

Case Report

Review of Community-Based Conservation Initiatives for Protecting a Primary Atlantic Forest Remnant: A Case Study

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Abstract: Effective forest conservation should go hand in hand with collaboration of the surrounding local communities. Bringing advancement and relief to marginalized communities is pivotal for conservation initiatives, with the objective of cultivating a sustainable ecosystem while protecting indigenous biodiversity. The lynchpin for developing successful partnerships begins with fostering a shared understanding of the intricate relationship between humanity and the natural environment. This awareness can be nurtured by interactive education and tangible outcomes that illuminate the profound long-term benefits of conscientious environmental stewardship. Therefore, an emphasis on community-driven conservation and environmental education becomes imperative, serving as a conduit for disseminating crucial information, fostering practical knowledge, and nurturing the attitudes and skills essential in the quest for environmental protection and sustainable development. Education, in this context, operates as a reciprocal process, demanding that educators glean insights from the local populace to effectively tailor strategies that elevate and empower them toward sustainable advancement. This dynamic interaction is where capacity development (CD) becomes indispensable. This paper delves into the unfolding of a series of conservation endeavors, initially driven by Anita Studer's commitment to preserving a fragment of the primary Atlantic Forest in northeastern Brazil. Evolving into a four-decade educational journey, the actions taken showcase enduring ripple effects across 14 states in Brazil, presenting a comprehensive survey of applied techniques in this unique context. The resources required to achieve collective conservation goals witness a continual upswing, a trend expounded in this paper. Hence, we have chronicled the history, methodology, and projects that transpired in response to the ever-evolving community needs. We will also look at the results and discuss the advancement that ensues following the CBD targets and goals presented at the 2022 UN Biodiversity Conference.



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1. Introduction

The Pedra Talhada forest, situated in the Pernambuco Endemism Center, is a critical biodiversity area under constant threat. This case study analysis aims to examine the conservation education (CE) strategies implemented in the region over four decades and evaluate their effectiveness in achieving the goals of forest preservation, community engagement, and sustainable biodiversity conservation.

Preserving natural resources is of paramount importance for sustainable environmental and community development. However, it is imperative to acknowledge the complex realities local communities face, especially concerning their economic choices. While the desire to engage in conservation activities exists, the prevailing economic disparities and

incentives make it considerably easier for communities to opt for more immediately rewarding but less sustainable practices, such as cattle ranching. Thus, to foster a sense of responsibility and encourage communities to protect their environment, it is crucial to establish connections by addressing their basic and immediate needs and supporting them in their quest for sustainable development through capacity development [1,2]. When communities are empowered to manage their natural resources with sustainability in mind, social resources become available [3]. Such resources lead to community relief and a willingness to engage in conservation activities.

Urgent transformative change at a societal level is called for to secure a sustainable future for the next generations [4]. We must strategically apply diverse and innovative mechanisms to conserve ecosystems [1,5,6]. Studer accomplished that throughout her quest to preserve the Pedra Talhada forest and its biodiversity [7]. She had to develop various competencies and apply diverse, innovative mechanisms.

Therefore, the significance of this review lies in the fundamental impact of human activity on the environment and how it has transformed ecological processes [8]. The case study emphasizes the positive impact of capacity-development-based conservation education initiatives on sustainability. It highlights how these initiatives have particularly engaged children and youth and different stakeholders, like farmers, technical and political authorities, and the general population, in activities that promote awareness and action for environmental and biodiversity conservation. The discussion also emphasizes the importance of local knowledge and the long-term commitment of the authors and organizations involved in driving these initiatives.

Understanding the complexity of current conservation problems and how they relate to education necessitates the exploration of case studies like ours to allow a comprehensive analysis of why we must adopt Sustainable Development Goals (SDGs). We are facing a time of crisis, and insights into the challenges we face provide a platform for our future imaginaries [9]. In this context, our study seeks to assess the efficacy of sustainable CE strategies in safeguarding the environment and biodiversity. By examining nearly four decades of innovative projects and processes, focusing on actions initiated by primary researcher Anita Studer, we aim to shed light on the impact and effectiveness of these initiatives. The actions undertaken by Anita Studer have set off a multiplier effect, inspiring communities to share their knowledge and experience and promote CE actions over 14 states in Brazil.

Our hypothesis posits that the sustainable CE strategies championed by Anita Studer significantly contribute to environmental and biodiversity protection. Thus, we hope to provide a suitable avenue to expand knowledge and understanding of available sustainable conservation strategies. In doing so, we aspire to unveil the complexity of our study area and offer a comprehensive background for analysis.

Additionally, we investigate how the outcomes of these initiatives align with and fulfill the critical goals and targets outlined by the Convention on Biological Diversity (CBD) at the UN Biodiversity Conference in 2022 [10], thereby contributing to the assessment of global biodiversity conservation and sustainability efforts. Ultimately, we hope this revelation will contribute to expanding knowledge and understanding around conservation education, advancing initiatives for sustainable environmental and community development.

However, forthcoming discussions on addressing these economic disparities and further analysis are needed to shed light on these complexities and provide a more comprehensive understanding of the challenges involved in steering communities toward sustainable conservation activities in the face of more immediately lucrative alternatives.

2. Study Area

2.1. Overview

The *Mata Atlântica* (Atlantic Forest) is a primary coastal forest that extends from north to south over 6000 km along the coast of Brazil. This phytogeographic domain contains the second largest rainforest in South America. The forest has mainly developed on moderately

deep clay or sandy clay soils and, due to the diversity of its soils, contains a significant variation in floristic structure and composition from north to south. The numerous vegetation layers are complex; thus, trees can reach up to 35 m [11]. An estimated 20,000 vascular plant species [12] and numerous endemic vertebrates and invertebrate species [11,13] have been recorded. Some authors consider the Atlantic Forest a juxtaposition of many ecosystems [14]. In the 15th century, it spanned over 1.1 million square kilometers adjacent to the Atlantic Ocean coastline from Rio Grande do Norte in northeastern Brazil to the province of Misiones in Argentina [15]. Regrettably, this forest is severely fragmented, with only approximately 8% of its original size remaining [16]. Currently, less than 2% of the entire biome has a protected status; between 1989 and 2000, another 10% of the remaining area was destroyed [17].

The Pernambuco Endemism Center, where Pedra Talhada forest is located, is a forest remnant in the northeastern Brazilian region of the Atlantic Forest (Figure 1). This is where our CE actions were carried out. This forest occupies an area of 4469 ha and houses a significant biodiversity of fauna and flora. The Pedra Talhada forest is one of the most important last forest refuges in this Center and one of the most devastated and threatened areas of biodiversity in the world, with dozens of endemic and extinct species [18,19]. Its favorable climatic conditions are maintained thanks to the relief of the Borborema Plateau, which blocks the oceanic winds, capturing the humidity of the air through condensation, which then returns in the form of rainfall [11]. The highest part of the Pedra Talhada forest culminates at 883 m. Due to its height and greater humidity, it forms one of the 21 “Brejo de altitude” identified in the northeastern region [20], consisting of gigantic rocky outcrops. These “Brejo de altitudes” are humid enclaves inserted in inselberg reliefs that host many endemics and are considered hotspots for biological diversity [21–24]. Therefore, the enclaves of this northeastern region have always served as a floristic refuge for the forests. Thus, they can sustain themselves during periods of drought and provide the necessary shelter for numerous fauna and flora species [11].

