



## **Environmental Perceptions from residents of the surroundings of a Protected Area: tool for Critical Environmental Education**

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#### ABSTRACT

The studies on the environmental perception of residents from Protected Areas (PAs) or its surroundings, can bring subsidies in the comprehension of how people perceive the place where they live or engage with, as well as, of issues related to nature conservancy. The aim for this paper was to investigate the environmental perceptions from students and teachers, residents of the surroundings of a PA, around climate change, the conservation of biodiversity and the threats faced by fauna and flora. It was an exploratory research, of qualitative nature, of the participant observation kind. To conduct the study, various activities were realized, such as talks, interpretive trail and dynamics. The data collection happened by the application of structured surveys and field diary, later submitted to Content Analysis. As a result, this research highlights the relevance of the interpretive trail in the development of awareness and connection with nature, ratified from the enthusiasm and interest of the participants for the chosen themes. It was also verified that the participants have comprehension and perception about the environmental issues worked upon. However, this comprehension still presents itself as superficial, emphasizing the need for the development of educational actions elaborated from the population's reality. The research done on environmental perception can bring subsidies for the PA's management, in the development of actions which involve communities in the decision processes and in the conservation of biodiversity.

**KEYWORDS:** Iguaçú National Park. Interpretive Trail. Climate Change.

## 1 INTRODUCTION

As man evolved and along with the technical-scientific advance made possible in the advent of the Industrial Revolution, an intense degradation of the environment occurred, due to the broad contamination by chemical wastes, fires, incorrect disposal of waste and, most importantly, the large exploration of natural resources (PESSANHA; LOUVEM; RANGEL, 2019). The rampant use of these resources caused wide environmental impacts, like extreme climate change and fragmentation of habitats, leading numerous species of fauna and flora to extinction (FRIEDE, 2020).

To restrain the decline of biodiversity, it was necessary to establish locations where human activities were more restricted and controlled, this way the Protected Areas (PAs) can be effective tools for preservation for presenting defined degrees of protection (CAZALIS; PRÉVOT, 2019). It is known that PAs alone can not restrain the crisis of biodiversity and climate change (PRÉVOT-JULLIARD *et al.*, 2011), however, the presence of these environments provide a bigger opportunity of experiencing nature for local residents and visitors and the contact with the natural environment can contribute in the learning process and acknowledgement of environmental issues, as well as, raise change towards preservation.

However, there is still little knowledge from the communities on the concept of PA, its goals and different management categories, not knowing its differences and specificities and a lot of the times not being aware that they reside inside or on the surrounding area (SILVA; OLIVEIRA; MELLO, 2021). Furthermore, the expropriation of land in PAs of Full Protection makes it so that the communities reduce the sense of belonging about these locations and many times create a feeling of sorrow and hatred in relation to the location (CALEGARE; HIGUCHI, 2013).

The existence of socioenvironmental conflicts are intrinsic to the appropriation of natural resources (QUINTAS, 2019). These conflicts can prevent management of PAs from meeting their conservation goals (GARCIA-FRAPOLLI *et al.*, 2018). That way, the environmental public management (EPM) arises and is understood as “process of interests and conflicts

mediation, among social actors, by controlling the destination of Environmental Resources in society, done by the Government" (QUINTAS, 2016, p. 37, own translation).

So, Environmental Education (EE) in EPM, belonging to the field of critical EE, defines the teaching and learning process as revealing of responsibilities, causes and consequences, whose pedagogical act goes beyond the promotion of ecologically correct behaviors, yet criticizing the social appropriation of physical, biological, environmental and economical asset (QUINTAS, 2019). Therefore, it is necessary to implement effective educational actions to preserve and ensure the natural resources, inserting local populations in a system of critical EE, so that they can understand the meaning of the creation of the PA and the importance of their participation in the process of local management (MADEIRA *et al.*, 2019).

In the same way, the studies of environmental perception by residents of the PAs or of its surroundings, can bring subsidies in the comprehension of relationships between the human being and nature, helping in the understanding of how people perceive the environment where they live or interact with (BATISTA; PAULA; MATOS, 2019). Environmental perception is associated with many elements of human existence, in an extremely complex way (MARIN, OLIVEIRA, COMAR, 2004), and people assess the same environment in distinct ways, according to their own lived experiences (TUAN, 1980). So, in order to comprehend the environmental perceptions of residents or of individuals who interact with the PAs, it can help in the elaboration of effective and participatory educational actions and management, in a dialogical and critical way.

