COST-EFFECTIVE RESOURCE ALLOCATOR: A DECISION SUPPORT TOOL FOR THREATENED SPECIES MANAGEMENT

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ABSTRACT

Faced with increasing rates of biodiversity loss and modest conservation budgets, it is essential that natural resource managers allocate their financial resources in a cost-effective manner and provide transparent evidence for extra funding. We developed the 'Cost-Effective Resource Allocator', a Microsoft Excel-based decision support tool to assist natural resource managers and policy makers, to prioritize the set of management strategies that maximize the total number of years that a suite of species is expected to persist given a budget constraint. We describe this tool using a case study of four locally threatened species from the Australian Commonwealth National Park of Christmas Island in the Indian Ocean. These include: a native fern (*Pneumatopteris truncata*), the Christmas Island Red Crab (*Gecarcoidea natalis*), the Golden Bosun (*Phaethon lepturus fulvus)*, and Abbott's Booby (*Papasula abbotti*). Under a hypothetical budget of 8,826,000 AUD over ten years, in which all species are considered equal, our tool recommends funding: fern propagation and planting, rat control, cat control, and Yellow Crazy Ant (*Anoplolepis gracilipes*) survey and control. We found that the cost-effectiveness rankings of these strategies were sensitive to the importance that assessors' assigned to different species. The 'Cost-Effective Resource Allocator' can accommodate input from up to eight assessors, and analyse a maximum of 50 management strategies for 30 species.

Key words: Conservation planning, expert elicitation, Microsoft Excel, prioritization, resource allocation, threatened species

INTRODUCTION

Confronted with increasing rates of biodiversity loss (Barnosky et al., 2011) and an underfunded global conservation budget as a result of low political and public support (McCarthy et al., 2012), natural resource managers face hard choices concerning how best to allocate funding across many threatened species. Structured frameworks based on cost-effectiveness analysis can help managers achieve the greatest gains for threatened species survival per dollar spent by trading off the expected benefits of candidate conservation strategies against their likelihoods of success and cost (Bottrill et al., 2008; Cullen, 2013). Despite the development of several approaches to cost-effectiveness for conservation decision making (summarized in Cullen, 2013), they often require a high level of technical expertise that may hinder their application on the ground. To make coherent allocation of finite resources more accessible we need to provide more user-friendly tools for prioritizing threatened species' conservation.

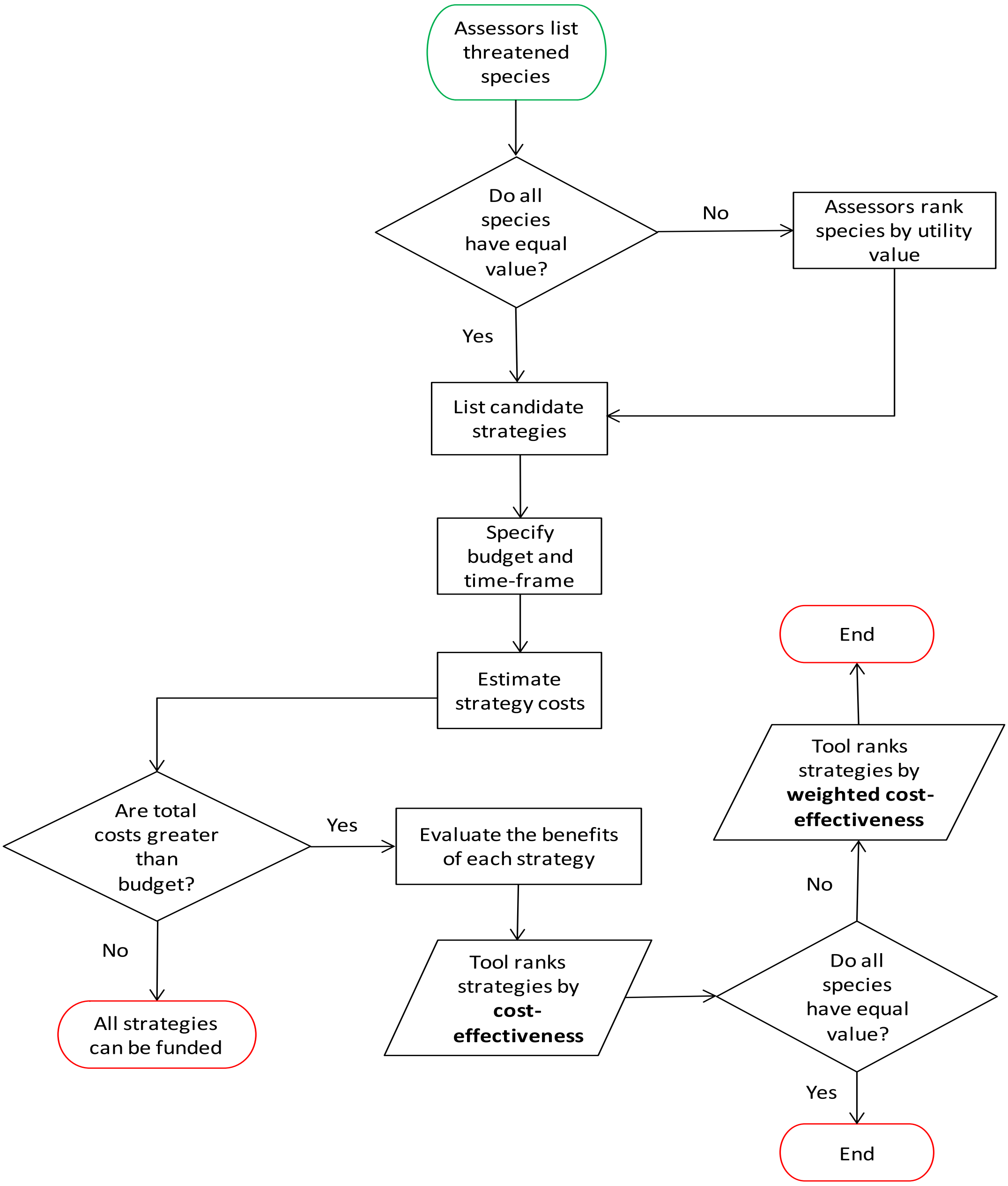


Figure 1. Flowchart representing the steps involved in the 'Cost-Effective Resource Allocator' decision support tool.

