Title: Wildlife species preferences differ among children in continental and island locations

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Abstract:

Efforts to prioritize wildlife for conservation benefit from an understanding of public preferences for particular species. Despite the growing number of studies addressing this issue, none 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). We found that children on islands prefer feral domestic species, which can pose a challenge to conservation. We also found that children on islands prefer different types of taxa than mainland children, perhaps due to the strongly divergent species richness among 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 suggest 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.

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Introduction:

Rapidly growing threats to biodiversity render prioritizing species for protection essential to conservation biology. 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 (Cumberlidge *et al.* 2009; Pimm *et al.* 2014, McCallum 2015). Wildlife conservation relies heavily on the attitudes of the general public (Dickman 2010), which often differ from the attitude of professionals, because protecting wildlife requires human intervention (Ericsson *et al.* 2004; Gratwicke *et al.* 2008; Prokop & Fancovicova 2013). The public's perception of an animal species directly impacts its conservation status, as negative cultural biases towards certain wildlife paired with anthropogenic impacts have driven several species to near extinction (Fita *et al.* 2010; Brito *et al.* 2012).

When creating conservation plans, scientists have used criteria including population size and dynamics, economic value, ecological significance, and endemism, to support their decisions (Avise 2005; Wilson *et al.* 2006; Naidoo *et al.* 2008; Sodhi *et al.* 2010; Curnick *et al.* 2015); however, they rarely take into consideration people's perception of a species, which can cause the plan to fail because of unanticipated public resistance or lack of public support (Kaltenborn *et al.* 2006). Recent research has been conducted in order to fill the gap between scientists' decisions and public perception because the public plays a vital role in the success of a conservation management plan (Boxall & Macnab 2000; Miller & McGee 2001; Martin-Lopez *et al.* 2007, 2009). These studies have identified important patterns. First, preferences for animals varies between wildlife species (Bjerke *et al.* 2003; Schlegel and Rupf 2010; Ballouard *et al.*

2011). The public generally prefers birds and mammals over reptiles and invertebrates (Czech *et al.* 1998). The reasoning behind this bias has been attributed to the "similarity principle," which explains that humans prefer animals that are biobehaviorally 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 the danger posed by a certain species, especially in the case of invertebrates (Kaltenborn *et al.* 2006; Batt 2009; Prokop & Fancovicova 2012). Women's preferences are generally dictated more by fear and disgust than men, especially in cases where the species pose a threat to humans, as with some snakes and parasites (Prokop *et al.* 2009a,b; Prokop *et al.* 2010c; Prokop 2013). Finally, people tend to favor animals with aesthetic value and charismatic species (Kattleborn *et al.* 2005; Schlegel & Rupf 2010; Prokop & Fancovicova 2012).

New research on species preferences among children suggests their views are similar to adults, but may differ in key ways that are beneficial for conservation biology. Because children fundamentally shape the views of their parents (Hampshire 2000; Legault & Pelletier 2000; Flurry & Burns 2005) and because conservation biology aims to protect resources for future generations (Weiss 1990; Meine *et al.* 2006), scholars have recently started focusing on the species preferences of children. This work has found that children's preferences are similar to those of adults in multiple ways: children rank mammals and birds higher than invertebrates and reptiles, children favor exotic megafauna over local species, and less dangerous animals are preferred, indicating that fear and disgust play a role in children's preferences (Bjerke *et al.* 1998; Ballouard *et al.* 2011; Borgi & Cirulli 2015). However, children favored certain species that are generally ranked low by adults, such as turtles, snails, and butterflies (Borgi & Cirulli 2015). This finding has been attributed to the anthropomorphization of certain species through

media targeting children (More 1979; Bjerke & Ostdahl 2005; Wagler 2010; Borgi & Cirulli 2015). Boys tend to favor animals that evoke fear and disgust over girls, and girls prefer more loveable or cute animals (Prokop & Tunnicliffe 2010; Schlegel & Rupf 2010). Despite these similarities, children appear to prioritize species groups in ways similar to conservation biologists by prioritizing importance in nature over other attributes (Shapiro *et al.* 2016; Frew *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).