Given the importance of the study of perception for the full management of PAs and development of actions in critical EE, this research had as a goal to investigate the environmental perceptions of students and teachers who live in an area encompassed by a Preservation Area (PA). The research's focus was to analyze the perceptions in relation to environmental issues, such as the conservation of biodiversity and the threats faced by fauna and flora in this specific region. Furthermore, it was sought to understand the level of comprehension of students and teachers about climate change and the impact of these changes in the area of the PA.

## 2 METHODOLOGY

The present work is part of the research project titled “Climate Change and socioenvironmental vulnerability associated to National Parks: strategies for management and Environmental Education” approved by the SISBIO (System of Authorization and Information in Biodiversity - SISBIO) under the number 80839-1.

In 2022, different activities at the Iguaçu National Park (*PNI*), located in the western state of Paraná were realized, like talks, interpretive trails and dynamics. The people involved were invited to participate voluntarily in the activities inside the area. In total, there were 16 participants, ages ranging between 15 to 40 years old, who were teachers and students of the public system of the state of Paraná.

This was an exploratory research, of qualitative character, of the participant observation kind. This method is done with direct and prolonged contact with the social actors participants of the research, where the investigator themselves becomes the tool of research

(CORREIA, 2009), offering great approximation to social representations, perceptions and historical-social-cultural dimensions of the individuals (MÓNICO *et al.*, 2017).

The participant observation is usually complemented by a data collection method, such as interviews and/or survey applications (CORREIA, 2009). This way, the application of pre and post-surveys was realized structured with open and closed questions. The field diary was also utilized, for annotations on the activities held that weren't specified on the survey.

The topics carried out on the workshops, theoretically, were the importance of the PAs, climate change and the importance of birds. As practice, an immersive interpretive trail was held in the *PNI*, on the *Poço Preto* Trail. With the trail, the participants were able to be in more contact with nature, through five interpretive points, and personally meet many species of flora and fauna at the park. Along the entire path curiosities about the species were explained and different dynamics were performed.

The data analysis, derived from the surveys and the field diary, were submitted to Content Analysis (BARDIN, 2011). According to the author, the analysis is constituted in three steps: the pre-analysis (organization of documents), the exploration of the material (codification and categorization) and the treatment of results (creation of meanings). Therefore, the meaning units were grouped in four categories, from the results obtained with the research: 1. The importance of interpretive trails; 2. Perceptions about climate change; 3. Perceptions and recognition about the importance of birds; 4. Perceptions and knowledge about the PAs.

### 3 RESULTS AND DISCUSSION

To facilitate presenting the results, the same were grouped in four subtopics based on this study's relevant themes and traced results, as follows: 1. *The importance of interpretive trails* (results related to the effectiveness of interpretive trails as an educational strategy in the PA area); 2. *Perceptions about climate change* (results referring to the perception and comprehension of students and teachers about climate change). 3. *Perceptions and knowledge about the importance of birds* (results of the perceptions about the importance of birds in the area of a PA); and 4. *Perceptions and knowledge about the PAs* (results related to the perceptions of students and teachers about the importance of the PAs).

#### 3.1 The importance of interpretive trails

Trails assist in the comprehension of the environment and in the relationships between living and non-living beings, approaching the importance of the mitigation of anthropic actions in the environment, awakening a critical consciousness and stimulating the development of sustainable practices (BUZATTO; KUHNNEN, 2020). They have the capacity of modification of feelings and interpretations of the landscape, increasing the environmental consciousness of individuals. By means of visits, group dynamics and image visualization, they promote conservationist actions, cooperative practices and interactions with different kinds of knowledge. Beyond this, they influence in the elaboration of public policies of environmental management and stimulate changes of pro-ecological attitudes and conducts (LIMA-GUIMARÃES, 2010).