Cost-effectiveness frameworks have been applied to optimize conservation investment in New Zealand (Department of Conservation, 2013), the Australian state of New South Wales (New South Wales Government, 2013), and across the Kimberley (Carwardine et al., 2011), Lake Eyre (Firn et al., 2013), Pilbara (Carwardine et al., 2014), and Kakadu National Park (Woinarski & Winderlinch, 2014) regions of Australia. These approaches can include simple spreadsheet methods where the benefits of alternative management strategies are divided by their cost (e.g. Auerbach et al., 2014; Carwardine et al., 2012), algorithms which iteratively remove low-ranking strategies and update cost-efficiency rankings (e.g. Joseph et al., 2009; Chadés et al., 2015), and spatially explicit systematic conservation planning software that solve integer programming problems (e.g. Marxan and Zonation; Ball et al., 2009; Moilanen, 2007). Complex approaches may provide normatively better decision support, but they can be difficult to implement and interpret for practitioners. Moreover, current methods commonly require experts to estimate the likely benefits of candidate management strategies using direct, probabilistic judgements (the 'probability of persistence' of a species; e.g. Carwardine et al., 2012; Joseph et al., 2009), which can be prone to error and bias (Lagnado & Sloman, 2004; O'Hagan et al., 2006; Bolger & Wright, 1994).

In this paper we provide a more tangible benefit estimation procedure by adapting the IUCN Red List Criteria (IUCN, 2001) to a local context, and make the process of calculating cost-effectiveness easily accessible, using a series of linked Microsoft Excel worksheets. This paper is a guide to the tool and details the process

For most of the year, Christmas Island red crabs (*Gecarcoidea natalis*) are found within the island's forests, only migrating to the coast once a year to breed. ©Martina Di Fonzo

involved in collecting the information required for the analysis. We provide users with a transparent decision-making process to determine which on-ground conservation strategies should be funded to maximize the sum of expected extant years for a set of threatened species, while taking into account assessors' uncertainty and distinctions in the value attributed to different species.

We developed this tool with the input of potential users from two Australian Commonwealth National Parks (Uluru-Kata Tjuta and Christmas Island National Parks), and refined it based on further feedback from two park staff (one of whom had no prior experience of the tool). The tool can accommodate input from up to eight assessors and can be used to analyse a maximum of 50 candidate management strategies for a total of 30 species. It can be expanded to include more assessors, strategies and species, if required. We recommend that the tool be operated by a single assessor/expert, charged with eliciting information from the remaining experts using the instruction sheets in Appendices S3 and S4. We describe how the tool identifies the best conservation strategies using a case study of four locally threatened species from Christmas Island National Park, an Australian territory in the Indian Ocean.

AN EXAMPLE: PRIORITIZING MANAGEMENT STRATEGIES FOR FOUR THREATENED SPECIES IN CHRISTMAS ISLAND NATIONAL PARK

We held an expert elicitation workshop with seven Christmas Island National Park staff in June 2014 to determine the strategies required to conserve four native species (a fern (*Pneumatopteris truncata*), the Christmas Island Red Crab (*Gecarcoidea natalis*), the Golden Bosun (*Phaethon lepturus fulvus)*, and Abbott's Booby (*Papasula abbotti*)), and the expected benefit of these strategies following their implementation over 10 years. The information was collected using the following steps (Figure 1), which involve: listing the species and strategies of interest, estimating their cost and benefits, and ranking them according to cost-effectiveness. These steps are represented within the spreadsheets that form the 'Cost-Effective Resource Allocator' tool (see Appendices S1 and S2 for additional screen shots to illustrate the steps below).

- **Part A – Setup**

Step 1: List biodiversity assets, generation length and assessor

The 'species and assessors' sheet requires the names of the focal species (Table 1), and their generation lengths. Generation length is defined as either the average age of mothers within a population (for animals) or the median time until germination (for plants; IUCN Standards and Petitions Subcommittee, 2010). We included species' generation length to compare the benefits of alternative strategies across different species (as applied in the IUCN Red List of threatened species; IUCN, 2001; further explained in step 5). This sheet is also used to record the identity of the assessors, after which they are represented by a single letter in the remainder of the worksheets. This ensures that their responses remain anonymous and do not influence the views of other experts.

Step 2: Weight species differently (optional)

The tool has the option of explicitly recognizing that species within an ecosystem are not all considered equal. For instance, if a species is iconic, endemic or listed at the national level, it may be allocated a higher 'value' in relation to other species. Appendix S3 provides

Table 1. Species names and generation length

Species name	Generation length (years)
Abbott's booby	16
Christmas Island red crab	12
Golden bosun	11
Native fern species	4

