reintroductions from the captive population (assuming successful breeding) to two new reintroduction sites. This will likely require a soft release strategy.

Year of translocation	Source	Destination	No. of birds
1	CANP	Captive	20 (even sex ratio)
??? (multiple years) Captive bred birds to commence being released once captive facility reaches carrying capacity	Captive	WMP (reinforcement)	Dependent on number of captive birds produced (aiming for 60 per year)
		Site 1	
		Site 2	

Reintroductions

This alternative focuses on establishing new wild populations at two different sites over a 10 year period with **36 founders for each** site. This includes increased introduced predator and fire management, increased Noongar engagement, education, partnerships, learning, monitoring and people management relative to Status Quo, Reinforcement A and Reinforcement B. Captive management will remain at the level of Status Quo

This strategy includes **Status Quo** plus:

- Increased fire and introduced predator management at CANP and WMP.
- Increased fire and introduced predator management at two new release sites (both prior to translocation and following release); at least two years of increased management will be required at each site to reduce threats before releases take place.
- Wild-to-wild reintroduction translocations from CANP to two new sites.
- Monitoring of translocated Kyloriny at the two new sites (both intensive post-release monitoring and long-term monitoring).
- Increased Noongar engagement, education, partnerships, learning, monitoring and people management.

Year	Source	Destination	No. of birds
3	CANP	Site 1	12
4	CANP	Site 1	12
5	CANP	Site 1	12
7	CANP	Site 2	12
8	CANP	Site 2	12
9	CANP	Site 2	12

Translocate+

This alternative is the same as **Reintroductions**, with the addition of a reinforcement translocation **(12 birds pa for up to three years)** to Waychinicup-Manypeaks.

Reintroductions plus:

- Reinforcement translocations from CANP to WMP.

Year of translocation	Source	Destination	No. of birds
1	CANP	WMP (reinforcement)	12
2	CANP	WMP (reinforcement)	12 (if required)
3	CANP	WMP (reinforcement)	12 (if required)
		Site 1	12
4	CANP	Site 1	12
5	CANP	Site 1	12
7	CANP	Site 2	12
8	CANP	Site 2	12
9	CANP	Site 2	12

Small fence

This alternative includes translocation **(maximum 10 individuals)** to a small, fenced site (<400ha with at least 100ha of Kyloriny habitat), that would require ongoing supportive management (feeding, water, refuges)**.** Dispersal and fence collisions are a risk with this alternative. Noongar engagement, education, partnerships, learning and people management would be increased under this alternative but other management would stay at the same level as Status Quo.

A small fenced enclosure would need to be constructed, and introduced predators removed from within the enclosure, unless the existing Normans enclosure is used (this enclosure is near Manypeaks and has a small amount of suitable Kyloriny habitat). Ongoing fence maintenance will be required.

This strategy includes **Status Quo** plus:

- Small fence (Normans enclosure?).
- 10 birds from CANP to the small fenced site.
- Resource provisioning.
- Increased Noongar engagement, education, partnerships and learning.

Year of translocation	Source	Destination	No. of birds
2	CANP	Small fenced site	10

Large fence

This alternative includes translocation to a 5000ha plus fenced site with at least 25% of the area high quality Kyloriny habitat. This alternative would not consider fencing the existing Cape Arid/Nuytsland

population. Management effort will largely be the same as the **Reintroductions** alternative but with additional resource provisioning and only one translocation site (large fenced site).

A large fenced enclosure would need to be constructed, and predators removed from within the enclosure, requiring additional management of introduced predators in the establishment phase. Ongoing fence maintenance will be required.

This strategy includes **Status Quo** plus:

- Large fence.
- Introduced predator removal within fenced area.
- 36 birds from CANP to the large fenced site.
- Resource provisioning.
- Increased Noongar engagement, education, partnerships, learning and monitoring.

Year of translocation	Source	Destination	No. of birds
5	CANP	Large fenced site	12
6	CANP	Large fenced site	12
7	CANP	Large fenced site	12

Wild only

This alternative would focus solely on the wild populations by abandoning the captive program, reinforcing Waychinicup-Manypeaks with wild-to-wild translocations (**12 birds estimated pa over three years),** increasing Noongar engagement relative to Status Quo, maintaining predator management, fire management, people management and monitoring at the same level, and decreasing education.