Highlighting the importance of this type of activity, after answering the pre survey and theoretical explanation about PAs, the participants were taken on a guided interpretive trail at the *Poço Preto* Trail, in the *PNI*. That way, there were five interpretive points instituted, with different objectives, as follows on table 1.

**Table 1: Systematization of the interpretive points held at the *Poço Preto* Trail**

Point	Objective	Discussions
Juçara Palm hearts	To debate about the illegal harvest of flora in PAs, as well as, warn about the risks of such practice.	<ul style="list-style-type: none"> <li>- Ecological and cultural importance of <i>Juçara</i> Palm hearts (<i>Euterpe edulis</i>).</li> <li>- Threats of the harvest to species and ecosystem.</li> <li>- Risk to public health associated with this practice.</li> <li>- Protection laws to PAs and native flora and the role of surveillance bodies in the fight against illegal harvests.</li> <li>- Actions which may be adopted, such as reports on illegal activities and support to preservation initiatives.</li> </ul>
Burlap	To discuss the process of decomposition that occurs inside the forest and its importance in nutrient recycling.	<ul style="list-style-type: none"> <li>- Did the participants know what burlap was?</li> <li>- Different stages of decomposition.</li> <li>- How biodiversity is an influential factor upon the decomposition rate.</li> <li>- Action of decomposers in all trophic stages of the food chain.</li> </ul>
Invasion of exotic species	To discuss how invasive exotic species affect biodiversity.	<ul style="list-style-type: none"> <li>- Definition of invasive exotic species.</li> <li>- Discussion on the negative impacts, like competition for resources and reduction of local biodiversity.</li> <li>- Invasive species present at the <i>PNI</i>.</li> </ul>
Mammal footprints	To highlight how footprints can be used in the realization of surveys about the fauna of a certain place.	<ul style="list-style-type: none"> <li>- Observation of land in search of footprints.</li> <li>- Visualization of spotted jaguar (<i>Panthera onca</i>) and deer (<i>Cervidae spp</i>) footprints.</li> <li>- Interpretation of the footprints in question.</li> <li>- Differentiation of feline and canid footprints.</li> <li>- Importance of footprints as evidence of the presence and the behavior of animals in the area.</li> </ul>
Balanced ecosystem	To demonstrate the importance of biodiversity and reinforce that all parts of an ecosystem are interdependent.	<p>Procedure: The participants formed a circle and received boards with names of animals, plants, decomposers and the sun. A ball was passed in between the students, representing the energy and nutrients transference in the food chain. The extinction of some animals was simulated by dropping the ball, showing how this affects the ecological balance. The activity synthesized the functioning of the food chain, emphasizing the importance of each species and illustrating how extinction can impair the ecosystem.</p>

Source: Own Authorship (2023).

It is highlighted that, the first interpretive point, was related to the illegal harvest of the *Juçara* Palm hearts (*Euterpe edulis*), due to the importance of raising the residents' awareness about the subject, since this practice is characterized as one of the main conflicts of the PA in question (FAURO *et al.*, 2014). By being a full protection area, any extractive activity is prohibited, however, it still happens illegally. In the harvest of palm heart, the palm tree dies, which resulted in the classification of the plant as threatened of extinction (MMA, 2014). Furthermore, by being done in a totally illegal way, the extraction process does not follow the quality standards established for this type of practice, compromising the product's integrity and potentially becoming a public health issue (OLIVEIRA; NASCIMENTO, 2016).

In relation to the second interpretive point, Giweta (2020) points out that the role of burlap in the functioning of forest ecosystems is still barely known, even though it presents direct effects on these locations and PAs, which is confirmed by the participants, who stated, in their majority, did not know what burlap is. Because of its importance to the ecological balance, during the stop, a discussion was held on how burlap can be considered an environmental indicator, once it reacts to alterations in the environment and ecosystem (SILVA *et al.*, 2022).

In addition to this, another point underscored, was the influence of the loss of biodiversity in burlap decomposition, as highlighted by Tonin (2018), who points out that hundreds of researches confirmed that changes in diversity of species, altered the ecosystems' processing rates, since decomposition involves multitrophic biological interactions. Thus, it's worth noting the importance of discussing the topic of interpretive trails, because PAs are normally locations with high rates of decomposition and cycling of nutrients.

