Environmental Conservation (2017) **44** (4): 389–396 © Foundation for Environmental Conservation 2017 doi:10.1017/S0376892917000133

Wildlife species preferences differ among children in continental and island locations

THEMATIC SECTION
Humans and Island Environments

HANNAH G. SHAPIRO*[1], M. NILS PETERSON[1], KATHRYN T. STEVENSON[2], KRISTIN N. FREW[1] AND R. BRIAN LANGERHANS[3]

[1]*Fisheries, Wildlife, and Conservation Biology Program, North Carolina State University, Raleigh, NC 27695, USA,* [2]*Parks, Recreation, & Tourism Management, 4217 Jordan II, Box 8008, North Carolina State University, Raleigh, NC 27695, USA and* [3]*Department of Biological Sciences and W.M. Keck Center for Behavioral Biology, North Carolina State University, Box 7617, Raleigh, NC 27695, USA*

Date submitted: 16 May 2016; Date accepted: 14 February 2017; First published online 29 March 2017

SUMMARY

Efforts to prioritize wildlife for conservation benefit from an understanding of public preferences for particular species, yet no studies have integrated species preferences with key attributes of the conservation landscape such as whether species occur on islands (where invasive exotics are the primary extinction threat) or continents (where land use change is the primary extinction threat). In this paper, we compare wildlife species preferences among children from a continental location (North Carolina, USA, n = 433) and an island location (Andros Island, The Bahamas, n = 197). Children on the island preferred feral domesticated species and different types of taxa than mainland children, perhaps due to the strongly divergent species richness between the regions (e.g. island children showed greater preferences for invertebrates, lizards and aquatic species). Boys preferred fish, birds and lizards more than girls, whereas girls preferred mammals. The fact that island children showed strong preferences for invasive species suggests challenges for conservation efforts on islands, where controlling invasive exotic species is often of paramount importance, but can conflict with cultural preferences for these same species.

Keywords: wildlife preferences, cross-cultural, human dimensions, children, environmental education, conservation

INTRODUCTION

Rapidly growing threats to biodiversity render prioritizing species for protection essential. Despite recent increases in conservation efforts (Hamber *et al.* 2011), factors such as invasive species, habitat destruction and climate change continue to cause global biodiversity loss (Pimm *et al.* 2014; McCallum 2015). Wildlife conservation relies heavily on the attitudes of the general public (Dickman 2010) because protecting wildlife requires human intervention (Ericsson *et al.* 2004; Gratwicke *et al.* 2008; Prokop & Fancovicova 2013). The public's perception of animal species directly impacts the conservation of those species, and negative cultural biases towards certain wildlife paired with anthropogenic impacts have driven several species to near extinction (Fita *et al.* 2010; Brito *et al.* 2001).

Conservation plans have widely relied on criteria including population size, economic value, ecological significance and endemism to support decisions (Wilson *et al.* 2006; Sodhi *et al.* 2010; Curnick *et al.* 2015); however, they rarely consider people's perceptions of species, which can cause the plan to fail because of unanticipated public resistance or a lack of public support (Kaltenborn *et al.* 2006). Species-specific preferences, defined as a greater liking for one species over others, exist (Bjerke *et al.* 2003; Schlegel & Rupf 2010; Ballouard *et al.* 2011), and the public generally prefers birds and mammals over reptiles and invertebrates (Czech *et al.* 1998). This bias has been attributed to the similarity principle, which suggests that humans prefer animals that are behaviourally or phylogenetically similar to themselves (Kellert 1985; Kellert 1993; Kellert 1996; Batt 2009). Fear appears to influence species preferences, and may do so independently of danger posed by a certain species, especially in the case of invertebrates (Kaltenborn *et al.* 2006; Batt 2009; Prokop & Fancovicova 2013). Women's preferences are generally dictated more by fear and disgust than men, especially when a species poses a threat to humans, as with some snakes and parasites (Prokop *et al.* 2009a; Prokop *et al.* 2009b; Prokop *et al.* 2010b; Prokop 2013). Finally, people tend to favour animals with aesthetic value and 'charisma' (Kaltenborn *et al.* 2006; Schlegel & Rupf 2010; Prokop & Fancovicova 2013).

In particular, scholars should focus on the species preferences of children, because conservation aims to protect resources for future generations and children tend to shape their parents' environmental behaviours (Weiss 1990; Meine *et al.* 2006; Damerell *et al.* 2013). Although bequest value, or the value of passing species on to future generations, is

*Correspondence: Hannah G. Shapiro email: hgshapir@ncsu.edu
Supplementary material can be found online at https://doi.org/10.1017/S0376892917000133

axiomatic to biodiversity conservation (Walsh *et al.* 1984; Meine *et al.* 2006), insufficient research has explored which species new generations are interested in or value. Species preferences among children may also be important because they influence parental preferences. This question has not been addressed, yet children influence a wide array of parental preferences and behaviours in similar domains, including purchasing decisions (Flurry & Burns 2005), information technology use (Hampshire 2000) and pro-environmental behaviours (e.g. encouraging their parents to recycle) (Legault & Pelletier 2000). Similarly, publishers capitalize on children's impacts on parental behaviour with animal-based story books focusing on popular species such as lions, tigers and elephants (More 1979; Shapiro *et al.* 2016). Further, children represent the most effective pathway to change their parents' views on ideologically charged environmental issues, because their own perceptions are less driven by ideology (Stevenson et al. 2014) and because they influence their parents' attitudes and behaviours (Duvall & Zint 2007). The latter is particularly important in ideologically charged conservation contexts (e.g. Peterson *et al.* 2002) in which adults may listen to their children, but filter out information from other sources (Uzzell *et al.* 1994; Leeming *et al.* 1997).