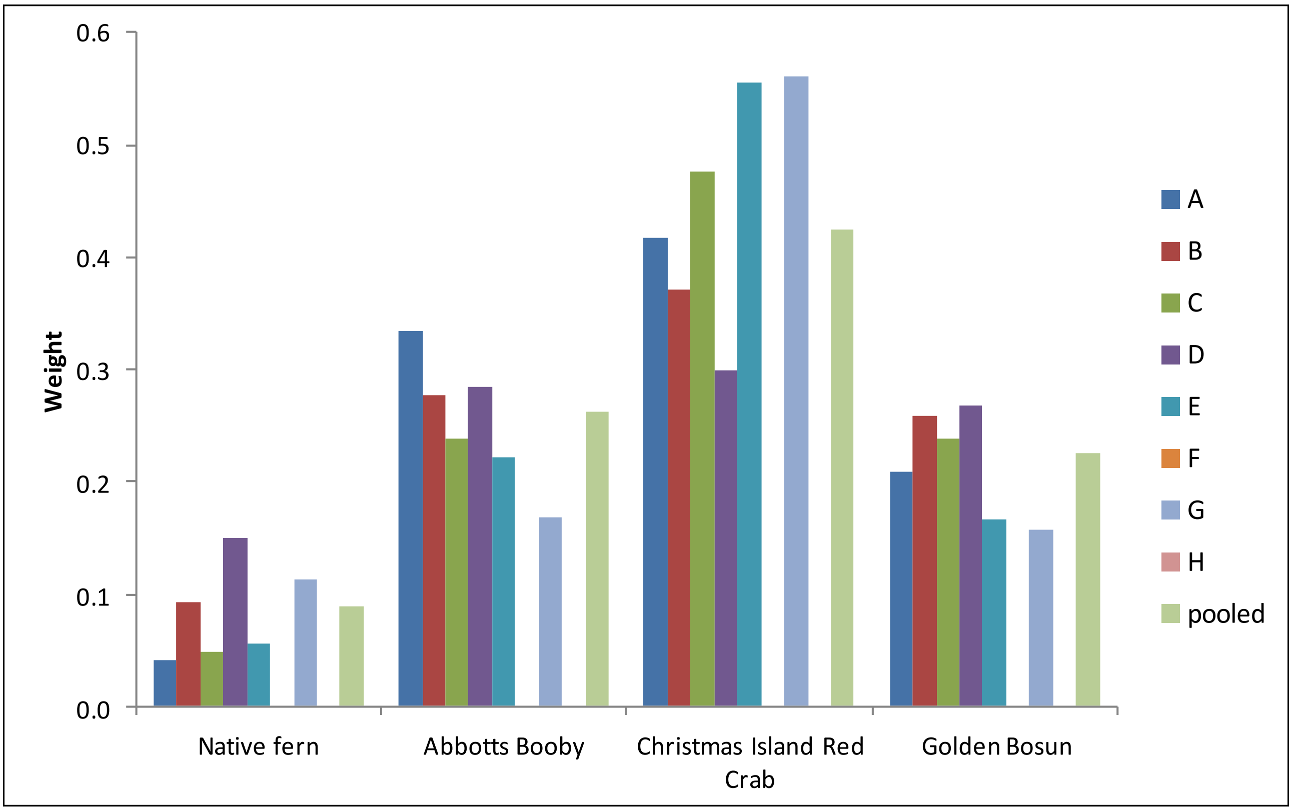


Figure 2. Species' value weightings, based on assessors A-H (where available), and pooled judgements. Gaps exist where assessors did not provide a value. All figures have been output from the Cost-Effective Resource Allocator tool.

instructions to the assessors for ranking species based on their perceived value. Columns B-H of the 'value-judgements' sheet can be used to record the basis for the assessors' value judgements (determined through informal group discussions), whereas columns L-S collect the assessors' precise rankings of species out of 100. 'Phylogenetically distinct' refers to whether the species is evolutionary distinct, with few extant relatives, and therefore more important for maintaining phylogenetic diversity, contributing to functional diversity and adapting to future conditions than species from diverse lineages, which are assumed to have greater genetic redundancy (Vane-Wright et al., 1991; Crozier, 1997). The value-based characteristics listed on the sheet can be altered as appropriate. Once the value judgements are collated, the graph below summarizes each species' weights, based on the proportion of the total value allocated to all species by each assessor (Figure 2). The pooled weights represent the species' ranking in proportion to the sum of all the assessors' rankings across species.

Step 3: List candidate strategies and their impact on species

Management strategies that may benefit the threatened species should be listed in the 'strategy table' sheet, preferably as individual strategies. When strategies must be implemented together to achieve their full conservation benefit, they can be combined within a single strategy. This option should be used sparingly as the tool cannot recognize if the same action is included in several strategies and may overestimate management expenses. Note that this tool is only applicable to *in-situ*, on-ground strategies due to the difficulties in assessing the benefit and probability of success of *ex-situ* strategies, such as conservation breeding programmes, or the impact of 'research and monitoring' strategies, which have no immediate benefit. From row 57 onwards, users must specify which species are impacted by each strategy.

Step 4: Specify the budget and time-frame

The 'budget' sheet requires input of the annual resources available for employing personnel and the monetary resources for on-ground activities. This spreadsheet contains a discount rate (specified in cell B13) that adjusts the cost of strategies for the effects of inflation over the planning period. The discount rate can be specified by the user. We do not recommend setting a long planning period (specified in cell B5) as this will reduce the accuracy of predicted changes in population size.

Step 5: Estimate costs

The cost of each management strategy can be broken down according to its annual set-up, operating and maintenance costs, and then adjusted based on the discount rate. For instance, in our case study, Yellow

