

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

2  
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5  
6 **Abstract:**

7       Efforts to prioritize wildlife for conservation benefit from an understanding of public  
8 preferences for particular species. Despite the growing number of studies addressing this issue,  
9 none have integrated species preferences with key attributes of the conservation landscape such  
10 as whether species occur on islands (where invasive exotics are the primary extinction threat) or  
11 continents (where land use change is the primary extinction threat). In this paper, we compare  
12 wildlife species preferences among children from a continental location (North Carolina, USA,  $N$   
13 = 433) and an island location (Andros Island, The Bahamas,  $N$  = 197). We found that children on  
14 islands prefer feral domestic species, which can pose a challenge to conservation. We also found  
15 that children on islands prefer different types of taxa than mainland children, perhaps due to the  
16 strongly divergent species richness among the regions (e.g. island children showed greater  
17 preferences for invertebrates, lizards, and aquatic species). Boys preferred fish, birds, and lizards  
18 more than girls, whereas girls preferred mammals. The fact that island children showed strong  
19 preferences for invasive species suggest challenges for conservation efforts on islands, where  
20 controlling invasive exotic species is often of paramount importance but can conflict with  
21 cultural preferences for these same species.

22 **Acknowledgements:**

23       We would like to thank North Carolina State University's Department of Forestry and  
24 Environmental Resources for support and North Carolina's K-5 teachers and students who  
25 participated in the study. We thank Forfar Field Station staff, particularly Kate Hammond and  
26 Lyndon Rolle, and the Bahamas National Trust, especially Portia Sweeting and Leslie Brace, for  
27 facilitating the Bahamian surveys. We also thank Kenneth Erickson, Alayne McKnight, and

28 Haley Doty for assistance conducting the surveys on Andros. This is Publication #6 from the  
29 NCSU Bahamas Field Course.

30 **Introduction:**

31 Rapidly growing threats to biodiversity render prioritizing species for protection essential to  
32 conservation biology. Despite recent increases in conservation efforts (Hamber *et al.* 2011),  
33 factors such as invasive species, habitat destruction, and climate change continue to cause global  
34 biodiversity loss (Cumberlidge *et al.* 2009; Pimm *et al.* 2014, McCallum 2015). Wildlife  
35 conservation relies heavily on the attitudes of the general public (Dickman 2010), which often  
36 differ from the attitude of professionals, because protecting wildlife requires human intervention  
37 (Ericsson *et al.* 2004; Gratwicke *et al.* 2008; Prokop & Fancovicova 2013). The public's  
38 perception of an animal species directly impacts its conservation status, as negative cultural  
39 biases towards certain wildlife paired with anthropogenic impacts have driven several species to  
40 near extinction (Fita *et al.* 2010; Brito *et al.* 2012).

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

51 2011). The public generally prefers birds and mammals over reptiles and invertebrates (Czech *et*  
52 *al.* 1998). The reasoning behind this bias has been attributed to the “similarity principle,” which  
53 explains that humans prefer animals that are biobehaviorally or phylogenetically similar to  
54 themselves (Kellert 1985; Kellert 1993; Kellert 1996; Batt 2009) Fear appears to influence  
55 species preferences, and may do so independently of the danger posed by a certain species,  
56 especially in the case of invertebrates (Kaltenborn *et al.* 2006; Batt 2009; Prokop & Fancovicova  
57 2012). Women’s preferences are generally dictated more by fear and disgust than men,  
58 especially in cases where the species pose a threat to humans, as with some snakes and parasites  
59 (Prokop *et al.* 2009a,b; Prokop *et al.* 2010c; Prokop 2013). Finally, people tend to favor animals  
60 with aesthetic value and charismatic species (Kaltenborn *et al.* 2005; Schlegel & Rupf 2010;  
61 Prokop & Fancovicova 2012).