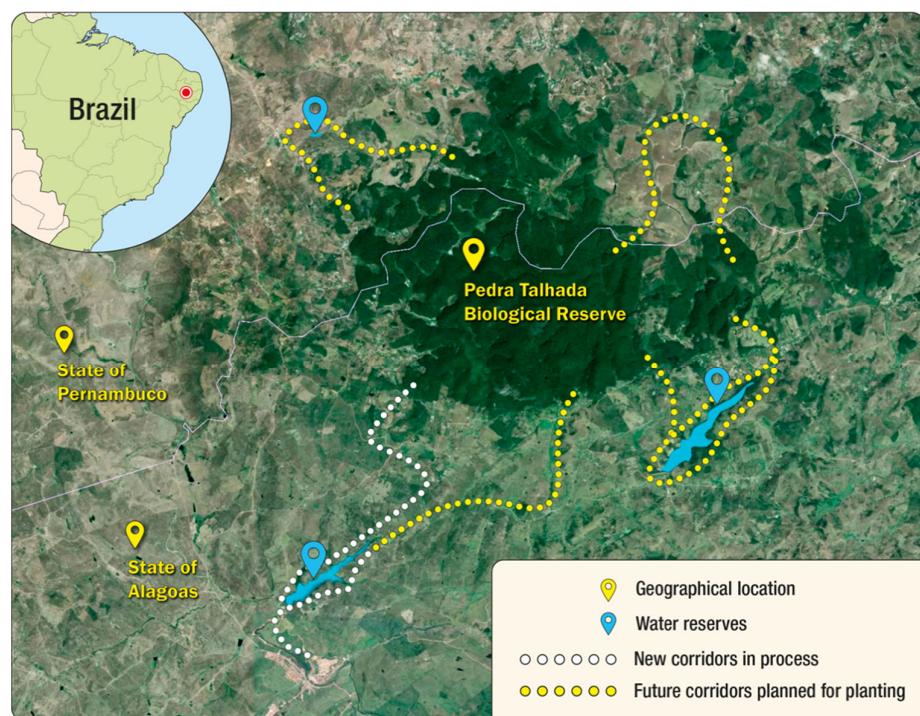


Figure 1. Current map of Pedra Talhada Biological Reserve showing the surrounding states and the water reserves toward which Nordesta Reforestation and Education is planting forest corridors (source: Google Maps).

The Pedra Talhada forest birthes 169 springs, which form the hydraulic basins of the Mundaú and Paraíba rivers of the states of Alagoas and Pernambuco [25]. Some of these springs on the Alagoas side supply two large water reservoirs, with a total capacity of 9,711,000 m³, which distribute water to six regional municipalities [26].

The resilience of the primary forest, the “Reserva Biológica de Pedra Talhada”, is a critical source of drinking water for over a million people. Yet, the forest is endangered due to isolation in the midst of pastures, lacking genetic contributions and connections to other forest massifs. The area suffers from the consequences of ill development, such as extensive deforestation for sugarcane cultivation and pastureland for cattle ranching, and relies primarily on an agricultural economy.

2.2. Local Context

The northeastern region of Brazil presents a complex social makeup. Within its rural areas is a combination of historical legacies, economic challenges, and cultural diversity, with each community offering unique characteristics and features. Most of the current social structure is characterized by closely knit communities, often formed by families who own and work small farms passed down through generations. These small-scale family farming communities predominantly focus on crops like fruits and vegetables, sugarcane, and cotton and rely on mutual assistance and collaboration.

Community life is vibrant, with festivals, religious events, and local celebrations that bring people together, fostering a sense of unity. In the daily lives of these communities, social interactions hold paramount significance. However, these rural areas face numerous challenges, like poverty and limited access to education, healthcare, and infrastructure, which contribute to social inequality. Gender disparity is still exacerbated by prevailing cultural norms and beliefs, impeding educational opportunities for girls.

Moreover, villagers often struggle with inadequate medical care due to clinics being located in distant urban centers, leading to untreated illnesses and a lack of preventive measures. Thus, economic hardships often prompt migration, particularly among the younger population seeking better opportunities in urban areas, altering the demographics and social dynamics of these rural communities. Government support and initiatives are crucial for the development of these regions.

3. Methodology

Over several decades, a range of initiatives were undertaken, including the construction of schools, pedagogical programs, youth clubs, radio programs, professional skills development workshops, reforestation projects, health centers, family agriculture and agroforestry projects, meliponiculture, animal welfare initiatives, scientist engagement, and publication of educational books. Thus, this study adopts a retrospective analysis approach, drawing on historical data, reports, and documentation related to the conservation education initiatives carried out in the Pedra Talhada forest. The information includes the establishment dates, key activities, participants, and outcomes of each strategy. The data are organized categorically and, when possible, chronologically to understand the progression of efforts over the decades. The large number of activities mentioned above were undertaken at different times and in various situations, always with discussions around the existing local knowledge concerning the environmental issues to be raised. However, it is important to note the particularity of Studer’s methodology.

In understanding the local communities’ perceptions of the forest in the northeastern region of Brazil and the methodology used to research these perceptions, it is vital to recognize the intricate social, economic, and cultural dynamics at play in the region. Preserving natural resources and ecosystems is essential for sustainable development, but it is equally important to align conservation efforts with the needs and beliefs of the local communities. Imposing external perspectives or educational programs without considering these local perspectives risks neglecting the communities’ unique needs and knowledge. Thus, let us dive into the development of Studer’s methodology.

3.1. Life Methodology—Anchoring Actions in the Preservation of the Ecosystem and the Community’s Well-Being

Notably, the methodology chronicled in this paper evolved progressively over four decades and was driven by a momentous decision. The approach outlined in this exposition is inherently intricate owing to its atypical genesis. It began incrementally with a unique sequence of events and observations and eventually developed into a dialogic-based methodology catalyzing successive project inceptions.

The origin of this methodology can be traced back to a pivotal moment when Studer’s professor highlighted the urgency of studying the *Anumara forbesi* due to the imminent threat of the extinction of the Pedra Talhada forest within a decade. Studer realized that preserving the forest was imperative to safeguard the species she was studying. This critical juncture birthed what is herein referred to as the “Life Methodology”, anchoring actions in the preservation of the ecosystem and the community’s well-being.

The framework rooted in the decision to set aside ornithological pursuits to champion forest conservation led to various encounters with locals like José Dias Barbosa (Zé Preto, Figure 2), among others, who helped Studer find nests during her ornithological exploration. Subsequently, Studer’s methodology germinated within the organic milieu of dialogues initiated in both the field and within the homes of locals. Long conversations over coffee and cachaça revealed the community’s adversities, notably the profound educational deficiencies, especially for young girls.



Figure 2. Anita Studer with José Dias Barbosa (Zé Preto) surrounded by the destruction of the Pedra Talhada forest (1985) (© Nordesta Collection).

