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Cognitive and emotional evaluation of two educational outdoor programs dealing with non-native bird species

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"Non-native organisms are a major threat to biodiversity". This statement is often made by biologists, but general conclusions cannot be drawn easily because of contradictory evidence. To introduce pupils aged 11-14 years to this topic, we employed an educational program dealing with non-native animals in Central Europe. The pupils took part in a lesson giving general information about the topic, followed by a species identification quiz. Attitude, emotions and state of knowledge of each pupil were surveyed throughout the program using standardized questionnaires (pre-/post- and follow up tests). One week after the first lesson, a field trip followed, focusing on one out of two non-native bird species in the city of Heidelberg, Baden-Württemberg, Germany. The first species was the Ring-necked Parakeet (*Psittacula krameri*) from the Indian subcontinent, and the second species was the East Asian Swan goose (*Anser cygnoides*). Life history information was delivered through a teacher and own observations during the excursions and after four weeks, the newly gained knowledge was tested in a third lesson. The "goose group" scored higher in goose-related questions, whereas the "parakeet-group" scored higher in their topic. The most impressive aspect of the whole program was, that the pupils rated the field trip per se as highest, and secondly, learning about unfamiliar species. Interestingly, the general attitude towards non-native species did not change as a result of this educational intervention.

Keywords: Anser cygnoides, Anseriformes, Aves, biodiversity, birds, Education, exotic, non-native, Outdoor, Psittaciformes, Psittacula krameri

Introduction

Teaching Biodiversity

Teaching biodiversity has been taught some hundred years ago, but due to low baseline level knowledge (Leather & Quicke, 2009) had become a challenging educational task at least since the conference of Rio in 1992 (Gaston & Spicer, 2004; van Weelie & Wals, 2002), and it has been emphasized again at the Conference of Bonn in 2008. From an educational point of view, however, biodiversity is a rather 'ill-defined' abstract and complex construct (van Weelie & Wals, 2002) which has to be transformed into small entities to enhance a sustained learning and understanding, especially during teaching at school. The most common entity used by conservation groups are species (van Weelie & Wals, 2002). Therefore, basic knowledge about animal

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species, their identification and life history has been targeted as a fundamental aspect for learning and understanding biodiversity (Gaston & Spicer, 2004; Lindemann-Matthies, 2005; Randler & Bogner, 2002), but baseline knowledge seemed to have declined significantly in recent decades (Leather & Quicke, 2009; but see Randler 2008).

Usually, natural or endemic species are in the focus of educational programs and non-native or established species have been rather neglected in educational settings, because they do not belong to our familiar environment and they are often not included into common identification keys or books. It is often stated that they pose a threat to the natural environment – an argument, which is most often untrue in many areas of the world (but see exceptions below). Nevertheless, we want to encourage teachers and practitioners to integrate the aspect of non-native species into their everyday teaching and we provide an example.

Non-Native Species

Non-native organisms are generally regarded as a major threat to biodiversity as they may predate upon, outcompete, hybridize with, or change the environment of native species with sometimes severe impacts, the heaviest one being extinction (Cambray, 2003; Cole, Jones, & Harris, 2005; Engeman, Groninger, & Vice, 2003; Imber, West, & Cooper, 2003; Jeschke & Strayer, 2005; McDonald, Birtles, McCracken, & Day, 2008; Smith, Henderson, & Robertson, 2005; Vavra, Parks, & Wisdom, 2007). Especially vulnerable are isolated tropical and subtropical island ecosystems (Briskie & Mackintosh, 2004; Cowan & Tyndale-Biscoe, 1997; Daehler, Denslow, Ansari, & Kuo, 2004; McDonald et al., 2008; Steiner, 2001). Findings at continental scales are different. Central Europe has a high rate of species turnover since the last Glacial maximum due to post-glacial colonization events from other parts of Europe (Kinzelbach, 1996) and no native animal species so far was actually lost due to competition with an introduced species. In South America only 6% of the animal taxa were threatened by exotic species with a higher risk in continental fishes and amphibians. As a possible reason it was stated that they are survivors of the Great American Biotic Interchange (GABI) during the Pliocene and already underwent an "extinction filter" (Rodriguez, 1983, 2001). Therefore it is important to distinguish between susceptible and relatively robust ecological regions and ecosystems.