The growing body of research on species preferences, however, has not addressed how preferences may change under different biogeographic contexts critical to conservation biology. Several potentially valuable contexts exist (e.g., different biomes, different climates), but the difference between islands and continents may represent the most obvious biogeographic driver of species threats and extinction (Simberloff 2000). In continental locations, the leading causes for wildlife endangerment are habitat conversion (e.g., from forests to agriculture or urban land use) and suppression of natural processes (e.g., fire) (Flather *et al.* 1998; Sharitz 2003; Backer *et al.* 2004; Kindall & Van Manen 2007). For example, reptiles, such as black water snakes and bog turtles, and amphibians, like the flatwoods salamander, are highly susceptible to extinction due to habitat loss (Gibbon *et al.* 2000; Stuart *et al.* 2004; Cushman 2006). 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), raccoons (Ikeda *et al.* 2004), the cane toad (Shine 2010), and the Brown Tree Snake (Rodda & Savidge 2007) have caused multiple extinctions and endangerments of native wildlife on islands. Understanding how to address these differing

biodiversity threats across diverse biogeographical contexts should also take into account the potentially differing perceptions of wildlife in these locations.

We began addressing this gap in the literature with a case study comparing 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 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., row crops, pine plantations, urban areas), threatening the entire suite of species associated with the once ubiquitous ecosystem type including an entire community 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—the most impactful invasive species of all—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, dogs, and wild pigs (Alberts *et al.* 2000; Carey *et al.* 2001; Knapp & Owens 2005; Knapp *et al.* 2011). In this initial assessment of how species preferences might differ between an island and continental location we tested the hypothesis that children on Andros (island) would prefer invasive or exotic species more than children in North Carolina (continental). This hypothesis was grounded in both previous studies suggesting islanders opposed 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 also evaluated differences between

gender, 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

We attempted to survey children between 5 and 12 years old, because they constitute the earliest ages when outdoor experiences are linked to environmental attitudes and knowledge (Carrier *et al.* 2014). In North Carolina, we used a stratified random sample of elementary school children. We randomly choose 60 public schools with 3rd and 5th grade classes from a list of all such schools in the state, compiled a list of all 3rd and 5th 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 5 because of scheduling conflicts) and 433 students completed written surveys in March 2014.

On Andros Island, we did not have access to a database of teachers, and several schools chose not to participate in the study, so we used a combination of school sampling and intercept sampling (Stedman *et al.* 2004) to achieve broad coverage across the island. The Bahamas National Trust facilitated sampling at primary schools where we visited 3 schools and 106 students completed written surveys. Andros comprises several islands, but our study focused on North Andros Island, the largest and most populous. We used intercept sampling in 7 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). The Forfar Field Station staff facilitated the intercept sampling, as they were the most familiar with households in the communities, by approaching households with children within the specified age range (5-12) to request participation from parents and children. Approximately

20% (n = 197) of all children aged 5-12 on the island participated in the study (Department of Statistics of The Bahamas). All research methods were reviewed and approved by the NC State University Institutional Review Board for the Protection of Human Subjects (Protocol 5941).

Questionnaire Design:

Our questionnaire was pre-tested with 3rd and 5th grade students from North Carolina. We administered the survey to two classes of 5th graders (N = 32), and they were asked to circle any questions that were difficult to understand and to make any suggestions that would clarify the question. After making changes, the second draft was given to two classes of 3rd grade students (N = 37), who were also asked for feedback. We then conducted cognitive interviews (Desimone & Le Floch 2004) with 12 students who identified versions of questions that were easier to comprehend. We asked "What does this question mean to you?" for each question that students acknowledged as problematic. If the student's response did not reveal the intended meaning of the question, we asked students to respond to different versions of the question until the responses supported face validity of each question (Frew *et al.* 2016).

We measured students' wild animal preferences using a ranking exercise where children were told wildlife referred to "all animals that live in nature," and then asked "What are your five favorite kinds of wild animals that live in North Carolina (or in The Bahamas)? Remember to put your most favorite 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 girl.

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, bird, crab). 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 data). Using the PRIMER 6 software package (Clarke & Gorley 2006), we conducted analysis of similarities (ANOSIM; 9,999 permutations) of the Bray-Curtis similarity matrix (Bray & Curtis 1957) of these data 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) using PRIMER 6 to visualize any differences in children's species preferences between regions and genders. We interpreted MDS axes using Spearman correlation between preferences for each taxonomic category and the two axes (*P*-values adjusted to control for a false discovery rate of 5%, following Benjamini and Hochberg 1995). We further calculated percent occurrence of preferences for each taxonomic category in each region to aid interpretation of any differences. Based on patterns observed in the data, we further calculated overall percent occurrence of preferences for three major groups of animals: invertebrates, aquatic species, and invasive species (cats, wild hogs, lionfish). We only included species that were obviously invasive in the latter category, although the vast majority of dogs on Andros are feral, and could have been included in this grouping as well.

