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# Bird Species Knowledge and Its Antecedents in US High School Students—A Case Study from Michigan

**Robin Egger, Talia Härtel * and Christoph Randler**

Department of Biology, Eberhard Karls University Tuebingen, 72076 Tuebingen, Germany; christoph.randler@uni-tuebingen.de (C.R.)
* Correspondence: talia.haertel@uni-tuebingen.de

**Simple Summary:** Raising awareness of nature conservation is important; therefore, bird identification is a key skill for everyone, especially young students. This study investigated how well Michigan high school students could identify common bird species. Students were asked to identify 21 different birds in an online survey. On average, students identified 35% of the birds correctly. The most commonly recognized birds were the American Robin, Blue Jay, Cardinal and Turkey Vulture. We found no difference in bird knowledge between boys and girls, but older students tended to score lower. Students who were more interested in birds and those who took part in activities such as field trips had better identification skills. Birds that were seen more frequently throughout the year, larger birds and those with a strong presence on the internet were better known. We suggest that similar studies be carried out in other states and encourage educators to use birdwatching trips to enhance learning and awareness about birds. This knowledge can play an important role in engaging the public in efforts to conserve bird species and biodiversity.

**Abstract:** Bird identification is a necessary skill for citizen science projects, and teaching and learning about species is essential to halt the decline in biodiversity. Here, we investigated bird species knowledge in a case study of Michigan high school students using an online survey. Participants were asked to identify 21 common species, covering a wide range of orders and families. On average, high school students achieved a correct identification score of 35%. The most well-known species were the American Robin, Blue Jay, Cardinal and Turkey Vulture. We found no difference between boys and girls, but identification scores declined with increasing age. Interest was an important predictor of identification knowledge, as were activities (field trips, outings) both in and out of class. Among species traits, high knowledge of a species was positively related to the number of eBird entries (as a proxy for year-round population size), body mass (heavier species were better known) and internet presence. We suggest expanding this study to other states, and we encourage educators and teachers to improve bird knowledge through birding field trips.

**Keywords:** activities; demographics; education for sustainable development; interest; bird species traits



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## 1. Introduction

Biodiversity is considered one of the fundamental concepts of nature conservation [1], and the decline in biodiversity is, along with climate change, one of the central challenges facing humanity [2]. Biodiversity is currently declining faster than ever before [3]. The World Biodiversity Council IPBES also assumes in its global report published in 2019 that one million animal and plant species will be threatened with extinction within the next few decades [4]. The extinction rate today is 100 to 1000 times higher than in pre-human times [5].

Birds, in particular, are now severely affected by this issue, with more than 10% of global bird species threatened with extinction [6]. This brings the topic of species knowledge and biodiversity into focus, an extremely relevant social topic [7]. The reasons for the rapid decline in global bird species diversity and abundance are complex, and in North America, a dramatic change in the soundscape has even occurred [8], i.e., the dawn chorus now sounds different than 25 years ago. The drivers of extinction are the intensification of agriculture, the deterioration of ecosystems, illegal hunting, bird strikes on buildings and light pollution [9]. In turn, the decline in bird diversity impacts public health [10]. Recent studies have shown that bird diversity has a positive impact on mental health and well-being, e.g., on the epidemiological level [11], where people living in a more bird rich (or diverse) are reported a higher life satisfaction, as well as on the individual level, where a more bird-diverse environment leads to higher emotional well-being [12]. Moreover, the decline in bird diversity and abundance is paralleled by a decline in direct nature experiences [13].

Given these profound impacts on bird diversity and its importance for ecosystem and human health, knowledge of bird species is becoming an increasingly important societal issue. While studies in Europe have already indicated a decline in species knowledge, particularly for birds [14], research in North America is scarce. Despite the widespread popularity of birdwatching as a leisure activity in the USA, there is still limited understanding of bird species knowledge in North America. Therefore, for the first time, we focus on assessing bird identification skills using exemplary studies conducted in Michigan middle schools.

There is no uniform definition of the term "species knowledge" [15,16]. It was designated previously by Van Weelie and Wals [16] as an "ill-defined" construct. However, some authors define it as "recognizing and correctly naming or labeling the species" [15,17,18]. Thus, bird species knowledge can be considered as the correct labeling at the taxonomic level of species. Other authors expand this definition to include a "deeper knowledge of the ecology, distribution and systematics of species" [19]. Further, to achieve a better distinction between the correct identification and a deeper knowledge of the species, Hooykaas et al. [19] coined the term "species literacy". However, there was a significant positive correlation between the correct identification of a species and basic knowledge about it, rendering it likely that correct identification can be used as a proxy for deeper knowledge [20]. We herein focus on the term species knowledge as a way to identify and correctly name a given bird species. However, we also consider higher taxonomic orders, because a bird species may be difficult to identify correctly on the species level but may be easily distinguishable on the family level [18,21].