This strategy includes **Status Quo** plus:

- Increased Noongar engagement.
- Reinforcement translocation from CANP to WMP.
- The captive programme at Perth Zoo is abandoned (unlike Status Quo).

Year of translocation	Source	Destination	No. of birds
1	CANP	WMP (reinforcement)	12
2	CANP	WMP (reinforcement)	12 (if required)
3	CANP	WMP (reinforcement)	12 (if required)

Aggressive learning

This alternative includes all management listed for **Reinforcement A**, as well as intensified learning and monitoring effort focussing on new and innovative methods. These may include Artificial Intelligence for acoustic monitoring, use of dogs to find nests, drones to find nests, genetic analysis, etc. Provided nests can be found, eggs would be sourced from the wild for the captive program. Cameras would be placed on nests to improve understanding of predator impact/timing on breeding, and to assess breeding success. This strategy also includes aggressive learning from the captives, which may include trialling new techniques and cutting-edge technology to achieve successful breeding.

This strategy has the potential to improve vital rates, with much greater capacity to apply learning to management. The cost will be relatively high, and there is potential uncertainty about whether the new learnings will result in population growth.

As already outlined in Reinforcement A, the wild-to-wild reinforcement translocations from Cape Arid National Park to Waychinicup-Manypeaks are **modelled at 12 birds estimated pa for up to three years**. The need for reinforcement translocations will be linked to monitoring. Only one might be needed, depending on survival and population growth at Waychinicup-Manypeaks.

This strategy includes **Status Quo** plus:

- Reinforcement translocation from CANP to WMP.
- Increased Noongar engagement.
- New and innovative methods to learn more about Kyloriny ecology, and to increase our ability to detect and monitor Kyloriny.
- Potential addition of birds to the captive management program, preferably sourced from eggs taken from the wild (provided nests can be found).
- Intensified learning to optimise fire and introduced predator management.
- Trialling new techniques and cutting-edge technology to achieve successful breeding in captivity.
- Applying all new learning to improve and refine management practices.

Year of translocation	**Source**	**Destination**	**No. of birds**
1	CANP	WMP (reinforcement)	12
2	CANP	WMP (reinforcement)	12 (if required)
3	CANP	WMP (reinforcement)	12 (if required)
TBC	CANP	Captive	Ideally only eggs to be taken.