These encounters also unveiled the impoverished circumstances and undeniable lack of environmental and academic awareness within the community. The absence of educational prospects casting a shadow on their future became the cornerstone for understanding community needs and creating projects to address them.

However, despite the prevailing inadequacy of formal education, community members exhibited an innate awareness of bird nest locations, catalyzing a collective fascination and eagerness to share their knowledge, and a spontaneous convergence of individuals from distant locales to showcase birds and nests was formed. One man traveled from

a neighboring state on horseback for 15 km to show Studer a bird. These interactions established enduring connections with individuals across socioeconomic strata; Studer bridged the gap between the affluent and underprivileged. She shifted the paradigm by aiming to find solutions that catered to the entire community, breaking down the historical divide through inclusive planning and decision-making processes. The enduring hallmark of Studer's approach lies in the continual refinement of her projects through ongoing dialogue and engagement with local families, allowing the identification of community needs and subsequent development of projects to address these requirements.

Thus, Studer's approach led to a more comprehensive understanding of the communities' perceptions of the forest and ensured conservation efforts aligned with their needs and beliefs. Acknowledging and valuing the local knowledge and incorporating it into the decision-making process prevented the imposition of external worldviews, thus fostering a more holistic and sustainable approach to conservation and community development.

3.2. Summary of Methodology Used in This Case Study

3.2.1. Contextual Background

The case study briefly overviews the establishment of the Pedra Talhada State Park in 1985 and its subsequent transformation into the Pedra Talhada Biological Reserve in 1989. This background sets the stage for understanding the conservation efforts discussed in the following sections.

3.2.2. Categories of Actions and Results

The case study identifies and presents several categories of actions implemented in the region, along with the corresponding results. These categories are discussed in separate sections, allowing a detailed analysis of each initiative. The categories include the following:

- I. Construction and renovation of schools;
- II. Pedagogical programs;
- III. Youth clubs;
- IV. Radio programs;
- V. Professional skills: workshops and ateliers;
- VI. Health centers;
- VII. Reforestation project;
- VIII. Meliponiculture with native bee species;
- IX. Family agriculture and agroforestry projects;
- X. Publication of educational books;
- XI. Animal welfare initiatives.

3.2.3. Ethical Considerations

Throughout the unfolding of these projects, ethical considerations and participant confidentiality were maintained. All participants were required to provide consent for their participation, and their identities were protected. Moreover, in the photographs provided in this text, the faces of participants have been blurred for confidentiality, except for those individuals who explicitly signed consent forms allowing their images to be used.

3.2.4. Funding

Most of the funds for the actions over these four decades came from impassioned private sponsors and members who believed in our projects. The funding played a crucial role in the success of these CE initiatives, and efforts to secure funding have been ongoing. Sustainable financial resources are necessary to sustain and expand any work, and funding availability remains a critical issue in successfully implementing CE initiatives. The Pedra Talhada forest, situated within the Pernambuco Endemism Center, remains under constant threat due to continued deforestation for intensive cattle ranching, poaching for animal

and plant trading, and urban expansion and industrialization in the surrounding areas, leading to its continued isolation.

The future holds tremendous challenges as actions must continue to increase wooded areas around the reserve to reduce the impact of its current isolation and guarantee the survival and expansion of its biodiversity. It is also imperative to improve projects for the local populations, such as the creation of economic activities that do not compromise the conservation of the environment, as well as to strengthen dialogue with the local authorities to raise awareness of the environment and preservation of the surrounding forest fragments to better protect the species and water resources it shelters.

Therefore, funding must continue to sustain the CE strategies discussed in this case study to ensure long-term conservation efforts toward protecting and expanding this crucial hotspot.

4. The Pedra Talhada Forest and a Short History of Different Approaches for Its Protection

The initiative for CE work came from ornithologist Anita Studer during the first half of the 1980s. She did not set out to conduct educational research. Her goal was, first and foremost, to save the Pedra Talhada forest. Thus, all the steps taken over the decades and the large number of activities were carried out at different times and in various situations.

Studer arrived in the region for ornithological research, but when she saw the Pedra Talhada forest's destruction rate, her priority became its protection. In her mission to accomplish this goal, she verified that very few landowners were interested in protecting the forest remnants. Only a few landowners protected some areas on their farms for hunting purposes and water spring maintenance. Aside from these isolated cases, the region's farmers and the population in both urban and rural areas showed no interest in forest conservation.

In the 1980s, from the economic perspective, in their opinion, trees had no value but cattle did. The argument was that pasturelands were more valuable than forests because it took hard labor to prepare them to initiate cattle breeding, from which meat could be sold to provide them with their income. Consequently, the Pedra Talhada forest was experiencing an expeditious deforestation process. Inhabitants were chopping down or setting fires to increase grazing areas. Oxcarts loaded with tree trunks were leaving the forest daily [27]. Trees were even considered enemies because they infringed on pastureland. Thus, the obstacles were many, and Studer realized that the forest could only be preserved with the local population's support.

Thus, after seeing the lack of interest in environmental issues and precarious living conditions among the population, Studer put her ornithological research on hold and sought to incorporate the local communities' perception and interest in the importance of the forest. She dedicated herself entirely to the search for mechanisms that would make the legal protection of the forest possible and allow the implementation of a series of activities aimed at education and awareness of the population. To achieve this goal, Studer first approached the local inhabitants, landowners, municipalities, states, and federal authorities, which yielded no results. She then took another approach, deciding to use the argument of water, which is vital to both the rich and poor given this northeastern region is repeatedly exposed to severe droughts and is known as a drought polygon; thus, water is a treasure. The original two Carangueja reservoirs, which collected water from the 169 Pedra Talhada forest springs, provided water to approximately 300,000 people. Hence, by using the argument of water, Studer succeeded in procuring public meetings with mayors, city councilors, landowners, and agricultural workers' unions.

The first step was taken in 1985 when she met Frederico Maia and Marcelo Vasconcelos Lima, the then mayor and deputy mayor of Quebrangulo, respectively. They told Studer that raising awareness of forest conservation among the population given their precarious social and economic situation could be complex for their political reputation. Studer realized that something had to be done for the community. Having noticed that the

school building of the Fazenda Pedra Talhada was in ruins, Studer made a proposal to Frederico Maia: she would commit to rebuilding the school and, in exchange, he would contact the mayors of all the surrounding municipalities directly supplied with the water originating from the Pedra Talhada massif. He would initiate a collective petition asking for the safeguarding of the forest, addressed to the governor of the state of Alagoas, Divaldo Suruagy. This agreement between Studer and Maia was made via a gentleman's handshake [7,11].

For Studer, the first step was to create conditions to collect monetary resources to rebuild the burnt-down school. On 15 May 1985, Studer created the Nordesta Reforestation and Education Association, whose objective was to finance projects for the population of Quebrangulo, who in turn should protect their forest (Figure 3).

