**Science** for Saving Species

Research findings factsheet

Project 7.7

Threatened Species Recovery Hub

National Environmental Science Programme

# Assessing the cost of recovering Australia's imperilled species

## In brief

The scale of actions and resources required to recover Australia's threatened species has never been comprehensively assessed, despite this being critical information for guiding biodiversity conservation and meeting species recovery obligations.

Using a novel threat-abatement cost framework, we undertook an assessment of the likely cost to achieve recovery of all known terrestrial and freshwater threatened species across Australia.

We developed a set of 18 Threat Abatement Strategies. Species differed in terms of the number of Threat Abatement Strategies they required to achieve recovery, with many plants only requiring one strategy, whereas birds needed up to 12. We modelled the implementation effort of these strategies based on best available data and expert knowledge.

Our preliminary assessment shows that the total cost of implementing all Threat Abatement Strategies across Australia is ~ $610 billion per year. This estimation is subject to change as the cost models are currently being peer-reviewed. Managing weeds was estimated to have the greatest implementation cost, comprising 70% of the total.

The total cost of implementing each Threat Abatement Strategy did not correlate with either the number of species that required the strategy, nor the area over which the strategy was needed to abate threats to imperilled species.

The benefits of Threat Abatement Strategies extend beyond recovering Australia's 1,659 threatened terrestrial and freshwater species. These efforts, if implemented, could provide a $9 annual billion benefit to the agricultural industry, and sequester over 98 million tonnes of carbon, over the next 80 years.

*Cycas megacarpa, an Endangered Cycad endemic to South East Queensland, is threatened by land clearing and agricultural land management practices. Image: Australian Network for Plant Conservation, Flickr, CC BY-NC-ND 2.0*

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## Background

Halting the high rate of species extinction and recovering imperilled species are vital tenets of any strategy aimed at abating Australia's biodiversity crisis. Estimating recovery costs requires improved information on why each individual species is threatened, where the species is located, an understanding of the actions that would abate each threat, and additional information on the cost of implementing each action, including how the costs scale across space.

There has been a concerted investment in research on Australia's threatened species, including through the Australian Government's National Environmental Science Program Threatened Species Recovery Hub, such that we now have a wealth of knowledge about where and how to improve the outlook for threatened species. However, this knowledge needs to be synthesised to provide useable and scalable guidance on the actions and financial resources required to abate threats and achieve the recovery of our nations threatened species.

## Research aims

We first aimed to determine which threat abatement actions are required to ensure that all threatened species can recover in the wild. Second, we aimed to estimate the extent and costs of actions required to achieve the recovery of threatened species across their potential range in Australia.

*The early stages of a habitat restoration project.*
*Image: Australian Network for Plant Conservation, Flickr, CC BY-NC-ND 2.0*

*LEFT: Balloon vine (*Cardiospermum grandiflorum*) is one of many environmental weeds that impact biodiversity and threatened species in Australia. Image: Tatters, Flickr, CC BY-SA 2.0*

## What we did

We synthesised research and expertise across threatened species in Australia to generate actions that could recover threatened species across the country. We defined a species' recovery as the persistence of the species across its potential range in Australia, and assumed that the management of all impacting threats is required across the species' habitat to achieve this outcome.

We included all threatened species and subspecies listed under the federal *Environment Protection and Biodiversity Conservation Act 1999* that occur in terrestrial and freshwater environments on the mainland or continental islands. We excluded species that occurred exclusively in marine waters. We included a total of 1659 taxa, which consists of species, subspecies and, in a few cases, important populations (e.g., the koala *Phascolarctos cinereus*).

We compiled data on the distributions of species and their threats, maps of relevant actions, and estimates of the costs and co-benefits of these actions. We costed out generic actions rather than attempting to prescribe detailed actions at a local scale, which requires local knowledge inputs. We focused on abating threats to species across their range, rather than focusing on ex-situ management, monitoring, research and social engagement.

