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Primary school children's knowledge of wildlife: the influences of child age and gender, and species' origin and taxonomy

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Running title: primary children's knowledge of wildlife

Key words: wildlife, indigenous, exotic, children, gender

Brief description: primary school children were tested on their knowledge of wildlife. Knowledge increased with age, but identification ability peaked at 9. Boys performed better than girls. More was known about mammals than about birds and arthropods.

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Abstract

We examined the wildlife knowledge of primary (aged 4-12) schoolchildren. In particular, we examined the effects of children's age and gender, and the taxonomy and origin (indigenous versus exotic) of wildlife, on the degree of knowledge about different species. We used illustrated 'flashcards' of mammals, birds and arthropods, drawn randomly from a species pool. Each indigenous example was paired with an exotic animal. Wildlife knowledge overall increased steadily with age, although the ability to identify species peaked at age 9 then declined slightly. Boys had significantly greater wildlife knowledge than girls, and children of both sexes identified more indigenous than exotic species. Knowledge of birds and arthropods was significantly worse than of mammals. Knowledge of some very common indigenous species, such as sparrow and earwig, was very poor. We conclude that the potential for primary school wildlife education using very common and easily accessible species of birds and arthropods is not fully realised, and that girls in particular lack knowledge of local species.

Introduction

The number of students studying science subjects at secondary and tertiary levels in Britain is declining. Some authorities interpret this as evidence of a general problem with school science education, and suggest that there is an urgent need 'to improve and enhance (the) provision of science education at all levels' (Scottish Science Advisory Committee, 2003). One implication of this for conservationists is that future generations may not be having the basic introductory education on diversity, wildlife and taxonomy that is desirable. In Scottish primary schools, environmental studies are not considered to be core subjects, and thus may have little or no time allocated within a crowded curriculum.

Most educators would agree that the best way of learning about animals is through direct 'hands-on' experience. Unfortunately, there is evidence that the exposure of children within schools to 'real' animals has been declining for many years (Reiss and Beaney, 1993). Given increasing urbanisation and declining populations of wildlife, this paucity of experience within schools may be matched by a similar reduction in children's direct experience of wildlife outside of school. One recent study found that eight-year-old children in Britain were better able to identify artificial 'Pokemon' creatures than real, native ones (Balmford et al., 2002). The same research suggested that children expanded their knowledge of wildlife until age eight or nine, but then showed a static or even decreasing level of knowledge until age eleven. This raises a worrying prospect for conservationists; that the next, largely urbanised, generation will have little knowledge of and interest in wildlife. The fact that many children increasingly rely on indirect, culturally mediated sources of information about

'wildlife' (both real and artificial) raises a related concern. The focus of both mainstream and educational filmmakers on 'spectacular animals in threatened habitats' (Braund, 1998) might imply that children are learning more about 'exciting' exotic species than about wildlife in their own neighbourhoods. Birds and arthropods are probably the easiest wildlife to access for primary schools; invertebrates in particular can be readily found and handled. However, children and their teachers might not see these as 'exciting', and most people have a strong bias in affinities towards mammals (Kellert 1996). Fostering an interest in, and knowledge of, animals other than mammals are important goals for conservation educators (if only as a tool for interactive teaching about wildlife in general).

Children's knowledge of indigenous and exotic wildlife was investigated in the present study. The subjects were children between the ages of 4 and 12 in primary schools in and around Edinburgh, Scotland. Four null hypotheses were tested:

1) There is no effect of children's gender on wildlife knowledge.
2) There is no effect of children's age on wildlife knowledge.
3) There is no difference in levels of knowledge about indigenous and exotic species.
4) There are no differences in levels of knowledge about mammals, birds and arthropods.

Methods

A4 sized flashcards were produced with pictures of indigenous and exotic species of animal. A pool of 68 species was prepared; 20 arthropods, 20 birds and 28 mammals. Each indigenous species was paired with an appropriate exotic species, chosen to

have a similar ecological niche and, as far as possible, size. For example, the red deer (*Cervus elaphus*) was paired with moose (*Alces alces*). For each child surveyed, 6 pairs of arthropods and birds, and 8 pairs of mammals, were drawn randomly from the species pool. The child was asked three questions: What is this animal? What does it eat? Where does it live? Following Balmford et al. (2002), the level of identification required for the first question depended on the category of animal, with mammals and birds requiring genus level identification (e.g. 'rabbit') and arthropods requiring only ordinal classification (e.g. 'beetle'). A pilot survey was conducted involving 20 children aged 9 to 11 (i.e. the older age groups). This tested the suitability of the species pool chosen for identification. Any species that could not be identified by any children were considered too hard and replaced using different examples.

