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Assessment of biology students' knowledge about the fauna and flora of the Campos Gerais

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ABSTRACT. Brazil stands out globally for its rich biodiversity, presenting a vast field of study. Despite this natural wealth, the population exhibits limited knowledge about it. This study was conducted at the *Universidade Estadual de Ponta Grossa* with Biology students to assess their perception of the native fauna and flora of Campos Gerais, Paraná. Data were collected in 2023 through questionnaires with 36 participants, including students at the beginning and end of their course. The results showed that, although students at the end of the course had slightly higher recognition of species, the difference was not statistically significant. Interestingly, the identification of exotic species surpassed that of many native species, including endangered species such as the giant anteater. We conclude that a knowledge gap exists regarding native species among future biologists and educators, underscoring the need to integrate place-based teaching approaches and revise educational materials.

Keywords: education; biodiversity; exotic species.

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Introduction

Brazil's status as a megadiverse country is underscored by its unparalleled species richness, shaped by its vast territory and heterogeneous ecosystems, ranging from the Amazon rainforest to the Atlantic Forest (Santos, 2010; Almeida, 2017). The Atlantic Forest, in particular, is a global biodiversity hotspot, with high endemism and ecological complexity, yet only 12% of its original coverage remains due to centuries of anthropogenic degradation (SOS Mata Atlântica, 2023; Myers et al., 2000). Within this biome, the Campos Gerais region of Paraná state represents a mosaic of grasslands and Araucaria forests, hosting unique species such as the critically endangered Araucaria (*Araucaria angustifolia*) and emblematic fauna like the Maned Wolf (*Chrysocyon brachyurus*) (Bianconi et al., 2020; Andrade et al., 2018; Wrege et al., 2017). Despite its ecological significance, the region faces escalating threats from agriculture, urbanization, and climate change, compounded by the pervasive introduction of exotic species (Alves et al., 2019; Melo et al., 2010).

A critical yet understudied challenge in the Campos Gerais is the public's limited ability to distinguish native from exotic species - a gap observed even among biology students (Melo et al., 2021). This misidentification risks undermining conservation efforts, as exemplified by misguided policies like the proposed protection of the exotic peacock bass (*Cichla* spp.) in Paraná, which disrupted native fish communities (Ota et al., 2019; Marques & Rezende, 2005). Exotic species not only threaten ecological balance through competition and habitat alteration but also distort cultural perceptions of local biodiversity, as they often dominate educational materials and public awareness (Proença et al., 2017; Frehse et al., 2016; Delazeri & Muller, 2017). For instance, endemic species like the Ball-cactus (*Parodia carambeiensis*) remain overlooked despite their ecological vulnerability, while exotic counterparts are erroneously naturalized in regional identity (Garcia et al., 2021).

The Campos Gerais' role as an academic hub for biological research (Guimarães et al., 2012) underscores the urgency to evaluate biodiversity literacy among future scientists and educators. Studies reveal that even basic education students more readily identify exotic species, reflecting a systemic bias in environmental education (Melo et al., 2021; Proença et al., 2017). This disparity highlights a paradox: while Brazil's biodiversity is a cornerstone of its scientific identity, its populace - including biology undergraduates - often

lacks foundational knowledge of native species. Such gaps may perpetuate 'biophobia' (Soga et al., 2020), where diminished contact with nature exacerbates disconnection from local ecosystems.

This study assesses the awareness of native fauna and flora among Biology students at the *Universidade Estadual de Ponta Grossa*, addressing three objectives: (i) their ability to differentiate native from exotic species in the Campos Gerais, (ii) their perceptions of regional conservation priorities, and (iii) the implications for environmental education. By examining these dimensions, we aim to identify gaps in biodiversity training and advocate for curricula that emphasize local species, fostering conservation strategies grounded in ecological and cultural authenticity.

Methodology

This study employed a cross-sectional design to assess biodiversity knowledge among undergraduate biology students at different stages of their academic training. Data collection occurred during the 2023 academic year at the *Universidade Estadual de Ponta Grossa* (UEPG), located in the Campos Gerais region of Paraná, Brazil. Participants were recruited through voluntary sampling from the Biological Sciences program (including both Bachelor's and Licentiate degrees), with no exclusion criteria applied beyond current program enrollment.

The sample consisted of 36 participants divided into two distinct groups: early-course students (n = 13, 1st or 2nd year) and final-course students (n = 23, 3rd or 4th year, including three recent graduates). This grouping allowed for comparison of knowledge acquisition across the curriculum. All participants provided informed consent, and the research was approved by the Ethics Committee for Research Involving Human Subjects at the *Universidade Estadual de Ponta Grossa* – CEP/UEPG, on the Brazil Platform (http://plataformabrasil.saude.gov.br/login.jsf), with the Certificate of Presentation for Ethical Consideration (CAAE) No. 64200922.0.0000.0105, under opinion 5.752.545.