There is some evidence of demographic correlates of species knowledge concerning age, gender and residency. Species knowledge development varies across age groups, with ambiguous findings. Huxham et al. [22] suggest that for 4–12-year-old children, knowledge increases until around the age of 8–9 and then declines. In contrast, adolescents seem to experience a knowledge boost until age 14, followed by a decrease [18]. In 2018, Gerl and colleagues [17] showed three minor peaks in students' species knowledge at the ages of 10, 15 and 19. Gender differences add another layer of complexity, as studies show inconsistent results. Some report no disparities between girls and boys in species knowledge [23,24], while others indicate varying performances, with boys excelling in some instances [22] and girls in others [14]. Rural residents have better species knowledge than urban residents [25]. This may be due to the greater distances to green spaces in cities [26]. Exposure to nature is an important factor in species identification skills. People who spend time in nature or go on field trips have higher species knowledge [27].

In addition to demographics, other predictors of species knowledge have been found. Randler and Heil [26] showed a correlation between interest in birds and adult knowledge of bird species. In addition, Härtel et al. [28] showed that interest is an important predictor of student species knowledge. As birdwatching is a common hobby in the USA [29], there may also be a higher level of interest in birds, leading to higher levels of knowledge. Interest is defined as a cognitive–emotional construct with a situational and a trait component [30]. We herein focus on individual interest, a variable somewhat comparable to other traits, like personality [30]. The level of a person's interest has repeatedly been found to be a powerful influence on learning, and it follows a four-phase model from situational interest that can be consolidated into general and sustained interest [31]. In this study, we focus on sustained general interest, which may influence knowledge about bird species.

Media such as documentaries and books are an important source of species knowledge [29,32]. Whether the frequency of use of these media is also responsible for the differences in species knowledge has not yet been investigated. Recent studies in Germany have shown that both adults and students can correctly self-assess their knowledge of bird species [26,28]. It remains to be seen whether this is also the case in the USA.

Species knowledge is an important skill for several reasons. For most conservation practitioners today, people can only protect what they are familiar with [14,33,34]. Hooykaas et al. [20] have shown that recognizing species is a very good predictor of deeper knowledge about the species and thus the environment. A Finnish study has also shown that familiarity with species has a positive effect on willingness to contribute to nature conservation [35]. In addition, higher species knowledge is associated with more positive attitudes towards animals [36] and pro-environmental attitudes [15]. Finally, another important aspect is related to citizen science. The average age of people who volunteer in nature conservation organizations or earn their living with taxonomic work is well over 50 years [37], meaning that biodiversity experts will become rare in the future [38]. Therefore, teaching taxonomic skills and identification has become extremely important in school and out-of-school settings [39,40]. From an educational point of view, observing birds in their natural habitat is a special experience that could promote motivation in biology lessons.

The acquisition of species knowledge is also defined in the UN implementation strategy as a central educational task to achieve the sustainability goals [41]. This aligns with the principles of Education for Sustainable Development (ESD), an educational initiative that empowers individuals to think and act with a focus on the future. In recent years, there has been a significant push to promote sustainable education in the United States [42]. The U.S. Partnership for Education for Sustainable Development, established in 2003, brought together various participants to respond to a United Nations call for a Decade of Education for Sustainable Development (2005–2014). The U.S. Department of Education Green Ribbon Schools program, launched in 2011, recognized schools excelling in reducing environmental impact, improving health and wellness and effectively teaching sustainability. Additionally, the Global Action Programme (GAP), led by UNESCO from 2015 to 2019, aimed to raise awareness and provide training in sustainable education globally, with a particular focus on the U.S. This initiative focused on advancing policies, transforming learning, enhancing educator knowledge, empowering youth and implementing sustainability measures [43]. Given the critical role of schools, especially through subjects like biology and science, in fostering future environmental protection efforts, imparting a broad knowledge of species can significantly contribute to environmental conservation.