Primary aged children attending schools in or near Edinburgh, Scotland were surveyed in 2003 and 2004. Inner city, suburban, rural, private and state schools were included. Interviews took place in class time or during after-school clubs with the consent of the teachers and supervisors involved. Children were interviewed singly in sight of the teacher or supervisor, with each child seeing a different random selection of animals. The scores for each question along with age, sex and school for each child were recorded.

To investigate cultural sources of information about animals available to children, a survey of fiction books featuring animals was conducted in public libraries in Edinburgh. Advice from librarians was taken on which books they recommended for the age groups covered in the present work, and animal species featured as main characters in these books were recorded.

Data were tested for normality and homoscedasticity, and transformed where necessary. Paired t-tests (paired within children) were used to test for significant differences in knowledge about indigenous and exotic species. ANCOVA was used to test for effects of primary year (or age) and gender, with year as the covariate. Differences in knowledge between the three categories of animal were tested using two-way ANOVA on percentage scores, with year and category as factors. All animals were ranked according to the percentage total successful answers given.

Results

A total of 338 children from 22 different schools were surveyed. Participants ranged in age from 4 to 12, representing the maximum spread of ages possible in Scottish primary education; sample sizes in each primary year were 36, 42, 49, 46, 48, 49 and 68 (years 1 to 7 respectively). The sample consisted of 175 girls and 163 boys.

Knowledge of wild animals increased from year 1 to year 7, for boys and girls and for exotic and indigenous species (figure 1). Average scores at year 1 were 29%, and at year 7 (aged 11 or 12) were 60%. The pattern for identification success only (discounting knowledge of food and habitat) was similar but not identical. Year 1 pupils achieved a mean of 37% successful identifications. This increased to 68% by year 5 (age 9), then declined slightly to 63% and 66% in years 6 and 7 respectively. Boys did significantly better than girls, and older children performed significantly better than younger ones (figure 1a; ANCOVA source gender, $F = 15.8$, $P < 0.001$, source year, $F = 152$, $P < 0.001$). Children showed greater knowledge about

indigenous than exotic animals at all ages (figure 1b; paired t-test d.f. = 337, t = 17.6, $P < 0.001$). Taking all ages together, there was greater knowledge shown about mammals than about birds and arthropods (figure 2). This difference was highly significant after accounting for age (two way ANOVA, source category, d.f. = 2, F = 35, $P < 0.001$). Post hoc Tukey tests showed that scores for mammals differed significantly from those for birds and arthropods, whilst there was no significant difference between scores for arthropods and birds.

No animals were correctly identified by all children, whilst all taxa were identified correctly by at least 12 children. The top and bottom 20% of taxa are given in table 1.

A sample of 279 different children's books from five public libraries was surveyed. Seventy key animal characters were recorded, of which 63, 14 and 6 percent were mammals, birds and invertebrates respectively. The most popular ten characters, in decreasing order, were dog, cat, pig, bear, chicken, elephant, rabbit, mouse, duck and wolf. 'Robin' was the only indigenous species of bird recorded, whilst 'spider' 'ladybird', 'ant' and 'snail' were the invertebrates. Overall, 42% of animals were wild exotic species, 28% wild indigenous and 28% domestic.

Discussion

The present results give a mixed message for conservationists. Unsurprisingly, children's knowledge of both exotic and indigenous wildlife increased with age (hence the second null hypothesis is rejected). The mean total score achieved by both girls and boys rose for each additional year, with a mean percentage score of 60 being

recorded in year 7. This is a different pattern to that reported by Balmford et al. (2002), who showed knowledge peaking at age 8 and then declining slightly. A number of factors could explain this difference. The current work involved a sample size of children three times that studied by Balmford et al. (2002), hence their relatively small sample could be misleading, and there may be differences in education between England, where their study was conducted, and Scotland. Balmford et al. (2002) investigated only identification success, whilst the present study included other questions about natural history knowledge. Children aged 9 identified an average of 68% of taxa; which was the best mean level of identification; 10 and 11 year olds showed lower means of 63% and 66% respectively. Hence considering only identification ability revealed a similar pattern to that reported by Balmford et al. (2002). This supports the worrying suggestion that children may lose, or at least cease to gain, capacity to identify wildlife in the last two years of primary education. More positively, it suggests that while identification success might peak, other types of knowledge concerning general natural history and ecology continues to rise throughout the primary years.

