Social preferences for adaptation measures to conserve Australian birds threatened by climate change

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SUPPLEMENTARY MATERIAL 1 The choice experiment setting

Introductory text for respondents

In the following eight pages you will be asked to choose between options for treating four Australian bird species should climate change start to affect them. We assume funds will be limited so trade-offs may be needed. We then ask some follow-up questions about attitudes and about yourself.

Each choice page has three options. One option is to leave the birds to cope as best they can, with extinction quite likely. This option costs nothing. The other two options involve at least some active management of the birds. This would require additional investment, either by the Government or by private donors.

The three management alternatives are more-or-less feasible with current levels of knowledge and technology:

(1) Help the birds survive in their natural habitat despite the changed climate by providing extra shelter, food, water, etc.
(2) Move them from their usual habitat to an alternative location that is expected to develop a more suitable climate. For the examples below, only Tasmania is expected to be suitable.
(3) Establish captive populations in zoos, where they will need to be kept indefinitely.

We use real bird examples based on current models of climate change. We have deliberately chosen fairly ordinary brown birds as we would like you to make your choice based on the type of management you favour, and not be too swayed by the attractiveness of the bird.

Description of case study birds

Rufous scrub-bird: These small reddish-brown birds from the dense forests of south-east Queensland and north-east New South Wales are highly secretive but their loud calls ring around the mountains where they live. These forests are predicted to become hotter and drier over the next 50 years, which will make it hard for scrub-birds to survive.

Photo credit: Graeme Chapman

Scrubtit: These tiny brown birds occur only in the wet forests of Tasmania. They feed on small insects and rarely venture out of cover. Unfortunately the Tasmanian climate is predicted to become much less suitable for them over the next half century, and nowhere else in Australia is likely to be any better. They can be helped to survive only in their natural habitat or kept in a zoo.

Photo credit: Allan Richardson

Brown thornbill: These little brown birds live in flocks eating insects in the forests and woodlands of both south-east Australia and Tasmania.

Mainland form: This bird is likely to face the same problems as the rufous scrub-bird as the climate changes. The pure form can be helped to survive only in its natural habitat or in a zoo. If moved to Tasmania it would interbreed with the Tasmanian form of brown thornbill. The species might survive but the pure form of mainland brown thornbill would be lost.

Photo credit: Graeme Chapman

Tasmanian form: The Tasmanian form of brown thornbill is like the scrubtit in that the climate it currently enjoys is predicted to change, with nothing quite like it developing elsewhere. It can be helped to survive only in its natural habitat or in a zoo.

Photo credit: Graeme Chapman

SUPPLEMENTARY MATERIAL 2 Questions supplementary to the choice model

Q1. How did you make your choices? (Tick one)

(1) I considered all aspects (type of bird, type of management, price) simultaneously.
(2) I considered a few aspects simultaneously.
(3) I considered only one aspect.
(4) I used my intuition.
(5) I made a random choice.
(6) I always chose the first (left-hand side) option.
(7) I don't know.

Q2. In making your choices, how important were the various birds to you?

	Very important	Important	Rather unimportant	Not important at all
Rufous scrub-bird				
Scrubtit				
Brown thornbill—mainland form				
Brown thornbill—Tasmanian form				

Q3. Only answer if you chose the 'no special treatment' option in ALL choice tasks. What was the most important reason for always choosing 'no special treatment'? (Tick one or leave blank if not applicable)

(1) I do not believe that climate change causes decline in bird species.
(2) I think no money should be spent on conserving birds in general.
(3) I could not understand the choice questions.
(4) I think that the money will not be used as specified.
(5) I felt that I did not know enough about the mentioned birds to make these choices.

Q4. How acceptable/unacceptable do you think the following approaches to protecting threatened birds are?

	Totally acceptable	Acceptable	Unacceptable	Totally unacceptable
Protect them in a zoo				
Protect them in the wild				
Moving them somewhere else; e.g. Tasmania				

Q5. Who should have the most say in decisions about what to do for birds affected by climate change? (Tick one)

(1) Conservation scientists
(2) Local people where the birds are living
(3) General public

Q6. How strongly do you agree/disagree with these statements?

	Strongly agree	Agree	Disagree	Strongly disagree
When humans interfere with nature it often produces disastrous consequences.				
Humans have the right to modify the natural environment to suit their needs.				
Plants and animals have as much right as humans to exist.				
The Earth is like a spaceship with very limited room and resources.				
Human ingenuity will ensure that we do not make the Earth unliveable.				
Humans will eventually learn enough about how nature works to be able to control it.				

Q7. When you see an unfamiliar bird do you: (Tick one)

(1) take no notice?
(2) enjoy watching it?
(3) try to identify it?
(4) add it to a list?

Q8. How would you describe your knowledge of birds? (Tick one)

(1) I can hardly identify or name any.
(2) I can identify and name common Australian birds.
(3) I can identify and name most birds occurring in Australia.
(4) I can identify and name all Australian birds, including vagrants.

Q9. Thinking about the causes of climate change, which of the following best describes your opinion? (Tick one)

(1) Climate change is mainly caused by natural processes.
(2) Climate change is mainly caused by human activity.
(3) Climate change is partly caused by natural processes and partly by human activity.
(4) Climate change is a scam and I don't believe it is happening.

