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Exploring Plural Values of Ecosystem Services: Local Peoples' Perceptions and Implications for Protected Area Management in the Atlantic Forest of Brazil

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Abstract: The remnants of the Atlantic Forest in Brazil are significant for biodiversity and provide benefits for people (climate regulation, water supply, health and welfare, among others). However, nature's importance for different people may vary, for social, environmental, and economic reasons. In this paper, we explore such differences among people living in communities surrounding the Cunhambebe State Park (PEC), a large area of Atlantic Forest. We assess their perceptions regarding the plural values of ecosystem services derived from the PEC and explore ways in which this could affect the management of this protected area. Our assumption is that analyzing the perceptions of people who live in the communities surrounding can be a key tool for the formulation of proposals to improve management models and address socio-environmental conflicts. Based on interviews, participant observation, and document analysis, our results show a direct link between culture and environment since relational values and cultural ecosystem services are closely related to local people's valuation of the PEC. Therefore, we support management strategies which are based on local values for land and forest use in a sustainable way. Our findings may contribute to decision making by PEC managers, governments, local stakeholders, and researchers.

Keywords: environmental management; community-based conservation; ecosystem services

1. Introduction

The concept of ecosystem services (ES) highlights the interdependence between ecosystems and human well-being [1,2]. In the Millennium Ecosystem Assessment, MEA [3], ES were conceptualized as the benefits that people obtain from ecosystems, grouped into four categories: supporting, provisioning, regulating and cultural services. This ES framework has become a major tool for linking nature conservation and human well-being goals, in which protected areas (PA) are essential for achieving conservation goals in practice and providing nature's benefits to people [4–6].

The ES framework can increase PAs support by contributing to a better understanding of the different types of benefits provided by these areas, and their values [7,8]. However, the conversion of ecosystem services into benefits often requires a joint contribution from nature and people [9]. The significance of these benefits depends largely on the different ways in which people value nature [10–12] (We used the concept of nature associated with environment, since we included the abiotic factors (soils, rocks) and biotic (diverse manifestations of plant and animal life), and understanding of nature is mediated by cultural expressions of the relationship between humans and nature (see more in Altman and Wohlwill [13])), since the ES concept on its own cannot explain the multiple ways in which people engage with nature [14].

Studies have advanced on different values of ecosystems (also nature): “intrinsic values” defined as the value of ecosystems as ends in themselves which are often represented as moral duties; “instrumental values” defined as the value of ecosystems as merely means to an end which are often measured in monetary terms; and “relational values” defined as preferences, principles, and virtues associated with relationships, both interpersonal and as articulated by policies and social norms [11,15,16].

Many publications on the ES framework have advocated for the need to include plural values of ecosystems in assessments, studies and reports [16]. That is because humans have multiple ways of relating to the environment, in its different dimensions (physical, biological and/or natural) [17]. These ways can be developed and change through long term interactions between people and ecosystems [9]. One crucial question is: how can non-instrumental values be integrated into the ES framework? Thus, we must take into account that the different values attributed to ecosystems are derived from the relational domain [11,18].

Recently, Arias-Arévalo et al. [15,16] classified three metaphors of human–nature relationships that correspond to the three value typologies: gaining from nature (instrumental), living for nature (intrinsic in the sense of the direct moral consideration of nonhuman subjects of a life), and living in nature (relational). Obviously, each person likely holds more than one of these senses of value, in varying combinations. A pluralistic approach not only captures the diversity of nature’s values, but also allows interdisciplinary analysis for environmental assessments and conservation strategies [12,19].

Plural values of ecosystems may represent different ways of valuing and engaging with PAs management. Such values can be integrated in a socio-environmental assessment, considering the environmental and social dimension as indivisible (Figure 1). Multiple typologies of values have been generated to try to capture the diversity of human values concerning nature [20,21]. Beyond the instrumental values and intrinsic values, the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) has included the category of relational values in its conceptual framework to address nature’s benefits to people [22–24]. Thus, the IPBES has acknowledged the relevance of integrating plural values of ES [25].

