

HOW ADOLESCENTS SEE THEIR LOCAL LANDSCAPE AND BIODIVERSITY? REPRESENTATIONS OF A TROPICAL RAINFOREST IN NORTHEASTERN BRAZIL

COMO É QUE OS ADOLESCENTES VÊM A SUA PAISAGEM LOCAL E A SUA BIODIVERSIDADE? REPRESENTAÇÕES DE UMA FLORESTA TROPICAL NO NORDESTE BRASILEIRO

Larissa Monteiro Rafael¹

Maria Luiza Schwarz²

Eugênia Cristina Gonçalves Pereira³

Resumo: A crise da biodiversidade e mudanças climáticas envolvem não apenas compreensão linear das ações das pessoas para mitigar seu impacto na natureza, mas como se relacionam em um mundo urbano em expansão. Foram analisados desenhos de adolescentes entre 10 e 15 anos sobre a Mata Atlântica e investigamos como eles representam a paisagem e a biodiversidade do entorno, e seus valores biofílicos relativos à natureza. Os desenhos representaram principalmente a paisagem preservada e degradada. Estudantes da escola pública estão ligados à natureza por valores moralistas e os da escola privada por valores estéticos. A extinção das interações entre pessoas e natureza pode desencorajar emoções e comportamentos positivos sobre o ambiente, levando-as a se perceberem dissociadas do mundo natural e com foco na pauta conservacionista global em detrimento da local. **Palavras-chaves:** Interações Pessoas-Natureza; Valores Biofílicos; Mata Atlântica.

Abstract: The biodiversity crisis and climate change involve a linear comprehension of people's actions to mitigate their impact on nature and how people affiliate with nature in a growing urban world. We analysed adolescents between 10- and 15-years old drawings regarding the Atlantic Rainforest and investigate how they represent the surrounding landscape and biodiversity as well as their biophilic values towards nature. Drawings represented mainly preserved and degraded landscapes. Public school participants were linked to nature by moralistic values and private school participants by aesthetic values. The extinction of human and nature interactions can discourage positive emotions and behaviour about the environment leading them to perceive themselves dissociated from the natural world and focusing on global conservationism demand more the local ones. **Keywords:** People-Nature interactions; Biophilic Values; Atlantic Rainforest.

1 Departamento de Geografia, Universidade Federal de Sergipe, Programa de Pós-Graduação em Ciências Naturais, Itabaiana, Sergipe, Brasil. E-mail: larissa.rafael@academico.ufs.br

2 Programa de Pós-Graduação em Patrimônio Cultural e Sociedade, Universidade da Região de Joinville. E-mail: luizaschwarz@hotmail.com

3 Programa de Pós-Graduação em Geografia, Universidade Federal de Pernambuco. E-mail: verticillaris@gmail.com

Introduction

In the last 30 years, the research about the link between people and nature have been increasing (Hoyle et al., 2019). The reason relies on the urge to understand the political, economic, social, and cultural role that drives people and nature coexistence to cause Climate Change, biodiversity and habitat loss, among others environmental degradations and systemic drivers of environmental justice or injustice. A growing body of research evidence the multiple benefits of nature for human health and well-being (Hoyle et al., 2019), in agreement with the Biophilia concept (Wilson, 1983). Biophilia emphasises the evolutionary connection between humans and other organisms represented by innate emotional affiliation. It explains why people, like urban citizens with less natural environment experiences, don't completely lose their emotional affiliation towards nature.

In a more urbanized culture, non-utilitarian, ethical and aesthetic values of nature have become more important (Lindemann-Matthies, 2017). Similar results were found among adolescents in South Brazil (Schwarz et al., 2008) and in Northeast Brazil (Rafael et al., 2010). These studies reinforce that adolescent tends to focus their preferences on landscapes that contain a variation of species, colour diversity, different plants heights due to their capability to perceive the number of independent elements in the scene (Kaplan et al., 1998). Although adolescents value the landscape mainly for its complexity, the species they prefer most are organisms that are not self-sustained, like pets and potted houseplants (Soga & Gaston, 2020; Rafael et al., 2010). Studies focusing on the species-level show a "plant blindness" and "loveable mammals" (Jaun-Holderregger et al., 2022), which means the students tend to identify the species they had previous experience with (Lindemann-Matthies, 2005; Soga & Gaston, 2016).

The understanding of innate emotional bond is related to subjective aspects of this connection, which influences and legitimize both positive and negative actions towards environmental conservation. How these spaces motivate or discourage people's attitudes is an important path toward environmental sustainability (Barraza & Robottom, 2008), particularly with Digital Technologies advance, when the digital native generations are growing and are less likely to interact with nature (Soga & Gaston, 2016). In a long term, the human connection with other organisms tends to become weaker, particularly because 68% of the world population is projected to live in urban areas by 2050 (United Nations, 2019), where the access to digital

technologies is greater and the natural landscape is converted to urban infrastructure (Stokes et al., 2010).