The third interpretive point was defined by the recognition coming from researchers all around the world, that PAs have been increasingly challenged by exotic species invasions (REN *et al.*, 2021). The invasions caused by exotic species are amongst the main reasons for the loss of global biodiversity (FRANÇA *et al.*, 2020) and the human being is most responsible for this introduction, whether intentional or not, impacting multiple spatial scales, like population and wealth of species and composition of ecosystems (PAGAD *et al.*, 2018).

In the case of the *PNI*, the most recent study found, done by Gonçalves *et al.* (2017), by a review of literature, there were 01 animal species and 16 exotic vegetal species, of which four are considered invasive: *Zebrina (Tradescantia zebrina)*, *Uva-do-japão (Hovenia dulcis)*, *Capim-mombaça (Megathyrsus maximus)* e *Laranja-amarga (Citrus aurantium)*. On the trail, it was possible to see that the two first species, coincidentally, the most named on the work analyzed by the authors above.

From the suggestions exposed by Ziller and Zalba (2007), this point also discussed examples of actions of mitigation of problems related to the invasive exotic species. For this purpose, there were mentions of the non cultivation and marketing of exotic species close to natural areas, incorporation of the subject in actions of formal and informal EE and multiplication of knowledge and support of research projects for the control and handling of invasive species (ZILLER; ZALBA, 2007).

The fourth interpretive point, had focused on the survey of wild fauna stemming from footprints. The subject choice happened due to the ecological importance of mammals, so much in the structuring of communities (by the predation, like felines), as in the regeneration of the forest (by dispersion of seeds and pollination) (TERASSINI *et al.*, 2008). Also, another important point for discussion, is the difficulty of direct visualization of mammals in a natural environment, because of, mainly, the nocturnal habits of most of the species, therefore, traces can be used to estimate the existence and abundance of populations (ZANK; KINDEL, 2002).

On the trail, it was possible to see a deer footprint (*Cervidae spp.*) and a spotted jaguar footprint (*Panthera onca*). During socialization, a participant showed a picture of a footprint found in their community, affirming that the residents had felt scared, for having linked the footprint to the presence of jaguars in the region. Seeing the image, it was possible to notice that it, actually, was from a canid, so, it was explained to the participants what the difference was between the footprints. Carvalho Júnior e Luz (2008), point out the differentiation of



footprints of various species of mammals, showing that, in the case of canids, there is the presence of strongly marked nails, which does not happen in the case of felines, who retract their nails when walking. From this perspective, Berlinck e Lima (2007), also emphasize, the educational aspect in footprints identification, that can bring subsidies for the discussion and appreciation of local biodiversity.

To end the trail, the participants were distributed in a circle and, then, a dynamic was performed to show the importance of biodiversity and reinforce that all parts of an ecosystem are interdependent (procedure available on board 1). Melián *et al.*, (2018) highlight that biological systems interact among themselves and in different hierarchical levels, mentioning as an example, the interactions between genes (that determine the characteristics of an individual), the competitive and cooperative interactions (that influence the population dynamic) and the interactions between species (that affect the communities and ecosystem processes). But, the loss of biodiversity is one of the main environmental issues today, seeing that many studies show that the Earth is entering the sixth mass extinction, but with a rate higher than in the previous (pre-humans), proving that hundreds of extinctions have anthropogenic cause (CEBALLOS *et al.*, 2015).

The inability in stopping the loss of biodiversity results, not only from the lack of scientific understanding about factors of extinction, but also from the shortage in societal actions and support. That way, the awareness and appreciation of society about nature and these problems, will define the involvement and efficiency of the conservation of species, because individuals protect that which they consider important (JARIC *et al.*, 2020). Roos (2012) stresses the importance of people understanding that all species are important, not only to serve human beings, but to guarantee ecosystemic balance. In this sense, it is worth noting the importance of the development of interpretive trails that instigates critical thinking and raises awareness in individuals, within a network of sharing knowledge.

The great relevance of the interpretive trail for the development of the present work, was ratified by the participants' enthusiasm and interest for the chosen topics. Many of them exposed that it had been their first experience with trails and nature immersion, because they live in a big urban center. In addition to the interpretive points, over the whole trajectory, there were observations of plants and animals (with the assistance of binoculars) and voice captures, allowing for contact and knowledge about fauna and flora of the *PNI*.