The goal of this study was to assess a baseline level of bird identification knowledge to allow comparison for future studies and to address a possible decline in knowledge. Further, we wanted to assess some antecedents and predictors of this bird species knowledge, e.g., demographic and individual factors, and, finally, make a first attempt in trying to explain why some bird species are better known than others by studying species traits.

## 2. Methods

### *2.1. Study Site*

Michigan is the tenth largest federal state in the USA and is situated near the northern border to Canada. According to the 2020 census, almost 10 million people live in Michigan, the majority of them on the southern peninsula. Most of the people live in the greater Detroit area in southeastern Michigan. The state is surrounded by four of the five Great Lakes (Michigan, Ontario, Superior, Huron and Erie), which is why Michigan is nicknamed "The Great Lakes State". Michigan is in the transition zone from boreal coniferous forest to eastern broadleaf forest. As a result, Michigan has a greater variety of different habitats than most other states. Typical trees of the northern peninsula are mainly conifers. On the southern peninsula, on the other hand, mainly deciduous trees can be found. Michigan has a temperate climate. The American Robin (*Turdus migratorius*) is the state bird.

### *2.2. Participants and Data Collection*

Most of the students surveyed in this study were at a high school in Michigan at the time of the survey. Data were collected using an online questionnaire from www.soscisurvey.de from 10 May 2023 to 8 June 2023, which corresponds approximately with the end of the school year in Michigan. The students had to complete a bird species identification test. In addition, information on sociodemographics and possible parameters that could influence knowledge of species was requested.

The sample included 332 students from the state of Michigan. The school classes that were surveyed were selected by the respective teachers. The schools and teachers were randomly selected using the search query "Michigan schools" on the Google browser engine. Care was taken to contact primarily science teachers. All students who had filled out the questionnaire on less than two thirds of the bird species or who had only given joking answers were excluded beforehand. Among the 332 students, there are 147 male students, 133 female students, 14 "others" and 6 who preferred not to answer. The remaining 32 students did not answer the gender question. The majority of students (84%) were of typical high school age (14–18 years), of which the largest proportion was 17 years old ($n = 107$). The sizes of hometowns were roughly evenly distributed among the students. Most students come from a town with between 5000 and 10,000 inhabitants ($n = 74$). More details about the sample are listed in the study results.

### *2.3. Questionnaire Design*

#### 2.3.1. Bird Identification Knowledge

The focus of the questionnaire was on determining the students' knowledge of bird species. They were presented with 21 color images of male bird species native to Michigan for identification (see Supplementary Material Table S1). Images of male birds were used because they usually have more noticeable features and are therefore easier to recognize and identify. The pictures of the birds were against a white background, all the same size and resolution. The pictures were sourced from the citizen science database eBird.com (Macaulay Library), a platform which was launched in 2002 by Cornell University in the USA. The database serves to connect professional and amateur ornithologists around the world and to keep people up to date when a particularly rare bird or a particularly large number of birds of a species are spotted somewhere in the world. The database is now also used by many scientists as a data basis for bird-specific research [44].Underneath the picture, there was a field to type in the species name.

The selection of bird species followed the procedure of Härtel et al. [33]. We produced a list of species ordered by their sightings in eBird, but we did not just select the 21 most common species, but also tried to reflect different taxonomic levels, mainly orders. To ensure that at least one bird from each important bird order was tested, the most common species of each order, except the passerines (Passeriformes), was selected. Since passerines make up almost half of all bird species, the most common species per family was selected. The 21 selected bird species are listed in the Supplementary Material Table S1.

#### 2.3.2. Demographic and Individual Questions

In addition to the bird species test, we asked about gender (male, female, other, prefer not to answer), age in years and hometown size (>100,000; 50,000–100,000; 20,000–50,000; 10,000–20,000; 5000–10,000; <5000 inhabitants). In addition, a self-assessment item of visual bird species identification knowledge adapted from Randler et al. [45] was provided ("How many bird species can you identify by sight without aid of books or apps?", coded as follows: 0–5, 6–10, 11–20, 21–30, 31–40, and >40). Interest was measured with the item "I am interested in ornithology", coded from 1 (fully disagree) to 5 (fully agree). Media usage was asked about for books and TV shows or streaming (How often do you read about birds?/How often do you watch documentaries about birds?), coded as follows: daily, weekly, monthly, once per year, once per life, never. The same coding was applied to leisure activities, separately for lakes and forests (How often do you visit. . .?). Similarly, we asked about field trips at school and personal ones, and how often birds were taught at school or handled during lessons.