One methodological approach to comprehend interactions between people and nature is through individual representation. The representation term has been applied to different contexts, from Social Psychology, through Moscovici's Social Representation (1961), to Geography's representation (Andre & Bailly, 1989). In the last decades, the concept of Environmental Representation has been used in environmental studies to address the people and nature links (Oliveira, 1999; Silva et al., 2014). In this paper, Representation means a guide to perceptions and behaviour that evolve through time (Guerin, 1989). This concept allows us to consider not only the human perceptive mechanisms but also the economic, social and cultural components that influence people's values, attitudes, preferences and conceptions.

In this paper, we focus on the empirical study of adolescents' representation of biodiversity and landscape. The research explores three main questions: (1) what is the adolescent's representation of the Atlantic Forest biodiversity? (2) what is the adolescent's representation of the Atlantic Forest landscape? And (3) what the adolescent's Biophilia value tells about their connection with nature? We applied an interdisciplinary framework to access the adolescent's Biophilia bound with their local landscape and biodiversity in a tropical rainforest fragment in Camaragibe, a municipality in northeastern Brazil. This fragment is immersed in an urban matrix threatening its biodiversity tending to expand toward the forest fragment (Rafael et al. 2010)

Material and Methods

Study site

In Brazil, the Atlantic Forest biome comprehend a mosaic of vegetation types. The biome complex would include vegetation formations that are typically forestry and other ecosystems (Sandbank habitats, Mangrove, Seasonal Forest, Swamp habitats, High altitude fields) (Marques et al., 2021). Common sense relates the biome mainly to the typically forestry formations (Rafael et al., 2010). This can cause an impact on landscape and biodiversity conservation planning and management since people don't recognize other vegetation formations and given that people tend to conserve what is important to them (Stokes, 2007). In this paper, we focused on a forest

fragment. Thus, the Atlantic Forest terminology is applied to refer to the forest ecosystem and not the Brazilian biome complex. If the adolescents represent the Atlantic Forest as a biome complex or as the vegetation type was also considered in the discussion of the results.

Fieldwork was conducted in Camaragibe, a municipality approximately 15 km far from Recife, the Pernambuco state capital, and an estimated population of 159 thousand inhabitants. This area faced different economic cycles commonly practised in this Brazilian northeast region, such as Pau-Brasil (*Paubrasilia echinata* (Lam.) Gagnon, H.C.Lima & G.P.Lewis) exploitation and sugar cane plantation (IBGE, 2017). Due to this land exploitation culture, most of the former tropical rainforest, known as the Atlantic Forest, was devastated remaining only small forests fragments. Whereas the municipality is in the state metropolitan area, the urbanization process is currently the greater threat. In the central part of Camaragibe, a Tropical Rainforest fragment of 1 km², known as Privê Vermont, faces the urbanization pressure due to residential area occupation advance and logging (Figure 1).

