This is the peer reviewed author accepted manuscript (post print) version of a published work that appeared in final form in:

Pearson, Elissa L, Mellish, Sarah, McLeod, Emily M, Sanders, Ben, Ryan, Jillian C 2022 'Can we save Australia's endangered wildlife by increasing species recognition?', Journal for Nature Conservation, vol. 69, article no. 126257, pp. 1-12

This output may not exactly replicate the final published authoritative version for which the publisher owns copyright. It is not the copy of record. This output may be used for non-commercial purposes. This version is licensed under a Creative Commons CC-BY-NC-ND 4.0 license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

The final definitive published version (version of record) is available at: https://doi.org/10.1016/j.jnc.2022.126257

Persistent link to the UniSA Research Outputs Repository: https://researchoutputs.unisa.edu.au/11541.2/30437

General Rights

Copyright and moral rights for the publications made accessible in the UniSA Research Outputs Repository are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognize and abide by the legal requirements associated with these rights.

- Users may download and print one copy for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the persistent link identifying the publication in the UniSA Research Outputs Repository

If you believe that this document breaches copyright, please contact us and provide details. We will remove access to the work immediately and investigate your claim.

COMMUNITY SPECIES RECOGNITION AND AUSTRALIAN ENDANGERED WILDLIFE

Can we save Australia's Endangered Wildlife by Increasing Species Recognition?

Elissa L. Pearson*[a]

https://orcid.org/0000-0002-7171-468X

Sarah Mellish[a]

https://orcid.org/0000-0002-0011-9939

Emily M. McLeod[b]

https://orcid.org/0000-0002-1811-6584

Ben Sanders[b]

Jillian C. Ryan[c]

https://orcid.org/0000-0003-0655-3047

[a]Conservation Psychology and Applied Animal Behaviour Research Group, Justice and Society (Discipline of Psychology), Magill Campus, University of South Australia, GPO Box 2471, Australia.

[b]Wildlife Conservation and Science, Zoos Victoria, Elliott Ave, Parkville VIC 3052

[c]School of Medical and Health Sciences, Edith Cowan University, WA, 6027.

*Corresponding author: Dr Elissa Pearson. E-mail: Elissa.Pearson@unisa.edu.au

Declarations of interest: Two authors (E.M.M. and B.S) are employees of Zoos Victoria. Role of funding source: Zoos Victoria provided financial support for the conduct of the research and preparation of the article including proof reading the article.

Acknowledgements: We wish to thank the anonymous reviewers for their feedback and valuable contributions to this manuscript ahead of publication.

Abstract

Australia's species extinction rate is one of the highest in the world. Yet, there is limited evidence regarding people's recognition of, and preferences and support for, Australian endangered wildlife. This paper presents survey responses from 223 Zoos Victoria visitors (response rate: 39.1%) and 90 community members (Victoria, Australia). We examined people's top 10 overall (global) and Australian favourite animals, and conducted an in-depth exploration of recognition of, and preferences and support for, seven Australian endangered species identified as being at risk of extinction within the next decade, including: the leadbeater's possum (*Gymnobelideus leadbeateri*), eastern barred bandicoot (*Perameles gunnii*), helmeted honeyeater (*Lichenostomus melanops cassidix*), southern corroboree frog (*Pseudophryne corroboree*), Lord Howe Island (LHI) stick insect (*Dryococelus australis*), Tasmanian devil (*Sarcophilus harrisii*), and the orange-bellied parrot (*Neophema chrysogaster*). Results indicate that the only Australian animals to feature in the overall top 10 favourite list were the kangaroo (ranked 9th for both sample groups) and koala (ranked 6th and 10th for the community and zoo sample, respectively). The Tasmanian devil had the highest rate of recognition (>86%), in comparison to the remaining six species (1.2-7.3% across both samples). Endangered species were not prominent in the top favourite Australian species. Australian endangered species' likeability ratings typically followed the pattern of mammals being most likeable (Tasmanian devil and leadbeater's possum), followed by birds, frogs, and insects (helmeted honeyeater, southern corroboree frog, and LHI stick insect). Importantly, for most endangered native species featured (4/7 and 6/7; zoo and community, respectively), simply being able to recognise species significantly (p<.05) increased people's willingness to support their conservation. Findings underscore several powerful opportunities for future conservation programs to contribute to Australian endangered species conservation by striving to increase public familiarity with Australian species most at risk of extinction.

Keywords: Australian wildlife; conservation education; threatened species; endangered; biodiversity; endemic

Australia's diverse and endemic species

Australia's geographical isolation has contributed to a rich array of biodiversity, with 87% of terrestrial mammal species endemic, and Australia named as one of only 17 'megadiverse' countries globally (Mittermeier et al., 1997; Woinarski et al., 2015). Yet, paradoxically, Australia's geographical isolation is also a key reason for its vulnerability to the endangerment of native wildlife (McLoughlin, 2001; Short & Smith, 1994). As a result, much of Australia's wildlife has been subject to considerable decline or extinction (Geyle et al., 2018; Woinarski et al., 2015). Woinarski et al. (2015) estimate that over one third of modern global mammal extinctions, occurring since 1500, have been Australian species, describing this loss as an 'extinction calamity' (p. 4533). More broadly, over 1700 Australian species and ecological communities are currently recognised as threatened and at risk of extinction according to the Australian Biodiversity Conservation Strategy 2010-2030 (Natural Resource Management Ministerial Council [NRMMC], 2010). This 'extinction crisis' shows little sign of abating and some have argued that there is little hope for biodiversity on a world scale if such high rates of extinction are condoned within a country such as Australia (Cresswell & Murphy, 2017; Woinarski et al., 2015).

Drivers of Australian wildlife decline and extinction are widespread and complex. They include but are not limited to introduced species and alien predators, fire, habitat loss and fragmentation, over-use of resources, and climate change (Banks et al., 2018; Kearney et al., 2019; Legge et al., 2008; Sands, 2018; Ward et al., 2019). Humans have a critical role to play in changing the outlook for Australia's unique biodiversity- both through behavioural choices that may lessen their personal impacts and through their ability to influence government conservation support (Mascia et al., 2003). Australia's Biodiversity Conservation Strategy and the subsequent Strategy for Nature 2018-2030 emphasise the importance of connecting (or re-connecting) Australians with nature and engaging all Australians in biodiversity conservation, for example, through community conservation campaigns. With millions of visitors each year, modern zoos are well-recognised for the contributions they can make to safeguarding a future for endangered species, both through ex-situ captive breeding programs and by providing opportunities for people to meet, learn about, and connect with/develop a desire to protect these species (Gippoliti & Carpeneto, 1997; Godinez & Fernandes, 2019; Rabb & Saunders, 2005; Robovský, Melichar, & Gippoliti, 2020). Underpinning such approaches is recognition that biodiversity conservation "is as much about people as it is about other species" (Martin-Lopez & Benayas, 2008, p. 625), with

human preferences regarding what species should be conserved likely to be as important for conservation effort and success into the future as biological factors (Gunnthorsdottir, 2001; Knight, 2008; Stokes, 2007).

Global determinants of species preferences and conservation support

Human preferences for species conservation can be helpful for informing conservation organisations and practitioners to target advocacy for new species for conservation campaigns, as well as directly influence an individual's conservation behaviour, and inform conservation policy more broadly (Gunnthorsdottir, 2001; Lundberg et al., 2019). At the individual level, factors such as one's values, knowledge, and beliefs, as well as experiences in natural environments and/or specific encounters with species, provide a foundation for the development of one's attitudes toward other species (Aslin, 1996; Dettmann-Easler & Pease, 1999; Schwartz, 2012). According to the Theory of Planned Behavior (Ajzen, 1991; Fishbein & Ajzen, 2011), which has been widely applied to research exploring the human dimensions of wildlife conservation (e.g. Daigle et al., 2002; López-Mosquera et al., 2014; MacDonald et al., 2015; Miller, 2017), such attitudes, in turn with perceived social norms, and perceptions of an individual's ability to perform a behaviour, directly influence one's behavioural intentions and subsequent behaviour. Other factors recognised to positively influence attitudes toward other species or conservation support include higher levels of education (Bjerke & Østdahl, 2004), pet ownership (Bjerke et al., 2003), and female gender (Schlegel & Rupf, 2010). There are also cultural variations in the ways animals are viewed (Packer et al., 2014), while age can have mixed effects (Bjerke & Østdahl, 2004). Of importance, is that several of these determinants of species preferences and conservation support are not fixed and are amenable to change across time.

In addition to within-person and between-person factors, attitudes toward animals and support for their conservation varies in relation to species characteristics. The public displays clear preferences in favour of some species- and to the detriment of others (Driscoll, 1995; Sitas et al., 2009). These preferences are complex and influenced by a myriad of evolutionary, psychological, and cultural factors (Tisdell et al., 2005). The similarity principle provides one framework for understanding such differences, asserting that humans give more consideration to those who are perceived as similar to themselves than those who are viewed as dissimilar (Plous, 1993). In the context of our relationships with other species,

this generally means that an animal's physical attractiveness (often determined by features such as being cute, cuddly, brightly coloured, strong, or possessing forward-facing eyes), larger body size, phylogenetic similarity to humans, perceived sentience/mental abilities, as well as cultural portrayals and relationships with humans all positively influence attitudes and conservation support (Bjerke & Østdahl, 2004; Knight, 2008; Woods, 2000). Operating alongside the similarity principle, are broader considerations regarding the utility of a given species, shaping whether they are valued intrinsically or in relation to the benefits they provide for humans (Driscoll, 1995). Previous research has demonstrated that species with higher utility values for humans are often rated as less intelligent or loveable (Driscoll, 1995), while Taylor and Signal (2015) have similarly demonstrated that attitudes toward species vary greatly depending on whether these are classified as a 'pet', 'pest' or 'for profit'.