Research on children's species preferences has revealed several important patterns. Like adults, children rank mammals and birds higher than invertebrates and reptiles, favour exotic megafauna over local species and prefer less dangerous animals (Bjerke *et al.* 1998; Ballouard *et al.* 2011; Borgi & Cirulli 2015). Moreover, both children and adults who own pets tend to have greater knowledge of and more positive attitudes towards wild animals (Bjerke *et al.* 2003; Prokop & Tunnicliffe 2010). However, children favour certain species that are typically ranked low by adults, such as turtles, snails and butterflies (Borgi & Cirulli 2015). This may reflect the anthropomorphization of certain species through media targeting children (Bjerke & Ostdahl 2004; Wagler 2010; Borgi & Cirulli 2015). Boys tend to favour animals that evoke fear and disgust over girls, and girls prefer more loveable or cute animals (Prokop & Tunnicliffe 2010; Schlegel & Rupf 2010). Children appear to prioritize species groups in ways that are similar to conservation biologists by prioritizing importance in nature over other attributes (Frew *et al.* 2016; Shapiro *et al.* 2016), whereas adults may place more emphasis on endemism and declining species (Czech *et al.* 1998; Meuser *et al.* 2009; Verissimo *et al.* 2009). Although importance in nature is necessarily a general concept, children tend to view it as referring to a species' overall significance and value to the natural system in which it resides (Shapiro *et al.* 2016).

The growing body of research on species preferences has not yet addressed how preferences may differ under different biogeographic contexts that are critical to conservation. Several potentially valuable contexts exist (e.g. different biomes and different climates), but the difference between islands and continents may represent one of the most obvious biogeographic drivers of species threats and extinction (Simberloff 2000). In continental locations, the leading causes of wildlife endangerment are habitat conversion, such as forests to agriculture, and suppression of natural processes, such as fire (Sharitz 2003; Backer *et al.* 2004; Kindall & Van Manen 2007). Conversely, the leading driver of species endangerment and extinction on islands is the spread of invasive exotic species (Duncan & Blackburn 2004; Clavero *et al.* 2009). For instance, feral cats (Nogales *et al.* 2004), feral hogs (Cruz *et al.* 2005), the cane toad (Shine 2010) and the brown tree snake (Rodda & Savidge 2007) have caused multiple extinctions and endangerments of native wildlife on islands.

The aim of this paper was to compare species preferences among children in North Carolina (USA) and children in Andros Island (The Bahamas). North Carolina and Andros Island provide useful, representative study sites because extinction drivers in these regions match those that are generally expected on continental and island locations, respectively. In North Carolina, over 90% of the most common ecosystem type (longleaf pine forest) was eliminated by fire suppression and other land uses (e.g. pine plantations and urban areas), threatening the entire suite of species, including communities of carnivorous plants, amphibians and birds, such as the red-cockaded woodpecker and Bachman's sparrow (Lueck & Michael 2000; Van Lear *et al.* 2005). The main threat to native species on Andros Island comes from invasive species. Although harvesting of wildlife by humans as well as habitat destruction contribute to declining populations of native species on Andros Island, many native species face their greatest threats from feral cats and dogs and wild pigs (Carey *et al.* 2001; Knapp & Owens 2005; Knapp *et al.* 2011).

Here, we tested two hypotheses. First, grounded in islanders' opposition to the eradication of non-native species (Fortwangler 2009; Lynch *et al.* 2010; Ogden & Gilbert 2011) and the fact that feral cats, dogs and pigs are more prevalent on Andros than in North Carolina, we tested the hypothesis that children on Andros (island) would prefer invasive or exotic species more than children in North Carolina (continental). Second, we evaluated differences between genders, testing the hypothesis that boys prefer animals that tend to invoke fear or disgust more than girls (Prokop & Tunnicliffe 2010; Schlegel & Rupf 2010).

MATERIALS AND METHODS

Sampling

In North Carolina, we used a stratified random sample of elementary school children. We randomly chose 60 public schools with third- and fifth-grade classes (ages 8–11 years) from a list of all such schools in the state, compiled a list of all third- and fifth-grade teachers in those selected schools and randomly selected 118 teachers for participation. From these, 36 teachers responded (30.5% response rate), with 21 giving consent to participate in the study (58.3% compliance rate). We visited 16 classrooms (we could not visit five of them

https://doi.org/10.1017/S0376892917000133 Published online by Cambridge University Press

because of scheduling conflicts), and 433 students completed written surveys in March 2014.

On Andros Island, we did not have access to a valid sampling frame, so we used a combination of school sampling and intercept sampling (Stedman *et al.* 2004) to achieve broad coverage across the island. Andros comprises several islands, but our study focused on North Andros Island, which is the largest and most populous. The Bahamas National Trust facilitated sampling at primary schools; we visited three schools and 106 students in grades 2–5 (ages 7–11 years) completed written surveys. We used intercept sampling at seven additional locations: Mastic Point ($n = 13$), Stafford Creek/Blanket Sound ($n = 7$), Staniard Creek ($n = 7$), Love Hill ($n = 9$), Fresh Creek ($n = 28$), Bowen Sound ($n = 12$) and Cargill Creek/Behring Point ($n = 15$). Forfar Field Station staff facilitated the intercept sampling – as they were familiar with local households – by approaching households with children within the specified age range (5–12 years) to request participation from parents and children. Approximately 20% ($n = 197$) of all children aged 5–12 years on the island participated in the study (Department of Statistics of The Bahamas 2013). All research methods were reviewed and approved by the North Carolina State University Institutional Review Board for the Protection of Human Subjects (Protocol 5941).