Thus, it was confirmed that the interpretive trails present a great possibility of raising awareness on and connection to nature, by the senses sharpening. These senses may bring back memories and feelings from past experiences (TUAN, 1980), having the power of redefining values for conservation (ORSI *et al.*, 2015), because environmental perception is directly linked to the sensory base, making it so individuals reflect and feel responsible for their conduct towards the environment (RISSO; PASCOETO, 2016). Also, practical experiences, that foster direct contact with nature, contribute to a larger knowledge and critical training surrounding the conservation and preservation of natural resources (PINTO *et al.*, 2022).

### **3.2 Perceptions about climate change**

The United Nations Framework Convention on Climate Change, held in Brazil in 1992, set out the need to promote awareness and public understanding about climate change by means of educational actions. Over the years, it has been observed that there is an increasing interest in Education on Climate Change (EMC), originally known as Climate Change Education (CCE), emphasized by the financial increase destined to researches and programs in this area, by the alterations in curricular guidelines and by the rising level of environmental concern (MONROE *et al.*, 2017).

However, educators still face various challenges when it comes to incorporating EMC in different sectors of society. They come across issues about the best ways of approaching the subject and which strategies and methods are more effective in the learning and teaching process, in formal education as well as non formal (REID, 2019). In this sense, there was an effort in investigating the participants' perception regarding climate change, with the goal of comprehending if they are aware of the existence of these environmental changes and if they are thinking of adequate stances to face the current crisis. When understanding the students and teachers' perceptions, it is possible to identify gaps of knowledge and to formulate actions of effectively raising awareness.

When questioned if they believe in climate change, 87,5% of the participants responded they totally believe in it and 12,5% affirmed they partially believe in it. But, all participants said climate change is already affecting people. The results coincide with researches done by Bursztyn e Eiró (2015) and Pinheiro, Cavalcanti and Barros (2018), showing that there is an ongoing overcoming of the “general denial” of the problem and that individuals have been trusting more in specialist institutions and informations passed on by means of communication and by the internet.

Although, Tuitjer e Dirksmeier (2021), point out in their results, of a research carried out in various European countries, that higher internet consumption and social media use can negatively impact the individuals' perceptions about climate change, as a direct result of fake news. In this regard, it is emphasized there is a need for dissemination of scientific clarifications through the means of communication and journalism so people understand climate change in all its aspects and, that way, decline the dissemination of denying speeches.

In relation to the causes of climate change, 75% believe that it stems from human activities and natural events, combined, 12,5% said it derives from human activities and 12,5% said it is caused exclusively by natural events. Valkengoed, Steg e Perlaviciute (2021) confirmed in their results that, the more people believe climate change is real, caused by human activities and that it presents bad consequences, the more they realize the risks, get involved in mitigation processes and support public policies of mitigation and adaptation. On the other hand, the authors stress that, those who assume that climate change has exclusively natural causes, tend to believe that the consequences are spatially distant, not applying to their reality, therefore, realizing fewer risks and not getting involved in mitigation actions. Finally, those who believe that the causes are anthropogenic and natural simultaneously, vary their perceptions, which may be positive or negative.

All participants declare they had felt changes in the environment in the last years and assimilate this to climate change. The most mentioned event was heat waves and temperature changes (75%), followed by storms and extreme events, such as cyclones and hurricanes (50%),



deforestation (25%), fires (12,5%), floodings (12,5%), landslides (12,5%) and drought (12,5%). In this perspective, in a bibliographic study done by Lee *et al.*, (2020), it is highlighted that the precision of knowledge on the impacts of climate change varies according with the method used, in which, with open questions, the participants had more difficulties to cite the impacts, compared to the closed questions. However, in both cases, the answers were simplistic, exemplifying that the participants recognize the increase in temperature, but don't assimilate it to the rise of desertification. The authors also cite that the socioeconomic impacts, like migration, were not recognized. These results meet the present research, done by means of open question, where the participants did not cite any socioeconomic impact.