Anthropogenic influenced habitats like cities, disturbed and fertile soils are commonly regarded as centres of bioinvasions (Bashkin, Stohlgren, Otsuki, Lee, Evangelista, & Belnap, 2003; Bear, Hill, & Pickering, 2006; Collingwood, Tigar, & Agosti, 1997; Hong, Song, Kim, & Lee, 2003). More than 50% of pest arthropods in greenhouse culture are of non-native origin, but also pest control organisms are often exotic, like the North American *Prospaltella pernicios* (Hymenoptera, Aphelinidae), which is used to control the San José scale (*Quadraspidiotus perniciosus*) in European agriculture. Furthermore, several insect species are applied against invasive plant species like *Eichhornia crassipes* or *Opuntia* species, which are controlled using the moth *Cactoblastis cactorum*, e.g. in Australia (Ajuonu, Byrne, Hill, Neuenschwander, & Korie, 2007; Ajuonu, Schade, Veltman, Sedjro, & Neuenschwander, 2003; Annecke & Moran, 1978; Mafokoane, Zimmermann, & Hill, 2007; Martin & Dale, 2001). In the case of *Cactoblastis cactorum* and the ladybird *Harmonia axyridis*, control organisms have become pests themselves (Johnson & Stiling, 1996; Koch & Galvan, 2008; Pemberton & Liu, 2007; Soares, Borges, Borges, Labrie, & Lucas, 2008; Ware, Yguel, & Majerus, 2008; Weihrauch, 2008).

The 'tens rule' (Williamson, 1996) states, that out of 1,000 introduced plant and animal species, 100 (10%) will appear in the wild, and 10 (1%) will become established, but the success in vertebrate species introductions between Europe and North America was found to be 50% at each

step (Jeschke & Strayer, 2005). In 2002, there were 1,322 animal species listed in the database of Germany with 262 being established here (Geiter, Homma, & Kinzelbach, 2002).

Relevance of Outdoor Biology Teaching

Teaching about animals and about biodiversity in general should give a preference to outdoor ecological settings (Killermann, 1998; Lock, 1998; Prokop, Tuncer, & Kvasničák, 2007a; Tilling, 2004). Previously, a lot of outdoor educational lessons often dealt with more or less immobile taxonomic groups such as plants or some invertebrates (Killermann, 1998). Mammals or birds are often difficult to observe under natural conditions, given the problems encountered, for example, by large classes comprising up to 33 pupils and the shyness of many bird species, or by the nocturnal activities of most mammals. However, one might use the tameness of urban-dwelling native and non-native species to teach these aspects.

Within the context of ecology, many educational researchers emphasised measuring psychological constructs such as attitude, perception and other personality factors rather than knowledge (Bogner, 2002; Randler & Bogner, 2002) but assessing cognitive learning outcome should support the possible benefits of outdoor ecology education. Evans, Dixon, and Heslop (2006) emphasise that the low knowledge of bird species seems to be linked to a decline in outdoor ecology teaching which has diminished in recent years.

Outdoor education must be enhanced and should be supported by previous learning within the classroom. This prepares the pupils for issues and task during outdoor field work and prevents pupils from novelty effects (Falk, 1983, 2005; Falk, Martin, & Balling, 1978). Such a novelty effect arises when pupils are confronted simultaneously with different environmental conditions. In terms of the non-native outdoor program this includes: i) species that are unfamiliar to the pupils, ii) a totally different learning environment (compared to familiar classroom settings: e.g. adverse weather conditions), and iii) different social forms, such as working in groups and doing hands-on activities and encountering living animals.

We chose two non-native bird species having established viable breeding populations in the study area within the past 10-20 years, the Indian Ring-necked Parkeet (*Psittacula krameri*) and the East Asian Swan Goose (*Anser cygnoides*). Both species are living close to humans, are social, easy to observe, have established sustainable populations and do not spread far away from the built-up areas. Both these species provide an optimal setting for outdoor biology teaching and there are no hints that any of these species posing a serious threat to biodiversity on the local, regional, or European level (Braun & Wegener, 2008; Randler, 2007; Strubbe & Matthysen, 2007). Both species are more or less accepted by the general public.