62       New research on species preferences among children suggests their views are similar to  
63 adults, but may differ in key ways that are beneficial for conservation biology. Because children  
64 fundamentally shape the views of their parents (Hampshire 2000; Legault & Pelletier 2000;  
65 Flurry & Burns 2005) and because conservation biology aims to protect resources for future  
66 generations (Weiss 1990; Meine *et al.* 2006), scholars have recently started focusing on the  
67 species preferences of children. This work has found that children’s preferences are similar to  
68 those of adults in multiple ways: children rank mammals and birds higher than invertebrates and  
69 reptiles, children favor exotic megafauna over local species, and less dangerous animals are  
70 preferred, indicating that fear and disgust play a role in children’s preferences (Bjerke *et al.*  
71 1998; Ballouard *et al.* 2011; Borgi & Cirulli 2015). However, children favored certain species  
72 that are generally ranked low by adults, such as turtles, snails, and butterflies (Borgi & Cirulli  
73 2015). This finding has been attributed to the anthropomorphization of certain species through

74 media targeting children (More 1979; Bjerke & Ostdahl 2005; Wagler 2010; Borgi & Cirulli  
75 2015). Boys tend to favor animals that evoke fear and disgust over girls, and girls prefer more  
76 loveable or cute animals (Prokop & Tunnicliffe 2010; Schlegel & Rupf 2010). Despite these  
77 similarities, children appear to prioritize species groups in ways similar to conservation  
78 biologists by prioritizing importance in nature over other attributes (Shapiro *et al.* 2016; Frew *et*  
79 *al.* 2016), whereas adults may place more emphasis on endemism and declining species (Czech  
80 *et al.* 1998; Meuser *et al.* 2009; Verissimo *et al.* 2009).

81 The growing body of research on species preferences, however, has not addressed how  
82 preferences may change under different biogeographic contexts critical to conservation biology.  
83 Several potentially valuable contexts exist (e.g., different biomes, different climates), but the  
84 difference between islands and continents may represent the most obvious biogeographic driver  
85 of species threats and extinction (Simberloff 2000). In continental locations, the leading causes  
86 for wildlife endangerment are habitat conversion (e.g., from forests to agriculture or urban land  
87 use) and suppression of natural processes (e.g., fire) (Flather *et al.* 1998; Sharitz 2003; Backer *et*  
88 *al.* 2004; Kindall & Van Manen 2007). For example, reptiles, such as black water snakes and bog  
89 turtles, and amphibians, like the flatwoods salamander, are highly susceptible to extinction due to  
90 habitat loss (Gibbon *et al.* 2000; Stuart *et al.* 2004; Cushman 2006). Conversely, the leading  
91 driver of species endangerment and extinction on islands is the spread of invasive exotic species  
92 (Duncan & Blackburn 2004; Clavero *et al.* 2009). For instance, feral cats (Nogales *et al.* 2004),  
93 feral hogs (Cruz *et al.* 2005), raccoons (Ikeda *et al.* 2004), the cane toad (Shine 2010), and the  
94 Brown Tree Snake (Rodda & Savidge 2007) have caused multiple extinctions and  
95 endangerments of native wildlife on islands. Understanding how to address these differing

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

98       We began addressing this gap in the literature with a case study comparing species  
99 preferences among children in North Carolina, USA and children in Andros Island, The  
100 Bahamas. North Carolina and Andros Island provide useful, representative study sites because  
101 extinction drivers in these regions match those generally expected on continental and island  
102 locations respectively. In North Carolina, over 90% of the most common ecosystem type  
103 (longleaf pine forest) was eliminated by fire suppression, and other land uses (e.g., row crops,  
104 pine plantations, urban areas), threatening the entire suite of species associated with the once  
105 ubiquitous ecosystem type including an entire community of carnivorous plants, amphibians, and  
106 birds such as the red cockaded woodpecker and Bachman's sparrow (Lueck & Michael 2000;  
107 Van Lear *et al.* 2005). The main threat to native species on Andros Island comes from invasive  
108 species. Although harvesting of wildlife by humans—the most impactful invasive species of  
109 all—as well as habitat destruction contribute to declining populations of native species on  
110 Andros Island, many native species face their greatest threats from feral cats, dogs, and wild pigs  
111 (Alberts *et al.* 2000; Carey *et al.* 2001; Knapp & Owens 2005; Knapp *et al.* 2011). In this initial  
112 assessment of how species preferences might differ between an island and continental location  
113 we tested the hypothesis that children on Andros (island) would prefer invasive or exotic species  
114 more than children in North Carolina (continental). This hypothesis was grounded in both  
115 previous studies suggesting islanders opposed eradication of non-native species (Fortwangler  
116 2009; Lynch *et al.* 2010; Ogden & Gilbert 2011), and the fact that feral cats, dogs, and pigs are  
117 more prevalent on Andros than in North Carolina. We also evaluated differences between