In general terms, mammals often receive more favourable public attitudes and conservation support than birds, reptiles, amphibians, fish and invertebrates (Driscoll, 1995; Gunnthorsdottir, 2001; Plous, 1993). This broadly aligns with taxonomic biases observed regarding scientific knowledge about the earth's biodiversity and also in conservation research, where mammals and birds are particularly over-represented, and insects and amphibians are significantly under-represented (e.g. Clark & May, 2002; Dos Santos et al., 2019; Troudet et al., 2017). Invertebrates tend to receive very little public support, arguably due to human fears and phobias or disgust (Bjerke et al., 1998; Kellert, 1993; Knight, 2008; Tisdell et al., 2005; Woods, 2000). Research considering species preferences has generally supported this hierarchy across both adult and child populations (e.g. Bjerke et al., 1998; Bjerke & Ostdahl, 2004; Knight, 2008; Schlegel & Rupf, 2010). However, there are some notable exceptions in the literature, for example bats received low ratings despite being a mammal (Knight, 2008), butterflies highly rated despite being an invertebrate (Bjerke & Ostdahl, 2004), and wide variability in ratings of birds (Bjerke & Ostdahl, 2004; Schlegel & Rupf, 2010; Woods, 2000). In these instances, it may be that aesthetic appeal is having a larger impact on species preferences than similarity.

Determinants of species preferences and conservation support in Australia

Limited research has focused upon public knowledge about, or attitudes toward, native Australian animals. Recent research examined how often Australian threatened species were 'mentioned' (i.e., tweeted about) on the social media platform Twitter (Kidd et al., 2018). Over half of the species (57%) had fewer than 20 tweets, with mammals and birds receiving the most tweets, while invertebrates and frogs received few tweets. This finding

supports results from previous work which considered community preferences toward 24 researcher-selected Australian mammals, birds and reptiles (Tisdell et al., 2005). This research found the group of mammals received the highest likeability scores on average, followed by birds, and then reptiles- with reptiles being considerably lower. There was also a significant association between likeability and support for species conservation, although the researchers emphasise that even the least popular species received support for their conservation from a majority of the sample. The animals with the highest likeability ratings were the koala, kangaroo, and wombat (Tisdell et al., 2007). These preferences are similar to those reported by Woods (2000), who asked 790 participants residing in or visiting Queensland in an open-ended item to list their favourite animals (domestic or wild). The koala, kangaroo, and dolphin were the most popular native species and the only Australian animals to feature in the 10 favourites. Domestic dogs were the most popular overall, reported as a favourite by 48.2% of the sample.

The literature available indicates possible gaps in community knowledge regarding native Australian wildlife. For example, in a community wildlife survey of 172 Brisbane residents, 74% of the sample lived in areas adjacent to bandicoot habitat but only 41% were aware of this (Fitzgibbon & Jones, 2006). Similarly, research with 200 residents from the state of Queensland, revealed only 27% were familiar with the endangered golden-shouldered parrot and a majority rated their knowledge of this species as poor (Wilson & Tisdell, 2005). This is consistent with research by Wilson and Tisdell (2004), who found a majority of their sample were unable to recognise native species such as the eastern pebble mouse (92.6%), the eclectus parrot (77.5%), the northern bettong (66.2%), or the golden finch (66%). The importance of such knowledge should not be underestimated, as this plays a critical role in shaping attitudes and preferences toward animals, as well as impacting conservation support (Schlegel & Rupf, 2010). As one example, research has demonstrated that an ‘unattractive’ animal (in this instance a bat) may be perceived as more attractive when it is presented as the subject of a conservation appeal (Gunnthorsdottir, 2001). Tisdell and Swarna Nantha (2005) similarly found that the hypothetical allocation of funds for wombats increased (relative to koalas), following an information session that detailed the threats and levels of endangerment for each species. Furthermore, the correlation between International Union for the Conservation of Nature (IUCN) status and allocation of funds for birds and mammals also increased after an educational session (Tisdell et al., 2007). Thus, it seems, individuals often report more positive attitudes or increased conservation support for a species if they are more endangered and if their conservation status is known. Accordingly, endangered species are

likely to be greatly disadvantaged in competing for conservation support and funds when the public is poorly informed about them (Martin-Lopez & Banayas, 2008).

Study purpose

This study seeks to add to the limited body of literature which explores knowledge of and preferences for Australian wildlife, as well as public willingngess to support their conservation. Such understanding is critically important given the dire extent of endangerment and extinction within Australia (Geyle et al., 2018**)** and the urgent need to educate and engage the public with biodiversity conservation (Novacek, 2008) as well as inform conservation-education programs and policies moving forward. This study extends on previous research by combining open-ended items exploring favourite animals, with an in-depth exploration of seven native Australian focal species, selected as being at risk of extinction within the next decade. Specifically, the research explores:

1. What do zoo visitors and community members in Victoria identify as their favourite animals and to what extent do native wildlife feature in these listings?
2. To what extent can visitors to a Victorian zoo and Victorian community members identify/name endangered native wildlife?
3. What are visitors to a Victorian zoo and Victorian community members attitudes toward these species (expressed in terms of likeability) and to what extent are they willing to act to protect these species?
    - It was hypothesised that familiarity with a species (ability to recognise the animal) would be associated with increased conservation support.
4. How willing are Zoos Victoria visitors and Victorian community members to financially support wildlife conservation? ; and if given a choice to allocate hypothetical funds between lesser-known endangered species, more well-known Australian species, and exotic non-native wildlife, what proportion of funds would they allocate to each?

Method

Procedure

This research followed a protocol approved by the University of South Australia Human Research Ethics Committee (ID: 0000034946) and was conducted in accordance with Zoos Victoria research guidelines. Surveys were distributed to visitors prior to entering one of three Zoos Victoria sites (Melbourne Zoo, Werribee Open Range Zoo, or Healesville Sanctuary) during December of 2015. Inclusion criteria included being at least 18 years of age and being fluent in English. Researchers invited visitors to participate in a research project about Australian wildlife, via a survey which would take approximately 10-minutes to complete. Prospective participants were selected at random, using a next-to-pass methodology, where upon completion of recruiting or approaching a previous potential participant, researchers approached the next visitor to cross an imaginary line. Most zoo visitors completed and submitted their survey responses electronically using an iPad and SurveyMonkey software, however, hard copy surveys were available for those who preferred to complete the survey in this format or in case of technological difficulties.

In total, 570 zoo visitors were approached to take part in the research and 223 took part (response rate: 39.1%). A community sample (N = 90) completed the same survey online, distributed by a market research company. An overview of participant demographic characteristics is provided in Table 2. Owing to differing socio-demographic characteristics between these samples, varied contexts for completing the survey (e.g. considering favourite animals while in a home or zoo environment) and anticipated pre-existing differences in knowledge about, and attitudes toward, animals between zoo visitors and the broader public (e.g. Mellish et al., 2017), the data for these two groups are presented separately. A zoo and community sample were included to explore both common trends and points of difference between these groups, including potential identification of shared gaps in knowledge or consistent patterns of species preference responses to endangered native Australian animals.

Materials

Favourite animal species. Participants were first asked via an open-ended item to name up to ten of their favourite animal species. The next item asked participants to list up to ten of their favourite Australian animal species. Consistent with Bjerke et al., (1998) and Woods (2000), these open-ended items were positioned at the beginning of the survey to ensure participant responses regarding their species preferences were not influenced by later items requiring ratings of species prescribed by the researchers.

Animal species recognition, knowledge, and preferences. Participants were then shown a series of colour images of Australian wildlife, followed by six questions. The use of pictures to assess respondents' attitudes and/or support for protection of various species follows the approaches used by Knight (2008) and Schlegel and Rupf (2010). The images selected were those featured on the Zoos Victoria website as part of their 'Love Your Locals' program information. In each image the animal was depicted in a natural environment and occupied the majority of the frame. The species were local to South East Australia, presently endangered, and had been named as focal species for Zoos Victoria's 'Love Your Locals' conservation-education program, which sought to raise awareness and public support for 21 of Australia's lesser known species, all at risk of extinction within the next ten years (Zoos Victoria, 2018). The seven species featured in the research were preselected to be the focus of initial 'Love Your Locals' program activities and to represent a broad cross-section of taxa. Additional information about the chosen species is available from Zoos Victoria in the Supplementary Materials. The species depicted included the leadbeater's possum (*Gymnobelideus leadbeateri*), eastern barred bandicoot (*Perameles gunnii*), helmeted honeyeater (*Lichenostomus melanops cassidix*), southern corroboree frog (*Pseudophryne corroboree*), Lord Howe Island (LHI) stick insect (*Dryococelus australis*), Tasmanian devil (*Sarcophilus harrisii*), and the orange-bellied parrot (*Neophema chrysogaster;* see Table 1). The questions were:

1. Do you recognise this animal (yes/no)?;
2. Can you name this species? (participants were instructed to provide as much detail as possible in their response, for example specifying whether an elephant was an African elephant or an Asian elephant);
3. Is this species found in Victoria? (yes/no/don't know);
4. Rate this species in terms of likeability (5-point Likert scale from 1= dislike very much, 3= neutral, 5= like very much);
5. Rate this species in terms of your desire to support their conservation (1= no desire to support, 3= neutral, 5= strong desire to support).