There were significant differences in the knowledge shown about different groups of animals. In particular, children of all ages and both sexes scored better with mammals than with birds and arthropods (hence null hypothesis 4 can be rejected). The bias towards mammals was unsurprising given previous work with adults showing that this is common to many cultures; ‘useful’ and ‘friendly’ species are particularly favoured (Kellert 1996). The poor performance of birds, which achieved a mean score slightly less than arthropods, was more surprising. Since it is much easier for most primary school children to interact directly with wild arthropods and birds, rather than wild

mammals, these results reinforce the impression that cultural sources of information about wildlife are generally more influential than direct 'hands-on' experience. 'Chaffinch', 'sparrow' and 'earwig' were all included in the bottom 20% ranked species, despite being ubiquitous and readily observed. The bird species 'oystercatcher' (*Haematopus oestralegus)* did particularly poorly, despite being large, distinctive and abundant on the shore and in fields near Edinburgh. Children are likely to obtain much of their information about wildlife from television, films and books. The small study of children's books conducted here supports previous work (and common sense) in showing that mammals, and particularly domestic mammals, are the most heavily featured species; the present finding of 63% mammals comes close to the 62% recorded by Gray (1995). With the exception of 'robin', the only wild species of birds featured in the current sample of books were exotic ('penguin' was the most popular), whilst only four species of invertebrate were featured. Even when children's picture books do feature wild species, they are typically 'transformed and domesticated' (Marriott, 2002), a process which may be easiest for mammals. If these books are at all representative of cultural sources of information in general, this survey suggests that educators need to make special efforts to introduce children to species other than mammals.

The book survey showed more wild exotic species as characters than wild indigenous ones, supporting the idea that children's information on wildlife might give particular emphasis to 'exciting' exotic species. Despite this, all ages scored better on indigenous compared to exotic species (thus null hypothesis three can be rejected). The interpretation of this result is not straightforward; concluding that children are better able to identify indigenous than exotic species in general is unjustified since the

present results might reflect the particular species chosen to form the species pool. The effect of age on mean scores is interesting, since it shows a very similar pattern of increasing knowledge for both indigenous and exotic. Since direct experience by Edinburgh children of exotic wildlife is unlikely, the similarity in the patterns supports the idea that much or most of children's knowledge of all wildlife is derived from secondary sources.

Boys performed better than girls at all but the youngest ages. The discrepancy was slightly greater for birds and arthropods than for mammals; mean percentage differences in score were 7, 7 and 5 for the three groups respectively. A large literature addresses gender differences in science achievement and motivation in school pupils, much of it documenting a bias towards boys in the physical sciences. However, few studies have considered gender differences in biological identification abilities. In a study of animal classification tasks and understanding of basic taxonomy amongst 12-15 year old pupils, Braund (1991) found that girls performed better than boys, and suggested this was because they were more confident about the application of basic taxonomic concepts. Bell (2001) considered gender differences amongst 16-year-old pupils in their ability to answer scientific questions that required retrieving information from memory, but which did not involve application of concepts. He found boys scored better than girls in the physical sciences, whilst girls outperformed boys in human biology. He suggests that this reflects differences in the attitudes and experiences of boys and girls that start in early infancy, in particular the tendency for boys to focus more on objects and girls on people. It is possible that most of the children in our study classified wild animals in a similar way to other 'objects', thus explaining the gender bias we found. Mammals are perhaps more likely

to be seen as ‘people’ (or characters) than other animals, explaining the smaller gender gap found for them.

Educational implications

The present results support the idea that the ability of primary school children to identify wildlife species reaches a plateau (or even declines slightly) before entering secondary school. The greater knowledge of mammals compared with birds and arthropods, and the similarity in trends of wildlife knowledge with age for indigenous and exotic species, suggest that secondary cultural sources of information are more important than hands-on experiences. The primary school curriculum should give greater emphasis to direct interaction with local wildlife, particularly with easily accessible species of birds and invertebrates, and educators may need to provide special encouragement to girls in these studies. The low scores achieved for most arthropods suggest that the teaching of ‘minibeasts’ is not as universal (or at least as successful) as might be expected (Braund, 1998). Given the identification with pets and anthropomorphised images of animals that children reveal (Littledyke, 2002), generating interest in and knowledge about non-mammalian animals may require some imaginative ‘characterisation’ of these species, particularly for girls.

