Threatened Species Recovery Hub

National Environmental Science Programme

Valuing multiple threatened species and ecological communities in Australia

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Final Report
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Executive Summary

Australia has more than 1,700 species and ecological communities that are known to be threatened and at risk of extinction. Given a large number of species to protect and limited funding, sound understanding of the values that the Australian community places on threatened species is important for decision makers. However, values are available only for a few of the species listed in the Australian Government's Threatened Species Strategy (TSS).

This study investigates preferences of the Australian public for improving the levels of extinction risk of 14 species including birds, mammals, fish, reptiles, plants, and two ecological communities that were identified in consultation with Department of Agriculture, Water and the Environment, and the Threatened Species Commissioner's office of the commonwealth government.

To investigate these preferences, we used a discrete choice experiment with three split-samples, each considering seven species and one ecological community. Given the number of species to value, we used a partial profile design to reduce cognitive burden on the respondents by letting them trade off a subset of species in each choice task. Our pilot tests with partial profile design (only changing the status of five or three species from the eight in each choice task) and traditional design of four species revealed that there was no degradation in respondent performance in terms of timing, protest behaviour and understanding in the partial profile designs. We therefore continued with partial profile design in the main surveys. We implemented three nationwide online surveys where about 1000 respondents completed each survey. In each choice task, respondents were required to make a choice from three alternatives: the current level of protection (status quo) and two alternative species protection plans that improve the status of species in terms of their risk of extinction. We sought preferences using three main designs based on number of species to protect (subset of 3, subset of 5 or all eight species) while maintaining the structure and the number of choice questions same for each respondent. We estimated willingness-to-pay (WTP) values for reducing each species' risk of extinction status in a 20-year period using a mixed logit model, implemented in Willingness-To-Pay space.

Our results show that respondents differentiate between species in terms of the amount that they value improved protection, and the degree to which the risk of extinction is reduced. A closer look at the results of final models estimated for the Survey 1 and Survey 2 revealed an insensitivity to scope, i.e., it appears as if the aggregate WTP for 3 species was similar to that of 5 species (once one controls for the scale of the improvement in probability of extinction). The implication is that the marginal WTP for protection of a species is affected by whether the species is seen as part of a three species or 5 species policy intervention. We suggest that this is some form of decision heuristic being adopted by respondents i.e. they are constructing some form of 'average' improvement across either three or five species. We also observed a scaling effect where the average value estimates for 3 species design was 5/3 times higher than that of 5 species design.

We further investigated how scope effect and scaling would be changed if we ask people to provide their preferences for all 8 species in our Survey 3. Comparison of results of all three surveys revealed that WTP values to save species were different based on the design – number of species that were planned to save. We observe a clear pattern, higher the number of species to save, lower the value that people want to pay for a species – for example, value estimates for 3 species design were higher most of the time compared to 5 species and 8 species designs. However, results of the 8 species design (Survey 3) was not very consistent as in the Survey 1 and 2, therefore only 3 species and 5 species designs were considered in proposing value estimates for species.

Based on estimates from 3 species and 5 species designs, we would propose that the range in the estimates across the designs be treated as a broader estimate, with the midpoint taken as the central estimate (see Table ES1 and ES2). For example, the value range for one percentage point improvement in risk level per year for Great Desert Skink is \$1.16 to \$2.57 using the 5 species design, but \$1.93 to \$4.28 for the 3 species design. Then we computed the midpoint of the extremes (\$1.16 to \$4.28) to come up with an estimate of \$2.72.

These results should be of interest to researchers and policy-makers, as we provide value estimates for several species. These values are benefits that Australian public derive from having improved status of species that can be used in cost-benefit analysis in species recovery/conservation projects. However, our results also suggest that people were willing to pay more per species when asked to consider conserving three species than they do when asked about five species i.e. the results suggest respondents fail a 'scope' test. Therefore, one should be wary in aggregating estimates of WTP that have been derived from single-species studies.

Table ES1. Value estimate for each species (Species set 1)

Species name *(species risk status in 20 years with no additional protection)*		**Value range**	**WTP ($)[3]**	**WTP ($)[4]**
Great Desert Skink *(High)*		1.16:4.28	2.72	54
Murray Cod *(Extinct)*		0.32:0.93	0.63	63
Numbat *(Very high)*		0.25:0.97	0.61	46
Banksia vincentia *(Extinct)*		0.20:0.73	0.47	47
Orange-bellied Parrot *(Extinct)*		0.15:0.68	0.42	42
Eastern Bristlebird *(Very high)*		0.06:0.63	0.35	26
Boggomoss Snail *(Extinct)*		0.01:0.48	0.29	29
Clay Pans of the Swan Coastal Plain *(Extinct)*		0.02:0.37	0.20	20

[3] WTP per year for 20 years for a 1 percentage point improvement in risk level: midpoint estimate.
[4] WTP per year for 20 years for improving species from their status quo level to lowest risk level: midpoint estimate.

Table ES2. Value estimate for each species (Species set 2)

Species name *(species risk status in 20 years with no additional protection)*	Value range	WTP ($)[5]	WTP ($)[6]
Brush-tailed Rabbit-rat *(High)* 	2.62:7.43	5.03	101
Giant Freshwater Crayfish *(High)* 	1.65:5.38	3.52	70
Australasian Bittern *(Very high)* 	0.57:1.67	1.12	84
Arnhem Plateau Sandstone Shrubland Complex *(Very High)* 	0.36:1.28	0.82	62
Far Eastern curlew *(Extinct)* 	0.37:1.07	0.72	72
Shaw Galaxias *(Extinct)* 	0.35:0.98	0.67	67
Gulbaru Gecko *(Extinct)* 	0.34:0.97	0.65	65
Acacia equisetifolia *(Extinct)* 	0.33:0.98	0.66	66

[5] WTP per year for 20 years for a 1 percentage point improvement in risk level: midpoint estimate.
[6] WTP per year for 20 years for improving species from their status quo level to lowest risk level: midpoint estimate.

1. Introduction

Continuous decline of species (flora and fauna) and ecosystems due to anthropogenic and natural factors compromises the invaluable ecosystem services that humans derive from these functioning ecosystems (Turner et al., 2007). Despite worldwide conservation efforts, protecting biodiversity has been a critical challenge at global, national and local scales due to increased threat of species extinction (Butchart et al., 2010). This is mainly due to the complexity of ecosystems, lack of information and the large number of threatened species that are at risk, which far exceed the resources available for conservation (Bottrill et al., 2008).

Australia is a megadiverse country with many endemic species. The rate of species extinction in Australia has been high since European settlement; for example, mammals extinction in Australia is the highest in the world (Woinarski et al., 2015). The *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) is the environmental legislation that provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places. The species that are nationally threatened and endangered are listed under this act with their threat status. Apart from the threat status, costs and benefits also play a big part in decision-making around conservation actions, yet using economic theory in developing decision frameworks for conservation has not been done in Australia. Understanding of the benefits derived from threatened species in the existing literature is also limited either in terms of the number of species covered or the type of benefit estimates (market or non-market) available. Therefore, benefit estimates are valuable for setting management priorities and assessing proposed investments, as well as underpinning the value of investment in actions to save species.

The aim of this study has been to estimate the benefits of multiple threatened species (14) including animals, and plants, and two ecological communities. We elicited preferences and estimated values that the Australian public place on improving the status of these species/ecological communities over the next 20 years using a choice experiment. The benefit estimates gained from this study can be used in making investment decisions on species conservation projects. This study will also contribute value estimates for the database of non-market values of threatened species that can be used in relevant benefit transfer studies.

Section 2 discusses the methods that we used to identify species, design the choice experiment, survey implementation and analysis of data. We present results and discussion in Section 3, and summary of estimation results and conclusion in Section 4. Section 5 presents policy implications of the findings with examples on how to use the species values in decision-making contexts.

2. Methods

2.1. Selection of threatened species and ecological communities

A tentative list of threatened and endangered species (including birds, mammals, reptiles, invertebrates and plants) and ecological communities[7] was prepared based on EPBC listing of threatened and endangered species. The list was further revised to include species from the Threatened Species Strategy as per the advice from the Department of Agriculture, Water and the Environment. The Department's guidance to select species was based on following criteria:

- Select species that are of most interest to the Threatened Species Commissioner's (TSC) office in relation to future communications and/or evaluation exercises.
- Select species that represent the widest range of geographies and/or species categories (i.e., priority was to ensure that birds, mammals and plants are represented).
- Select species for which a new original study will have the greatest impact in testing/illustrating the utility of the work.
- Select species, which make the best use of existing valuation data in testing/illustrating the utility of the work.

In addition to the above criteria, various project partners of National Environmental Science Program, Threatened Species Recovery Hub were consulted to make sure the selection of species has some relevance to benefit transfer. The initial list prepared to select species is shown in the Annex A. The final list of species used in the survey with acknowledgments and credit for the sources of the images or photos is given in Annex B.

Given the objective of valuing a large number of species, across three surveys, it was planned to have a similar composition in each survey. Hence, we decided to focus our study on seven species and one ecological community in each survey; comprised of two birds, one fish, one mammal, one invertebrate, one reptile, one plant, and one ecological community. These species and ecological communities include:

[7] Ecological communities are naturally occurring groups of native plants, animals and other organisms that are found in unique habitats.

	Survey 1 and Survey 3	Fire severity
Great Sandy National Park	Coastal heath, paperbark wetland and woodland, Littoral Rainforest	Low-High
Bird 1	Eastern Bristlebird	Far Eastern curlew
Bird 2	Orange-bellied Parrot	Australasian Bittern
Fish	Murray Cod	Shaw Galaxias
Mammal	Numbat	Brush-tailed Rabbit-rat
Invertebrate	Boggomoss Snail	Giant crayfish
Reptile	Great desert Skink	Phyllurus gulbara
Plant	*Banksia Vincentia*	*Acacia Equisetiflia*
Ecological community	Clay Pans of the Swan Coastal Plain	Arnhem Plateau Sandstone Shrubland Complex

2.2. Collection of key information about species

We collected key background information on selected threatened species and ecological communities (see Table 1). The background information included EPBC status, geographical spread of the species, estimated population size, and other available relevant information. Status listed under *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) and geographical spread were available for these species and ecological communities. However, the estimated population was available only for some species.

Table 1. Species selected for the survey with background information

	EPBC status	Found in	Estimated Population	Other remarks
Eastern Bristlebird 	EN	New South Wales	2500	A small, brown, well-camouflaged, ground-dwelling bird. It is generally shy and cryptic, spending most of its time in low, dense vegetation and rarely appearing in the open or flying.
Australasian Bittern 	EN	Queensland, South Australia, Tasmania and Western Australia	250-800	A secretive, large, stocky, heron-like bird, living in wetlands where it forages.
Orange-bellied parrot 	CR	South-east Australia including Tasmania	33 (wild-born) and 350 (captive bred)	A small 'grass parrot' and as its name suggests, has an orange patch on its belly. One of Australia's most threatened species, with less than 50 parrots thought to exist in the wild today.
Far Eastern curlew 	CR	Coastal regions across all Australian states and territories	35,000 estimated total population	Largest migratory shorebird in the world. Endemic to East Asian Australasian flyway (breed in China and Russia). Migrate as far south as Australia and New Zealand. Majority of the population spending the non-breeding season in Australia.

	EPBC status	Found in	Estimated Population	Other remarks
Murray Cod 	CR	South Australia Victoria New South Wales Australian Capital Territory and Queensland		A large Australian predatory freshwater fish. The largest exclusively freshwater fish in Australia, and one of the largest in the world
Shaw Galaxias 	CR	Victoria	80	A small, scale less, non-migratory freshwater fish. Endemic to a small upland area in central Victoria.
Numbat 	EN	Woodland close to urban Perth	1365	Existing study. Charismatic.
Brush-tailed Rabbit-rat 	VU	Northern Territory and the Kimberley, Western Australia	50,000 mature individuals	The Brush-tailed Rabbit-rat is a small-medium rodent (ca. 100-250 g), with thickset body and long (100-240 mm) tail supporting distinctively longer hairs around the tail tip ("brush tail"). The body colour is mostly grey-brown with pale undersides.
Giant Freshwater Crayfish 	VU	Streams and lakes in northern and north-western Tasmania	No estimates	A slow-growing and long-lived freshwater crustacean. It can grow to over 4 kg in weight. The species is endemic to Tasmania.
Boggomoss snail 	CR	Queensland	152	A medium-sized snail characterised by a relatively thin, semi transparent shell. An endemic species found only in the Dawson River catchment, in the Brigalow Belt Bioregion of Queensland.

	EPBC status	Found in	Estimated Population	Other remarks
Gulbaru Gecko 	CR	Queensland	600	Indigenous connection.
Great Desert Skink, Tjakura, Warrarna, Mulyamiji 	VU	South Australia Northern Territory	6250	Indigenous connection.
Acacia equisetifolia 	CR	Endemic to Northern Territory Kakadu National Park		A very distinctive perennial bush with grey-green foliage.
Banksia vincentia 	CR	NSW		Threatened species strategy species. Listed very recently.
Arnhem Plateau Sandstone Shrubland Complex 	EN	Northern Australia		Widely distributed. A type of scrublands that contains naturally large portion of plant species that found after recovery of disturbances. Comprised mostly of native shrubs, grasses and animals (birds, mammals and reptiles) living in rock country.
Clay Pans of the Swan Coastal Plain 	CR	WA		New recovery plan. Narrowly distributed. There are three critically endangered fauna known to be dependent on clay pans and the surrounding communities for a portion of their life/breeding cycle.

2.3. Defining threat status/ extinction risk levels

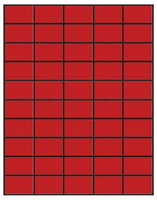
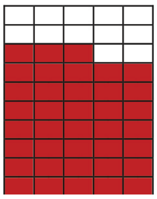
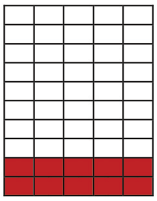
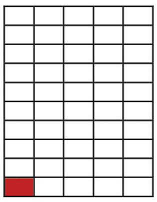
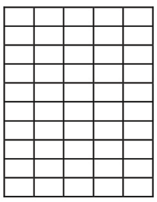
Information on species threat status was available from two sources: (1) IUCN classification and; (2) EPBC Act listing (see Table 2 for comparison of threat status). Since the words used to classify the threat status of species in both of these sources may not be familiar to the general public, we translated them into an “extinction risk category”. The extinction risk category had five levels - extinct, very high, high, moderate, and low – corresponding to the threat status in IUCN and EPBC listings.

Table 2. Comparison of threat status

IUCN listing status	EPBC Act listing status	Extinction risk category
Least Concern (LC)	Not listed	Low
Vulnerable (VU)	Vulnerable	Moderate
Endangered (EN)	Endangered	High
Critically Endangered (CR)	Critically Endangered	Very high
Extinct	Extinct	Extinct

Further, we illustrated the extinction risk category in the surveys in two ways: (1) bubbles with a relevant letter to represent the corresponding risk and (2) risk grids (coloured with red to show chance of extinction) (see Table 3).

Table 3. Illustration of extinction risk categories

Illustration 1		Illustration 2	
	Extinct		There is a 100% chance of extinction in the next 20 years.
	Very high risk		There is a 75% chance of extinction in the next 20 years. *(i.e., at least 1 out of 50 species with this risk would be expected to go extinct in 20 years)*
	High risk		There is a 20% chance of extinction in the next 20 years. *(i.e., at least 5 out of 50 species with this risk would be expected to go extinct in 20 years)*
	Moderate risk		There is a 2% chance of extinction in the next 20 years. *(i.e., at least 38 out of 50 species with this risk would be expected to go extinct in 20 years)*
	Low risk		Virtually no chance of extinction in the next 20 years.

2.4. Development of choice experimental design

In typical choice experiment designs, each alternative is represented by a full profile of attributes. In our case, attributes are species/ecological communities (see Table 4), and the levels of the attributes are the extinction risk (either under the current, "status quo" conditions, or under increased protection). Since the number of attributes is large, we decided to undertake split-sample survey where respondents in each sample will be shown only eight species.[8] Even with eight species, the choice tasks are quite complex for respondents and this will put a significant cognitive burden on respondents and may increase error. Therefore, we decided to use a partial profile design where only a subset of species have improved protection, and the other species remain at the same level as currently. In principle, this reduces the amount of information that needs to be processed by a respondent as they need concentrate only on the species that have a changing protection level.

Table 4. Attributes and levels used in the experimental design

Attribute	Status quo level *(Extinction risk in 20 years without additional protection)*	Other levels *(Extinction risk in 20 years with additional protection)*
Eastern Bristlebird	Very high	High, Moderate, Low
Orange-bellied Parrot	Extinct	Very high, High, Moderate, Low
Murray Cod	Extinct	Very high, High, Moderate, Low
Numbat	Very high	High, Moderate, Low
Boggomoss snail	Extinct	Very high, High, Moderate, Low
Great Desert Skink	High	Moderate, Low
Banksia vincentia	Extinct	Very high, High, Moderate, Low
Clay Pans of the Swan Coastal Plain	Extinct	Very high, High, Moderate, Low
Australasian Bittern	Very high	High, Moderate, Low
Far Eastern curlew	Extinct	Very high, High, Moderate, Low
Shaw Galaxias	Extinct	Very high, High, Moderate, Low
Brush-tailed Rabbit-rat	High	Moderate, Low
Giant Freshwater Crayfish	High	Moderate, Low
Gulbaru Gecko	Extinct	Very high, High, Moderate, Low
Acacia equisetifolia	Extinct	Very high, High, Moderate, Low
Arnhem Plateau Sandstone Shrubland Complex	Very high	High, Moderate, Low
Cost	$0	$75, $150, $225, $300, $375

2.5. Testing design of choice question with focus groups

Focus group discussion is an essential stage in any choice experiment design: they allow for considered feedback on issues of wording and question presentation, allowing for refinements in how these are presented in the final survey.

We conducted a focus group discussion with 8 participants. The participants were recruited by a local survey company, with diversity in age, sex and occupational categories.

At the focus group discussion stage, we presented a number of alternative partial designs with only two alternatives: the status quo and an option with a set of improved protection levels. We also presented a traditional choice experiment design with four species in a choice task with the focus group.

2.5.1 Explicit Partial Profiles

In an explicit partial design, both the species that are being managed and hence have additional level of protection are shown, as well as those that are not being managed, and hence have the status quo level of risk in both options. We use a colour coding system that highlights which species are improved (from red to green) and which species are unchanged (in grey).

[8] For reporting convenience, the ecological community valued in each survey is part of the eight species set (seven species + one ecological community).

Design 1: Eight species were shown with their extinction risk levels and preferences were sought only for five species (see Figure 1).

Design 2: Eight species were shown with their extinction risk levels and preferences were sought only for three species (see Figure 2).

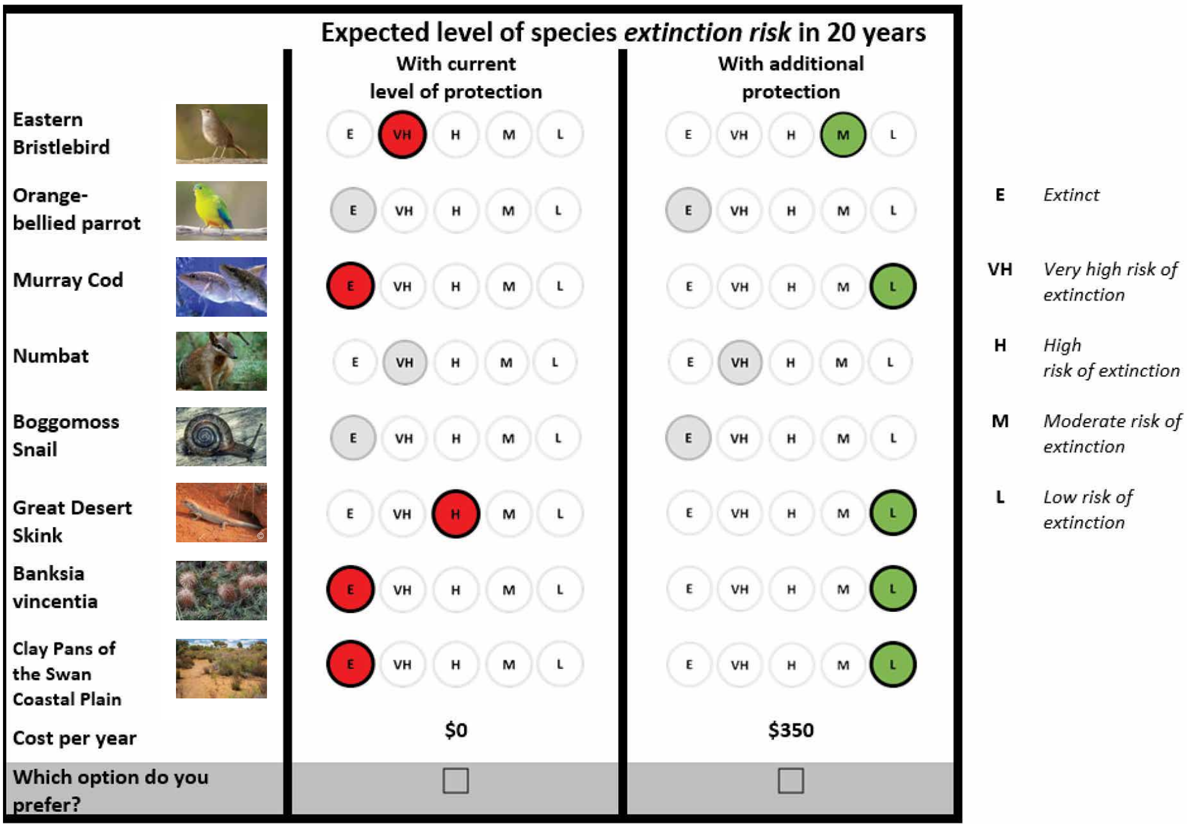


Figure 1. Explicit partial profile design seeking preferences for five species.

