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KNOWLEDGE ABOUT COMMON VERTEBRATE SPECIES IN GERMAN KINDERGARTEN PUPILS

Christoph Randler,
Lisa Wieland

Abstract. *Biodiversity has become a challenging educational topic and knowledge about animal species and their identification is one aspect of learning about biodiversity. There are few studies addressed at assessing vertebrate species knowledge and species identification skills in children prior to schooling ('kindergarten'). Here, we tried to quantify the knowledge about fifteen animal species in a period before the onset of schooling as an assessment of prior knowledge. Children in the kindergarten were found to be able to identify common vertebrate species. Boys and girls scored equal in knowledge, but pupils with German as foreign language scored lower. There were significant differences between the eight kindergartens in our study. High scores have been found in a kindergarten within a large city.*

Key words: *biodiversity, gender, kindergarten, pre-schooling, vertebrate animal species knowledge.*

Christoph Randler & Lisa Wieland
University of Education Heidelberg, Germany

Introduction

Biodiversity has become a challenging educational topic especially since the conference of Rio in 1992 (van Weelie & Wals, 2002; Gaston & Spicer, 2004; and followed by the conference of Bonn), and the year 2010 has been declared as the year of biodiversity. In recent times, the value of biodiversity – even in currency – and the general importance remains unquestioned (Gaston & Spicer, 2004). Nevertheless, the term biodiversity is still a rather 'ill-defined' and complex construct, at least in educational terms, because it is difficult to teach at secondary school levels (van Weelie & Wals, 2002). Therefore, such complex and abstract constructs have to be transformed into smaller entities to aid learning and understanding especially in school students, and of course, also in the general public. With regard to vertebrate species, the most common entity used by conservation groups is the species level (van Weelie & Wals, 2002). Therefore, basic knowledge about animal or plant species, their identification and life history has been targeted as one fundamental aspect for learning and understanding in biodiversity (Lindemann-Mathies, 2002; Randler & Bogner, 2002; Gaston & Spicer, 2004; Randler, Ilg & Kern, 2005). This has been extended also to the framework of ecological questions (Leather & Helden 2005). However, researchers found that basic knowledge in biodiversity

is very low or even decreasing (e.g. Leather & Quicke, 2010; despite the lack of clear studies from earlier times, see Randler, 2008a). Such a fundamental view of biodiversity (based on assemblages of species) is shared by both, educational instructors at schools and in informal settings as well as by conservation biologists. Many conservation agencies and NGOs make use of flagship species to raise money, again, emphasising the value of species (Czeck, Krausman & Borkhataria, 1998; Dalton, 2005).

Animals are fascinating for children and adolescents, e.g. in Norway animal-related activities received high scores, such as bird feeding, or watching hare, fox and moose (Bjerke et al., 2001), and especially in school settings of secondary schools, animals as living objects within the classroom are highly appreciated (Hummel & Randler, 2010). Watching TV programmes received an almost similar proportion compared to learning about animals in schools (Bjerke et al., 2001). There were few studies aiming at assessing knowledge about vertebrate species and identification skills in pupils (overview: Randler & Bogner, 2002; Randler, 2008 a, b).

Additionally, species knowledge in kindergarten children has not yet been studied. Although the quality of instruction in the kindergarten seems of high value less research was undertaken to improve learning environments in this educational setting (Alexander et al., 2004; Eshbach & Fried, 2005). Making use of species at this developmental stage seems promising because children are highly interested in animal species (Kellert, 1985). Therefore, assessing knowledge at the baseline level of kindergarten children is necessary as a prerequisite to implement programs about biodiversity at this educational level.

The aim of the study was 1) to quantify the knowledge about common vertebrate species in kindergarten children and to provide a basis that might be used for educational programs directed towards learning in biology and conservation especially in young children; to assess differences 2) between boys and girls, and 3) between pupils for whom German is a foreign language, and 4) to address differences between the kindergartens.