Using different sampling methods in the continental and island locations could create unwanted bias in comparisons. However, the only expected bias associated with sampling differences between locations would likely result in our finding less support for children on Andros preferring invasive or exotic species more than children in North Carolina. This is because the Andros sample had greater representation (37%) of children who participated in an environmental education programme that was designed and demonstrated to promote preferences for endemic and threatened species (Shapiro *et al.* 2016) than the North Carolina sample (near 0%). Specifically, these children on Andros participated in Discovery Club, an elective environmental club through which children learn about natural areas, species found in The Bahamas and the importance of conservation (Bahamas National Trust 2016). Previous research suggests Discovery Club members prioritize for conservation those native species whose numbers are rapidly declining, while non-members do not show this prioritization (Shapiro *et al.* 2016). In North Carolina, there were no large biodiversity-centred environmental education curricula at the elementary level, and in a survey of 627 randomly selected teachers from kindergarten to fifth-grade classes (ages 5–11 years) in North Carolina, only 27% included any form of environmental education curricula in their instruction (Stevenson *et al.* 2014). Our sampling approach could not generate age differences between locations, but 76% of students in both locations were between 8 and 11 years old, yielding high overlap. Further, the only age effects on wildlife preferences to have been previously identified were for more disparate ages than those observed in this study (e.g. ages 9–10 years versus 11–15 years) (Bjerke *et al.* 1998).

Questionnaire design

Our brief questionnaire was pre-tested with third-grade ($n = 37$) and fifth-grade students ($n = 32$) from North Carolina. They were asked to circle any parts of the questions that were difficult to understand and to make any suggestions that could clarify the question. We then conducted cognitive interviews (Desimone & Le Floch 2004) with 12 students. We asked students to respond to different wordings until the responses supported the face validity of the question (Frew *et al.* 2016). We measured students' wild animal preferences using a ranking exercise in which children were told that wildlife referred to "all animals that live in nature," and then asked, "What are your five favourite kinds of wild animals that live in North Carolina (or in The Bahamas)? Remember to put your most favourite first. If you don't know the name of five animals, just list as many as you can." Students were also asked to indicate whether they were a boy or a girl (see Supplementary Material online).

Statistical analysis

We assigned each species listed by students to one of 24 taxonomic categories. A single species received its own category if it occurred in at least 10% of surveys within either region. For all other species, we used relevant taxonomic groupings (e.g. fish or bird). For each child, a score of 1 (preferred species) was assigned to each taxonomic category listed by the child, while a 0 was scored for all others (i.e. presence/absence). Using the PRIMER 6 software package (Clarke & Gorley 2006), we conducted analysis of similarities (ANOSIM; 9999 permutations) of the Bray–Curtis similarity matrix (Bray & Curtis 1957) to test whether children's native wildlife preferences differed between regions (Andros Island and North Carolina) and genders. We conducted two-dimensional non-metric multidimensional scaling (MDS) to visualize any differences in children's species preferences between regions and genders. We interpreted MDS axes using Spearman's correlation between preferences for each taxonomic category and the two axes (p-values adjusted to control for a false discovery rate of 5%) (Benjamini & Hochberg 1995). We calculated overall percentage occurrences of preferences for three major groups of animals: invertebrates, aquatic species and invasive species (cats, wild hogs and lionfish). We only included species that were obviously invasive in the latter category, although the vast majority of dogs on Andros are feral.

RESULTS

We had roughly equal representations of genders in both regions (53% female in North Carolina and 49% female in Andros), with a total of 630 completed surveys. In North Carolina, we surveyed children between the ages of 8 and 11 years. On Andros Island, we surveyed children between the ages of 4 and 14 years, with an average age of

https://doi.org/10.1017/S0376892917000133 Published online by Cambridge University Press

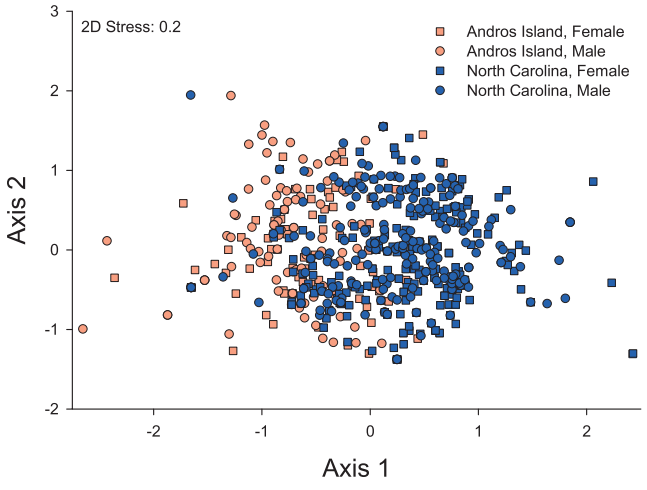

Figure 1 Non-metric multidimensional scaling plot of children's species preferences. Loadings for the taxonomic groups along the axes are given in Table 1. Axis 1 correlates with location and axis 2 correlates with gender.

8.9 years (±SD 1.8). Children's species preferences differed between regions (ANOSIM, $R = 0.262$, $p < 0.0001$) and genders (ANOSIM, $R = 0.025$, $p < 0.0001$). MDS revealed clear differences between regions, and weaker differences between genders (Fig. 1). Based on correlations between taxonomic groups and MDS axes, as well as percentage occurrences of children's preferences for the taxonomic groups, the strongest differences between regions were that preferences on Andros were stronger for dog, cat and wild hog, whereas preferences in North Carolina were stronger for deer, fox, wolf and bear (Table 1, Fig. 2). Andros children also showed greater preferences for crab, flamingo, fish, lizard and insect–arachnid, while North Carolina children had greater preferences for squirrel and rabbit (Table 1, Fig. 2). Boys in both regions had greater preferences for lizard and fish, while girls had stronger preferences for 'other mammal', rabbit and horse. Among the three major animal groups, island children had stronger preferences for invertebrate, aquatic and invasive species than continental children (Fig. 3).

