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Spending to save

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Spending to save: What will it cost to halt Australia's extinction crisis?

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Abstract

As with most governments worldwide, Australian governments list threatened species and proffer commitments to recovering them. Yet most of Australia's imperiled species continue to decline or go extinct and a contributing cause is inadequate investment in conservation management. However, this has been difficult to evaluate because the extent of funding committed to such recovery in Australia, like in many nations, is opaque. Here, by collating disparate published budget figures of Australian governments, we show that annual spending on targeted threatened species recovery is around U.S.$92m (AU$122m) which is around one tenth of that spent by the U.S. endangered species recovery program, and about 15% of what is needed to avoid extinctions and recover threatened species. Our approach to estimating funding needs for species recovery could be applied in any jurisdiction and could be scaled up to calculate what is needed to achieve international goals for ending the species extinction crisis.

KEYWORDS
budget, costs, Endangered Species Act, funding, government spending, recovery plan, resource allocation, threatened species, transparency, the United States

1 | INTRODUCTION

The Anthropocene is characterized by species extinction rates between 100 and 1,000 times higher than background rates (Barnosky et al., 2011). Humans are responsible for the vast majority of extinctions in the past 400 years due largely to habitat destruction and degradation, overexploitation and the introduction of invasive species and diseases (Lewis & Maslin, 2015). In Australia, the drivers of extinction broadly reflect the global profile, although invasive species have played a relatively larger role compared to most of the rest of the world (Kearney et al., 2018). A potent combination of rapid habitat destruction and introduced predators, herbivores and pathogens, has resulted in Australia losing more biodiversity than any other developed nation in the past 200 years (Waldron et al., 2017).

Australia's obligations under the Convention for Biological Diversity (CBD) include meeting the United Nation's Strategic Plan for Biodiversity Aichi Target 12: "…by 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained" (CBD, 2010). However, during the past decade, imperiled species in Australia have continued to decline and at least three species have been allowed to go extinct (Woinarski, Garnett, Legge, & Lindenmayer, 2017).

There is an urgent need to address the extinction crisis in Australia; the response will require legislative reform, increased funding allocated to species security, protection and recovery, and more effective, targeted and enduring management (Kearney et al., 2018; Walsh, Watson, Bottrill, Joseph, & Possingham, 2013). This paper focuses on the funding shortcomings that have contributed to Australia's failure to meet the Aichi target. To date, arguments for increasing funding have not been backed by detailed analysis of the current situation (but see Howell & Rodger, 2018 for an analysis of *research* investment). Such analysis has been hampered by poor information about what is currently spent on threatened species conservation and recovery in Australia. While there have been estimates made of Australia's environmental and biodiversity expenditure as a whole (ABS, 2004; Cresswell & Murphy, 2017), here we provide the first published estimate of direct expenditure by Australian governments on threatened species recovery aggregated across the Commonwealth, states and territories, and estimate how much Australia *should* have been spending to meet its CBD obligations to prevent further biodiversity loss. While the paper focuses on Australian spending, the approach we take to estimating funding requirements and shortfalls could be applied in any country or jurisdiction from local governments to multicountry entities, such as the European Union. The approach could be scaled up to calculate spending required to achieve international commit-

ments to ending the extinction crisis, recognizing that adequate spending will need to be accompanied by regulatory and policy reform to curb habitat loss and overexploitation.

1.1 | Australia's extinction crisis

Australia has 1890 taxa listed as extinct or threatened with extinction under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia, 1999), hereafter EPBC Act. Of these, the majority (1,373) are plants, followed by birds (156), mammals (134), invertebrates (66), reptiles (63), fishes (59), and amphibians (41). Consistent with overall levels of endemism in Australian biota (Chapman, 2009) most of the Australian listed threatened species are endemic, and hence their survival is entirely dependent on the extent and success of conservation actions taken in Australia. These tallies are likely to severely underestimate the numbers of species that are actually threatened with extinction: species that are undescribed, data deficient, or less charismatic (e.g., invertebrates) are much less likely to be listed (Walsh et al., 2013).

The proportional extent of known loss has been largest for endemic mammals: at least 34 Australian mammal species—10% of its endemic mammalian fauna—have become extinct since European settlement (Figure 1) (Woinarski, Burbidge, & Harrison, 2015). Extinction of Australian reptiles is also notable. The three recent Australian reptile extinctions (Andrew et al., 2018) are the only known extinctions of reptiles in the world since the 1970s (IUCN, 2018).