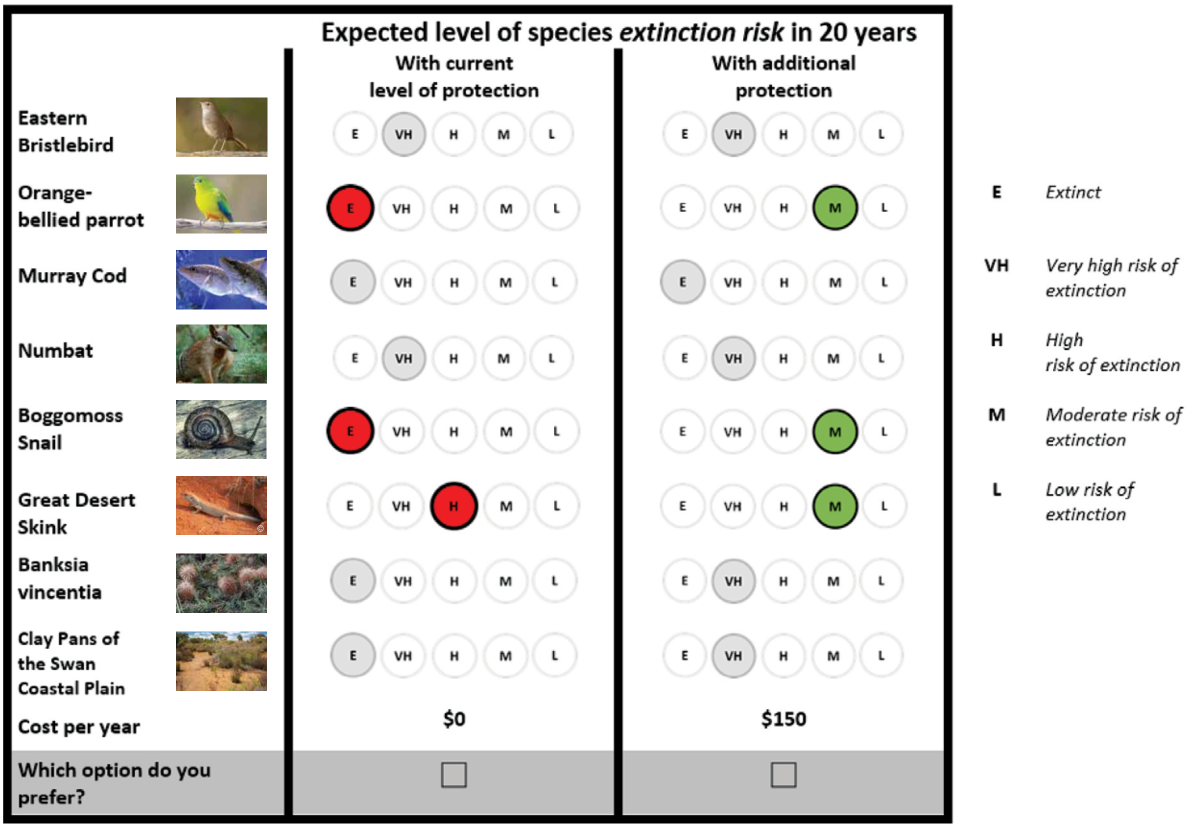


Figure 2. Explicit partial profile design seeking preferences for three species..

2.5.2 Implicit partial Profiles

In an implicit partial design, the attribute levels that are not being modified are not shown at all.

Design 3: Eight species were shown (without their extinction risk levels) and preferences were sought only for five species (see Figure 3).

Design 4: Eight species were shown (without their extinction risk levels) and preferences were sought only for three species (see Figure 4).

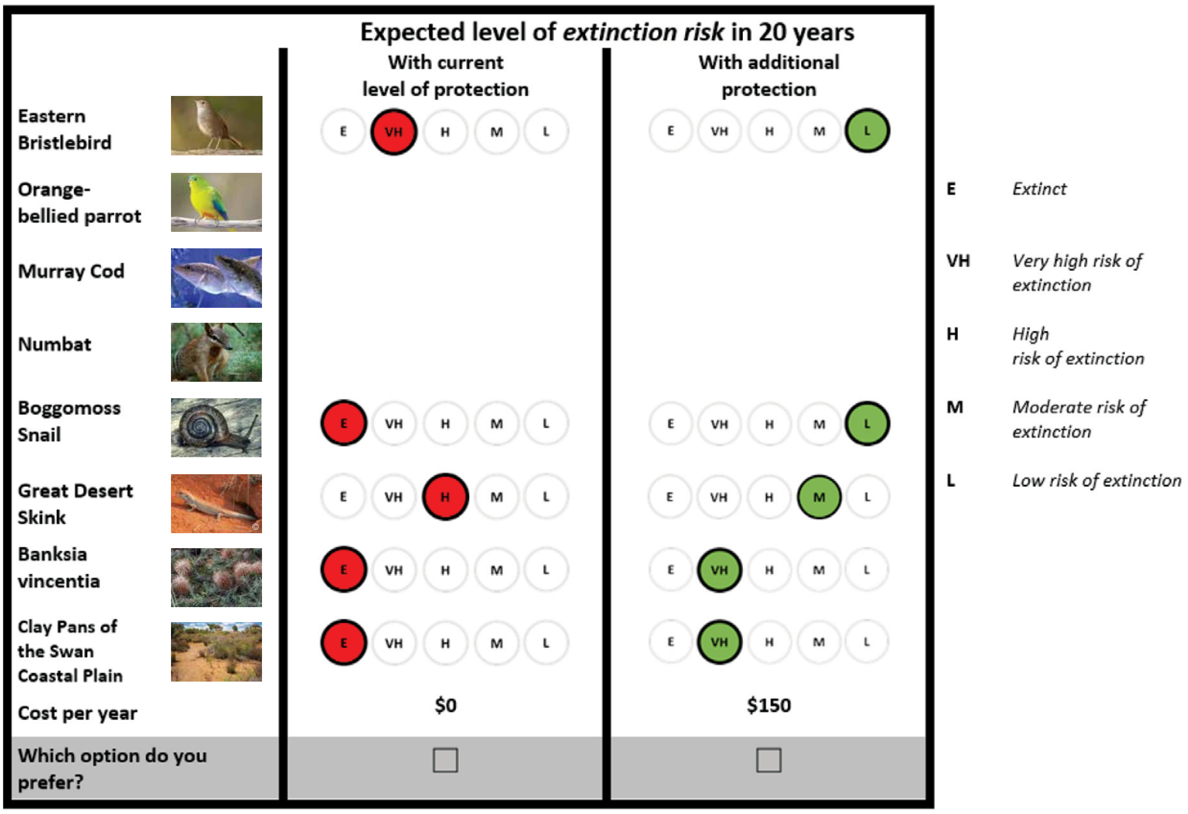


Figure 3. Implicit partial profile design seeking preferences for five species.

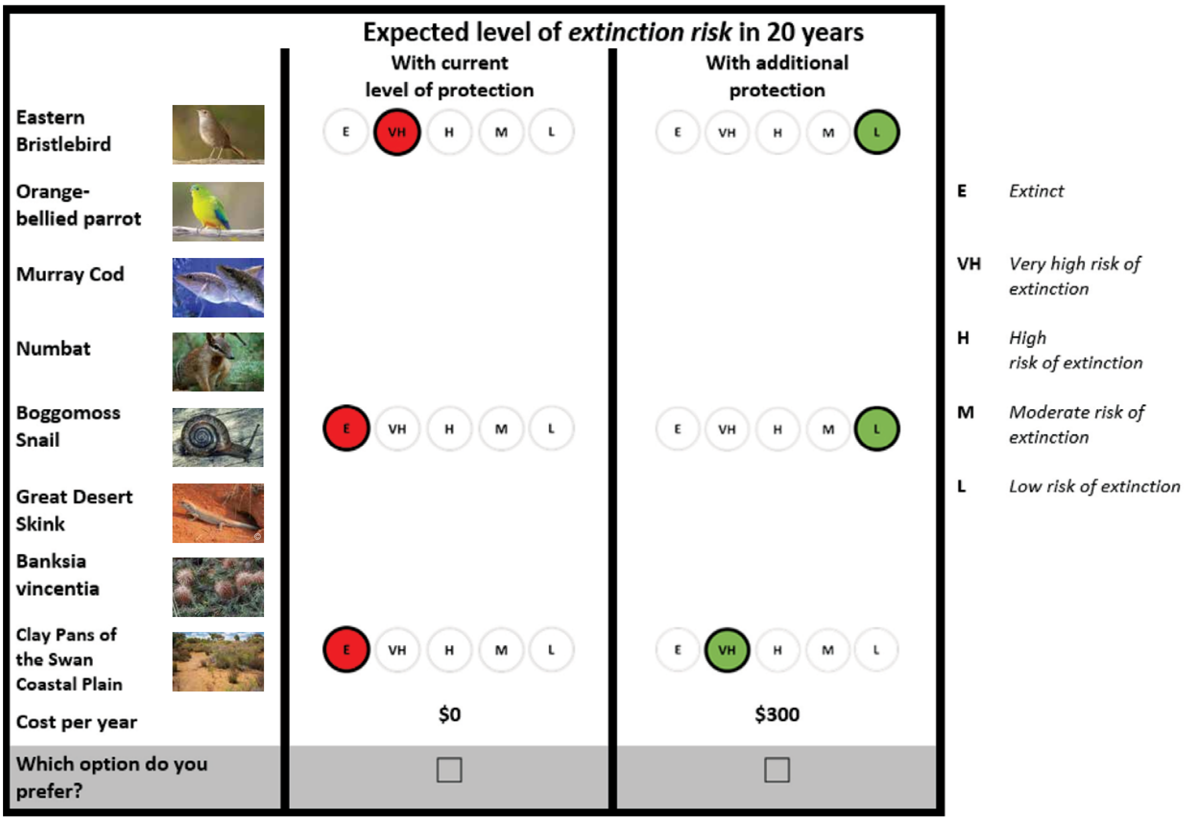


Figure 4. Implicit partial profile design seeking preferences for three species.

2.5.3 Standard Design

In a standard design, fewer attributes are presented, but all are varied. For the purposes of comparison, we included a 4 species conventional design for discussion in the focus groups.

Only four species were shown with their extinction risk levels and preferences were sought for all four species (see Figure 5).

In addition to the status quo, two alternatives (plan 1 and plan 2) were shown in this design.

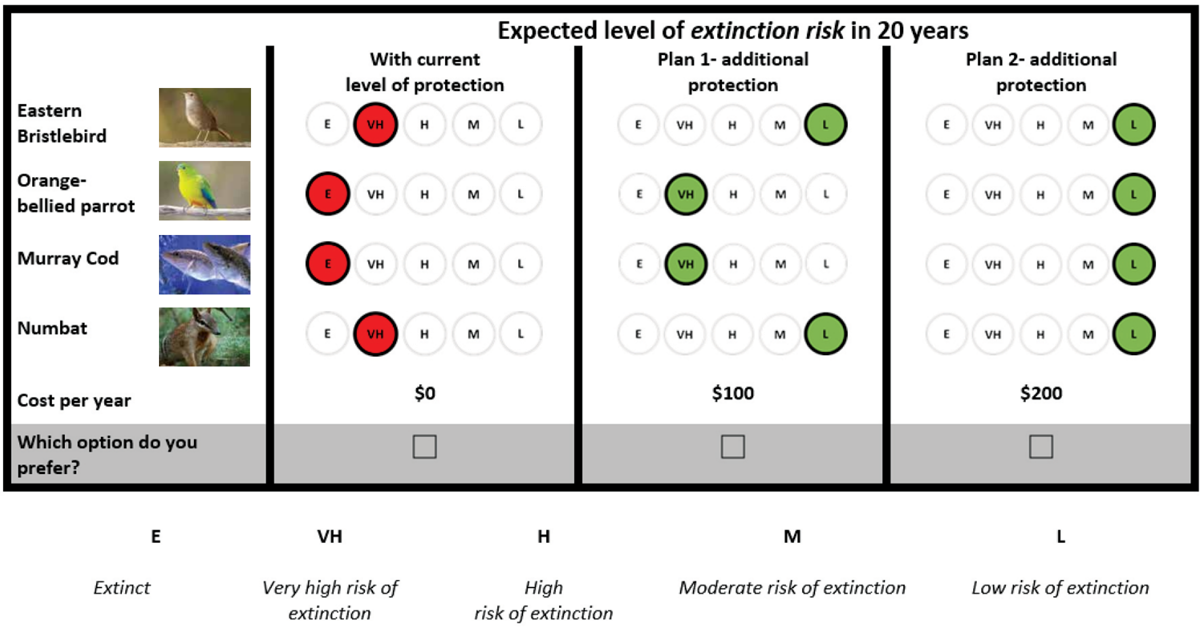


Figure 5. Standard design with three alternatives.

2.5.4 Outcome of the focus group discussion

Many participants preferred the explicit partial profile design and some participants preferred the standard design. They also suggested that having three columns in an explicit partial profile design (status quo and two alternatives) would not make the design too complicated for them to be able to respond.

2.6. Survey Development

2.6.1 Questionnaire

The questionnaire that we developed and implemented in Qualtrics consisted of eight main sections. A full version of the questionnaire is provided in Annex C.

Section 1: Introduction about the survey

Section 2: Screening questions and few socio-economic information about the respondents

Section 3: Brief explanation about threated and endangered species

Section 4: Key information about the species that are being asked for preferences

Section 5: Payment information and explanation on why additional funding is required for conservation of species

Section 6: Explanation of choice questions with examples followed by eight choice questions

Section 7: Questions to identify protestors (respondent who always selected either status quo option or non-status quo option

Section 8: Follow- up questions

2.6.2 Experimental design

Having selected the attributes, levels and number of alternatives, an experimental design for the survey was generated. Given the number of attributes (eight) and levels (at least two but up to five), a full factorial design including all possible combinations of attributes and their levels was not feasible. Therefore, a D-efficient experimental design that maximized model statistical efficiency by minimizing the parameter standard errors was generated using Ngene (ChoiceMetrics, 2018). In the design for the pilot study, the prior coefficients were set to zero.

2.6.3 Pilot testing with online panels

Based on the comments received from the focus group discussion, we decided to test three designs using online panels.

1. **Design A:** Explicit partial profile design with two alternatives
   We created 64 choice sets. In order to make it simple and comparable, preferences for a subset of five species were sought (see Figure 6)
2. **Design B:** Explicit partial profile design with three alternatives
   64 choice sets were created with two protection plans in addition to the status quo. Here also preferences were sought for five species out of eight (see Figure 7)
3. **Design C:** Normal standard design (four species with three alternatives)
   34 choice sets were created with two protection plans in addition to the status quo (see Figure 8)

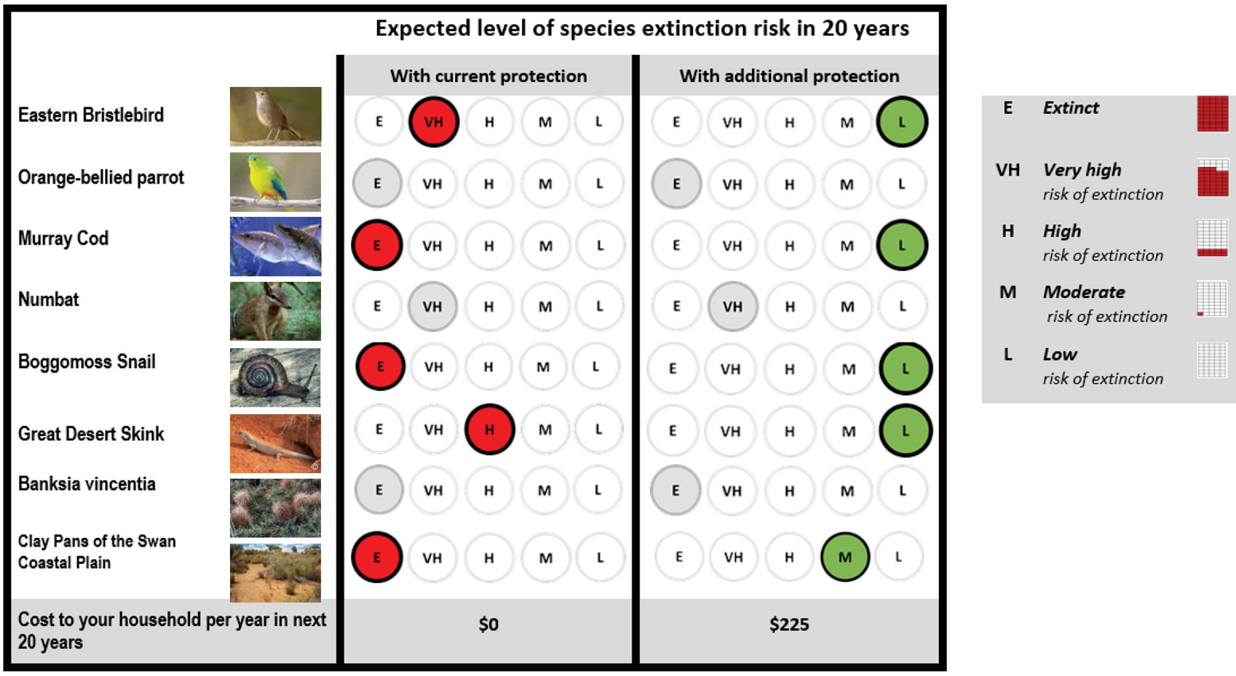


Figure 6. Explicit partial profile design with two alternatives.

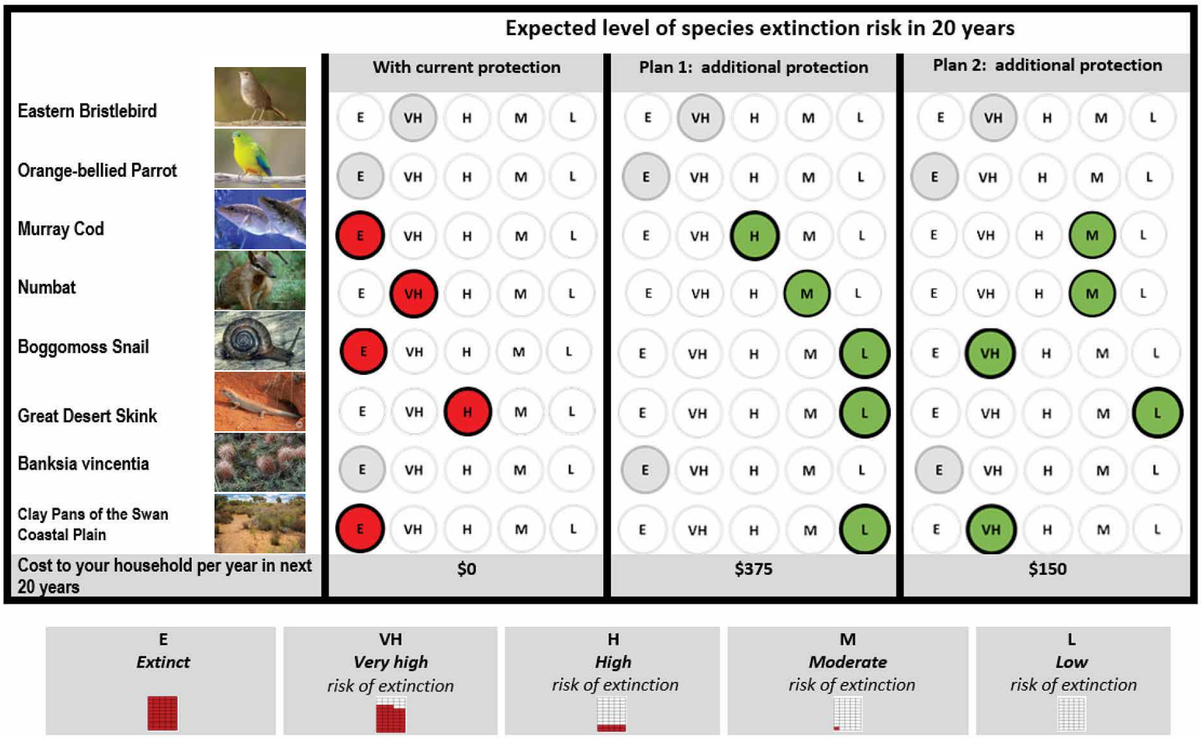


Figure 7. Explicit partial profile design with three alternatives.

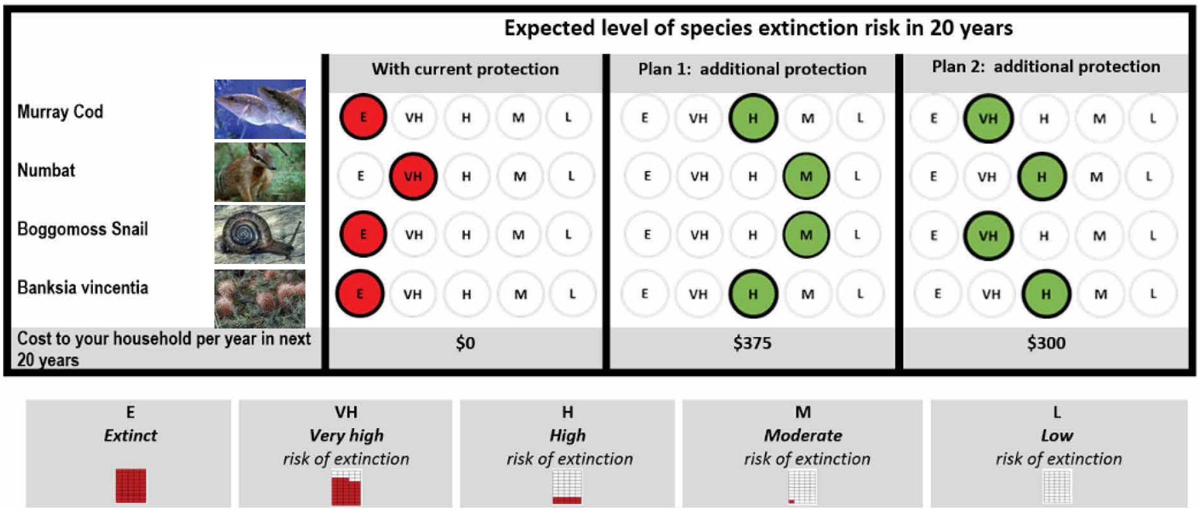


Figure 8. Standard four species design.

Each respondent was asked to answer eight choice questions. Three pilots were completed using the above-mentioned designs, each with an initial sample of approximately 100. Table 5 reports some summary statistics for the pilot surveys based on each design.

Table 5. Summary statistics for the three pilots

	Design A 3 alternative (n=100)	Design B 2 alterative (n=99)	Design C 4 species (n=99)
All SQ protest	6	3	8
No SQ protest	11	10	29
Median time (minutes)	8.5	7.4	7.1
10% quartile (minutes)	3.6	3.0	3.5
Understanding			
Fully	70	71	75
Partially	29	27	23
Not at all	1	1	1
Consider all aspects (yes)	84	81	83

We note a consistent response across the versions in terms of timing, protest behaviour and understanding (see Table 5). We didn't observe a preponderance of people always picking the non-SQ option (i.e., they were not just selecting for improvements irrespective of cost even in the 2 option case), apart from in the four species option where there is some evidence of more respondents always selecting the non-SQ option. This suggests that the partial profile designs were not problematic for respondents, and hence an appropriate way to deal with the large number of attributes in our design.

2.6.4 Survey design and arrangement of choice questions

Based on results gained from pilot surveys, we decided to implement an explicit partial profile design (eight species with three alternatives) where respondents see subsets of species are being protected further. Then that was repeated for the second set of eight species (Survey 2). In each case a sample size of 1000, which allowed us to be more confident on whether any species are being ignored, and issues like whether shifting species from the extinction level is seen as particularly valued.

The experimental design for the survey was re-done using the parameters estimated in the pilot study as priors, and using an S-efficiency criteria (which attempts to minimise the size of the sample needed to obtain robust parameter estimates see Scarpa and Rose (2008)).

2.6.5 Survey implementation

We implemented the survey in three phases:

1. Phase 1 – Survey 1/Sample 1 (first set of eight species)

Following two choice designs were used for the survey 1.

a) Partial profile with subset of five species (Figure 9): There were 64 such choice sets in the design, and each respondent saw four of these.

b) Partial profile with subset of three species (Figure 10): There were 64 choice sets with three species being given additional protection. Each respondent saw four of these choice sets.

In survey 1, we had a fixed order: respondents saw four 5-species choice sets first, followed by four 3-species choice sets. In the initial analysis of that sample we found some differences in valuation, which meant it was important to be able to distinguish between order effects, and 5/3 species effects.