Table 1 Associations between preferences for each taxonomic category and the non-metric multidimensional scaling (MDS) axes depicted in Figure 1 (p-values adjusted to control for a false discovery rate of 5%; ρ = Spearman's correlation coefficient). For MDS axis 1, positive correlations indicate stronger preferences for a given category in North Carolina compared to Andros Island. For MDS axis 2, positive correlations indicate stronger preferences for a given category in males compared to females.

	MDS axis 1		*MDS axis 2*	
Species	ρ	p	ρ	p
Insect–arachnid	–0.13	0.0018	0.14	0.0012
Crab	–0.22	<0.0001	0.13	0.0027
Other marine invertebrate	–0.06	0.1890	0.07	0.0800
Other invertebrate	–0.08	0.0519	0.06	0.1920
Fish	–0.17	<0.0001	0.33	<0.0001
Shark	–0.11	0.0067	0.01	0.8711
Lizard	–0.14	0.0010	0.24	<0.0001
Turtle	0.11	0.0084	0.08	0.0567
Snake	–0.04	0.3487	0.09	0.0384
Other reptile/ amphibian	0.08	0.0468	0.16	<0.0001
Flamingo	–0.19	<0.0001	0.11	0.0098
Other bird	0.05	0.2141	0.60	<0.0001
Bear	0.33	<0.0001	–0.09	0.0432
Cat	–0.59	<0.0001	–0.11	0.0093
Deer	0.63	<0.0001	0.15	0.0004
Dog	–0.66	<0.0001	–0.29	<0.0001
Fox	0.43	<0.0001	–0.05	0.2525
Horse	–0.04	0.3694	–0.11	0.0098
Lion	–0.21	<0.0001	–0.32	<0.0001
Rabbit	0.21	<0.0001	0.09	0.0335
Squirrel	0.24	<0.0001	0.16	<0.0001
Wild hog	–0.34	<0.0001	–0.04	0.3580
Wolf	0.34	<0.0001	–0.16	<0.0001
Other mammal	0.10	0.0125	–0.65	<0.0001

DISCUSSION

Children from Andros preferred non-native invasive species or taxa that are characteristic of islands with low species richness, whereas children from North Carolina preferred charismatic native species. These differences might arise for several reasons, some of which seem clearly related to the distinction between island and continental locations. Species assemblages and abundances fit the island versus mainland distinction, as feral cats and pigs often persist at high densities on islands relative to continents (D'Antonio & Dudley 1995). Similarly, crabs and fish (notably saltwater fish species) would intuitively play a more central role in the lives of people living on small islands than in the lives of people distributed across a continental land mass. Conversely, there may be some elements of Androsian and North Carolina culture that impact species preferences without being related to the island versus continent distinction, which may be identified in future research with replication of island and continental locations.

Three of the most frequently preferred species on Andros Island were invasive species, and all reflect feral domesticated animals: dogs, cats and wild hogs. Most (65%) children surveyed on Andros Island mentioned at least one of these species. These three species also exhibited some of the strongest differences between regions, with North Carolina children much more rarely listing these species among their favourites, despite these species existing in North Carolina. The observed preference for invasive species by children on Andros corroborates previous findings that islanders view an invasive species more positively if that species serves some cultural or economic role in the society (Fortwangler 2009; Lynch *et al.* 2010; Ogden & Gilbert 2011). Feral dogs and cats are often viewed positively because of their likeness to pets, even in the face of negative impacts on native species

https://doi.org/10.1017/S0376892917000133 Published online by Cambridge University Press

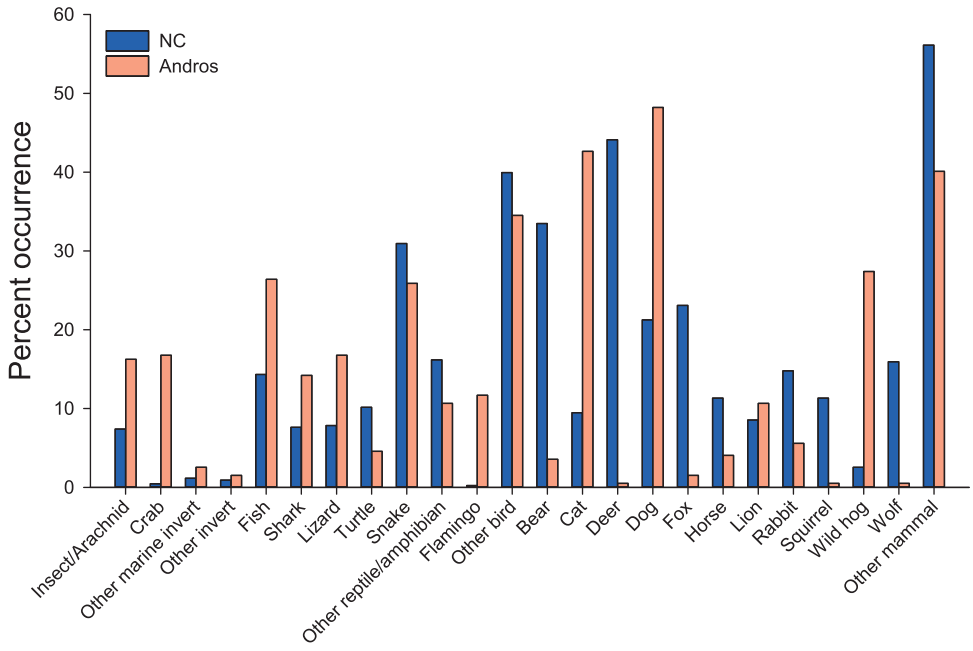

Figure 2 Children's species preferences. Percentage occurrences of children's wildlife preferences for 24 taxonomic categories between an island location (Andros Island, The Bahamas) and a continental location (North Carolina, USA).