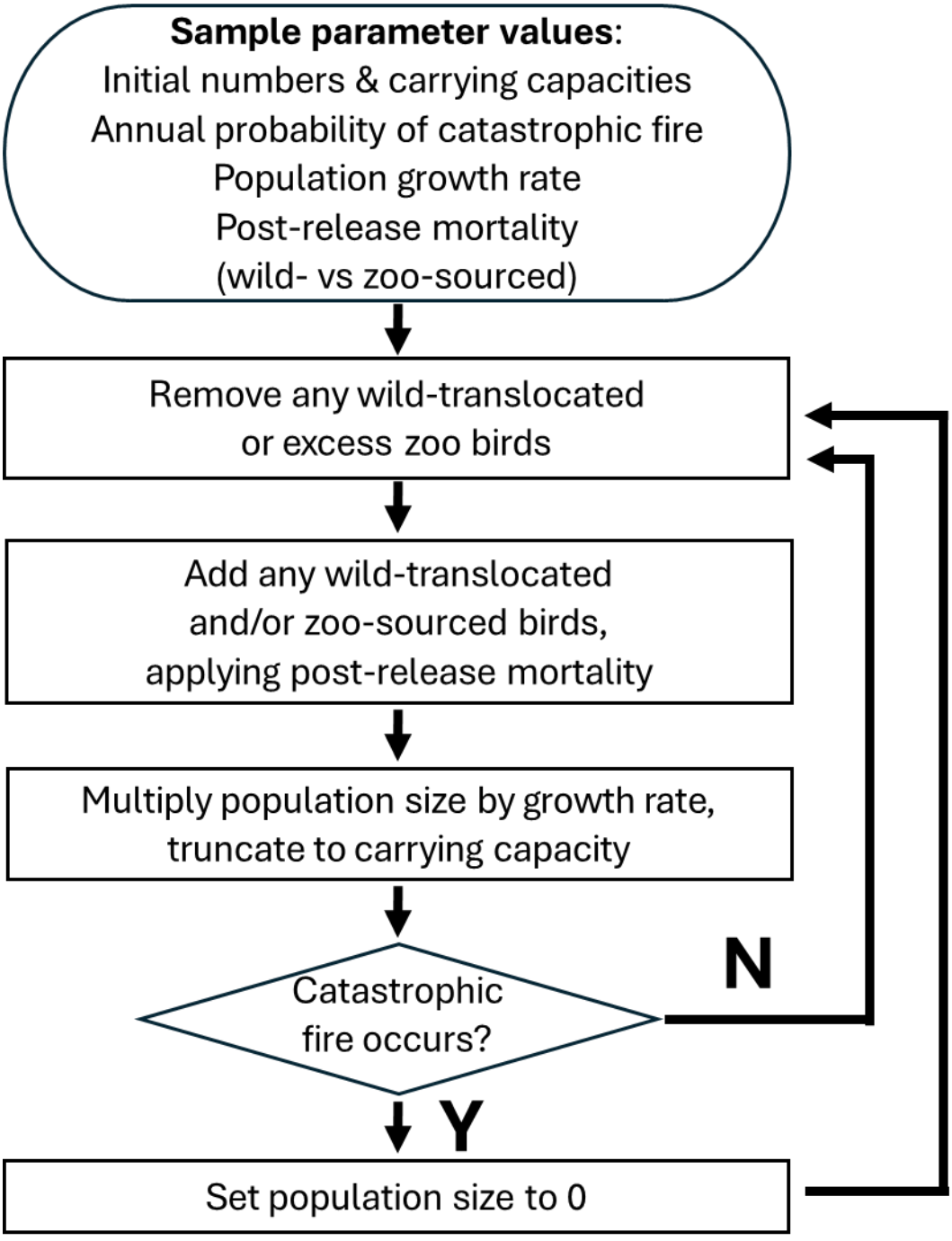
Appendix 5

Questions for eliciting model structure

1. Do we just need to consider the number of adult females in the population (i.e., single-stage female-only model), or is growth likely to be affected significantly by changes in the population's sex ratio or age structure?
2. What is the best way to predict the mean growth of the existing populations? Is it better to directly infer population growth (r or λ) through trends in abundance, or consider component vital rates (e.g., adult survival, juvenile survival, juveniles produced per female)?
3. How should we predict how population growth (or its components) will differ at new sites (i.e., following reintroduction) or with changes in management? Expert elicitation will probably be required since no data will be available under the new conditions.
4. How should we estimate K for each population and potential population? We did this at the workshop but should discuss the logic used, and then probably use expert elicitation.
5. What should the form of density dependence be? The simplest form is a "ceiling model" whereby the population experiences no density dependence until it reaches K, and is then constrained at that level. If directly modelling growth rate (r or λ) you could apply logistic, Gompertz or Ricker functions, and could include an Allee effect whereby the growth rate also decreases at low density. If modelling component vital rates, individual rates can change as a function of density.
6. How should fires (or other catastrophes) by modelled? For example, is it reasonable to assume a fixed probability of fire each year (simplest) or necessary to consider the time since the last fire? Should we assume that a fire would exterminate a population (simplest), or necessary to create probability distributions for the likely impact on N or K?
7. Should we incorporate annual variation in population growth rate, and if so, how? E.g., should we directly elicit a SD around the expected rate, or elicit values for a good, bad, and average year and use those to calculate an SD?
8. How should we estimate sizes of existing populations? Does this require a sex/age breakdown?
9. What proportion of translocated animals are likely to be lost because of post-translocation stress, i.e., how strong are the likely post-release effects? And what is the likely acclimation period, e.g., is it reasonable to assume that any impacts will occur before the start of the breeding season following translocation?
10. What do the alternative management strategies (Tables 1–2) mean in terms of mean population growth rates and translocations conducted (sites, years, numbers moved) over the 10-year time frame of the projections?