Table 1

Australian endangered species focal to Zoos Victoria's 'Love Your Locals' program



Leadbeater's possum

(*Gymnobelideus leadbeateri*)



Eastern barred bandicoot

(*Perameles gunnii*)



Helmeted honeyeater

(*Lichenostomus melanops cassidix*)



Southern corroboree frog

(*Pseudophryne corroboree*)



Lord Howe Island stick insect

(*Dryococelus australis*)



Tasmanian devil

(*Sarcophilus harrisii*)



Orange-bellied parrot

(*Neophema chrysogaster)*

Note. Images courtesy of Zoos Victoria

The first item asked participants whether they recognised the animal depicted. Question 2 expanded on this, asking whether participants could identify (name) the species depicted. Following Schlegel and Rupf (2010), the ability to identify and name a species was scored as correct, partially correct, and incorrect (or not specified). The category of partially correct was selected when participants assigned a pictured species to a higher taxonomic level (e.g. labelling the animal as a possum rather than Leadbeater's Possum or frog rather than southern corroboree frog). The likeability item (Q4) was included as a broad single-factor item assessing respondent preferences toward other species, which may capture elements such as attractiveness, familiarity, and similarity to humans (Bjerke & Østdahl, 2004; Tisdell et al., 2005).

To determine whether there were significant differences in responses between the zoo visitor and community groups on these items, a series of chi-square and Mann-Whitney tests were performed using SPSS with an alpha level of 0.05. To determine whether the ability to recognise each focal species (Q1) impacted on self-reported levels of conservation support (Q5) for each sample group (zoo and community), a further series of Mann-Whitney tests were performed. Non-parametric tests were determined most appropriate due to data being non-normally distributed (negatively skewed; Field, 2015). Following test conventions, the pattern of distribution of conservation support scores was cross-tabulated and reviewed for each group (those who recognised the species and those who did not) and each focal species. Where these were similar, the median conservation support scores for each group (recognised, not recognised) were compared. Where these were dissimilar, the mean ranks for each group (recognised, not recognised) were compared. This is reflected in the reporting for each analysis within the results section.

Willingness to pay. Participants' were asked a hypothetical 'willingness to pay' item to assess willingness to support the conservation of Australian engendered wildlife. Participants were invited to respond to a fixed choice, single bid response regarding how they would allocate a spare $20 between one of three wildlife charitable causes, either supporting the species depicted in the survey, supporting other Australian wildlife (e.g. kangaroos, koalas, echidnas), or supporting species abroad (e.g. elephant, orang-utan, tigers, gorillas). They were also provided with the option to keep the money. The phrasing used was consistent with previous willingness to pay research (Tisdell et al., 2007), and this item was designed to reduce potential variations in responses as a result of the varying financial status of respondents (Gunnthorsdottir, 2001; Tisdell et al., 2007).

Sample demographics. Participants were asked to provide demographic information including their sex, age, income, zoo membership status, whether they had visited a zoo in the previous 12-months, level of education, residency, pet ownership, and whether they identified as vegetarian. A summary of the demographic profile of the sample is provided in Table 2. Consistent with zoo visitation characteristics, the zoo visitors were primarily female. A majority of both samples were also pet owners.

Table 2

Demographic information for the zoo visitor and community sample groups.

Demographic item	Zoo (N = 223)	Community (N = 90)
Sex (Female)	65.1%	64.6%
Age (Mean, SD)	33.9 (12.4)	50.9 (15.8)
Income Category		
Less than $50,000	52.6%	64.9%
$50,001-$75,000	21.1%	15.6%
$75,001-$100,000	11.3%	13.0%
>$100,000	15.0%	6.5%
Prior Zoo visit in past 12-months (Yes)	53.8%	24.4%
Zoos Victoria member (Yes)	34.0%	1.3%
Vegetarian (Yes)	8.6%	9.0%
Pet Owner (Yes)	57.1%	68.0%
Education Level		
High School	13.8%	35.1%
TAFE/Certificate	7.1%	28.6%
Undergraduate degree	51.5%	23.4%
Post-graduate degree	27.6%	13.0%
Residential Status		
Victorian Resident	62.9%	100%
Non-Victorian Australian Resident	18.8%	
International Visitor	18.3%	

Results

Favourite animal species. The ten animal species most commonly reported as favourites by both the zoo and community sample are displayed in Table 3, where the percentage represents the proportion of the total sample who featured this animal in their top 10. In many instances these are groups of species, as individual species were not specified by respondents (following methods applied by Bjerke & Ostdahl, 2004). The primary difference between the zoo and community sample was in relation to the rankings for domestic dogs and cats (with cat not appearing in the zoo visitor top 10 and dog ranking at 8th for zoo visitors in contrast to 1st for the community sample). However, there was also consistency across groups regarding the popularity of lions, tigers and elephants. The only Australian animals featured for both the zoo and community samples were the koala and kangaroo.

Table 3

The ten most commonly listed favourite animal species, by sample group (zoo visitor, community).

Ranking	Zoo (Valid *n* = 222)	Community (Valid *n* = 90)
1.	Lion 55.0%	Dogs 48.9%
2.	Elephant 46.9%	Tiger 46.7%
3.	Meerkat 42.8%	Elephant 45.6%
4.	Giraffe 41.4%	Lion 42.2%
5.	Tiger 41.0%	Cats 38.9%
6.	Monkey 27.5%	Koala 33.3%
7.	Hippo 27.0%	Giraffe 31.1%
8.	Dog 27.0%	Monkey 28.9%
9.	Kangaroo 24.8%	Kangaroo 22.2%
10.	Koala 24.8%	Meerkats 22.2%

When asked about Australian animals specifically (see Table 4), kangaroos and koalas topped the favourite list for both the zoo and community samples. The majority of favourite animals listed were mammals, with the only birds featured being the emu and kookaburra. No reptiles, amphibians or insects were included in the top 10 favourite Australian animals for either group.

Table 4

Ten most commonly listed favourite Australian animals by zoo visitor and community samples and percentage of participants who identified them.

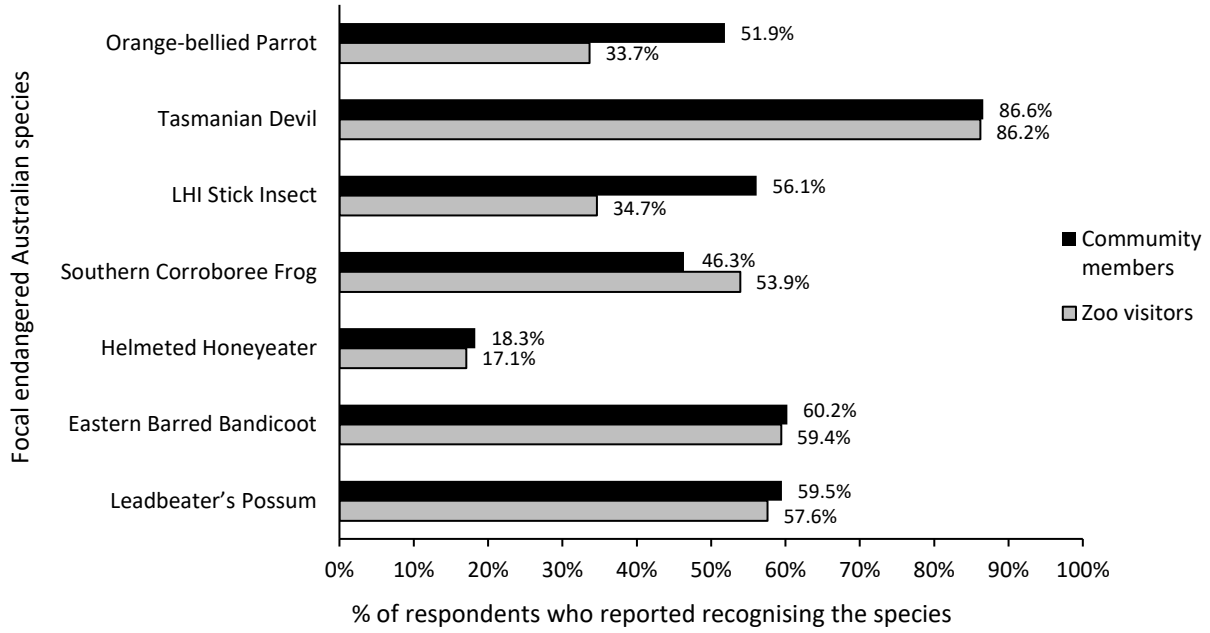
Ranking	Zoo (Valid *n* = 195)	Community (Valid *n* = 84)
1.	Kangaroo 69.1%	Kangaroo 61.1%
2.	Koala 69.1%	Koala 53.3%
3.	Wombat 43.5%	Wombat 33.3%
4.	Platypus 43.1%	Platypus 31.1%
5.	Emu 33.2%	Possum 26.7%
6.	Wallaby 25.1%	Echidna 26.7%
7.	Echidna 21.5%	Wallaby 25.6%
8.	Dingo 21.1%	Emu 24.4%
9.	Tasmanian Devil 19.7%	Dingo 18.9%
10.	Possum 18.4%; Kookaburra 18.4%	Tasmanian Devil 14.4%

Animal species recognition, knowledge, and preferences.

Animal species recognition. Participants' ability to recognise the Tasmanian devil was markedly higher than all other species, (86% across both zoo and community groups). Most zoo visitors and community members did not recognise the helmeted honeyeater. A significantly higher proportion of the community group compared with the zoo group recognised the: orange-bellied parrot, $X^2(1, N = 313) = 9.32$, $p < .01$, Ψ effect size = large; and the LHI stick insect, $X^2(1, N = 313) = 11.76$, $p<.001$, Ψ effect size large; see Figure 1).

Figure 1

Percentage of zoo visitors and community members who reported recognising the endangered Australian species.