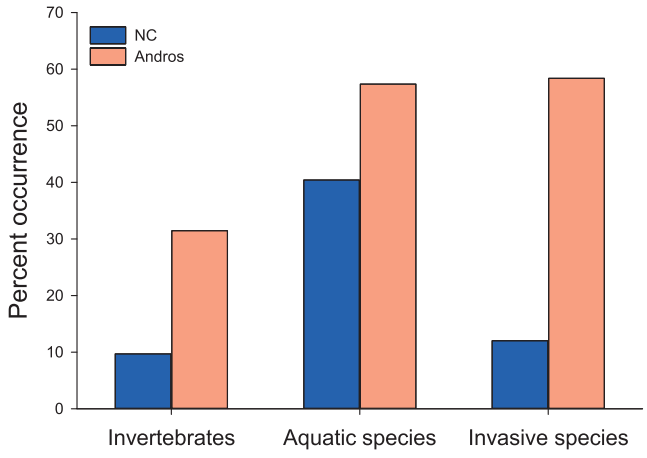

Figure 3 Children's preferences for three major species groups. Percent occurrences of preferences for three major species groups between an island location (Andros Island, The Bahamas) and a continental location (North Carolina, USA).

(Ash & Adams 2003; Prokop & Tunnicliffe 2010), and wild hogs provide a source of recreation, hunting and food on the island. Another explanation for this preference is the lack of native charismatic mammals on Andros Island. Children often prefer mammals and exotic megafauna (Schlegel & Rupf 2010; Ballouard *et al.* 2011; Borgi & Cirulli 2015). The absence of native charismatic mammals, coupled with the anthropomorphization of species non-native to Andros in media targeting children, could lead to their greater preference for non-native species (Bjerke & Ostdahl 2004; Wagler 2010; Borgi & Cirulli 2015).

Our findings suggest that biodiversity conservation on Andros Island may face interacting challenges from both natural and social systems. Island wildlife populations are especially vulnerable to the negative impacts of invasive species, and conservation actions often focus on the eradication of invasive species in island situations (Mack & Lonsdale 2002; Howald *et al.* 2007). However, conservation plans can fail because of public resistance (Kaltenborn *et al.* 2006; Fortwangler 2009). Our finding that children on Andros had a strong preference for invasive species indicates that any plan to eradicate or reduce these popular species could be met with resistance. Although preference for the species does not necessarily translate to opposition to lethal management, the relationship is intuitive and will be important to explore in future research. To change children's preferences for non-native species, environmental education programs will need to both introduce children to native species and effectively convey the impacts of invasive species on the local environment. On Andros, participation in environmental education through Discovery Club did predict concern for native species experiencing population declines (Shapiro *et al.* 2016), so tailoring education materials to help children understand how invasive species impact the declining native species seems like a logical first step. Once children learn about native species, their preference for them typically rises (Lindemann-Matthies 2005). Similarly, environmental education programmes that focus on knowledge of and direct experiences with natural places and native species can help increase appreciation for threatened species (Shapiro *et al.* 2016).

Children tended to prefer locally abundant or charismatic native animals in both locations. The species preferences that were greater for children in North Carolina exclusively involved mammals native to North Carolina that do not exist on Andros: deer, fox, wolf, bear, squirrel and rabbit.

https://doi.org/10.1017/S0376892917000133 Published online by Cambridge University Press

Species with greater preferences by children on Andros either involved charismatic species native to Andros and not found in North Carolina (flamingo) or species commonly encountered on Caribbean islands: crab, fish, lizard and insect–arachnid. Island children exhibited much stronger preferences for the latter species, despite these taxonomic groups being native to North Carolina. With the absence of charismatic mammals on islands, insect–arachnid groups may be more noticeable. Children may exhibit preferences for common native species because they have an innate curiosity regarding the natural world (Maltese & Tai 2010; Kirikkaya 2011) and learn about their surroundings through direct observation (Kellert 2002). Developmentally, young learners interpret the world through direct experiences, personal or egocentric concerns and local geographies (Kellert 2002). It follows that children are likely to name common native species among their favourites because those are the ones they observe directly and relate most to their own context.

Differences in species preferences between genders largely coincided with patterns found in previous studies (Prokop & Tunnicliffe 2010; Schlegel & Rupf 2010). The fact that boys preferred fish, a species grouping with utilitarian associations (food and recreation) whereas girls preferred mammals such as rabbits and horses could reflect boys' more utilitarian perspective towards non-human animals (Kellert & Berry 1987; Bjerke *et al.* 1998; Tarrant & Cordell 2002). We acknowledge that horses and rabbits can have utilitarian associations, but such use of those species is essentially non-existent on Andros and certainly less common than the utilitarian use of fish species in North Carolina.

Our study uncovered clear differences in native wildlife species preferences of children between these island and continental locations. However, the ability to generalize these results is limited by not replicating the island and continental locations, and thus further research is needed to test whether the pattern observed here holds in other places. This replication would identify any impacts of unique cultural and geographic attributes that cannot be defined by the island–continent distinction. There is very limited research on the wildlife preferences of children, and there have been virtually no cross-culture studies conducted on these. Previous cross-cultural studies have focused on wildlife preferences for a specific, often unpopular species (Prokop *et al.* 2009b; Prokop *et al.* 2010a). In this context, research exploring whether children from other island nations prefer invasive species and why they do, as well as how to use environmental education to combat these predilections, would be particularly valuable. We need more research into which species children prefer, both because biodiversity conservation is for their benefit and because children directly influence the opinions of their parents (Hampshire 2000; Legault & Pelletier 2000; Flurry & Burns 2005). Understanding children's wildlife species preferences would help scientists to design better conservation strategies that incorporate all people's preferences into successful conservation plans.

ACKNOWLEDGEMENTS

We thank North Carolina State University's Department of Forestry and Environmental Resources for support and the teachers and students who participated in the study. We thank Forfar Field Station staff, particularly Kate Hammond and Lyndon Rolle, and the Bahamas National Trust, especially Portia Sweeting and Leslie Brace, for facilitating the surveys. We also thank Kenneth Erickson, Alayne McKnight and Haley Doty for assistance in conducting the surveys. This is publication #7 from the North Carolina State University Bahamas Field Course.