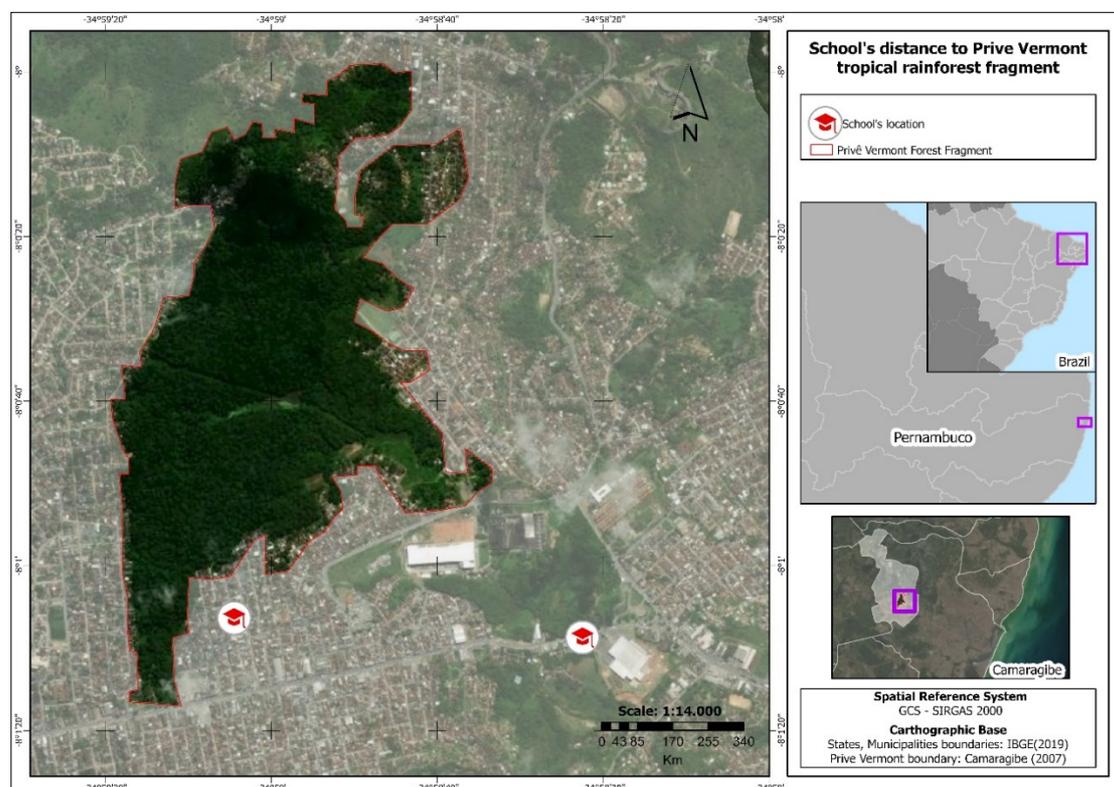


Figure 1: Study site location map, highlighting Camaragibe municipality and distance from schools to Privê Vermont tropical rainforest fragment.

The native forest has dense, arboreal vegetation, with the occurrence of herbaceous and shrub strata where species such as *Paubrasilia echinata* and visgueiro (*Parkia pendula* (Willd.) Benth. ex Walp.) can be found. The remaining vegetation is a dense pluvial forest, with sub evergreen species, in which most arboreal individuals range from five to 20 meters in height. Due to the presence of 1st order streams and the Privê dam, there is the presence of gallery forest. Secondary vegetation is marked by the presence of recovering forest, located mostly in the edge area and in the floodplains by species of herbaceous or shrubby habit (Oliveira et al., 2007).

Participants

Two groups of adolescents both ranging in age from 10 years to 15 years old, took part in this survey. The first group consisted of 105 students from a private school and the second group consisted of 131 students from a public school (Table 1). Four grades were selected (sixth to ninth grade), where 236 out of 980 students participate, representing 24% of these grade sample population. School proximity to Privê Vermont fragment was the criteria to choose the students (Figure 1). Although both schools develop environmental conservation projects, they don't focus on Atlantic Forest or biodiversity. Normally they approach the environmental awareness theme, aiming for actions that reduce environmental impact.

Table 1: Participant's frequencies by a group of age and school administration

| School Administration | Fifth grade | Sixth grade | Seventh grade | Eighth grade | Total |
|-----------------------|-------------|-------------|---------------|--------------|-------|
| Private | 37 | 23 | 27 | 18 | 105 |
| Public | 27 | 36 | 38 | 30 | 131 |
| Total | 64 | 59 | 65 | 48 | 236 |

Ethics statement

All adolescents were allowed to participate in the survey both from their parents and the school authority who formally granted this permission by signing an informed consent term.

Procedures

Throughout the drawing children organize information and process lived and thought experiences (Goldberg et al., 2005). Thus, this can be a methodological approach to catch

students' thoughts concerning environmental issues and experiences (Alerby, 2000) and a powerful tool since students may not like to answer questions and drawing can be a de-stressing activity (Lewis & Greene, 1983). In this paper, the empirical material consists of students drawing about the Atlantic Forest.

Drawing sessions with the adolescents were carried out in the schools. We first explained to the students the research's main purpose was to understand their knowledge and preferences about nature and the surrounding landscape. After, the following question was written on the whiteboard: "What comes to my mind when I think Atlantic Forest?". A blank page was given to each student, and we asked them to express the image by drawing. We explained that in case they face a problem drawing some element, they could write their name. Finally, we asked them to write a text explaining what they have drawn.

Data analysis

The Atlantic Forest is the landscape participants have contact with. Thus, we analysed if the drawings were representative of the local biodiversity and landscape. Drawings were analysed from quantitative and qualitative categories. To assess the number of drawing details, each element was counted (e.g., human, tree, flower, cloud, sun). Thus, the quantitative category comprehends the element's frequency which was separated into four main categories: faunal, floral, abiotic and anthropic. Together they make up the total elements drawn by the students. The frequency of biotic elements such as floral and faunal was considered to understand the biodiversity knowledge.

When analysing the drawings and the short essay the adolescents wrote to express what they represent as Atlantic Forest, we were able to relate the illustration to an ecosystem (Atlantic Forest, Amazonia Forest, $n=236$) and to forest conservation status and world view perspectives. The short essay content analysis resulted in themes classified adapted from Alerby (2000): (1) Preserved; (2) Degraded; (3) Dialectics between Preserved and Degraded; (4) Environmental Conservation.