Methodology of Research

Kindergarten Children Sample

The data for the present study were collected during December 2005 and January 2006. The parents of the kindergarten children received a factual sheet where the details of the study were explained and written consent was obtained. We did not separate ethnic groups, but pooled children whose first language was German (N = 61) into one group, while others (N = 56) were grouped into a class with German as foreign language. 58 children of our sample were boys and 59 were girls. The children were aged between 5 and 6 years in their last year of kindergarten visit, immediately prior to the onset of schooling.

Interviews were carried out in eight different kindergartens (between 4 and 28 children per kindergarten). The kindergartens were situated in a 30 km circle around Stuttgart, the federal capital of the state Baden-Württemberg in south-western Germany. We tried to sample different kindergartens in rural (e.g. Erdmannhausen: 4891 inhabitants) and urban towns (e.g. Stuttgart: 591 550 inhabitants), and from both public and private institutions. Although a comparison between public and private institutions and between urban and rural kindergartens might be of interest, the material presented here does not allow a comparison and was not in the focus of our study.

Structured Interviews

To assess knowledge about species, we presented fifteen vertebrate animal species to the children. Birds and mammals were presented as stuffed taxidermies, while reptiles and amphibians were presented as plastic models. Both, models and taxidermies closely resembled natural species and were scientifically sound, i.e. all relevant identification traits were visible and correct. The interviewing was made by LW who owns a degree in kindergarten education. The female interviewer was dressed casually

and conducted interviews with a consistent appearance and technique.

The children had to identify the respective animals as precise as possible, e.g. as Mallard (*Anas platyrhynchos*). This was scored with 1.0. However, if the *genus* or family name was correct but the species identification was not, then it was scored 0.5 (e.g. duck for mallard, or songbird for the robin), otherwise the value 0 was assigned. Also, when one part of the name was correct, but the other one not, we scored it 0.5. This was to ensure that prevailing concepts were not omitted but taken into account (Eschenhagen, 1982 used a similar procedure). Such concepts often exist (Randler & Bogner 2002, 2006), i.e. children are able to classify the animal in a taxonomic group such as order, family or genus, but lack a precise identification at the species level. Every child was tested alone to avoid communication among children about the species.

The selection of the species followed a detailed procedure. Previous studies often used a battery of species without any substantial reasoning about the abundance or frequency of these species. Therefore, Randler and Bogner (2002) displayed a listing which should be taken into account when selecting species for questionnaires. In a previous study, 54 vertebrate species were used in a primary school (grade 4, age 9-10 years; Randler, 2008a). We focused the selection of species for the kindergarten study based on these 54 species. We used those species that were identified correctly by a large proportion of the 4th graders (age 9-10 years) and we decided to use species from four vertebrate classes (amphibians, reptiles, birds and mammals).

Statistical Procedures

Apart from comparative bi-variate statistics we used general linear modelling (GLM) to test the influence of different factors that might influence species knowledge in one single model. The first model contained the fixed factors 'gender' and 'German as foreign language', while 'kindergarten' was used as random factor. Further, all two-way-interactions were included. By performing a stepwise backward procedure always the variable or interaction with the highest non-significant P-value was removed until the final model contained only significant explanatory variables. Means ± SE are given.

Results of Research

On average, children scored 5.95 ± 0.17 SE from a possible maximum score of 15. Figure 1 presents the percentage of correct identification for each animal species. High percentages on the genus and family level were found in mallard, tawny owl, common frog, bat and grass snake. Thus, kindergarten children could identify these vertebrate species on the level of "duck", "owl", "frog", "bat" and "snake".

Squirrel, hedgehog, and mole were often precisely identified by their correct species name. These high identification scores all belong to species of the class mammals (Mammalia).

Significant differences in identification scores existed between the eight kindergartens (One-way-ANOVA; $F_{7, 109} = 15.475$; $p < 0.001$; Figure 2). The highest scores were obtained in kindergarten 1 which is situated in the city of Stuttgart, a large town with 591 550 inhabitants. Further, children with German as foreign language scored significantly lower (4.89 ± 0.18) than children with German as mother tongue (6.92 ± 0.21; t-test; $t = 7.101$ $p < 0.001$; Figure 3). Differences between boys and girls did not exist (boys: 6.01 ± 0.26; girls 5.88 ± 0.21; t-test; $t = 0.372$; $p = 0.711$).