ETHICAL STANDARDS

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

Supplementary Material

For supplementary material accompanying this paper, visit https://doi.org/10.1017/S0376892917000133

References

Ash, S.J. & Adams, C.E. (2003) Public preferences for free-ranging domestic cat (*Felis catus*) management options. *Wildlife Society Bulletin* **31**: 334–339.

Backer, D.M., Jensen, S. & McPherson, G. (2004) Impacts of fire-suppression in activities on natural communities. *Conservation Biology* **4**: 937–946.

Bahamas National Trust (2016) Discovery Club [www document]. Available at: http://www.bnt.bs/_m1891/Discovery-Club

Ballouard, J.M., Brischoux, F. & Bonnet, X. (2011) Children prioritize virtual exotic biodiversity over local biodiversity. *PLoS ONE* **6**: e23152.

Batt, S. (2009) Human attitudes towards animals in relation to species similarity to humans: a multivariate approach. *Bioscience Horizons* **2**: 180–190.

Benjamini, Y. & Hochberg, Y. (1995) Controlling the false discovery rate: a practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society B*. **57**: 289–300.

Borgi, M. & Cirulli, F. (2015) Attitudes toward animals among kindergarten children: species preferences. *Anthrozoös* **28**: 45–59.

Bjerke, T., Ødegårdstuen, T.S. & Kaltenborn, B.P. (1998) Attitudes toward animals among norwegian children and adolescents: species preferences. *Anthrozoös* **11**: 227–235.

Bjerke, T., Østdahl, T. & Kleiven, J. (2003) Attitudes and activities related to urban wildlife: pet owners and non- owners. *Anthrozoös* **16**: 252–262.

Bjerke, T. & Østdahl, T. (2004) Animal-related attitudes and activities in an urban population. *Anthrozoös* **17**: 109–129.

Bray, J.R. & Curtis, J.T. (1957) An ordination of upland forest community of Southern Wisconsin. *Ecological Monographs* **27**: 325–349.

Brito, J.C., Rebelo, A. & Crespo, E.G. (2001) Viper killings for superstitious reasons in Portugal. *Bolletin Asociacion Herpetologica Española* **12**: 101–104.

Carey, E.S., Buckner, S.D., Alberts, A.C., Hudson, R.D. & Lee, D. (2001) Protected areas management strategy for Bahamian terrestrial vertebrates: iguanas and seabirds. IUCN/SSC Conservation Breeding Specialists Group Report, Apple Valley, Minnesota [www document]. Available at: http://www.cbsg.org/sites/cbsg.org/files/documents/Bahama%20Iguanas%20and%20Seabirds%20CAMP%202000.pdf

Clarke, K.R. & Gorley, R.N. (2006) *PRIMER v6: User Manual/Tutorial*. Plymouth, UK: PRIMER-E.

Clavero, M., Brotons, L., Pons, P. & Sol, D. (2009) Prominent role of invasive species in avian biodiversity loss. *Biological Conservation* **142:** 2043–2049.

Cruz, F., Donlan, J.C., Campbell, K. & Carrion, V. (2005) Conservation action in the Galapagos: feral pig (*Sus scrofa*) eradication from Santiago Island. *Biological Conservation* **121**: 473–478.

Curnick, D.J., Head, C.E.I., Huang, D., Crabbe, M.J.C., Gollock, M., Hoeksema, B.W., Johnson, K.G., Jones, R., Koldewey, H.J., Obura, D.O. & Rosen, B.R. (2015) Setting evolutionary-based conservation priorities for a phylogenetically data-poor taxonomic group (Scleractinia). *Animal Conservation* **18**: 303–312.

Czech, B., Krausman, P.R. & Borkhataria, R. (1998) Social construction, political power, and the allocation of benefits to endangered species. *Conservation Biology* **12**: 1103–1112.

Damerell, P., Howe, C. & Milner-Gulland, E.J. (2013) Child-oriented environmental education influences adult knowledge and household behavior. *Environmental Research Letters* **8**: 1–7.

D'Antonio, C.M. & Dudley, T.L. (1995) Biological invasions as agents of change on islands versus mainlands. In: *Islands*, pp. 103–121. Heidelberg, Germany: Springer.

Department of Statistics of The Bahamas (2013) Population Census 2010 [www document]. Available at: http://statistics.bahamas.gov.bs/key.php?cat=13

Desimone, L.M. & Le Floch, K.C. (2004) Are we asking the right questions? Using cognitive interviews to improve surveys in education research. *Education Evaluation and Policy Analysis* **26**: 1–22.

Dickman, A.J. (2010) Complexities of conflict: the importance of considering social factors for effectively resolving human–wildlife conflict. *Animal Conservation* **13**: 458–466.

Duncan, R.P. & Blackburn, T.M. (2004) Extinction and endemism in the New Zealand avifauna. *Global Ecology and Biogeography* **13**: 509–517.

Duvall, J. & Zint, M. (2007) A review of research on the effectiveness of environmental education in promoting intergenerational learning. *The Journal of Environmental Education* **38**: 14–24.

Ericsson, G., Heberlein, T.A., Karlsson, J., Bjärvall, A. & Lundvall, A. (2004) Support for hunting as a means of wolf *Canis lupus* population control in Sweden. *Wildlife Biology* **10**: 269–276.

Fita, D.S., Neto, E.M.C. & Schiavetti, A. (2010) 'Offensive' snakes: cultural beliefs and practices related to snakebites in a Brazilian rural settlement. *Journal of Ethnobiology and Ethnomedicine* **6**: 1.

Flurry, L.A. & Burns, A.C. (2005) Children's influence in purchase decisions: a social power theory approach. *Journal of Business Research* **58**: 593–601.