We also verified what elements they consider most important, thereafter the Biophilic Values toward Nature. We used a content analysis technique based on Biophilia Values (Kellert & Wilson, 1993) to classify these values (Figure 2). This classification represents nine values toward

nature and is influenced by learning, culture, and experience. They describe how humans affiliate with nature (Lumber et al., 2017).

| Value | Definition |
|--------------------------|--|
| Utilitarian | Practical use of material nature |
| Naturalistic | Pleasure from contact with nature |
| Ecologicistic-scientific | Scientific study of the interconnectedness of nature and natural systems |
| Aesthetic | Appeal of nature's physical beauty |
| Symbolic | Expressing ideas through nature-based language and metaphors |
| Humanistic | Strong affection, emotional bond, and "love" for nature |
| Moralistic | Ethical concern/judgements and revering nature |
| Dominionistic | Control and dominance of nature |
| Negativistic | Aversion, removal and fear of nature |

Figure 2: Biophilia Values (Kellert, Wilson, 1993).

In Brazil, the educational system administration reflects students' social, economic, and cultural backgrounds (McCowan, 2007). Students who attend a school with socioeconomic higher status, tend to present a better educational outcome (Thomson, 2018). Thus, considering school administration in the Brazilian scenario can be a variable to understand if socioeconomic background shows some influence on students and nature interaction. To address this matter, the public-school students' Biophilic Values were compared to the private school ones. The chi-square test (X^2) was used to assess both the possible difference between the adolescents' socioeconomic background and the interaction with nature. All analyses were carried out with SPSS version 25.

Results and discussion

Adolescents' representation of Atlantic Forest biodiversity

On average, regarding Atlantic Forest biodiversity, adolescents could identify 15 plants and 21 animal taxa (Table 2). Unspecified taxa (e.g., trees, birds, flowers, bees) were among the most illustrated by students and can indicate either a lack of training in taxonomy at school (Lindemann-Matthies, 2000) or a lack of species characteristics traits knowledge, which makes it difficult to draw the details of the shape. Although adolescents recognize greater animal taxonomic diversity in contrast to plants, on average, floral elements ($n=477$) were more

frequent than faunal ($n=264$). On the one hand, they have greater faunal species richness knowledge, on the other hand, plants, in general, are more representative.

Table 2: Incidence of biotic (fauna and flora) elements represented in adolescents' drawings from Camaragibe – Pernambuco, Brazil regarding the Atlantic Forest.

| Category | Local Biodiversity Representation | Frequency | Represented Taxa |
|----------|-----------------------------------|-----------|---|
| Fauna | Wide geographic range | 251 | Birds, Bees, Butterflies, Snail, Snake, Bunny, Owl, Ant, Alligator, Lizard, Bat, Duck, Fish, Turtle, Toucan, Macaw, Beetle, Sloth |
| | Endemic species | 7 | Lion Tamarin (<i>Leontopithecus</i> sp.), |
| | Alien species | 6 | Shark, Starfish |
| Total | | 264 | |
| Flora | Wide geographic range | 384 | <i>Tree, Flower, Grass, Bindweed, Pine Tree, Palm Tree</i> |
| | Endemic species | 1 | <i>Pau-Brazil (Paubrasilia echinata)</i> |
| | Alien species | 92 | Palm Oil Tree, Banana Tree, Strawberry, Orange Tree, Apple Tree, Watermelon, Grape, Rose |
| Total | | 477 | |

The student's Atlantic Forest biodiversity representation evidence they perceived the floral elements as a homogenous matrix and less diverse than the animal components. Due to chromatic and spatial homogeneity and lack of movement that makes the plant edge-detection difficult, plants are perceived as a uniform green matter. Therefore, plants are perceived more poorly than animals (Jaun-Holderregger, 2022). Although this plant blindness can influence why adolescents tend to perceive animal diversity more than plants, the fear and disgust that some animal taxa can trigger can be also a reason. According to Breuer et al. (2015) children are afraid of insects and invertebrates that can potentially cause pain and are disgusted by animals that crawl on the ground. In this study, the snakes were frequently cited (Table 2).

The students live in an urban environment and the results show their lack of ability to specify unique traits of the Atlantic Forest faunal and floral biodiversity, which can indicate they are losing contact with nature. This is especially relevant because although they live and study near a forest fragment, they have either few interactions with the forest or lack a person or learning situations to bring them knowledge about plants and animals. Silva et al. (2010) came to the same conclusion when analysing children's Atlantic Forest fragment representation in

Pernambuco. The authors pointed out that school knowledge is not well adjusted to their local reality. As urban areas tend to expand to the detriment of the natural ecosystem, it is important to understand how wildlife species can function in urbanized landscapes (Rastandeh; Jarchow, 2020). The identification of species traits is an important road toward this understanding.