Q10. What is your postcode?

Q11. How old are you?

Q12. What is your gender?

(1) Female
(2) Male

Q13. Do you have children?

(1) Yes
(2) No

Q14. What is your highest level of education? (Tick one)

(1) Did not go to school
(2) Year 7 or below
(3) Years 8 or 9
(4) Years 10 or 11
(5) Year 12
(6) Certificate/Diploma
(7) University degree

Q15. Which best describes your current employment situation? (Tick one)

(1) Work full-time
(2) Work part-time
(3) Casual
(4) Don't work at the moment
(5) Retired
(6) Student

Q16. What is your personal gross income per year?

SUPPLEMENTARY MATERIAL 3 Development of the latent class model

Firstly, we determined the number of classes by estimating a sequence of models with an increasing number of classes (Table S1). Based on Bayesian Information Criteria we chose the three-class model, which has the lowest criterion value for the number of classes.

TABLE S1 The number of latent classes identified using Bayesian Information Criteria.

Number of classes	Bayesian Information Criteria
1	9232
2	7367
3	7305
4	7326
5	7364
6	7418
7	7472
8	7521
9	7569
10	7638

All attribute levels were highly significant with positive signs in the conditional logit model with three classes (Table S2). Thus, a choice not to 'leave it to cope' and select one of the other levels positively influenced respondents' choice of an alternative. Respondents in the smallest class (status quo, 21%) identified using the latent class model preferred to leave birds to cope. None of the management actions systematically influenced the choices of respondents assigned to this class. In contrast, respondents likely to be members of the second largest class (wild preferred, 29%) appeared to focus on the management option 'help it to stay where it is'. The option is highly significant for all bird taxa, whereas some of the other options are not statistically significant at the 5% level. Finally, the largest class (no extinction, 50%) included respondents who can be characterized as being keen on protecting all birds against the consequences of climate change. They did not favour any specific adaptation options provided none of the birds are left to cope. All attributes were highly significant but no obvious pattern was apparent.

TABLE S2 Estimations of preferences for alternative adaptation strategies for four Australian bird taxa derived from conditional logit and latent class models.

	Conditional logit		Latent class					
			Status quo		Wild preferred		No extinction	
	Coef.	|Z-value|	Coef.	|Z-value|	Coef.	|Z-value|	Coef.	|Z-value|
Class size (% of 1,119 respondents)	100%		50%		29%		21%	
Constant status quo	0.987	4.64	2.376	2.72	2.352	1.95	−1.238	2.99
Rufous scrub-bird: zoo	0.285	3.12	−0.153	0.38	−0.114	0.24	0.507	3.42
Rufous scrub-bird: wild	0.831	8.15	−0.275	0.62	3.286	4.35	0.648	3.58
Rufous scrub-bird: move	0.650	7.95	0.276	0.77	1.630	3.83	0.723	4.94
Scrubtit: zoo	0.459	5.30	−0.209	0.55	0.791	1.66	0.710	4.62
Scrubtit: wild	0.730	8.76	−0.158	0.41	3.323	4.37	0.537	3.43
Brown thornbill—mainland: zoo	0.303	3.43	−0.152	0.38	0.726	1.68	0.369	2.59
Brown thornbill—mainland: wild	0.797	9.70	0.108	0.29	2.984	4.61	0.534	3.46
Brown thornbill—mainland: move	0.572	5.49	−0.194	0.44	1.500	2.41	0.683	4.05
Brown thornbill—Tasmanian: zoo	0.385	4.89	−0.139	0.41	1.144	2.49	0.503	3.88
Brown thornbill—Tasmanian: wild	0.706	9.50	−0.041	0.12	3.059	4.43	0.693	5.05

Coef. = coefficient

The features of the three classes can be more clearly identified when the results are expressed in terms of the likelihood ratio test (Table S3). For the status quo class, none of the likelihood ratio tests indicated a significant impact of the attributes of their levels on choices. For the 'wild preferred' class there was a strong contrast between options. The management options 'help it stay where it is' had the strongest impact on the choices of respondents assigned to this class regardless of taxon. In the largest, 'no extinction', class the likelihood ratio test values are more similar to each other, supporting the interpretation that respondents assigned to this class did not have clear preferences for management options except that they did not want to leave the birds to cope with climate change without assistance. Results from bootstrapping (500 repetitions) showed that the confidence intervals for the likelihood ratio statistic were strongly overlapping in the class 'no extinction', whereas in the class 'wild preferred' the confidence levels strongly suggested that the conservation option 'help it stay where it is' had the highest impact on choices in this class. Only the option 'move' for the rufous scrub-bird was statistically inseparable. Moreover, the tests indicated that although respondents did not select individual bird taxa they did discriminate among adaptation options.

TABLE S3 Ranking of attribute importance for alternative climate change adaptation strategies for four Australian bird taxa.