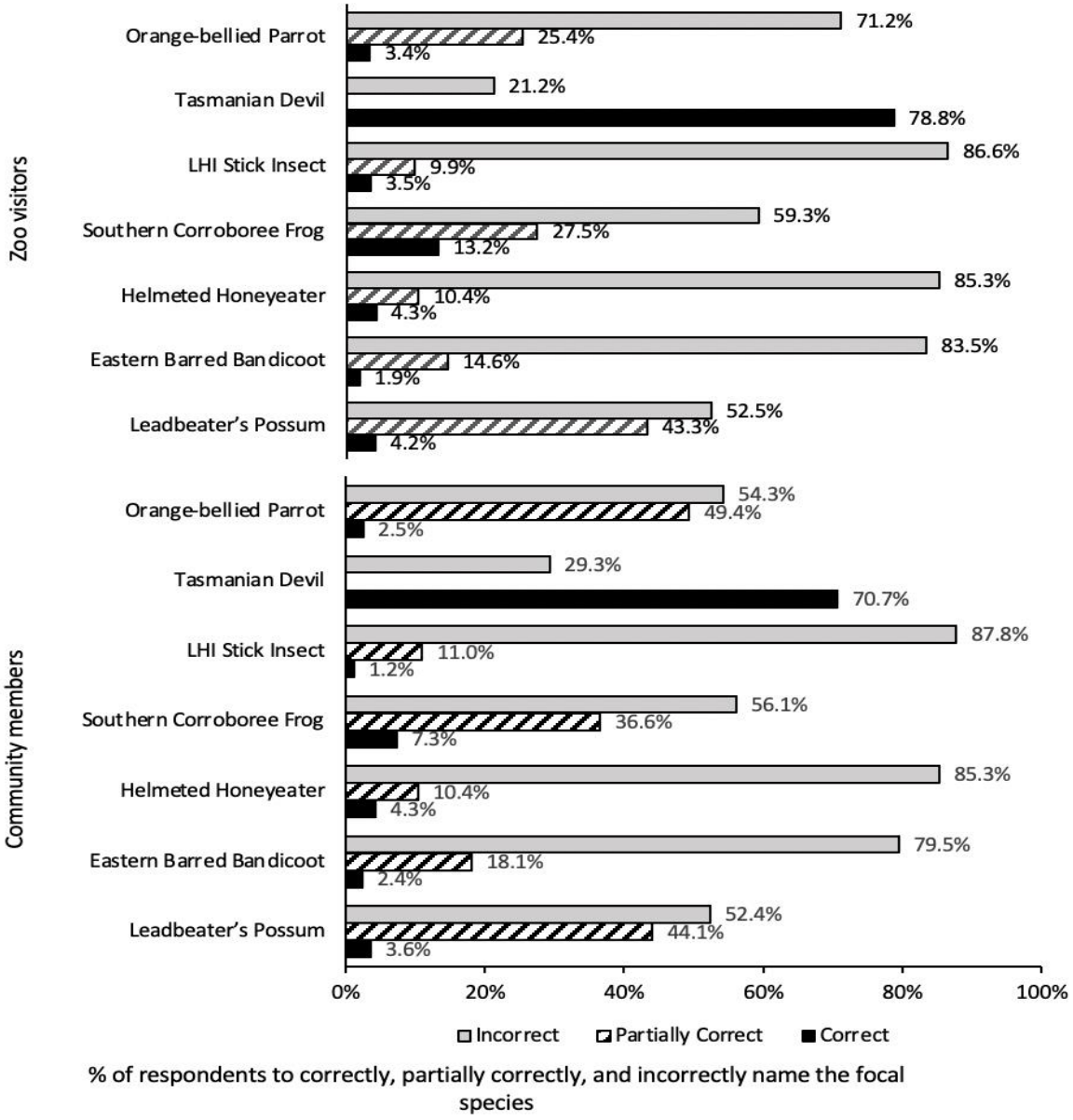


Animal species knowledge. In addition to whether participants recognised images of each species, they were also asked to name them (Figure 2). In contrast to the rates of recognition for the species photographs, the ability to correctly name the species was consistently below 8% for all species, with the exception of the Tasmanian devil (>70% correct) and the southern corroboree frog at 13.2% for the zoo sample. The species mislabelled most often was the eastern barred bandicoot, which was often misidentified as a bilby. There were no significant differences between the zoo visitor and community sample on the proportion of correct/partially correct vs incorrect names provided for all species, except the orange-bellied

parrot where a higher proportion of the community group were able to respond correctly, $X^2(1, N = 313) = 15.50$, $p < .001$, Ψ effect size = large.

Figure 2

Percentage of zoo (top) and community (bottom) participants who correctly, partially correctly, and incorrectly named the focal Australian endangered species.

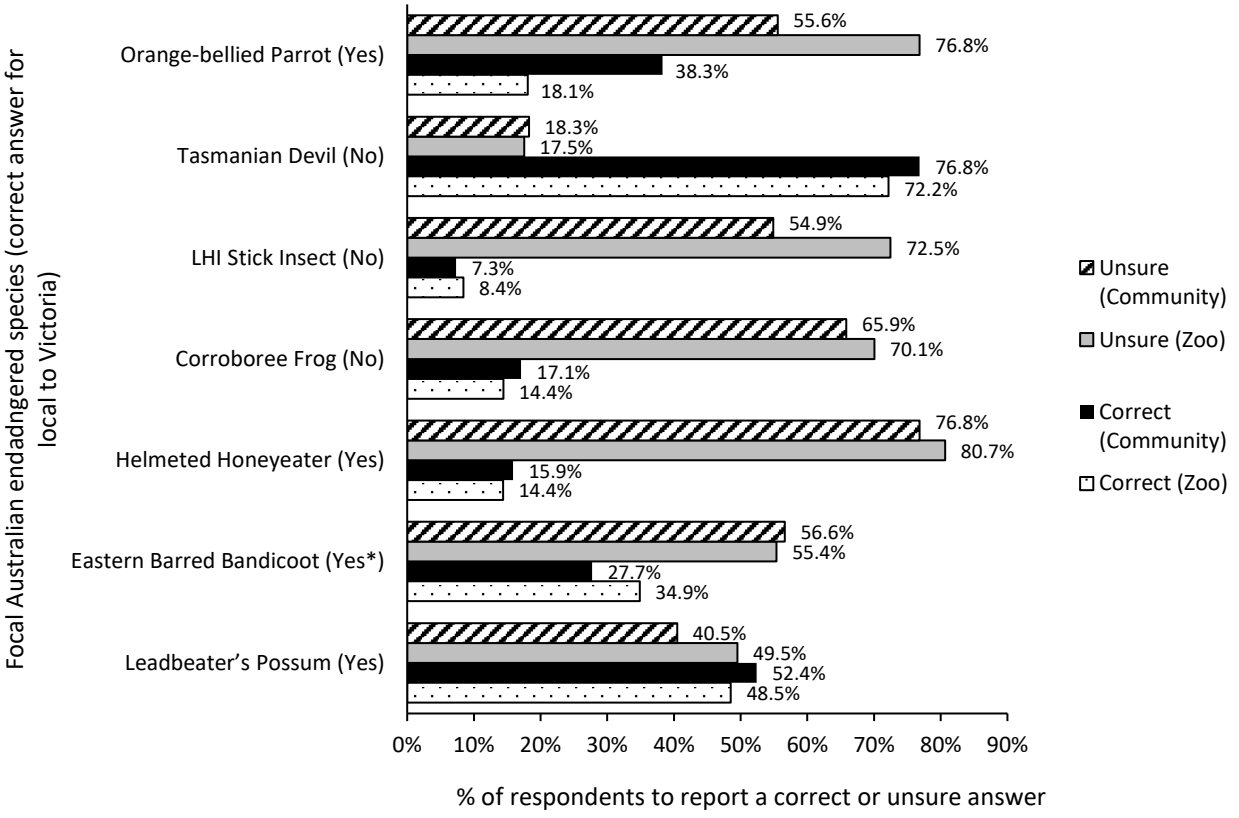


Note. Partially correct zoo responses for the helmeted honeyeater contained 'honeyeater' (6.6%) and other bird (3.8%); partially correct community responses for the helmeted honeyeater contained 'honeyeater' (4.9%) and other bird (6.1%); partially correct zoo responses for the orange-bellied parrot contained 'parrot' (22.4%) and other bird (2.9%); partially correct community responses for the orange-bellied parrot contained 'parrot' (43.2%) and other bird (6.2%)

Further, participants generally demonstrated limited knowledge regarding whether the focal species were local to Victoria. As depicted in Figure 3, correct responses were highest for the mammals (e.g., Tasmanian devil and leadbeaters possum), and lowest for frog, birds, and insect (e.g., LHI stick insect, southern corroboree frog, and helmeted honeyeater). There were no significant differences between the zoo visitor and community sample on the proportion of correct vs unsure/incorrect responses for all species, except the orange-bellied parrot where the community group were significantly more likely to respond correctly, $X^2(1, N = 278) = 13.51$, $p < .001$, Ψ effect size = large.

Figure 3

Participant responses to whether each focal species is local to Victoria.