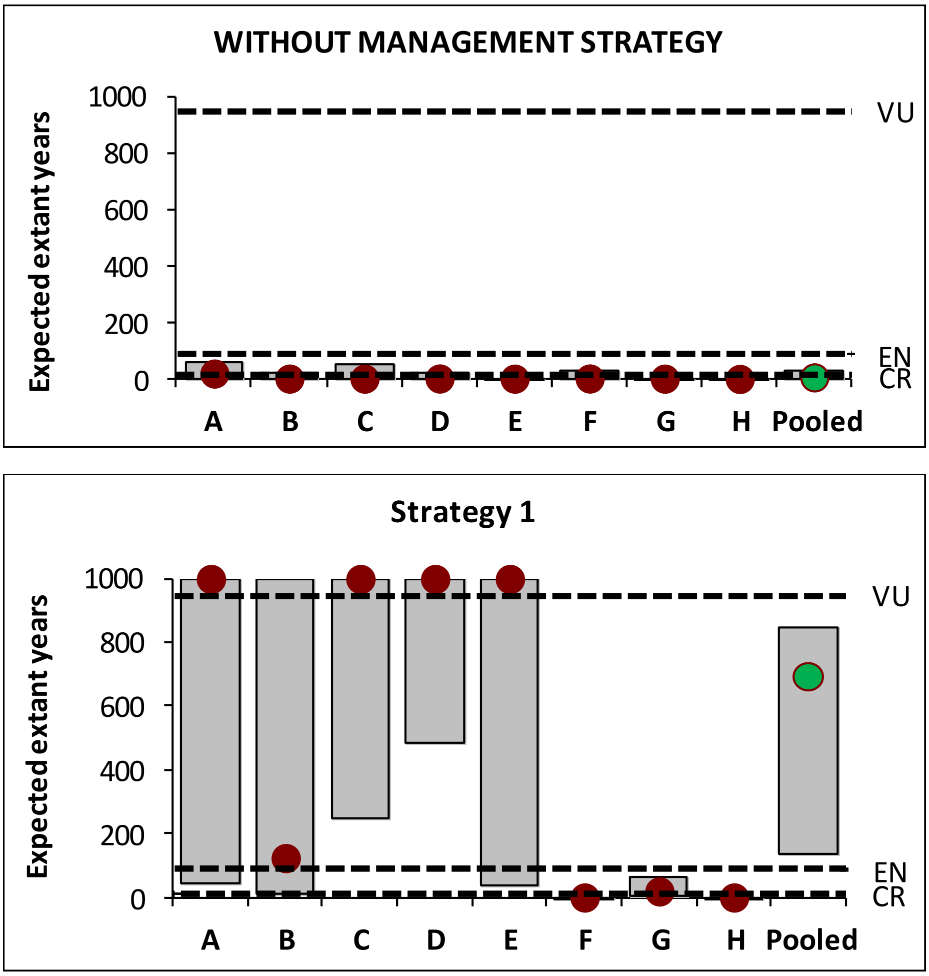


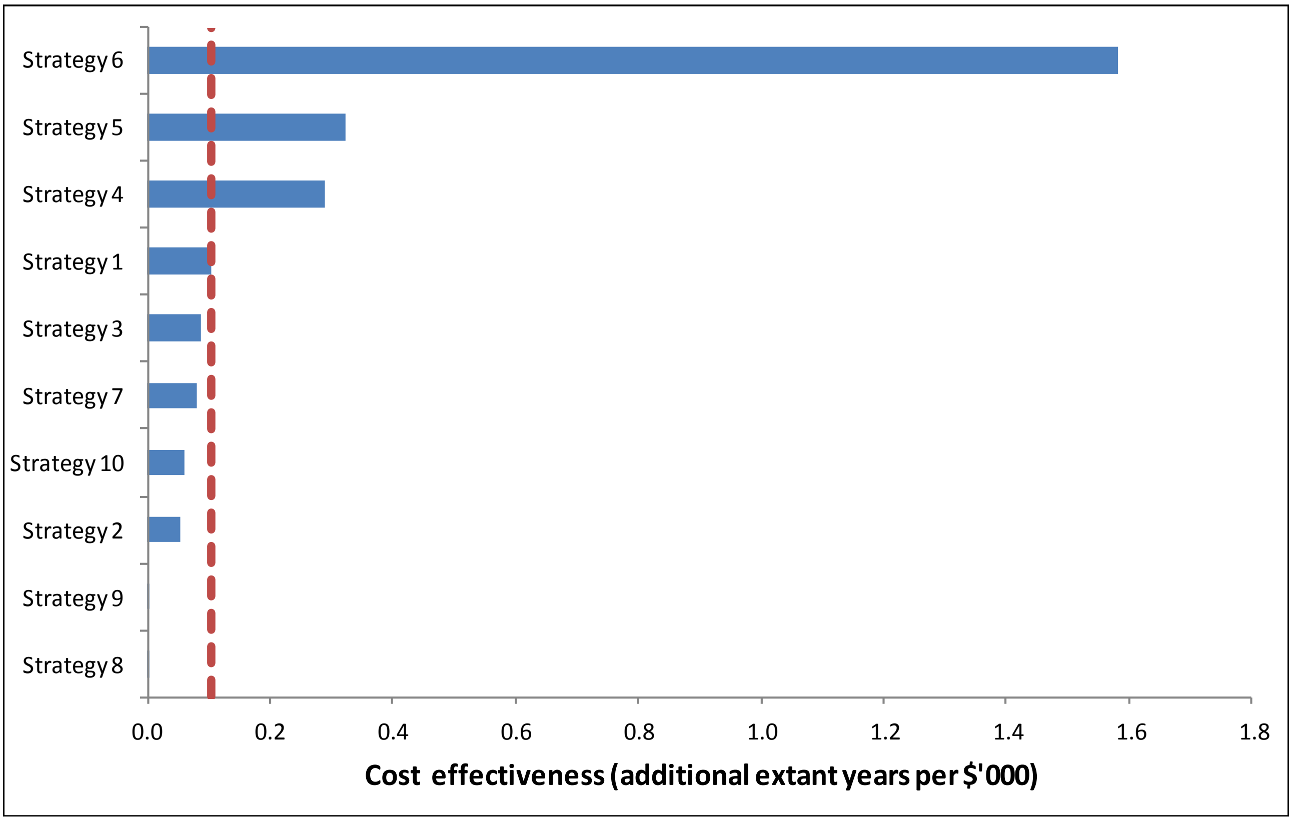
Figure 3. A (top) Expected extant years that the Christmas Island Red crab will persist without management at the end of the 10 year planning period. B (bottom) Expected extant years that the Christmas Island Red crab will persist following the implementation of Strategy 1 (Yellow Crazy Ant survey and control) at the end of the 10 year planning period. Bars A – H illustrate each assessor's judgement separately, and the pooled bar represents their harmonic mean. The red dots represent the best estimate according to different assessors and the green dot represents the pooled estimate. The error bars are represented in grey. The horizontal dashed lines represent the number of extant years which a species would be expected to persist if they were listed as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) according to the IUCN Red List.

Crazy Ant (YCA; *Anoplolepis gracilipes*) survey and control requires 1,200 hours of personnel time, and 350,000 AUD of operating materials annually over 10 years, resulting in a total cost of 6,902,000.05 AUD. If the total funding required for all management strategies is less than the total amount provided in the budget sheet there is no need to continue this analysis as all strategies can be funded. If the total funding required is greater than the total amount provided in the budget, then the analyst has two options: 1) assess whether it is possible to reduce the cost of any strategy (through running a 'reduced conservation programme') in order to meet the funding budget, or 2) start the process of prioritizing strategies by following the steps below.

- **Part B – Perform Assessments**

Step 6: Determine the benefit of each strategy for each species

A separate 'benefit calculation sheet' must be completed for each species, which contains the assessors' evaluations of the benefit of each management strategy for each species, as well as a baseline scenario of the species' likely persistence without conservation management. We addressed the difficulties associated with eliciting benefit through judgements of 'probability of persistence' (which mainly occur due to managers' unfamiliarity with the probability metric; Bolger & Wright, 1994), by basing the expert elicitation process on more well-known notions of population decline and abundance. We also anticipate that asking for information that is closer to managers' expertise will result in better quality judgement (Bolger & Wright, 1994; Kynn, 2008). In particular, we determined benefit using simplified variants of IUCN Red List Criteria A (percentage population decline), D (number of mature individuals) and E (probability of extinction; IUCN, 2001). We asked assessors to predict the percentage population decline and number of mature individuals at the end of the planning period under best-case, worst-case and most likely scenarios with and without each candidate management strategy (a strategy table is provided in Appendix S4 to collect assessors' responses). Once the information is entered, the tool converts these values into species' 'expected extant years' using the calculations detailed in Appendix S5. The tool presents each species' expected extant years under the scenario where no management strategies were applied, and following the application of each individual management strategy with confidence intervals of 80 per cent (intervals can be adjusted according to user preferences; Figures 3 A-B; see Appendix S5 for full methods).