### *2.4. Statistical Analyses*

To quantify species knowledge, a system based on the "partial credit model" and a strict model was used [14]. The students were asked to identify the bird species as precisely as possible. For a correctly identified species, the respondent received 1 point (full credit, strict model). If at least the genus, family or order was correct, the students received 0.5 points (partial credit model). This more differentiated awarding of points describes species knowledge more precisely than a dichotomous assessment in which there is only right and wrong [26]. For families of which there is only one species in Michigan, 1 point was also awarded for the correct family or genus. For example, 1 point was given for the answer "Vulture" instead of "Turkey Vulture" because it is the only vulture in Michigan. The Cronbach's alpha was $\alpha$ = 0.887 for the partial credit model, and $\alpha$ = 0.866 for the strict model.

Concerning data on the species level, we extracted body mass, geographic range and internet salience from Ladle et al. [46]. The number of eBird observations was used as a proxy for population size because eBird reflects the annual cycle, which a breeding bird atlas does not [33]. In addition, data from Project FeederWatch [47] for the season 2022–2023 in Michigan were used.

The statistical analysis of the data was carried out using SPSS 29. We herein present the means and the standard deviations. To test the hypotheses, Spearman correlation analysis was performed when data were ordinally scaled, and Pearson's correlation when they were parametric.

## 3. Results

The average identification score based on the partial credit model was (mean $\pm$ SD) 7.41 $\pm$ 3.98, which corresponds to 35% of the bird species. The correlation between the partial credit model and the strict model was high, with r = 0.98, $p < 0.001$ and $n = 332$. Five students could not identify a single bird correctly (2%), and only one student identified all birds correctly (0.3%). Figure 1 shows the percentage of correct identification for every bird species. The American Robin, Blue Jay *Cyanocitta cristata*, Northern Cardinal *Cardinalis cardinalis* and Turkey Vulture *Cathartes aura* were the most well-known species with a correct identification score of more than 50% (Figure 1).

Strong discrepancies in the percentages of answers between the correct species name and a higher taxonomic level were found in some species. For example, the Ring-billed Gull *Larus delawarensis* was mostly identified as a gull, the Downy *Woodpecker Dryobates pubescens* as a woodpecker, and the Canada Goose *Branta canadensis* as a goose.

Concerning demographic effects and antecedents of species knowledge, there were no significant gender differences based on the partial credit model (T = −0.57, df = 278, $p = 0.57$) and the strict model (T = −0.32, df = 278, $p = 0.75$). There were significant age effects, with decreasing knowledge in older age, both in the partial credit model (rho = 0.18, $p = 0.003$) and the strict model (rho = −0.16, $p = 0.007$). Thus, older students had lower bird species knowledge. There was no relationship between hometown size and species knowledge (Table 1).

**Table 1.** Relationship between the familiarity of high school students with a species (based on the mean percentage of students being able to recognize this species) and sociodemographic as well as individual variables. (*) indicates significance at the $p < 0.05$ level; (**) indicates significance at the $p < 0.001$ level.

| | | Mean Score (Partial Credit) | Mean Score (Strict) |
|---|---|---|---|
| Age | Spearman's rho | −0.18 ** | −0.16 ** |
| | *P* | 0.003 | 0.007 |
| Hometown size | Spearman's rho | −0.04 | −0.06 |
| | *P* | 0.51 | 0.34 |
| Self-assessment of species knowledge | Spearman's rho | 0.63 ** | 0.60 ** |
| | *P* | <0.001 | <0.001 |
| Interest in ornithology | Spearman's rho | −0.44 ** | −0.42 ** |
| | *P* | <0.001 | <0.001 |
| Reading books about birds | Spearman's rho | −0.44 ** | −0.40 ** |
| | *P* | <0.001 | <0.001 |
| Watching documentaries about birds | Spearman's rho | −0.35 ** | −0.33 ** |
| | *P* | <0.001 | <0.001 |
| Personal field trips | Spearman's rho | −0.16 ** | −0.16 ** |
| | *P* | 0.007 | 0.006 |
| Field trips at school | Spearman's rho | 0.11 | 0.12 * |
| | *P* | 0.06 | 0.04 |
| Visits to lakes | Spearman's rho | −0.10 | −0.10 |
| | *P* | 0.07 | 0.08 |
| Visits to forests | Spearman's rho | −0.21 ** | −0.17 ** |
| | *P* | <0.001 | 0.003 |
| Birds as topic in class | Spearman's rho | −0.22 ** | −0.18 ** |
| | *P* | <0.001 | 0.002 |

Interest in birds, personal field trips and media use (books, documentaries) were also significantly related to knowledge in the bivariate correlations (Table 1), with higher scores for interest, more bird trips and more specific bird-related media use related to better bird identification scores.