Data were collected using a structured questionnaire administered via Google Forms (Appendix I, available at: https://drive.google.com/file/d/1BurG9IbM6axa-00yV5B9VgRQmXhTK8M4/view?usp=sharing), comprising three sections. The first section gathered demographic and academic information, including year of study and residential context (urban/rural). The second section assessed nature interaction patterns through questions about frequency of contact with natural environments and participation in field activities. The third and most substantial section evaluated species recognition through image-based identification tasks.

For the species identification tasks, participants viewed images of 12 representative species (6 native and 6 exotics to the Campos Gerais region) selected through a literature review of local biodiversity. Each image was accompanied by two standardized multiple-choice questions: (1) "What is the name of this animal/plant?" presenting four vernacular name options (one correct), and (2) "Is this species native to the Campos Gerais region?" (Yes/No). This fixed-response format controlled for variation in response specificity while maintaining ecological relevance.

Response data were processed by calculating accuracy percentages for each participant across two dimensions: (1) correct species name identification and (2) correct native/exotic classification. These composite scores served as the primary dependent variables for between-group comparisons. Independent samples t-tests were employed to compare the early- and final-course groups, with verification of normality (Shapiro-Wilk test) and homogeneity of variance (Levene's test) assumptions (all $p > 0.05$). The significance threshold was set at $\alpha = 0.05$ for all tests. Results were visualized using box plots to display distribution characteristics of both groups' performance. All statistical analyses were performed using R software (R Core Team, 2023).

This methodological approach provided a standardized assessment of biodiversity knowledge while accounting for the natural variation in academic progression among undergraduate students. The use of image-based identification tasks with constrained response options offered a balanced measure of recognition ability that was both ecologically relevant and psychometrically controlled.

Results

A total of 36 responses were obtained from undergraduates and/or graduates of the Biological Sciences program, allowing for a comparison between early-course (13 students from the 1st or 2nd year) and final-course and/or graduates (23 students from the 3rd or 4th year and graduates) of the program. Among the graduates, only three participated, all of whom were postgraduate students.

The first stage of the questionnaire revealed that most participants reside in the municipality of Ponta Grossa (26), three in Imbituva, two in Piraí do Sul, and one each in the following municipalities: Palmeira,

Carambeí, Teixeira Soares, Castro, and São Paulo. Only one person reported living in a rural area, in the city of Ponta Grossa, while the remaining 35 live in urban areas.

In the second section of the questionnaire, 31 respondents reported having contact with nature at least once a month. Specifically, 18 stated they only occasionally have contact with nature, 13 frequently, three always, and only two reported having no contact with nature. In addition to direct contact with nature, 29 respondents confirmed having gone on field trips during their undergraduate studies to parks and trails, five had never been on such trips, and two reported having gone to other places, such as the Paranaguá Aquarium and Buraco do Padre's Park.

Among the species that should be prioritized for conservation in the region, the Araucaria tree was the most cited (26 responses), followed by the Maned Wolf, with 13 responses. Other species mentioned included the Azure Jay (4) and the Capybara (3) (Figure 1). A total of 30 respondents indicated that exotic species cause harm. Some of the harms mentioned were: "They influence other limiting factors for native species," "They use the food and habitats of native species," and "Ecological imbalance, such as reducing habitats for native species, competition for resources, etc." Six respondents stated that exotic species do not cause harm.