The adolescent's drawings analysis also showed the presence of generalist species, classified as "wide geographic range". Most cited floral and faunal taxa are not endemic species. In fact, just one faunal and floral endemic species was cited (Table 2) which is concerning since the Atlantic Forest is a megadiverse complex comprehending more than 20,000 species of which at least 6,000 are endemic (Marques et al., 2021). The biotic components were more related to utilitarian species such as Banana trees and Palm Oil trees and animal species that can be seen in a Zoo nearby, such as Duck, Toucan and Macaw. When approaching the conservation issues perspective, most media focus on a few iconic, appealing, species (Ballouard et al., 2011), such as *Paubrasilia echinata* and Lion Tamarin that are endangered species.

A notable aspect of the abiotic components of the graphic representation is that, although the adolescents were asked to represent a tropical rainforest, no drawing showed the rain component (Table 3). In Santa Catarina state, students from Joinville urban area also represented the Atlantic Forest without the rain component (Schwarz et al. 2007). The rain plays a central role in the Atlantic Forest's ecological processes maintenance. Thus, representing the Atlantic Forest without rain indicates the lack of ecological knowledge and can influence perceptions and attitudes regarding biodiversity (Lindemann-Matthies, 2017). According to Lindemann-Matthies (2017), the largest independent of local environmental goods and services is the group, the greater the lack of ecological knowledge and environmental expertise. In this survey, students live in an urban area and are less dependent on environmental resources.

Regarding the anthropic represented compounds, 66% of them were directly related to degradation sources (Table 3), especially the human presence which was always related to forest degradation (**iError! No se encuentra el origen de la referencia.**b). Evidence about the role people can play in maintaining the ecosystem has increased in the last decades (Hoyle, 2019). Thus, the representation of a conserved forest as a landscape with people's absence can drift apart the youth to reconnect to nature and take conservation actions. When comparing the representation of indigenous and urban children about nature, Profice (2018) found that the

social-cultural context that encourages in everyday life the interaction with nature can help new generations feel that they belong to nature.

Table 3: Incidence of abiotic and anthropic elements represented in adolescents' drawings from Camaragibe – Pernambuco, Brazil

| Category | Local Landscape Representation | Frequency | Represented Compounds |
|-----------|--------------------------------|-----------|---|
| Abiotic | Meteorology | 275 | Sun, Cloud, Stars, Moon, Rainbow, |
| | Geology | 15 | Rock |
| | Pedologic | 11 | Soil |
| | Hydrography | 101 | River, Lake, Waterfall, Dam |
| | Geomorphology | 12 | Hill, Flatland |
| Total | | 414 | |
| Anthropic | Leisure | 2 | Soccer field, Watering Can |
| | Infrastructure | 15 | Road, Bridge, Supermarket, Fabric, Church |
| | Transportation | 28 | Aeroplane, Boat, Truck, Car, Helicopter, Train, Tractor |
| | Housing | 13 | Urban, Indigenous |
| | Degradation sources | 113 | Aerosol, Fire Gun, Fire, Trash, Axe, Chainsaw, Machete, Sewer, Human Presence |
| Total | | 171 | |

Adolescents' representation of Atlantic Forest landscape

To investigate how the adolescents recognize the Atlantic Forest landscape, the students were asked to represent this complex biome through drawing and a short essay explaining the drawing. Their Atlantic Forest representation, more than related to the biome's unique features, evokes a general forestry landscape with trees, birds, and flowering plants. This representation is notable when considering that 17,4% ($n=236$) of the adolescents drew the Amazonia biome (Figure 3) instead of the Atlantic Forest (82,6%, $n=236$), showing they perceived Atlantic and Amazon Forest as a similar landscape.

Our result revealed they recognize the Atlantic Forest, not as the biome complex that encompasses other than forest vegetation formation, but as a forest in general. This representation has two main implications for conservation: i) drawings manifest scenes perceived by adolescents and help assess their ecological knowledge (Profice, 2018). The results showed a lack of ecological knowledge, which is not linked to what they experience in the everyday environment; ii) recognizing just the forest formation as part of the biome, can

distance the other associated ecosystems to the public conservation support, since they tend to protect what is important to them (Stokes, 2007); iii) Undervalued ecosystems, like Mangrove, that also play their role in the ecosystem services (Unep, 2014), can receive less attention from the media or conservation plans since adolescents are inclined to value landscape by aesthetic values (Rafael et al., 2011; Schwarz et al., 2007).



Figure 3: Amazonia biome instead of Atlantic Forest represented in a 13-year-old student drawing.