Results:

We had roughly equal representation of genders in both regions (53% female in North Carolina, 49% female in Andros), with a total of 630 completed surveys. In North Carolina, we surveyed children between the ages of 8 and 11, as this corresponds to the age range of 3rd and 5th graders. On Andros Island, we surveyed children between the ages of 4 and 14, with an average age of 8.9 (std dev = 1.8). Because 76% of children surveyed on Andros were 8-11 years old, we had broad overlap in age between the two regions. Children's species preferences differed between regions (ANOSIM, $R = 0.262$, $P < 0.0001$) and genders (ANOSIM, $R = 0.025$,

189 $P < 0.0001$). Non-metric multidimensional scaling revealed clear differences between regions,
190 and weaker differences between genders (Fig. 1). Based on correlations between taxonomic
191 groups and MDS axes, as well as percent occurrence of the taxonomic groups, the strongest
192 differences between regions were that preferences on Andros were stronger for dog, cat, and wild
193 hog, while preferences in North Carolina were stronger for deer, fox, wolf, and bear (Table 1,
194 Fig. 2). We also found smaller differences, where Andros children showed greater preferences
195 for crab, flamingo, fish, lizard, and insect-arachnid, while North Carolina children had greater
196 preferences for squirrel and rabbit (Table 1, Fig. 2). Inspecting multivariate results and percent
197 differences among genders, we found that boys in both regions had greater preferences for lizard
198 and fish, while girls had stronger preferences for 'other mammal,' rabbit, and horse. When
199 comparing regions for our three major animal groups, we found that island children had stronger
200 preferences for invertebrates, aquatic species, and invasive species than continental children (Fig.
201 3).

202 **Discussion:**

203 We found that children's preferences for wildlife species strongly differed between island
204 and continental locations. Children from Andros preferred non-native invasive species or taxa
205 characteristic of islands with low species richness, whereas children from North Carolina
206 preferred charismatic native species. These differences might arise for several reasons, and could
207 have important consequences for conservation.

208 Three of the most frequently preferred species on Andros Island were invasive species,
209 and all reflect feral domesticated animals: dogs, cats, and wild hogs. Most (65%) children
210 surveyed on Andros Island mentioned at least one of these species. These three species also
211 exhibited some of the strongest differences between regions, with North Carolina children much

more rarely listing these species among their favorites. Moreover, children in North Carolina did not exhibit preferences for any invasive species, even though invasive species do exist there. The observed preference for invasive species by island children is consistent with results of previous studies, which have found that islanders view 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), and dogs and cats are often viewed positively even in the face of negative impacts on native species, while 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. Previous studies show that 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 island children preferring non-native species relative to children from continental locations (Bjerke & Ostdahl 2005; Wagler 2010; Borgi & Cirulli 2015).

Our findings suggest biodiversity conservation on islands may face interacting challenges from both natural and social systems. Island wildlife populations are extremely vulnerable to the negative impacts of invasive species, so conservation biologists have often suggested complete eradication of invasive species on islands (Mack & Lonsdale 2002; Cromarty *et al.* 2002; Howald *et al.* 2007). However, conservation plans often fail because of public resistance or lack of support (Kaltenborn *et al.* 2006). For example, studies in Tristan and the US Virgin Islands outline the risks of implementing an eradication plan without considering the level of public support (Fortwangler 2009; Varnham *et al.* 2011). Our finding that island children have a strong preference for invasive species indicates that any plan to completely eradicate (or even reduce)

these popular species would be met with resistance. To combat 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. Once children learn about native species, their preference for them typically rises (Lindemann-Matthies 2005).

In addition to differential preferences for invasive species between regions, children tended to prefer locally abundant or charismatic native animals. The species preferences that were greater for children in North Carolina exclusively involved mammals native to North Carolina that did not exist on Andros: deer, fox, wolf, bear, squirrel, and rabbit. For the species with greater preferences by children on Andros, these either involved charismatic species native to Andros and not found in North Carolina (flamingo) or represented species commonly encountered on Caribbean islands: crab, fish, lizard, and insect-arachnid. For the latter species, island children exhibited much stronger preferences even though these taxonomic groups are also native to North Carolina. With the low species richness on islands, children may prefer species that often go relatively unnoticed in continental locations because of the absence of charismatic mammals. Children may exhibit preferences for common native species because they have an innate curiosity toward 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 concrete and direct experiences, personal or egocentric concerns, and local geographies (Kellert 2002). It follows that children are likely to name common native species among their favorites because those are the ones they can observe directly, relate most to their own context, and can be found locally.

