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Holding up a mirror to the society: Children recognize exotic species much more than local ones

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ABSTRACT

From childhood to adulthood we receive a lot of information on animal key species with a high charismatic value. Flagships species are also frequently used to raise awareness, stimulate conservation and to increase political support for conservation issues. Since flagship species do not, in many cases, represent the local ecological community, there is the risk that exotic species are more readily identified than local ones and this could be problematic, as knowledge is critical to promote conservation. Conservation is especially crucial on islands, where populations may be more prone to extinctions than in the mainland, and where isolation may favor endemism. To test the hypothesis that exotic species are better known than local ones, we surveyed high school children in the Balearic Islands, a biodiversity hot spot for conservation priorities. We quantified children's knowledge of native and exotic vertebrate groups by using a computer-aided multiple choices questionnaire. We found that exotic species are better known than local fauna, even when local fauna is broadly common or of greater conservation concern. We also found strong differences in knowledge between different vertebrate groups: the best known were mammals whereas fishes were the least known. Surprisingly, even if less known than mammals, local amphibians and reptiles were better known than exotic ones. Children's poor knowledge on the local fauna in relation to other exotic vertebrates may lead them to associate wildlife and its conservation with exotic species. We suggest increasing efforts on environmental education and focussing on direct experience of children in their local environment to increase their knowledge of the local fauna, and engage their interest in their own natural world.

1. Introduction

Children receive a lot of information about wild animals on books, cartoons, television programmes and animated films. However the information they receive may be biased for commercial or other reasons and this may have consequences on their future vision of wildlife (Brewer, 2002). Regarding wild vertebrates children receive much more information on key species with a high charismatic value than on those perceived as more cryptic or less charismatic. Also conservation efforts have often focussed on these flagship species to increase awareness and political support for conservation issues and to maintain donor attention and sympathy (Clucas et al., 2008). The central role of these 'flagship' species, defined as "popular, charismatic species that serve as symbols and rallying points to stimulate conservation and awareness and action" (Heywood, 1995), has also been translated into the scientific literature where a few species commanded a great proportion of scientific attention (Clarck and May, 2002; Griffiths and Dos Santos, 2012). Additionally flagship species have been used as ideal targets for education and dissemination, because charismatic animals are usually better in capturing the attention of a non-expert audience (Clucas et al., 2008; Ray, 2005). But is this situation the most appropriate for communicating on biodiversity, especially when there is need to protect an endangered local wildlife? Since flagship species do not, in many cases, represent the local ecological community, there is the risk the exotic species to be much more identified than local ones; following the principle that 'people care about what they know' (Balmford et al., 2002; Lindemann-Matthies, 2005) this could turn risky from a conservation point of view. This effect would be particularly negative in biodiversity hotspots or where local species are of particular conservation concerns. The latter is often the case for islands: island biota is typically of conservation concerns due to the large proportion of endemic species they host (MacArthur and Wilson, 1967; Whittaker and Fernández-Palacios, 2007), the pressure of new species introduced by humans, and the higher extinction rate of their isolated populations (Frankham, 1998; Frankham et al., 2002).

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Our aim here is to quantify the knowledge of vertebrate fauna by 11–15 year old children and assess whether there is a lack of knowledge of local species compared with exotic species. We conducted a survey in the Balearic Islands (Spain), an archipelago in the western Mediterranean basin considered a biodiversity hot spot for conservation priorities (Myers et al., 2000). We compared high-school children's knowledge of local (present in the Balearic archipelago) versus exotic (not present in the Balearic archipelago) vertebrate fauna. As a reference, we repeated the survey to children of the same age and school grades living in Asturias, Northern continental Spain (850 km far from the Islands), where we expect pupils are less aware of the fauna of the Balearic archipelago. Our main objectives were to: (a) compare the knowledge of local versus exotic species, (b) investigate possible differences across vertebrate groups, and (c) evaluate the knowledge of local species of particular conservation concerns and propose guidelines for directing future educational efforts.