118 gender, testing the hypothesis that boys prefer animals that tend to invoke fear or disgust more  
119 than girls (Prokop & Tunnicliffe 2010; Schlegel & Rupf 2010).

## 120 **Materials and Methods**

### 121 Sampling

122 We attempted to survey children between 5 and 12 years old, because they constitute the  
123 earliest ages when outdoor experiences are linked to environmental attitudes and knowledge  
124 (Carrier *et al.* 2014). In North Carolina, we used a stratified random sample of elementary school  
125 children. We randomly choose 60 public schools with 3rd and 5th grade classes from a list of all  
126 such schools in the state, compiled a list of all 3rd and 5th grade teachers in those selected  
127 schools, and randomly selected 118 teachers for participation. From these, 36 teachers responded  
128 (30.5% response rate) with 21 giving consent to participate in the study (58.3% compliance rate).  
129 We visited 16 classrooms (we could not visit 5 because of scheduling conflicts) and 433 students  
130 completed written surveys in March 2014.

131 On Andros Island, we did not have access to a database of teachers, and several schools  
132 chose not to participate in the study, so we used a combination of school sampling and intercept  
133 sampling (Stedman *et al.* 2004) to achieve broad coverage across the island. The Bahamas  
134 National Trust facilitated sampling at primary schools where we visited 3 schools and 106  
135 students completed written surveys. Andros comprises several islands, but our study focused on  
136 North Andros Island, the largest and most populous. We used intercept sampling in 7 locations:  
137 Mastic Point (N = 13), Stafford Creek/Blanket Sound (N = 7), Staniard Creek (N = 7), Love Hill  
138 (N = 9), Fresh Creek (N = 28), Bowen Sound (N = 12), and Cargill Creek/Behring Point (N =  
139 15). The Forfar Field Station staff facilitated the intercept sampling, as they were the most  
140 familiar with households in the communities, by approaching households with children within  
141 the specified age range (5-12) to request participation from parents and children. Approximately

142 20% ( $n = 197$ ) of all children aged 5-12 on the island participated in the study (Department of  
143 Statistics of The Bahamas). All research methods were reviewed and approved by the NC State  
144 University Institutional Review Board for the Protection of Human Subjects (Protocol 5941).

#### 145 Questionnaire Design:

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

156 We measured students’ wild animal preferences using a ranking exercise where children  
157 were told wildlife referred to “all animals that live in nature,” and then asked “What are your five  
158 favorite kinds of wild animals that live in North Carolina (or in The Bahamas)? Remember to put  
159 your most favorite first. If you don’t know the name of five animals, just list as many as you  
160 can.” Students were also asked to indicate whether they were a boy or girl.

#### 161 Statistical Analysis:

162 We assigned each species listed by students to one of 24 taxonomic categories. A single  
163 species received its own category if it occurred in at least 10% of surveys within either region.  
164 For all other species, we used relevant taxonomic groupings (e.g. fish, bird, crab). For each child,  
165 a score of “1” (preferred species) was assigned to each taxonomic category listed by the child,