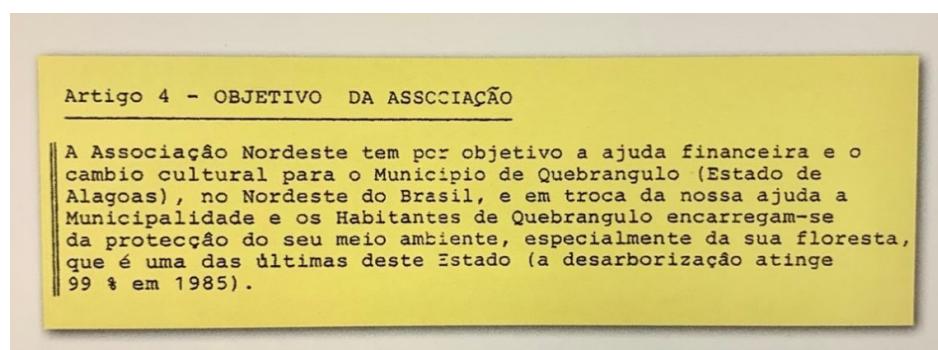


Figure 3. Extract of legal status, 15 May 1985 (© Nordesta Collection).

Maia collected the signatures of all seven municipalities benefiting from Pedra Talhada's water springs. As a result, on 18 August 1985, the school was built, and Governor Divaldo Suruagy signed decree N° 6551, instituting the creation of the Pedra Talhada State Park.

During this same period, the first reforestation project was implemented by Nordesta. In 1988, the first tree nursery was created with native species of the Atlantic Forest, aiming to reconnect the isolated forest fragments and create avenues for the circulation for fauna and flora to enable genetic exchanges. At the same time, the forest corridors would recompose and protect areas of springs and riverbanks against erosion. Thus, other social actions ensued, such as the construction of schools, health centers, and workshops for vocational education and training.

5. Results

The following results highlight the implementation and outcomes of CE strategies employed in the Pedra Talhada forest, situated on the border of Alagoas and Pernambuco states, Brazil. Given the first steps toward the protection of the Pedra Talhada forest, the identification of the primary problems, and the environmental and social realities of the municipalities and villages surrounding the forest, various capacity development initiatives took place, including the construction of schools, pedagogical programs, youth clubs, radio broadcasts, professional skills workshops, health centers, reforestation projects, meliponiculture, agroforestry practices, educational publications, and animal welfare campaigns.

We present the conservation strategies implemented in and around the Pedra Talhada forest by individualizing the activities carried out with an emphasis on conservation education for sustainable biodiversity conservation and meeting the Sustainable Development Goals. Several categories of actions had positive and sustainable results.

The effectiveness of these strategies is examined in the context of meeting the goals and targets outlined in the Kunming–Montreal Global Biodiversity Framework (GBF) in Table 1, where we present the results as they align with the GBF set out at the UN Biodiversity Conference 2022. Table 1 features the projects numbered with Roman numerals I to XI, each

uniquely represented by a different color. This categorization aids in the clarity and ease of understanding of the alignment between these projects (I to XI) and the specific goals and targets outlined by the Convention on Biological Diversity (CBD). The purpose is to showcase how each project contributes to meeting the goals and targets set by the CBD. The CBD goals and targets can be accessed here: <https://www.cbd.int/article/cop15-final-text-kunming-montreal-gbf-221222> (accessed on 25 August 2023).

Table 1. How our projects meet the Convention on Biological Diversity framework.

CBD Framework's 4 Long-Term Goals and 23 Targets															
PROJECTS	Goals														
	I. Construction and renovation of schools														
		II. Pedagogical programs													
		III. Youth clubs													
			IV. Radio programs												
			V. Professional skills: workshops and ateliers												
				VI. Health centers											
				VII. Reforestation project											
					VIII. Meliponiculture with native bee species										
					IX. Family agriculture and agroforestry project										
						X. Publication of educational books									
						XI. Animal welfare initiatives									
GOALS															
Goal A	I		III	IV	V		VII	VIII	IX	X	XI				
Goal B	I	II	III	IV	V	VI	VII	VIII	IX	X					
Goal C	I	II	III	IV	V	VI	VII	VIII	IX	X					
Goal D	I	II	III	IV	V	VI	VII	VIII	IX	X	XI				
ACTION-ORIENTED TARGETS															
Reducing threats to biodiversity															
Target 1.	I		III	IV			VII	VIII	IX	X	XI				
Target 2.	I		III	IV			VII	VIII	IX	X	XI				
Target 3.	I		III	IV	V		VII	VIII	IX	X	XI				
Target 4.	I		III	IV	V		VII	VIII	IX	X	XI				
Target 5.	I			IV			VII	VIII	IX	X	XI				
Target 6.				IV			VII	VIII	IX	X					
Target 7.				IV			VII	VIII	IX	X					
Target 8.				IV			VII	VIII	IX	X					
Meeting people's needs through sustainable use and benefit sharing															
Target 9.	I	II		IV	V	VI	VII	VIII	IX	X	XI				
Target 10.		II		IV	V	VI	VII	VIII	IX	X					
Target 11.	I	II		IV	V	VI	VII	VIII	IX	X					
Target 12.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI				
Target 13.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI				
Tools and solutions for implementation and mainstreaming															
Target 14.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI				
Target 15.			III	IV	V	VI	VII	VIII	IX	X					
Target 16.	I		III	IV	V	VI	VII	VIII	IX	X					
Target 17.				IV		VI	VII	VIII	IX	X					
Target 18.		II		IV		VI	VII	VIII	IX	X	XI				
Target 19.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI				
Target 20.		II	III	IV	V	VI	VII	VIII	IX	X	XI				
Target 21.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI				
Target 22.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI				
Target 23.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI				

5.1. I. Construction and Renovation of Schools

The establishment of the first school, Enrico Monfrini, on the border of the Pedra Talhada forest in 1987 was the cornerstone for the subsequent construction of Alethéia, the second school, in 2012. The Enrico Monfrini school resulted from the agreement between Studer and Maia to give the local children of Pedra Talhada access to education in exchange for the population's involvement in forest protection (Figure 4).



Figure 4. (a) Anita Studer and Maia collaborating (© Nordesta Collection). Enrico Monfrini school before (b) and (c) after (© Nordesta Collection).

Through the community capacity development of school renovation and construction, a base was established for education. An integrated curriculum with an interdisciplinary approach was adopted, where conservation education was included in all the subjects and lectures provided. Information, knowledge, and raising students' awareness of the importance of the Pedra Talhada forest was the fundamental goal. Pedagogical programs, educational films, and theatrical performances related to the environment also took place for community awareness and engagement. These actions aimed to educate students and teachers and contributed to capacity development by enhancing their understanding of environmental issues and conservation principles, approaches, and techniques.

Thus, Targets 1–4 were addressed through participatory integrated biodiversity planning, effective conservation and management of the protected area, and ecosystem restoration. Actions and dialogue to halt species extinction and maintain genetic diversity were ongoing. Hence, these initiatives significantly contributed to achieving Goal A and its associated targets. These actions also touched on Goals B, C, and D and some of their associated targets by securing the means of implementation by enhancing nature's contributions to people, ensuring equitable access to benefits, and mainstreaming biodiversity considerations.

5.2. II. Pedagogical Programs

Various activities were developed starting in 1987 to ensure consistency in awareness of school children, university students, teachers, and the general population. Writing and maquette contests were organized to stimulate students' creativity and perception. The themes covered the importance of water, trees, and forests, such as "The tree, my friend" and "The water in my city, its origin, and its destination".