The Value of Species in Biology Education

Animal species rank high in the favourite interest of children and adolescents (Bjerke, Odegardstuen, & Kaltenborn, 1998; Lindemann-Matthies, 2002, 2005; Morgan, 1992; Prokop, Tuncer, & Kvasničák, 2007b). Prokop and Tunnicliffe (2008) found that the correlation between attitudes and knowledge is stronger for species that pose no serious threat to humans and vice versa, and in our educational setting, both species do not pose a threat to humans. However, these assumptions, that living animals elicit positive reactions and emotions and henceforth a higher learning success remain poorly empirically tested (Morgan, 1992). Morgan (1992) found that a balance between cognitive input and level of involvement fosters learning success at best. There-

fore, the combination of classroom activities prior to a field trip to enhance knowledge and of an outdoor activity to foster emotions seems a worthwhile task.

Outline and Aims of the Study

In this study, we aimed at assessing the impact of an outdoor ecological program dealing with two different non-native species on the learning and retention effect and on emotional variables. Further, we look at the possible change in the assessment of the value of non-native species. Our program was concerned with the Ring-necked Parakeet (*Psittacula krameri*) and the Swan Goose (*Anser cygnoides*). We enrolled two groups of pupils in two different programs, therefore, each group served as a control group for the other in detailed knowledge about the species, while both groups should obtain the same level of general knowledge about non-native species during the classroom session. To compare both groups, we tested the knowledge prior to the intervention to get a baseline level, and both groups received general questions about non-native species, as well as detailed questions about the respective species in the post-test and retention test. Further, the species do not seem to differ in any cultural history since both geese and parakeets have been companion species since many centuries.

Research Questions:

1. Are there significant differences in achievement between the Parakeet and the Goose group in species-specific and general knowledge about non-natives immediately after the educational treatment?
2. Are there significant differences in achievement in the Parakeet and the Goose group in species-specific and general knowledge about non-natives, measured by a retention test applied with a delay of three to four weeks?
3. Are there any significant differences between the treatments (parakeet/goose) in the emotional variables well-being, boredom and interest?
4. Are there gender differences in achievement, attitude and emotional variables?
5. Is there an increase or decrease when assessing the value of non-native species?

Methods

Information about the Species

Non-native species are commonly regarded as a major threat to biodiversity. Nonetheless most exotic bird species are neglected by field ornithologists and regarded as escaped cage birds. Therefore those species in Europe are poorly studied. To sensitise pupils for nature belongings, we initiated an educational program on two exotic species which were locally abundant and easy to observe.

Example 1: The Ring-necked Parakeet

The Ring-necked Parakeet is native to Asia and Africa. Two subspecies (*P. k. manillensis, P. k. borealis*) are living on the Indian Subcontinent, and further two subspecies (*P. k. krameri, P. k. parvirostris*) in sub-Saharan Africa. Having bred for the first time in 1974 in a park of Neckarhausen (8° 36’ E, 49° 27’ N), northwest of Heidelberg, the population grew steadily up to 100 birds in the beginning of the 1990s. The first brood in Heidelberg was found in 1990 (Poley,

1993). The birds breed in cavities of trees (esp. *Platanus x hispanica*), from 2000 onwards in thermal insulation of buildings, and, since 2004, in purpose-built nest boxes. Nest boxes were hang up on affected buildings to avoid further damage to facades (Braun, 2007). Despite their tropical origin, the birds survive even the harshest winter with temperatures less than -20 °C (Niederwolfsgruber, 1990). In 2007, more than 800 birds were counted on the local roost in Heidelberg (Randler, Braun, & Lintker, 2010; Braun, 2009).

Example 2: The Swan Goose

The Swan Goose is a non-native species in Europe, having been introduced in the 18th century (Delacour, 1958). The study flock in Heidelberg, south-western Germany (8° 41' E, 49° 25' N) was established in the 1990s. The birds breed on an island in the Neckar River and soon after hatching, families move to feed on a lawn which extends 1.1 km along the river. In 2002, the population was 140 individuals in 2002 and 174 in 2003 (Randler, 2007).