In relation to the impacts, it was emphasized to the workshop participants the concept of vulnerability, which, according to Conrado *et al.* (2000) varies depending on the cultural, social and economic possibilities of a population, where, those who possess fewer resources, will have more difficulties in implementing actions of mitigation and adaptation, consequently becoming the most vulnerable. The authors highlight that populations of developing or underdeveloped countries are far more impacted by extreme events caused by climate change, where the impact can be up to 30 times larger than in developed countries.

By the acceleration of these impacts, there is an urgent need for the creation of effective actions of mitigation and adaptation (ARTAXO, 2020). So, the participants were asked about their mitigation actions, and 75% responded they are doing little, 12,5% state they are acting in the right amount and 12,5% did not know how to answer. As for the individual and collective actions of mitigation, most of the participants cited EE, through raising sensitization and awareness of the population. Other actions cited were the fight against deforestation, hunting and fishing, decrease in use of pesticides, sorting of waste, slowing down the economy and global agreements about CO<sub>2</sub> emissions.

Fawzy *et al.*, (2020), also stress the urgency in developing effective mechanisms of mitigation and point to three strategies, called: 1. Conventional strategies of mitigation; 2. Technologies of negative emissions; and 3. Technologies of geoengineering of radiative forcing. The first one uses techniques that reduce greenhouse effect gas emissions, as for example, renewable energy and fuel switching. The second one points to techniques of carbon sequestration in the atmosphere, like capture directly from the air and land and afforestation. The third one aims at the stabilization and reduction of temperature, for example, by means of stratospheric aerosol injection and thinning the cirrus clouds. However, the authors emphasize that many of these technologies are still very new, and need to be developed and tested, which can take a long time.

As highlighted by the participants of the present research, EE can be an important tool for the mitigation of climate change, because it encompasses approaches that develop conducts, values, awareness and knowledge, that can prepare the individuals to take action in favor of the environment (ARDOIN; BOWERS; GAILLARD, 2020). That way, it is crucial that the entire population have access to climate literacy and to EE, because understanding the causes and effects of climate change is essential for the involvement in actions of mitigation and adaptation (LEE *et al.*, 2015).

### 3.3 Perceptions and knowledge about the importance of birds

The application of activities that stimulate the perceptions of the environment using senses like hearing and sensation can be effective tools to reach such goals (MARIN; OLIVEIRA; COMAR, 2003). Within the activities that follow said ideal and present a spotlight on triggering of thoughts, which seek environmental protection and the sustainable use of natural resources, are those that provide direct contact with nature (COOPER *et al.*, 2015) like for example, the practice of bird watching (RODRIGUES *et al.*, 2020; SON; DUNG; VAN, 2011; VELUZA; RECHETELO; PEREIRA, 2022).

In order to work with the observation of nature it is important to know its elements. Brazil is a megabiodiverse country that fosters the second largest biodiversity of birds on the planet, in total there are 1919 species spread through the national territory, with 293 of them being endemic (PACHECO *et al.*, 2021). In this perspective, there was an aim to inquire about the familiarity of individuals with wild birds, the acknowledgement of the role executed by these animals on the environment, as well as the threats faced by this group.

Looking to identify the knowledge of the participants about the species of birds, exclusively during the application of the pre survey, the same were asked if they knew any species, by citing their name and what most drew their attention. Amongst the most mentioned species were the Toucan, of the Ramphastidae family, as most cited species (n=3). Of the Psittacidae family, were mentioned the macaw (n=2) and parrot (n=2). Within the participants, only one of them mentioned more than 3 species, including species such as the kiskadee (*Pitangus sulphuratus*), rufous hornero (*Furnarius rufus*) and sparrow (*Passer domesticus*), which are usually easier to remember for residing in urban centers and rural environments (SICK, 1984; MENCATO; TRECO, 2016).

The birds' characteristics that draw the most attention are colors, the beauty of their plumage, the singing, the shape of the beak. These attributes, also mentioned in other works (VIVIANI; RODRIGUES; EBERT, 2016), are what generate the “enchantment” and sensitize individuals, because when observing the details of morphology and listening to the vocalizations the senses are activated, thus favoring learning (BENITES; MAMEDE, 2008), as well as, the change in behavior, because, as said by Alves (2006), the “truth” imposed by science would not be capable of shaping personal behavior, but would do emotions, once the behavior is set by emotions, which are able to interfere in actions of the individual themselves.