2. Materials and methods

2.1. Study area

The survey was conducted in Mallorca (39°58′00″N 3°08′00″E, Spain), the largest Island of the Balearic Archipelago, in the Western Mediterranean (Fig. 1). The island covers an area of 4492 km^2 with about a million inhabitants. The Mediterranean Basin is classified as a Biodiversity hotspot for conservation (Myers et al., 2000), and Mallorca hosts about 33 endemic vertebrate species and subspecies (Pons and Palmer, 1996). A second survey, used as a reference, was conducted in Asturias (43°21′00″N 5°51′00″E, Spain) a Spanish region facing the Atlantic Sea, and with different climate and biota (Anadón et al., 2007; Vargas et al., 1998). Note that some of the species present in the Balearic Islands ("local species") might also be present in Asturias but in many cases, those species considered as "local" are not present in Asturias (and viceversa).

2.2. Participants and survey characteristics

We employed a computer-aided multiple choices questionnaire distributed during school time to 10 schools in Mallorca and 6 schools in Asturias. Schools were located both in urban ($N = 6$; $N = 4$) and rural areas ($N = 3$; $N = 3$) in Mallorca and Asturias respectively (see Appendix 1). During the survey we asked children to identify the vertebrate species depicted in 10 photos randomly selected among 134 available (34 birds, 34 fishes, 33 mammals, 33 reptiles and amphibians; see Table S1). In each group half of the species belong to the Balearic fauna (local) whereas the other half did not (exotic). Species were chosen, with the help of 5 zoologists independently, among those with the greatest probability of being recognized by children, prioritizing those species that were either highly widespread or endangered. Each child was asked to select the name of the species by choosing among five possible responses, i.e. popular species names. These names included the correct one and four additional names randomly selected from the same vertebrate group. We included a dummy question with a picture of a domestic cat. If the answer to this question was incorrect, we discarded the whole questionnaire. We ensured that teachers and pupils did not previously know the survey to avoid any effect of previous information. The survey was electronically filled on a web page (http://www.imedea.uib.es/enquestabiodiversitat/) and questionnaires were simultaneously presented to children of the same class. The independent random choice of the picture insured that the probability to have two identical questionnaires in the same class was very small ($<10^{-10}$).

2.3. Data analysis

Responses were analyzed using generalized linear mixed-effects models (package lme4 in R; http://www.R-project.org), with the response variable being either correct (1) or incorrect (0). As explanatory variables we considered the species taxonomic group (Birds, Mammals, Fishes, Amphibians/Reptiles), whether the species was local or exotic, and the gender of the child. We included pupil identity as a random effect in all analyses to control for differences across individuals. We considered the main effects and their statistical interactions with the exception of the gender term, which was always considered in an additive relationship. Model selection was based on Akaike's Information Criterion (AIC); the model with the lowest AIC value was considered as the best compromise between model deviance and model parameters (Anderson, 2008). We also calculated the AIC weight as a measure of relative plausibility of each model. We first carried out separate analyses for each of the two surveys. Subsequently, we carried

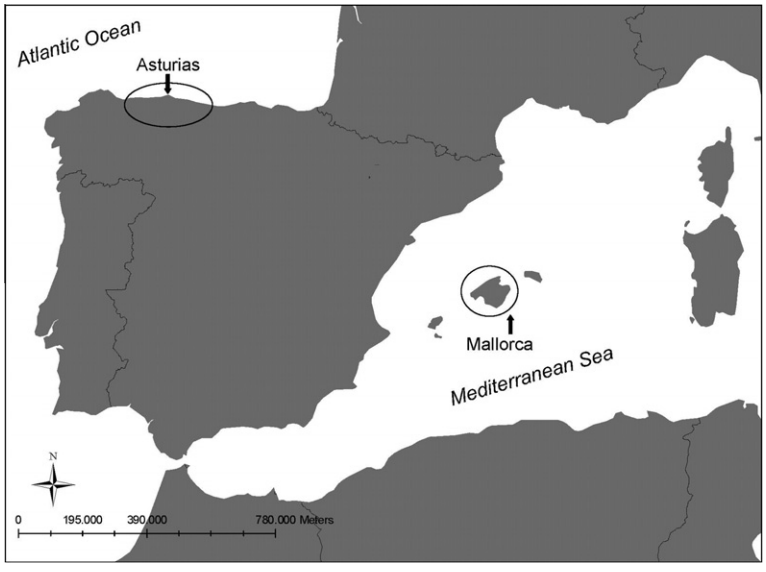

Fig. 1. Location of the Balearic Islands, in the Mediterranean Sea, and Asturias, the two regions were surveys were conducted.

out a joint analysis including the community effect to assess differences regarding knowledge of Balearic fauna. We also computed the proportion of correct answers for each species and for each region. Finally, we extracted the average score for the species of highest conservation concerns in each region.