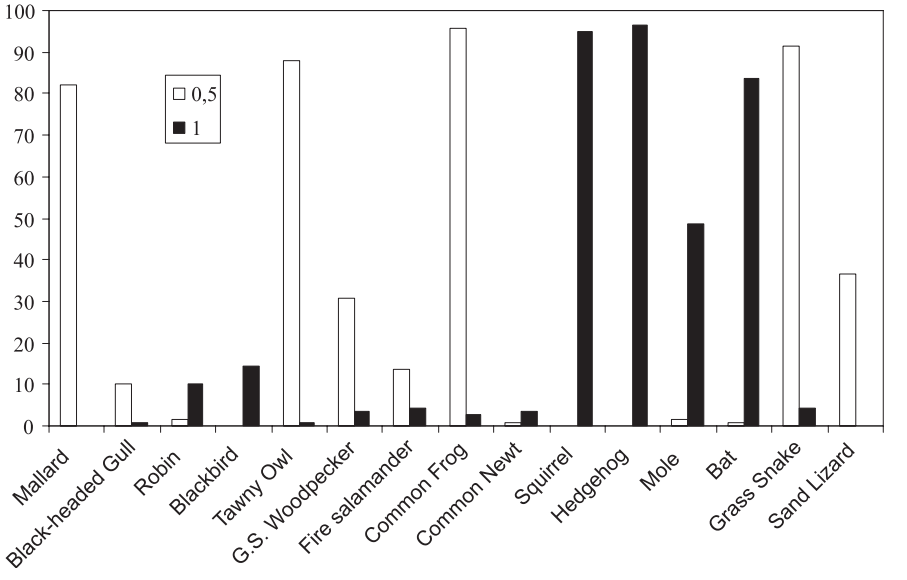

Figure 1. Percentage of children correctly identifying each species. Black columns (1) represent a correct identification on the species level, white columns (0.5) represent the correct identification on the genus or family level (or correct identification of another part of the name).

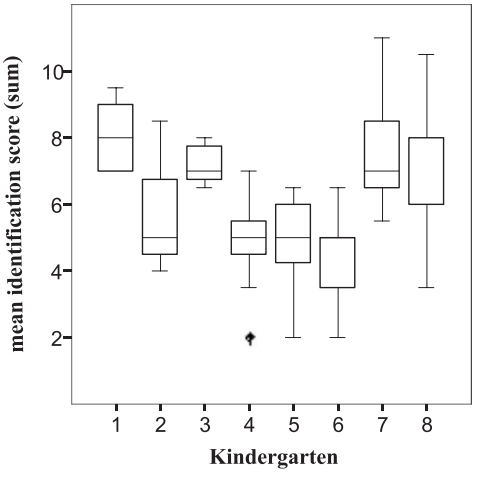

Figure 2. Box plot of the mean identification scores of the respective kindergartens.

The first general linear model (GLM) showed no significant influence of the two way interactions which were subsequently deleted. The second model found a significant influence of 'language' and of 'kindergarten', while gender showed no influence. The final model (total model: $p < 0.001$), contained the fixed factor language ($F_{1, 108} = 5.263$; $p = 0.024$) and the random factor kindergarten ($F_{7, 108} = 6.998$; $p < 0.001$).

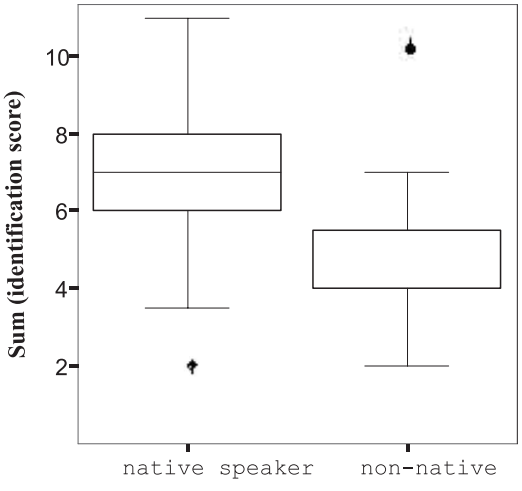

Figure 3. Comparison of native and non-native German language speakers.