Fortwangler, C. (2009) A place for the donkey: natives and aliens in the US Virgin Islands. *Landscape Research* **34**: 205–222.

Frew, K., Peterson, M.N. & Stevenson, K. (2016) Are we working to save the species our children want to protect? Evaluating species attribute preferences among children. *Oryx* 1–9.

Gratwicke, B., Mills, J., Dutton, A., Gabriel, G., Long, B., Seidensticker, J., Wright, B., You, W. & Zhang, L. (2008) Attitudes toward consumption and conservation of tigers in China. *PLoS ONE* **3**: e2544.

Hamber, C., Henderson, P.A. & Speight, M.R. (2011) Extinction rates, extinction-prone habitats, and indicator groups in Britain and at larger scales. *Biological Conservation* **144**: 713–721.

Hampshire, M. (2000) Lost in cyberspace. *The Times Educational Supplement*, 30–31.

Howald, G., Donlan, C., Galván, J.P., Russell, J.C., Parkes, J., Samaniego, A., Wang, Y., Veitch, D., Genovesi, P., Pascal, M., Saunders, A. & Tersy, B. (2007) Invasive rodent eradication on islands. *Conservation Biology* **21**: 1258–1268.

Kaltenborn, B.P., Bjerke, T., Nyahongo, J.W. & Williams, D.R. (2006) Animal preferences and acceptability of wildlife management actions around Serengeti National Park, Tanzania. *Biodiversity & Conservation* **15**: 4633–4649.

Kellert, S.R. (2002) Experiencing nature: affective, cognitive, and evaluative development in children. In: *Children and Nature: Psychological, Socio-cultural and Evolutionary Investigations*, eds. P.H. Kahn & S.R. Kellert, pp. 117–151. Cambridge, MA: MIT Press.

Kellert, S.R. (1996) *The Value of Life: Biological Diversity and Human Society*. Washington, DC: Island Press.

Kellert, S.R. (1993) Values and perceptions of invertebrates. *Conservation Biology* **7**: 845–855.

Kellert, S.R. & Berry, J. (1987) Attitudes, knowledge, and behaviors toward wildlife as affected by gender. *Wildlife Society Bulletin* **15**: 363–371.

Kellert, S.R. (1985) Public perceptions of predators, particularly the wolf and coyote. *Biological Conservation* **31**: 167–189.

Kindall, J.L. & Van Manen, F.T. (2007) Identifying habitat linkages for American black bears in North Carolina, USA. *Journal of Wildlife Management* **71**: 487–495.

Kirikkaya, E.B. (2011) Grade 4 to 8 primary school students' attitudes towards science: science enthusiasm. *Educational Research and Reviews* **6**: 374–382.

Knapp, C.R. & Owens, A.K. (2005) Home range and habitat associations of a Bahamian iguana: implications for conservation. *Animal Conservation* **8**: 269–278.

Knapp, C.R., Iverson, J.B., Buckner, S.D. & Cant, S.V. (2011) Conservation of amphibians and reptiles in The Bahamas. In: *Conservation of Caribbean Island Herpetofaunas*, eds. A. Hailey, B.S. Wilson, & J.A. Horrocks, pp. 53–87. Leiden, The Netherlands: Brill NV.

Legault, L. & Pelletier, L.G. (2000) Impact of environmental education program on students' and parents' attitudes, motivations and behaviours. *Canadian Journal of Behavioral Science*, **32**: 243–250.

Leeming, F.C., Porter, B.E., Dwyer, W.O., Cobern, M.K. & Oliver, D.P. (1997) Effects of participation in class activities on children's environmental attitudes and knowledge. *The Journal of Environmental Education* **28**: 33–42.

Lindemann-Matthies, P. (2005) "Loveable" mammals and "lifeless" plants: how children's interest in common local organisms can be enhanced through observation of nature. *International Journal of Science Education* **27**: 655–677.

Lueck, D. & Michael, J.A. (2000) Preemptive Habitat Destruction Under the Endangered Species Act [www document]. Available at: http://ssrn.com/abstract=223871

Lynch, A.J.J., Fell, D.G. & McIntyre-Tamwoy, S. (2010) Incorporating Indigenous values with 'Western' conservation values in sustainable biodiversity management. *Australasian Journal of Environmental Management* **17**: 244–255.

Mack, R.N. & Lonsdale, W.M. (2002) Eradicating invasive plants: hard-won lessons for islands. In: *Turning the Tide: The Eradication of Invasive Species*, eds. C.R. Veitch & M.N. Clout, pp. 164–172. Auckland, New Zealand: Hollands Printing Ltd.

Maltese, A.V. & Tai, R.H. (2010) Eyeballs in the fridge: sources of early interest in science. *International Journal of Science Education* **32**: 669–685.

McCallum, M.L. (2015) Vertebrate biodiversity losses point to a sixth mass extinction. *Biodiversity & Conservation* **24**: 2497–2519.

Meine, C., Soulé, M. & Noss, R.F. (2006) 'A mission-driven discipline': the growth of conservation biology. *Conservation Biology* **20**: 631–651.

Meuser, E., Harshaw, H.W. & Mooers, A.O. (2009) Public preference for endemism over other conservation-related species attributes. *Conservation Biology* **23**: 1041–1046.

More, T.A. (1979) Wildlife preferences and children's books. *Wildlife Society Bulletin* **7**: 274–278.

Nogales, M., Martín, A., Tershy, B.R., Donlan, C.J., Veitch, D., Puerta, N., Wood, B. & Alonso, J. (2004) A review of feral cat eradication on islands. *Conservation Biology* **18**: 310–319.

Ogden, J. & Gilbert, J. (2011) Running the gauntlet: advocating rat and feral cat eradication on an inhabited island – Great Barrier Island, New Zealand. In: *Island Invasives: Eradication and Management*, eds. C.R. Veitch, M.N. Clout & D.R. Towns, pp. 467–471. Christchurch, New Zealand: The Caxton Press.