Educational Program

Indoor Program

The total duration of the educational program took place between 02.02.-21.06.2007. During the indoor program, the testing procedure (pre-test) was administered and the following details were taught.

1) Theoretical background: In a 15 minutes introduction the definition and etymological background of "Neozoa" (greek: "neos" = new and "zoon" = animal) was given with respect to the terms "Neophyta" (plants) and "Neobiota" (all organisms). The definition included an introduction by man after 1492 and leading to viable populations in the new area (at least three generations). Subsequently important New World plant introductions to Europe were shown (potato, tomato, cacao, maize) with their daily life products (potato chips, ketchup, cocoa, pop corn). Finally the exchange between Old and New World animals was shortly discussed. This was done as a short teacher-centered introduction into the topic and to raise pupils' interest. Then a quiz followed. The pupils participated in a slide-show-quiz including 30 animal species of Central Europe (Appendix 1). This set consisted of 25 vertebrates and 5 invertebrates (Appendix 1). They had to decide whether a species was native or non-native in respect to the area given above. The pupils had 30 seconds for each animal to identify and write down the name or taxonomic unit (as precise as possible → score) as well as the status of its nativeness. After the test the German and scientific names were presented together with the pictures.

Outdoor Program

The outdoor program took place in 2007 in February and for one group by the end of May. During the outdoor program, the pupils were assigned either to the parakeet group or the goose group (see below). Pupils went with their group leader to a location to watch geese or parakeets for about 3 hours. The program included several aspects like historical background of their introduction, ecology (habitat, breeding biology, social behavior, reaction towards people), morphology (bill, feet, feathers, sexual dimorphism, cross-like silhouette in flight) and problems associated with urban habitats.

Research Design

Educational field studies are often difficult to plan because total classes were used as the entity of teaching (Randler & Bogner, 2006). However, we aimed at a complete randomisation procedure within each group (for groups see pupil sample). Within each group, pupils were randomly assigned to either the goose or the parakeet group by using cards. That is, pupils of each of our subsamples were nearly equally distributed.

Pupil sample

The study subjects were pupils from different classes and groups:

- A special interest project with highly skilled pupils, 12-14 years old (Hector-Seminar, Heidelberg; 7^{th} and 8^{th} graders)
- Pupils from a gymnasium (highest stratification) with a special interest into biology, 11-12 years old (5^{th} graders)

According to the school classes, there were:

- 5^{th} graders (N=11; 7 parakeet, 4 goose)
- 7^{th} graders (N=33; 15 parakeet, 18 goose)
- 8^{th} graders (N=10; 4 parakeet, 6 goose)

There were no significant differences in the distribution of the classes and groups (χ^2_2=1.14, p=0.49). Boys and girls were equally distributed to the treatments (boys: 15 parakeet, 16 geese; girls: 11 parakeet, 12 geese; χ^2_1=0.002; p=0.96). Please note that the German school system splits children after the 4^{th} grade into three different stratifications according to their cognitive abilities (high, medium and low stratification). All of our pupils came from the highest stratification to avoid interference.

Instrumentation and Procedure

Achievement test

An achievement test was developed according to the content of the educational program. The pre-test consisted of five questions (definition of non-native species, morphological and behavioural traits of parakeets, morphological and behavioural traits of geese [these were reproductive questions], which aspects are necessary that non-natives can establish [reorganisation], and finally, "Imagine a non-native species was released. What can be expected? [transfer]. The post-test repeated the first three questions, then asked the names of the non-native species learned in the quiz, and asked for the relevance of the year 1492. Retention test asked for definition of non-natives, some detailed questions to be filled in a table (about both, geese and parakeets), and the two questions from the pre-test concerning reorganisation and transfer (see above). Thus, post-test and retention test contained two parts: more general aspects of non-native species biology, and some special questions dealing with goose and parakeet biology.