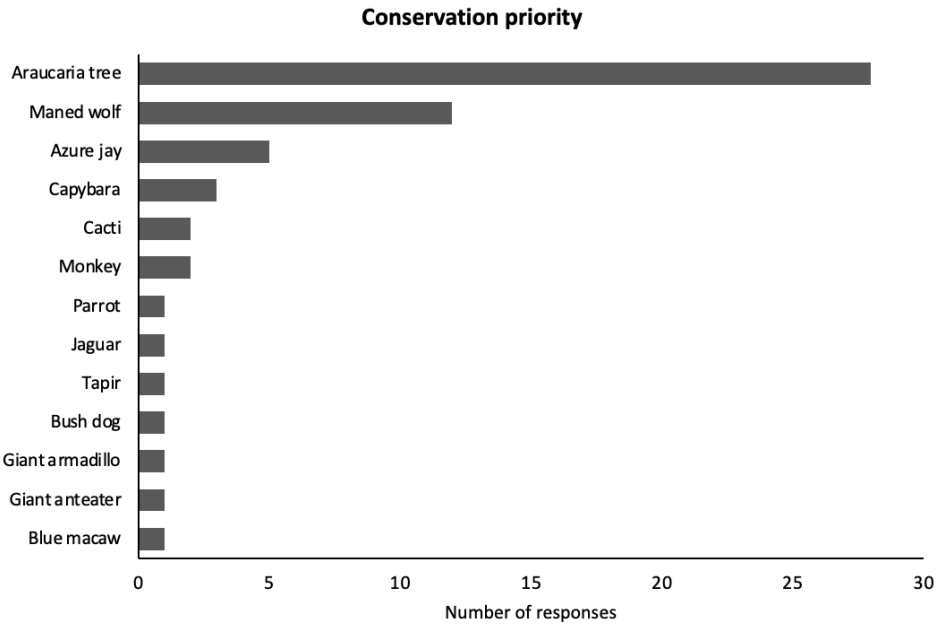

Figure 1. Species cited by participants as conservation priorities in the Campos Gerais region. Total number of cited species = 59.

Students nearing the end of their course exhibit a slightly superior ability to recognize species names compared to their counterparts at the outset of their studies, although the analysis revealed no significant difference ($t = 1.98$; $df = 22$; $p = 0.24$; Figure 2A). Approximately 80% of students nearing graduation accurately identified the presented species, contrasting with a 68% accuracy rate among students at the beginning of their academic journey (Figure 2A). Similarly, there was no significant variance in responses between late-stage and early-stage students regarding the species' origins (i.e., whether they were exotic or native; $t = 0.75$; $df = 22$; $p = 0.46$; Figure 2B). However, there was a noticeable distinction in accuracy rates, with late-stage students achieving 67% accuracy compared to 60% among early-stage students (Figure 2B).

Furthermore, regarding the identification of species origin (i.e., whether they were native to the Campos Gerais region), early-stage students demonstrated a 63% accuracy rate in recognizing native species, while their accuracy dropped slightly to 58% for identifying exotic ones. In contrast, final-year students showcased a higher proficiency, achieving 70% accuracy in recognizing native species and 63% accuracy in identifying exotic ones (see Figure 2B).

For native species, the most identified by early-course students was the Araucaria (92%), while the least identified was the Giant Anteater (53%). Final-year students also excelled in identifying the Araucaria (100%), whereas the Giant Anteater was less recognized as a native species (69%). Moving on to exotic species, the Bald Eagle was better identified by first or second-year students (76%), whereas the least identified was the Coypu (69%). Final-year students also demonstrated better identification of the Bald Eagle (91%) and struggled to identify the Coypu (78%).