The past decade has seen a rapid decline in expenditure on environmental management in Australia, with cuts of 37% to environmental investments in the Australian Government budget since 2013 (ACF, 2018). The decline in expenditure and ongoing species loss has drawn sharp criticism from the international community for over a decade (OECD, 2008, 2019) as well as from independent domestic authorities (ANAO, 2006; Cresswell & Murphy, 2017). Relative to the scale of biodiversity loss, it has been asserted that Australia underspends on biodiversity conservation relative to other countries of comparable wealth (Waldron et al., 2017). However, detailed accounting of actual spending on threatened species recovery in Australia is currently lacking.

2 | WHAT IS AUSTRALIA DOING?

2.1 | Funding for threatened species recovery in Australia

Ideally an assessment of the effectiveness of funding to recover listed threatened species would be based on a collation of budgetary requirements foreshadowed in species' recovery
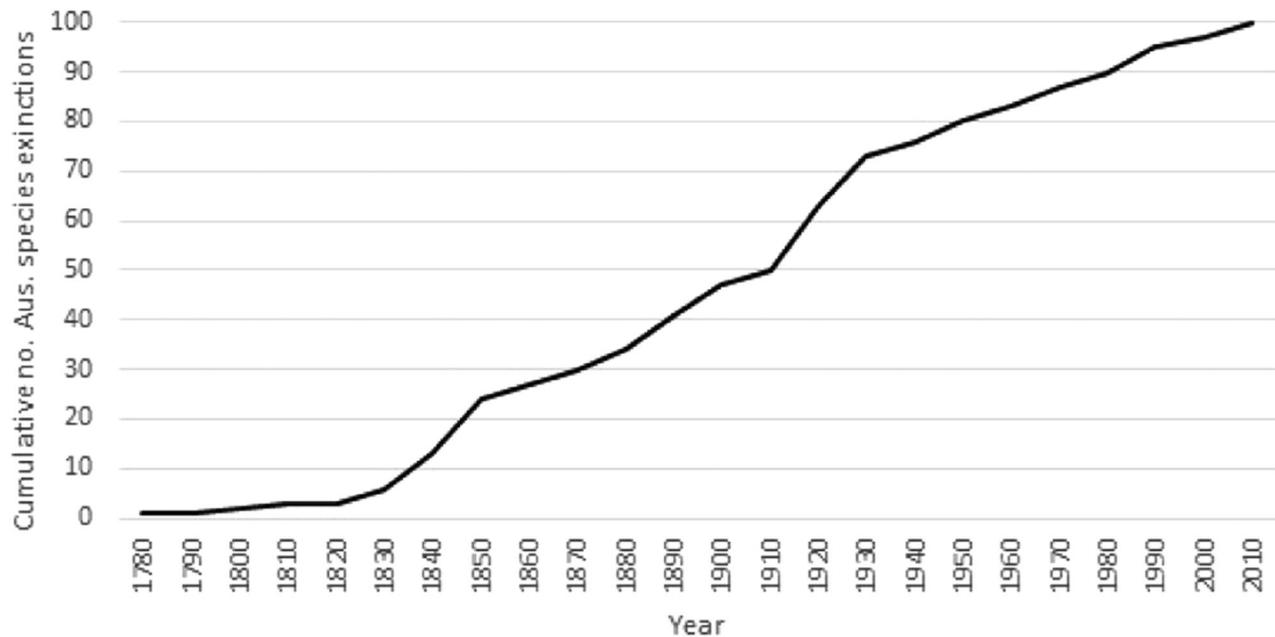
FIGURE 1 The cumulative number of extinctions of Australian endemic mammal species since 1800. Note that, for some species, the dating of extinction is difficult to assess, so there is uncertainty in the exact (*x*-axis) position of some of the extinct accumulations, especially earlier in the time series. (Modified with permission from Woinarski, Burbidge, & Harrison, 2014)

plans, budgets actually allotted to such recovery efforts, and the extent to which this expenditure has led to recovery. However, all three of these components are difficult to assess in Australia, because many listed species do not have (and are not required to have) recovery plans; many recovery plans do not include budgets; budgets, where included, contain too little detail to assess whether the estimates are reasonable; there is no legal obligation to implement recovery plans or to allocate the funds earmarked in them; there is little accounting of expenditure on individual species' recovery efforts; few Australian threatened species are monitored with sufficient statistical power (Legge et al., 2018); and few Australian threatened species have demonstrably recovered.

With the direct approach unavailable, we instead attempt to estimate the spending by Australian governments on conservation of threatened species and benchmark this rate of spending against a comparable nation that has achieved demonstrable recovery of threatened species.