Pimm, S.L., Jenkins, C.N, Abell, R., Brooks, T.M., Gittleman, J.L, Joppa, L.N, Raven, P.H., Roberts, C.M. & Sexton, J.O. (2014) The biodiversity of species and their rates of extinction, distribution, and protection. *Science* **344**: 1246752.

Peterson, M.N., Peterson, T.R., Peterson, M.J., Lopez, R.R. & Silvy, N.J. (2002) Cultural conflict and the endangered Florida Key deer. *The Journal of Wildlife Management* **66**: 947–968.

Prokop, P., Fančovičová, J. & Kubiatko, M. (2009a) Vampires are still alive: Slovakian students' attitudes toward bats. *Anthrozoös* **22**: 19–30.

Prokop, P., Özel, M. & Usak, M. (2009b) Cross-cultural comparison of student attitudes toward snakes. *Society & Animals* **17**: 224–240.

Prokop, P., Tolarovičová, A., Camerik, A.M. & Peterková, V. (2010a) High school students' attitudes towards spiders: a cross-cultural comparison. *International Journal of Science Education* **32**: 1665–1688.

Prokop, P. & Tunnicliffe, S.D. (2010) Effects of having pets at home on children's attitudes toward popular and unpopular animals. *Anthrozoös* **23**: 21–35.

Prokop, P., Usak, M. & Fančovičová, J. (2010b) Risk of parasite transmission influences perceived vulnerability to disease and perceived danger of disease-relevant animals. *Behavioural Processes* **85**: 52–57.

Prokop, P. & Fančovičová, J. (2013) Does colour matter? The influence of animal warning coloration on human emotions and willingness to protect them. *Animal Conservation* **16**: 458–466.

Rodda, G.H. & Savidge, J.A. (2007) Biology and impacts of Pacific Island invasive species. 2. *Boiga irregularis*, the brown tree snake (Reptilia: Colubridae). *Pacific Science* **61**: 307–324.

Schlegel, J. & Rupf, R. (2010) Attitudes towards potential animal flagship species in nature conservation: a survey among students of different educational institutions. *Journal of Nature Conservation* **18**: 278–290.

Shapiro, H.G., Erickson, K.A., Peterson, M.N., Frew, K.N., Stevenson, K.T., Langerhans, R.B. (2016) Which species to conserve. Evaluating children's species-based conservation priorities. *Biodiversity & Conservation* **25**: 539–553.

Sharitz, R.R. (2003) Carolina bay wetlands: unique habitats of the southeastern United States. *Wetlands* **23**: 550–562.

Shine, R. (2010) The ecological impact of invasive cane toads (*Bufo marinus*) in Australia. *The Quarterly Review of Biology* **85**: 253–291.

Simberloff, D. (2000) Extinction-proneness of island species – causes and management implications. *Raffles Bulletin of Zoology* **48**: 1–9.

Sodhi, N.S., Posa, M.C., Lee, T.M., Bickford, D., Koh, L.P., Brook, B.W. (2010) The state and conservation of Southeast Asian biodiversity. *Biodiversity & Conservation* **19**: 317–328.

Stedman, R., Diefenback, D.R., Swope, C.B., Finley, J.C., Luloff, A.E., Zinn, H.C., San-Julian, G.J. & Wang, G.A. (2004) Integrating wildlife and human-dimensions research methods to study hunters. *Journal of Wildlife Management* **68**: 322–348.

Stevenson, K.T., Peterson, M.N., Bondell, H.D., Moore, S.E. & Carrier, S.J. (2014) Overcoming skepticism with education: interacting influences of worldview and climate change knowledge on perceived climate change risk among adolescents. *Climatic Change* **126**: 293–304.

Stevenson, K.T., Carrier, S.J. & Peterson, M.N. (2014) Evaluating strategies for inclusion of environmental literacy in the elementary school classroom. *Electronic Journal of Science Education*, **18**: 1–17.

Tarrant, M.A. & Cordell, H.K. (2002) Amenity values of public and private forests: examining the value-attitude relationship. *Environmental Management* **20**: 692–703.

Uzzell, D., Davallon, J., Bruun Jensen, B., Gottesdiener, H., Fontes, J., Kofoed, J. *et al.* (1994) Children as catalysts of environmental change. Report to DGXII/D-5 Research on Economic and Social Aspects of the Environnent (SEER) [www document]. Available at: http://s3.amazonaws.com/academia.edu.documents/6978005/ECFINAL.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1487291451&Signature=yVHUv3aUlbnzBJKepBeJ1YqPoPU%3D&response-content-disposition=inline%3B%20filename%3DChildren_as_Catalysts_of_Environmental_C.pdf

Van Lear, D.H., Carroll, W.D., Kapeluck, P.R. & Johnson, R. (2005) History and restoration of the longleaf pine-grassland ecosystem: implications for species at risk. *Forest Ecology and Management* **211**: 150–165.

Verissimo, D., Fraser, I., Groombridge, J., Bristol, R. & MacMillan, D.C. (2009) Birds as tourism flagship species: a case study of tropical islands. *Animal Conservation* **12**: 549–558.

Wagler, R. (2010) The association between preservice elementary teacher animal attitude and likelihood of animal incorporation in future science curriculum. *The International Journal of Environmental and Science Education* **5**: 353–375.

Walsh, R.G., Loomis, J.B. & Gillman, R.A. (1984) Valuing option, existence, and bequest demands for wilderness. *Land Economics* **60**: 14–29.

Weiss, E.B. (1990) Our rights and obligations to future generations for the environment. *The American Journal of International Law* **84**: 198–207.

Wilson, K.A., McBride, M.F., Bode, M. & Possingham, H.P. (2006) Prioritizing global conservation efforts. *Nature* **440**: 337–340.