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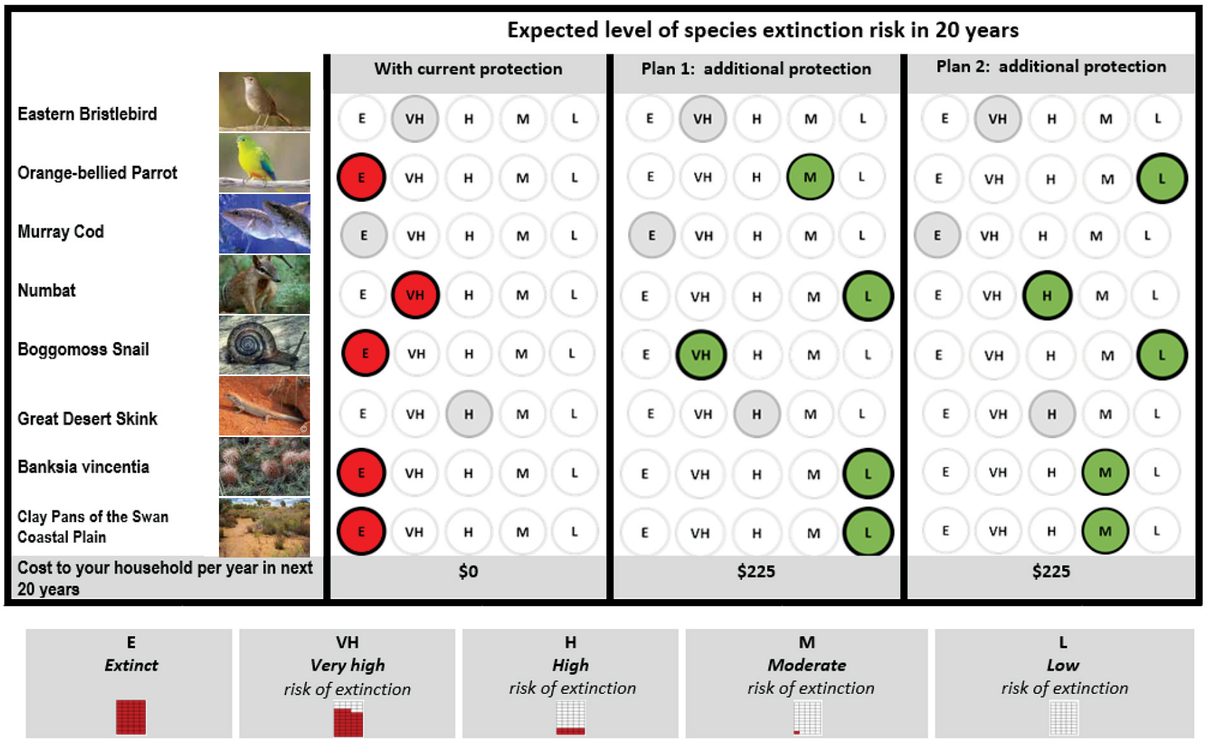

Figure 9. An example choice question in survey 1 (five species are given additional protection).

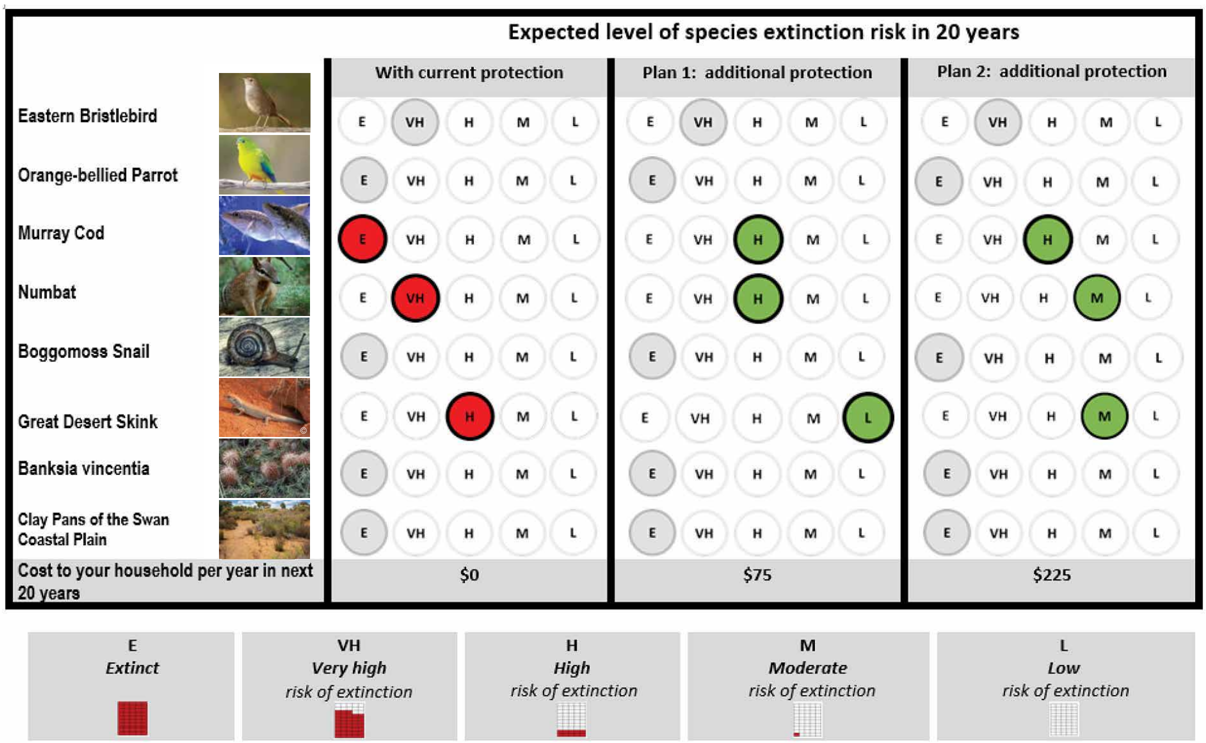

Figure 10. An example choice question in survey 1 (three species are given additional protection).

2. Phase 2- Survey 2/Sample 2 (second set of eight species)

Similar to the survey 1, two choice designs were used (Figures 11 and 12). Each respondent saw four choice sets from design 1 (Figure 11: 5 species) and four choice sets from design 2 (Figure 12: 3 species). However, unlike in the first survey, in the second survey, we randomised the order in which they saw the five and three species sets. Examples of the choice sets (phase 2) are given below.

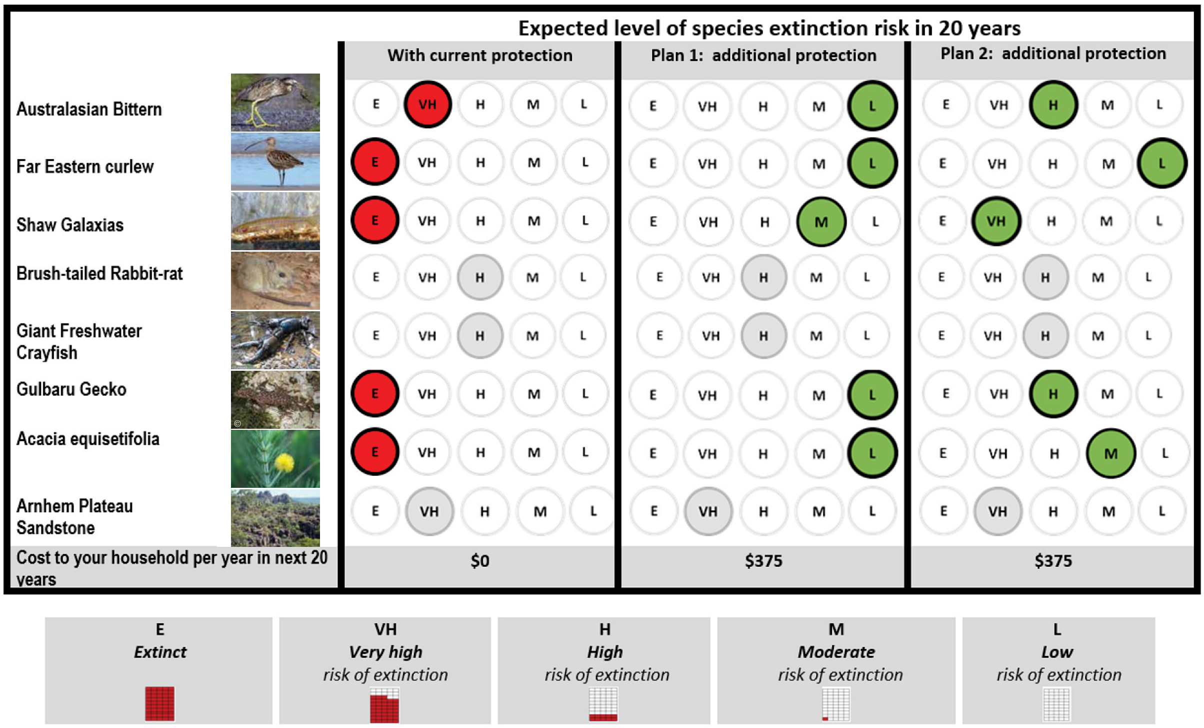

Figure 11. An example choice question in survey 2 (five species are given additional protection).

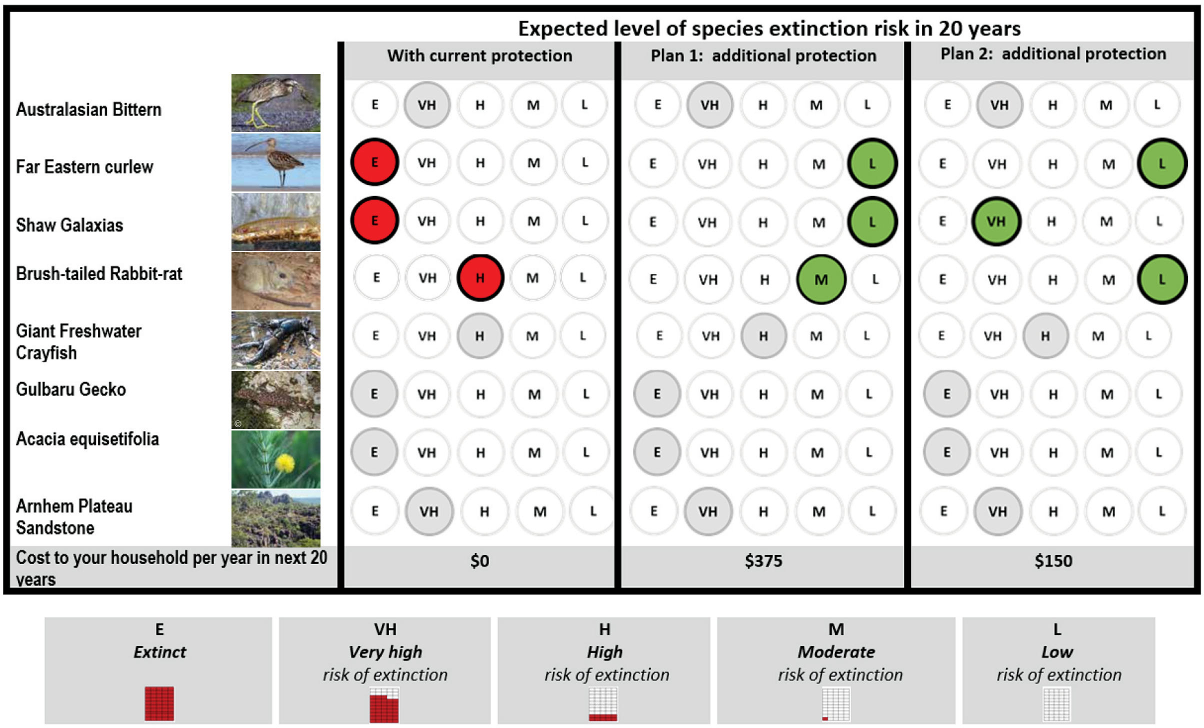

Figure 12. An example choice question in survey 2 (three species are given additional protection).

The reason for doing this mixture of 5/3 species was a concern about the degree to which respondents dealt with 'scope' i.e., did the value of a species change as you change the number of species being protected? You might expect there to be a degree of decreasing marginal valuation, simply because budgets become more restricted. This could be an issue if one does 'single species' valuation studies, and then aggregate them to identify what people are willing to pay for the group of species: you may overstate the value. This design was intended to give some light on this possibility, because we now have the same species being valued in a five species and three species context.

3. Phase 3- Survey 3/Sample 3 (first set of eight species)

Here, we used the first set of 8 species that we studied in Survey 1. Only the difference with survey 1 was that the preferences were sought for all eight species (not a sub set of species as in the survey 1 and survey 2). An example of a choice set is shown below (Figure 13).

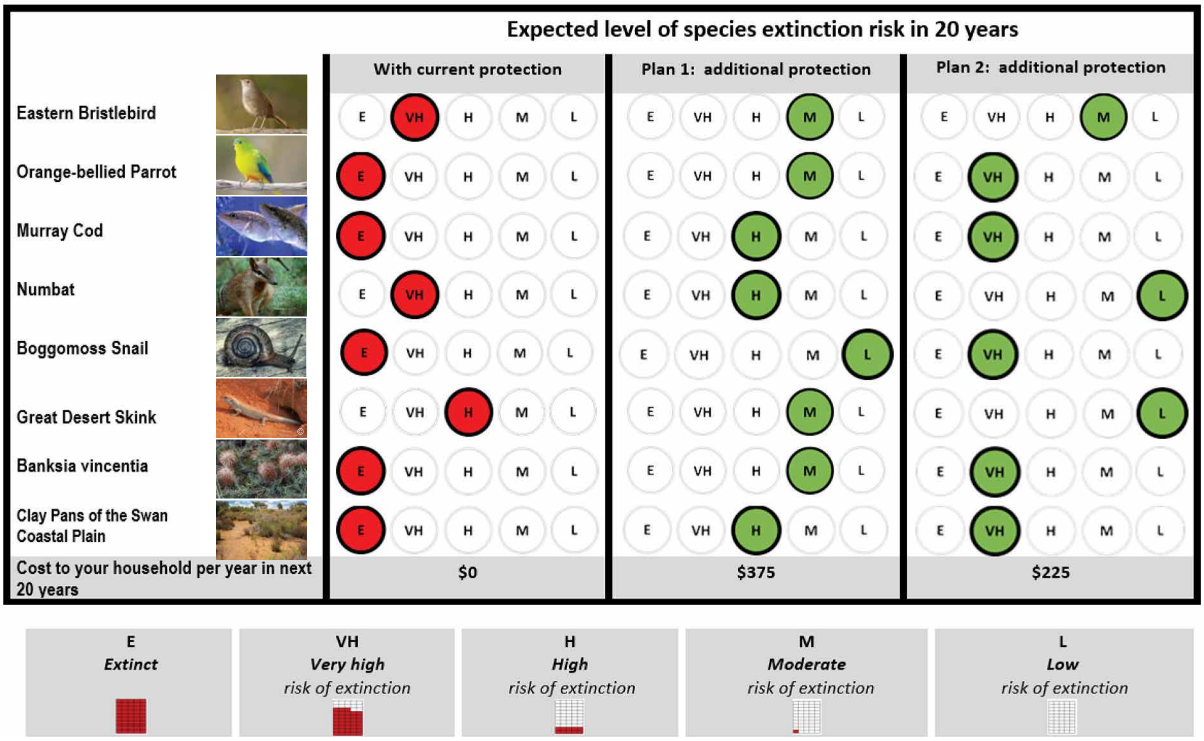

Figure 13. An example choice question in survey 3 (all eight species are given additional protection)

2.6.6 Sample selection

The survey was administered by an online survey company. We set quota through Qualtrics to make sure a representative sample of Australian public (age, gender and state) was selected for the survey.

2.6.7 Data management

The total number of people responding for Survey 1, Survey 2, and Survey 3 were 1026, 1131 and 1050, respectively. We dropped anyone who completed the survey in less than five minutes, as that seemed an unreasonably short time to complete the survey and to have considered the information. Some additional analysis suggests that those who completed in less than five minutes had responded randomly in the choice sets. Therefore, we have 817 valid responses for Survey 1, 985 responses for Survey 2, and 889 responses for Survey 3 (see Table 6).

2.6.8 Screening protestors and collecting additional information

We also identified 'protest' respondents (or more strictly, those who appeared to use a heuristic when making choices). Those were the ones who always selected the status quo in all eight choice sets, plus an additional 'test' choice set (with a very low cost), and then gave particular responses to debrief questions (see Annex C- Questionnaire for further details). All of these indicated that these respondents were not making considered choices across all alternatives.
We also identified those who never selected a status quo option (Table 6) in all eight choice sets, or in a 'test' choice set (with a very high cost) and then gave particular responses to debrief questions. This looks like a group who are prepared to pay any amount to achieve protection, which may not be reasonable.

Table 6. Information about protestors

Survey # (sample size)	Who always selected status quo option	Who never selected status quo option
Survey 1 (n = 817)	94	190
Survey 2 (n = 985)	91	146
Survey 3 (n = 889)	48	206

2.6.9 Other socio economic information

Some summary statistics for all three surveys are reported below, with a full set of descriptive statistics of the socio economic information for the three samples is given in Annex D. Note that because not all questions were forced response, the total 'n' may vary.

The distribution of survey respondents across the states follows actual population distribution (Table 7). Table 8 presents the distribution of age categories. All three samples are somewhat biased towards the more highly educated group (degree and above) which is quite normal for online surveys (Table 9). Similarly, we found a larger percentage of high income earners in our samples (Table 10). We also noted that we have a slightly higher percentage of retired respondents (Table 11) than in the national population.

Table 7. Respondents by Australian states and territories by survey

	Survey 1		Survey 2		Survey 3	
Please select which State you live in	Freq. (n=810)	Percent	Freq. (n=981)	Percent	Freq. (n=889)	Percent
NSW	255	31.48	330	33.64	273	30.71
Queensland	164	20.25	165	16.82	191	21.48
South Australia	62	7.65	64	6.52	69	7.76
Tasmania	16	1.98	20	2.04	18	2.02
Victoria	205	25.31	283	28.85	227	25.53
Northern Territory	5	0.62	2	0.20	6	0.67
ACT	14	1.73	7	0.71	15	1.69
Western Australia	89	10.99	110	11.21	90	10.12

Table 8. Respondents by age category in each survey

	Survey 1		Survey 2		Survey 3	
Could you please indicate your age group?	Freq. (n=811)	Percent	Freq. (n=983)	Percent	Freq. (n=889)	Percent
18-24 years	61	7.52	60	6.10	67	7.54
25-34 years	151	18.62	141	14.34	165	18.56
35-44 years	127	15.66	133	13.53	135	15.19
45-54 years	133	16.40	169	17.19	156	17.55
55-64 years	172	21.21	291	29.60	180	20.25
>64 years	167	20.59	189	19.23	186	20.92

Table 9. Education levels of respondents by survey

	Survey 1		Survey 2		Survey 3	
State the highest level of education you have completed so far	Freq. (n=811)	Percent	Freq. (n=983)	Percent	Freq. (n=889)	Percent
Year 11 or below	108	13.32	112	11.39	107	12.04
Year 12	124	15.29	145	14.75	131	14.74
Certificate III/IV	151	18.62	178	18.11	144	16.20
Advanced Diploma and Diploma	131	16.15	186	18.92	134	15.07
University Undergraduate/ Bachelor Degree	191	23.55	232	23.60	237	26.66
Post Graduate (Diploma/ Masters/ PhD)	106	13.07	130	13.22	136	15.30

Table 10. Respondents by income categories in each survey

	Survey 1		Survey 2		Survey 3	
Please indicate your current annual household income	Freq. (n=809)	Percent	Freq. (n=842)	Percent	Freq. (n=886)	Percent
Negative income	7	0.87	4	0.48	6	0.68
Nil income	24	2.97	29	3.44	21	2.37
$1- $7,799 per year	15	1.85	15	1.78	15	1.69
$7,800 - $15,599 per year	20	2.47	23	2.73	16	1.81
$15,600 - $20,799 per year	24	2.97	30	3.56	30	3.39
$20,800 - $25,999 per year	42	5.19	42	4.99	51	5.76
$26,000 - $33,799 per year	54	6.67	43	5.11	55	6.21
$33,800 - $41,599 per year	53	6.55	71	8.43	67	7.56
$41,600 - $51,999 per year	76	9.39	81	9.62	66	7.45
$52,000 - $64,999 per year	84	10.38	82	9.74	83	9.37
$65,000 - $77,999 per year	62	7.66	69	8.19	75	8.47
$78,000 - $90,999 per year	71	8.78	70	8.31	79	8.92
$91,000 - $103,999 per year	70	8.65	73	8.67	84	9.48
$104,000 - $155,999 per year	132	16.32	124	14.73	142	16.03
$156,000 or more per year	75	9.27	86	10.21	96	10.84

Table 11. Respondents by employment status in each survey

	Survey 1		Survey 2		Survey 3	
What is your current employment status?	Freq. (n=800)	Percent	Freq. (n=829)	Percent	Freq. (n=822)	Percent
Employed full time (35 or more hours per week)	259	32.38	271	32.69	297	33.67
Employed part time (less than 35 hours per week)/ causal?	141	17.63	144	17.37	167	18.93
Unemployed and currently looking for work	40	5.00	43	5.19	42	4.76
Unemployed and not currently looking for work	8	1.00	8	0.97	10	1.13
Student	32	4.00	35	4.22	28	3.17
Retired	180	22.50	204	24.61	195	22.11
Homemaker (manages a home and family)	65	8.13	62	7.48	64	7.26
Self-employed	39	4.88	36	4.34	47	5.33
Unable to work	36	4.50	26	3.14	32	3.63

2.7 Discrete choice experiments

The Discrete Choice Model is a formal model of choice based on random utility theory. A definitive exposition of the model is given in Train (2009) but the model is widely applied. Here we follow the notation used by Hole and Kolstad (2012).

We assume that an individual, when evaluating an option i, which can be described by a vector of attributes x, each of which can have varying levels, will construct an estimate of the utility that would be gained from that option, defined as:

$$U_{njt} = \alpha_n \text{Cost} + \beta_n' x_{njt} + \varepsilon_{njt} \tag{1}$$

where α_n and β_n are individual specific marginal utilities associated with cost and other attributes. ε_{njt} is an individual specific random component that is assumed to be drawn from an extreme vale distribution, with a variance equal to $\mu_n^2(\Pi^2/6)$, where μ_n is an individual specific scale parameter. Explicit in this specification is the possibility that both the marginal utilities and the variance of the random term are individual specific.

When faced with multiple options, and required to select one of them, the assumption is that they select the option that has highest utility. Given utility has an unobservable component, the analyst can at best predict the probability that option i will be selected i.e.,

$$P_{nit} = \text{Prob}(V_{nit} + \varepsilon_{nit} > V_{njt} + \varepsilon_{njt} \ \ \forall j \neq i) \qquad (2)$$

where V_{nit} is the deterministic part of utility, i.e., the probability that option i is selected will depend on the probability that the utility from option i is greater than that of another option j, across all options.