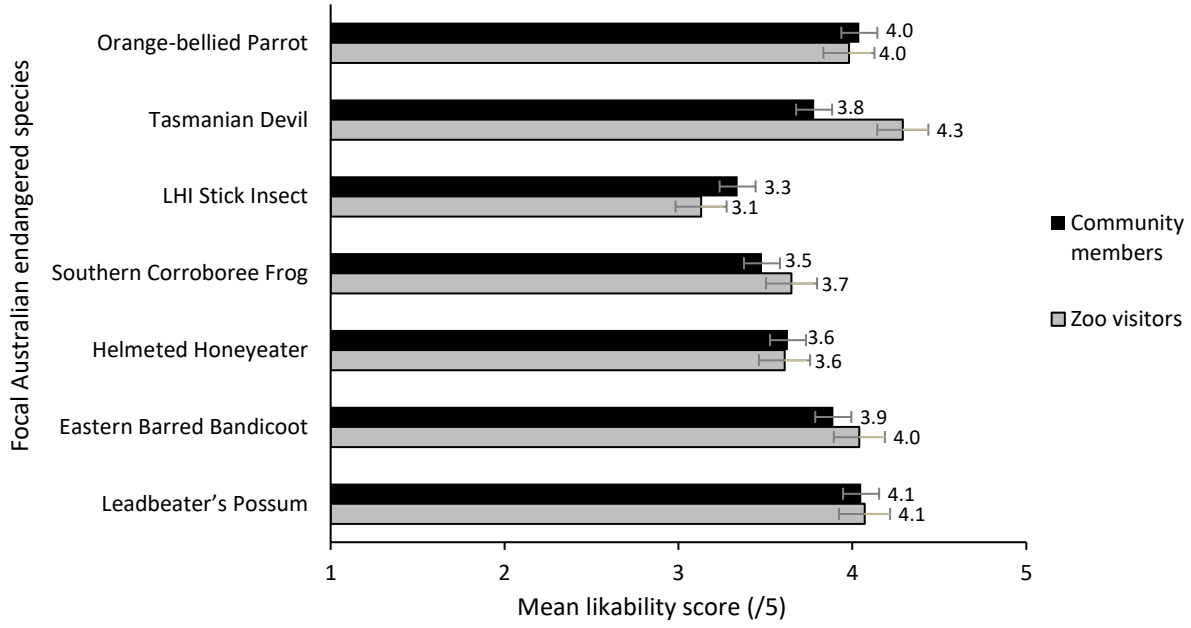
Note. Owing to missing data, valid n ranges from 177-195 for the zoo sample and 81-83 for the community sample. *Reintroduced populations of eastern barred bandicoots reside in protected areas within Victoria.

Animal species preferences.

Likability. Figure 4 displays the mean likeability ratings for each of the focal species across both the zoo and community groups. The helmeted honeyeater, southern corroboree frog and LHI stick insect were consistently the least-liked species, however all species had an average score of above neutral indicating most participants liked these species to some degree. Independent samples Mann Whitney U Tests were performed to determine whether likability ratings differed between zoo visitors and community members. There were no significant differences between groups ($p>.05$), apart from the Tasmanian devil for which the zoo visitor group gave significantly higher ratings, $U = 11061.5$, $p <.001$, $d = 0.265$ (indicating a small-moderate effect size difference in likeability ratings between groups).

Figure 4

Mean likeability ratings for focal species by sample group (zoo visitor and community). Error bars display standard deviation.

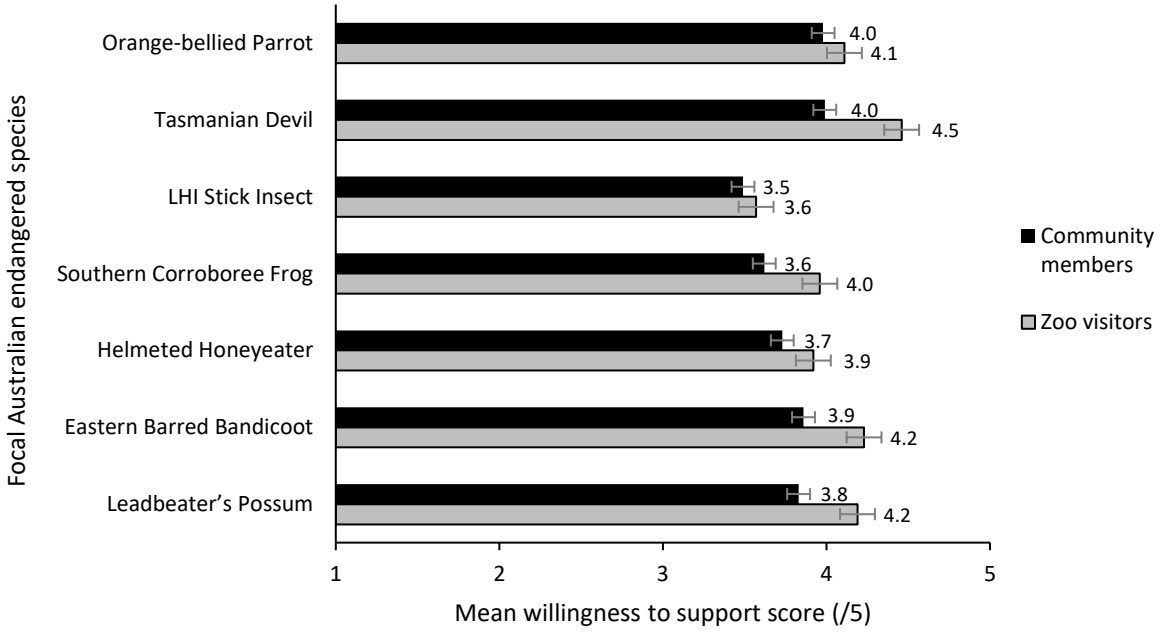


Willingness to support conservation. Figure 5 displays the mean willingness to support conservation reported for each of the focal species across both the zoo and community group. Mean scores follow a very similar pattern to the likeability means, with helmeted honeyeater, southern corrobboree frog, and LHI stick insect means lower than most other species. Independent samples Mann Whitney U Tests were performed to determine whether

conservation support ratings differed between zoo visitors and community members. There were no significant differences between groups for the helmeted honeyeater, the LHI stick insect, or the orange-bellied parrot ($p>.05$). Zoo visitors reported significantly higher levels of conservation support for the leadbeaters possum, $U = 10596$, $p <.001$, $d = 0.193$ (indicating a small effect size difference between groups); the eastern barred bandicoot, $U = 10220$, $p <.001$, $d = 0.193$ (indicating a small effect size difference between groups); the southern corroboree frog, $U = 9211.5$, $p = .016$, $d = 0.146$ (indicating a small effect size difference between groups); and the Tasmanian devil, $U = 10816$, $p <.001$, $d = 0.281$ (indicating a small-moderate effect size difference between groups).

Figure 5

Mean willingness to support ratings for focal species by sample group (zoo visitor and community) with error bars display standard deviation.



Influence of species recognition on conservation support. There was partial support for the hypothesis that recognition of the focal species would be associated with higher conservation support, with recognition significantly associated with conservation support for 4 of 7 species within the zoo sample (leadbeater's possum, eastern barred bandicoot, southern corroboree frog, and the Tasmanian devil) and 6 of 7 (all species except the southern corroboree frog) in

the community sample. Mann-Whitney test results for each species, by sample group, are reported in Table 5.

Table 5

Mann-Whitney tests for differences on conservation support score (/5) between participants who recognised the species and those who did not, by sample group (zoo and community).

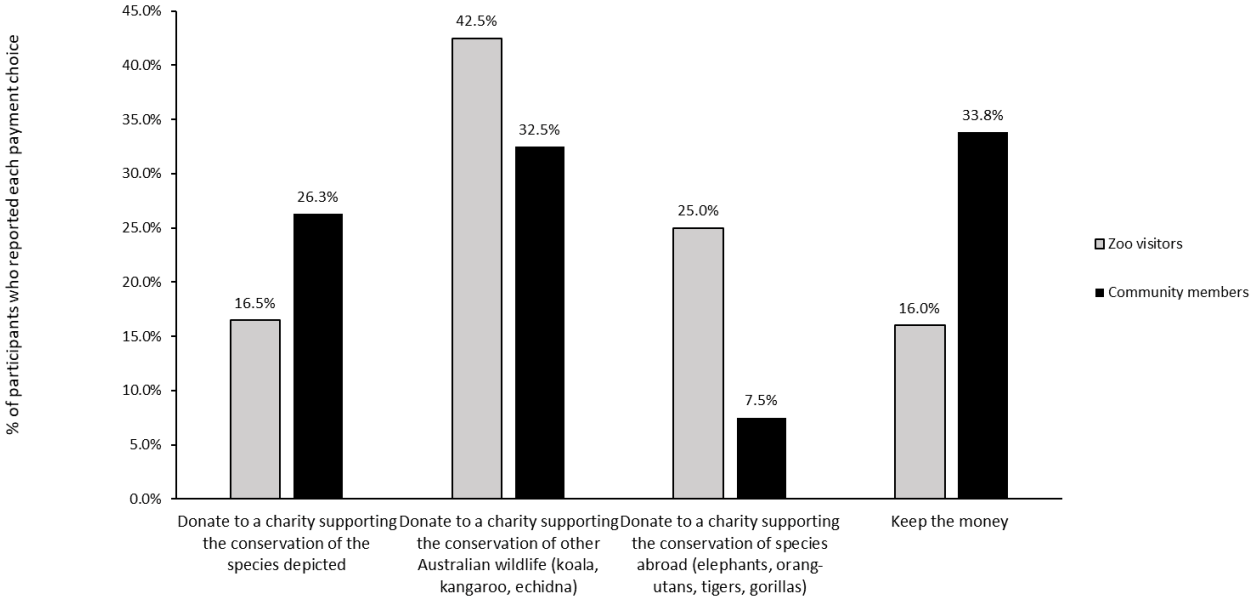
Species (by sample group)	Median or mean rank for conservation support (/5) (recognised species)	U	z	*p*	η^2
Zoo					
Leadbeater's possum	5	4224.5	1.795	.037	0.02
Eastern barred bandicoot	5	2789	-4.595	p<.001	0.11
Helmeted honeyeater	4	2320.5	-0.531	p>.05	
Southern corroboree frog	98.86*	3460	-1.988	.024	0.02
LHI stick insect	91.33*	3311	-0.825	p>.05	
Tasmanian devil	102.41*	955.50	-4.467	p<.001	0.10
Orange-bellied parrot	4	3544.5	-0.828	p>.05	
Community					
Leadbeater's possum	46.18*	666.00	-1.770	.034	0.04
Eastern barred bandicoot	49.70*	440.00	-3.775	p<.001	0.17
Helmeted honeyeater	55.37*	294.5	-2.635	.004	0.08
Southern corroboree frog	45.22*	694.5	-1.375	p>.05	
LHI stick insect	45.76*	632	-1.910	.028	0.04
Tasmanian devil	44.73*	161.00	-3.314	p<.001	0.13
Orange-bellied parrot	49.13*	477.50	-3.417	p<.001	0.14

Note. *denotes mean rank score. Following test conventions, the pattern of distribution of conservation support scores was reviewed for each sample group (those who recognised the species and those who did not) and each focal species. Where medians were similar, the medians for each group (recognised, not recognised) were compared. Where these were dissimilar, the mean ranks for each group (recognised, not recognised) were compared.