Detailed analysis of Australia's current threatened species expenditure is hampered by the lack of specific reference to threatened species spending in Australian Government federal and state budget papers, and a lack of reporting on conservation expenditure for individual threatened species. To estimate government spending on threatened species, we examined environment-relevant budgets from 2015–2016 to 2018–2019 across all Australian jurisdictions. Australian Government budgets report down to just a few program lines (Table S1), requiring further investigation beneath the program level to ascertain which components of program spending were either directly, indirectly, or not at all related

to threatened species recovery. Direct spending included programs that supported activities such as captive breeding of a threatened species or targeted threat management (e.g., fox control) to secure a population of a threatened species. Indirect spending included activities such as general weed or predator control that may benefit a threatened species without being expressly for that purpose. Unrelated spending was all other environment-related spending unlikely to contribute directly to threatened species persistence. We classified each program line into targeted (direct), relevant, or nonrelevant threatened species recovery components, justifying each breakdown with reference to program annual reports and other evidence obtained via grey literature or personal communications (Tables S1–S2). In all cases, we detailed assumptions and references to relevant documents, such as annual reports, for each budget line.

We estimate that targeted threatened species allocated spending by the Australian Government amounts to U.S.$38.1m (AU$49.6m) for the 2018–2019 financial year (Table S1), down from U.S.$65.1m (AU$86.9m) the previous year (Supporting Information S4). All price figures throughout have been converted from their original nominal amounts to 2018 constant prices to account for inflation, unless otherwise specified. The newly released figures for 2019–2020 show a slight increase of U.S.$3.8m (AU$5m) (Supporting Information S4).

Including both targeted (direct) expenditure seeking to recover threatened species and other relevant expenditures, the estimated upper limit of investment by the Australian Government in biodiversity in 2018–2019 is about U.S.$293m

(AU\$391m). This is down from U.S.\$574m (AU\$766m) in 2017–2018, due largely to an increased, one-off spend in that financial year on the "Reef 2020 Plan" program (Commonwealth of Australia, 2018). The broad category of relevant but not targeted programs includes several programs that *may* contribute to some aspects of threatened species recovery. For example, expenditure under the Commonwealth Environmental Water Office might assist threatened species conservation by improving some habitats in some areas that contain threatened species; however, its activities are not *targeted* to deliver specific outcomes for particular threatened species (Table S1). Given the number of objectives outside of threatened species recovery that such programs set out to achieve, it is reasonable to assert that the Australian Government spends much less than this amount on targeted threatened species recovery actions.

A similar process was applied to obtain spending estimates for Australian states and territories (Supporting Information S2). We stress that, because of the challenges with getting exact and comparable estimates of expenditure across jurisdictions for the period of interest, our figures are not to be considered precise estimates, but rather a reasonable approximation. Our best estimate of combined state and territory expenditure on targeted threatened species recovery is U.S.\$54.3m/year (AU\$72.4m/year) over recent years (Table S2).

Summing across state, territory and commonwealth jurisdictions results in an estimated net public investment in targeted threatened species recovery in Australia of U.S.\$92m/year (AU\$122m/year), or ca U.S.\$51,000 per extant EPBC Act listed species per year.

3 | WHAT SHOULD AUSTRALIA HAVE BEEN DOING?

Current levels of government funding are inadequate to address Australia's extinction crisis. This is apparent in the ongoing species loss, the ongoing decline of most listed species, and the increasing number of species being identified as threatened every year. So, what should Australia be spending if it is to prevent further species loss and maximize the chance that listed species recover? Significant uncertainty exists about exactly which actions should be taken to conserve species, and how effective those actions will be (Garnett et al., 2018b), so precise species-by-species costing is not possible. We looked to the United States where species recovery has been demonstrated for many species, where a similar number of species have been listed as threatened under a comparable (but typically less discretionary) threatened species protection legislation over a comparable land area. The United States also has a similar level of per-capita wealth, equivalent federalized administrative responsibility for threatened species, a

strong judicial system, and a strong tradition of public investment in tackling environmental issues.

There is empirical evidence that the more a country spends on conservation, the fewer species it loses (Waldron et al., 2017). The United States provides a strong case in point. Funding for actions listed under recovery plans is mandated under the *Endangered Species Act 1973* (U.S.C., 1973), and the United States has seen relatively strong recovery in listed species. Money spent strategically on threatened species has achieved improvements in species' status (Taylor, Suckling, & Rachlinski, 2005). For example, 85% of listed birds achieve a documented stabilization or recovery following listing.