Returning to the ecological questions of birds, when asked during the pre-survey if birds have or don't have some ecological importance, 25% of participants did not know how to answer, while 75% answered yes and mentioned as an example the propagation of plant seeds, which was also mentioned during the researches by Viviani, Rodrigues e Ebert (2016). Another example mentioned was pest control.

As matter of fact birds do have great influence in propagating seeds, in addition to effectively contributing to pollination of some plant species, acting in pest control, where some species may assist in the cycling of nutrients and in the control of disease and microorganisms spreading in the environment (WENNY, *et al.*, 2011; MORANTE-FILHO; FARIA, 2017).

During the post-survey, still while being questioned on the ecological importance of these animals new examples emerge, like the “assistance in the biological cycle”, “the

pollination”, “the maintenance of the planet’s balance” and “measuring local preservation” referencing the role that birds represent as bioindicators.

The investigations done by Silva *et al.*, (2020) as well as Kross *et al.*, (2018) and Herzog and Mikk (2007) demonstrate that in agricultural environments, generally, birds aren’t seen as important components of the ecosystem, mainly due to the damages caused to cultures. According to the same authors, most farmers don’t recognize the benefits that birds may have in pest control. In this sense, it is noticeable how relevant EE activities that stimulate the acknowledgement of interactions between birds and agricultural environments are, especially for this public.

In relation to the threats faced by birds, the participants pointed to, among the options of: hunting and wild animals trafficking; predation by domestic animals; pollution, degradation and fragmentation of forests, as main factors during the pre survey the hunting and animal trafficking of wild animals and pollution, and all options in the post survey.

Of the 1971 species of birds registered in the country (PACHECO *et al.*, 2021), 239 are under some level of threat (ICMBIO, 2018). Morini and Garcia (2005) point out the loss and fragmentation of habitats as the main threat faced by Brazilian birds, followed by excessive capture. Concerning hunting, it is estimated that over the whole Brazilian territory, around 4 million birds are annually withdrawn from nature (RENTAS, 2001), while most of them end up dying before even being commercialized (NEVES; ERBESDOBLER, 2021).

It is commonly observed in big urban centers, as well as in small towns and in the rural area birds stuck in cages, reflecting the culture of poultry farming that is strongly rooted in part of the population to which it contributes to strengthening from the withdrawal of animals from nature to the maintenance of animal trafficking (COSTA *et al.*, 2018; FREITAS, *et al.*, 2021). The illegal trafficking of wild animals has been a crime in Brazil since 1998, by the Law of Environmental Crimes (Brazil, 1998). Moreover there is still a regulation for the commercial and amateur activity of native passerines that foresees the identification of these animals from the use of rings, making it possible to control and supervise this activity (COSTA; MONTEIRO, 2016).

In this context, when asked about their perspectives regarding commercialization (acquisition, sale and/or capture) of wild birds, 62,5% of participants pointed to said activity as environmental crime while 37,5% affirmed that there should not be commercialization of wild birds without the legal authorization of the environmental agency during the pre-survey. Yet in the post-survey, 85,7% of participants said it is an environmental crime to commercialize wild birds and 14,3% said that it should not happen without legal authorization of the environmental agency. In many territories the populations do not have knowledge on or do not consider the fact of withdrawing a wild bird from its natural environment as an environmental crime for being a common thing in their reality (COSTA *et al.*, 2018). Therefore, it is important to establish actions of EE with the populations with the goal of informing them of the illegality of these practices.

### 3.4 Perceptions and knowledge about PAs

During the theoretical explanation about protected areas, the participants were asked about what a PA is and what is their importance. The large majority affirmed to not know the meaning of it, only some participants commented on it being an environment where nature is found to be protected, without major further developments around its ecological and social importance. In this sense, Carvalho, Alves e Santos (2021) highlighted that despite the availability of documents that speak of the importance of PAs, there is still a lack of the popularization of knowledge and diffusion of these informations to the population, reinforcing the need to promote and develop non formal activities in these locations.