If one makes an assumption about the functional form of the term ε, then one can derive a closed form expression for the probability. A common assumption is that the random term follows a Gumbel (or type I extreme value) distribution, in which case it can be shown (Train, 2009, Chapter 3) that the probability is given by:

$$P_{nit} = \frac{e^{\mu_n V_{nit}}}{\sum_j e^{\mu_n V_{njt}}} \qquad (3)$$

which is the logit probability.

Standard statistical software can estimate this model, identifying the parameters that best explain the choices made.

A key outcome from such models is what is known as the 'partworth' associated with an attribute. The partworth is defined as the change in the monetary attribute of an option that would exactly offset the effect on utility of a unit change in one of the other attributes, leaving the individual at an equal levels of utility. It can be defined as the maximum amount that they would be prepared to pay to gain a unit change in an attribute that they value (or the amount they would have to be compensated by if an attribute they disliked were to increase). Analytically, the partworth for attribute k can be calculated as:

$$partworth_{nk} = -\frac{\beta_{nk}}{\alpha_n} \qquad (4)$$

Where α_n is the parameter associated with the monetary attribute of the option.

However, there are some advantages in re-expressing the model in what is known as 'Willingness to Pay space" (Hole and Kolstad, 2012, Scarpa and Rose, 2008). As noted above, the partworth is expressed as a ratio of two estimated parameters. Statistically, these are random variables, following normal distributions. The ratio of two normal distributions does not follow a well-behaved functional form. In particular, theoretically, the denominator (the cost coefficient) has some probability of passing through zero, making the distribution of the partworth indeterminate.

Re-expressing the model in WTP space avoids this issue, and leads to estimated parameters being directly interpretable (Scarpa et al., 2008). Dividing (1) through by μ_n (the individual-specific scale parameter that defines heterogeneity in variance) leaves the relationship fundamentally unchanged, but gives an error term that is homoscedastic:

$$U_{njt} = \lambda_n \text{Cost} + \text{c}_n^{'} x_{njt} + \varepsilon_{njt}^{\sim} \qquad (5)$$

Where $\lambda_n = \alpha_n / \mu_n$ and $c_n = \beta_n / \mu_n$

Observing that the WTP for an attribute is given by $\Upsilon_n = c_n / \lambda_n$ one can reframe (5) as:

$U_{njt} = \lambda_n \left[\text{Cost} + \gamma_n^{'} x_{njt} \right] + \varepsilon_{njt}^{\sim}$ and directly estimate the WTP assuming a specific distribution (e.g., normal) for the WTP coefficients.

The model is flexible in that one can selectively choose whether attributes are fixed across a population or follow a distribution. It is normal to impose some restriction on the distribution of λ_N. Given it is a function of the marginal utility of cost (which is negative) and the individual-specific scale coefficient (which is positive), it should be restricted to be negative. The most common way to do this is to redefine cost as -1*cost, and then impose a log normal distribution for λ_n which is by definition always positive.

The model has no closed form for the likelihood, and therefore has to be estimated using simulation methods. We use 800 Halton draws in estimation, which we arrived at by increasing draw numbers until results only changed marginally.

3. Results and discussion

An important issue in the analysis is the treatment of the level of protection. In principle, this can take up to five levels for those species where the status quo level is extinction. There is a numerical definition of the five levels based on the level of risk (1, 0.75, 0.2, 0.02, and 0) that is not linear, and the level could be coded with those values. We adopt this approach, but in fact we could code the level as the probability of survival, scored as: 0, 25, 80, 98, 100. However, it's not clear that heuristically the marginal utility is linear in the probability. One could use a series of dummy variables for each level and allow complete flexibility. Alternatively, one can allow for parametric non-linearity by e.g. employing a quadratic function of risk level, allowing for decreasing or increasing marginal benefits as one approaches 100% probability of protection.

As noted above in the survey development, three surveys were completed, first and third with same and second with different set of eight species. The structure of the surveys also differed in terms of the choice sets viewed:

Survey 1: First four choice sets showing a partial profile of five species followed by four choices sets showing a partial profile of three species.

Survey 2: Four choice sets showing a partial profile of five species, and four choices sets showing a partial profile of three species, with the 5/3 blocks shown in random order.

Survey 3: All eight choice sets showing all 8 species in random order. We describe details of Survey 3 analysis in the later part of this section.

The conceptual issue of interest is whether showing alternatives with five or three species changes the marginal value of those species, but that is potentially conflated in Survey 1 with the order effect. That does not occur in Survey 2, as one can control for the order in which the respondent saw the five and three species sets.

We therefore start the analysis with Survey 2, and test whether the order in which one sees the five species sets (first or second) changes the WTP for a marginal change in level of protection. One can then repeat this for the three species sets. We do this by estimating separate models for the questions seen first, and those seen second, and then pool the model and conduct a Chi-squared test on the log-likelihood values.

For the three species sample, the Chi-squared test statistic is 7.40, and an associated p-value of 0.6874, which implies we cannot reject the restriction of a common model for preferences when the respondent saw the 3 species sets either first or second.

The case of the five species model is less clear cut. One rejects the assumption of equivalent values within the 1st and 2nd order samples, even if one allows for differences in the error variance across the two subsamples: the Chi-squared static is 29.07 and p-value is 0.0012. It is not clear why this result should differ across the two survey setups. Inspection of the results suggests that a significant part of the difference between the two lies in the status quo effect, which might imply that having seen a three species option first, there is difference in the way that respondents view the protection of five species.

We then need to test whether the WTP values are the same for the five and three species versions. We start with Survey 2.

We start by estimating a general model that assumes: WTP for a marginal change in risk levels are fixed, but there is an interaction effect with the dummy variable identifying if the sets are drawn from three species or five species versions (=1 if 3 species , 0 if 5). This allows for a potential difference in the marginal utility of protection depending on whether the species was seen in a five-or three- species design. The status quo parameter (associated with a dummy variable which is equal to one if the alternative is the status quo and zero otherwise) is specified as a normally distributed random parameter, again with a fixed effect shifter if the observation is from a three species choice set. This setup allows us to test 2 complementary hypothesis: whether the WTP for a species differs if it is seen in a three or five species choice set, and whether there is a similar shift in the status quo value in a three species set up (the status quo parameter identifies any utility level that is associated with the status quo option over and above what one might expect from the level of attributes in the status quo). We can formally test these propositions by estimating restricted models (i.e. restricting all the interaction effects to be zero) or in the case of the status quo effect, whether the interaction parameter is significant.

When we do this we find that we cannot confidently restrict the species interaction effects to be zero (Chi-squared test statistic of 15.49 with p-value of 0.502, but note that the value can cross the 0.05 limit by changing the number of draws used in the estimation process). The status quo interaction effect is also significant (p-value=0.001), suggesting that respondents view the current situation differently if they have three or five species being managed.

This is troubling, in that it implies that respondents are valuing improvement of a species differently if they are presented in the five-species design compared to a three-species design. In order to understand what heuristic respondents may be using, an alternative framework was tested.

We assume that respondents' measure of utility from protection under a particular alternative is a weighted average of the species being protected, i.e. in the case of a five species design we assume that the ecological improvement is defined as:

$$\frac{\sum_{i=1}^{5} \beta_i x_i}{5}$$

While the utility from a three species design is given by:

$$\frac{\sum_{i=1}^{3} \beta_i x_i}{3}$$

Where 'i' is a counter identifying the five or three species that are the subject of improved management.

Note that this is a rather extreme assumption: although it allows for differences in values across species (the β_i) when considering a suite of species being managed what is important is the (weighted) average improvement. The implication of this specification is that the value of a species when seen in a three-species design is by construction 5/3 more than it was when seen in a five-species design. As an assumption this could only be justified if it was supported statistically. Assuming that the initial definition of the protection variable for species # is defined as #r, we create a new suite of species protection variables #rp, defined as:

#rp=#r if seen in a five species design

#rp=#r*5/3 if seen in a three species design

i.e., we normalise the definitions of weighted ecological outcome so the five species design is taken as the base and the three species design is weighted up by a factor of 5/3 (where # identifies one of the eight species in the design).

We can then estimate this model and conduct a further test: can the unrestricted model that allows parameters for the three and five species designs to vary be restricted to a version where the parameters are not identical, but have a 5/3 ratio?

We find that we fail to reject the restriction of the parameters having a proportionality of 5/3 for the three species design as compared to the five species design. The Chi-squared value is 7.85 and the p-value is 0.4483, which is robust to changes in the draws needed for estimation. In that case our alternative heuristic is supported: respondents are valuing species differently in the three and five species design, but in a systematic way. If the 'scope' of the policy is greater i.e. protecting more species, one would expect the WTP for a bundle of species to be greater, but this does not seem to be occurring.

It should be noted that in all of these cases, we have assumed that the marginal utility associated with a change in the probability of extinction is constant. Introducing dummy variables for each level of protection for each species (relative to the status quo) is possible, but introduces a large number of parameters, which makes estimation difficult. An alternative approach is to introduce non-linearity in marginal values by introducing a quadratic term for the risk level for each species.

Although this does not introduce complete flexibility in response, it does allow for difference in values, including diminishing marginal values associated with achieving higher levels of protection, or increasing marginal values if respondents only care if high levels of protection are achieved.

A formal test of this model (using the 5/3 weighting specification) found that one failed to reject the restriction that the responses were linear in the probability of survival, i.e. that the quadratic specification did not improve model fit (Chi-squared test statistic =7.85, p-value=0.4479).

Table 12 below reports the results of the preferred model: linear in risk levels, but weighted by 5/3 for the three species model, relative to the five species model with a weight of 1.

Table 12. WTP-space model results for eight species: Survey 2

	Coefficient	SE	95% confidence interval	
Coefficient	Coefficient			
Brush-tail Rabbit-rat	0.0354	0.0046	0.0262	0.0446
Giant F/w Crayfish	0.0244	0.0040	0.0165	0.0323
Australasian Bittern	0.0078	0.0010	0.0057	0.0099
Arnhem Plateau	0.0056	0.0010	0.0036	0.0077
Far Eastern curlew	0.0050	0.0006	0.0037	0.0064
Shaw Galaxias	0.0047	0.0005	0.0035	0.0058
Gulbaru Gecko	0.0046	0.0006	0.0034	0.0058
Acacia equisetifolia	0.0046	0.0006	0.0033	0.0059
SQ*sp3	0.3191	0.0794	0.1634	0.4748
SQ	-1.3994	0.2741	-1.9368	-0.8620
SD(SQ)	5.0120	0.3438	4.338	5.6860
Het	0.8508	0.1072	0.6407	1.0609
/tau	1.3494	0.0795	1.193	1.5053
Number of choices	6144			
Number of individuals	768			
Log likelihood	-4338.5223			

NB: Species risk levels rescaled by 5/3 if the choice set was a 3-species partial profile design i.e. reported values are for a 5-species partial profile, and should be increased by 5/3 to represent values in a 3-species partial profile design.

The cost attribute has been defined in $100s, and hence coefficients are the WTP expressed in $100 per unit change in probability of extinction in next 20 years, payable for 20 years, per household i.e. they are willing to pay 78c per percentage point improvement for the Australasian Bittern. Also note that the implied values are for a species when seen in the five species design. The values would be increased by 5/3 if the species was seen in a three-species design.

We then repeat this process for Survey 1, testing to see if the values for species differ if seen in a five or three species design. Again we find that we cannot restrict the WTP to be equal across all species (Chi-squared statistic=24.06, p-value=0.0022) but when we employ the weighting approach, then we can accept the restriction (14.08, 0.0797 respectively). Again, we seem to have a systematic heuristic being adopted whereby the utility from an alternative is determined by a (weighted) average of improvement in the species present, rather than the aggregate improvement in species protection.

Table 13. WTP-space model results for eight species: Survey 1

	Coefficient	SE	95% confidence interval	
-1*Cost	1 (constrained)			
Great Desert Skink	0.0187	0.0036	0.0116	0.0257
Murray Cod	0.0044	0.0005	0.0032	0.0056
Numbat	0.0042	0.0008	0.0025	0.0058
Banksia vincentia	0.0032	0.0006	0.0020	0.0044
Orange-bellied Parrot	0.0029	0.0006	0.0015	0.0041
Eastern Bristlebird	0.0022	0.0008	0.0006	0.0038
Boggomoss snail	0.0020	0.0004	0.0010	0.0029
Clay Pans of the Swan Coastal Plain	0.0012	0.0005	0.0002	0.0022
SQxsp3	0.2664	0.0821	0.1055	0.4274
SQ	-1.719	0.1980	-2.1076	-1.3313
SD(SQ)	3.891	0.2782	3.3460	4.4367
Het	1.2051	0.16475	0.8821	1.5280
/tau	1.708	0.1242	1.4648	1.9519
Number of choices	4104			
Number of individuals	513			
Log likelihood	-3139.0892			

NB: Species risk levels rescaled by 5/3 if the choice set was a 3-species partial profile design i.e. reported values are for a 5-species partial profile, and should be increased by 5/3 to represent values in a 3-species partial profile design.

Again we test for whether there is any non-linear (quadratic) change in WTP as the level of protection varies. As a group of effects this was significant (chi squared statistic of 25.55, p=0.001), but inspection of the estimates suggests that in only one case there was a significant effect (for Clay Pans) where there was some evidence of increasing marginal utility associated with reducing the risk of extinction. For simplicity, we report just the linear model.

One issue that we have identified is that there does appear to be an insensitivity to scope, i.e., the marginal WTP for protection of a species is affected by whether the species is seen as part of a three species or 5 species policy intervention. We suggest that this is some form of decision heuristic being adopted by respondents, i.e., they are constructing some form of 'average' improvement across either three or five species. We explored this effect further by conducting Survey 3 where preferences were sought for all eight species. We combined data sets of Survey 1 and Survey 3 and estimated an unrestricted full model (Table 14), having different coefficients for each set: subset of 3 (SP3), subset of 5 (SP5) and all 8 species (SP8).

Table 14. Full (unrestricted) WTP-space model results

	Coefficient	SE	95% confidence interval	
-1*Cost	1 (constrained)			
SP3				
Great Desert Skink	0.0331	0.0063	0.0207	0.0454
Murray Cod	0.0122	0.0012	0.0098	0.0146
Numbat	0.0044	0.0020	0.0005	0.0083
Banksia vincentia				
Orange-bellied Parrot	0.0051	0.0012	0.0027	0.0075
Eastern Bristlebird	0.0038	0.0014	0.0011	0.0065
Boggomoss snail	0.0083	0.0016	0.0052	0.0114
Clay Pans of the Swan Coastal Plain	0.0023	0.0011	0.0002	0.0045
SP5				
Great Desert Skink	0.0086	0.0056	-0.0025	0.0196
Murray Cod	0.0041	0.0008	0.0024	0.0057
Numbat	0.0073	0.0017	0.0041	0.0106
Banksia vincentia	0.0032	0.0010	0.0013	0.0051
Orange-bellied Parrot	0.0036	0.0009	0.0018	0.0054
Eastern Bristlebird	0.0050	0.0014	0.0022	0.0077
Boggomoss snail	0.0020	0.0006	0.0007	0.0032
Clay Pans of the Swan Coastal Plain	-0.0002	0.0007	-0.0016	0.0012
SP8				
Great Desert Skink	-0.0085	0.0391	-0.0851	0.0681
Murray Cod	0.0032	0.0007	0.0019	0.0045
Numbat	0.0056	0.0030	-0.0003	0.0114
Banksia vincentia	0.0027	0.0006	0.0015	0.0038
Orange-bellied Parrot	0.0042	0.0008	0.0027	0.0058
Eastern Bristlebird	0.0010	0.0029	-0.0048	0.0067
Boggomoss snail	0.0030	0.0007	0.0017	0.0043
Clay Pans of the Swan Coastal Plain	0.0030	0.0007	0.0017	0.0043
SQ				
SQ-Sp3	-1.5248	0.2039	1.9244	-1.1252
SQ-Sp5	-1.3752	0.2086	-1.7840	-0.9663
SQ-Sp8	-3.9216	1.1750	-6.2246	-1.6186
SD				
SD(SQ-Sp3)	3.6159	0.2551	3.1160	4.1158
SD(SQ-Sp5)	3.5855	0.2766	3.0433	4.1276
SD(SQ-Sp8)	5.1285	0.3026	4.5354	5.7217
Het	1.3340	0.1720	0.9970	1.6710
Cons	1.3340	0.1720	0.9970	1.6710
Sp5	0.0143	0.1834	-0.3451	0.3737
Sp8	-0.3947	0.1626	-0.7134	-0.0761
/tau	1.7406	0.0834	1.5772	1.9040
Number of choices	9184			
Number of individuals	1147			
Log likelihood	-7537.5731			

Then we constrained the full model to have the same coefficients, (1) in percentage without rescaling and (2) in percentage with rescaling. We tested two constrained models against full model using likelihood-ratio tests and found that both full model restricted to same coefficients, no scaling (Chi-squared statistic=44.92s, p-value=0.0001) and also full model restricted to same coefficients, with scaling (Chi-squared statistic=50.78, p-value=0.0000) were rejected.

As the next step, we estimated a model with 3 species design and with 5 species design constrained, with scaling and 8 species design unconstrained. We tested whether this model can be constrained against the full model and was accepted (Chi-squared statistic=8.34, p-value=0.4011). Therefore, we estimated a separate model for the Survey 3 sample which has 8 species design. The results of this model are reported in Table 15.

Table 15. WTP-space model results for eight species: Survey 3

	Coefficient	SE	95% confidence interval	
-1*Cost	1 (constrained)			
Great Desert Skink	-.01009	0.0447	-0.0977	0.0775
Murray Cod	0.0030	0.0007	0.0016	0.0045
Numbat	0.0052	0.0033	-0.0013	0.0117
Banksia vincentia	0.0019	0.0007	0.0005	0.0034
Orange-bellied Parrot	0.0036	0.0009	0.0019	0.0053
Eastern Bristlebird	0.0006	0.0032	-0.0057	0.0069
Boggomoss snail	0.0028	0.0007	0.0013	0.0043
Clay Pans of the Swan Coastal Plain	0.0017	0.0008	0.0001	0.0033
SQ	-3.375	1.310	-5.943	-0.8067
SD(SQ)	6.8751	0.6225	5.6552	8.0950
Het	0.8462	0.1353	0.5810	1.1112
/tau	1.763	0.1116	1.5448	1.9826
Number of choices	5080			
Number of individuals	634			
Log likelihood	-4172.80			

4. Summary of estimation results

The first point to note is that there are significant, positive willingness to pay for all species. Further, there are differences in the level of WTP across species. Based on the model results of combined Survey 1 and Survey 2, we can summarise the willingness to pay values of threatened species and ecological communities among the public in Australia (Table 16, and Table 17). The most highly valued species among the first set of eight species[9] (Survey 1) was the Great Desert Skink, the least valued was the (Clay pan of the Swan Coastal Plain), with the WTP estimate of $1.87 ($0.12) per year per household for 20 years respectively for a one percentage point improvement in its status, i.e. reduction of its extinction risk. In survey 2, the most highly valued species was the Brush-tailed Rabbit-rat, with the least being the (Gulbaru Gecko and *Acacia equisetifolia*) with the WTP estimate of $3.54 ($0.46) per year per household for 20 years for a one percentage point improvement in its status, i.e., reduction on its extinction risk. The full set of WTP estimates and their 95% confidence intervals are reported in Tables 16 and 17.

We also report in those Tables the WTP for moving each species from its expected outcome in 20 years, with no further protection (i.e., the status quo level in the choice experiment) up to the lowest level of risk. It should be noted that differences in these values across species are a combination of the differences in values per percentage point improvement for each species, and the differences in their initial risk status.

What this analysis has shown is that respondents are able to express differential values for the species shown, and that these can be estimated with relatively high statistical precision. We find there are no non-linearity in marginal WTP estimates when the risk status is expressed as a numerical probability of extinction.

[9] Seven species and one ecological community.

A closer look at the results of final model estimated for the Survey 1 and Survey 2 revealed an insensitivity to scope, i.e., it appears as if the aggregate WTP for 3 species was similar to that of 5 species (once one controls for the scale of the improvement in probability of extinction). The implication is that the marginal WTP for protection of a species is affected by whether the species is seen as part of a three species or 5 species policy intervention. We suggest that this is some form of decision heuristic being adopted by respondents i.e. they are constructing some form of 'average' improvement across either three or five species. We also observed a scaling effect where the average value estimates for 3 species design was 5/3 times higher than that of 5 species design. In Table 15 and 16, we report values associated with the 5-species design, which will give a lower estimate. These values have to be multiplied by 5/3 if one were to prefer to use the 3-species values.

We investigated how scope effect and scaling would be changed if we ask people to provide their preferences for 8 species in our Survey 3. As mentioned in the results section, a full model with constraints to have same coefficients with scaling was rejected. As a result we estimated a model for Survey 3 separately. Then we compared value estimates obtained from Survey 1 and Survey 3 for the first set of species for different designs (see Table 18). Comparison of results revealed that WTP values to save species were different based on the design – number of species that were planned to save. We observe a clear pattern, higher the number of species to save, lower the value that people want to pay for a species – for example, value estimates for 3 species design were higher most of the time compared to 5 species and 8 species designs. However, results of the 8 species design (Survey 3) was not very consistent as in the Survey 1 and 2, where only 3 species and 5 species deigns were presented. The value estimates of species based on Survey 2 for 3 species and 5 species designs are given in Table 19.

Table 16. Value estimates ($) for threatened species and ecological community studied in Survey 1

Species set 1		Status quo level (species risk status in 20 years with no additional protection	WTP ($) per year for 20 years for a 1 percentage point improvement in risk status	95 % CI	WTP ($) each year for 20 years for improving species from their status quo level to lowest risk level
Great Desert Skink		High	1.87	1.16:2.57	37.4
Murray Cod		Extinct	0.44	0.32:0.56	44
Numbat		Very high	0.42	0.25:0.58	31.5
Banksia vincentia		Extinct	0.32	0.20:0.44	32

Species set 1		Status quo level (species risk status in 20 years with no additional protection	WTP ($) per year for 20 years for a 1 percentage point improvement in risk status	95 % CI	WTP ($) each year for 20 years for improving species from their status quo level to lowest risk level
Orange-bellied Parrot		Extinct	0.29	0.15:0.41	29
Eastern Bristlebird		Very high	0.22	0.06:0.38	16.5
Boggomoss Snail		Extinct	0.20	0.10:0.29	20
Clay Pans of the Swan Coastal Plain		Extinct	0.12	0.02:0.22	12

NB: Species risk levels rescaled by 5/3 if the choice set was a 3-species partial profile design i.e. reported values are for a 5-species partial profile, and should be increased by 5/3 to represent values in a 3-species partial profile design.

Table 17. Value estimates for threatened species and ecological community studied in Survey 2

Species set 2		Status quo level (species risk status in 20 years with no additional protection	WTP ($) per year for 20 years for a 1 percentage point improvement in risk status	95 % CI	WTP ($) each year for 20 years for improving species from their status quo level to lowest risk level
Brush-tailed Rabbit -rat		High	3.54	2.62:4.46	70.8
Giant Freshwater Crayfish		High	2.44	1.65:3.23	48.8

Species set 2	Status quo level (species risk status in 20 years with no additional protection	WTP ($) per year for 20 years for a 1 percentage point improvement in risk status	95 % CI	WTP ($) each year for 20 years for improving species from their status quo level to lowest risk level
Australasian Bittern 	Very high	0.78	0.57:1.00	58.5
Arnhem Plateau Sandstone Shrubland Complex 	Very high	0.56	0.36:0.77	42
Far Eastern curlew 	Extinct	0.51	0.37:0.64	51
Shaw Galaxias 	Extinct	0.47	0.35:0.59	47
Gulbaru Gecko 	Extinct	0.46	0.34:0.58	46
Acacia equisetifolia 	Extinct	0.46	0.33:0.59	46

NB: Species risk levels rescaled by 5/3 if the choice set was a 3-species partial profile design i.e. reported values are for a 5-species partial profile, and should be increased by 5/3 to represent values in a 3-species partial profile design.