Willingness to pay. When asked to allocate a spare $20 to one of three wildlife charities *or* to keep the money, the most frequent response by the community sample was to keep the money (34%), while the most frequent response for the zoo sample was to donate this money to a charity that supports other Australian wildlife (e.g. kangaroos, koalas, echidna; 43%; Figure 6). There was a significant difference in the willingness to pay responses between the zoo visitor and community group $X^2(3, N = 313) = 23.69$, $p < .001$, Cramer's *V* effect size = large.

Figure 6

Percentage differences between zoo and community groups on willingness to pay (allocation of $20) to one of three wildlife charities or to keep the money.



Discussion

This study set out to gain a detailed understanding of zoo visitor and community perceptions of different endangered and native Australian species and to investigate relationships between these perceptions and participants' willingness to support the conservation of that species. Results suggest that Australians have limited familiarity and knowledge of native, endangered species, there are minimal differences between zoo visitor and community groups, and that a lack of awareness is associated with reduced willingness to support that species. It was encouraging to find that participants reported high likeability and willingness to support native Australian species though participants showed a preference to donate a

hypothetical amount towards to conservation of other Australian wildlife over the seven Zoos Victoria's focal species.

What do community members and zoo visitors identify as their favourite species and to what extent do native animals feature?

All animals that featured in the top 10 overall favourites were mammals, with a majority being exotic and with larger body sizes. The species preferences displayed by participants in this study were consistent with previous research (e.g. Bjerke & Østdahl, 2004; Knight, 2008; Tisdell et al., 2005; Troudet et al., 2017; Woods, 2000). These results further reflect the 'similarity principle' (Plous, 1993; Gunnthorsdottir, 2001), which suggests humans tend to prefer animals most similar to us and that when only a limited number of species can be conserved, mammals are likely to be over-represented at the expense of other taxa (Gunnsthorsdottir, 2001; Plous, 1993), even if those mammals are not endangered (Colléony et al., 2017). Of significance, in the context of Australia's 'extinction crisis' (Woinarski et al., 2015), is that the only native animals to feature within the top 10 overall favourites were the kangaroo and koala.

Favourite native animals mirrored these broader patterns, with mammals predominant, and the kangaroo and koala remaining the most popular Australian species (Tisdell et al., 2007; Woods, 2000). In this study, kangaroos and possums rated very favourably across both zoo and community groups, which somewhat contrasts with previous research where these were rated as disliked or perceived as pests (e.g. Miller et al., 1999; Oliver & Walton, 2004). No reptiles, amphibians, or insects featured in the top 10 animals overall or the top 10 Australian animals, which strongly reflects taxonomic biases in species preferences and conservation support (e.g. Clark & May, 2001; Plous, 1993). Endangered species were not prominent within the favourite native animals list, with neither the kangaroo, platypus, emu, echidna, or kookaburra currently listed as endangered in Australia (IUCN Red List, 2019). Among other animals listed, while some specific species are endangered, these were generally not specified by respondents, for example in responses of 'possum', 'wombat', or 'wallaby'. This presents a potential barrier to greater conservation action on behalf of some of Australia's most endangered wildlife, given research has demonstrated public concern and species preferences influence both conservation policies and funding support (Martin- López & Banayas, 2008; Martín-López et al., 2009; Tisdell et al., 2007).

To what extent can Victorian zoo visitors and community members identify native endangered wildlife and what are their attitudes toward these species and willingness to protect them?

The Tasmanian devil had the highest rate of recognition (>86%), was most often correctly named, and received the highest level of conservation support from both the zoo and community groups. This is unsurprising, given the highly publicised threats to their survival in the form of the Devil Facial Tumour Disease (McCallum et al., 2007) and due to featuring more prominently in popular culture (e.g. the character 'Taz' in Looney Tunes; ABC News, 2015). Notably, despite being the animal emblem of Victoria, under 60% of zoo visitors and community members reported recognising the leadbeater's possum and less than 5% named this correctly. There was also a low level of understanding regarding which species were local to Victoria with many 'unsure' responses across five of the seven focal species. These findings are consistent with previous research suggesting gaps in public knowledge about native Australian wildlife (Fitzgibbon & Jones, 2006; Wilson & Tisdell, 2005; Wilson & Tisdell, 2007) and supports arguments that Australia's 'extinction crisis' may be going largely unnoticed by the broader public (e.g. Taylor & Trezise, 2016). This is a critical issue as our study suggests that for most of the endangered native species featured, simply being able to recognise them increases people's willingness to support their conservation. This follows previous research which also indicates a familiar species has a substantially greater chance of being conserved than an unfamiliar species (Schlegel & Rupf, 2010), and that greater awareness of a species' conservation status impacts on donation preferences (Tisdell et al., 2007). Collectively, these results suggest a strong need to increase awareness about endangered Australian wildlife amongst members of the Australian public.

While all focal species received likeability and conservation support ratings on the positive side of neutral (mean >3), the rankings typically followed the pattern of mammals being preferred, followed by birds, then frogs, and then insects (Bjerke et al., 1998; Bjerke & Ostdahl, 2004; Knight, 2008; Schlegel & Rupf, 2010). The exception was the orange-bellied parrot, which received the second highest rating by the community sample. This may reflect the higher proportion of the community sample who reported recognising the orange-bellied parrot, as well as their bright colouration and aesthetic appeal in comparison with Helmeted Honeyeater, which ranked at 6th for the zoo sample and 5th for the community sample in terms of likeability and conservation support (Tisdell et al., 2005). The LHI Stick Insect was consistently the least popular species with the lowest conservation support, which follows research from Woods (2000) that revealed insects were disliked by 85% of participants and were rated among the least favourite animals overall. This suggests conservation efforts for

this, and other less popular, species may hinge on the ability to change public perceptions (see for example Cardoso et al., 2011; Curtin & Papworth, 2018; Goedeke, 2004). Such initiatives might emphasise qualities of the LHI Stick Insect anticipated to make this species more relatable and/or intriguing to engender greater public support, such as their resilience and survival against the odds, their ability to reproduce without males (parthenogenetically), their tendency to form large social aggregations during the day, or that their foot pads are heart shaped (Priddel et al., 2003).

Despite variations in reported likeability between the focal species, the majority of the zoo visitor and community samples favoured the survival of all endangered focal species, a commonality with previous research by Tisdell et al. (2005). However, when presented with a hypothetical scenario in which funds had to be allocated to the focal species or other Australian wildlife or species abroad, allocations favoured the more iconic Australian animals, despite the focal species collectively having a much greater conservation need. Similar findings were observed by Colléony et al. (2007) in their study of animal adoptions in a zoo, with charismatic species favoured over endangered species.

It is important to acknowledge that the findings from this research should be interpreted in the context of several limitations. Firstly, this study was conducted in Victoria and focused specifically upon seven endangered focal species. Future research regarding Australian wildlife would benefit from national sampling across a wider range of endangered native species, encompassing a broader range and diversity of taxa. This research also explored participants' self-reported willingness to support conservation and donation preferences. Future research is required to examine the relationship between these stated preferences and actual conservation actions. The research also sampled visitors to a Victorian zoo and consistent with zoo visitation trends, a smaller sub-group of the zoo sample (18.3%) were international visitors, which is likely to influence pre-existing knowledge of Australian species. Last, our categorical scoring for naming species (correct, partially correct, incorrect) does not fully account for the varied amount of detail of responses within the 'potentially correct' group.

However, the findings do highlight several potentially powerful opportunities for future conservation programs to contribute to native species conservation by striving to increase public familiarity with, and a sense of responsibility for the protection of, these (and perhaps other) lesser-known endangered species. Such strategies may integrate conservation marketing (Veríssimo et al., 2017) or community based social marketing approaches (McKenzie-Mohr, 2011), programs in schools and in zoos (e.g. Fisher-Maltese, 2016; Zoos

Victoria, 2018), images and exhibits (Stokes, 2007), and also initiatives which seek to support children and adults to spend more time in nature to re-connect with local species and habitats (Gifford & Nilsson, 2014; Stokes, 2006; Wells & Lekies, 2006). In fact, since the time of this research, as part of the plan-implement-evaluate conservation education cycle (Jacobson, McDuff, & Monroe, 2015), Zoos Victoria's Love Your Locals program has evolved in response to these initial findings. The program shifted to elevate the status of specific focal animals from the group of endangered LYL species and raise the profile of these one at a time. Example program activities in the intervening period include a Southern Corroboree Frog Disco, a giant 3m Southern Coroboree Frog Puppet paraded through the zoo, and banners promoting the Southern Corroboree Frog through the main drive of the zoo for a 6-week period in 2018-2019. Meanwhile, in April-July of 2019, the Helmeted Honeyeater was featured on tote bags visitors could purchase from the zoo, and profiled throughout the zoo. For each bag sold, a tree was planted in helmeted honeyeater habitat. Data from these subsequent program activities suggests these were effective in enhancing public knowledge of these endangered species, with correct identifications increasing from 4.3% and 7.3% for the helmeted honeyeater and southern coroborree frog respectively during the initial research to 26.8% and 16% while featuring as the focal species within subsequent LYL program activities (Zoos Victoria, 2022). The evaluation and sharing of knowledge from such programs is crucial to inform future practice such that the vision of Australia's Biodiversity Conservation Strategy and the subsequent Strategy for Nature 2018-2030 can be realised and the rich abundance of wildlife within Australia can be preserved.