2.4. Children's literature on vertebrate fauna

To give more support to the assumption that children receive much more information on exotic species than on local fauna, we inspected all the children's books (not comics) covering age ranges from 0 to 10 years old, in two schools and two important libraries in Mallorca. We then compared by the use of an exact binomial test (Null hypothesis, $p = 0.5$), the number of books based on local fauna (present in the island) and those based on exotic fauna. As a conservative manner we considered unspecified mousses and frogs as local fauna. When the book reported both local and exotic species, it was considered as "exotic" if the ratio between both exotic and local species was strongly biased towards exotic species (i.e. one local species and seven exotic species), and as "local" on the contrary; the book was excluded from the sample if the bias was not strong. All domestic animals were excluded from the sample.

Table 1
Modeling vertebrate knowledge in children from the Balearic Islands and Asturias; AIC: Akaike Information Criterion; Dev: relative deviance; np: number of parameters; Δ: the AIC difference between the current model and the one with the lowest QAIC value; w_i: Akaike's weight. Model notation: 'grup' = taxonomic group effect, 'local' = species location effect, 'sex' = gender effect, '·' = constant (i.e. no effects considered), '+' = additive effect, '*' = interaction between terms. All models include individual as a random effect to avoid correct for individual variation on knowledge. The model with the lowest AIC is in bold.

Region	Model	AIC	Dev	np	Δ	w_i
Balearic Islands						
	Grup * local + sex	**9066.23**	**9046.23**	**10**	**0**	**0.88**
	Grup * local	9070.30	6052.30	9	4.07	0.12
	Grup + local	9176.26	9164.26	6	110.03	0.00
	Grup	9194.23	9184.23	5	128.00	0.00
	Local	9711.47	9705.47	3	645.23	0.00
	Null	9730.44	9726.44	2	664.63	0.00
Asturias						
	Grup * local + sex	2949.91	2939.91	10	1.26	0.35
	Grup * local	**2948.65**	**2930.65**	**9**	**0**	**0.65**
	Grup + local	2964.84	2952.84	6	16.19	0.00
	Grup	3004.57	2994.57	5	55.92	0.00
	Local	3171.84	3165.84	3	223.19	0.00
	Null	3210.29	3206.29	2	261.64	0.00

3. Results

We surveyed 777 children in Mallorca and 245 in Asturias, with a total of 10,210 photo-tests. Ages ranged from 11 to 15 years and sex-ratio seemed to be slightly skewed towards males (0.55) in both regions.

The best model explaining species recognition in the Balearic Islands included the taxonomic group, the species location (local versus exotic), their statistical interaction and the additive effect of gender (Tables 1 and S2). The proportion of correct answers varied across taxonomic groups, with mammals being the best known group and fishes the least (Table 1 and Fig. 2). Exotic birds, fishes and especially mammals were better identified than local species, whereas local Reptiles and Amphibians were better identified than exotic ones (Table 1, Fig. 2). Male children were slightly better in species recognition than females (Table 1).

Similar to results for Mallorca, the retained model for the Asturian data included an effect of location, indicating that the species classed as exotic for the Balearic Islands (and mostly exotic also in the Atlantic region of Asturias), were better known than the species from the Balearic Islands (Table 1). However in the joint analysis we observed that children in the Balearic Islands knew their own fauna better than children from Asturias (Table 2). In contrast, in Asturias we did not find any influence of the gender of the child.

The empirical probability of species recognition varied between 0.04 for the Mallorcan midwife toad *Alytes muletensis* (an endemic, threatened, Balearic toad species) in Asturias, to 1 for several species, mainly large mammals in both regions (Table 3). Recognition of the Ferreret in the Balearic Islands was not very high (58%) but much higher than in Asturias (4%; Table 4). Recognition of some other local species was very low even for those very abundant in the Balearic Islands, such as the Pine marten *Martes martes*, the Damselfish *Chromis chromis*, the Stone Curlew *Burhinus oedicnemus*, or for the most critically endangered species, e.g. the Balearic shearwater *Puffinus mauretanicus* (Tables 3 and 4).