	CL	Latent class: status quo		Latent class: wild preferred		Latent class: no extinction	
	LR	LR	95% CI	LR	95% CI	LR	95% CI
Rufous scrub-bird: zoo	9.80	0.18	−2.75–3.11	0.81	−4.43–6.05	21.18	3.37–38.99
Rufous scrub-bird: wild	67.70	0.71	−2.83–4.25	137.15	89.89–184.41	14.85	−0.15–29.86
Rufous scrub-bird: move	64.84	0.65	−4.19–5.48	93.37	58.10–128.64	27.79	7.17–48.40
Scrubtit: zoo	28.29	0.12	−2.74–2.99	0.33	−4.07–4.74	59.34	28.88–89.80
Scrubtit: wild	78.93	0.00	−2.62–2.63	184.98	134.29–235.67	27.77	7.10–48.44
Brown thornbill—mainland: zoo	11.79	0.16	−2.37–2.69	7.13	−3.92–18.17	9.74	−2.96–22.44
Brown thornbill—mainland: wild	97.21	0.20	−3.04–3.43	180.25	130.90–229.60	6.60	−3.86–17.05
Brown thornbill—mainland: move	30.30	0.05	−2.76–2.86	27.04	9.36–44.72	16.37	−0.23–32.97
Brown thornbill—Tasmania: zoo	24.10	0.01	−2.78–2.79	11.87	−0.55–24.29	17.42	0.04–34.79
Brown thornbill—Tasmania: wild	92.72	0.02	−2.98–3.02	162.84	115.75–209.92	37.90	12.43–63.37

CL, conditional logit; LR, score from likelihood ratio test; 95% CI, 95% confidence interval

SUPPLEMENTARY MATERIAL 4 Comparison of results from Tasmania and the mainland

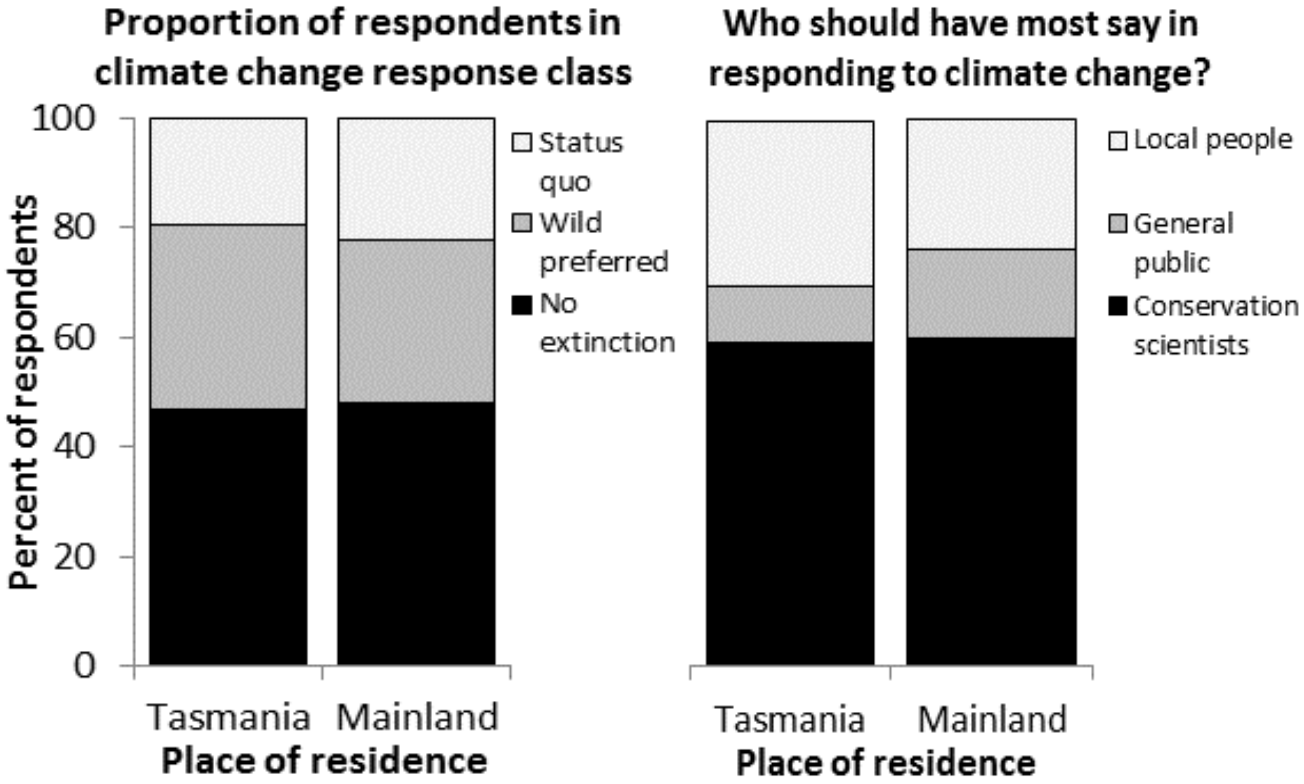

FIG. S1 Comparison of results from the mainland and from Tasmanian for the percentage of respondents in each response class and the percentage of respondents identifying 'Who should have the most say in decisions about what to do for birds affected by climate change?'