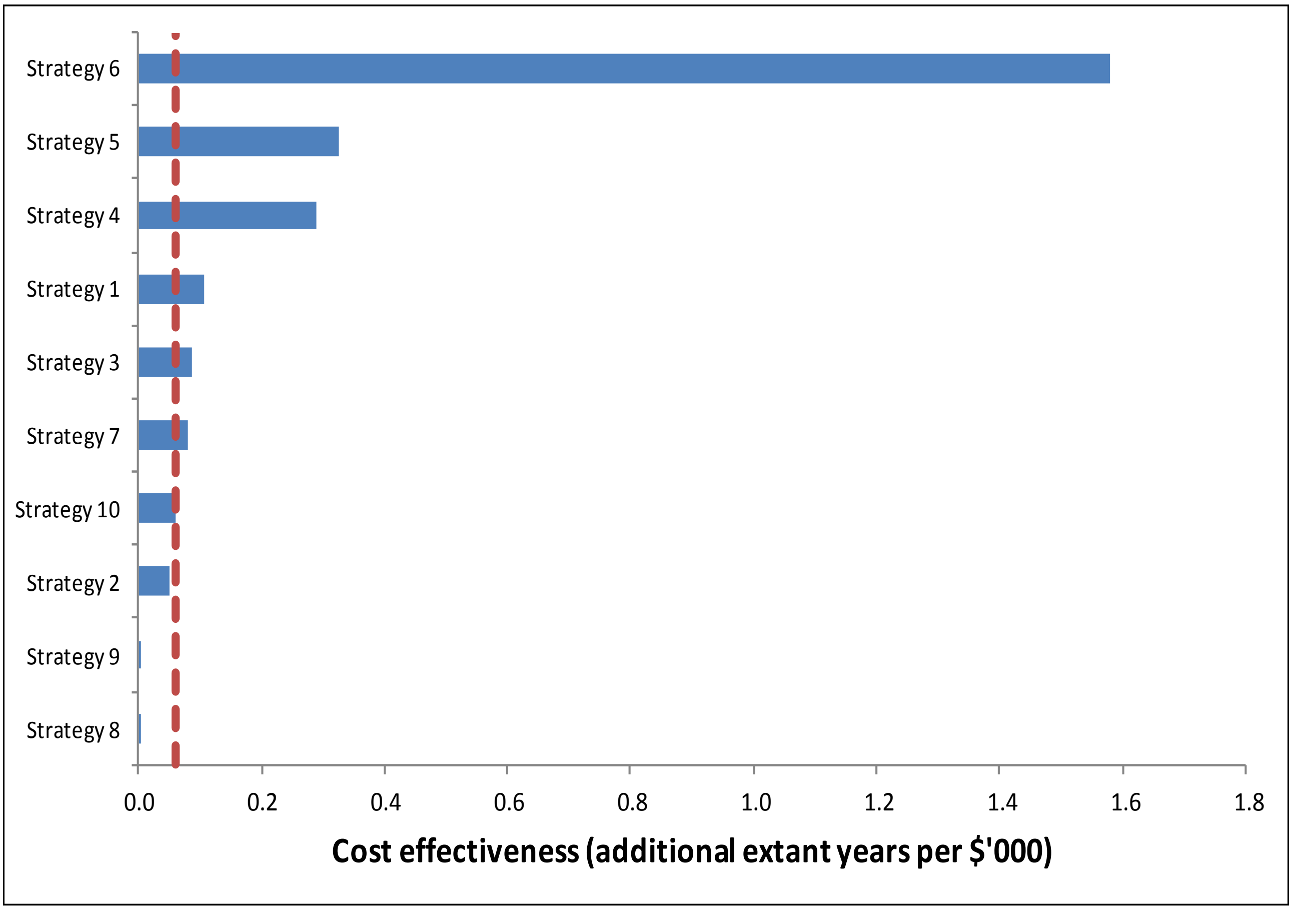


Figure 4. A (top) Cost-effectiveness ranking of each strategy where all species are considered equal. The red dashed horizontal line indicates the budget threshold, below which no further strategies can be funded. B (bottom) Cost-effectiveness ranking of each strategy where all species are considered equal and the budget is increased by 50 per cent.