### *Threat Abatement Strategies and cost models*

First, we assigned a Threat Abatement Strategy (TAS) to each biodiversity threat. We then derived a suite of actions for each TAS, described the cost components within these actions, and defined the cost multipliers required. Second, we built cost models based on detailed TAS assumptions, and depending on the action required they were costed on a per km2 basis, per waterway-km basis, or per in-stream structure basis. Third, we extrapolated costs to spatial layers by incorporating the relevant threat, vegetation type, landscape resistance and travel time layers. This process was undertaken for each TAS for all relevant management areas in Australia. We costed out the implementation of actions needed to recover species over 80 years, with cost estimates reported as annualised net present value, as of 31 December 2020.

We estimated the broader ecological benefits of restoration, such as carbon benefits of restoring threatened species habitats, and the jobs created, as well as financial benefits to agriculture.

## Key findings

Australian species are threatened by a myriad of processes, which we classified into eight broad threat categories: adverse fire regimes; changed surface and groundwater regimes; climate change and severe weather; disrupted ecosystem and population processes; habitat loss; fragmentation and degradation; invasive species and diseases; and overexploitation and other direct harm from human activities and pollution.

The three most frequent threats to species were habitat loss, fragmentation, and degradation (n = 1,210 taxa), invasive species and diseases (n = 966 taxa), and adverse fire regimes (n = 683 taxa).

The 1,659 species assessed each needed between one and 12 TASs, although the majority (n = 669) of species required just one (Figure 1). A strong taxonomic bias in the number of Strategies recommended was evident: over 50% of plant species were assigned just one TAS, whereas birds were assigned the most TASs, with five bird species requiring more than 10 strategies each.

Habitat restoration was the most frequent TAS required by species (n = 1,095, 66%), followed by management of fire (n = 676), weed management (n = 528) and grazing management (n = 286) (Figure 2).

Our estimated total modelled cost of implementing all TASs in all required locations was ~610 billion per year. Controlling weeds cost the most, making up 69% of total costs. The next highest costs were estimated for managing invasive fish, habitat restoration and managing disease. These estimations are now going through extensive review and could well change so we suggest checking the updated science on this topic.

Habitat restoration had the greatest cost per unit area of any TAS. We costed habitat restoration only where there was some likelihood of restoring species the habitat.

## Key findings (continued)

This excluded land that is currently under intensive agriculture; therefore, in reality, a greater area would be needed for most species to be recovered across their total potential ecological range.

The field-based TASs had a substantially higher cost than those without a field component. Controlling weeds was the costliest strategy (Figure 3), partly because it is labour-intensive and would take place over a large area. The next highest total costs were for managing invasive fish, habitat restoration and managing disease. Managing invasive fish would require costly infrastructure and labour.

The fifth highest total cost was for management of grazing, which predominantly involved fencing to manage the number of livestock and reduce grazing pressure. As for managing the native herbivores that are impacting threatened species, the costs were due to fencing. The lowest overall cost was for "map and protect refugia". This was primarily a desktop exercise, with a small budget for on-ground surveys; and predominantly required for species occurring in relatively accessible areas.

The east coast, Tasmania and south-west Western Australia had high estimated costs of threat abatement for species recovery, as well as high numbers of threatened species (Figure 4). Areas that could provide opportunities for a high return on investment are those with high numbers of threatened species and comparatively low implementation costs.