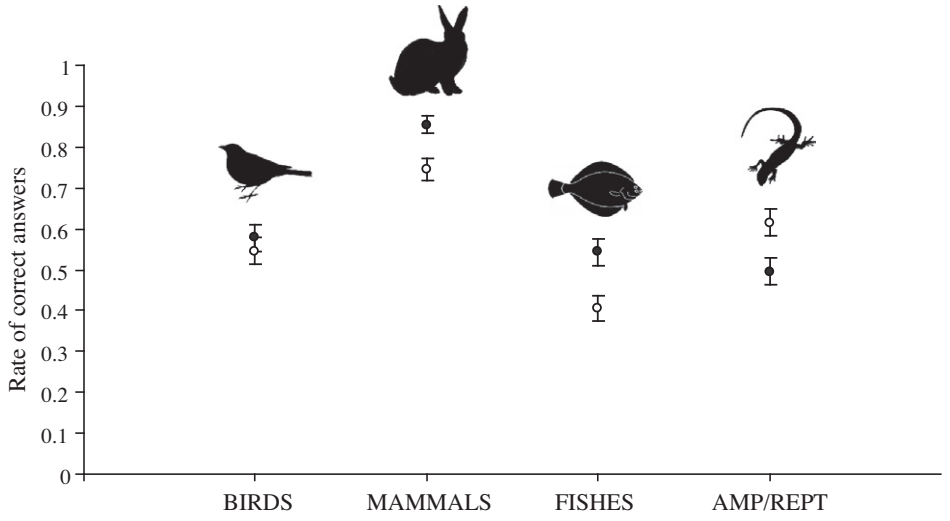

Fig. 2. Average rate of correct answers and 95% confidence interval probabilities of correctly identify local (circles) and exotic (black dots) animal's species in each group of vertebrates, birds, mammals, fishes and amphibians/reptiles for children in Balearic Islands.

Table 2
Joint modeling analysis of vertebrate knowledge in children from Balearic Islands and Asturias; AIC: Akaike Information Criterion; Dev: relative deviance; np:number of parameters; Δ: the AIC difference between the current model and the one with the lowest QAIC value; w_i: Akaike's weight. Model notation: 'community' = community effect, 'grup' = taxonomic group effect, 'local' = species location effect, 'sex' = gender effect, '+' = additive effect, '*' = interaction between terms. All models include individual as a random effect to avoid correct for individual variation on knowledge. The model with the lowest AIC is in bold.

Model	AIC	Dev	np	Δ_i	w_i
Null	13419.91	13415.91	2	1418.63	0.00
Community	13423.88	13417.88	3	1420.6	0.00
Sex	13418.67	13412.67	3	1415.39	0.00
Grup	12659.14	12649.14	5	651.86	0.00
Local	13366.00	13,360	3	1362.72	0.00
Grup + sex	12657.93	12645.93	6	648.65	0.00
Grup + local	12606.14	12594.14	6	596.86	0.00
Grup + community	12663.11	12651.11	6	653.83	0.00
Local * community	13364.4	13354.4	5	1357.12	0.00
Grup * community	12189.11	12185.11	9	187.83	0.00
Grup * local	12484.61	12466.61	9	469.33	0.00
Grup * local + community	12488.54	12468.54	10	471.26	0.00
Grup * local + sex	12483.52	12463.52	10	466.24	0.00
Grup * local + grup * community	12040.73	12014.73	13	17.45	0.00
Grup * local + local * community	12023.71	12001.71	11	4.43	0.09
Grup * local + local * community + sex	**12021.28**	**11997.28**	**12**	**0**	**0.82**
Grup * local * community	12040.25	12006.25	17	8.97	0.01
Grup * local * community + sex	12037.8	12001.8	18	4.52	0.08

Table 3
List of best (A) and worse (B) known species by Balearic and Asturian children among 134 vertebrate species. We also indicated the taxonomic group (T), if the species is present in the region and its conservation status (P: C (common), VU (Vulnerable), NEnd (Near endangered), End (Endangered), from Blanco and González, 1992 and Mayol et al., 2000), or not (–), the probability of child to correctly identify the species (Score) and the number of individuals that found the species on its questionnaire (N).