Concerning the self-assessment item, there was a medium–high correlation between the self-assessment and species knowledge (Figure 2, Table 1). Most students assessed their knowledge as low (39.2%) (0–5 species) and 26.2% as fairly low (6–10 species); 14.5% estimated their species knowledge as being able to identify between 11 and 20 species; 4.5% estimated 21–30 species; 1.8% estimated 31–40 species; and 5.1% of the students estimated that they could identify more than 40 species.

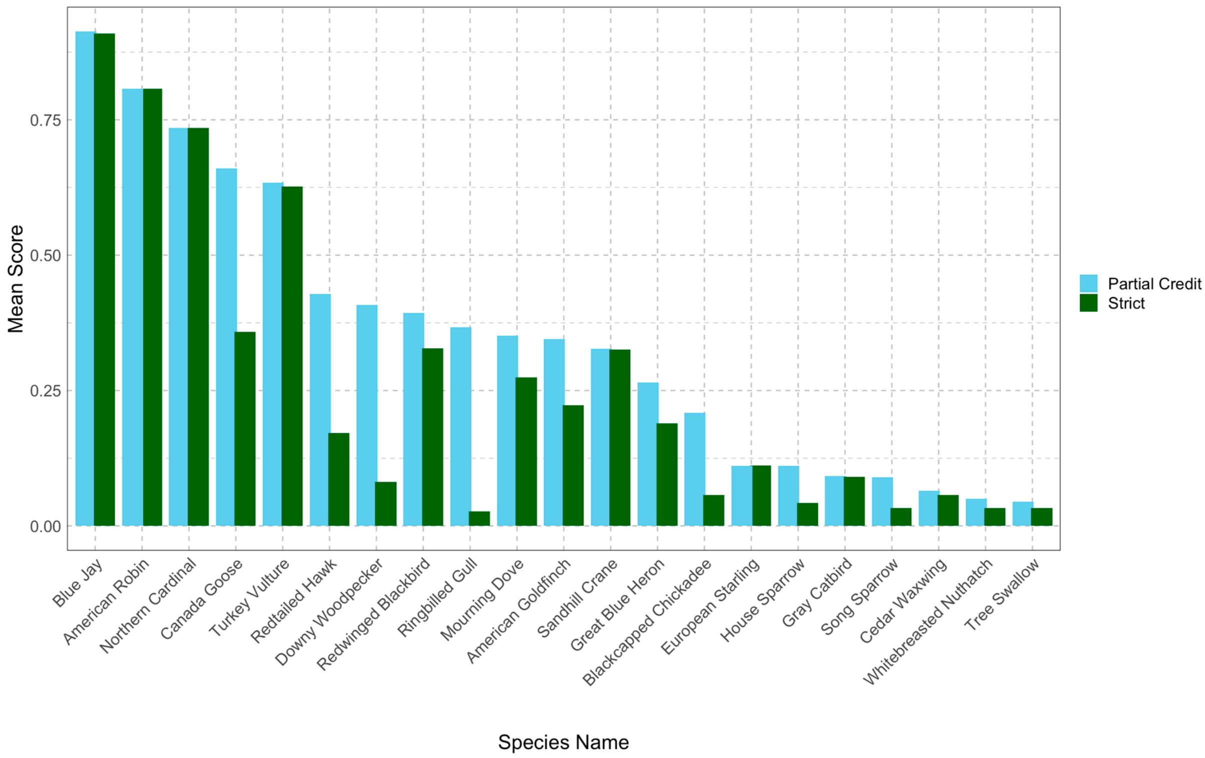


**Figure 1.** Percentage of familiarity of high school students with 21 bird species, using both a strict model (only correct species name) and a partial credit model (correct genus, order or family).

