Science for Saving Species

Research findings factsheet

Project 4.1.5

Threatened Species Recovery Hub

National Environmental Science Programme

PACES: a decision tool to support the comparison and evaluation of in-situ and ex-situ conservation options for threatened species

In brief

Ex-situ (off-site) management of threatened species can be used to support their conservation in the wild, but to do so can be a complex and costly undertaking. To help assess whether adding or continuing an ex-situ program is the best way to conserve a species in the wild, we created PACES – the Planning and Assessment for Conservation through Ex-Situ management tool. This decision support tool is designed for use in expert workshops or by the individual, and guides users through determining the best strategy for conserving species in the long-term.

A case study of the long-lived, Critically Endangered western swamp tortoise is included, to show how this tool can be applied. For the western swamp tortoise, the PACES tool showed that in the long term, only an ex-situ management approach yielded benefits for population growth and a downgrading of threat status. Following a facilitated PACES tool workshop, the participating conservation managers felt that the costs of captive breeding programs were reasonable for protecting this unique and iconic species.

Ex-situ management

Ex-situ management (literally, "off-site") involves taking and maintaining a threatened species away from its natural setting to an environment without the threats that impacted the species in its original location. Comparatively, in-situ management is the management of a species within its natural setting. Ex-situ actions are used to support the long-term persistence of species by supplementing or creating new wild populations. Examples of ex-situ actions include botanical gardens, and zoos, where individuals and populations of species are housed for captive breeding and when possible, reintroduction into the wild.

There is the risk, as with any management intervention, that ex-situ approaches will fail. Ex-situ strategies can also have a negative impact on the wild population from which animals or plants are sourced for the ex-situ program. Managers therefore need to consider the risks and costs when evaluating whether an ex-situ management plan is the best strategy for conserving a species over the long term.

PACES

To assist with threatened species management, we created an Excel-based decision support tool. The Planning and Assessment for Conservation through Ex-Situ management (PACES) tool helps conservation managers predict and compare the outcomes of different in-situ and ex-situ conservation management plans to support robust and transparent decision making.

It is designed for either expert workshop settings, or for use by individuals. The PACES tool can be applied to a range of management scenarios for both animal and plant species. The tool has been developed with the intention of being accessible and is able to be used with only basic knowledge of Excel.

PACES allows users to predict and compare the outcomes of three management plans:

- an in-situ management option,
- an ex-situ management option (which includes an in-situ component) and
- an in-situ plus option.

In-situ plus explores a hypothetical scenario where the resources that could have been used for ex-situ management are dedicated toward additional in-situ management instead.

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PACES

Users set a time horizon for predicting the benefits of management, which is usually the length of time required for desired benefits to be discernible. Time horizons can vary substantially between species based upon biological factors such as generation time and reproductive output. PACES steps users through defining, and costing each management plan over this time horizon, then helps predict the likely conservation outcomes of each alternative in terms of a species' relative population size or probability of persistence. As a baseline for comparison, this includes predicting the consequences without management action, i.e., a 'do nothing' scenario.

To help make these predictions, PACES breaks them down into component parts, so they are easier to estimate. For example, it may be very difficult to predict how much an ex-situ program will increase population size in the wild in 20 years' time given all the uncertainties involved. PACES breaks an ex-situ program down into the three stages:

- sourcing individuals from the wild (which may impact the wild population)
- captive breeding or propagation, and
- releasing individuals back into the wild.

Each of these stages has a chance it will succeed or fail, and whether it succeeds or fails has associated consequences for wild conservation. PACES asks for separate estimates of the chances of success or failure and associated consequences.

These estimates can be made using:

- expert elicitation, for which PACES automatically provides the forms and figures required to facilitate a structured elicitation process,
- models, such as population viability analyses,
- data from previous studies, for example, breeding success rates, or
- a combination of the above.

Estimates are then logically combined using a decision tree to get overall predictions of the likely benefit of each alternative management plan. Additionally, PACES can be used to elicit subjective trade-offs (or 'value judgments') from the user or workshop participants, i.e., whether they believe the likely conservation outcomes of a management plan are worth its cost. This functionality can be used to scope out support or opposition for different management plans given their predicted costs and benefits.