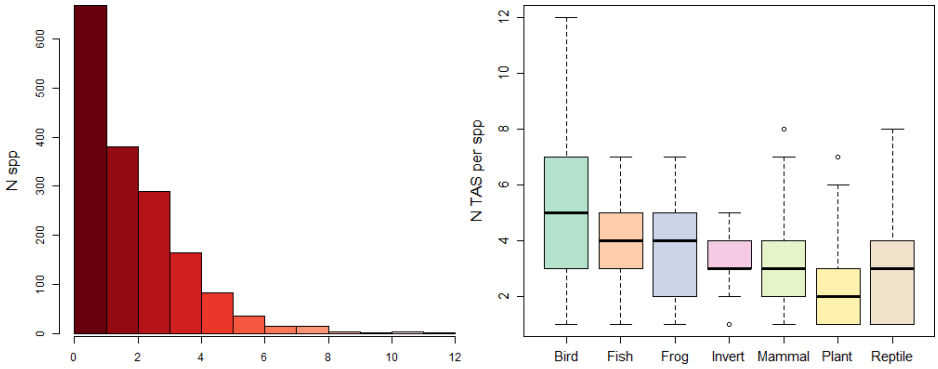


*Figure 1. The number of Threat Abatement Strategies (TAS) required by species (left) and across taxonomic groups (right).*

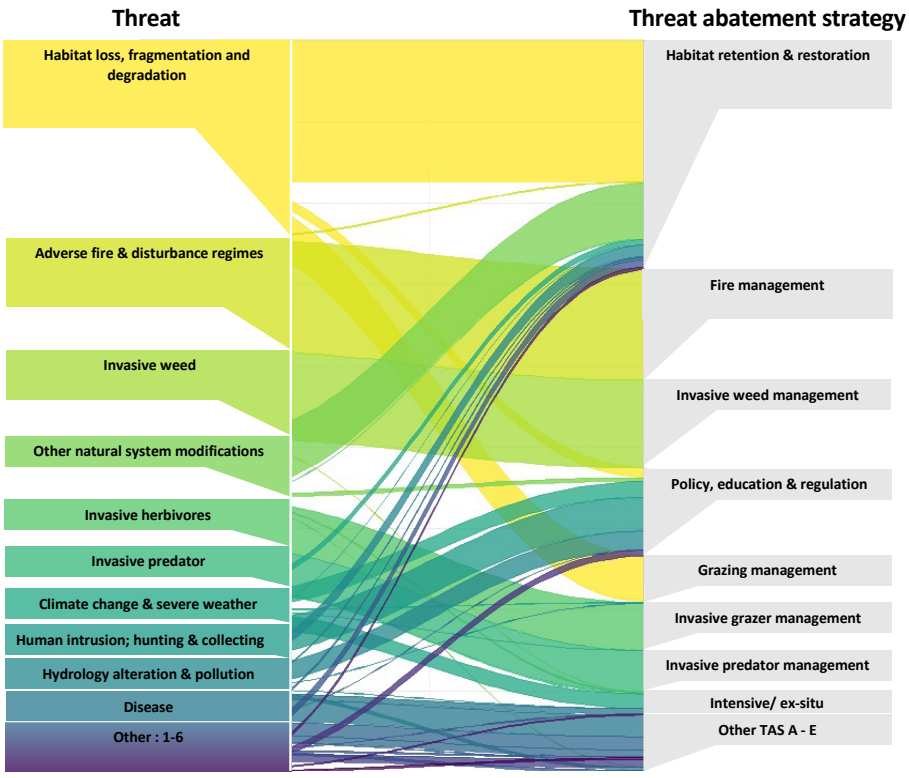


*Figure. 2. The threats impacting species on the left, and their corresponding Threat Abatement Strategies on the right. Bar widths indicate the relative number of species in the threat and Threat Abatement Strategy categories. Threats in the "Other: 1–6" category were: problematic native species, invasive animals (not otherwise stated), invasive fish, biological resource use (fisheries, forestry), small/restricted population, invasive/problematic birds and bees. Threat Abatement Strategies in the "Other TAS A – E" bar were disease management and biosecurity, native herbivore management, invasive/problematic bird and bee management, invasive fish management, aquatic connectivity, Invasive management (not otherwise stated).*

*LEFT: The numbat (*Myrmecobius fasciatus*) is an endangered species threatened by feral predators and habitat loss. Image: S J Bennett, Flickr, CC BY 2.0*

## Key findings (continued)

These areas can be found across northern Australia, particularly the tropical parts of the Northern Territory and north-west Western Australia. In contrast, parts of the inland, particularly western New South Wales and Queensland, have high implementation costs but fewer species (Figure 4). However, managing parts of the country will of course only achieve a partial recovery solution for threatened species.