For further assessment, we built a multivariate linear model with the identification score and the self-assessment as dependent variables, and all other variables that were significant in the bivariate correlations as predictors. The overall model showed a significant influence of age (Wilk's $\lambda = 0.91$, $F = 13.49$, $p < 0.001$, partial eta$^2 = 0.09$) and interest in ornithology (Wilk's $\lambda = 0.83$, $F = 28.46$, $p < 0.001$, partial eta$^2 = 0.17$). The other variables were not significant in the model. Subsequent univariate analyses showed a significant influence of age on identification score ($F = 4.84$, $p = 0.03$, partial eta$^2 = 0.02$) and self-assessment ($F = 6.05$, $p = 0.02$, partial eta$^2 = 0.02$). Similarly, interest had a significant influence on identification score ($F = 49.13$, $p < 0.001$, partial eta$^2 = 0.15$) and self-assessment ($F = 41.73$, $p < 0.001$, partial eta$^2 = 0.13$).

The analysis on the species level showed that larger birds are better known (Table 2), while geographic range and coloration were unrelated to the identification scores. Concerning internet salience and population size, the results were mixed. Population size, determined based on the eBird entries, was related to identification scores in the partial credit model, and internet salience was related to identification scores in the strict model. The data from Project FeederWatch were not significantly related to species familiarity.

**Table 2.** Relationship between the familiarity with a species (based on the mean percentage of students being able to recognize this species) and eBird entries, colorful plumage, internet salience, geographic range, body mass and data from FeederWatch (from Michigan in 2022–2023). (*) indicates significance at the $p < 0.05$ level.

| | | eBird Entries | Coloration | Internet Salience | Geographical Range | Body Mass | Feeder Watch |
|---|---|---|---|---|---|---|---|
| Mean Score (strict) | Spearman's rho | 0.38 | 0.22 | 0.47 * | −0.04 | 0.53 * | 0.11 |
| | *P* | 0.09 | 0.35 | 0.03 | 0.87 | 0.02 | 0.62 |
| Mean Score (partial credit) | Spearman's rho | 0.47 * | 0.12 | 0.41 | −0.06 | 0.53 * | 0.18 |
| | *P* | 0.03 | 0.59 | 0.07 | 0.79 | 0.01 | 0.44 |