T	Balearic Islands		P	Score	N	T	Asturias		P	Score	N
(A)											
M	Lion	*Panthera leo*	–	1	59	M	Lion	*Panthera leo*	–	1	20
M	Elephant	*Loxodonta africana*	–	1	60	M	Elephant	*Loxodonta africana*	–	1	13
M	Gorilla	*Gorilla gorilla*	–	1	52	M	Gorilla	*Gorilla gorilla*	–	1	14
M	Tiger	*Panthera tigris*	–	1	62	M	Leopard	*Panthera pardus*	–	1	19
M	Camel	*Camelus bactrianus*	–	1	49	B	Common Barn Owl	*Tyto alba*	C	1	16
M	Chapman's Zebra	*Equus quagga*	–	1	55	F	Clownfish	*Amphiprion ocellaris*	–	1	19
B	Ostrich	*Struthio camelus*	–	0.97	62	B	Ostrich	*Struthio camelus*	–	1	17
M	Rabbit	*Oryctolagus cuniculus*	C	0.97	65	M	Fox	*Vulpes vulpes*	C	1	21
M	Koala	*Phascolarctos cinereus*	–	0.97	72	M	Koala	*Phascolarctos cinereus*	–	1	16
M	Bottlenose Dolphin	*Tursiops truncatus*	VU	0.98	53	M	Bottlenose Dolphin	*Tursiops truncatus*	VU	1	19
(B)											
F	Atlantic halibut	*Hippoglossus hippoglossus*	–	0.11	54	A/R	Mallorcan midwife toad	*Alytes muletensis*	–	0.04	28
F	Atlantic cod	*Gadus morhua*	–	0.15	61	F	Atlantic halibut	*Hippoglossus hippoglossus*	–	0.06	16
F	Siamese fighting fish	*Betta splendens*	–	0.15	54	A/R	Blue tongue skink	*Tiliqua scincoides*	–	0.08	13
F	Coelacanth	*Latimeria chalumnae*	–	0.16	61	B	Yellow tipped pardalote	*Pardalotus striatus*	–	0.1	20
B	Common Murre	*Uria aalgae*	–	0.17	48	A/R	Bedriaga's Skink	*Chalcides bedriagai*	–	0.13	15
F	Greater amberjack	*Seriola dumerilii*	NEnd	0.17	73	F	Damselfish	*Chromis chromis*	C	0.14	14
A/R	Green anole	*Anolis carolinensis*	–	0.18	48	F	Rainbow Wrasse	*Corys julis*	C	0.15	20
A/R	Bedriaga's Skink	*Chalcides bedriagai*	–	0.19	48	F	Siamese Fighting Fish	*Betta splendens*	–	0.15	26
A/R	Mediterranean Tree Frog	*Hyla meridionalis*	–	0.20	60	F	Cod	*Gadus morhua*	VU	0.15	26
B	Stone Curlew	*Burhinus oedicnemus*	C	0.22	59	F	Smooth-hound	*Mustelus mustelus*	C	0.17	24

3.1. Children's literature

We checked 364 children's books and most of them involved exotic species (N = 267; $P < 0.001$).

4. Discussion

The information on animals we receive from childhood to adulthood is strongly biased towards key species with a high charismatic value, especially mammals, and partly ignores local species. Also from a scientific point of view a relatively few species command a great proportion of attention, and the disparity between animal groups is enormous, with the mean number of records for threatened large mammal species over 500 times greater than for threatened amphibians (Bonnet et al., 2002; Clarck and May, 2002; Trimble and Van Aarde, 2010). Moreover, mammal species are the most represented in conservation programmes (Seddon et al., 2005). Thus, in relation to funding, promotion, scientific attention or public knowledge, not all species are treated equally, and flagship species lead awareness, funding, attention and knowledge.