Emotional variables

We measured emotional variables after the educational treatment as part of the retention test. These emotions are derived from two publications (Gläser-Zikuda, Fuß, Laukenmann, Metz, &

Randler, 2005; Randler, Ilg, & Kern, 2005). We chose four question items from these different emotional constructs: well-being ("Was the treatment pleasant for you?"), interest ("How interesting was the topic non-native species for you?"), boredom ("Was it boring"), and difficulty of the task ("Please assess the difficulty of the tasks for your?"). Further, we asked the pupils to grade the treatment in general. This grading of the emotional variables was analogous to the German grading system, where 1=best and 6=worst.

Attitude

Attitude towards the value of non-native species was measured prior and after the treatment during pre-test and retention test following Tisdell, Wilson, and Nantha (2006). The questionnaire contained eleven dichotomous (yes/no) question: "Imagine, the following exotic (non-native) species from outside would be introduced into Germany. Which of these species should survive, which should be eradicated?" The list contained the following animals: Goose, parakeet, deer, squirrel, wild dog, non-venomous snake, venomous snake, non-venomous spider, frog, fish, lizard (Table 3). Further, we used an open-ended question „What was the most impressive aspect of the program? "to assess the different aspects (indoor, outdoor or different aspects of the species' behaviour).

Procedure

The pre-test was applied immediately prior to teaching, to assess a baseline level of knowledge about non-native species. Also, we assessed the attitudes towards different species. The immediate post-test was applied immediately after the indoor educational treatment and shortly before the outdoor program (to assess short-term learning effects). The retention test (knowledge) and the emotional variables were applied with a delay of three to four weeks to assess the retention of knowledge and long term learning effects. During the retention test, we again assessed the attitudes towards different species to control for changes in attitude. Pupils never were aware of any further testing.

Statistical analysis

We used T-tests to compare the means of the different tests. Chi-square tests were used to examine categorical variables. All tests were carried out two-tailed using SPSS 16.0. Levene tests all showed a $p>0.05$ for the achievement tests. Please note that not all respondents filled in all questionnaires because of absence from some parts of the programme (e.g. illness). 40 pupils filled in all tests (21 parakeet, 19 goose group). We therefore analysed the sample in addition to the t-tests using a general linear multivariate model with pre-test as covariate and post-test and retention test as outcome variables.

Results

Knowledge

There were no significant differences between both groups (goose versus parakeet) neither in prior knowledge, nor in the total scores of post-test and retention test (Table 1). Concerning the different parts of the tests, we could not reveal differences between both groups in the questions about the general aspects of non-natives. In the post-test, the Goose group scored higher in their

Table 1. Comparison of both groups (goose group versus parakeet group) in their cognitive achievement, their emotional variables (interest, boredom, well-being), difficulty, and grading of the unit by the pupils after the treatment. Please note that the German grading systems is based on scoring 1-6 with 1 = best and 6 = worst. Pre-test df=45, post-test df=43, retention df=52.

		N	Mean	SD	T	P
Pre-test (sum)	Parakeet	23	6.30	2.80	-1.20	.234
	Goose	24	7.25	2.57		
Post-test general questions	Parakeet	24	10.06	3.49	1.14	.259
	Goose	21	8.66	4.66		
Post-test Geese	Parakeet	24	1.16	0.96	-3.61	.001
	Goose	21	2.19	0.92		
Post-test Parakeets	Parakeet	24	2.62	1.17	0.17	.861
	Goose	21	2.57	0.81		
Post-test (sum)	Parakeet	24	13.85	4.39	0.29	.768
	Goose	21	13.42	5.21		
Retention general questions	Parakeet	26	5.34	2.13	-0.62	.533
	Goose	28	5.71	2.17		
Retention Geese	Parakeet	26	3.30	2.73	-5.88	.000
	Goose	28	7.89	2.97		
Retention Parakeet	Parakeet	26	6.19	3.55	2.82	.007
	Goose	28	3.67	2.98		
Retention (sum)	Parakeet	26	14.84	5.93	-1.50	.138
	Goose	28	17.28	5.94		
Interest	Parakeet	26	2.13	1.14	-.71	.477
	Goose	28	2.33	0.95		
Boredom	Parakeet	26	2.37	1.29	.08	.932
	Goose	28	2.34	0.92		
Difficulty	Parakeet	26	2.27	1.12	.15	.880
	Goose	28	2.23	0.61		
Well-Being	Parakeet	26	1.97	1.21	.05	.959
	Goose	28	1.96	1.00		
Grading	Parakeet	26	2.26	1.29	.52	.599
	Goose	28	2.10	0.77		