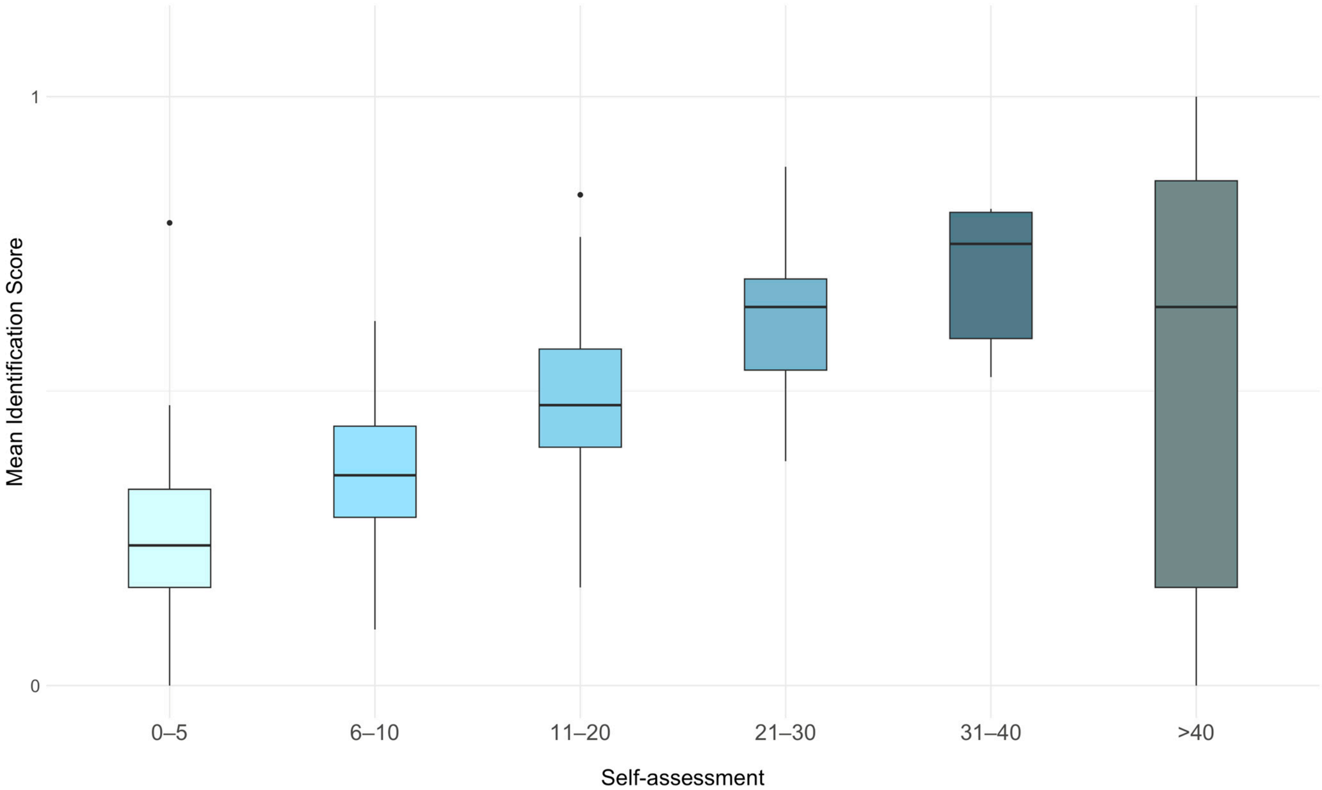


**Figure 2.** Boxplots of high school students' identification scores (mean score of 21 bird species) according to their self-assessment of visual bird species identification. 0–5: $n$ = 130; 6–10: $n$ = 87; 11–20: $n$ = 48; 21–30: $n$ = 15; 31–40: $n$ = 6; >40: $n$ = 17.

## 4. Discussion

### *4.1. Knowledge Level of Michigan High School Students*

The participants of this study were able to identify about 35% of the bird species correctly on average. This value is close to other studies dealing with bird identification skills, e.g., from Germany, the UK and Slovakia [17,48–50]. These authors reported 35% for Bavaria [48], about one third of species in the second Bavarian study [17], 39% in Slovakia [49] and 31% in the UK [50]. This study therefore is in line with previous bird species knowledge studies from other countries around the world.

### *4.2. Antecedents of Bird Species Knowledge*

There were no differences between boys and girls in bird identification scores, which is in line with more recent previous work. For example, Härtel et al. [15] found no gender differences in species knowledge. Similarly, Wold et al. [51] found no significant differences between boys and girls in kindergarten when asked to identify species. Bird knowledge decreases with increasing age. This is comparable to other studies that have dealt primarily with vertebrate knowledge, including birds.

As students progress through the education system, the curriculum may shift away from topics like natural sciences, ecology or ornithology [52]. If there is less emphasis on these subjects in higher grades, students may not receive ongoing exposure to bird species knowledge. At primary school age, biological interest is still general, but becomes more specific with increasing age [53]. If interest in nature is transferred from parents to children, this interest may be maintained as children grow up because of family support [54]. Students who maintain their interest in ornithology have a higher level of species knowledge, according to this study. This is because interest is an important predictor of achievement [30]. In addition, young people are more likely to adopt pro-environmental behaviors if they are interested in nature and perceive it as deserving of conservation efforts [55].

Individuals who engage in outdoor activities often demonstrate a greater understanding of biodiversity, as confirmed by Pilgrim et al. [56], highlighting the importance of direct experiences in nature as a predictor of eco-literacy. Research suggests that the family environment, particularly when characterized by frequent outdoor experiences and pro-environmental attitudes, plays a crucial role in shaping an individual's connection to nature [55,57]. Furthermore, family dynamics, including parental discussions, have been identified as important factors that scaffold children's learning processes [58] and serve as important sources of species knowledge [54]. Therefore, fostering a supportive family context is essential for the development of species knowledge. However, it is important not to overlook the contributions of schools and the media in fostering species knowledge [54]. In this study, the frequent reading of bird books and watching documentary films about birds also play an important role in learning about species. This is quite intuitive, as repetition is important in the learning process [59].

Another important yet unstudied aspect with regard to age or cohort effects is the impact imposed by the COVID-19 pandemic, which may have had an influence on 17-year-old students. Due to the date on which the questionnaire was carried out, these students must have been starting high school, and if some parts of the curriculum, especially natural ecology or ornithology, were not addressed during the pandemic, this could impact the results. This would be an interesting avenue for further research.

In this study, there was very good agreement between knowledge in the test scores and the self-assessment in the categories (coefficient around 0.6). This is in line with other studies, e.g., [26]. Some of the students (5.1%) had a self-assessment of more than 40 species. This category can be classified as birders [60,61]. Birders are people who observe wild birds in their natural habitats, often using binoculars [62], and birders can identify many more species than the general public. In addition, birders more often show pro-environmental behavior [63]. As birders can be classified into groups from casual/novice to intermediate and advanced [61], the self-assessment item has the advantage of using only one question rather than many images, and it is especially useful the more species people know (i.e., advanced birders).