Similarly, managing a subset of threats will also leave many species at risk of continued decline, with most species requiring multiple actions to achieve recovery. Without fully funding the three most expensive TASs, we estimate only a small proportion (22%) of threatened species could fully recover. This means that an approach that only focuses on specific TASs and ignores others will likely lead to a very small number of species being recovered.

### *Flow-on benefits*

By removing threats that also impact on agricultural production, we have estimated the savings in production to be more than $9.9 billion per year. Tourism would also benefit from threat management.

If we were to manage invasive predators, herbivores and weeds, we estimate the benefit to the Australian economy to be at least $9.9 billion per year. The benefit of invasive predator management is more than $98 million dollars per year for dogs, more than $30 million per year for foxes, and more than $5.9 billion per year for cats. We estimate the benefits of managing invasive herbivores is more than $10.1 million for pigs, $6.7 million for goats, and $16.7 million for starlings. Invasive weed control would result in more than $3.7 billion dollars in benefit.

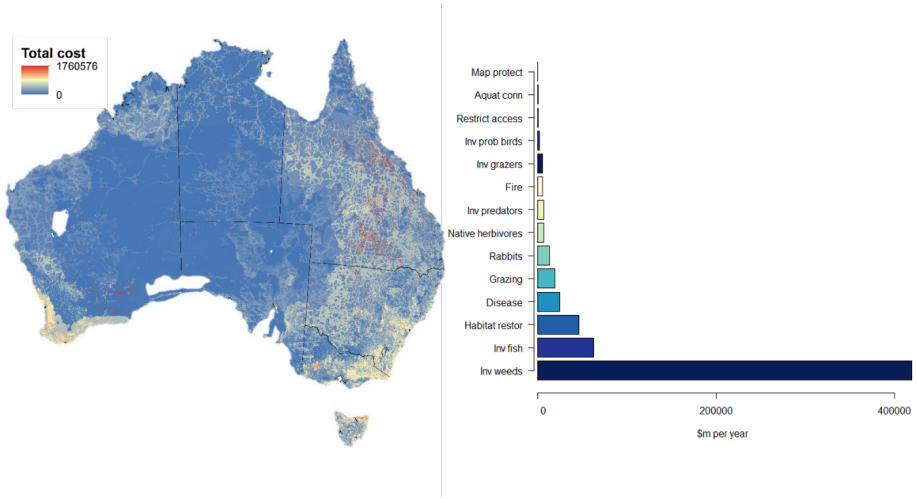


***Figure 3:*** *The total cost of all Threat Abatement Strategies (TASs) across Australia (legend shows amount in dollars) (left) and the total cost of each TAS (right). Inv = invasive, aqua conn = aquatic connectivity*

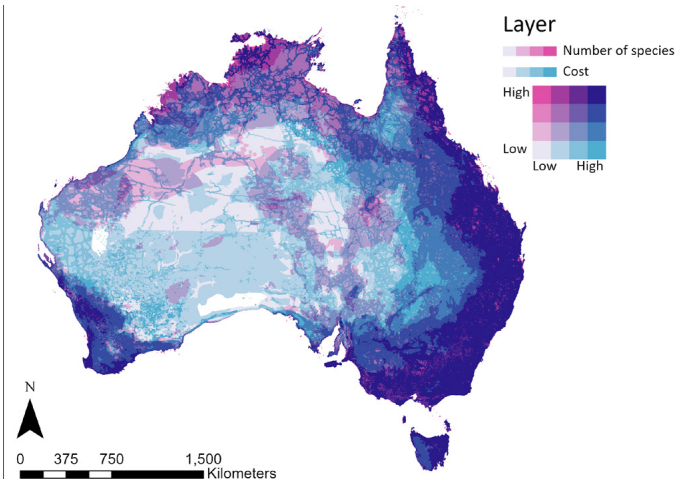


***Figure 4:*** *The total cost compared with the number of threatened species occurring across Australia. Paler areas denote lower cost and fewer species; dark purple denotes high cost and greater number of species.*