From 2011 to 2016, the U.S. government spent at least U.S.\$1.45b/year on direct threatened species conservation and recovery actions, equating to about U.S.\$903k/species/year (USFWS, 2016). This is augmented by between U.S.\$60m/year and 100m/year in U.S. State investments in threatened species recovery (USFWS, 2016). The Federal (U.S. Fish and Wildlife Service) reports expenditure on direct threatened species recovery projects and does not include land acquisition or administration costs of the major agencies. In 2018, 1,662 species were listed as threatened and endangered under the U.S. Endangered Species Act (ESA), about 100 *fewer* than listed in equivalent categories under Australia's EPBC Act (1,798, excluding extinct species).

Evidence for the effectiveness of U.S. investment in threatened species recovery is strong. The U.S. track record in recovery far exceeds Australia's, with 39 species de-listed due to recovery[1] and strong recovery trends observed in many species, including the iconic grey wolf, grizzly bear, and bald eagle (Suckling, Mehrhoff, Beam, & Hartl, 2016; Taylor et al., 2005). Suckling et al. (2016) found that birds listed under the U.S. ESA increased in population size on average by 624% since their listing, while unlisted birds declined by 24% on average over the 42 years since the inception of the Act. This comparison suggests that the recovery of listed birds in the United States can be attributed largely to the regulations, mandated funding, and recovery actions associated with listing a species.

Using the U.S. species recovery expenditure figures for 2013 (Gerber, 2016), we computed median and mean (within taxonomic groups) funding allocations to 284 species that were assessed by Gerber (2016) as having adequate funding.[2] Mean and median per-species costs were then multiplied by the number of species in each taxonomic group listed under Australia's *EPBC Act 1999* to provide a preliminary estimate of targeted funding required to recover Australia's listed threatened species (see Supporting Information S3 for more detail). The total estimate ranges from U.S.\$684m/year to 1.27b/year (AU\$911m/year to 1.69b/year) depending on whether median or mean U.S. funding figures were used for each taxonomic group (Table 1). Funding Australian

TABLE 1 Annual average and median expenditure (across species within taxonomic groups) allocated to achieve recovery under the U.S. *Endangered Species Act 1973* in 2015 (Gerber, 2016). Column 4 gives the number of species listed under Australia's *EPBC Act 1999* by taxonomic group. Columns 5 and 6 provide the product of the average or median expenditure and the number of species in each taxonomic group to provide an estimate of the total funding required to secure Australian threatened species within taxonomic groups. Amounts shown have been adjusted to 2018USD; total amounts in brackets are 2018AUD

Taxa	2018USD $'000 U.S. allocated funding Median	Mean	Number of species (EPBC Act*)	2018USD $'000 Estimated expenditure to recover Based on median	Estimated expenditure to recover Based on mean
Plant	$53	$125	1,336	$70,406	$167,112
Invertebrate	$126	$320	65	$8,183	$20,812
Fish	$212	$2,091	58	$12,294	$121,286
Amphibian	$517	$1,124	37	$19,138	$41,587
Reptile	$757	$1,998	61	$46,203	$121,889
Bird	$3,379	$3,430	134	$452,797	$459,595
Mammal	$700	$3,131	107	$74,848	$334,965
Total 2018 USD				$683,868	$1,267,246
Total 2018 AUD				($910,853)	($1,687,861)

Note: Amounts shown are adjusted to 2018 USD constant prices (from 2013 USD), with AUD totals conversion rate at 2018–2019 average as per the Australian Tax Office (AU$1 = U.S.$0.7508).
*Excludes species listed as Extinct and Extinct in the Wild.

threatened species recovery at the taxonomic mean rate of funding provided to species recovery in the United States would result in an approximately 20-fold increase in funding in Australia compared with current expenditure. The relative merits of using mean versus median rates are discussed in Supporting Information S3. Recovery here, as in the study by Gerber (2016), is defined as achieving security such that delisting of the species under the EPBC Act is justified.

4 | WHAT AUSTRALIA NEEDS TO DO NOW

Our estimates of recovery funding requirements for Australia's threatened species based on the median cost of recovery in the United States may be optimistically low. Invasive animals, plants and pathogens play a larger role in Australian extinctions than they do in many other places (Garnett et al., 2018b; Kearney et al., 2018), and many of these invasive species are extremely difficult to eradicate or suppress to the level required to allow threatened native species to persist (Burbidge & McKenzie, 1989; Moseby et al., 2011). This is compounded by the logistical challenges of managing those threats over the immense area in which they manifest. Other caveats on our estimates include the fact that Australia's EPBC Act listing is incomplete and new species are likely to enter the list as more information accumulates and listing catches up with biodiversity loss. These and other deep uncertainties make any method of costing extremely challenging, and cross-jurisdictional comparisons of recovery costs should be made with care.