Differences in species preferences between genders largely coincided with patterns found in previous studies. In our study, boys more strongly preferred lizards and fish, while girls more strongly preferred mammals. This appears at least partially consistent with work showing that boys tend to prefer animals that evoke fear and disgust, whereas girls prefer "cute or loveable" animals (Prokop & Tunnicliffe 2010; Schlegel & Rupf 2010: 286). The fact that boys preferred fish, a species grouping with extremely utilitarian associations (food and recreation), while girls preferred mammals such as rabbits and horses could reflect boys' more utilitarian perspective toward non-human animals (Kellert & Berry 1987; Bjerke *et al.* 1998; Tarrant & Cordell 2002). We acknowledge that horses and rabbits can have utilitarian associations, but use of those species is essentially non-existent on Andros and certainly less common than utilitarian use of fish species in North Carolina.

Our study uncovered clear differences in native wildlife species preferences of children from island and continental locations; however, this is only the beginning. There is very limited research on the wildlife preferences of children, and there have been virtually no cross-culture studies conducted on this topic. Previous cross-cultural studies have focused on wildlife preferences toward a specific, often unpopular, species (Ozel *et al.* 2009; Prokop *et al.* 2010). We need more research into which species children prefer, both because biodiversity conservation is for their benefit and because children influence the opinions of adults (Hampshire 2000; Legault & Pelletier 2000; Flurry & Burns 2005). Our results show that species preferences differ widely between countries and geographical locations, so additional studies need to be conducted in multiple locations in order for scientists to gain a better understanding how people in different regions view their wildlife. Additional research should also explore why island nations prefer invasive species and how to use environmental education to combat these

predilections. Understanding children's wildlife species preferences is particularly valuable because scientists can better design conservation strategies that incorporate people's preferences in order to create successful plans that preserve local biodiversity.

References:

Alberts, A.C., Carter, R.L., Hayes, W.K., & Martins, E.P. (2000) *Iguanas: Biology and Conservation*. University of California Press.

Benjamini, Y., Hochberg, Y. (1995) Controlling the false discovery rate: a practical and powerful approach to multiple testing. *J. Roy. Stat. Soc. B.* **57**: 289–300.

Borgi, M., & Cirulli, F. (2015) Attitudes toward Animals among Kindergarten Children: Species Preferences. *Anthrozoös* **28**: 45-59.

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

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.

Broome, K. G., Cox, A., Empson, R. A. & Hutchinson, W. M. (2002) Eradication planning for invasive alien animal species on islands-the approach developed by the New Zealand Department of Conservation. In: *Turning the Tide: The Eradication of Invasive Species: Proceedings of the International Conference on Eradication of Island Invasives* (No. 27, p. 85). IUCN.

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*.

Carrier, S.J., Thomson, M.M., Tugurian, L.P., & Stevenson, K.T. (2014) Elementary Science Education in Classrooms and Outdoors: Stakeholder views, gender, ethnicity, and testing. *International Journal of Science Education*, *36*(13): 2195-2220.

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

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

Cushman, S. A. (2006) Effects of habitat loss and fragmentation on amphibians: A review and prospectus. *Biological Conservation* **128**: 231–240.

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.

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.

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.

Gibbon, J. W., Scott, D. E., Ryan, T. J., Buhlmann, K. a., Tuberville, T. D., Metts, B. S., Greene, J.L., Mills, T., Leiden, Y., Poppy, S. & Winne, C. T. (2000) The Global Decline of Reptiles, Déjà Vu Amphibians. *BioScience* **50**: 653–666.

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.

Ikeda, T., Asano, M., Matoba, Y. & Abe, G. (2004) Present Status of Invasive Alien Raccoon and its Impact in Japan. *Global Environmental Research* **8**: 125–131.

Kellert, S.R. (2002) Experiencing nature: affective, cognitive, and evaluative development in children. P.H. Kahn & S.R. Kellert (eds). pp 117-51 in: *Children and Nature: Psychological, socio-cultural and Evolutionary Investigations*. MIT Press.

Kellert, S.R. (1996) *The Value of Life: Biological Diversity and Human Society*. Washington: 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. A. Hailey, B.S. Wilson, & J.A. Horrocks (Eds.). In: *Conservation of Caribbean Island Herpetofaunas*. pp. 53-87. The Netherlands: IDC Publishers.