Discussion

One point in the discussion should be made about the scoring. Nearly 6 correct identifications out of 15 seem a low result and may imply that there is a low baseline level of knowledge in kindergarten children (see Leather & Quicke 2010). Most of the species that were known by kindergarten children are usually depicted in books for children (e.g. mallard duck, owl, frog; CR unpublished survey). Therefore, pre-kindergarten experience may significantly contribute to the species knowledge. Children more often assigned mammal species the correct name compared to birds or herpetofauna. This may be a result of the phylogenetic relatedness (i.e. because humans are also mammals).

The data presented here are a kind of base-line level and of pre-school knowledge. Assessing prior knowledge to aid learning and understanding is a useful tool (Prokop et al., 2007; Prokop & Rodak, 2009). The material presented here might give a starting point for primary school teachers seeking to teach about animals. Such educational approaches should start in elementary schools (Bjerke et al., 2001; Kellert, 1985; Randler et al., 2005). Our study suggests that there is some basic knowledge that should be taken into account both by kindergarten instructors as well as by elementary school teachers. Further, it seems that early positive experience with animals (before the age of ≈ six years) may have a long lasting impact on future decisions about nature and conservation, although this statement is in question (see discussion in Bjerke et al., 2001).

We found no difference between boys and girls. Other studies assessing species identification in pupils revealed inconsistent results. Lazarowitz (1981), for example, found no differences between boys and girls in 7th graders (12-13 years), while 9th grade boys (14-15 years) scored better than girls. Higher scores in boys were also reported by Ryman (1974, 1977), while Killermann (1998) found girls scoring higher. Braund (1991), again, found no gender differences. In a survey study (Randler, 2008a) gender differences existed with girls scoring higher, but effect sizes were low.

Language was a significant predictor of identification score with non-native or foreign language speakers scoring lower. Other studies already emphasise the importance of language for teaching (Duran, Dugan & Weffer, 1998). Therefore, it is necessary for educators to assess the language abilities of the children and to adapt the teaching materials. One idea might be to explain the names of the animals from a linguistic aspect (Randler, 2008b).

Kindergartens in this study differed with regard to the knowledge of the children. This might be either a result of different instructions or of different environments, or may be based simply on socio-economic factors. It is interesting that the kindergarten with the highest score was found within a

large city (Stuttgart). This is counter-intuitive but there is a strong trend in animal ecology with some species moving towards the city centres where these animals are much easier to observe than outside in nature. Such factors may also contribute to the knowledge of city-dwellers (Randler, Höllwarth & Schaal, 2007).

Implications

Children in the kindergarten naturally enjoy observing and thinking about nature (Eshbach & Fried, 2005). Therefore, educators and instructors should make use of discrete animal species to aid learning because species are not an abstract construct (van Weelie & Wals, 2002). Further, the focus should be on vertebrate species, especially focusing on mammals might be a promising idea. The species which were well-known in this study may be useful to start with during kindergarten education. However, frightening species, such as large dogs and insects (Prokop & Tunnicliffe, 2008) should be avoided and instruction should focus on less frightening animals, such as small passerines (songbirds) or squirrels (see Bjerke et al., 1998 for details). In addition, experiencing animals outside is also promising (Falk, 1983; Randler et al., 2005). Further, focusing on a few species or on one species and embedding information about its live history into stories could be helpful.

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Christoph Randler Dr., Professor at the University of Education in Heidelberg, Didactics of Biology / Zoology, D-69120 Heidelberg, Germany.
Phone: 0049-6221-477-344.
E-mail: Randler@ph-heidelberg.de
Website: http://www.ph-heidelberg.de/org/allgemein/2242.0.html

Lisa Wieland Primary school teacher, Heidelberg, Germany.
E-mail: Lisawieland@gmx.de