Lectures addressing nature preservation were given by Nordesta's collaborators, like researchers, technicians, and university students, who live in the region and know the forest's potential and the reality of the surrounding population. Also, scientists from all over the world came to conduct research in the forest and offered lectures. Many lectures were accompanied by musical performances focused on ecological themes. Some examples include the musicians Deusamar Santos and Adauto Carvalho (State of Maranhão) and the street theater group MaMaFele (Geneva, Switzerland), who collaborated and offered all the communities and schools around Pedra Talhada musical and theatrical performances on the preservation of water and trees (Figure 5).



Figure 5. (a) The street theatre group MaMaFele (© Nordesta Collection). (b) Deusamar Santos and Adauto Carvalho performing (© Nordesta Collection). (c) A lecture presented by Marcelo Cardoso (© Nordesta Collection).

An audience of approximately 18,700 municipal and state school students of all ages attended the lectures. Among them, in the state of Alagoas, ±4567 were from Quebrangulo, ±3000 from Paulo Jacinto, and 120 were from Chã Preta. In the state of Pernambuco, ±4930 attended from Correntes and ±5890 from Lagoa do Ouro.

The effectiveness of combining these awareness creation actions with pedagogical programs contributed enormously to engaging local communities in conserving the forest and its biodiversity. For example, reforestation and agriculture to restore ecosystem functions were brought to the forefront and aligned with Goals B, C, and D, ensuring sustainable use of biodiversity and enhancing nature's contributions to people. Thus, by meeting people's needs through sustainable and equitable use and benefit sharing, Targets 9–13 were addressed. Targets 14–23 were also partially met by integrating conservation education into policies, regulations, and planning processes for knowledge transfer, such as adopting an integrated curriculum with an interdisciplinary approach where conservation education was the foundation of all the subjects and lectures provided.

Hence, the success of these strategies underscores the importance of comprehensive conservation education approaches in achieving sustainable biodiversity conservation objectives by mainstreaming biodiversity considerations and securing the means of implementation.

5.3. III. Youth Clubs

5.3.1. Amigos das Árvores

In the beginning, Studer was alone and in search of ideas to protect the forest. One certainty she had was the need to find people who could be interested in the forest, so she devised a plan:

1. Target young people (children–teens or adults).
2. Target people who were in some way benefitting from the forest, including those who had a link in some way even without knowing it.
3. Reach as many areas as possible from where future multiplier effects could arise (like villages and rural communities benefitting from water flowing from Pedra Talhada).

Once these areas were chosen, she created a program:

- a. Establish a hydrological map of the sources with their destinations (rivers, dams, and their communities).
- b. Form local clubs, each of at least 10 participants.
- c. Choose a practical activity for them, i.e., create a tree nursery for 100 tree saplings of at least 10 local native species. Visit them regularly and compose a jury at the end of the first year. Give a prize to the three best tree nurseries (computers) and a smaller prize for each other club (pedagogical material).
- d. Visit all the communities and meet people through events like conferences on the environment, musicals, or other events. Identify young people who could be interested and expose her plan.

Finally, in 1988, a movement with young people was created in the rural areas around the Pedra Talhada forest. The departing point was that they all shared the direct daily use of Pedra Talhada's water. Everyone became actively busy with planting their tree nursery. Then, at the end of the first year, a jury of three people visited every club and established an evaluation based on several criteria. An event was organized in the town of Quebrangulo with media coverage, during which every club leader made a speech. Finally, the prizes were distributed.

This movement later resulted in the creation of 27 youth clubs named "Amigos das Árvores". Each received material and information for setting up an ecological campaign in their area. They received the task of establishing their own tree nursery in view of participating in tree planting activities. This program continued until 2008, when they became adults, and the movement took its roots with the following generation, creating a satisfactory multiplier effect. Some of the adults continued with Nordesta, either voluntarily or professionally.

5.3.2. Advogados da Natureza

In 2013, another movement, "Advogados da Natureza", was created in the urban area of Quebrangulo with the purpose of defending biodiversity by giving voice to fauna and flora. The children that comprised the Advogados da Natureza came from the edge of what is now called the "Swiss Forest" that adjoins a row of houses along its entire length on the eastern edge of Quebrangulo. It is an area inhabited by impoverished families.

At the time, the commune had not yet organized systematic garbage collection, and some inhabitants had gotten into the habit of dumping their garbage in the Swiss Forest. Once a month, the Nordesta team would collect the trash and take it to the landfill, some 3 km away. Little by little, some children and teens spontaneously came to help. When Studer noticed this phenomenon, she started talking to them and realized they were a bit lost, hanging around in the streets and avoiding school.

With the help of a few friends, Studer invited these kids over for a weekend meal and a chat. She noticed they were very curious to learn about the nuisance of garbage, where their water came from, and the sad fate of animals mistreated in the village streets. In short, one word led to another, and these encounters with meals and dialogues became a regular occurrence. They grew into educational events by distributing teaching materials based on various environmental themes and offering educational support. The name "Advogados da Natureza" was chosen unanimously. It means that these youths are the voice that defends those who do not have one, namely, trees and animals. The slogan is "My voice for trees and animals".

Over time, the group has grown, and today it is relatively well structured, with 50 members aged 6 to 18. Moreover, gender equality is respected, giving equal opportunity to everyone. This group of children gather each weekend under the supervision of Marcio José Soares Alves and Sonia M. de Lima Araújo. They receive educational reinforcement and participate in field trips comprising various ecological activities (Figure 6).



Figure 6. (a) An ecological march (© Nordesta Collection). (b) Nature conservation education with Anita Silva (© Nordesta Collection). (c) Children planting seeds in the tree nursery (© Nordesta Collection).

These youth clubs were created to engage other young people in the project's context and motivate them to value knowledge, especially about the potential of studying the richness of the Pedra Talhada forest and the need for its protection. School competitions with essays and models on the importance of trees and water were promoted in events such as Water Week, Environment Day, and Tree Day. Promotional materials, such as posters, T-shirts, and caps, were produced and distributed to youth and the public in general. Furthermore, engaging and training young people in ecological issues through capacity-building conservation activities, lectures, organic vegetable gardens, tree planting, nursery management, and field visits led to the creation of two football clubs in 2020, feminine and masculine, to broaden the youth's social involvement. Thus, these youth club initiatives met Goals A, C, and D, addressing Targets 1–4, 12–16, and 19–23.

5.4. IV. Radio Programs

Starting in 2000, weekly radio programs were broadcast to disseminate information, announcements, and interviews regarding the protection of the Pedra Talhada forest, reaching local communities in Quebrangulo, the state of Alagoas, and Lagoa do Ouro, the state of Pernambuco. These weekly one-hour broadcasts on local radio stations took place over several years. Our multiplier agents, Leandro Ferreira de Melo, Michele Ramalho da Silva, William Ryam Barros Tenório, and Cleydeanne E. H. de Oliveira, broadcasted information and announcements about environmental issues and the protection of the Pedra Talhada forest (Figure 7). There were also interviews and popular songs with ecological messages about its significance as a refuge for the fauna and flora of the Atlantic Forest and its importance as a water source for the region. The programs were organized to empower individuals with the necessary knowledge and awareness to actively participate in conservation efforts and to ensure the long-term effectiveness and sustainability of conservation education in the Pedra Talhada forest. The continuation of the weekly radio programs to disseminate information and announcements about the protection of the Pedra Talhada forest addresses Goals A–D and their associated targets in the sense that the dissemination and mainstreaming of conservation topics ensure the implementation of participatory integrated biodiversity planning, ecosystem restoration, effective conservation education, and awareness raising of what can be done to manage and protect threatened biodiversity.