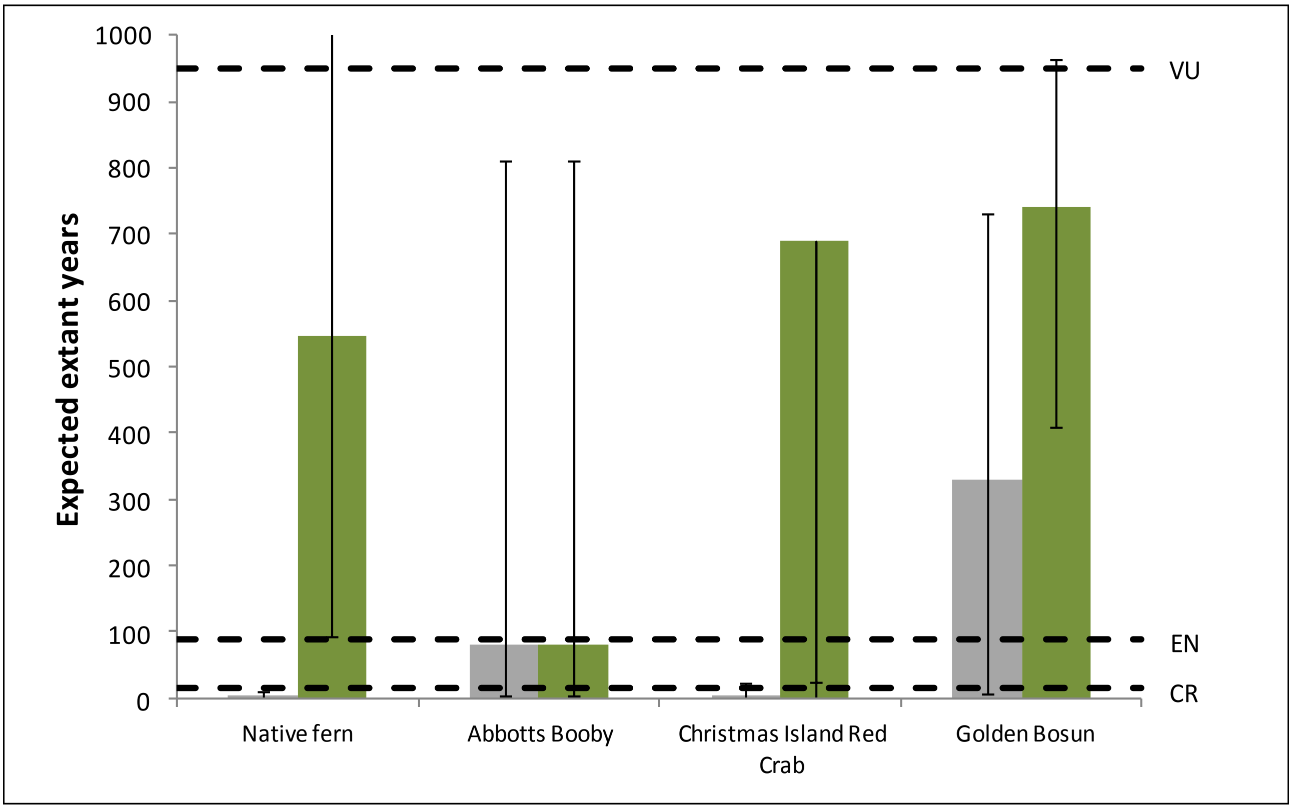


Figure 5. Species expected extant years with (green bars) and without management (grey bars) based on funded strategies in Figure 4 A. Dashed horizontal lines indicate different IUCN Red List category thresholds. The error bars represent 80 per cent confidence intervals.

- **Part C – Explore outputs**

Step 7: Management strategies are ranked by cost-effectiveness

Once all the species have been assessed, the first 'outcomes' sheet ('outcomes – all species equal') calculates the overall number of expected extant years conveyed by each management strategy by aggregating the differences in expected extant years with and without the strategy across all species where this strategy has been applied. The overall number of expected extant years conveyed by each strategy is then divided by their total cost (across all species), providing a list of strategies ranked by cost-effectiveness (Figures 4 A-B). Within this scenario, all species are considered equal.

The dashed vertical red line reports the critical cost-effectiveness threshold for the specified budget: strategies with bars extending beyond this threshold or touching the red vertical dashed line fall within the budget, and those that do not touch the line are insufficiently cost-effective for the budget. The column to the left of the figures (column V) allows the user to specify the inclusion or exclusion of certain strategies, and view their effect on the cost-effectiveness rankings. When all species in our case study are considered equally valuable, fern propagation and planting (strategy 6) is the most cost-efficient strategy, followed by rat control (strategy 5), cat control (strategy 4), and YCA survey and control (strategy 1). No further strategies can be funded under the current budget.

Within the same spreadsheet, users will find a figure illustrating the impact of funding those strategies that meet the cost-effectiveness threshold on the survival of threatened species (Figure 5). The grey bars refer to the predicted expected extant years in the absence of any management intervention, whereas the green bars represent the expected extant years resulting from funding the strategies that meet the cost-effectiveness threshold. The graphs are truncated at 1,000 years on the *y*-axis, which equates approximately to delisting a threatened species. Cells H5, H6 and H7 display the specified budget, the total cost of all funded strategies, and the amount of 'loose change', which we define as the difference between the budget and the total cost of all selected strategies. Loose change arises because the tool stops selecting strategies once the next most cost-effective strategy breaches the budget constraint. The next most cost-effective strategy may be too expensive to fund, resulting in a large amount of 'loose change', which could be used to fund other strategies. To resolve this issue, the user can manually include affordable strategies (cells V7-V57) in a sequence consistent with cost-effectiveness up to the point where no further strategies can be afforded. The user may also manually include or exclude strategies depending on their own management

View of Christmas Island National Park forests and coastline © Martina Di Fonzo

requirements. The 'outcomes' sheets also include a figure illustrating the expenditure on personnel and cash resources (i.e. operating funds) for the funded strategies over the planning period, and a figure displaying changes in the number of species under different extinction risk categories before and after management. The remaining charts have been left empty, as only four species were included within our case study.

The subsequent 'outcomes' sheets present the candidate management strategies ranked according to their weighted cost-effectiveness (calculated by multiplying their cost-effectiveness estimate by the value of the species they benefit). The 'pooled' outcomes results assume that the value judgements of all assessors have equal weighting, whereas 'outcomes – A' to 'outcomes – H' present the weighted cost-effectiveness rankings according to each individual assessor's value judgement. In our case study, the pooled value-adjusted cost-effectiveness strategy rankings do not differ from the 'all species equal' results, however some changes in rankings occur when each assessor's value adjustment is considered in turn. For instance, assessors E and G's rankings substitute 'YCA Survey and Control' as the second most cost-efficient strategy, in the place of 'rat control'. This occurs because YCA control benefits Christmas Island Red Crabs, which is the species that was weighted highest by assessors E and G.

Step 8: Manipulate the budget (optional)

The user may return to the original 'budget' worksheet and change the median annual salary, the annual allocation of personnel and cash resources, or the time horizon for planning to assess how potential decreases/ increases in funding or project length may impact the list of priority strategies and the total species' expected extant years. Alternatively, if the user is interested in observing how a percentage change in the budget may affect the outcomes, they can manipulate the 'Budget scenario' cell (H4) in the 'outcomes – all species' worksheet to view how this affects all subsequent worksheets. An increase in funding will shift the cost-effectiveness threshold closer to the left-hand side of the 'cost-effectiveness' figures in the 'outcomes' worksheets, allowing more strategies to be implemented. Similarly, the user will observe an increase in the number of species listed with lower extinction risk categories, higher cash and personnel cost estimates, and a greater number of expected extant years following management intervention. A decrease in the budget will move the cost-effective threshold to the right and cause the opposite changes. In our case study, a 50 per cent increase in the budget (i.e. setting the budget scenario to 150 per cent) would enable the implementation of three more strategies (strategy 3, 7 and 10; Figure 4 B) and result in downlisting all species to the IUCN Red List extinction risk category of 'vulnerable'