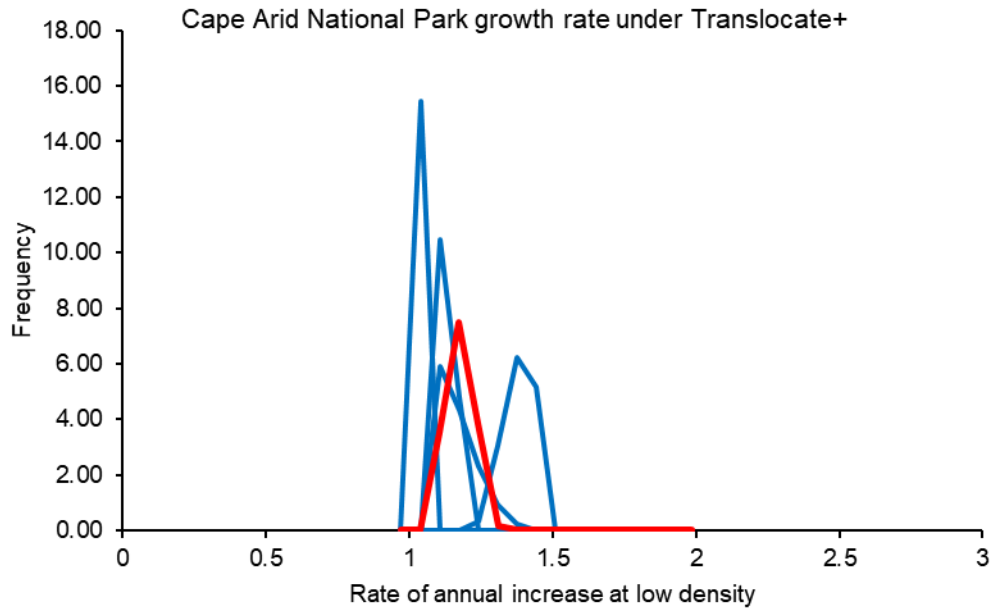
Appendix 6

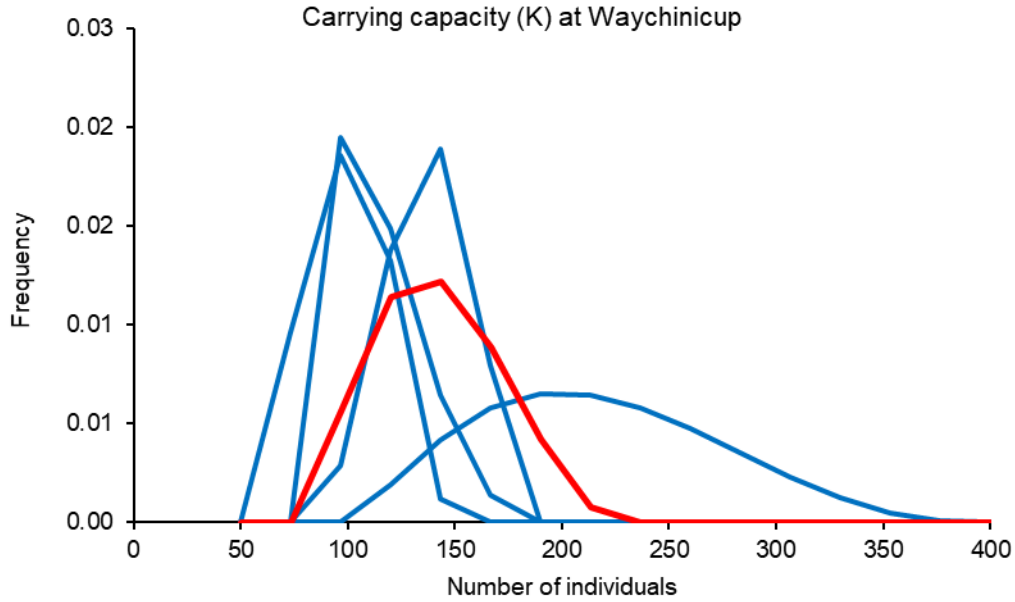
Model structure for projecting outcomes under different management alternatives for each run of the model, each population, each strategy and each year.