166 while a “0” was scored for all others (i.e. presence/absence data). Using the PRIMER 6 software  
167 package (Clarke & Gorley 2006), we conducted analysis of similarities (ANOSIM; 9,999  
168 permutations) of the Bray-Curtis similarity matrix (Bray & Curtis 1957) of these data to test  
169 whether children’s native wildlife preferences differed between regions (Andros Island and  
170 North Carolina) and genders. We conducted two-dimensional non-metric multidimensional  
171 scaling (MDS) using PRIMER 6 to visualize any differences in children’s species preferences  
172 between regions and genders. We interpreted MDS axes using Spearman correlation between  
173 preferences for each taxonomic category and the two axes ( $P$ -values adjusted to control for a  
174 false discovery rate of 5%, following Benjamini and Hochberg 1995). We further calculated  
175 percent occurrence of preferences for each taxonomic category in each region to aid  
176 interpretation of any differences. Based on patterns observed in the data, we further calculated  
177 overall percent occurrence of preferences for three major groups of animals: invertebrates,  
178 aquatic species, and invasive species (cats, wild hogs, lionfish). We only included species that  
179 were obviously invasive in the latter category, although the vast majority of dogs on Andros are  
180 feral, and could have been included in this grouping as well.

## 181 **Results:**

182 We had roughly equal representation of genders in both regions (53% female in North  
183 Carolina, 49% female in Andros), with a total of 630 completed surveys. In North Carolina, we  
184 surveyed children between the ages of 8 and 11, as this corresponds to the age range of 3<sup>rd</sup> and  
185 5<sup>th</sup> graders. On Andros Island, we surveyed children between the ages of 4 and 14, with an  
186 average age of 8.9 (std dev = 1.8). Because 76% of children surveyed on Andros were 8-11 years  
187 old, we had broad overlap in age between the two regions. Children’s species preferences  
188 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

212 more rarely listing these species among their favorites. Moreover, children in North Carolina did  
213 not exhibit preferences for any invasive species, even though invasive species do exist there. The  
214 observed preference for invasive species by island children is consistent with results of previous  
215 studies, which have found that islanders view invasive species more positively if that species  
216 serves some cultural or economic role in the society (Fortwangler 2009; Lynch *et al.* 2010;  
217 Ogden & Gilbert 2011), and dogs and cats are often viewed positively even in the face of  
218 negative impacts on native species, while wild hogs provide a source of recreation, hunting, and  
219 food on the island. Another explanation for this preference is the lack of native charismatic  
220 mammals on Andros Island. Previous studies show that children often prefer mammals and  
221 exotic megafauna (Schlegel & Rupf 2010; Ballouard *et al.* 2011; Borgi & Cirulli 2015). The  
222 absence of native charismatic mammals, coupled with the anthropomorphization of species non-  
223 native to Andros in media targeting children, could lead to island children preferring non-native  
224 species relative to children from continental locations (Bjerke & Ostdahl 2005; Wagler 2010;  
225 Borgi & Cirulli 2015).

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

235 these popular species would be met with resistance. To combat children's preferences for non-  
236 native species, environmental education programs will need to both introduce children to native  
237 species, and effectively convey the impacts of invasive species on the local environment. Once  
238 children learn about native species, their preference for them typically rises (Lindemann-  
239 Matthies 2005).

240 In addition to differential preferences for invasive species between regions, children  
241 tended to prefer locally abundant or charismatic native animals. The species preferences that  
242 were greater for children in North Carolina exclusively involved mammals native to North  
243 Carolina that did not exist on Andros: deer, fox, wolf, bear, squirrel, and rabbit. For the species  
244 with greater preferences by children on Andros, these either involved charismatic species native  
245 to Andros and not found in North Carolina (flamingo) or represented species commonly  
246 encountered on Caribbean islands: crab, fish, lizard, and insect-arachnid. For the latter species,  
247 island children exhibited much stronger preferences even though these taxonomic groups are also  
248 native to North Carolina. With the low species richness on islands, children may prefer species  
249 that often go relatively unnoticed in continental locations because of the absence of charismatic  
250 mammals. Children may exhibit preferences for common native species because they have an  
251 innate curiosity toward the natural world (Maltese & Tai 2010; Kirikkaya 2011) and learn about  
252 their surroundings through direct observation (Kellert 2002). Developmentally, young learners  
253 interpret the world through concrete and direct experiences, personal or egocentric concerns, and  
254 local geographies (Kellert 2002). It follows that children are likely to name common native  
255 species among their favorites because those are the ones they can observe directly, relate most to  
256 their own context, and can be found locally.