This may be due to having large number of attributes (8 species) that contributes to complexity of choice decisions that people have to make. Although empirical evidence on error variance and choice complexity is not conclusive (Burton and Rigby, 2012, Rigby et al., 2016),complexity of the choice tasks can lead to response strategies not consistent with fully compensatory rational decisions that maximize utility (Johnston et al., 2017). We also couldn't observe scaling effect as we observed in 3 species and 5 species designs.

Table 18. Value estimates ($) for threatened species and ecological community studied in Survey 1 and Survey 3

	Subset of 3 species		Subset of 5 species		All 8 species	
Species name *(species risk status in 20 years with no additional protection)*	WTP[10] ($)	95 % CI	WTP[11] ($)	95 % CI	WTP[12] ($)	95 % CI
Great Desert Skink *(High)* 	3.12	1.93:4.28	1.87	1.16:2.57	-1. 01	-9.77: 7.75
Murray Cod *(Extinct)* 	0.73	0.53:0.93	0.44	0.32:0.56	0. 30	0.16:0.45
Numbat *(Very high)* 	0.70	0.42:0.97	0.42	0.25:0.58	0. 52	-0.13:1.17
Banksia vincentia *(Extinct)* 	0.53	0.33:0.73	0.32	0.20:0.44	0.19	0.05:0.34
Orange-bellied Parrot *(Extinct)* 	0.48	0.25:0.68	0.29	0.15:0.41	0.36	0.19:0.53

Species name *(species risk status in 20 years with no additional protection)*	Subset of 3 species		Subset of 5 species		All 8 species	
	WTP[10] ($)	95 % CI	WTP[11] ($)	95 % CI	WTP[12] ($)	95 % CI
Eastern Bristlebird *(Very high)* 	0.37	0.10:0.63	0.22	0.06:0.38	0.06	-0.57:0.69
Boggomoss Snail *(Extinct)* 	0.33	0.17:0.48	0.20	0.10:0.29	0.28	0.13:0.43
Clay Pans of the Swan Coastal Plain *(Extinct)* 	0.10	0.03:0.37	0.12	0.02:0.22	0. 17	0.01:0.33

[10] WTP per year for 20 years for a 1 percentage point improvement in risk status when preferences were sought for 3 species out of eight.
[11] WTP per year for 20 years for a 1 percentage point improvement in risk status when preferences were sought for 5 species out of eight..
[12] WTP per year for 20 years for a 1 percentage point improvement in risk status when preference were sought for all 8 species.

Table 19. Value estimates ($) for threatened species and ecological community studied in Survey 2

	Subset of 3 species		Subset of 5 species	
Species name *(species risk status in 20 years with no additional protection)*	WTP[13] ($)	95 % CI	WTP[14] ($)	95 % CI
Brush-tailed Rabbit-rat *(High)* 	5.90	4.37:7.43	3.54	2.62:4.46
Giant Freshwater Crayfish *(High)* 	4.07	2.75:5.38	2.44	1.65:3.23
Australasian Bittern 	1.30	0.95:1.67	0.78	0.57:1.00
Arnhem Plateau Sandstone Shrubland Complex 	0.93	0.60:1.28	0.56	0.36:0.77
Far Eastern curlew *(Extinct)* 	0.85	0.62:1.07	0.51	0.37:0.64
Shaw Galaxias *(Extinct)* 	0.78	0.58:0.98	0.47	0.35:0.59
Gulbaru Gecko *(Extinct)* 	0.77	0.57:0.97	0.46	0.34:0.58
Acacia equisetifolia *(Extinct)* 	0.77	0.55:0.98	0.46	0.33:0.59

[13] WTP per year for 20 years for a 1 percentage point improvement in risk status when preferences were sought for 3 species out of eight.
[14] WTP per year for 20 years for a 1 percentage point improvement in risk status when preferences were sought for 5 species out of eight.

5. How to use species values reported in this study

This study has focused on a set of specific species and ecological communities. If management actions can be interpreted in terms of changes in extinction risk for those species/communities then the estimates reported here can be used to value those improvements. There are a number of issues that need to be considered when doing so, however.

Non- linearity of extinction risk levels

As we defined by the attribute levels, extinction risk level can take up to five levels for those species where the status quo level is extinction. There is a numerical definition of the five levels based on the level of risk of extinction, (1, 0.75, 0.2, 0.02, and 0), or one could recode so that they represent the probability of survival scored as: 0%, 25%, 80%, 98%, and 100%.

However, it's not clear that heuristically the marginal utility is linear in the probability, i.e., it could be possible that the marginal utility loss increases as one approaches the probability of survival of zero, or that the marginal gain in utility declines as the probability of survival approaches 100%. Instead of adopting this approach one could use a series of dummy variables for each level and allow complete flexibility in the values over the range. Alternatively, one can allow for parametric non-linearity, by e.g. employing a quadratic function of risk level, allowing for decreasing or increasing marginal benefits as one approaches 100% probability of survival. We tested this with parametric quadratic function and found that the linear model that we employed using probability of survival provides a better model fit, but this could be influenced by the range of values employed in the design, i.e., with greater discrimination at the values close to extinction one may detect non-linearity. However, for large changes in probabilities one would anticipate that the reported results will be appropriate for measuring values.

The study also explored the issue of whether the value for each species varied with the context that it was in (i.e., whether there were 3, 5 or 8 species being valued). This has led to different values for each species. Although the 3 and 5 species design appeared to have some consistency up to a scaling factor, the 8 species model diverted from that. It is perhaps not unexpected that estimates should be context specific, but this leaves us with a number of potential estimates of values that could be used in a valuation exercise.

As mentioned above we found that the estimates from the eight species design are less consistent, in terms of wider confidence intervals (CI), to the extent that some species have insignificant estimates. Therefore, we consider only values that come from the designs with subset of 3 species and subset of 5 species. We would propose that the range in the estimates across the designs be treated as a broader estimate, with the midpoint taken as the central estimate. For example, the value range for Great Desert Skink is 1.16:2.57 using the 5 species design, but 1.93:4.28 for the 3 species design. Then we computed the midpoint of the extremes (1.16:4.28) to come up with an estimate of 2.72.

Table 20. Value estimate for each species (Species set 1)

Species name *(species risk status in 20 years with no additional protection)*	**Value range**	**WTP[15] ($)**	**WTP[16] ($)**
Great Desert Skink *(High)* 	1.16:4.28	2.72	54
Murray Cod *(Extinct)* 	0.32:0.93	2.75:5.38	2.44
Numbat *(Very high)* 	0.25:0.97	0.61	46
Banksia vincentia *(Extinct)* 	0.20:0.73	0.47	47
Orange-bellied Parrot *(Extinct)* 	0.15:0.68	0.42	42
Eastern Bristlebird *(Very high)* 	0.06:0.63	0.35	26
Boggomoss Snail *(Extinct)* 	0.01:0.48	0.29	29
Clay Pans of the Swan Coastal Plain *(Extinct)* 	0.02:0.37	0.20	20

[15] WTP per year for 20 years for a 1 percentage point improvement in risk level: midpoint estimate.
[16] WTP per year for 20 years for improving species from their status quo level to lowest risk level: midpoint estimate.

Table 21. Value estimate for each species (Species set 2)

Species name *(species risk status in 20 years with no additional protection)*	Value range	WTP[17] ($)	WTP[18] ($)
Brush-tailed Rabbit-rat *(High)* 	2.62:7.43	5.03	101
Giant Freshwater Crayfish *(High)* 	1.65:5.38	3.52	70
Australasian Bittern *(Very high)* 	0.57:1.67	1.12	84
Arnhem Plateau Sandstone Shrubland Complex *(Very high)* 	0.36:1.28	0.82	62
Far Eastern curlew *(Extinct)* 	0.37:1.07	0.72	72
Shaw Galaxias *(Extinct)* 	0.35:0.98	0.67	67
Gulbaru Gecko *(Extinct)* 	0.34:0.97	0.65	65
Acacia equisetifolia *(Extinct)* 	0.33:0.98	0.66	66

[17] WTP per year for 20 years for a 1 percentage point improvement in risk level: midpoint estimate.
[18] WTP per year for 20 years for improving species from their status quo level to lowest risk level: midpoint estimate.

5.1 How to use these values?

The estimated values of species and ecological communities can be used in different ways, primarily in benefit transfer and conservation decisions, with necessary adjustments.

5.1.1 Benefit Transfer

The values and the range reported in the Table 20 and Table 21 can be used in benefit transfer. However, it is important to note that the values reported in this study for each species are in terms of changes in extinction risk level.

Benefit transfer is required when a values from one context are transferred to another. One might consider the case where values are needed for a species that has not been valued using a unique primary study. There are a number of ways to conduct a benefit transfer, which vary according to accuracy and expertise required. Two main approaches are unit-value transfer and benefit-function transfer (Johnston et al., 2015). One might consider a unit value transfer i.e. taking a value estimated here and applying it to the new context directly. However, there is a requirement that the site, context and commodity are sufficiently similar to support this approach (Bateman et al. 2011; Johnston et al., 2015). For example, this study is conducted for entire Australia so that one might be confident that the value estimates produced in this study can be applied anywhere in Australia using unit value transfer approach with appropriate post- adjustments for the same or similar species. Adjustments are required depending on the new context where values will be applied. Johnston et al. (2015) provide a non-exhaustive list of specific items that should be considered when matching the study context and new context for benefit transfer such as broader policy context, commodity being valued, similarity of the economic framework[19] and socio-demographics of the population. Gunawardena et al. (2017) summarize a check list, key steps and some examples on unit-value transfers using non-market values of species.

In the current case one could take a view of sufficiently similar species and similar policy context of conserving threatened species to decide on whether values could be transferred. It may be sufficient to attempt to map across type of species (i.e. frog to frog, or bird to bird) but with the caveat that if one of those species is iconic/charismatic then the values may be prone to higher error (Subroy et al., 2019), indicating that even with similar species the public's awareness of them could affect the transferred values.

When the new context is dissimilar to the context where study was conducted, one could use a benefit transfer approach. For example, if we want to apply the values we estimated for a particular species in a country where context is considerably different, use of benefit transfer function is more appropriate than unit- value approach. This requires more information, resources and expertise. The most common method is the use of a function derived from meta- analysis which requires data from several primary studies (Subroy et al., 2019; Loomis and White 1996, Richardson and Loomis 2009; Martín-López et al. 2008).

This study estimates values for a variety of species that includes, birds, mammals, reptiles, plants and ecological communities in Australia. These values can be added into a meta-analysis of species (for example Subroy et al) and then possibly be used to predict values of other species.

5.1.2 Benefit transfer examples

In this section we show two examples to illustrate how to use estimated species values in other contexts.

Example 1: Painted Honeyeater

Assume that the Government wishes to find out benefits (the non-market value) of conserving *Painted Honeyeater* in Gunbower Koondrook Perricoota (GKP) site in the Murray Darling Basin to help evaluate a conservation policy. If the resources and time available are limited, and it is not possible to undertake an original non-market valuation study, one could think of applying benefit transfer. Here we go through a **step by step process** to illustrate how to apply values estimated in this study to value the *Painted Honeyeater*.

1. Identify any original non-market valuation studies done anywhere on *Painted Honeyeater*. We couldn't find any non-market valuation study.
2. Identify species (that already have estimated non-market values) that are closely matching with the characteristics of *Painted Honeyeater*.
3. Here we assume people would place similar values on Eastern Bristlebird and *Painted Honeyeater* as both are small birds, endemic to Australia, and generally shy and cryptic (rarely seen by ordinary people). Therefore, we will use values that we estimated for Eastern Bristlebird for benefit transfer.

[19] For example, if the original study measures willingness to pay (WTP) it can't be used to infer values for a policy context that needs to measure willingness to accept compensation.

4. Understand details of the value estimate of Eastern Bristlebird:
   a. Commodity being valued: WTP for 1 percentage point improvement of extinction risk level of Eastern Bristlebird.
   b. Table 22 shows how extinction risk categories were defined in this valuation study.

Table 22. Definition of extinction risk category

IUCN listing status	EPBC Act listing status	Extinction risk category	Probability of extinction
Least Concern (LC)	Not listed	Low	Virtually no chance of extinction in the next 20 years.
Vulnerable (VU)	Vulnerable	Moderate	There is a 2% chance of extinction in the next 20 years.
Endangered (EN)	Endangered	High	There is a 20% chance of extinction in the next 20 years.
Critically Endangered (CR)	Critically Endangered	Very high	There is a 75% chance of extinction in the next 20 years.
Extinct	Extinct	Extinct	There is a 100% chance of extinction in the next 20 years.

   c. Mean annual WTP per household for 20 years for 1% improvement of risk level = AU$ 0.35 in 2019
   d. Survey method: Discrete choice experiment
   e. Survey details: Representative sample of Australian public
   f. Study site: Australia

5. Adjust the WTP value to suit the new policy context.

   Adjust WTP for different biological context
   The value estimate AU$ 0.35 is for 1 percent improvement of risk level for all Eastern Bristlebirds available in Australia. So we assume this value is equal to the value for 1 percent improvement in extinction risk level, i.e. one percent reduction in extinction risk or one percent improvement is probability of survival of *Painted Honeyeater* species available throughout Australia.

   Our new context is GKP site in Murray Darling Basin. We assume that 80 percent of the Australian population of *Painted Honeyeaters* is found in the GKP site in the Murray Darling Basin. Therefore, the value that people would be willing to pay for 1 percent improvement of extinction risk level of *Painted Honeyeaters* can be lower than improving the species found in Australia. Implicit in this assumption is that respondents' values are responsive to scale, in a linear fashion. In the absence of any other information this is probably the appropriate consideration.

   Therefore, we can assume the value estimate for 1% improvement in extinction risk level of *Painted Honeyeaters* in GKP =AU$ 0.35* 80% = AU$ 0.28

6. Adjust WTP for inflation.

   The survey for this study was conducted in 2019. Therefore, the WTP value reflected the values that people placed on conserving the species in 2019.

   We can adjust these values to 2020 Australian dollar before we transfer them to the new context.

   CPI for 2019 = 115.4 (Australian Government[20])

   CPI for 2020 = 116.2 (Australian Government)

   Adjusted WTP value for 2020 for 1% reduction of extinction risk level of *Painted Honeyeater* at GKP site:
   WTP 2020 = AU$ 0.28 x 116.2/115.4 = AU$ 0.28 per household per year for 20 years.

7. Adjust WTP for change in real income.

   Average adult weekly earnings/ person in Australia in May 2019 was $ 1237.86 and $1304.70 in May 2020[21].

   Adjusting for inflation, real weekly earnings/person in 2019 was 1237.86* (116.2/115.4) = $1246.44.

   Rate of change in real income = (1304.70 – 12.46.44)/1246.44 =0.0467

   Allowing for inflation, this represents a 4.67% increase in real incomes from 2019 to 2020. Such increases are likely to increase the WTP for environmental goods, although the specific relationship between income and WTP for a particular environmental asset is uncertain. For simplicity, we assume that the change in WTP is proportional to the change in real income (assuming constant income elasticity of WTP equal to 1, Czajkowski et al. 2017).

   Adjusted WTP 2020 = AU$ 0.28 + $0.28 x 0.467 = $0.28 x (1 + 0.0467) = AU$ 0.29

[20] Australian Government/ Australian tax office: https://www.ato.gov.au/rates/consumer-price-index/
[21] Weekly earnings data: Australian Bureau of Statistics: https://www.abs.gov.au/AUSSTATS/abs@.nsf/second+level+view?ReadForm&prodno=6302.0&viewtitle=Average%20Weekly%20Earnings~Mar%201975~Previous~30/05/1975&&tabname=Past%20Future%20Issues&prodno=6302.0&issue=Mar%201975&num=&view=&

8. We also can estimate the value people would place on improving the extinction risk of species from current level to lowest level (see Table 22). The current risk level (Threat status) for *Painted Honeyeater* is Moderate (Vulnerable, i.e. 2% chance of species being extinct or 98% chance of species survival in the next 20 years). Moving the species to the lowest risk level (i.e., 0% extinction risk or 100% survival probability in the next 20 years) would be achieved by a 2% improvement of extinction risk level which is equal to AU$ 0.29*2 = AU$ 0.58 per household per year for 20 years.
9. Aggregate value of benefits from conserving *Painted Honeyeater*

   Assuming that preferences are sought from Australian public, the total number of estimated households in Australia in 2020 is about 10 million (based on 2020 Australian Institute of Family Studies[22]).
10. Aggregate value of benefits for conserving *Painted Honeyeater* (moving from the current level of extinction risk to the lowest level) is **AU$ 5.8 million per year for 20 years**.

Example 2: Superb Parrot

Suppose we are asked to estimate the non-market value of *Superb Parrot* in GKP site in the Murray Darling basin. We can go through the same steps we described for Painted Honeyeater.

1. In the absence of an original study on *Superb Parrots*, the next best alternative is to use value estimates from a similar species. We assume that people would value both parrots similarly as Orange-bellied Parrot and *Superb Parrot* share similar characteristics in terms of size and colour.
2. Understanding details of the value estimates for Orange-bellied Parrot:
   a. Commodity being valued: WTP for 1 percentage point improvement of extinction risk status of Orange-bellied Parrot (See Table 22 for further information on extinction risk categories)
   b. Mean annual WTP per household : AU$ 0.42 in 2019
   c. Survey method: Discrete choice experiment.
   d. Survey details: Representative sample of Australian public
   e. Study site: Australia
3. Adjust the WTP value to suit the new policy context.

   Adjust WTP for different biological context

   The value estimate AU$ 0.42 is for 1 percent improvement of extinction risk level for all Orange-bellied parrots available in Australia. So we assume this value is equal to the value for 1 percent improvement in survival probability or 1 percent reduction in extinction risk of *Superb Parrot* species available throughout Australia.

   The entire range of *Superb Parrots* are found in Murray Darling Basin. Therefore, we don't need to adjust the values for biological context.
4. Adjust WTP for inflation.

   The survey for this study was conducted in 2019. Therefore, the WTP value reflected the values that people placed on conserving the species in 2019.

   We can adjust these values to 2020 Australian dollar before we transfer them to the new context.

   CPI for 2019 = 115.4 (Australian Government[23])

   CPI for 2020 = 116.2 (Australian Government)
5. Adjusted WTP value for 2020 for 1% reduction of extinction risk level or 1% improvement in survival probability of *Superb Parrots* at GKP site: WTP 2020 = AU$ 0.42 x 116.2/115.4 = AU$ 0.42 per household per year for 20 years

[22] Australian Institute of Family Studies: https://aifs.gov.au/facts-and-figures/households-australia/households-australia-source-data#:~:text=Number%20of%20households%20and%20families%20projections&text=The%20number%20of%20households%20in,and%2012.57%20million%20by%202036
[23] Australian Government/Australian tax office: https://www.ato.gov.au/rates/consumer-price-index/

6. Adjust WTP for change in real income.

   Average adult weekly earnings/ person in Australia in May 2019 was $ 1237.86 and $1304.70 in May 2020[24].

   Adjusting for inflation, real weekly earnings/person in 2019 was 1237.86* (116.2/115.4) = $1246.44.

   Rate of change in real income = (1304.70 - 1246.44)/1246.44 =0.0467

   Allowing for inflation, this represents a 4.67% increase in real incomes from 2019 to 2020. Such increases are likely to increase the WTP for environmental goods, although the specific relationship between income and WTP for a particular environmental asset is uncertain. For simplicity, we assume that the change in WTP is proportional to the change in real income (assuming constant income elasticity of WTP equal to 1, Czajkowski et al. 2017).

   Adjusted WTP 2020 = AU$ 0.42 + $0.42 x 0.0467 = $0.42 (1+0.0467) = AU$ 0.44

7. We also can estimate the value people would place on improving the species from current risk level to lowest risk level. The current risk level (Threat status) for *Superb parrot* is Moderate (Vulnerable, i.e. 2% chance of extinction in next 20 years). Moving the species to lowest risk level (0% chance of extinction in next 20 years) can be achieved by 2% improvement of risk level which is equal to : AU$ 0.44*2 = AU$ 0.88 per household per year for 20 years

8. Aggregate value of benefits from conserving *Superb parrot*

   Assuming that preferences are sought from Australian public, the total number of estimated households in Australia in 2020 is about 10 million (based on 2020 Australian Institute of Family Studies[25]).

9. Aggregate value of benefits for conserving *Superb parrot* (moving from the current risk level to lowest risk level) is **AU$ 8.8 million per year for 20 years**.

5.1.3 Decision-making

The estimated values of species and ecological communities could be applicable in a range of decision-making contexts. Some of the applications of these values are described below.

1. Informing judgements that underpin decisions: Even without utilising them in a formal accounting framework or a decision support tool (such as Benefit: Cost Analysis), quantitative estimates of non-market values for threatened species can assist decision makers. They can influence the subjective judgements that people make about the relative importance of different projects or interventions, and thereby influence the decisions that are made.

2. Using non-market valuation to inform environmental accounting: In this section we show how the results of a non-market valuation study (e.g., a discrete choice experiment) that is used to estimate the value of a marginal change in an environmental benefit can be used to calculate the "exchange value" for use in environmental accounting.

Assume that the asset that is to be included in the environmental accounts is an area of native vegetation. For convenience we assume that the stock of this vegetation is measured on an index that has a potential range from 0 to 100. The index represents the extent of native vegetation and its quality as habitat.

The aim of the environmental account is to report each year on changes in the exchange value of this area of vegetation, calculated as the change in the vegetation index times its marginal value (its marginal social benefit, or marginal willingness to pay, or marginal WTP). In principle, there is a relationship between the level of the vegetation index and its marginal WTP. Assume we have conducted a discrete choice experiment that has allowed us to identify the relationship. A potential shape for it is shown in Figure 14. Economists expect that most goods exhibit the illustrated pattern of marginal value falling as the availability of the good increases.