One important TAS in our analysis focused on improving the integrity of threatened species habitat and extending it through restoration. This would also improve habitat conditions for non-threatened species, improve soil stability and integrity, decrease run-off, and lead to cleaner waterways and oceans. When the restored vegetation reaches maturity, it would sequester at least 98 million tonnes CO2 in above- and below-ground biomass. At a carbon price of $20 per tonne, this carbon could be worth $23-502 billion.

## Works cited

Reside, A.E , Ward, M., Yong CJ, Watson J.E.M, Rogers, A., Li, R.V. and Carwardine, J. (2021). A knowledge synthesis to inform a national approach to fighting extinction. NESP Threatened Species Recovery Hub Project 7.7 report, Brisbane.

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## Implications and recommendations

Genuine commitment to species conservation targets requires significant resourcing. The cost of recovering all threatened species per annum ($61 billion) equates to approximately 34% of Australia's 2020 Gross Domestic Product. Threatened species, and their corresponding threatening processes, occur broadly across Australia, and the recovery of all of Australia's threatened species will require action across most of the continent. For many species, changes in current or planned land use would be required to achieve recovery, as many human activities that clear or degrade species habitat are not compatible with a plan to recover those species. But, critically, we found that many widespread TASs are low-cost per $km^2$, so that their implementation in many places is likely to be viable.

Over 84% of species listed as threatened nationally in Australia experienced habitat loss through clearing within the government's own species-specific maps of habitat extent in the past two decades. Restoring threatened species habitat had the greatest cost per area of any strategy. Therefore, recovery plans must include the proactive prevention of future habitat loss and degradation, as a genuinely cost-effective action.

Achieving the recovery of Australia's threatened species will require an inclusive broadscale effort, that supports Indigenous leadership in decision making and accounts for the values and aspirations of Indigenous Traditional Custodians, farmers and other land holders and managers.

The activities required can be beneficial across multiple sectors and, if implemented effectively and in collaboration with local decision makers and knowledge holders, could improve cultural values, as well as farming and land-use practices. Moreover, activities that reverse impacts of habitat loss, degradation and fragmentation will have significant positive effects on salinisation, erosion, water quality and microclimate, which would benefit multiple industries.

Meeting Australia's species recovery obligations under the Convention on Biological Diversity requires a steep increase in conservation funding, and taking a broader view of how landscapes are managed across Australia. Attention is needed to how agricultural lands are managed while retaining and improving threatened species habitat, controlling invasives and managing fire. Over 50% of mainland Australia is under a stock-grazing tenure; much of this is grazing of native vegetation, which is home to many threatened species. Constructive partnerships with landholders with compatible objectives will therefore be a major determinant of the success of threatened species recovery.

Some emerging funding mechanisms have great potential, if managed wisely, to substantially increase recovery work efforts. These include carbon markets, biodiversity accreditation for farms, and funding for increasing water quality in barrier reef catchments. Crucially, governance needs to accompany these mechanisms to ensure that actions undertaken are additional to those already undertaken, so that important funding does not simply maintain business as usual.

This information can help planners and decision-makers understand the likely resources and actions required to achieve species recovery at a range of scales. It can be used for coordinated action in threat mitigation and species recovery; and help to inform options to support the management of protected areas and other important conservation areas.

Furthermore, this information can provide input to strategic assessments, and contribute to frameworks for identifying measures of success in threatened species recovery. It can help inform policy processes across different jurisdictions and identify opportunities for investments that benefit multiple species and achieve broader environmental outcomes. Importantly, this information can also help guide future assessments into the likely consequences of management and land-use change on species persistence.

## Further Information

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