DISCUSSION

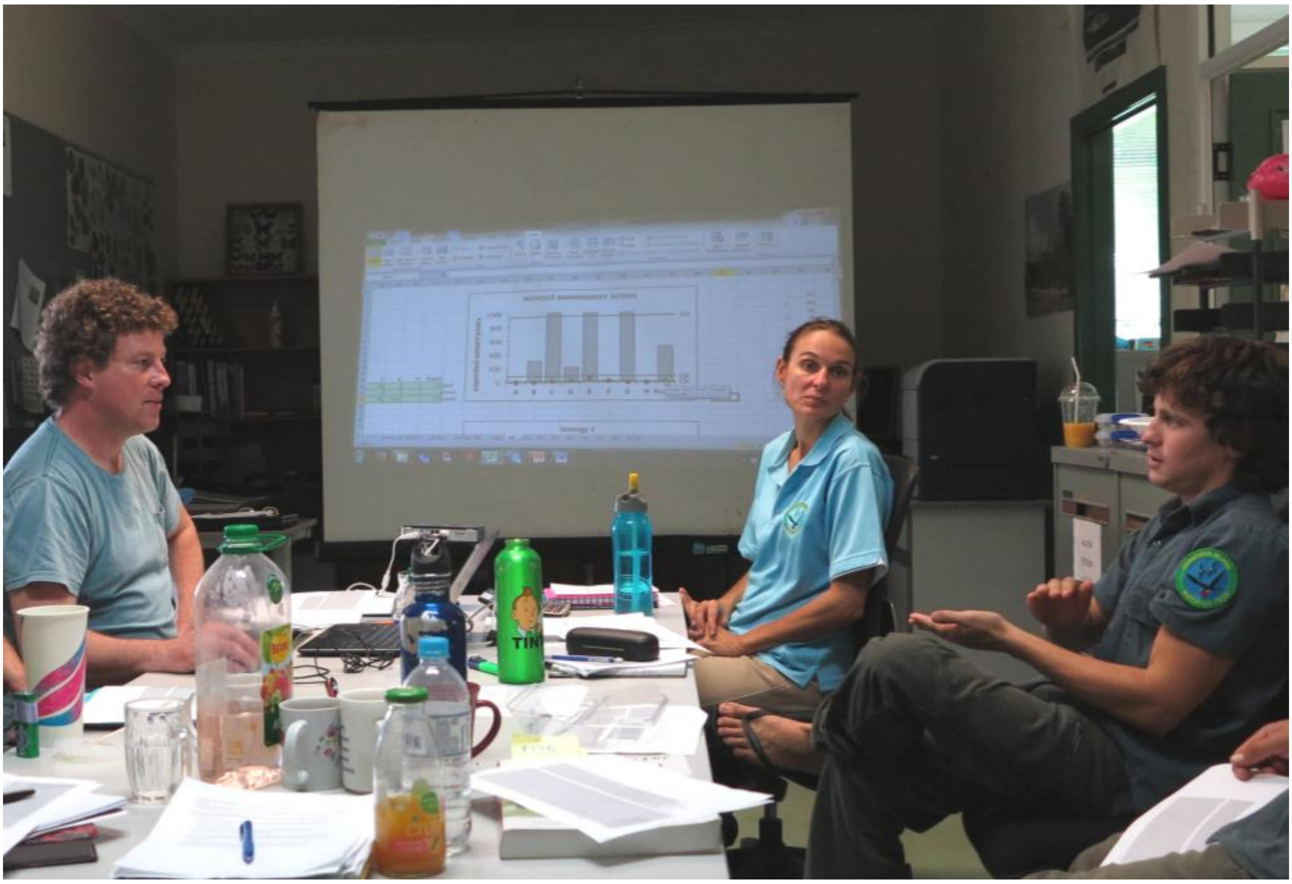
There is still a tendency to prioritize species (e.g. flagships; Verissimo et al., 2011) in conservation biology despite natural resource management being tied more specifically to the application of precise management strategies, with explicit costs, benefits and feasibilities (Game et al., 2013). We fill this gap by providing a user-friendly decision support tool based on cost-effectiveness calculations, which determines the set of management strategies that achieve the highest number of expected extant years across a group of threatened species given a budget constraint. The 'Cost-Effective Resource Allocator' is an advancement over approaches that prioritize the conservation of species with no consideration of data uncertainties or potential management trade-offs (as discussed in Tulloch et al., 2015). This tool also builds on previous frameworks (e.g. Joseph et al., 2009), as prioritizing at the strategy-level allows for more flexible resource allocation across multiple species (described in Game et al., 2013). It also provides a further example of a non-target based conservation prioritization framework, where the objective is to maximize the sum of expected extant years across a group of species, as opposed to maximizing the number of species that meet a specific persistence target (see Di Fonzo et al., 2016 for further examples of this approach, Chadés et al., 2015).

In addition to prioritizing management strategies according to their cost-effectiveness, the 'Cost-Effective Resource Allocator' offers the option of adjusting the results by excluding or including specific strategies, and through weighting strategies according to their value. Although weights have already been applied within species-level prioritization exercises (based on phylogenetic distinctiveness; Joseph et al., 2009; Bennett et al., 2014), this tool allows management strategies to be weighted according to a variety of favourable characteristics (e.g. whether they benefit species of iconic status, economic value or keystone importance). Additionally, managers can use the 'Cost-Effective Resource Allocator' to explore the impact of increasing or decreasing budgets on species' expected extant years, which can be useful for budget planning and as justification for greater funding if the current budget does not cover all proposed strategies.

The 'Cost-Effective Resource Allocator' does not have the capacity to evaluate the benefits of *ex-situ* captive breeding or research and monitoring activities as their outcomes require a series of probabilistic judgements that are not included in our spreadsheet file. We acknowledge that this shortcoming may be an issue for analysing species that are dependent on such management strategies (e.g. the Christmas Island Blue-tailed Skink (*Cryptoblepharus egeriae*) is entirely reliant on captive breeding; Smith et al., 2012). In situations where such strategies are expected to be beneficial, natural resource managers could apply approaches specifically designed for evaluating these strategies, such as the framework of Canessa et al. (2014) to determine the most cost-efficient *ex-situ* release strategy, or the value-of-information analysis of Maxwell et al. (2015) for deciding between gaining new information or funding direct management. The values obtained from these approaches could be included within this tool and evaluated against other strategies.