Even if the use of flagship or umbrella species on conservation policies is controversial (Andelman and Fagan, 2000; Caro and O'Doherty, 1999; Simberloff, 1998; Sergio et al., 2008), these species, at a global scale, have played an important role in raising environmental awareness and funds for conservation (Entwistle and Dunstone, 2000; Walpole and Leader-Williams, 2002), increasing at the same time their knowledge in people living outside their distributions. In our study we found that in the Balearic Islands, the knowledge of local fauna is poor, and the same applies to pupils from Asturias and possibly from many other regions. Also the fact that many children books are produced in foreign countries and later translate to local language may contribute to increase knowledge on flagship or charismatic species, with scarce input on

Table 4
Average score for different species in each region. It is also indicated if the species is present in one or both regions.

	Balearic Is.	Asturias
Species only present in Balearic islands		
Alytes muletensis	0.58	0.04
Puffinus mauretanicus	0.30	0.35
Podarcis lilfordi	0.50	0.80
Podarcis pityusensis	0.67	0.64
Larus audouinii	0.90	0.81
Testudo hermanni	0.90	0.81
Burhinus oedicnemus	0.21	0.41
Species present in both regions		
Martes martes	0.27	0.25
Genetta genetta	0.60	0.50
Phalacrocorax aristotelis	0.61	0.46
Chromis chromis	0.22	0.14
Species only present in Asturias		
Tetrao urogallus	0.60	0.96
Salmo salar	0.59	0.69

local species. This bias in communication may modify our vision of wildlife (Eagles and Demare, 1999). Accordingly, Ballouard et al. (2011) in a similar study also found that the knowledge of children and their consideration to protect animals was mainly limited to a few exotic and charismatic species.

With this work we want to hold up a mirror to the society of the Balearic Islands, as an example of a region with many endemic species: children recognize exotic species much more than local ones, although few of them would probably have the possibility to see exotic species in the wild. This bias could turn problematic, since it is well known that conservation and management depends on public knowledge of environmental problems (Lindemann-Matthies, 2005; Lindemann-Matthies and Bose, 2008).

We believe that there are several ways to bridge the knowledge gap on local fauna. One would be to introduce the concept of local flagship species to increases awareness on local fauna (see for example Home et al., 2009; Verissimo et al., 2011). In Mallorca this has been at least partially achieved with the Mallorcan midwife toad *Alytes muletensis,* an endemic toad species which has been the focus of a EU Life Program in 1994–1997, but not with the Balearic shearwater, an endemic seabird at the edge of extinction (Oro et al., 2004) that has also been the focus of a EU Life Program during 1998–2001. However, from an educational point of view it would also be advisable to avoid focusing on one sole species, but to engage children's interest in the natural world surrounding them.

Childhood is the key period to introduce environmental education owing to the strength and lasting quality of an early relationship formed between children and the natural world (Caro et al., 1994; Kellert, 1985). Young children have a tremendous capacity for learning about creatures (Balmford et al., 2002) and certainly many species are very well known. Educational programs have the potential therefore to easily improve their knowledge of the local natural world. Schlegel and Rupf (2010) showed that animal species that could be identified and named, received higher affinity levels and by heightening awareness of nature on their doorsteps, children affinities shifted towards local flora and fauna. We propose to increase effort on environmental education at schools and that those educational approaches focus on direct experiences in the local environment of children (Lindemann-Matthies, 2006). We think that this educational effort would be welcomed by teachers, who during our study proved to be highly interested and sometime enthusiastic in discussing biodiversity issues and conservation biology in general. Additionally the form we chose to test pupil knowledge (on-line or computer questionnaires with rotating pictures) could be also used at schools as a friendly educational tool.

We stress that this study only quantified knowledge on vertebrate species, but we suspect that knowledge on invertebrates or plants would be much lower (Cardoso et al., 2011; Kellert, 1993). Focussing educational strategies on direct experiences would also allow to increase knowledge and awareness of invertebrates and flora.

5. Conclusions

Children recognize much better exotic species than local ones, being the knowledge of local fauna in Balearic Islands poor. We strongly recommend that if we are to protect local fauna we should engage children's interest in their natural environment. We propose to change political strategies, attitudes at home and educational strategies, and increase effort on environmental education which should focus on early and direct experiences with the local environment.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.biocon.2012.10.028.

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