knowledge about Swan Geese, but the differences between both groups in Parakeet knowledge did not emerge. Finally, in retention, the goose group scored significantly higher in their knowledge about the geese, and the parakeet group scored higher in parakeet knowledge. By using a general linear multivariate model, results were similar. Pre-test had a significant influence on all post- and retention test variables (Wilks-Lambda = 0.603, F=3.507, P=0.009, Partial eta^2 =0.397). Group also accounted for significant differences in the post-test questions about geese and retention test questions about geese and parakeets (Wilks-Lambda = 0.304, F=12.187, p<0.001, Partial

eta^2 =0.696). These results were similar to our t-tests. The goose group scored higher in the post-test questions about geese (post-hoc comparison, p=0.001), and also in the retention test questions about geese (p<0.001), while the parakeet group scored higher in the retention test questions about the parakeets (p=0.001). No differences have been found in the general questions about non-native species.

Emotional Variables

There were no significant differences between both groups in emotional variables (see Table 1). Pupils expressed a moderate to high interest and a high well-being during the educational unit, while boredom was rated low. Also, the tasks were not assessed as difficult. Pupils gave good marks for the unit (see Table 1).

Gender Differences

We found no gender differences in emotional variables (always p>0.5). However, in knowledge, girls scored higher in the post-test, both in the questions concerning geese and parakeets and the general questions on non-natives (Table 2). In the retention test, girls also scored higher in the questions concerning geese and parakeets, but not in the general questions on non-natives. This suggests that at least in the general parts of the educational programme, no gender differences remained.

Attitude

There were no significant differences between boys and girls in their attitude towards the eleven non-native species, neither prior, nor after the treatment. Table 3 lists the species according to their percentage. The mean value was calculated so that a value of 1.0 means that none of the species should be eradicated and a value of 0 that all species listed should be eradicated. There were no significant changes in attitude towards non-native species (Mean score before 0.78 ± 0.20, after 0.76 ± 0.19; T=1.15 df=46 p=0.25). Answers to the open-ended question "What was the most impressive aspect of the program?" were the outdoor field trip (N=36), the quiz (N=7) and learning about unfamiliar species (N=8).

Discussion

Knowledge

The results show that retention scores differ between both groups as expected, with the goose group scoring higher in goose knowledge and the parakeet group scoring higher in parakeet knowledge. This is an expected result and it provides insight into the learning and retention of both groups because each group can be considered a control group for the other one. Because the goose group learned about non-native species with the Swan Goose as an example, these pupils gained more specific knowledge about the geese, and in the parakeets, it was vice versa.

What is more interesting is that both groups scored similar on the questions dealing with general biology and ecology of non-native species, thus suggesting that both educational treatments foster general knowledge about non-natives and that both treatments are equally suited for teaching aspects of exotic species. We therefore suggest using non-native species which are often tame and easy to observe in biology teaching. Such short-term effects of an outdoor program on knowledge have been revealed, e.g. by Randler et al. (2005), Prokop et al. (2007b), and by

Bogner (1998) emphasising the quality of such educational programmes. These results and previous research strongly suggest that educational outdoor programs are a worthwhile means for teaching species identification ecology and environmental education from a cognitive viewpoint. Another aspect that should be mentioned is that the pupils were highly motivated in biology, and such studies should be repeated with a more representative sample of "average" pupils.