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.

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. Available at SSRN: 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. *Turning the tide: the eradication of invasive species*, 164-172.

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.

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

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. *Island Invasives: Eradication and Management*. pp. 467–471.

Özel, M., Prokop, P. & Uşak, M. (2009) Cross-Cultural Comparison of Student Attitudes toward Snakes. *Society & Animals* **17**: 224–240.

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. & 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.

Prokop, P., Tolarovičová, A., Camerik, A.M. & Peterková, V. (2010) High School Students' Attitudes Towards Spiders: A cross-cultural comparison. *International Journal of Science Education* **32**: 1665-1688.

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

Rodda, G.H. & Savidge, J.A. (2007). Biology and Impacts of Pacific Island Invasive Species. 2. Boiga irregularis, the Brown Tree Snake (Reptilia: Colubridae)1. *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 and Conservation* **25**: 539-553.

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

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

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.

Stuart, S. N. (2004). Status and Trends of Amphibian Declines and Extinctions Worldwide. *Science* **306**: 1783–1786.

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

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.

Varnham, K., Glass, T., & Stringer, C. (2011). Involving the community in rodent eradication on Tristan da Cunha. In *Island invasives: eradication and management.* pp. 504-507. Proceedings of the international conference on Island invasives. IUCN, Gland, Switzerland and Auckland, New Zealand.

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.

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

499 **Table 1**. Associations between preferences for each taxonomic category and the non-metric
500 multidimensional scaling axes depicted in Fig. 1 (*P*-values adjusted to control for a false
501 discovery rate of 5%).

	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

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503

504 **Fig. 1** Non-metric multidimensional scaling plot of children's species preferences. Loadings for
505 taxonomic groups along the axes are given in Table 1.