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

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

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

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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%).

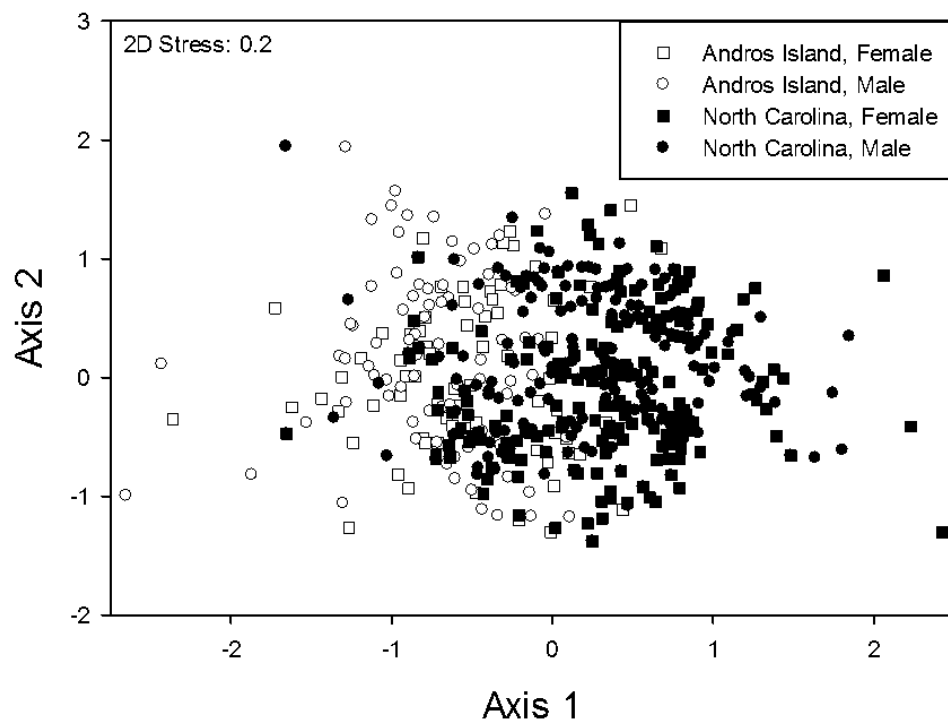
Species	MDS Axis 1		MDS Axis 2	
	$\rho$	P	$\rho$	P
Insect/Arachnid	-0.13	0.0018	0.14	0.0012
Crab	-0.22	<0.0001	0.13	0.0027
Other Marine Invertebrate	-0.06	0.1890	0.07	0.0800
Other Invertebrate	-0.08	0.0519	0.06	0.1920
Fish	-0.17	<0.0001	0.33	<0.0001
Shark	-0.11	0.0067	0.01	0.8711
Lizard	-0.14	0.0010	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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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.