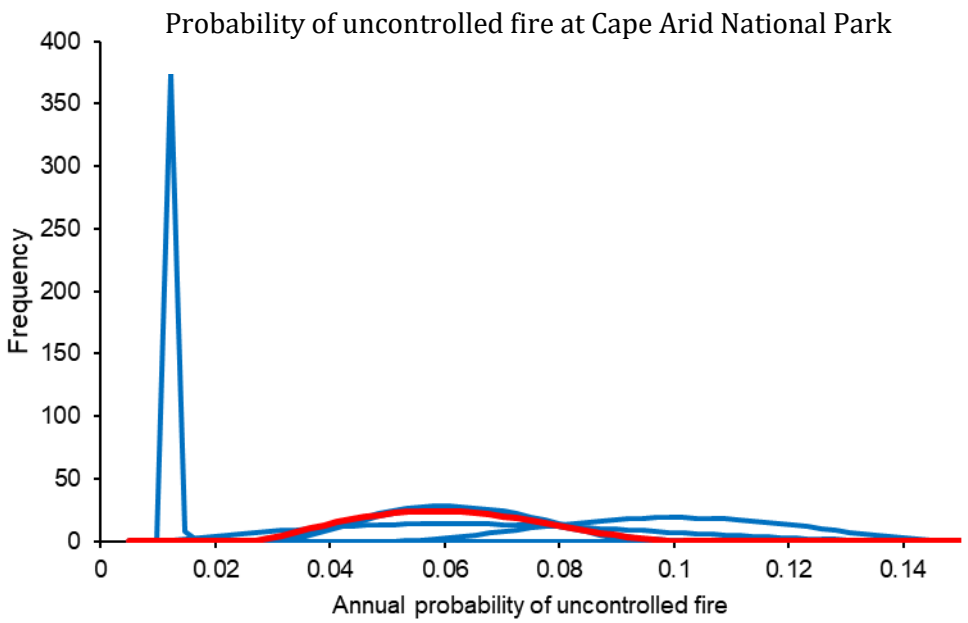


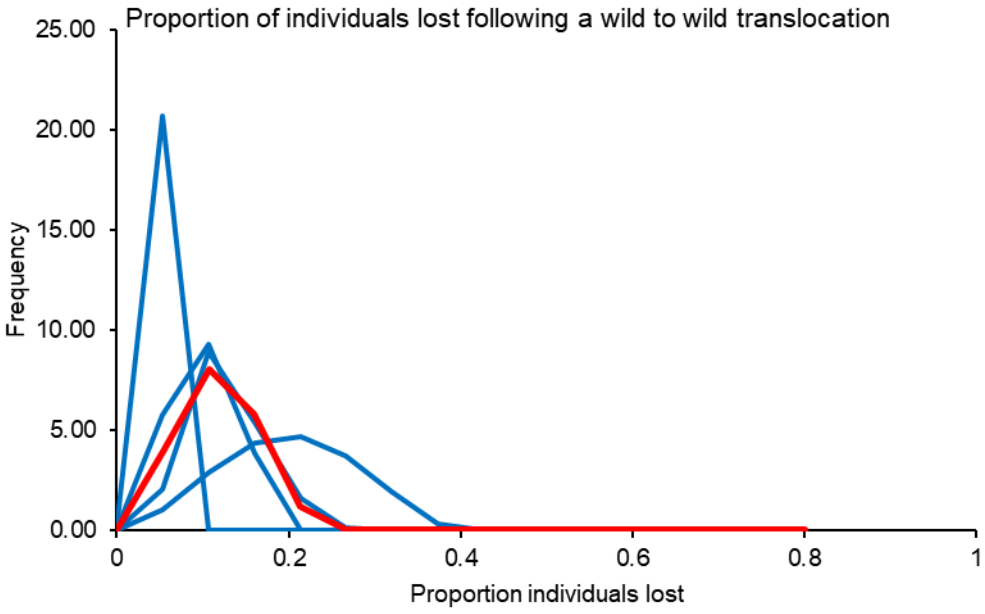
Appendix 7

Examples of BetaPERT distributions of the parameters used for population modelling including population growth rates, carrying capacities (K), annual probabilities of fire and the proportions of individuals lost following translocation. Blue lines show BetaPERT distributions based on values solicited from individual experts and red lines show distributions based on averaged values. The jaggedness of the curves just reflects the resolution of the graphing.






Probability of uncontrolled fire at Cape Arid National Park
Frequency
400
350
300
250
200
150
100
50
0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
Annual probability of uncontrolled fire


Proportion of individuals lost following a wild to wild translocation
Frequency
25.00
20.00
15.00
10.00
5.00
0.00
0
0.2
0.4
0.6
0.8
1
Proportion individuals lost