Conclusion

If Australia is to reduce the ongoing threats to its biodiversity and stem the current extinction tide, this will require an informed, engaged, and mobilised public (NRMMC, 2010; Woinarski et al., 2015). The findings of this study indicate that limited recognition of, and knowledge about, endangered Australian wildlife may be a significant barrier to increased conservation support and success- especially for Australia's highly endangered but lesser known species. Among this sample of zoo visitors and community members, there was very low recognition regarding most of the focal endangered wildlife or knowledge of their local habitat. Furthermore, endangered native species did not feature prominently in the favourite animal listings for zoo visitors or community members and hypothetical donation preferences also favoured more iconic Australian species over the endangered Australian species. Yet, when these endangered species were recognised, in a majority of cases, this was associated

with increased willingness to support their conservation, which provides an important avenue for future conservation education programs. The findings further support the need for a nuanced approach to conservation education across species, and highlight the additional challenges associated with the conservation of amphibian and invertebrate species within Australia.

References

ABC News. (2015, December 23). Popularity of Tasmanian devil cartoon character helps researchers raise funds to save species. http://www.abc.net.au/news/2015-12-23/tasmanian-devil-cartoon-character-popularity-helps-raise-funds/7050516

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Aslin, H. J. (1996). *Speaking of the wild: Australian attitudes to wildlife* [Doctoral dissertation, Australian National University]. https://www.worldcat.org/title/speaking-of-the-wild-australian-attitudes-to-wildlife/oclc/647037938

Banks, P. B., Carthey, A. J., & Bytheway, J. P. (2018). Australian native mammals recognize and respond to alien predators: A meta-analysis. *Proceedings of the Royal Society B: Biological Sciences, 285*(1885), 20180857. https://doi.org/10.1098/rspb.2018.0857

Bjerke, T., Ødegårdstuen, T. S., & Kaltenborn, B. P. (1998). Attitudes toward animals among Norwegian children and adolescents: Species preferences. *Anthrozoös, 11*(4), 227-235. https://doi.org/10.2752/089279398787000544

Bjerke, T., & Østdahl, T. (2004). Animal-related attitudes and activities in an urban population. *Anthrozoös, 17,* 109-129. https://doi.org/10.2752/089279304786991783

Bjerke, T., Østdahl, T., & Kleiven, J. (2003). Attitudes and activities related to urban wildlife: Pet owners and non-owners. *Anthrozoös, 16,* 252-262. https://doi.org/10.2752/089279303786992125

Braby, M. F. (2018). Threatened species conservation of invertebrates in Australia: An overview. *Austral Entomology, 57*(2), 173-181. https://doi.org/10.1111/aen.12324

Cardoso, P., Erwin, T. L., Borges, P. A., & New, T. R. (2011). The seven impediments in invertebrate conservation and how to overcome them. *Biological Conservation*, *144*(11), 2647-2655. https://doi.org/10.1016/j.biocon.2011.07.024

Gippoliti, S., & Carpaneto, G. M. (1997). Captive breeding, zoos, and good sense. *Conservation Biology*, *11*(3), 806-807.

Clark, J. A., & May, R. M. (2002). Taxonomic bias in conservation research. *Science, 297* (5579), 191-192. https://doi.org/10.1126/science.297.5579.191b

Colléony, A., Clayton, S., Couvet, D., Saint Jalme, M., & Prévot, A. C. (2017). Human preferences for species conservation: Animal charisma trumps endangered status. *Biological Conservation, 206,* 263-269. https://doi.org/10.1016/j.biocon.2016.11.035

Cresswell, I. D., & Murphy, H. T. (2017). Australia state of the environment 2016: Biodiversity, independent report to the Australian Government Minister for the Environment and Energy. *Australian Government Department of the Environment and Energy: Canberra, ACT*.

Curtin, P., & Papworth, S. (2018). Increased information and marketing to specific individuals could shift conservation support to less popular species. *Marine Policy, 88,* 101–107. http://doi.org/10.1016/j.marpol.2017.11.006

Daigle, J. J., Hrubes, D., & Ajzen, I. (2002). A comparative study of beliefs, attitudes, and values among hunters, wildlife viewers, and other outdoor recreationists. *Human Dimensions of Wildlife, 7*(1), 1–19. https://doi.org/10.1080/108712002753574756

Dettmann-Easler, D., & Pease, J. L. (1999). Evaluating the effectiveness of residential environmental education programs in fostering positive attitudes toward wildlife. *The Journal of Environmental Education, 31*(1), 33-39.

Dos Santos, M. M., Griffiths, R. A., Jowett, T., Rock, J., & Bishop, P. J. (2019). A comparison of understanding of the amphibian crisis by zoo visitors across three countries. *Zoo Biology, 38*(6), 471-480. https://doi.org/10.1002/zoo.21516

Driscoll, J. W. (1995). Attitudes towards animals: Species ratings. *Society and Animals, 3*(2) 1995, 139-150. https://doi.org/10.1163/156853095X00125

Field, A. (2015). *Discovering statistics using IBM SPSS statistics*. SAGE Publishing.

Fishbein, M., & Ajzen, I. (2011). *Predicting and changing behavior: The Reasoned Action approach* (3rd ed.). Psychology Press. https://doi.org/10.4324/9780203838020

Fisher-Maltese, C. (2016). "We Won't Hurt You Butterfly!" Second-graders become environmental stewards from experiences in a school garden. *International Journal of Early Childhood Environmental Education, 4*(1), 54-69. https://files.eric.ed.gov/fulltext/EJ1120191.pdf

Fitzgibbon, S. I., & Jones, D. N. (2006). A community-based wildlife survey: The knowledge and attitudes of residents of suburban Brisbane, with a focus on bandicoots. *Wildlife Research, 33,* 233-241. https://doi.org/10.1071/WR04029

Geyle, H. M., Woinarski, J. C., Baker, G. B., Dickman, C. R., Dutson, G., Fisher, D. O., Ford, H., Holdsworth, M., Jones, M. E., Kutt, A., Legge, S., Leiper, I., Loyn, R., Murphy, B. P., Menkhorst, P., Reside, A. P., Ritchie, E. G., Roberts, F. E., Tingley, R., & Garnett, S. T. (2018). Quantifying extinction risk and forecasting the number of

impending Australian bird and mammal extinctions. *Pacific Conservation Biology*, *24*(2), 157-167. https://doi/org/10.1071/PC18006

Gifford, R., & Nilsson, A. (2014). Personal and social factors that influence pro-environmental concern and behaviour: A review. *International Journal of Psychology*, *49*(3), 141-157. https://doi.org/10.1002/ijop.12034

Godinez, A. M., & Fernandez, E. J. (2019). What is the zoo experience? How zoos impact a visitor's behaviors, perceptions, and conservation efforts. *Frontiers in Psychology*, 1746. https://doi.org/10.3389/fpsyg.2019.01746

Goedeke, T. L. (2004). In the eye of the beholder: Changing social perceptions of the Florida manatee. *Society & Animals, 12*(2), 99-116. https://doi.org/10.1163/1568530041446562

Gunnthorsdottir, A. (2001). Physical attractiveness of animal species as a decision factor for its preservation. *Anthrozoös, 14*(4), 204-215. https://doi.org/10.2752/089279301786999355

International Union for the Conservation of Nature [IUCN]. (2019). IUCN Red List of Threatened Species. http://www.iucnredlist.org/

Jacobson, S. K., McDuff, M. D., & Monroe, M. C. (2015). *Conservation education and outreach techniques*. Oxford University Press.

Kearney, S. G., Carwardine, J., Reside, A. E., Fisher, D. O., Maron, M., Doherty, T. S., Legge, S., Silcock, J., Woinarski, J. C. Z., Garnett, S. T., Wintle, B. A., & Watson, J. E. M. (2019). Corrigendum to: The threats to Australia's imperilled species and implications for a national conservation response. *Pacific Conservation Biology*, *25*(3), 328-328. https://doi.org/10.1071/PC18024

Kellert, S. R. (1993). Values and perceptions of invertebrates. *Conservation Biology*, *7*(4), 845-855. https://doi.org/10.1046/j.1523-1739.1993.740845.x

Kidd, L. R., Gregg, E. A., Bekessy, S. A., Robinson, J. A., & Garrard, G. E. (2018). Tweeting for their lives: Visibility of threatened species on twitter. *Journal for Nature Conservation*, *46*, 106-109. https://doi.org/10.1016/j.jnc.2018.10.001

Knight, A. J. (2008). "Bats, snakes and spiders, Oh my!" How aesthetic and negativistic attitudes, and other concepts predict support for species protection. *Journal of Environmental Psychology, 28*(1), 94-103. https://doi.org/10.1016/j.jenvp.2007.10.001

Legge, S., Murphy, S., Heathcote, J., Flaxman, E., Augusteyn, J., & Crossman, M. (2008). The short-term effects of an extensive and high-intensity fire on vertebrates in the

tropical savannas of the central Kimberley, northern Australia. *Wildlife Research*, *35*(1), 33-43. https://doi.org/10.1071/WR07016

López-Mosquera, N., García, T., & Barrena, R. (2014). An extension of the Theory of Planned Behavior to predict willingness to pay for the conservation of an urban park. *Journal of Environmental Management, 135,* 91-99. https://doi.org/10.1016/j.jenvman.2014.01.019

Lundberg, P., Vainio, A., MacMillan, D. C., Smith, R. J., Verissimo, D., & Arponen, A. (2019). The effect of knowledge, species aesthetic appeal, familiarity and conservation need on willingness to donate. *Animal Conservation*. Advanced online publication. https://doi.org/10.1111/acv.12477