[24] Weekly earnings data :Australian Bureau of Statistics: https://www.abs.gov.au/AUSSTATS/abs@.nsf/second+level+view?ReadForm&prodno=6302.0&viewtitle=Average%20Weekly%20Earnings~Mar%201975~Previous~30/05/1975&&tabname=Past%20Future%20Issues&prodno=6302.0&issue=Mar%201975&num=&view=&

[25] Australian Institute of Family Studies: https://aifs.gov.au/facts-and-figures/households-australia/households-australia-source-data#:~:text=Number%20of%20households%20and%20families%20projections&text=The%20number%20of%20households%20in,and%2012.57%20million%20by%202036

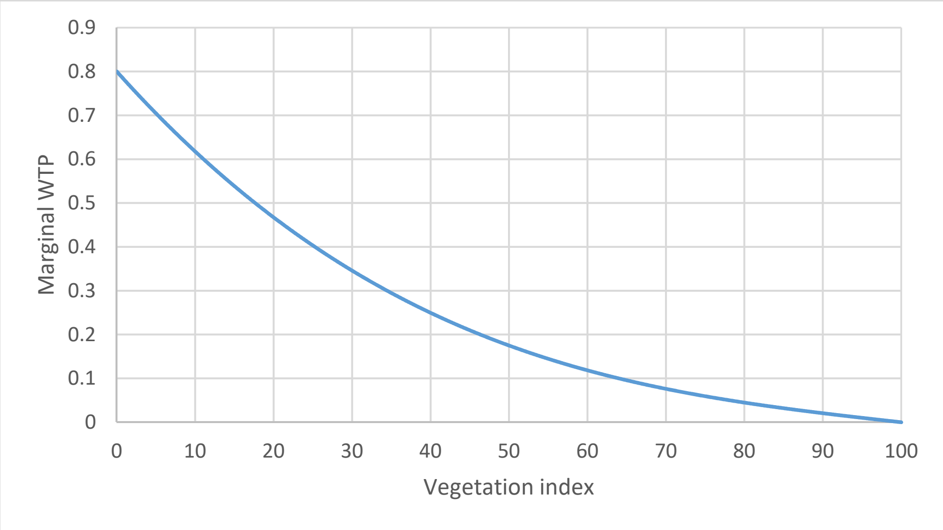

Figure 14. Marginal willingness to pay for vegetation index

Suppose that, in a reporting period, the level of the vegetation index falls from 60 to 40. The marginal WTP (Figure 14), estimated using the discrete choice experiment, can be used to estimate the exchange value of the fall in the index. Figure 15 and Figure 16 show two possible ways in which the exchange value could be calculated.

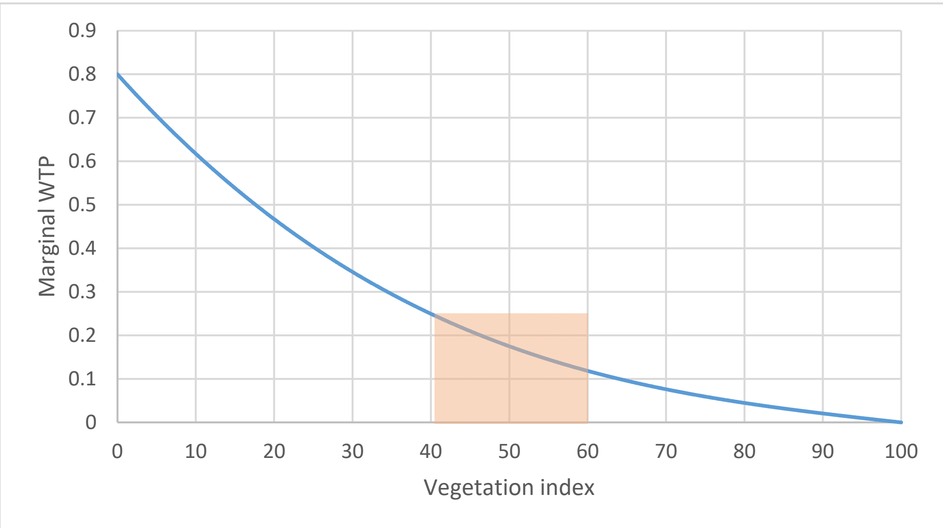

Figure 15. Calculating exchange value of fall in vegetation index: Option 1

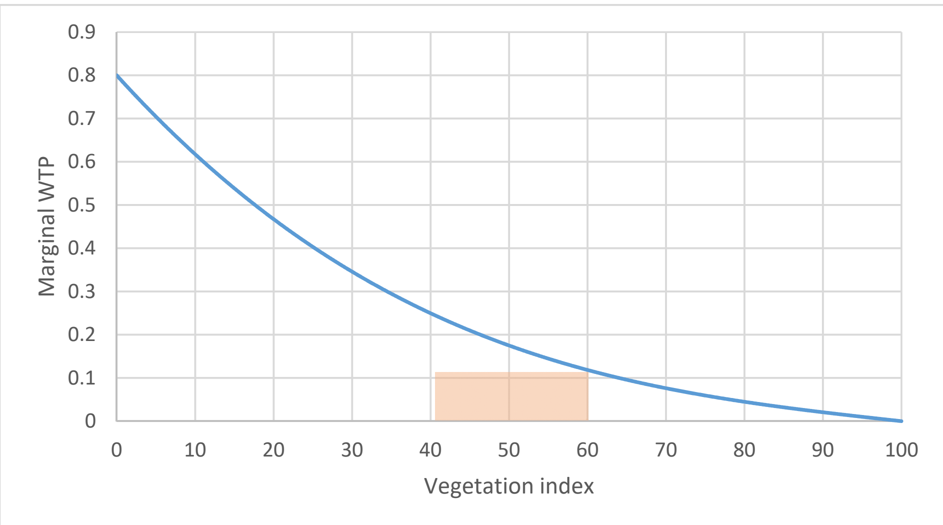

Figure 16. Calculating exchange value of fall in vegetation index: Option 2

The shaded area in Figure 15 represents the exchange value of the fall in vegetation index if we use the marginal WTP for the end of the reporting period, after the index has fallen. The exchange value is the change in index level (20) times the marginal WTP at the index level for the end of the period (0.2496), equalling 9.984.

Figure 16 shows the exchange value if we use the marginal value for the start of the reporting period, before the index has fallen. In this case, the exchange value is the change in index level (20) times the marginal WTP at the index level for the start of the period (0.1184), which equals 7.104.

Clearly, the choice of which marginal value to use could affect the reported exchange value markedly. There is no theoretical reason in economics to prefer the approach in Figure 15 or Figure 16, or potentially an average of the two. Whichever we choose, the marginal value will change over time as the vegetation index changes (unless the marginal WTP curve in Figure 14 happens to be a horizontal line).

If the vegetation index oscillates up and down over time, there could be some asymmetry in the exchange values reported in the accounts. For example, if we chose to use the marginal WTP at the end of each reporting period, the exchange values reported would be higher in years when the index fell (Figure 15) than in years when it rose (Figure 16), even if the index oscillated between the same two levels over a number of years.

As a side comment, economists note that the exchange values illustrated in Figures 15 and 16 are not equal to the change in consumer surplus, which is a better measure of the value of the change. The consumer surplus for the change is shown as the shaded area in Figure 17. The difference reflects that environmental accounts are not actually measuring the social values of the changes they report on because, within any one report, they apply the same marginal value to all quantities of the good, ignoring that marginal value changes as the quantity changes.

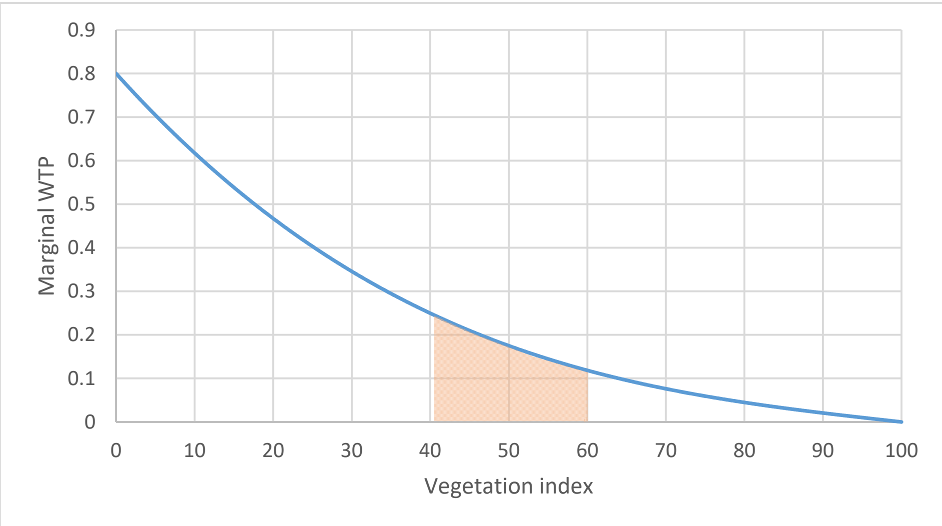

Figure 17. Consumer surplus for changes in vegetation index

Vegetation index as a proxy for other benefits

In the above example, it was assumed that the discrete choice experiment directly measured the marginal WTP for the vegetation index, using the index as a proxy for benefits (ecosystem services) such as the provision of habitat, or the provision of opportunities for recreation. What if the available non-market valuation study directly measures those other benefits but the environmental accounts require results to be reported for the vegetation index?

To illustrate, suppose that the only value associated with the vegetation is conservation of a threatened species. A choice experiment has been conducted to plot the relationship between the species' probability of survival over the next 50 years (= 1 – probability of extinction) and the marginal willingness to pay to increase the probability of survival (Figure 18). As illustrated, this also slopes down, reflecting a greater concern about the species as its risk of extinction increases.

Assuming that the environmental account is reported in terms of the vegetation index, the relationship in Figure 18 (with probability of survival as the independent variable) needs to be converted to Figure 14 (with the vegetation index as the independent variable). This requires quantitative information about the relationship between the vegetation index and the probability of survival of the species.

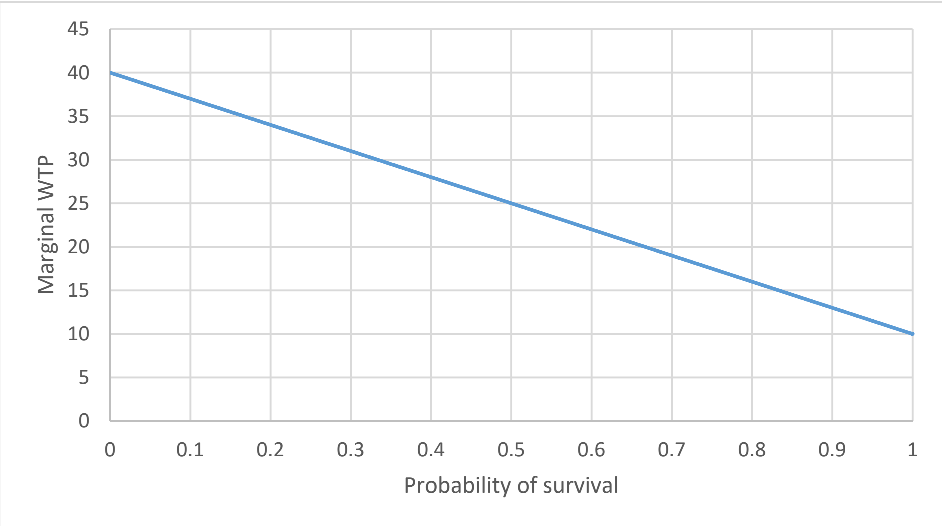

Figure 18. Marginal willingness to pay and probability of survival

Quantifying this relationship is often difficult and subject to considerable uncertainty, but it is an unavoidable requirement if the non-market values for one variable are to be adjusted to represent a different related variable. For this example, Figure 19 shows the assumed relationship between vegetation index and the probability of survival for a species. This quantitative relationship provides an exact conversion from Figure 18 to Figure 14.

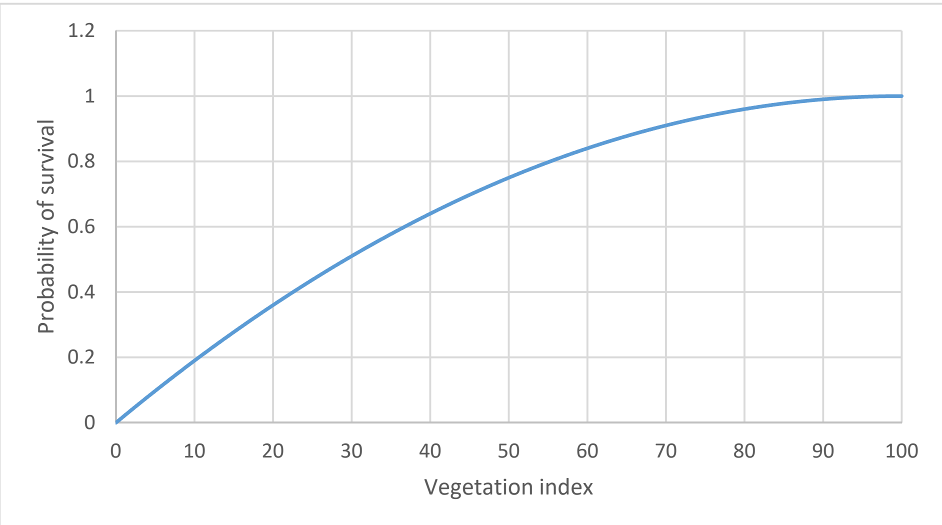

Figure 19. Assumed relationship between vegetation index and probability of survival

Note that (in this hypothetical example) a vegetation index of 100 corresponds to a probability of survival of 1. Even though they correspond, they have quite different marginal WTPs. At a probability of survival of 1, the marginal WTP for changes in probability of survival is 10. However, at the corresponding vegetation index of 100, the marginal WTP for changes in vegetation index is zero. This is because, at that point, the marginal change in probability of survival from a change in vegetation index is zero (Figure 19, but note that this is for a specific hypothetical case). More generally, the WTP for a marginal change in the vegetation index is the product of the marginal WTP for the species, and the marginal change in the probability of survival that occurs with a marginal change in the vegetation index.

It would be possible to calculate the exchange value of a change in probability of survival using Figure 18 rather than converting the marginal WTPs from the probability of survival to the vegetation index (Figure 14). Although this would save one step in the process, it would not provide the same results for the environmental accounts, except in the unlikely case where Figure 19 is a straight line through the origin.

To illustrate, let us return to our example, where the vegetation index falls from 60 to 40 in a reporting period. Using the relationship in Figure 19 to convert, this corresponds to a fall in the probability of survival from 0.84 to 0.64. If we use the marginal WTP for the final value of each variable (0.2496 for vegetation index, 20.800 for probability of survival), the exchange values for the change are 4.992 and 4.160, respectively. If we use the marginal WTP for the starting value of each variable (0.1184 for vegetation index, 14.800 for probability of survival), the exchange values for the change are 2.368 and 2.960, respectively. Therefore, the shortcut of calculating exchange values using available non-market values without converting them to marginal values for the variable that is being reported against should not be taken.

Accounting for time when converting non-market values to exchange values

The aim in this type of accounting is to report on changes in asset values. This has two implications for the design of stated-preference non-market valuations studies, and the way that results are processed.

(a) The environmental changes presented in the survey need to be described as persisting in perpetuity. That way, they would reflect the types of asset values that accounts typically seek to capture.

(b) Non-market values obtained from stated-preference studies need to be converted to asset values before they are used in the calculations discussed here. This means discounting and aggregating any future payments. If the payment vehicle in the study is a single up-front payment, then no discounting is needed. If the payment vehicle involves an annual payment for a certain number of years, this needs to be reflected in the calculation of the aggregate present value of payments.

People wishing to use non-market valuation studies to inform environmental accounts need to be aware of these requirements.

3. Benefit – cost analysis for conservation investment: Resources to conserve threatened species are always limited and a sound approach is needed to make investment decisions where benefits of species conservation actions/projects needs to be compared with the costs of such actions/projects.

There could be a host of questions to decide first in doing a benefit cost analysis of projects or management alternatives to conserve threatened species in a given context (say Painted Honeyeater in the Murray-Darling basin). That include:

a. Nature of conservation project – single species or multiple species?
b. Number of management alternatives or projects?
c. Duration of projects or management alternatives (5 year, 10 year, 20 year etc.);
d. Schedule of management actions – what happens when for each project or management alternative; If it is multiple species project, are the management actions same or different?
e. Estimated cost of each management actions for each management alternative or project;
f. Benefits of management alternative or project;
g. Risk of failure of the management alternative or project;
h. Discount rate to be used to convert the future benefits and costs to present values.

For details on a systematic way of doing a BCA for environmental projects, see Pannell et al. (2013).

Once these questions are answered, we can then do a standard benefit-cost analysis of species conservation projects or alternative management options. We can compute net present value of benefits or benefit cost ratios to rank the projects or alternative management options (see Table 23).

This is where the values of threatened species or ecological communities estimated through economic valuation methods, including benefit transfer approach, would be applicable.

Example BCA: Management alternatives to conserve Painted Honeyeater in Murray-Darling basin

- Nature of conservation project: Single species (Painted Honeyeater)
- Number of management alternatives or projects: alternative 1 (focus on private lands), alternative 2 (focus on public lands), and alternative 3 (focus on both private and public lands)
- Duration of projects or management alternatives: 10 years
- Management actions within each alternative or project: These could vary depending on the nature of management alternatives or projects considered (see the texts and table below for more on this)
- Schedule of management actions: Timeline of management actions for each alternative or project (see the text and table below for more on this)
- Estimated cost of each management action: See table below for more on this. The estimated cost per unit of action is for illustrative purpose.
- Benefit of management alternatives or projects: Here we consider that the benefit of all management alternatives or projects is to reduce the risk of extinction of Painted Honeyeater by 1%. The value of this benefits is $ 5.8 million/year as derived earlier in benefit –transfer example. Depending on how we define the benefit measure, it could just be something else than reducing the extinction risk by 1%, such as increase in population of Painted Honeyeater by some number in Murray-Darling basin or increase in its habitat area in the basin by some amount.
- Risk of failure of the management alternative or project: It is estimated at the alternative or project level than at the individual action level. The assumed risk of failures of the management alternatives to generate benefits are 50%, 40% and 30% for management alternative 1, 2, and 3, respectively. Note these are assumed percentages for illustrative purposes, but they are generally based on past projects or expert opinion.
- Discount rate: The real discount rate used by the governments for environmental projects. We use a conservative rate of 5%.

Following are the potential management actions that can be implemented to conserve Painted Honeyeater in Murray-Darling basin in order to reduce its risk of extinction by 1% for the next 20 years. There are three management alternatives: alternative 1 focuses on private lands (actions 1, 2, 3), alternative 2 focuses on public lands (actions 4, 5, 6), and alternative 3 focuses on both types of lands (actions 1, 2, 5, 6).

Management actions:

1. Encourage private land holders to enter into stewardship agreement
2. Raise awareness among agricultural landholders of the importance of mistletoe as a resource for Painted Honeyeaters
3. Encourage landholders to protect ground layer and mid-storey vegetation
4. Conduct strategic planting of acacia species to restore Brigalow, Boree and Yarran woodlands and connect fragmented patches
5. Target removal of weeds significantly compromising habitat values (e.g. invasive perennial grasses) and restore native vegetation
6. Conduct targeted research into identifying different practical methods for restoring the structure and function of the ground layer in degraded habitat

Table 23. Benefit-cost analysis table (base year - year 0 - is 2020)

Particulars	Year (t)	Extent/frequency	Unit cost ($)	Management alternatives and associated costs		
				Management alternative 1	Management alternative 2	Management alternative 3
Management actions						
1	0 to 4	50 landholders/year	$1500.00	$340,946.30*		$340,946.30
2	0 to 9	5 meetings-workshops/year	$2000.00	$81,078.22		$81,078.22
3	0 to 9	5 demonstration events/year	$2500.00	$101,347.80		
4	0 to 9	50 ha/year	5,000/ha		$2,026,955.00	
5	0 to 9	25 ha/year	3,000/ha		$608086.60	$608086.60
6	0 and 5	2 research projects	30,000/ project		$53,505.78	$53,505.78
Present value of costs (PVC = sum of discounted costs)				$523,372.30	$2,688,548.00	1083617
Present value of benefits (PVB)				$5,800,000.00	$5,800,000.00	$5,800,000.00
Probability of realising benefits p = 1 - RF				0.5	0.6	0.7
Present value of expected benefits (PVEB = p*PVB)				$2,900,000.00	$3,480,000.00	$4,060,000.00
Net present value of benefits (PVEB – PVC)				$2,376,628.00	$791,452.20	$2,976,383.00
Benefit : cost ratio (PVEB/PVC)				5.54	1.29	3.75

* Present value of cost of action 1 for management alternative 1 = $\sum_{t=0}^{4} \frac{50*1500}{(1+0.05)^t}$ = $340,946.30. Present values of other costs are computed in the same way.

Based on the above analysis, it is clear that all management alternatives generate positive benefits to the society by investing in Painted Honeyeater conservation in Murray-Darling basin. However, based on the benefit to cost ratio, management alternative 1 (protecting and improving habitats on private lands) would be most effective as it generates $5.54 benefits for $1 investment.

Some caveats or limitations in the use of estimated values

1. The values of threatened species or ecological communities are estimated based on reducing their extinction risk (or increasing their probability of survival) by 1% for the next 20 years. If the metric used to consider the value of species is different, then a way needs to be found to link the two metrics in order to adjust the estimated values.
2. There is a fundamental difference in what the estimated values from DCE represent (welfare values) and what kind of values are used in environmental or species/ecosystem accounting (exchange values). This distinction and potential implications need to be closely considered as discussed earlier (in section 5.1.3, part 2).