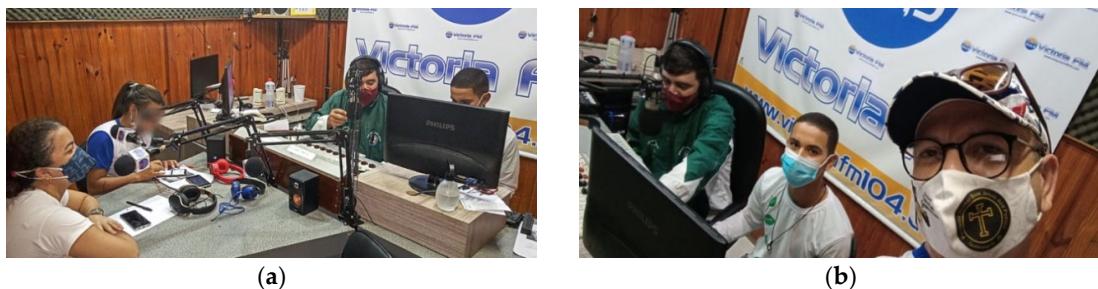


Figure 7. (a,b) Radio programs live at the station with our multiplier agents broadcasting information and announcements about protecting the Pedra Talhada forest (© Nordesta Collection).

5.5. V. Professional Skills: Workshops and Ateliers

To raise awareness about the need to conserve the Pedra Talhada forest, various vocational courses were offered to combat illiteracy and provide specialized skills to the youth, focusing on ecological issues and practical field visits for a self-sustainable future.

In our forest research center, between 1988 and 2004, several workshops were established and attended by approximately 100 young people of both genders.

The Girassol group was created in 1989 when we adopted 20 young illiterate boys living under precarious circumstances in the local region (Figure 8a). They were integrated into our forest research center and cared for. Over 10 years, they received accommodation,

food, healthcare, schooling, and professional training (Figure 8b). This group was followed by a second group of 20 boys who stayed with Nordesta for another 10 years.



Figure 8. (a) Girassol boys (© Nordesta Collection). (b) Till Rabus and students in the carpentry workshop (© Nordesta Collection). (c) “The way to school for girls” (© Nordesta Collection).

During all these periods, we trained all these boys in ecological issues through classroom-based lectures, setting up organic vegetable gardens, and frequent field and forest visits.

In 1999, a scholarship program was created. Initially, the scholarship sponsored “The Way to School for Girls” (Figure 8c). Later, it was extended, and nowadays, these scholarships support new generations of both genders. In 2005, the workshops began to function under municipal responsibility.

The workshops and ateliers enhanced the integrity and resilience of these youth and ensured sustainable, fair benefit sharing and the implementation of strategies for raising new and additional resources. Thus, the success of these capacity development initiatives underscores the importance of comprehensive CE approaches in achieving biodiversity conservation objectives. Through conservation-based vocational workshops and ateliers like these, Targets 3–4, 9–13, 14–16, and 19–23 were addressed, touching on Goals A, B, C, and D.

5.6. VI. Health Centers

During regular visits with locals and families, Studer noticed that when an individual was injured or fell ill, most families would use the distilled spirit made from sugarcane juice called cachaça as medicine. For example, they would rub cachaça on their wounds and pains, drink it, and pray for the injury or ailment to disappear. After extensive dialogue with the community, in 1997, two healthcare centers were built in the rural areas of Quebrangulo to contribute to the population’s health and well-being. Doctors and dentists tended to residents of all ages equally, and each visitor (patient) received a leaflet on nature conservation issues. One of these health centers still exists today, and hundreds of people have been treated over the years (Figure 9).



Figure 9. (a–c) Temporary and permanent medical staff with some patients (© Nordesta Collection).

The sustainable development of these healthcare centers significantly contributed to inclusive and sustainable urbanization and the provision of ecosystem services. Divulging leaflets on the local conservation issues mainstreamed the potential for sustainable use of biodiversity, enhancing integrity and connectivity to green and blue spaces and improving the quality of the area. Meeting people's needs through improving the population's health and well-being aligned with Goals B, C, and D and met various targets, notably Target 12. However, sustained financial resources and ongoing capacity-building efforts are crucial to ensure the long-term implementation and expansion of this project.

5.7. VII. Reforestation Project

When Studer began to plant her first trees, she had no model in mind. She and the locals who voluntarily joined her in her efforts at the time put their heads together and started planting seeds like one would plant flowers or cabbage. Finally, through trial, error, and observation, they discovered that each seed had unique needs and processes. For some seeds, it took seven years to discover their germination process. Thus, over time, the construction of a tree nursery was inevitable.

Since the first tree nursery was installed in 1988, Nordesta has planted 3,000,000 native trees around the Pedra Talhada forest reserve in the form of forest corridors to connect isolated forest fragments. Through the years, the tree nursery has been improved and enlarged (Figure 10). Since 2022, we have instituted a tree nursery that contains 300,000 seedlings from 100 native tree species. Some of the local trees are endangered according to the IUCN list (<https://www.iucnredlist.org/> (accessed on 26 April 2023)). We have dedicated special attention to them and collected seeds. Currently, 21 of these endangered species, including the newly discovered *Dipteryx hermetopascoaliana* [28], are growing in our tree nursery to be planted in the near future.



Figure 10. (a) First tree nursery (1989) (© Nordesta Collection). (b) Nursery team in the new nursery (2022) (© Nordesta Collection). (c) Aerial shot of the current tree nursery (© Rolex \\ Diego Bresani 2021).

Along with reforestation and involving the community in this practical activity, this project's development set an example. It brought information to the neighboring residents and landowners, spreading the idea of planting trees and building forest seedling nurseries. It resulted in a multiplier effect across Brazil, where people in 14 states are currently planting trees.

The goal of reforestation is not only to connect isolated forest fragments through planting ecological corridors but also to create awareness among populations of various age groups and social classes (Figure 11). We, therefore, believe that the CE strategies for reforestation employed in the Pedra Talhada forest effectively addressed all the goals and targets outlined in the Kunming–Montreal Global Biodiversity Framework. However, continued collaboration among stakeholders, including indigenous peoples, local communities, and policymakers, is necessary to advance the goals and protect threatened ecosystems like the Pedra Talhada forest.



Figure 11. (a) Seed storage room with Luis Batista de Freitas and Flavio dos Santos Pereira (© Nordesta Collection). (b) José Rodrigo de Araujo Guimarães planting with children (© Nordesta Collection). (c) The tree nursery team (© Nordesta Collection).