Emotional Variables

As the emotional variables did not differ between the goose and the parakeet group, this again

Table 2. Comparison of boys and girls (Pre-test df=45, post-test df=43, retention df=52)

		N	Mean	SD	T	P
Pre-test (sum)	G	19	7.52	3.04	1.56	.124
	B	28	6.28	2.37		
Post-test general questions	G	21	10.97	4.49	2.54	.015
	B	24	8.04	3.20		
Post-test Geese	G	21	2.23	.88	4.04	.000
	B	24	1.12	.94		
Post-test Parakeet	G	21	3.19	.81	4.35	.000
	B	24	2.08	.88		
Post-test (sum)	G	21	16.40	4.46	4.30	.000
	B	24	11.25	3.56		
Retention general questions	G	23	6.00	2.23	1.37	.174
	B	31	5.19	2.03		
Retention Geese	G	23	6.78	4.29	1.94	.057
	B	31	4.87	2.91		
Retention Parakeets	G	23	6.56	3.53	3.32	.002
	B	31	3.64	2.90		
Retention (sum)	G	23	19.34	5.13	3.82	.000
	B	31	13.70	5.52		
Interest	G	23	2.28	.78	.25	.803
	B	31	2.21	1.21		
Boredom	G	23	2.42	.75	.40	.685
	B	31	2.30	1.32		
Difficulty	G	23	2.41	.63	1.16	.249
	B	31	2.13	1.03		
Well-Being	G	23	2.09	.93	.70	.481
	B	31	1.87	1.21		
Grading	G	23	2.27	.73	.54	.588
	B	31	2.11	1.24		
Mean Attitude score pre	G	19	.79	.21	.28	.775
	B	28	.77	.19		
Mean Attitude score post	G	23	.80	.16	1.59	.118
	B	31	.71	.24		

reinforces the quality of both educational programmes. Although both bird species are quite different, there were no effects on the interest, boredom or well-being, suggesting that both treatments could be considered equally worthy.

Table 3. "Imagine, the following exotic (non-native) species from outside would be introduced into Germany. Which of these species should survive, which should be eradicated?"

Species	Should survive (pre)	Should survive (post)
Goose	78.7	86.8
Parakeet	97.9	90.6
Deer	87.0	88.7
Squirrel	85.1	83.3
Wild dog	70.2	64.8
Non poisonous snake	83.0	74.1
Poisonous snake	38.3	25.9
Non poisonous spider	78.7	72.2
Frog	78.7	72.2
Fish	83.0	81.5
Lizard	85.1	90.7

Gender Differences

There were no gender differences in emotional variables and in assessing the value of non-native species, but in knowledge. With regard to the retention test, girls showed a more detailed knowledge, while boys and girls performed equally in the more general questions concerning non-natives. This is important since it shows, that both gender learned similarly about the general biology of non-native species while girls additionally acquired more knowledge in details. Such results fit into the current literature with girls performing better in the life sciences (Kelly, Brown, & Crawford, 2000; Prokop, Prokop, & Tunnicliffe, 2008). However, as boys and girls did not differ with regard to the general questions in retention test, we have developed a programme that is equally suited for both gender.

Attitude

The attitude towards non-native species did not change during the educational programme. This was against the expectations since both, a decrease of the value of non-natives could have been expected because of better information about them, and also, an increase because of the original encountering of these non-natives. However, attitude scores were rather high at the start of the programme, and then, an increase might be more or less impossible due to ceiling effects. It is interesting, that species differ slightly in their appreciation, and that all of them are rated as high (above 70 % of the pupils want them to survive), the only exception is the poisonous snake, which is perhaps due to the fact that it could harm people.

Conclusion

This study suggests that the use of non-native species in teaching is of a high value because it connects information with an outdoor field trip. In addition, these data show that pupils gain

knowledge in an outdoor excursion. Therefore, we suggest that one should include non-natives in biology teaching rather than neglecting them and to make use of their tameness, thus they are easy to observe.

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Appendix.