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Table 1. The top and bottom ranked 20% of all taxa for the whole sample of children's responses

Taxa	Indigenous/ Exotic	% identification success
Ranked top		
Penguin	E	98
Swan	I	98
Red admiral butterfly	I	97
Rabbit	I	97
Squirrel	I	96
Parrot	E	95
Hedgehog	I	94
Fox	I	94
Dolphin	I	93
Ladybird	I	93
Tarantula	E	92
Tiger	E	92
Spider	I	92
Ranked bottom		
Meerkat	E	22
Earwig	I	22
Sparrow	I	19
Leech	E	17
Praying mantis	E	16
Kestrel	I	13
Kiwi	E	11
Chaffinch	I	10
Manatee	E	8
Stoat	I	8
Oystercatcher	I	4
Albatross	E	4
Termite	E	4

Figure 1. Mean (± S.E.) total scores (on all questions) achieved by children in seven different primary years, with results for girls and boys (a) and indigenous and exotic taxa (b) shown separately

Figure 2. Mean (± S.E.) success (presented as a percentage of the maximum score possible) achieved by all children for mammals, birds and arthropods. The mean for mammals was significantly greater than that for the other two categories.

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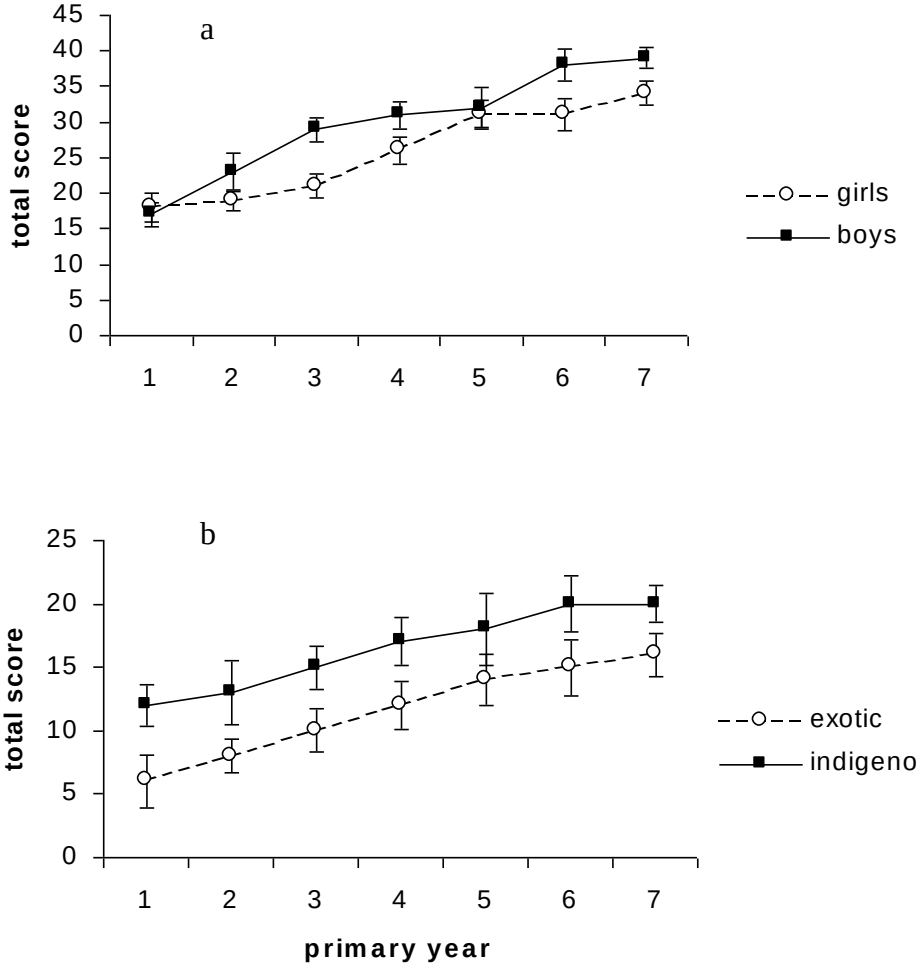

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