### *4.3. Bird Species Traits Influencing Species Knowledge*

The results of this study suggest that familiarity with bird species is influenced by various species traits. Body mass was related to species knowledge, with larger birds tending to be better known. This could be because they are more conspicuous and easier to observe, making them more likely to be recognized by people [64]. Smaller birds might be harder to notice or identify, leading to lower identification scores. Surprisingly, geographical range and coloration did not show significant associations with identification scores, indicating that these factors might not play as prominent a role in species recognition. Individual differences in birdwatching experience and exposure to different bird species could also influence recognition patterns, potentially masking the effects of geographical range and coloration [61,65]. There was a discrepancy in the influence of population size (determined based on eBird entries) on knowledge of genus, family or order names versus species names. Individuals might be more likely to remember genus, family or order names for species with larger populations. This could be because species with larger populations are more likely to receive greater attention, and higher taxonomic levels are more important in public language. Internet salience, however, had a positive effect on knowledge of species names, probably because this is needed for a precise search. Notably, the data from Project FeederWatch did not exhibit a significant relationship with species knowledge, suggesting that the act of observing birds at feeders may not directly translate to increased knowledge of bird species. The limited range of bird species typically observed at feeders in Project FeederWatch [47] may have constrained participants' exposure to the broader spectrum of species assessed in the knowledge test. However, the sample size of the species was *n* = 21, and therefore, a higher number of species might change the results.

### 4.4. Limitations

This study included Michigan high school students, and future studies could be extended across a wider range of federal states, but in this case, the bird species selection needs to be adapted to the local situation. Also, the number of bird species to be tested could be higher. The inconclusive results on the species level may be related to the small sample size of bird species (*n* = 21) and should be extended to a larger number of species tested; however, it is always difficult to balance questionnaire length with respondent compliance. Further, hometown size may be an inaccurate measure of access to nature for several reasons, which could explain the lack of a relationship in the data. A better predictor for naturalness may be some degree of urbanization [66]. Interest was measured using a single statement, and this could be criticized, as both cognitive and emotional constructs (like interest; see Gläser-Zikuda et al. [30]) require multiple statements with a test of internal validity [67]. Finally, this study did not address all relevant aspects that might be related to species knowledge, e.g., environmental attitudes [68], or worldviews, values or personality factors that may impact environmental behavior or even birdwatching [69]. Knowledge transmission between family members is also an important factor [54]. Therefore, future studies could delve deeper into this complex phenomenon by using more complex constructs and scales, but should probably be carried out in the lab or in a controlled setting to establish high compliance.

## 5. Conclusions and Implications

This study's findings on species knowledge among Michigan high school students, which closely mirror those of previous studies, provide valuable insights that can be applied beyond local boundaries to inform educational strategies on a global scale. With an average correct identification score of 35% per respondent, these results highlight both the challenges and opportunities of engaging youth in biodiversity. Given the significant results concerning interest, media use and field trips, we strongly recommend including (more) outdoor biology activities, preceded by classroom teaching [40], and raising interest in birds in adolescence, but also trying to keep interest high during emerging adulthood. Furthermore, focus could be placed on familial activities that increase interest in biodiversity and birding. NGOs could develop different programs, such as cooperating more with schools or developing projects with family members to strengthen the connections between parents/grandparents and children. Future studies could also be concerned with a wider concept of knowledge reaching beyond species identification.

**Supplementary Materials:** The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/birds5020018/s1, Table S1: Species list of the bird species used in the questionnaire. English name, scientific name, order/family and eBird entries are given for each species.

**Author Contributions:** Conceptualization, R.E. and C.R.; methodology, R.E.; validation, R.E., T.H. and C.R.; formal analysis, R.E. and C.R.; investigation, R.E.; resources, C.R.; data curation, T.H. and C.R.; writing—original draft preparation, T.H. and C.R.; writing—review and editing, T.H. and C.R.; visualization, T.H.; supervision, C.R.; project administration, C.R. All authors have read and agreed to the published version of the manuscript.

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**Institutional Review Board Statement:** This study was conducted in an ethical and responsible manner in accordance with US law and the laws of the State of Michigan. Ethical oversight was provided by Christoph Randler and the principals of the schools. This study is part of a master's thesis, which are not subject to ethical review by the university.

**Data Availability Statement:** Data can be provided on request to the authors.

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