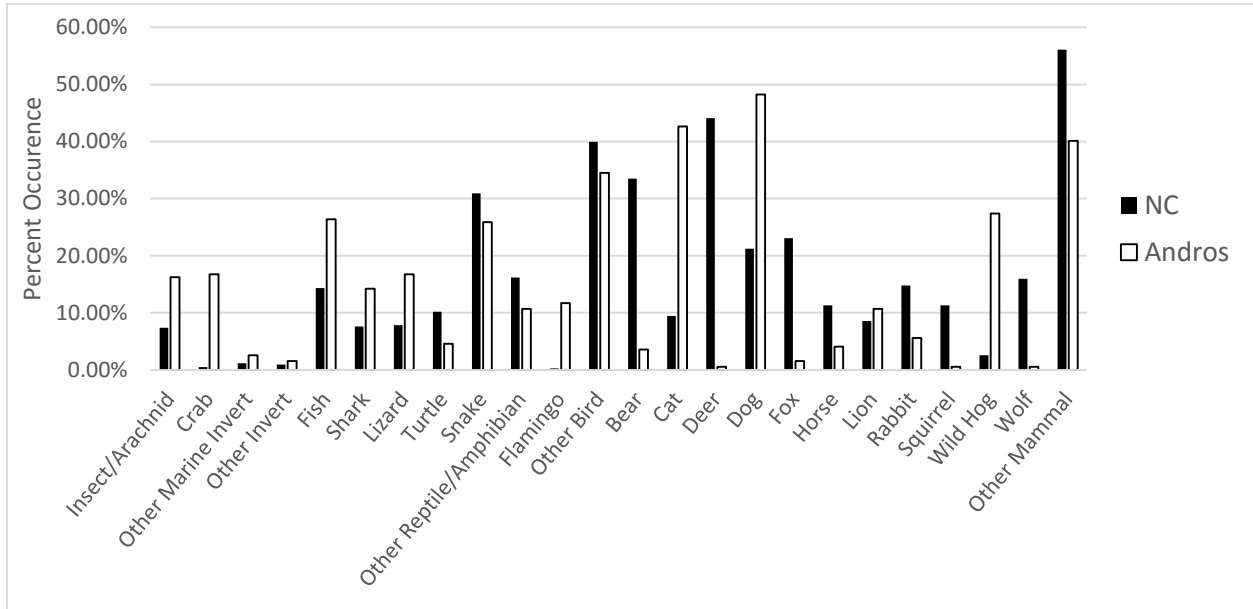
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508 **Fig. 2** Percent occurrence of children’s wildlife preferences for 24 taxonomic categories between  
 509 an island location (Andros Island, The Bahamas) and a continental location (North Carolina,  
 510 USA).

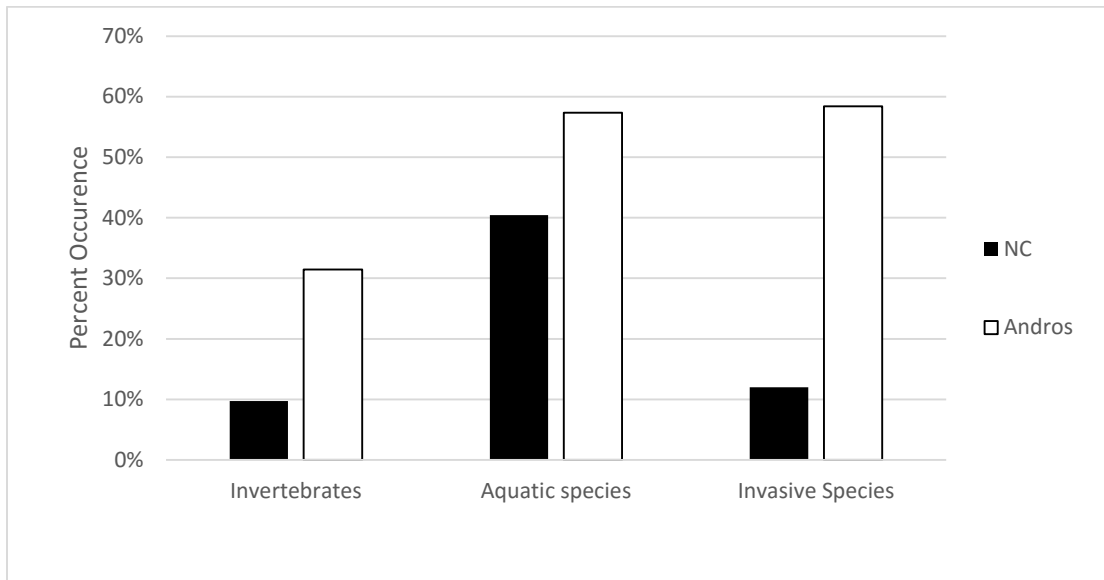
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514 **Fig. 3** Percent occurrence of preferences for three major species groups between an island  
515 location (Andros Island, The Bahamas) and a continental location (North Carolina, USA).



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