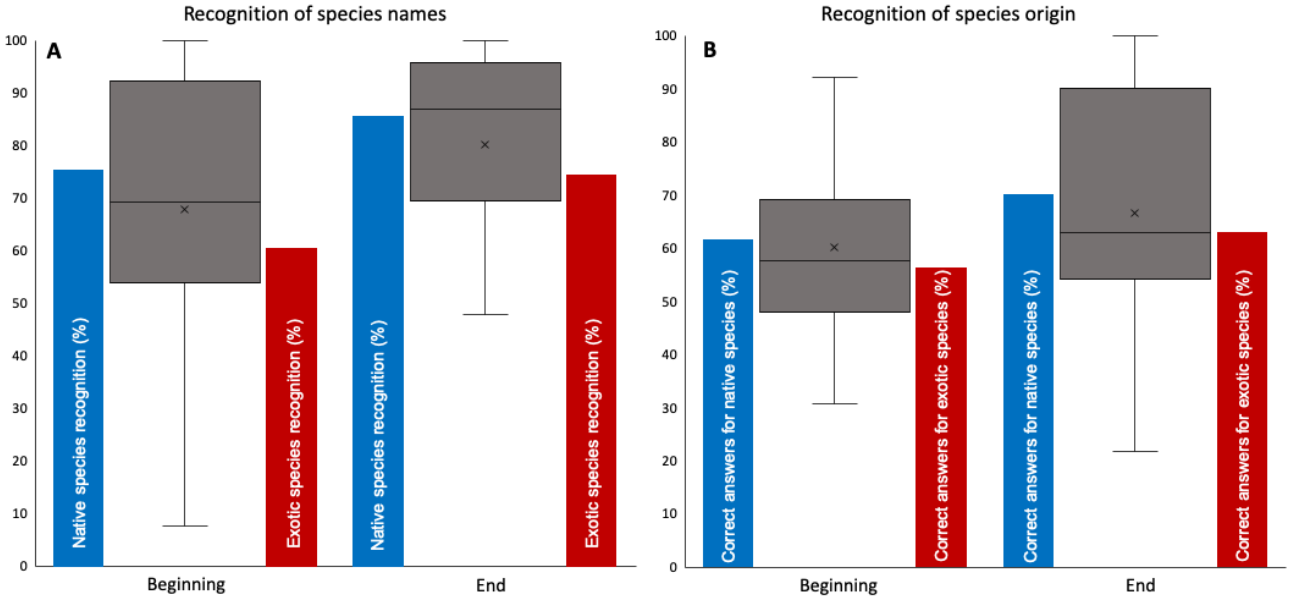

Figure 2. Box plots (median, 1st and 3rd quartiles, minimum and maximum) depicting the proportion (%) of Biology students at the beginning and the end of their course who identified the (A) name and (B) origin of the species (native or exotic). The 'x' within the box plot denotes the overall mean of the responses; the bars represent the means (in %) of responses for correct identifications related to native species (blue) and exotic species (red).

Discussion

Our findings reveal significant gaps in biology students' ability to recognize native species from the Campos Gerais region, challenging the initial assumption that they possess comprehensive knowledge of local biodiversity. While some species, such as the Araucaria (*Araucaria angustifolia*), were correctly identified by over 90% of participants, others - particularly threatened native fauna like the giant anteater (*Myrmecophaga tridactyla*) - showed alarmingly low recognition rates (53-69%). These results align with previous studies (Melo et al., 2021) indicating that even biology students struggle with species identification, especially for less charismatic or locally rare animals. The case of the giant anteater is particularly concerning, as it is classified as vulnerable by The IUCN Red List of Threatened Species (2022) yet remains poorly recognized, suggesting that conservation status alone does not guarantee visibility in environmental education.

The strong recognition of certain species, such as the Araucaria and the maned wolf (*Chrysocyon brachyurus*), likely stems from their symbolic and institutional prominence rather than mere ecological relevance. The Araucaria, for instance, is not only a keystone species in the Campos Gerais but also a cultural icon, featured on Paraná's state flag and widely publicized in regional media (Wrege et al., 2017). Similarly, the maned wolf benefits from extensive coverage in conservation campaigns due to its charismatic appearance and threatened status (Silva-Diogo et al., 2020). In contrast, equally important but less visible species, such as the Ball-cactus (*Parodia carambeiensis*), remain overlooked despite their ecological uniqueness and conservation needs (Garcia et al., 2021). This disparity underscores a troubling pattern in biodiversity education: species that receive institutional or media attention dominate public perception, while others - even those at high risk of extinction - are neglected.

A striking finding was the higher accuracy in identifying exotic species (78-91%) compared to many native taxa. This trend reflects a broader issue in Brazilian biology education, where foreign species -particularly North American ones like the bald eagle - are disproportionately emphasized in teaching materials (Proença et al., 2017). As noted by Delazeri and Muller (2017), this 'pedagogical exoticism' creates a cognitive dissonance between classroom content and local ecosystems, potentially undermining conservation efforts. While 94% of participants reported regular contact with nature (at least monthly), we emphasize that this study did not statistically test the relationship between exposure and species recognition. However, prior research suggests that frequent, meaningful interactions with local biodiversity can enhance familiarity and appreciation (Soga et al., 2020), pointing to the need for more structured field experiences in biology curricula.

These findings carry important implications for the training of future biologists and educators. First, there is a clear need for place-based learning approaches that prioritize local species, particularly those that are endangered or endemic. Integrating case studies of regional biodiversity - such as the Ball-cactus or the giant

anteater - into coursework could help bridge the gap between theoretical knowledge and real-world conservation challenges. Second, teaching materials must be critically evaluated to ensure they reflect the biogeographic context of Brazil rather than relying on foreign examples. Finally, partnerships with conservation units, such as the Campos Gerais National Park, could provide students with hands-on experiences that reinforce classroom learning.

We acknowledge several limitations of this study, including its modest sample size (n = 36) and single-institution sampling frame, which may affect the generalizability of the results. However, the consistency of our findings with broader literature (Melo et al., 2021; Proença et al., 2017) strengthens their validity. Future research should explore the specific factors influencing species recognition, such as the role of urban versus rural upbringing or the impact of different teaching methodologies.

Conclusion

Ultimately, our study highlights the urgent need to re-center local biodiversity in biological education. By valuing regional species not just as ecological components but as essential elements of cultural and scientific identity, we can better prepare future professionals to address conservation challenges. As Brazil continues to grapple with biodiversity loss, fostering deeper connections between students and their natural heritage will be crucial for developing effective, context-aware conservation strategies. This shift requires collaboration among educators, researchers, and policymakers to ensure that biodiversity education reflects the richness and urgency of Brazil's ecological reality.

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