A second simplification of this tool is its assumption that the implementation of multiple management strategies will extend species' extant years in a straightforward, additive manner, which may not always be the case. Indeed, the combination of different strategies may lead to a range of synergistic and/or antagonistic effects (but see Auerbach et al., 2014 for an approach which considers co-variation between the benefits and costs of different actions). Furthermore, our tool assumes that the return-on-investment of different management strategies is linear, however it may be more plausible for increasing management effort to result in diminishing species' benefits (e.g. as represented by Wilson et al., 2009; Di Fonzo et al., 2016), which would slightly alter the results. The tool also assumes that all management strategies should be fully implemented to obtain their desired conservation outcomes, which may not always be the most cost-effective option depending on the form of their return-on-investment relationship (e.g. Cattarino et al., 2016).

Finally, this tool does not account for possible interspecific interactions (e.g. mutualisms, commensalisms, or predation), which may reduce



Expert elicitation discussions with Christmas Island National Park staff © Martina Di Fonzo

species' extant years if ignored. Resource allocation algorithms that account for these specific issues could be applied in situations where this is the case (e.g. Chadés et al., 2015; Firn et al., 2013).

The 'Cost-Effective Resource Allocator' is freely available, and can be operated with basic knowledge of Microsoft Excel. To further aid managers, the tool employs a simplified form of the IUCN Red List Criteria to ascertain the benefit of candidate management strategies for locally threatened species, which is an approach that we believe delivers a more rigorous and unbiased estimate than through direct elicitation of species' probabilities of persistence. This tool goes one step further in adapting the Red List Criteria to provide a continuous assessment of benefit, which allows for greater resolution than if the categorical Red List threat status (i.e. Critically endangered, Endangered and Vulnerable) were employed on their own. We hope that by developing a more user-friendly and accessible tool for prioritizing threatened species conservation, we can help natural resource managers achieve the greatest benefits for biodiversity per dollar spent.

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SUPPLEMENTARY ONLINE MATERIAL

Appendix S1. 'Cost-Effective Resource Allocator' spreadsheet tool. Assessors' identities have been replaced with fictional names.

Appendix S2. Tutorial with spreadsheet screenshots for each step.

Appendix S3. Instructions for undertaking value judgements.

Appendix S4. Strategy tables for expert elicitation.

Appendix S5: Steps for determining the benefit of each candidate action.

ABOUT THE AUTHORS

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Hugh Phillip Possingham is the Chief Scientist of The Nature Conservancy having recently moved from the University of Queensland. His group of 29 PhD students and 15 postdocs (embedded in three centres) work all over the world using decision science tools from economics and applied mathematics to formulate and solve conservation problems in the real world. His interests include: conservation metrics, biodiversity offsetting, population modelling, sea-sharing and sea-sparing, prioritizing actions, spatial zoning with Marxan and other tools, optimal monitoring and government policy. Hugh was recently elected a Foreign Associate of the National Academy of Sciences (USA).

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RESUMEN

Ante los crecientes índices de pérdida de biodiversidad y los modestos presupuestos de conservación, es esencial que los administradores de los recursos naturales asignen sus recursos financieros de manera eficaz en cuanto a costos y que aporten pruebas transparentes para una financiación adicional. Desarrollamos el programa "Asignación eficaz de los recursos en función de los costos", una herramienta de apoyo a la toma de decisiones basada en Microsoft Excel para ayudar a los administradores de recursos naturales y a los responsables de la formulación de políticas a priorizar el conjunto de estrategias de gestión que maximizan el número total de años que se prevé persistirá un grupo de especies bajo una determinada limitación presupuestaria. Describimos esta herramienta utilizando un estudio de caso sobre cuatro especies amenazadas localmente del Parque Nacional de la Isla Navidad del Commonwealth de Australia en el Océano Índico. Estas incluyen: un helecho nativo (*Pneumatopteris truncata*), el cangrejo rojo de la Isla de Navidad (*Gecarcoidea natalis*), el rabijunco (*Phaethon lepturus fulvus*) y el piquero de Abbott (*Papasula abbotti*). Con base en un presupuesto hipotético de 8.826.000 dólares australianos en diez años, en el que todas las especies son consideradas iguales, nuestra herramienta recomienda financiar: la propagación y siembra de helechos, el control de ratas y gatos, y el estudio y control de la hormiga loca (*Anoplolepis gracilipes*). Determinamos que las clasificaciones en cuanto a costos de estas estrategias eran susceptibles a la importancia que los evaluadores asignaban a las diferentes especies. La herramienta "Asignación eficaz de los recursos en función de los costos" puede incorporar el aporte de hasta ocho evaluadores y analizar un máximo de 50 estrategias de gestión para 30 especies.

RÉSUMÉ

Afin de faire face à l'appauvrissement de la biodiversité et aux budgets de conservation limités, il est essentiel que les gestionnaires des ressources naturelles administrent leurs ressources de manière efficace, et puissent fournir des justifications pertinentes pour toute demande de financement additionnel. Nous avons mis au point un module de rentabilité et d'allocation des ressources: «Cost-Effective Resource Allocator», un outil d'aide à la décision basé sur Microsoft Excel pour aider les gestionnaires des ressources naturelles et les décideurs à hiérarchiser des stratégies de gestion qui optimisent le nombre d'années de survie possibles d'espèces dans le cadre de contraintes budgétaires. Nous présentons cet outil en nous appuyant sur une étude de cas basée sur quatre espèces localement menacées au parc national de l'île Christmas du Commonwealth d'Australie, situé dans l'océan Indien. Il s'agit notamment d'une fougère indigène (*Pneumatopteris truncata*), du crabe rouge de l'île Christmas (*Gecarcoidea natalis*), du Bosun d'or (*Phaethon lepturus fulvus*), et du Fou d'Abbott (*Papasula abbotti*). Avec l'hypothèse d'un budget de 8 826 000 AUD sur dix ans, et en partant du principe que toutes les espèces sont considérées comme égales, notre outil recommande le financement de: la propagation et de la plantation des fougères, la lutte contre les rats, le contrôle des chats et la surveillance et la lutte contre la fourmi folle jaune (*Anoplolepis gracilipes*). Nous avons constaté que le classement coût-efficacité de ces stratégies pouvait varier selon l'importance que les évaluateurs assignent aux différentes espèces. Cet outil peut incorporer la contribution de jusqu'à huit assesseurs et analyser un maximum de 50 stratégies de gestion pour 30 espèces.