5.8. VIII. Meliponiculture with Native Bee Species

Through regular visits to small farmers' residences and local dwellings, as well as encountering inhabitants engaged in tree sawing, Studer discovered a tradition that was well established in the Pedra Talhada forest, which consisted of cutting down a tree and sawing the segment sheltering a beehive to hang in front of their houses. Studer discerned that this tradition was harmful to the bees and the trees and that numerous trees were being felled solely for the extraction of beehives for honey production. The most sought-after bees were the *Melipona*, the native stingless bees of the *uruçu* species *Melipona* sp., and trigones of the *jataí* species, *Tetragonisca* sp. [11]. Regrettably, the locals would often harvest the honey and subsequently dismantle the hives, resulting in the demise of the resident bee populations. Therefore, the Nordesta Association created a project to offer specially constructed bee-friendly hives for bee-friendly beekeeping and breeding from which honey can be extracted without causing harm to the colony (Figure 12a,b). Moreover, this project also averted the need for further hive removals from the forest due to the ability to divide and multiply bees harmlessly.



Figure 12. (a) A meliponiculture educational event, 2017 (© Nordesta Collection). (b) New beehives on their way to families (© Nordesta Collection). (c) A bee honey processing and production center (© Nordesta Collection).

Since 2002, Nordesta's conservation education program for the keeping of native stingless bees has been flourishing. The main objective is to encourage the breeding of native stingless bees from the *Melipona* and *Trigona* families to improve the pollination of trees and all other kinds of flowering vegetation and generate alternative income for local farmers and families. In addition, a bee honey processing and production center, The Honey House, was built (2013–2014) to support beekeepers in the production and commercialization phases (Figure 12c).

Beekeeping courses and hive boxes are regularly provided to inhabitants so that small local farmers and future beekeeper families who acquire meliponiculture techniques and knowledge can generate alternative income. Beekeeping education creates awareness of the importance of bees and shows how both humans and nature benefit from each other.

As the benefitting families become more conscious of the source of their income, they are more willing to preserve the species' natural habitats, like trees.

The CE strategies implemented in the region and their effectiveness in achieving the goals of forest preservation, community engagement, and biodiversity conservation addressed Goals A–D and contributed to all 23 targets in the CBD framework. This project continues throughout 14 states in Brazil.

5.9. IX. Family Agriculture and Agroforestry Project

Since 2016, support has been provided to small local farmers in adopting sustainable agricultural practices, diversifying crops, and implementing agroforestry systems. We have been approaching small local farmers to assist them in growing better crops by encouraging them to plant more diversity, make soil turnovers, and plant tree corridors between their plots (Figure 13a). We also help them to grow organic produce and to refrain from using chemicals and pesticides (Figure 13b). These productive areas sustain the stakeholders and their families (Figure 13c). Conservation education plays a vital role in these projects in promoting environmental awareness, fostering sustainable behaviors, and protecting natural resources. The strategies enhance the integrity and resilience of ecosystems, promote sustainable use of biodiversity, ensure fair benefit sharing, and secure means of implementation.



Figure 13. (a) Aerial view of the agroforestry project (© Nordesta Collection). (b) Mané Nazario planting a tree on his farm (© Nordesta Collection). (c) Agroforestry families and their harvest (© Nordesta Collection).

Thus, Targets 1–23 were addressed, especially when considering sustainable management of agriculture and forestry, restoration of ecosystem functions, and equitable benefit sharing. These actions align with Goals A, B, C, and D and aim to ensure sustainable use of biodiversity and enhance nature's contributions to people, planning processes, sustainable consumption patterns, biosafety measures, elimination of harmful incentives, financial resource mobilization, technology transfer, and inclusive decision making.

5.10. X. Publication of Educational Books

Scientific research conducted in the Pedra Talhada forest resulted in the publication of “Biodiversity of Pedra Talhada Reserve” in 2015, followed by four volumes of children’s comic books between 2015 and 2019 focused on forest conservation.

Between 1985 and 2015, scientists from various research disciplines conducted academic fieldwork in the Pedra Talhada forest. The research accumulated a considerable amount of new information that young students could use to protect the forest and its biodiversity.

Therefore, Studer, in collaboration with scientists L. Nusbaumer, Ph.D., and R. Spichiger, Ph.D., published all the research; Nordesta coordinated this project. The collaboration of 75 researchers and 200 specialists from Brazil and outside gave birth to the book “Biodiversity of Pedra Talhada Reserve” in Portuguese and French [11]. Around 2000 copies were distributed to schools and universities in both the states of Alagoas and Pernambuco. The book covers the topics of geology, geomorphology, hydrography, fauna, and flora. A pdf

version is freely available online at <https://nordesta.org/publications/?lang=en> (accessed on 14 June 2023). As this book was destined for higher education and scientific disclosure, we decided to create something accessible to children. Thus, between 2015 and 2019, four volumes of children's comic books were published in various languages, all based on the theme of saving forests and biodiversity (www.lililafourmi.com/) (accessed on 14 June 2023)).

Simultaneously, under the sponsorship and coordination of the Nordesta Association, research was carried out by several researchers from Brazil and abroad to obtain knowledge that would substantiate the arguments for transforming the Pedra Talhada forest into a legally protected area. Thus, Goals A, B, C, and D and their accompanying targets can be highlighted as they were all addressed during this process.

5.11. XI. Animal Welfare Initiatives

During the process of protecting the Pedra Talhada forest, Studer noticed the need for the protection and care of animals. Through Nordesta, she inspired initiatives aimed at creating awareness around animal welfare. Media campaigns, conferences, posters, and animal welfare education programs were organized to raise awareness of animal suffering among the population and schoolchildren in particular. The topics covered were rescuing, safeguarding, providing sustenance and healthcare, and sheltering animals that have been hunted illegally, mistreated, or abandoned, whether domestic or wild. A veterinary team worked hand in hand with Nordesta to aid in divulging knowledge around topics like why spaying and neutering and vaccines are essential for the well-being of an entire community. Lectures on the role both wild and domestic animals play in our lives were given so that the population was informed about responsible pet ownership and the consequences of neglect or abuse.

These animal protection initiatives aimed to improve the lives of domestic and wild animals in the poverty-stricken areas surrounding the Pedra Talhada forest, and through the education of the population to create a more compassionate and responsible community, these actions helped reduce the number of stray animals and prevented dangerous and unwanted litters. These initiatives helped reduce threats to biodiversity and significantly contributed to achieving Goals A and D and various associated targets.

6. Evolving from State Park to Biological Reserve

An essential first step was taken when the Pedra Talhada became a state park on 18 August 1985. However, more than 30% of the forest area was located outside the park in the neighboring state of Pernambuco. Only a federal reserve status could protect the entire Pedra Talhada. Thus, in December 1985, Anita Studer appealed again to the authorities of Quebrangulo, Maceió, and Brasília to ask for the creation of a federal reserve.

Brazilian and European specialists in various fields came together to support its case by drawing up an inventory (location, geomorphology, geology, climatology, hydrography, fauna, and flora) of the territory of the future reserve to demonstrate the interest in transforming the forest into a biological reserve.