Animal Groups Used in the Experiment

Group	Total	native	non-native
mammals (Mammalia)	8	3	5
birds (Aves)	10	4	6
reptiles (Reptilia)	2	1	1
amphibians (Amphibia)	5	4	1
crustaceans (Crustacea)	2	1	1
beetles (Coleoptera)	3	2	1
Sum	**30**	**15**	**15**

Order of Species Used for the Quiz

Scientific name	**English name**	**German name**	**native/exotic to Central Europe**
Leptinotarsa decemlineata	Colorado Beetle	Kartoffelkäfer	e
Lucanus cervus	Stag Beetle	Hirschkäfer	n
Coccinella septempunctata	Seven-spot Ladybird	Siebenpunkt-Marienkäfer	n
Castor fiber	Beaver	Biber	n
Ondatra zibethicus	Muskrat	Bisamratte	e
Vulpes vulpes	Red Fox	Rotfuchs	n
Nyctereutes procyonoides	Raccoon Dog	Marderhund	e
Procyon lotor	Raccoon	Waschbär	e
Ovis gmelini musimon	Moufflon	Mufflon	e
Cervus elaphus	Red Deer	Rothirsch	n
Dama dama	Fallow Deer	Damhirsch	e
Perdix perdix	Grey Partridge	Rebhuhn	n
Phasianus colchicus	Pheasant	Fasan	e
Anas platyrhynchos	Mallard	Stockente	n
Aix galericulata	Mandarin Duck	Mandarinente	e
Anser cygnoides	Swan Goose	Schwanengans	e
Anser anser	Greylag Goose	Graugans	n
Alopochen aegyptiacus	Egyptian Goose	Nilgans	e
Otis tarda	Great Bustard	Großtrappe	n
Rhea americana	Greater Rhea	Nandu	e
Psittacula krameri	Ring-necked Parakeet	Halsbandsittich	e

Astacus astacus	European Crayfish	Europäischer Flusskrebs	n
Pacifastacus leniusculus	Signal Crayfish	Signalkrebs	e
Hyla arborea	European Tree Frog	Europäischer Laubfrosch	n
Triturus vulgaris	Smooth Newt	Teichmolch	n
Bufo bufo	European Toad	Erdkröte	n
Rana catesbeiana	American Bullfrog	Amerikanischer Ochsenfrosch	e
Rana kl. *esculenta*	Edible Frog	Teichfrosch	n
Trachemys scripta elegans	Red-eared Slider	Rotwangen-Schmuckschildkröte	e
Emys orbicularis	European Pond Turtle	Europäische Sumpfschildkröte	n

İstilacı kuş türleri ile ilgili iki okul dışı eğitsel programın bilişsel ve duyuşşal değerlendirilmesi

"İstilacı türler biyolojik çeşitlilik için büyük bir tehdittir". Bu ifade biyologlar tarafından sıklıkla telaffuz edilir fakat çelişkili kanıtlar nedeni ile genel bir karara kolaylıkla ulaşılamaz. Merkezi Avrupa'daki istilacı türleri konu alan bir eğitsel program ile yaşları 1-14 arasında değişen öğrencilere bu konuda bir program uyguladık. Öğrenciler tür tayinine ilişkin bir testin ardından konu ile ilgili genel bilgi aldılar. Standardize edilmiş bir test ile (ön test-son test ve takip testi) Öğrencilerin tutum, duygu ve bilgi düzeyi program boyunca gözden geçirildi. İlk dersten bir hafta sonra bir arazi gezisi yapıldı (Heidelberg, Baden-Württemberg – Almanya) ve iki istilacı kuş türünden birisi üzerinde odaklanıldı. İlk tür Hindistan orijinli bir halkalı boyunlu papağan *(Psittacula krameri)* ve ikinci tür Doğu-Asya kuğu kazı *(Anser cygnoides)* idi. Gezi esansında Bir öğretmen tarafından türlerin yaşamıyla ilgili bilgi verildi ve gözlemler paylaşıldı. Dört hafta sonra üçünü derste yeni kazanılan bilgiler test edildi. Kaz grubu, kazlarla ilgili verilen testte, papağan grubu da kendileri ile ilgili konuda daha yüksek puanlar aldılar. Bütün programın en etkileyici yanı öğrencilerin arazi gezisini en yüksek daha sonra yabancı türleri ikinci olarak değerlendirmeleri oldu. İlginç biçimde, istilacı türlerle ilgili genel tutum eğitsel müdahaleye sonunda da değişmedi.

Anahtar kelimeler: *Anser cygnoides*, Anseriformes, Aves, biyolojik çeşitlilik, kuşlar, eğitim, ekzotik, yerli olmayan, açik alan, Psittaciformes, *Psittacula krameri*