Taking these factors into account, it is likely that the actual cost of recovering Australia's listed threatened species is closer to the estimated U.S.$1.27b/year (AU$1.69b/year) based on the mean per-species expenditure on recovery in the United States. Although governments may consider this to be a large sum relative to current levels of funding, a useful context is that Australians will spend more than double this amount on pet cat care in 2019 (REF), the Australian Government expects to pay U.S.$143.9 billion (AU$191.8b) in social security and welfare payments in 2019–2020, and forewent U.S.$735m (AU$980m) tax revenue through fuel tax credits to coal mining companies in 2018 (ACF, 2018; Klapdor & Arthur, 2018). Unfortunately, preventing extinction will most likely cost more relative to GDP in Australia than it will in the United States.

Our estimates of recovery expenditure in Australia and the United States excludes the efforts of local government, and importantly, the private sector and NGOs, who undoubtedly make a significant contribution to the conservation of threatened species. Unfortunately for Australia, the relative contribution of private NGOs is much larger in the United States. For example, The Nature Conservancy operational budget in

the United States is U.S.$1.2b/year, compared with the relatively modest ~U.S.$30m combined annual operating budget of Australia's two large land management NGOs, Bush Heritage Australia and the Australian Wildlife Conservancy (Australian Wildlife Conservancy, 2018; Bush Heritage Australia, 2018; PricewaterhouseCoopers, 2018).

4.1 | Continuity, transparency, and accountability

Threatened species management requires long-term (decadal scale) continuity and consistency to be effective (Garnett, Woinarski, Lindenmayer, & Latch, 2018a). Many of Australia's ecosystems are characterized by decadal drought and wet cycles and reliance on rare stochastic disturbances such as fires or floods for regeneration; consequently, opportunities to act to conserve species occur infrequently and unpredictably (Dickman, Wardle, Foulkes, & de Preu, 2014). Committing to support the conservation of such species requires long-term and flexible funding arrangements in which funds can be deployed rapidly when the need or opportunity arises. Moreover, the capacity to report on what is achieved through management, or to identify and act on precipitous declines in species is severely compromised when funding is not committed to the establishment and implementation of powerful monitoring programs (Legge et al., 2018).

Improving the accountability and transparency of expenditure on conservation of threatened species in Australia would also enable a better understanding of the effectiveness of conservation investment (ANAO, 2006). Clear reporting on expenditure, combined with measurement of conservation outcomes, provides a sound basis for analyzing cost-effectiveness of conservation actions, and supports rational prioritization of future investments to maximize conservation outcomes (Iacona et al., 2018). A feature of the U.S. threatened species recovery system is a high degree of transparency on expenditure to recover each species listed under the ESA (USFWS, 2016). Future reporting of threatened species conservation spending in Australia could be modeled on the annual endangered and threatened species expenditure report compiled by the U.S. Fish and Wildlife Service (e.g., USFWS, 2016). Or by tailoring versions of previously used reporting formats—like that of the Australian Bureau of Statistics environmental expenditure reports on local governments (ABS, 2004)—to explicitly address threatened species.

Several of the targeted investments of the Australian Government represent good practice and national leadership in threatened species protection and recovery. Notably, the leadership and coordinated strategy for feral cat management provided through the national Threatened Species Strategy and a National Feral Cat Taskforce provides a model that could usefully be applied to managing other threats. The National Environmental Science Program provides a model

for research designed specifically to inform environmental management and includes an U.S.$23m (AU$30m) investment over 6 years (2015–2021) by the Australian Government on targeted threatened species recovery research.

Without adequate resourcing, supporting legislation, and strong governance of threatened species recovery, monitoring systems that can report species declines and recovery in a timely fashion, and strong regulation and management of threatening processes, we will leave a tragic legacy of extinction and fail in our obligations to future generations of Australians, and the international community. Clarifying our current targeted threatened species expenditure and setting out costing options to estimate long-term funding needs is a necessary first step towards supporting successful threatened species recovery programs. We have set out an approach to provide preliminary estimates of funding needs to delist threatened species, which could be applied in any jurisdiction where there is a list of species to be conserved and recovered. We acknowledge that our approach should be used only as a first parse and does not substitute for detailed analysis of recovery costs that are sensitive to the particular needs of each species, the threats they face, and their local contexts, which are always somewhat unique. We have provided a defensible costing model and starting point for governments seeking to halt the extinction crisis.

ENDNOTES

[1] https://ecos.fws.gov/ecp0/reports/delisting-report.

[2] Gerber (2016) reallocated surplus funding from 50 overfunded to 182 underfunded species. We used these reallocated figures to calculate taxonomic group means and medians (see Gerber, 2016 for reallocation details).

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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