In July 1989, during Studer's research on the characterization of the Pedra Talhada massif, Professor Domicio Alves Cordeiro of the Federal Rural University of Recife became aware of this cause. He met with Studer and accompanied her to Brasília, where, on 9 August 1989, they met the President of IBAMA, Mr. Fernando Mesquita, and the Director of Ecosystems, Mr. Célio Carvalho Valle. Anita Studer presented the results of her actions and officially requested that the whole forest of Pedra Talhada (including the portion in the state of Pernambuco) be protected by creating a federal reserve.

The response was positive, and the principle of creating a federal reserve, including the state park and the neighboring forests, was accepted. The mandate was given to IBAMA/ITERAL (Instituto de Terras e Reforma Agrária de Alagoas) and Nordesta to carry out a topographic survey defining a perimeter as large as possible, including these forest areas, to choose a name, and to establish an agreement by which Nordesta undertook to finance this work.

On Wednesday, 13 December 1989, presidential decree N° 98,524 ordered the creation of the Federal Biological Reserve of Pedra Talhada. This status confers to this reserve the most important degree of conservation: any entry is subject to an authorization issued by its managers.

The search for financial resources and the hard work of convincing the population and various political and environmental sectors over decades continue to bring results. Most of the actors mentioned above continue their actions and research with discussions around local knowledge concerning environmental issues in other states within Brazil.

7. Discussion

The conservation education strategies that took place over four decades were motivated by the quest to reverse the imminent destruction of the Pedra Talhada forest on the border of the states of Alagoas and Pernambuco. When analyzing the outcomes, conservation education, capacity building, capacity development, and community capacity building all played a vital role in promoting environmental awareness, fostering sustainable behaviors, and protecting biodiversity and natural resources [29].

After being encouraged to prioritize their basic needs, communities came together and collaborated on activities aligned with Sustainable Development Goals, such as protecting soil, planting trees, and safeguarding water resources. The goal of these efforts was to benefit everyone in the community. Local traditional knowledge was usually handed down orally; thus, getting together and dialoguing was the gateway and bridge between researchers, their findings, local communities, and decision makers [30]. At every stage, effective communication was imperative for the communities to become aware of what needed to happen [31]. The strategies employed seem similar to the first documented CE initiatives implemented in the United States in the 1930s and have since become integral to environmental education worldwide [32,33]. The successes achieved in the Pedra Talhada forest underscore the importance of comprehensive CE approaches in achieving biodiversity conservation objectives. They resonate with conservation projects globally, demonstrating the potential of education in achieving SDGs and protecting threatened ecosystems [32,33]. The experiences gained in the Pedra Talhada forest on the border of Alagoas and Pernambuco created a multiplier effect currently being applied in 14 other states in Brazil. Hence, conversations about the potential for scaling up the successful CE model presented here have evolved nationally.

For Sherrow [33], environmental education focuses on general teaching about the environment, often without a conservationist approach. It is a widely used practice that ranges from environmental groups to large economic corporations, which is labeled the same despite having different content and programs. She also stated that conservation education is much more direct and is used to describe the process by which individuals or groups are motivated and educated to conserve and protect certain species and their natural environments. Moreover, she mentioned that despite the success of many awareness programs worldwide, there are difficulties in measuring and quantifying the positive impacts and achievements of their goals. In Brazil, successful conservation projects like the Golden Lion Tamarin Project and Projeto Tamar have extensively contributed to awareness raising and the protection of species and their habitats [34,35].

The aim of conservation education in this work was to impart knowledge and awareness of forest protection by involving diverse audiences and creating inclusive, participatory approaches by varying activities to the utmost. Thus, implementing strategies like engaging local communities and raising awareness has shown promising outcomes for sustainably conserving the forest and its biodiversity. Furthermore, the strategies implemented in the Pedra Talhada forest contributed to meeting the Kunming–Montreal Global Biodiversity Framework's 23 targets. The initiatives aimed to enhance the integrity, connectivity, and resilience of ecosystems (Goal A); halt human-induced extinction of threatened species and increase their abundance (Goal A); maintain genetic diversity within populations (Goal A); sustainably use biodiversity and nature's contributions to people (Goal B); promote fair and

equitable benefit sharing (Goal C); and secure means of implementation, including financial resources and capacity building (Goal D) [10]. However, the results highlighted in this paper were merely the first steps on a long road that must subsist. Continued collaboration among stakeholders, including indigenous peoples, local communities, and policymakers, is necessary to advance the goals of the Kunming–Montreal Global Biodiversity Framework and protect threatened ecosystems like the Pedra Talhada forest.

Myers et al. [36] posed the fundamental question, “How can we support the most species at the least cost?” The question has echoed for decades, and the answer always fades before reaching the necessary ears. Unfortunately, little of what is in this text could have been done without funding. Funding played a crucial role in the success of these CE initiatives. Due to a lack of funding, associations like Nordesta and conservationists are dramatically limited in what they can do to educate, raise awareness, support, or protect species under threat for our future generations. It took earnest and committed hard work to find the funding for all these projects. Our efforts to secure funding have been ongoing.

8. Conclusions

To conclude, the Pedra Talhada forest reserve, located in the Pernambuco Endemism Center, remains one of the most threatened, critical biodiversity areas of the Atlantic Forest due to its isolation (Figure 14). Efforts and the search for new research advances must continue for future generations’ education. While conscientization is a vital step toward fostering sustainable and ecologically conscious communities, significant areas remain for improvement and expansion [37]. Consistency is key, as breaking deeply ingrained cultural practices and challenging misperceptions regarding ecology is a gradual process [37].



Figure 14. The Pedra Talhada forest today (© Rolex \\ Diego Bresani 2021).

However, it is important to note that significant strides have been made over the last four decades by garnering the support of the local population to reduce methods like chopping down trees or setting fires for expanded grazing space and prioritizing cattle breeding over preserving forests. To enhance this journey, providing platforms for individual expression, like inviting community members to share their views on radio programs and fostering group discussions, can empower other communities and broaden the scope of awareness. Actively involving the community in practical actions, such as tree planting initiatives, is a positive step, though challenges persist, such as addressing the

pervasive issue of pollution through waste disposal. Organizing waste collection efforts is commendable, but further exploration of sustainable solutions is imperative.

Today, despite the prevailing belief that the profitability of pasturelands for cattle breeding provides a more lucrative source of income through meat sales, efforts are being made to balance economic activities like cattle breeding and produce farming with the preservation and sustainable use of forests, as seen in our agroforestry project. Ecologically and economically, there is a greater recognition of the value of forests. This new focus on coexistence and finding ways for economic growth and environmental preservation reflects a more conscientious approach toward environmental conservation and sustainable practices. It has even provided a fresh outlook for those concerned with political reputation. Therefore, attention should be directed toward refining strategies, ensuring community engagement, and continually seeking innovative solutions to address ecological concerns. The process demands a sustained commitment to practical actions. It is through awareness creation, education, and new initiatives that more effectively enlist individual and collective action for transformative change that the conservation of forests, waters, and biodiversity will be achieved [4]. Therefore, we must stand together and align with the concept of conservation education, aiming to motivate and inspire individuals and communities to conserve and protect heavily threatened hotspots like the Pedra Talhada forest reserve.

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