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APPENDICES

Annex - A: Initial list of multiple species and there relevance under three criteria

TSS taxon		Genetic augmentation	Fencing	Valuation	Testing benefit transfer
		Tests perceptions of the acceptability of augmenting inbred populations with genes from other taxa, primarily to increase fertility. May also test differences in tone of messaging, information, costs	Tests the extent to which fencing affects value of taxa protected by a fence, including effect of type of fence (boviphobic, susphobic, pheliphobic, musphobic etc.), area, perception of captivity. May test differences in tone of messaging	Simultaneous multi-entity valuation using the same wording	Will compare direct valuation with values derived from a model developed from values given to other species. Could compare similar species pairs
White-throated grasswren	Bird			Yes	
Night parrot	Bird			Yes	Western Ground Parrot (Critically Endangered), Eastern Ground Parrot (Near Threatened), Tasmanian Ground Parrot (Least Concern)
Eastern bristlebird	Bird	Yes		Yes	Northern (CR) and southern (VU) subspecies, legally considered same subspecies
Western ground parrot	Bird	Yes		Yes	Night Parrot (EN high profile), Eastern Ground Parrot (Near Threatened), Tasmanian Ground Par-rot (Least Concern
Norfolk Island green parrot	Bird			Yes	
Norfolk Island boobook owl	Bird	Yes		Yes	
Plains wanderer	Bird		Yes	Yes	
Australasian bittern	Bird			Yes	
Swift parrot	Bird			Yes	Orange-bellied Parrot (CR, high profile, also migratory parrot but no commercial impact); Swift Parrot (CR, also migratory nomad in same habitat)
Mallee emu-wren	Bird			Yes	
Orange bellied parrot	Bird	Yes		Yes	Swift Parrot (CR, high profile, also migratory parrot but commercial impact on forestry if protected)
Yellow chat	*Bird*			Yes	Alligator Rivers and Capricornia subspecies, both threatened and in remote, marginal habitat)
Malleefowl	Bird		Yes	Yes	
Golden shouldered parrot		Yes	Yes	Yes	

TSS taxon		Genetic augmentation	Fencing	Valuation	Testing benefit transfer
		Tests perceptions of the acceptability of augmenting inbred populations with genes from other taxa, primarily to increase fertility. May also test differences in tone of messaging, information, costs	Tests the extent to which fencing affects value of taxa protected by a fence, including effect of type of fence (boviphobic, susphobic, pheliphobic, musphobic etc.), area, perception of captivity. May test differences in tone of messaging	Simultaneous multi-entity valuation using the same wording	Will compare direct valuation with values derived from a model developed from values given to other species. Could compare similar species pairs
Regent honeyeater		Yes	Yes	Yes	Swift Parrot (CR, also migratory nomad in same habitat), Regent Honeayeter (also a honeyeater but less distinct genetically and sedentary)
Southern Cassowary	*Yes*		Yes	Yes	
Eastern curlew			Yes	Yes	Curlew Sandpiper (also CR but much smaller)
Hooded plover			Yes	Yes	Fairy Tern (also beach dependent)
Red-tailed black cockatoo (south-eastern)			Yes	Yes	Carnabys Black-Cockatoo (EN, high progfile urban south-west WA species), Baudin's Black-Cockatoo (EN, low profile south-west WA species co-occurring with Carnaby's). South-western Red-tailed Black-Cockatoo (EN, same species but different subspecies in south-west WA)
Helmeted honeyeater	*Yes*		Yes	Yes	Regent Honeayeter (also a honeyeater but more distinct genetically and migratory)
Western ringtail possum	*Yes*		Yes	Yes	
Numbat			Yes	Yes	
Greater bilby		Yes	Yes	Yes	
Western quoll		Yes	Yes	Yes	
Northern hopping mouse		Yes	Yes	Yes	
Mahogany glider		Yes	Yes	Yes	
Gilbert's potoroo			Yes	Yes	
Eastern barred bandicoot		Yes	Yes	Yes	
Brush-tailed rabbit-rat		Yes	Yes	Yes	
Mountain pygmy-possum		Yes	Yes	Yes	

TSS taxon		Genetic augmentation	Fencing	Valuation	Testing benefit transfer
		Tests perceptions of the acceptability of augmenting inbred populations with genes from other taxa, primarily to increase fertility. May also test differences in tone of messaging, information, costs	Tests the extent to which fencing affects value of taxa protected by a fence, including effect of type of fence (boviphobic, susphobic, pheliphobic, musphobic etc.), area, perception of captivity. May test differences in tone of messaging	Simultaneous multi-entity valuation using the same wording	Will compare direct valuation with values derived from a model developed from values given to other species. Could compare similar species pairs
Mala			Yes	Yes	
Eastern bettong	Mammal		Yes	Yes	
Black-footed rock-wallaby	*Mammal*		Yes	Yes	
Eastern quoll	*Mammal*			Yes	
Central rock-rat	*Mammal*		Yes	Yes	
Leadbeater's possum	*Mammal*			Yes	
Kangaroo Island dunnart	*Mammal*		Yes	Yes	
Woylie	*Mammal*		Yes	Yes	
Golden bandicoot	*Mammal*		Yes	Yes	
Christmas Island flying-fox	*Mammal*			Yes	
Blue-top sun-orchid	*Plant*				
Mongarlowe mallee	*Plant*				
Morrisby's gum bat	*Plant*	Plant			
Small purple pea	*Plant*	Plant			
Silver gum	*Plant*	Plant			
Glossy-leaved hammer-orchid	*Plant*	Plant			
Turnip Copperburr	*Plant*	Plant			
Matchstick banksia	*Plant*	Plant			
Central Australian cabbage palm	*Plant*	Plant			
Bulberin macadamia nut	*Plant*	Plant			
Fleurieu leek orchid	*Plant*	Plant			

TSS taxon		Genetic augmentation	Fencing	Valuation	Testing benefit transfer
		Tests perceptions of the acceptability of augmenting inbred populations with genes from other taxa, primarily to increase fertility. May also test differences in tone of messaging, information, costs	Tests the extent to which fencing affects value of taxa protected by a fence, including effect of type of fence (boviphobic, susphobic, pheliphobic, musphobic etc.), area, perception of captivity. May test differences in tone of messaging	Simultaneous multi-entity valuation using the same wording	Will compare direct valuation with values derived from a model developed from values given to other species. Could compare similar species pairs
Shy susan	Plant	Plant			
Black grevillea	Plant				
Magenta lilly pilly	Plant				
Vincentia banksia	Plant				
Kakadu hibiscus	Plant				
Mossman fairy orchid	Plant				
Fairy bells	Plant				
Ant Plant	Plant				
Southport heath	Plant				
Purple wattle	Plant				
Silver daisy bush	Plant				
Fitzgerald mulla-mulla	Plant				
Spiny rice-flower	Plant				
Little mountain palm	Plant				
Caley's grevillea	Plant				
Scaly-leaved featherflower	Plant				
Whibley's wattle	Plant				
Button wrinklewort	Plant				
Ormeau bottle tree	Plant				

Annex – B: Image credits and acknowledgements

We have used images of the following species and ecological communities in this report. We acknowledged the sources of each images and provided the image credit as follows. In cases where we needed to replace the images used in the survey by a similar image due to low resolution of the original images for publication purposes, we have indicated that in the comments section.

Species/ecological commu-nity	Image source/ credit	Comments
Australasian Bittern	© Graeme Lembcke	Same image as used in the survey
Orange-bellied parrot	© J J Harrison; License: CC BY-SA 3.0	Same image as used in the survey
Eastern Bristlebird	© JJ Harrison CC BY-SA 4.0 Wikimedia Commons	Replaced image
Far Eastern curlew	© Micha Jackson	Replaced image
Murray Cod	© Jabin Watson	Replaced image
Shaw Galaxias	© Tarmo A. Raadik	Replaced image
Numbat	© Dilettantiquity CC-BY-SA-2.0 Wikimedia Commons	Replaced image
Brush-tailed Rabbit-rat	© Hugh Davies	Replaced image
Giant Freshwater Crayfish	© Todd Walsh	Replaced image
Boggomoss snail	© John Stanisic	Replaced image
Gulbaru Gecko	© Anders Zimny	Replaced image
Great Desert Skink	© Martin Whiting	Replaced image
Acacia equisetifolia	© Kym Brennan	Replaced image
Banksia vincentia	© Tony Auld	Replaced image
Arnhem Plateau Sandstone Shrubland Complex	© Jaana Dielenberg	Replaced image
Clay Pans of the Swan Coastal Plain	© Tim Swallow	Same image as used in the survey

Annex – C: Model Questionnaire

Social preferences for conserving threatened species

You are invited to participate this online survey that seek your preferences conserving multiple species. The survey will take about 15-20 minutes to complete.

What is the project about?

The aim of the study is to understand preferences of Australian public for conserving multiple threatened species (animals, plants and ecological communities). The study will estimate the dollar values that people will place on protecting different types of species that are facing different levels of extinction risk.

What does participation involve?

The participation of the survey means that you have to answer an online survey. You will be provided with information of multiple species that are facing risk of extinction at different levels. Then you will be asked make choices of protection programs that involve reducing the risk of extinction of combination of species.

Voluntary Participation and Withdrawal from the Study

Your participation will be on a voluntary basis and you can withdraw your participation at any stage of research without prejudice. However, your participation will prove important to complete this research.

Your privacy

Your information will be anonymously stored on the questionnaire forms initially and later on the researcher's laptop and finally in University of Western Australia (UWA) data backup system for at least seven years. This information will be kept strictly confidential and will not be made available to other people.

Possible Benefits

This research project will estimate the monetary benefits of protecting threatened species. Benefits (values) of threatened species are not currently available for most species listed in the Australian Government's Threatened Species Strategy (TSS). Decisions on program funding at Commonwealth and state levels rest on sound understanding of the values of threatened species. Selection of projects for species management are improved, through identifying projects that provide that best value for money.

By answering these questions, you will have the opportunity to express your opinions in protecting Australia's threatened animals and plants and ecological communities.

Possible Risks and Risk Management Plan

There are no foreseeable risks and potential harm associated on providing personal information and opinions. If any aspects of this research project distresses you, you can contact me at the above address or the UWA Human Research Ethics office at the below address.

Contacts

If you have any questions with any aspects of this interview, please feel free to contact either at my work phone number (+61864881353) or on my mobile phone number (+610422185791).

Sincerely,
Dr. Ram Pandit, Chief Investigator

Approval to conduct this research has been provided by The University of Western Australia (ethics reference number: RA/4/20/5471), in accordance with its ethics review and approval procedures. Any person considering participation in this research project, or agreeing to participate, may raise any questions or issues with the researchers at any time. In addition, any person not satisfied with the response of researchers may raise ethics issues or concerns, and may make any complaints about this research project by contacting the Human Ethics office at UWA on (08) 6488 4703 or by emailing to humanethics@uwa.edu.au.

All research participants are entitled to retain a copy of Participant Information Form relating to this research project.

Q1 Could you please indicate your age group?

❏ Less than 18 years ❏ 45-54 years

❏ 18-24 years ❏ 55-64 years

❏ 25-34 years ❏ >64 years

❏ 35-44 years

Q2. Please select which State you live in

❏ ACT ❏ NSW

❏ Northern Territory Queensland

❏ South Australia ❏ Tasmania Victoria

❏ Western Australia ❏ Outside of Australia

Q3. What is your gender? Please select one answer

❏ Male ❏ Female ❏ Other (please specify)

Q4. State the highest level of education you have completed so far

❏ Year 11 or below ❏ Advanced Diploma and Diploma

❏ Year 12 ❏ University Undergraduate/ Bachelor Degree

❏ Certificate III/IV ❏ Post Graduate (Diploma/Masters/ PhD)

In this survey, we will be talking about species and ecological communities

A species is the name given to a group of plants or animals consisting of similar individuals.

Ecological communities are naturally occurring groups of native plants, animals and other organisms that are found in unique habitats. In the last 200 years, hundreds of species have gone Extinct in Australia, including some in the last ten years.

More than 1,700 Australian species and ecological communities are known to be threatened and at risk of extinction due to human activity. Australia has more endemic (species which occur nowhere else on earth) mammals, reptiles and plants than any other country in the world.

Q5. Can you name any animal or plant that have become extinct in Australia?

❏ Yes (please mention)

❏ No

We are asking your opinions about reducing the risk of extinction of multiple threatened species and ecological communities in the next 20 years.

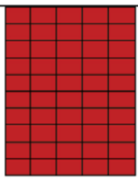
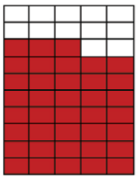
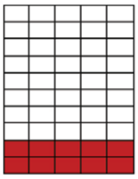
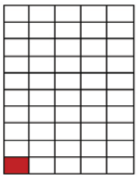
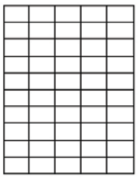
It takes a long time for species and ecological communities to recover so we consider how their risk of extinction might change in the next 20 years. It is also important to note that even to maintain the current risk level of species for the next 20 years requires some conservation effort.

In the next section, we describe the different levels of extinction risk that we will be using in the survey.

1. Levels of Extinction risk

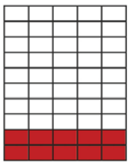
We consider 5 levels of extinction risk in this survey. We provide a description of each risk level and a visual representation of risk.

In each grid there are 50 squares, each square represents a species, and a red colour represents a species expected to be extinct in 20 years.

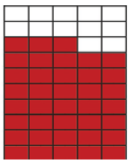
E	**Extinct**		There is a 100% chance of extinction in the next 20 years.
VH	**Very high risk**		There is a 75% chance of extinction in the next 20 years.
H	**High risk**		There is a 20% chance of extinction in the next 20 years
M	**Moderate risk**		There is a 2% chance of extinction in the next 20 years.
L	**Low risk**		Virtually no chance of extinction in the next 20 years.

Q6. Which of these two species have the higher risk of extinction?

❑ Species A



❑ Species B

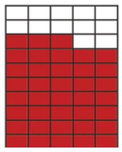
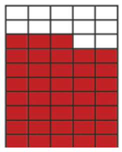
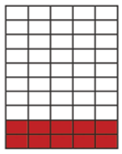


2. List of Species

In this survey, we will be considering **6 different animals, one plant and one ecological community**.

The table below provides information on the current level of extinction risk and geographical range of species considered in this survey.

For example, with current funding levels, the Orange-bellied Parrot, which breeds in Tasmania, is in the Very high-risk category for being extinct in 20 years.

Species name		Found in	Expected level of extinction risk in 20 years with on additional funding
Eastern Bristlebird		New South Wales	Very high (VH) 
Orange-bellied Parrot		South-east Australia including Tasmania	Extinct (E) 
Murray Cod		South Australia, Victoria, New South Wales, Australian Capital Territory and Queensland	Extinct (E) 
Numbat		Western Australia	Very high (VH) 
Boggomoss Snail		Queensland	Extinct (E) 
Great Desert Skink		South Australia	High (H) 
Banksia vincentia		New South Wales	Extinct (E) 
Clay Pans of the Swan Coastal Plain *(Extinct)*		Western Australia	Extinct (E) 

3. Additional funding for Conservation

We can make a prediction of the risk of extinction if the current level of funding for conservation is maintained. However, if we were to allocate more funding to conservation then we can reduce the risk.

In the survey questions we will be asking whether you would be willing to contribute personal funds for this to happen.

These extra funds would be collected through an additional tax that would be used to create a special "Threatened Species Conservation Fund". This fund would be used solely for conserving threatened species and ecological communities. However, it is not always possible to allocate enough funds to protect all species.

4. Your Choices

We are going to ask a number of questions on which species to protect from Extinction.

Before continuing, it is also important to take note of the following instructions:

Please try to consider each question independently of each other.

When you are making choices, it is important to keep in mind your financial situation,

i.e. consider much you can realistically afford to pay each year, given your household income and expenses.

Please consider your answers carefully. We value your feedback greatly and the results of this study will be made available to relevant agencies.

In the next section, we are presenting an example of a choice question

Example 1: Improvement in protection of 5 species (out of 8)

		Expected level of species *extinction risk* in 20 years		
		With current level of protection	Plan1 : additional protection	Plan2 : additional protection
Eastern Bristlebird		E **VH** H M L	E VH H M **L**	E VH H M **L**
Orange-bellied Parrot		E VH H M L	E VH H M L	E VH H M L
Murray Cod		**E** VH H M L	E **VH** H M L	E VH H **M** L
Numbat		E **VH** H M L	E VH H **M** L	E VH H M **L**
Boggomoss Snail		E VH H M L	E VH H M L	E VH H M L
Great Desert Skink		E VH **H** M L	E VH H **M** L	E VH H **M** L
Banksia vincentia		E VH H M L	E VH H M L	E VH H M L
Clay Pans of the Swan Coastal Plain		**E** VH H M L	E **VH** H M L	E VH H **M** L
Cost to your household per year in next 20 years		$0	$150	$250

In this example, only five species were identified to provide additional protection.

The second column shows expected levels of extinction risk in 20 years under current level of protection. The extinction risk levels are presented from extinct to low risk. The relevant level for each of the 5 species or community that are considered are coloured in RED.

The third and fourth columns show the expected levels of extinction risk if we implement additional programs (plan 1 or plan 2) to protect the species and ecological communities. The relevant risk level for each species or ecological community is coloured in GREEN.

You need to consider the species being protected, the change in risk levels and relevant cost (last row) when making your choices.

1. Consider the following three choice options assuming that you have only these three options. Which option will you choose?

Please bear in mind your financial situation when making a choice.

	Expected level of species extinction risk in 20 years		
	With current protection	Plan 1: additional protection	Plan 2: additional protection
Eastern Bristlebird	VH	H	H
Orange-bellied Parrot	E	E	E
Murray Cod	E	M	M
Numbat	VH	VH	VH
Boggomoss Snail	E	VH	L
Great Desert Skink	H	L	L
Banksia vincentia	E	E	E
Clay Pans of the Swan Coastal Plain	E	VH	M
Cost to your household per year in next 20 years	$0	$75	$75

E	VH	H	M	L
Extinct	*Very high* risk of extinction	*High* risk of extinction	*Moderate* risk of extinction	*Low* risk of extinction

2. Consider the following three choice options assuming that you have only these three options. Which option will you choose?

Please bear in mind your financial situation when making a choice.

Please answer this question independent of your answers to previous question.

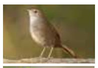
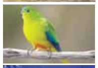
	Expected level of species extinction risk in 20 years		
	With current protection	Plan 1: additional protection	Plan 2: additional protection
Eastern Bristlebird	VH	M	L
Orange-bellied Parrot	E	E	E
Murray Cod	E	M	L
Numbat	VH	VH	VH
Boggomoss Snail	E	VH	L
Great Desert Skink	H	L	L
Banksia vincentia	E	E	E
Clay Pans of the Swan Coastal Plain	E	M	H
Cost to your household per year in next 20 years	$0	$75	$75

E	VH	H	M	L
Extinct	*Very high* risk of extinction	*High* risk of extinction	*Moderate* risk of extinction	*Low* risk of extinction

3. Consider the following three choice options assuming that you have only these three options. Which option will you choose?

Please bear in mind your financial situation when making a choice.

Please answer this question independent of your answers to previous question.

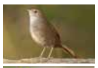
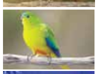
	Expected level of species extinction risk in 20 years		
	With current protection	Plan 1: additional protection	Plan 2: additional protection
Eastern Bristlebird 	VH	L	M
Orange-bellied Parrot 	E	E	E
Murray Cod 	E	VH	M
Numbat 	VH	VH	VH
Boggomoss Snail 	E	E	E
Great Desert Skink 	H	L	L
Banksia vincentia 	E	VH	VH
Clay Pans of the Swan Coastal Plain 	E	H	H
Cost to your household per year in next 20 years	$0	$75	$375

E	VH	H	M	L
Extinct	*Very high* risk of extinction	*High* risk of extinction	*Moderate* risk of extinction	*Low* risk of extinction

4. Consider the following three choice options assuming that you have only these three options. Which option will you choose?

Please bear in mind your financial situation when making a choice.

Please answer this question independent of your answers to previous question.

	Expected level of species extinction risk in 20 years		
	With current protection	Plan 1: additional protection	Plan 2: additional protection
Eastern Bristlebird 	VH	VH	VH
Orange-bellied Parrot 	E	M	L
Murray Cod 	E	E	E
Numbat 	VH	VH	VH
Boggomoss Snail 	E	VH	L
Great Desert Skink 	H	L	L
Banksia vincentia 	E	H	L
Clay Pans of the Swan Coastal Plain 	E	H	L
Cost to your household per year in next 20 years	$0	$150	$150

E	VH	H	M	L
Extinct	*Very high* risk of extinction	*High* risk of extinction	*Moderate* risk of extinction	*Low* risk of extinction

Example 2: Improvement in protection of 3 species (out of 8)

Expected level of species extinction risk in 20 years

		Expected level of species *extinction risk* in 20 years	
	With current level of protection	Plan1 : additional protection	Plan2 : additional protection
Eastern Bristlebird 	E **VH** H M L	E VH H M **L**	E VH H M **L**
Orange-bellied Parrot 	**E** VH H M L	**E** VH H M L	**E** VH H M L
Murray Cod 	**E** VH H M L	**E** VH H M L	**E** VH H M L
Numbat 	E **VH** H M L	E **VH** H M L	E **VH** H M L
Boggomoss Snail 	**E** VH H M L	**E** VH H M L	**E** VH H M L
Great Desert Skink 	E VH **H** M L	E VH H **M** L	E VH H **M** L
Banksia vincentia 	**E** VH H M L	**E** VH H M L	**E** VH H M L
Clay Pans of the Swan Coastal Plain 	**E** VH H M L	E **VH** H M L	E VH H **M** L
Cost to your household per year in next 20 years	$0	$150	$250

In this example, only three species were identified to provide additional protection.

The second column shows expected levels of extinction risk in 20 years under current level of protection. The extinction risk levels are presented from extinct to low risk. The relevant level for each of the 3 species or community that are considered are coloured in RED

The third and fourth columns show the expected levels of extinction risk if we implement additional programs (plan 1 or plan 2) to protect the species and ecological communities. The relevant risk level for each species or ecological community is coloured in GREEN.

You need to consider the species being protected, the change in risk levels and relevant cost (last row) when making your choices.

5. Consider the following three choice options assuming that you have only these three options. Which option will you choose?

Please bear in mind your financial situation when making a choice.

Please answer this question independent of your answers to previous question.

	Expected level of species extinction risk in 20 years		
	With current protection	Plan 1: additional protection	Plan 2: additional protection
Eastern Bristlebird	VH	L	M
Orange-bellied Parrot	E	E	E
Murray Cod	E	E	E
Numbat	VH	L	H
Boggomoss Snail	E	E	E
Great Desert Skink	H	M	L
Banksia vincentia	E	E	E
Clay Pans of the Swan Coastal Plain	E	E	E
Cost to your household per year in next 20 years	$0	$150	$150

E	VH	H	M	L
Extinct	***Very high*** *risk of extinction*	***High*** *risk of extinction*	***Moderate*** *risk of extinction*	***Low*** *risk of extinction*

6. Consider the following three choice options assuming that you have only these three options. Which option will you choose?

Please bear in mind your financial situation when making a choice.

Please answer this question independent of your answers to previous question.

	Expected level of species extinction risk in 20 years		
	With current protection	Plan 1: additional protection	Plan 2: additional protection
Eastern Bristlebird	VH	VH	VH
Orange-bellied Parrot	E	E	E
Murray Cod	E	E	E
Numbat	VH	L	H
Boggomoss Snail	E	E	E
Great Desert Skink	H	L	L
Banksia vincentia	E	VH	L
Clay Pans of the Swan Coastal Plain	E	E	E
Cost to your household per year in next 20 years	$0	$225	$300

E	VH	H	M	L
Extinct	***Very high*** *risk of extinction*	***High*** *risk of extinction*	***Moderate*** *risk of extinction*	***Low*** *risk of extinction*

7. Consider the following three choice options assuming that you have only these three options. Which option will you choose?

Please bear in mind your financial situation when making a choice.

Please answer this question independent of your answers to previous question.

	Expected level of species extinction risk in 20 years		
	With current protection	**Plan 1: additional protection**	**Plan 2: additional protection**
Eastern Bristlebird	VH	VH	VH
Orange-bellied Parrot	E	E	E
Murray Cod	E	E	E
Numbat	VH	VH	VH
Boggomoss Snail	E	VH	L
Great Desert Skink	H	L	L
Banksia vincentia	E	E	E
Clay Pans of the Swan Coastal Plain	E	M	M
Cost to your household per year in next 20 years	$0	$150	$300

E	VH	H	M	L
Extinct	*Very high* risk of extinction	*High* risk of extinction	*Moderate* risk of extinction	*Low* risk of extinction

8. Consider the following three choice options assuming that you have only these three options. Which option will you choose?

Please bear in mind your financial situation when making a choice.

Please answer this question independent of your answers to previous question.