Western swamp tortoise. Image: Nicolas Rakotopare

*RIGHT: There has been a successful captive breeding program for the birdwing butterfly (*Ornithoptera priamus*). Image: David Bygott, Flickr, CC BY-NC-SA 2.0*

PACES (continued)

Case study: Western swamp tortoise

Western swamp tortoises (*Pseudemydura umbrina*) are a small and long-lived species. They are Critically Endangered nationally, and are one of Australia's most highly threatened reptiles. Land development in the Perth region has greatly reduced the amount of suitable seasonal swamp habitat and has influenced the water cycles at remaining sites; the tortoises and their eggs are predated on by feral cats, rats and foxes; they have little adaptability to inappropriate fire regimes; and climate change is reducing the suitability of the weather cycles that constrain their life histories.

Western swamp tortoises are confined to swamp habitats in Western Australia which are only seasonally flooded. While the wetland is flooded the tortoises feed, grow and reproduce; then during the remainder of the year, the dry season, the tortoises enter a state of dormancy, like hibernation. Changes in climate are causing unseasonably long dry seasons, which is reducing the amount of time tortoises are able to feed and breed and for young to grow before entering dormancy. This may reach a critical threshold in which there are no-longer sufficient wet months to complete essential life cycle requirements in all or some years, with severe consequences for the long-term persistence of the population.

Historically reduced to two swamps on the Swan Coastal Plain, recent translocation efforts have successfully established two new populations. Captive breeding underpins this success, but the number, and severity of threats limit the availability of new translocation sites for captive-bred tortoises within its historical distribution. Translocation sites outside its historical distribution are currently being investigated.

This current management was captured under the "ex-situ" alternative in the PACES tool. Under this option, we explored extending captive breeding of swamp tortoises for a further 25 years. The "in-situ" option included only managing the habitat at tortoise locations with the current estimated level of investment. The "in-situ plus" option involved increasing this investment by 20%.

To account for the long life-cycle of the species and its exposure to risks associated with climate change, workshop participants considered an extensive time horizon of 100 years appropriate for the assessment. Population viability analyses were run in real time during the workshop, to supplement participants' expert judgements.

Over a 100-year time horizon, the best estimate for "do nothing" was a 91% decline in wild population size, with extinction plausible. "In-situ" and "in-situ plus" were anticipated to lead to 47% and 41% declines, respectively. Only the "ex-situ" option was estimated to lead to an improvement in conservation status, at least for the best estimate (see figure 1).

This outcome was driven by the success of the captive breeding program in making individuals available for release, and the pooled judgment of workshop participants that there was a 61% chance of successful release into the wild. Success was described as at least 10% of released