Two main drawing themes were the representation of the Atlantic Forest as “Preserved” (43,3%, $n=236$) and as a “Degraded” (25,8%) landscape. Some participants represented the Atlantic Forest as a landscape where “Environmental Conservation” is needed (14,4%) and as a “Dialectic between Preserved and Degraded” landscape (5%) (Table 4).

Students tend to focus on the “Preserved” landscape by representing the Atlantic Forest as a portrayed environment, related to the clean, beautiful, and idyllic natural landscape (**¡Error! No se encuentra el origen de la referencia.**). A similar result was also found by Alerby (2000) with students from a Mixed Forest in Sweden and by Schwarz et al (2007) with children from Atlantic

Forest in southern Brazil. According to Stokes (2007), conservation projects must pay attention to potential aesthetic pattern responses that may influence conservation efforts.

Table 4: Main drawings themes about the Atlantic Forest from students in Camaragibe - Pernambuco.

| Drawings main Themes | Frequency (%) | Illustrative examples |
|---|---------------|--|
| Preserved | 43,3 | The Atlantic Forest is beautiful, colourful with birds and trees (private school, 6th grade) |
| Degraded | 37,3 | The Atlantic Forest is being deforested (public school, 6th grade) |
| Environmental Conservation | 14,4 | It would be good if people respected the Atlantic Forest as it deserves (public school, 7th grade) |
| Dialectics between the Preserved and Degraded | 5,0 | I think the Atlantic Forest used to be very beautiful but now man destroys it and damages the trees (public school, 7th grade) |
| Total | 100,0 | |

When comparing indigenous and urban child’s drawings, Profice (2018) concluded that children or urban spaces tend to represent the environmental issue they experience. In their survey students living in New York represented the air pollution. In the present survey, the focus on the “Degraded” landscape was represented as a forest with a dead animal, burning forests and logging (iError! No se encuentra el origen de la referencia.b), which are common environmental problems to the forest fragments in Camaragibe.



Figure 4: Adolescent’s representation of the Atlantic Forest as (a) a Preserved Landscape: “- The Atlantic Forest is beautiful, colourful with birds and trees” (private school, 6th grade); (b) a Degraded landscape “- The Atlantic Forest is being deforested” (public school, 6th grade).

The representation of the Atlantic Forest as a landscape that needs to be preserved (**¡Error! No se encuentra el origen de la referencia.a**) indicate that part of the students is aware of the Atlantic Forest degradation but restrain this understanding to logging and death of animals. None of the drawings showed options for forest conservation. They only represented that it needed to be preserved, showing a partial awareness of the problem, and suggesting that attitudes must be taken and demanded. In the last four decades, most conservation biology research focused on problem-based (Fonseca et al., 2021). This reflects directly on the educational level when the teaching-learning situations focus mainly on environmental issues and less on solutions to local problems. Thus, to a more effective approach to the biodiversity crisis, the educational environment should expand a solution-based agenda, contacted to local problems that can favour a positive public perception.

The daily life of people living in urban areas happen disconnected from natural processes and they do not consider how they are connected to nature (Alerby, 2000). As a result, the student's drawings approach a dichotomy between the past and the present or the ideal of preserved nature and degraded nature (**¡Error! No se encuentra el origen de la referencia.b**) and do not include themselves in this landscape. This can indicate that students do not see themselves as a part of the solution to environmental issues. The future reality, when conservation actions can reflect improvements to natural environments, was not represented in the Atlantic Forest illustrations.

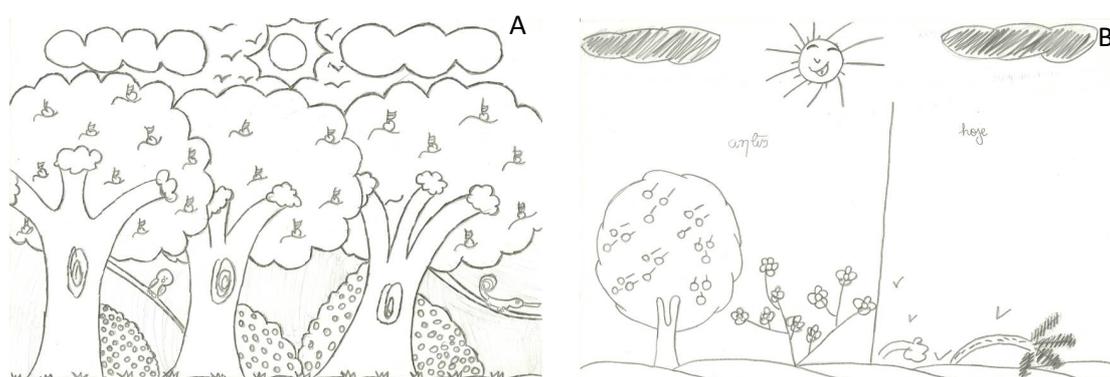


Figure 5: Adolescent's representation of the Atlantic Forest as (a) a landscape in need of Environmental Conservation: “-It would be nice if people respected the Atlantic Forest as it deserves” (public school, 7th grade); (b) a Dialectic between Preserved and Degraded landscape: “- I think the Atlantic Forest used to be very beautiful but now man destroys it and damages the trees” (public school, 7th grade).