Regarding the state of conservation of the Atlantic Forest, everyone said that the Biome is threatened. In their research, Santos *et al.* (2020) identified that the main causes of deforestation of the Atlantic Forest are associated with population growth, subsequent to agriculture, livestock, urban expansion and forestry. The *PNI* is situated in the ecoregion of the Atlantic Forest, being one of the last remainders preserved, but, studies show that, over the last 20 years, around 13% of the ecoregion was drastically reduced due to deforestation and habitat degradation, threatening local biodiversity (MOHEBALIAN *et al.*, 2022). On the other hand, positively, Rezende *et al.*, (2018) say that the Atlantic Forest has great regeneration potential, in a way that, if conservation public policies are effectively applied, there is a great potential of decreasing deforestation, mitigation of water and food insecurity and adaptation of ecosystems to climate change.

When asked about the importance of the park, in the pre and post survey, 100% of participants marked that, for them, the park is important for the protection and housing of threatened wild animals, contributing to the maintenance of biodiversity. In this same question, 75% and 81,3% answered, respectively, in the pre and post survey that the park is important to preserve the historical and cultural memory of the places, its traditional landscapes and associated human activities.

Manetta *et al.* (2015) affirmed that PAs consist in an effective way to protect biodiversity, through practices attributed to the protection of biological diversity. Hassler (2005) highlights that the benefits of PAs go beyond the conservation of fauna and flora, mentioning the conservation of water resources, scenic beauty, historical and cultural sites, air quality and ordination of regional economic growth. In the economic sense, the PAs can be sources of income generation, for example tourism, which is largely adopted, especially by PAs of the National Park category.

In the question “Which factors do you think are contributing to the disappearance of some wild animals?”, exclusively on the pre survey, 86,7% marked the option degradation of habitats (pollution, fires, waste disposal). 80% marked the option destruction of habitats (Forests and fields) and 66,7% marked the options for hunting and trafficking of wild animals. Diniz (2017) warns about some factors that may lead to fauna extinction, like fragmentation and destruction of habitats, hunting and fishing, illegal wild animal trade, chain extinction (occurs when the extinction of one species leads to another) and introduction of exotic species.

The environmental degradation entails a series of negative consequences, such as land erosion, changes in climate factors and extinction of species of fauna and flora (LANDIM *et al.*, 2021). These changes have significant impacts on the ecosystems and biodiversity as a whole. It is also worth emphasizing that the uncontrolled urban expansion, the degradation of natural

ecosystems, the destruction of habitats, traffic of wild animals and illegal hunting also have an important role in the appearance and dissemination of new zoonosis (PASSOS; MARTINS, 2020).

Because of these numerous issues, the most urgent environmental challenges currently are climate change and biodiversity loss, that happen in an interconnected way. Therefore, many studies highlight that actions of conservation, like creation and maintenance of PAs can interrupt, delay or reverse the loss of biodiversity and mitigate the climate change of anthropogenic cause (SHIN *et al.*, 2022).

#### 4 FINAL CONSIDERATIONS

The PAs are spaces with great potential for the application of educational actions, because by connecting people with nature they provide an immersion and a learning from practice. The effectiveness of these environments in the teaching learning process and environmental awareness has been investigated and proven by many researchers, teachers and environmental managers, however, before the geographical magnitude of Brazil, there is still a lot that needs to be done in order for these environments to be used better in the scope of EE and GAP.

The studies of perceptions give subsidies in the understanding of how the population that resides or interacts with the PA perceive the environment and in the comprehension of the level of knowledge and attitudes in relation to the conservation of biodiversity and mitigation of climate change. With the comprehension of meanings attributed to the environmental issues worked on, it is expected that the managers of the PA might be able to elaborate educational projects according to the people’s reality, beyond implementing approaches of inclusive and participatory management.

With the activities applied on this project, it was possible to note that people have an awareness about the importance of the preservation and mitigation of climate change, but their comprehension is still limited. It is emphasized that more investigative studies are necessary, as a means to comprehend how the educational actions must be applied to get a real awareness and critical thinking to populations about the importance of protected areas for the conservation and preservation of natural resources, as well as, an awareness of the problems caused by man to the environment and means of mitigation.

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