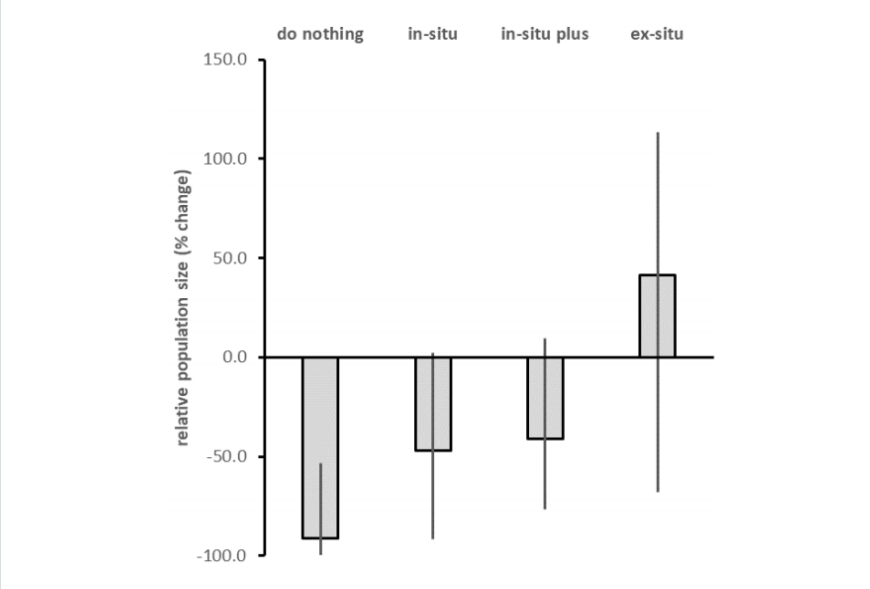

Figure 1: *Predicted outcomes of each management alternative over a 100 year time horizon for Western swamp tortoises.*

LEFT: A western swamp tortoise in a swamp on the Swan coastal plains. Image: Nicolas Rakotopare

PACES (continued)

Case study: Western swamp tortoise

individuals surviving for 10 years post-release. Given the species is long-lived, a 10-year outlook is critical for understanding the effectiveness of an ex-situ approach.

All five participants involved in the exercise had "ex-situ" as their top-ranking alternative (see figure 2).

Without any conservation benefit from an "in-situ plus" approach, there was a complete lack of support for this option. Similarly, the substantial cost and poor conservation pay-off associated with the "status quo in-situ" option resulted in the "do nothing" option being the second choice of three of the five participants.

Although climate change and other threats may limit the future availability of new sites for translocation of western swamp tortoise, there are reasonably good prospects for the survival of the species with continuation of captive breeding.

Captive breeding is an expensive undertaking, but workshop participants felt that these costs were reasonable because the tortoise is an iconic and taxonomically distinct species.

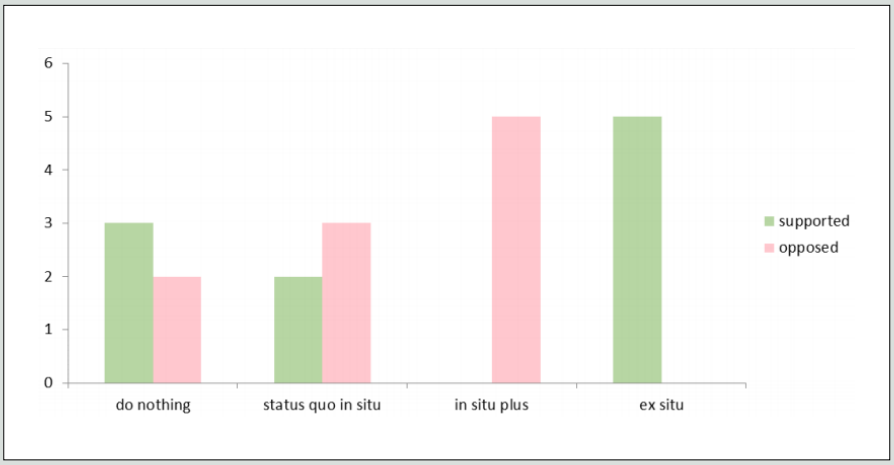

Figure 2: *A summary of participants' value judgments, showing the number of participants supporting and opposing each alternative for the western swamp tortoise, as determined by their relative value for conservation outcomes versus the cost of the management alternative.*

Cited material

NESP Threatened Species Recovery Hub. 2021. A user guide to the PACES tool: Planning and Assessment for Conservation through Ex-Situ management, Report. Brisbane.

Rout, T., 2021. A decision tool for evaluating whether ex-situ management is appropriate for a threatened species. NESP Threatened Species Recovery Hub Project 4.1.5 report, Brisbane.

PACES Tool - probability of persistence measure: Excel Workbook. https://www.nespthreatenedspecies.edu.au/publications-and-tools/paces-tool-probability-of-persistence-measure-excel-workbook

PACES Tool - relative population size measure: Excel Workbook. https://www.nespthreatenedspecies.edu.au/publications-and-tools/paces-tool-relative-population-size-measure-with-example-excel-workbook

Further Information

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