Adolescent's connection with nature: Biophilia Values

The Biophilia values indicate how people interact with nature (Kellert & Wilson, 1993). The adolescents of Camaragibe presented two values: Aesthetic and Moralistic (Table 5). They show a superficial level of interaction with nature since students represented biodiversity and landscape related to their everyday life more than endemic elements of the Atlantic Forest or the forest nearby, indicating a disconnection to nature.

Aesthetic values are related to the beauty of nature, such as colour, shape and forms that please the sense (Figure 4a). In Lindemann-Matthies's (2017) survey, variation in species, colour diversity and different plants height were frequently mentioned reasons to prefer plants. The colour importance was also an important feature for children to recognize animals (Breuer et al., 2015). The aesthetic value of nature, represented in students' illustrations, highlights the need for school and family practices to develop other values. Public support based on aesthetic values can create barriers to the conservation of less valued ecosystems, especially those with few colour variations and vegetation formation structures.

Moralistic values (Figure 4b) are related to compassion towards nature (Lumber et al., 2017). Profice (2018) concluded that children living in cities tend to view nature in a more impersonal manner. In our survey students with moralistic values indicated to be aware of sources of environmental problems, such as logging, deforestation, hunting, forest fire but not the problems it can cause, such as forest fragmentation, habitat, and biodiversity loss.

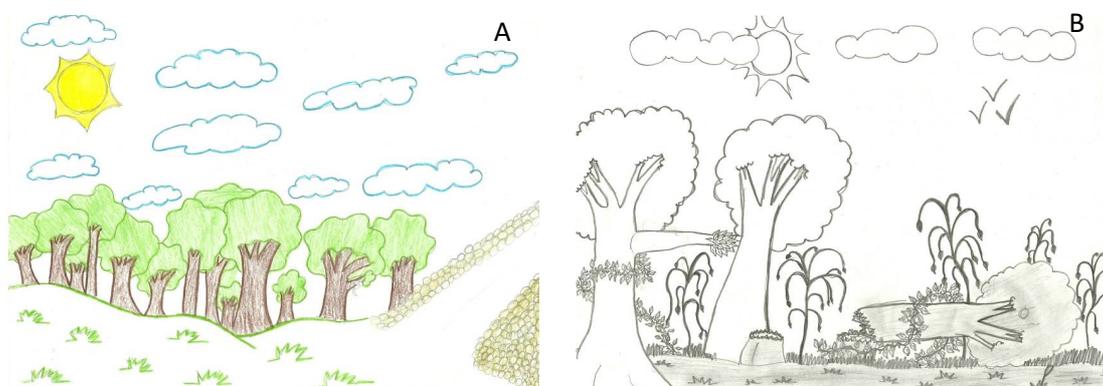


Figure 4: Representative drawings of adolescents' Biophilia values. (a) Aesthetic value; (b) Moralistic value.

Adolescents from different socioeconomic background showed a significant difference ($X^2(1) = 21,1; p < 0,001$) between their interaction with nature. Moralistic values (37,3%) prevail among the public-school students, while aesthetic values (28%) were often among private school students (Table 5). Most of the public-school participants live nearby the school that is located near the city centre. Especially in the city centre, Camaragibe has a low public roads afforestation coverage compared to other Brazilian municipalities (IBGE, 2010). According to Soga e Gaston (2020), socioeconomically advantage groups have a more positive interaction with nature since they tend to have greater access to a domestic garden, greater coverage of public green spaces and houses sited near to parks and trees. This can contribute to students from the private school to evoke a positive perspective of the Atlantic Forest. Public school participants tend to value the Atlantic Forest from a more critical perspective, pointing out its degradation problems. Although the understanding of socioeconomic background on adolescents' connectedness to nature is important to conduct oriented strategies for conservation, management and action plans must focus less on the narrative of economic vulnerability and more on the capability of local knowledge to support policies for the conservation of social-ecological systems (Dawson et al., 2021).