506

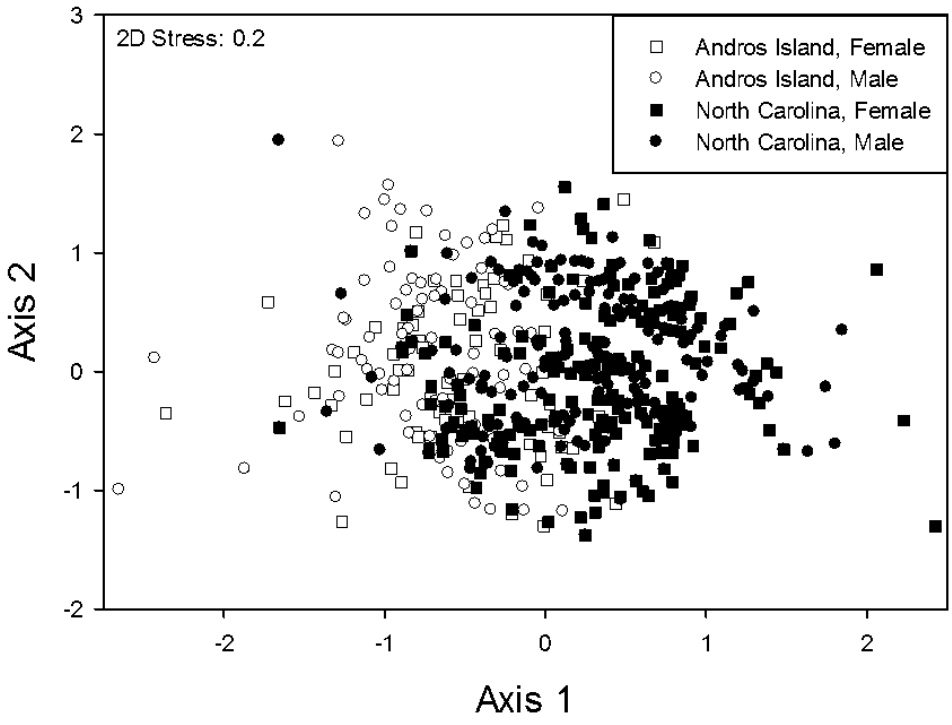

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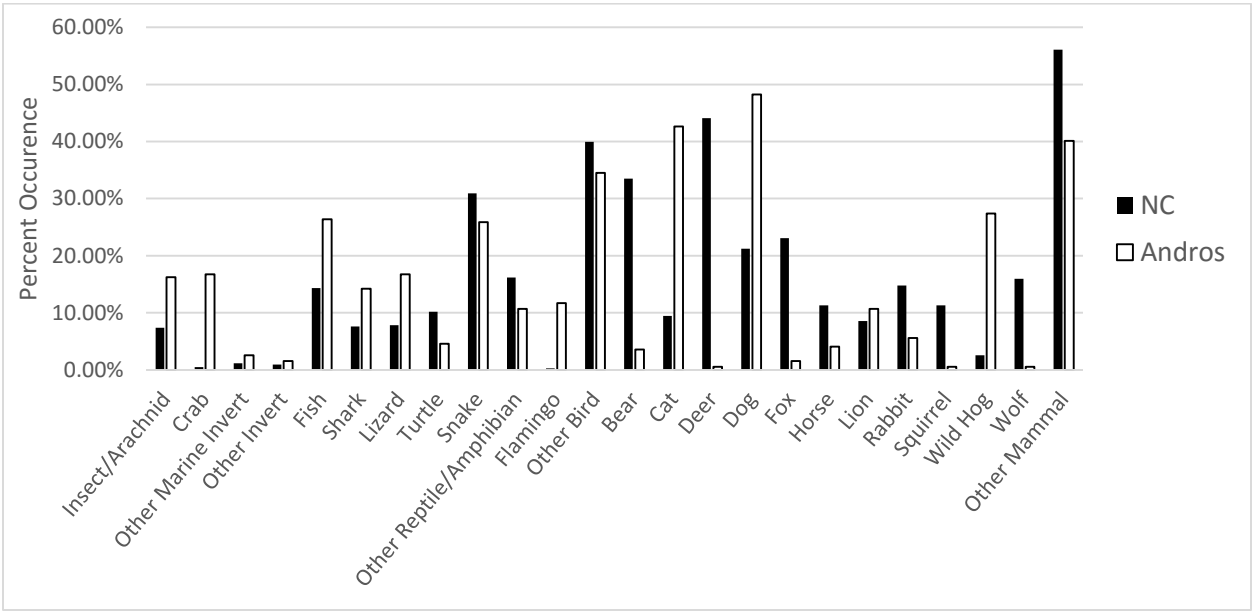
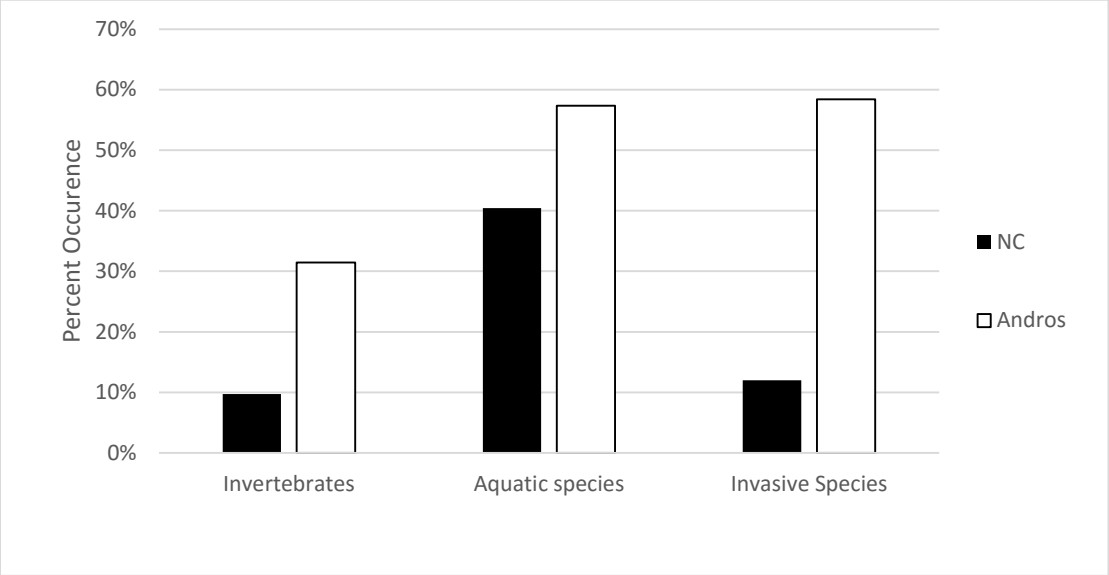
Fig. 2 Percent occurrence of children's wildlife preferences for 24 taxonomic categories between an island location (Andros Island, The Bahamas) and a continental location (North Carolina, USA).



514 **Fig. 3** Percent occurrence of preferences for three major species groups between an island
515 location (Andros Island, The Bahamas) and a continental location (North Carolina, USA).



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