MacDonald, E., Milfont, T., & Gavin, M. (2015). What drives cat-owner behaviour? First steps towards limiting domestic-cat impacts on native wildlife. *Wildlife Research, 42(*3), 257-265. https://doi.org/10.1071/WR14164

Martin-Lopez, B., & Benayas, J. (2008). Economic valuation of biodiversity conservation: The meaning of numbers. *Conservation Biology, 22*(3), 624-635. https://doi.org/10.1111/j.1523-1739.2008.00921.x

Martin-Lopez, B., Montes, C., & Benayas, J. (2007). The non-economic motives behind the willingness to pay for biodiversity conservation. *Biological Conservation, 139*, 67-82. https://doi.org/10.1016/j.biocon.2007.06.005

Mascia, M. B., Brosius, J. P., Dobson, T. A., Forbes, B. C., Horowitz, L., McKean, M. A., & Turner, N. J. (2003). Conservation and the social sciences. *Conservation Biology, 17*, 649-650. https://doi.org/10.1046/j.1523-1739.2003.01738.x

McCallum, H., Tompkins, D. M., Jones, M., Lachish, S., Marvanek, S., Lazenby, B., Hocking, G., Wiersma, J., & Hawkins, C. E. (2007). Distribution and impacts of Tasmanian Devil facial tumour disease. *EcoHealth,4*(3). https://doi.org/10.1007/s10393-007-0118-0

McKenzie-Mohr, D. (2011). *Fostering sustainable behavior: An introduction to community-based social marketing*. British Columbia, Canada: New Society Publishers.

McLoughlin, S. (2001). The breakup history of Gondwana and its impact on pre-Cenozoic floristic provincialism. *Australian Journal of Botany, 49*(3), 271. https://doi.org/10.1071/bt00023

Mellish, S., Pearson, E. L., Sanders, B., & Litchfield, C. A. (2017). Marine wildlife entanglement and the Seal the Loop initiative: A comparison of two free-choice

learning approaches on visitor knowledge, attitudes and conservation behaviour. *International Zoo Yearbook, 50*(1), 129-154. https://doi.org/10.1111/izy.12132

Miller, K. K., Brown, P. R. & Temby, I. (1999). Attitudes towards possums: A need for education? *The Victorian Naturalist, 116*(4), 120–126. https://eurekamag.com/research/010/217/010217982.php

Miller, Z. D. (2017). The enduring use of the Theory of Planned Behavior, *Human Dimensions of Wildlife, 22*(6), 583-590. https://doi.org/10.1080/10871209.2017.1347967

Mittermeier, R. A, & Mittermeier, C. G., & Robles, G., & Patricio (1997). *Megadiversity: Earth's Biologically Wealthiest Nations* (1st English ed). Monterray, Mexico: Conservation International and Agrupación Sierra Madre.

Natural Resource Management Ministerial Council [NRMMC]. (2010). *Australia's Biodiversity Conservation Strategy 2010-2030.* https://www.environment.gov.au/system/files/resources/58321950-f8b6-4ef3-bb68-6f892420d601/files/biodiversity-strategy-2010.pdf

Novacek, M. J. (2008). Engaging the public in biodiversity issues. *Proceedings of the National Academy of Sciences, 105*(Supplement 1), 11571-11578. https://doi.org/10.1073/pnas.0802599105

Oliver, J. & Walton, C. (2004). *Pests in Queensland baseline survey 2003: A survey of primary producers and residents of regional centres and large country towns.* Queensland Department of Natural Resources, Mines, and Energy. Queensland, Australia.

Packer, J., Ballantyne, R., & Hughes, K. (2014). Chinese and Australian tourists' attitudes to nature, animals and environmental issues: Implications for the design of nature-based tourism experiences. *Tourism Management, 44*, 101-107. https://doi.org/10.1016/j.tourman.2014.02.013

Plous, S. (1993). Psychological mechanisms in the human use of animals. *Journal of Social Issues, 49*(1), 11-52. https://doi.org/10.1111/j.1540-4560.1993.tb00907.x

Priddel, D., Carlile, N., Humphrey, M., Fellenberg, S., & Hiscox, D. (2003). Rediscovery of the 'extinct' Lord Howe Island stick-insect (Dryococelus australis Montrouzier) (Phasmatodea) and recommendations for its conservation. *Biodiversity & Conservation*, *12*(7), 1391-1403. https://doi.org/10.1023/A:1023625710011

Rabb, G. B., & Saunders, C. D. (2005). The future of zoos and aquariums: conservation and caring. *International Zoo Yearbook*, *39*(1), 1-26.

Robovský, J., Melichar, L., & Gippoliti, S. (2020). Zoos and conservation in the Anthropocene: opportunities and problems. In *Problematic Wildlife II* (pp. 451-484). Springer, Cham. Doi: 10.1007/978-3-030-42335-3_14

Sands, D. P. A. (2018). Important issues facing insect conservation in Australia: Now and into the future. *Austral Entomology*, *57*(2), 150-172. https://doi.org/10.1111/aen.12342

Schlegel, J., & Rupf, R. (2010). Attitudes towards potential animal flagship species in nature conservation: A survey among students of different educational institutions. *Journal for Nature Conservation, 18*(4), 278-290. https://doi.org/10.1016/j.jnc.2009.12.002

Schwartz, S. H. (2012). An overview of the Schwartz theory of basic values. *Online Readings in Psychology and Culture, 2*(1). https://doi.org/10.9707/2307-0919.1116

Short, J., & Smith, A. (1994). Mammal decline and recovery in Australia. *Journal of Mammalogy, 75*(2), 288-297. DOI: 10.2307/1382547

Sitas, N., Baillie, J. E. M., & Isaac, N. J. B. (2009). What are we saving? Developing a standardized approach for conservation action. *Animal Conservation, 12*(3), 231-237. https://doi.org/10.1111/j.1469-1795.2009.00244.x

Stokes, D. L. (2007). Things we like: Human preferences among similar organisms and implications for conservation. *Human Ecology, 35*(3), 361-369. https://doi.org/10.1111/j.1469-1795.2009.00244.x

Stokes, D. L. (2006). Conservators of experience. *BioScience*, *56*(1), 6-7.

Taylor, M., & Trezise, J. (2016, 23 June). Why is Australia's extinction crisis being ignored? *SBS News.* https://www.sbs.com.au/news/comment-why-is-australia-s-extinction-crisis-being-ignored

Taylor, N., & Signal, T. D. (2009). Pet, pest, profit: Isolating differences in attitudes towards the treatment of animals. *Anthrozoös*, *22*(2), 129-135. https://doi.org/10.2752/175303709X434158

Tisdell, C., & Swarna Nantha, H. (2005). *Comparison of funding and demand for the conservation of the charismatic koala with those for the critically endangered wombat Lasiorhinus krefftii* (working paper 125). The University of Queensland, Brisbane. https://espace.library.uq.edu.au/view/UQ:84522/WP125.pdf

Tisdell, C., Swarna Nantha, H., & Wilson, C. (2007). Endangerment and likeability of wildlife species: How important are they for payments proposed for conservation?. *Ecological Economics*, *60*(3), 627-633. https://doi.org/10.1016/j.ecolecon.2006.01.007

Tisdell, C., Wilson, C., & Nantha, H. S. (2005). Association of public support for survival of wildlife species with their likeability. *Anthrozoös*, *18*(2), 160-174. https://doi.org/10.2752/089279305785594216

Troudet, J., Grandcolas, P., Blin, A., Vignes-Lebbe, R., & Legendre, F. (2017). Taxonomic bias in biodiversity data and societal preferences. *Scientific Reports, 7*(1), 9132. https://doi.org/10.1038/s41598-017-09084-6

Veríssimo, D., Vaughan, G., Ridout, M., Waterman, C., MacMillan, D., & Smith, R. J. (2017). Increased conservation marketing effort has major fundraising benefits for even the least popular species. *Biological Conservation, 211*, 95-101. https://doi.org/10.1016/j.biocon.2017.04.018

Ward, M. S., Simmonds, J. S., Reside, A. E., Watson, J. E., Rhodes, J. R., Possingham, H. P., Trezise, J., Fletcher, R., File, L., & Taylor, M. (2019). Lots of loss with little scrutiny: The attrition of habitat critical for threatened species in Australia. *Conservation Science and Practice*. Advanced online publication. https://doi.org/10.1111/csp2.117

Wells, N. M., & Lekies, K. S. (2006). Nature and the life course: Pathways from childhood nature experiences to adult environmentalism. *Children Youth and Environments*, *16*(1), 1-24. https://doi.org/10.7721/chilyoutenvi.16.1.0001

Wilson, C., & Tisdell, C. (2005). What role does knowledge of wildlife play in providing support for species' conservation. *Journal of Social Sciences*, *1*(1), 47-51. https://doi.org/10.22004/ag.econ.51417

Wilson, C., & Tisdell, C. (2007). How knowledge affects payment to conserve an endangered bird. *Contemporary Economic Policy*, *25*(2), 226-237. https://doi.org/10.1111/j.1465-7287.2006.00021.x

Woinarski, J. C. Z., Burbridge, A. B., & Harrison, P. L. (2015). Ongoing unraveling of a continental fauna: Decline and extinction of Australian mammals since European settlement. *Proceedings of the National Academy of Sciences of the United States of America, 112*, 4531-4540. https://doi.org/10.1073/pnas.1417301112

Woods, B. (2000). Beauty and the beast: Preferences for animals in Australia. *The Journal of Tourism Studies, 11*, 25-35. https://search.informit.com.au/fullText;dn=200110918;res=IELAPA

Zoos Victoria. (2018). *Love Your Locals.* http://www.zoo.org.au/loveyourlocals