Table 5: Difference between Biophilic Values of adolescents from public and private schools in Camaragibe, Pernambuco and their collective subject discourse.

| Biophilia Values (%) | School administration | | Collective subject discourse |
|----------------------|-----------------------|--------|---|
| | Private | Public | |
| Aesthetic | 28,0 | 18,2 | It represents peace, love, union, passion, happiness. I think it is very beautiful. A forest with birds, owls, trees, fruits. The trees are the most beautiful and old in the world with lots of green. |
| Moralistic | 16,5 | 37,3 | It is being deforested. People don't know how important this forest is. It is our home because animals and trees are our greatest richness. Sadly, some people cut the trees and kill the animals. It would be nice if people respect the Atlantic Forest as it deserves. |
| Total | 44,5 | 55,5 | $(X^2(1) = 21,1; p < 0,001)$ |

People's attitudes are related to their knowledge and perception about nature and, especially children, can have a strong affinity toward nature so long it is reinforced in a meaningful way (Andresen et al., 2020). In immediate future, the loss of interaction with nature can discourage

positive emotions and attitudes toward nature (Alerby, 2000). Thus, as the students tend not to recognize specific landscape characteristic traits, they will be less inclined to protect biodiversity. Therefore, it is important that environmental education design programs related to ecological knowledge and local biodiversity importance and focus on the way children connect to their environment (Stokes et al., 2010; Franquesa-Soler et al., 2019). In the case of the urban population, cultivating a Private Garden can improve connectedness to nature (Lindemann-Matthies, 2016). It is also important to understand how green spaces can function as habitats for wildlife species (Rastandeh & Jarchow, 2020).

In the drawings, the nature perspective illustrates the human presence as a source of negative impact on nature. Evidence about the importance of people's participation in conservation plans is increasing (Fischer & Young, 2007; Dawson et al., 2021). The students tended to see humankind as separate from nature and humans as generally harmful to their environment therefore their interaction with nature was a superficial one.

Conclusion and implications for practice and further research

Although the theoretical approach suggested that children often know more than their drawings reveal (Farokhi, Hashemi, 2011), drawings related to essays can be an important instrument to access children's environmental representation and perceptions (Profice, 2018). Biotic compounds can be better understood by interview. When drawing specific parts of organisms' taxonomic knowledge is required. Thus, it is important that research focusing on students' environmental representation also consider how students' knowledge is being acquired, such as teaching methods, information sources, development of school projects. Those are especially important to give the results some context and help understand their perspective. As this research employs an exploratory methodology, our results provide potential relationships rather than a validation of how adolescents are connected to nature and thus represent an encouraging steppingstone for research on human and nature interaction.

Adolescents represented landscape and biodiversity components from their everyday life instead of endemic Atlantic Forest biota. This research highlights the lack of biodiversity, ecological and landscape knowledge that can be related both for a teaching-and-learning

method dissociated from students' local environment and everyday life and for the lack of stimulus of experiences in nature. The student's drawing evidence a significant presence of biota with a wide geographic range, meaning that they can be found in the Atlantic Forest but also in other ecosystems. The high presence of unspecified taxa demonstrates that the students know there is a notable frequency of biotic elements on Atlantic Forest, especially plants, but they show difficulty to identify them at the species level. Also, the abiotic and anthropic elements have fewer shape and traits details. This difficulty to identify species traits can impose a great challenge to landscape management since children will not be able to identify natives from exotic species, thus favouring charismatic and colourful species (Ballouard et al., 2011).

The more people feel connected to nature, the less they are affected by animal fears or phobias (Zsido et al., 2022). The more apart from nature interactions, the less attitude towards nature conservation adolescents will have. The lack of biodiversity, ecological and landscape knowledge can indicate the loss of interaction with nature which impacts conservationist behaviour. The difficulty to identify biodiversity and landscape traits can reduce their interest in living with these spaces, resulting in a preference for spaces produced by human beings, and developing adults with low interest in nature. Although they can be inclined to conserve nature, they don't seem to understand which nature needs to be preserved. Teaching-and-learning situations should begin with the environment students inhabit (Alerby, 2000). Environmental Education should focus on outdoor activities to develop consciousness and concerns about local biodiversity conservation (Ballouard et al., 2011). A challenge for Environmental Education is to associate the students' day-to-day opinions with the scientific knowledge of nature. To address that matter, the approach of social and biodiversity linked problems is important.

Students' connection to nature showed Aesthetic and Moralistic biophilia values indicating their conceptions of people as separate from the environment. The limiting of human and nature interactions can discourage positive emotions and behaviour about the environment leading them to perceive themselves dissociated from the natural world and focusing on global conservationism demand more the local ones. Although humans are framed as degraders, recent studies shows that indigenous and local communities have strong motivation to conserve and take part in conservation actions (Dawson et al., 2021) so long the conservation planning projects take their need into consideration. Understanding peoples' representation and

perception of the natural world through an evidence-based approach can contribute to effective decisions (Hadavi et al., 2018) and lead to reducing the “extinction of experience” with nature and supporting people and nature interactions that benefit both sides.

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