	Expected level of species extinction risk in 20 years		
	With current protection	**Plan 1: additional protection**	**Plan 2: additional protection**
Eastern Bristlebird	VH	VH	VH
Orange-bellied Parrot	E	L	L
Murray Cod	E	E	E
Numbat	VH	M	M
Boggomoss Snail	E	E	E
Great Desert Skink	H	H	H
Banksia vincentia	E	E	E
Clay Pans of the Swan Coastal Plain	E	L	L
Cost to your household per year in next 20 years	$0	$225	$225

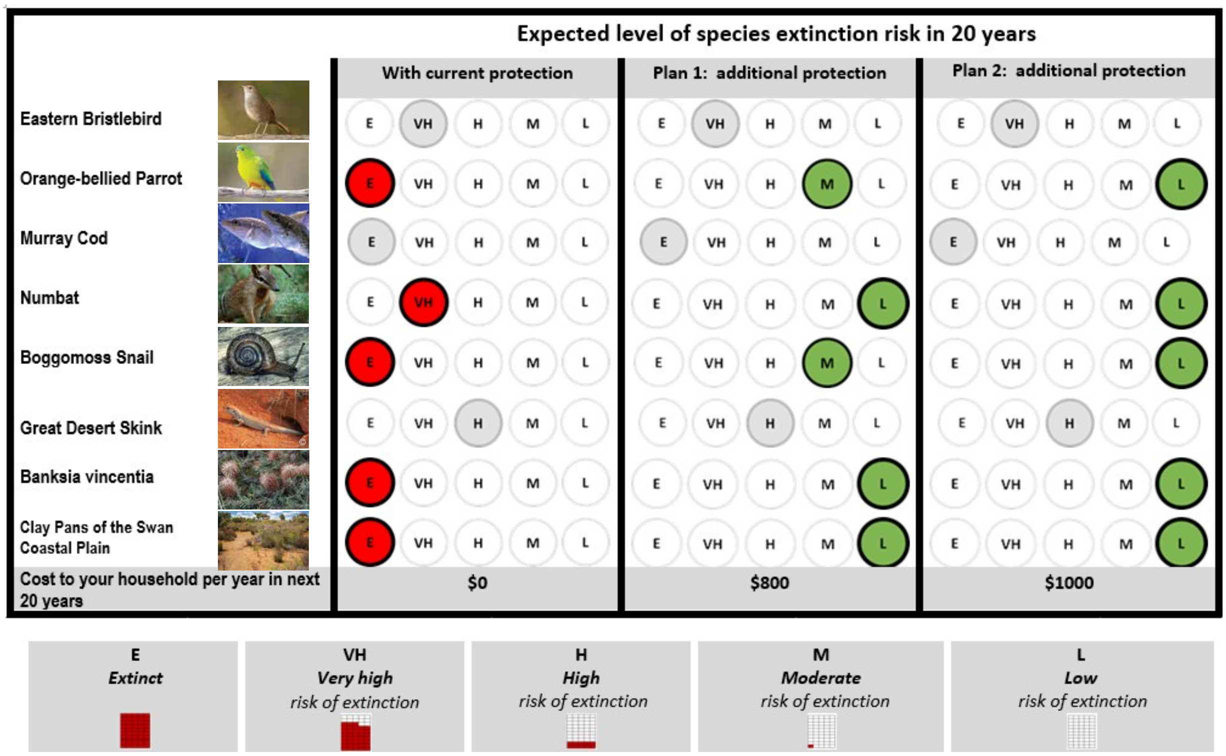
E	VH	H	M	L
Extinct	*Very high* risk of extinction	*High* risk of extinction	*Moderate* risk of extinction	*Low* risk of extinction

This question was asked form the respondents who selected zero cost option (no additional protection) for all 8 choice questions

9. Consider the following three choice options assuming that you have only these three options. Which option will you choose?

Please bear in mind your financial situation when making a choice.

Please answer this question independent of your answers to previous question.



	Expected level of species extinction risk in 20 years		
	With current protection	Plan 1: additional protection	Plan 2: additional protection
Eastern Bristlebird	VH	VH	VH
Orange-bellied Parrot	E	M	L
Murray Cod	E	E	E
Numbat	VH	L	L
Boggomoss Snail	E	M	L
Great Desert Skink	H	H	H
Banksia vincentia	E	L	L
Clay Pans of the Swan Coastal Plain	E	L	L
Cost to your household per year in next 20 years	$0	$800	$1000

E	VH	H	M	L
Extinct	*Very high* risk of extinction	*High* risk of extinction	*Moderate* risk of extinction	*Low* risk of extinction

This question was asked from the respondents who selected zero cost option (no additional protection) for all 8 choice questions

Q7. Tick the reason if you always selected zero cost option (no additional protection) for all the choices (Tick all that apply)

❑ I preferred this option to all others

❑ I could not afford the other options

❑ I believe funding to manage endangered species should come from somewhere other than my own pocket

❑ I believe funding to manage endangered species should be collected by some other means than a State tax

❑ I don't trust that the funds would be used to manage endangered species

❑ I do not believe that there will any impacts on the extinction of species during this period

❑ I do not believe I should have to make these choices

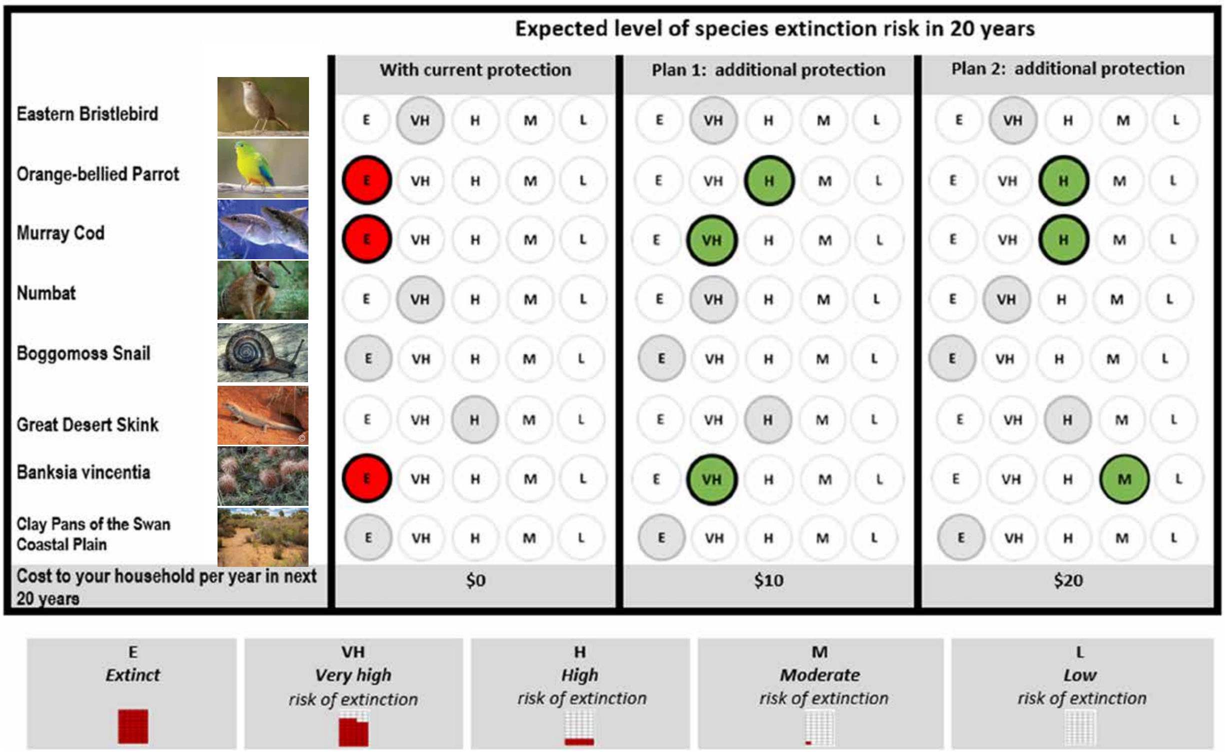
❑ Other

This question was asked from the respondents who always selected plan1 or plan 2 (additional protection) for all 8 choice questions

9. Consider the following three choice options assuming that you have only these three options. Which option will you choose?

Please bear in mind your financial situation when making a choice.

Please answer this question independent of your answers to previous question.



This question was asked from the respondents who always selected plan1 or plan 2 (additional protection) for all 8 choice questions

Q8. Tick the reason/reasons if you always selected the option with additional protection for all the choices

- ❏ I preferred these options to all others
- ❏ I was happy to make the payment asked, given the protection that was offered
- ❏ I ignored the cost of the option
- ❏ I believe you should protect all species irrespective of any cost
- ❏ I did not think I would ever be asked to make the payments
- ❏ Other

Q9. To what extent did you understand the questions in the previous section? Please select one answer

- ❏ Fully understood
- ❏ Partially understood
- ❏ Did not understand the questions at all

Q10. If this program of species protection was implemented, how certain are you that you would actually be asked to pay annual additional tax to fund it?

❑ Very certain

❑ Certain

❑ Uncertain

❑ Very uncertain

Q11. Did you consider all 3 features (Cost, Species, Extinction risk) when you answered the choice questions?

❑ Yes

❑ No

Q12. If no, please indicate the features that you ignored in answering choice questions (Tick all that apply)

❑ Costs (the additional annual tax)

❑ Which species to be protected

❑ Level of improvement in protection (level of extinction risk)

❑ All of them

Q13. Number of people living in your household

❑ Adults	
❑ Children <5 years	
❑ Children >5 years and <18 years	

Q14. Do you identify yourself as one of the following group?

❑ Aboriginal African Anglo-Saxon

❑ Asian / Asian American Australian

❑ Mixed descent (e.g. White & Asian, White & Black) North African and Middle Eastern

❑ North American

❑ North East Asian (e.g. Chinese, Japanese, Korean)

❑ North and West European (e.g. United Kingdom, France, Germany, Norway, Sweden) Pacific Islander

❑ South American

❑ South and East European (e.g. Spain, Italy, Greece, Hungary, Romania, Ukraine) Southern and Central Asian (e.g. Indian)

❑ South East Asian (e.g. Vietnamese, Filipino, Indonesian) Torres Strait Islander/ Indigenous Australian

❑ Other Oceanian

❑ Prefer not to answer

❑ Others, please specify

Q15. Please indicate your current annual household income (i.e. before tax and including all people living in your household)

❏ Negative income Nil income

❏ $1- $7,799 per year

❏ $7,800 - $15,599 per year

❏ $15,600 - $20,799 per year

❏ $20,800 - $25,999 per year

❏ $26,000 - $33,799 per year

❏ $33,800 - $41,599 per year

❏ $41,600 - $51,999 per year

❏ $52,000 - $64,999 per year

❏ $65,000 - $77,999 per year

❏ $78,000 - $90,999 per year

❏ $91,000 - $103,999 per year

❏ $104,000 - $155,999 per year

❏ $156,000 or more per year

Q16. What is your current employment status?

❏ Employed full time (35 or more hours per week)

❏ Employed part time (less than 35 hours per week) /causal? Unemployed and currently looking for work

❏ Unemployed and not currently looking for work Student

❏ Retired

❏ Homemaker (manages a home and family) Self-employed

❏ Unable to work

Q17. Did your household pay any taxes last year?

❏ Yes

❏ No

Q18. Do you actively support (financial donations or volunteering your time) any environmental groups or organizations associated with conservation of Australian threatened animals or plants?

❏ Yes

❏ No

Q19. Are you currently engaged or have you ever been engaged work related to species conservation

❏ Yes

❏ No

Thank you! Your support of this research is much appreciated.

If you have any comments about the survey or about the conservation of threatened animals

Annex – D: Descriptive Statistics

	Sample 1		Sample 2		Sample 3	
Could you please indicate your age group?	Freq. *(n=811)*	Percent	Freq. *(n=983)*	Percent	Freq. *(n=889)*	Percent
18-24 years	61	7.52	60	6.10	67	7.54
25-34 years	151	18.62	141	14.34	165	18.56
35-44 years	127	15.66	133	13.53	135	15.19
45-54 years	133	16.40	169	17.19	156	17.55
55-64 years	172	21.21	291	29.60	180	20.25
>64 years	167	20.59	189	19.23	186	20.92

Please select which State you live in	Freq. *(n=810)*	Percent	Freq. *(n=981)*	Percent	Freq. *(n=889)*	Percent
NSW	255	31.48	330	33.64	273	30.71
Queensland	164	20.25	165	16.82	191	21.48
South Australia	62	7.65	64	6.52	69	7.76
Tasmania	16	1.98	20	2.04	18	2.02
Victoria	205	25.31	283	28.85	227	25.53
Northern Territory	5	0.62	2	0.20	6	0.67
ACT	14	1.73	7	0.71	15	1.69
Western Australia	89	10.99	110	11.21	90	10.12

What is your gender? Please select one answer	Freq. *(n=811)*	Percent	Freq. *(n=983)*	Percent	Freq. *(n=889)*	Percent
Male	437	53.88	459	46.69	459	51.63
Female	370	45.62	523	53.20	430	48.37
Other (please specify)	4	0.49	1	0.10		

State the highest level of education you have completed so far	Freq. *(n=811)*	Percent	Freq. *(n=983)*	Percent	Freq. *(n=889)*	Percent
Year 11 or below	108	13.32	112	11.39	107	12.04
Year 12	124	15.29	145	14.75	131	14.74
Certificate III/IV	151	18.62	178	18.11	144	16.20
Advanced Diploma and Diploma	131	16.15	186	18.92	134	15.07
University Undergraduate/Bachelor Degree	191	23.55	232	23.60	237	26.66
Post Graduate (Diploma/Masters/ PhD)	106	13.07	130	13.22	136	15.30

Can you name any animal or plant that have become extinct in Australia?	Freq. *(n=810)*	Percent	Freq. *(n=983)*	Percent	Freq. *(n=888)*	Percent
Yes (please mention)	522	64.44	606	61.65	597	67.23
No	288	35.56	377	38.35	291	32.77

To what extent did you understand the questions in the previous section?	Freq. *(n=810)*	Percent	Freq. *(n=983)*	Percent	Freq. *(n=888)*	Percent
Fully understood the questions	588	72.59	704	71.62	666	75.00
Partially understood the questions	203	25.06	255	25.94	205	23.09
Did not understand the questions at all	19	2.35	24	2.44	17	1.91

	Sample 1		Sample 2		Sample 3	
If this program of species protection was implemented, how certain are you that	**Freq. *(n=810)***	**Percent**	**Freq. *(n=983)***	**Percent**	**Freq. *(n=888)***	**Percent**
Very certain	130	16.05	144	14.65	135	15.20
Certain	271	33.46	371	37.74	366	41.22
Uncertain	356	43.95	395	40.18	325	36.60
Very uncertain	53	6.54	73	7.43	62	6.98

Did you consider all 3 features (Cost, Species, Extinction risk)	Freq. *(n=808)*	Percent	Freq. *(n=983)*	Percent	Freq. *(n=888)*	Percent
Yes	686	84.90	834	84.84	827	93.13
No	122	15.10	149	15.16	61	6.87

If no, please indicate the features that you ignored in answering choice question	Freq. *(n=811)*	Percent	Freq. *(n=983)*	Percent	Freq. *(n=888)*	Percent
Costs (the additional annual tax)	108	13.32	286	29.09	27	3.04
Which species to be protected	122	15.04	249	25.33	27	3.04
Level of improvement in protection (level of extinction risk)	84	10.36	87	8.85	15	1.68

Tick the reason if you always selected zero cost option (no additional protection)	Freq. *(n=811)*	Percent	Freq. *(n=983)*	Percent	Freq. *(n=888)*	Percent
I preferred this option to all others	30	3.70	18	1.83	12	1.35
I could not afford an additional tax	77	9.49	89	9.05	38	4.28
I believe funding to manage species should be collected by some other means than a State tax	40	4.93	34	3.46	22	2.48
I don't trust that the funds would be used to manage endangered species	50	6.17	47	4.78	26	2.93
I don't believe that there will any impacts on the extinc-tion of species during this period	27	3.33	12	1.22	10	1.13
I don't believe I should have to make these choices	30	3.70	18	1.83	16	1.80

Number of people living in your household - Adults	Freq. *(n=810)*	Percent	Freq. *(n=843)*	Percent	Freq. *(n=888)*	Percent
1	175	21.60	153	18.15	198	22.30
2	437	53.95	502	59.55	490	55.18
3	119	14.69	124	14.71	113	12.73
4	62	7.65	48	5.69	53	5.97
5	12	1.48	12	1.42	24	2.70
6	3	0.37	2	0.24	6	0.68
7	1	0.12	1	0.12	1	0.11
8	1	0.12	1	0.12	1	0.11

Number of people living in your household - Children <5 years	Freq. *(n=810)*	Percent	Freq. *(n=843)*	Percent	Freq. *(n=888)*	Percent
0	726	89.63	763	90.51	802	90.32
1	65	8.02	62	7.35	64	7.21
2	17	2.10	16	1.90	22	2.48
3	2	0.25	2	0.24		

	Sample 1		Sample 2		Sample 3	
Number of people living in your household - Children >5 years and <18 years	Freq. *(n=810)*	Percent	Freq. *(n=843)*	Percent	Freq. *(n=888)*	Percent
0	611	75.43	658	78.05	685	77.14
1	110	13.58	93	11.03	104	11.71
2	63	7.78	71	8.42	79	8.90
3	21	2.59	18	2.14	15	1.69
4	5	0.62	2	0.24	4	0.45
5			1	0.12	1	0.11

Did your household pay any taxes last year?	Freq. *(n=807)*	Percent	Freq. *(n=833)*	Percent	Freq. *(n=882)*	Percent
Yes	623	77.20	607	72.87	692	78.46
No	184	22.80	226	27.13	190	21.54

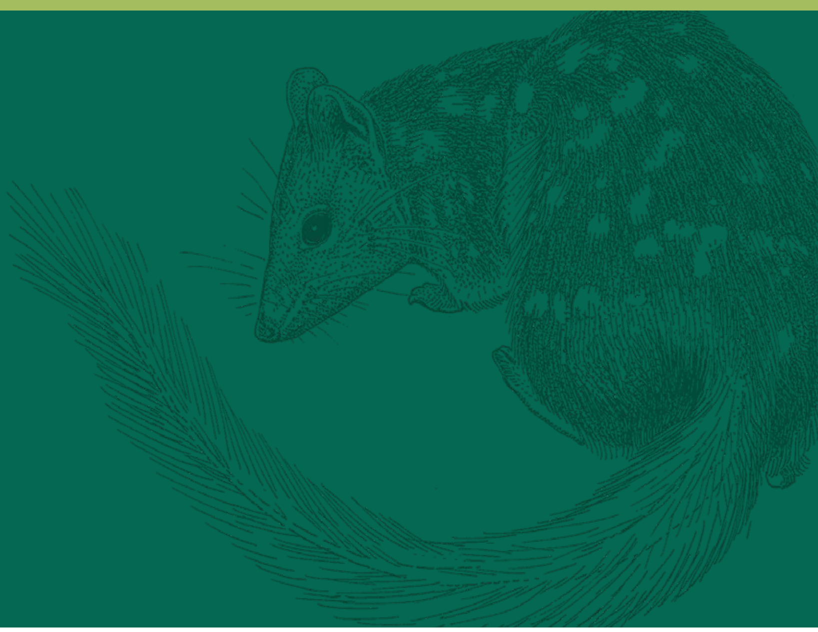
Please indicate your current annual household income	Freq. *(n=809)*	Percent	Freq. *(n=842)*	Percent	Freq. *(n=886)*	Percent
Negative income	7	0.87	4	0.48	6	0.68
Nil income	24	2.97	29	3.44	21	2.37
$1- $7,799 per year	15	1.85	15	1.78	15	1.69
$7,800 - $15,599 per year	20	2.47	23	2.73	16	1.81
$15,600 - $20,799 per year	24	2.97	30	3.56	30	3.39
$20,800 - $25,999 per year	42	5.19	42	4.99	51	5.76
$26,000 - $33,799 per year	54	6.67	43	5.11	55	6.21
$33,800 - $41,599 per year	53	6.55	71	8.43	67	7.56
$41,600 - $51,999 per year	76	9.39	81	9.62	66	7.45
$52,000 - $64,999 per year	84	10.38	82	9.74	83	9.37
$65,000 - $77,999 per year	62	7.66	69	8.19	75	8.47
$78,000 - $90,999 per year	71	8.78	70	8.31	79	8.92
$91,000 - $103,999 per year	70	8.65	73	8.67	84	9.48
$104,000 - $155,999 per year	132	16.32	124	14.73	142	16.03
$156,000 or more per year	75	9.27	86	10.21	96	10.84

Do you actively support(financial donations or volunteering your time) any environmental groups or organizations associated with conservation of Australian threatened animal or plants	Freq. *(n=810)*	Percent	Freq. *(n=842)*	Percent	Freq. *(n=888)*	Percent
Yes	187	23.09	166	19.71	251	28.27
No	623	76.91	676	80.29	637	71.73

Are you currently engaged or have you ever been engaged work related to species	Freq. *(n=810)*	Percent	Freq. *(n=842)*	Percent	Freq. *(n=888)*	Percent
Yes	76	9.38	69	8.19	100	11.26
No	734	90.62	773	91.81	788	88.74

	Sample 1		Sample 2		Sample 3	
Do you identify yourself as one of the following group - Selected Choice	Freq. *(n=809)*	Percent	Freq. *(n=843)*	Percent	Freq. *(n=887)*	Percent
Aboriginal	14	1.73	7	0.83	13	1.47
Others, please specify	6	0.74	9	1.07	8	0.90
African	3	0.37	2	0.24	2	0.23
Anglo-Saxon	110	13.60	110	13.05	105	11.84
Asian / Asian American	33	4.08	29	3.44	38	4.28
Australian	494	61.06	546	64.77	559	63.02
Mixed descent (e.g. White & Asian, White & Black)	2	0.25	7	0.83	8	0.90
North African and Middle Eastern	2	0.25	2	0.24	4	0.45
North American	5	0.62	3	0.36	11	1.24
North East Asian (e.g. Chinese, Japanese, Korean)	11	1.36	10	1.19	13	1.47
North and West European (e.g. United Kingdom, France, Germany, Norway, Sweden)	32	3.96	32	3.80	30	3.38
Pacific Islander	3	0.37	2	0.24	5	0.56
South American	3	0.37	1	0.12	1	0.11
South and East European (e.g. Spain, Italy, Greece, Hungary, Romania, Ukraine)	33	4.08	26	3.08	26	2.93
Southern and Central Asian (e.g. Indian)	23	2.84	18	2.14	23	2.59
Torres Strait Islander/ Indigenous Australian					19	2.14
South East Asian (e.g. Vietnamese, Filipino, Indonesian)	25	3.09	15	1.78	2	0.23
Other Oceanian	5	0.62	1	0.12	6	0.68
Prefer not to answer	5	0.62	8	0.95	14	1.58

What is your current employment status?	Freq. *(n=800)*	Percent	Freq. *(n=829)*	Percent	Freq. *(n=887)*	Percent
Employed full time (35 or more hours per week)	259	32.38	271	32.69	297	33.67
Employed part time (less than 35 hours per week) /causal?	141	17.63	144	17.37	167	18.93
Unemployed and currently looking for work	40	5.00	43	5.19	42	4.76
Unemployed and not currently looking for work	8	1.00	8	0.97	10	1.13
Student	32	4.00	35	4.22	28	3.17
Retired	180	22.50	204	24.61	195	22.11
Homemaker (manages a home and family)	65	8.13	62	7.48	64	7.26
Self-employed	39	4.88	36	4.34	47	5.33
Unable to work	36	4.50	26	3.14	32	3.63



Further information:

http://www.nespthreatenedspecies.edu.au

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Threatened Species Recovery Hub

National Environmental Science Programme