1.1. Plural Values of Protected Areas, Local Communities, and Management

Especially for PA, the values of the ecosystem are often strongly interlinked with the cultural role these areas play in people’s lives and their ethical motivations to protect nature [26,27]. Local communities related to PAs have significant and lasting relationships with these areas. Because of this, it is interesting to consider the relational values in PA management, since relational values explain how and why people value nature [11,12]. Strategically, it may be better for management to consider the needs, aspirations, and attitudes of local communities [28], since it is common for conflicts to occur when conservation is seen as an impediment to human development [29].

The main reasons for such conflicts are restrictions on the use of local resources—established in management plans, economic activities, and displacement of local people [29–32]. For better management of PAs, local perceptions need to be understood, which can help to identify problems and recognize possible solutions for the development

of appropriate plans [28,33]. It is important to recognize and cater to pluralism in the relational values held by different local people [34]. Moreover, as citizens and community members, it is essential to respect local people's views and conceptions of the environment in which they live.

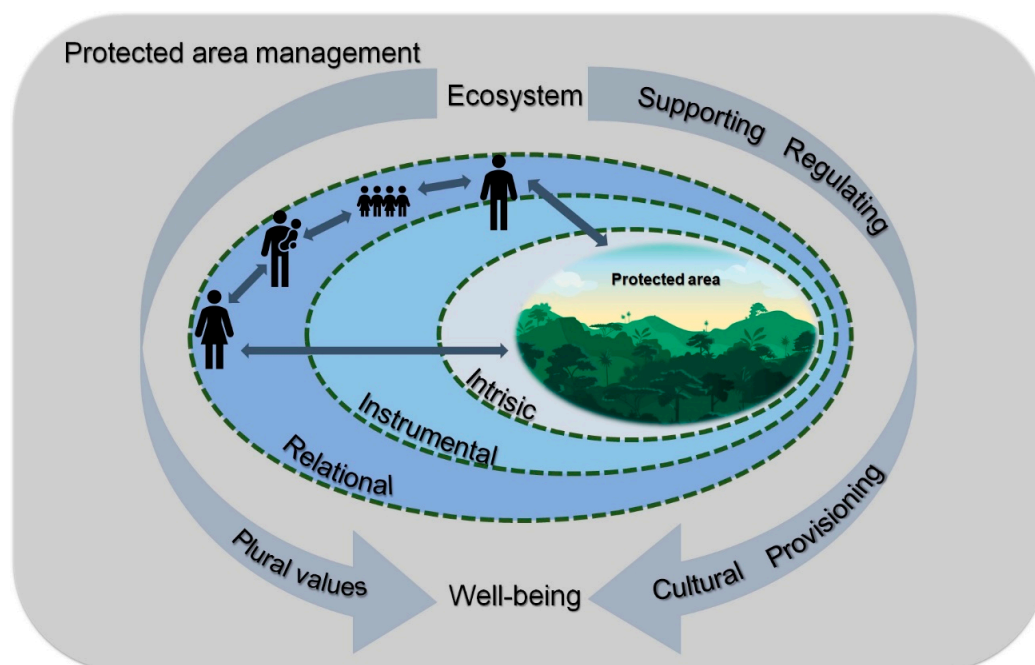


Figure 1. Plural values of ecosystem services connecting ecosystems and well-being for protected area management. Source: The authors.

1.2. Local Context and Goals

The Brazilian Atlantic Forest has many PAs, but only 30% of the total vegetation cover is located inside PAs, of which 9% are fully protected (IUCN Categories I–IV) and 21% permit sustainable use (IUCN Categories V and VI) [35]. These two categories of protected areas are established by Federal Law 9.985/2000. The meaning of the category “full protection” is that generally the area allows only recreational use and scientific research. On the other hand, the category “sustainable use” allows local communities’ sustainable use of resources. The conservation of remnants of the Atlantic Forest is extremely important due to its great richness of species, many of which are endemic [36], and to the proximity to cities and dense settlements that show a clear growth trend [37]. In recent decades, efforts to conserve this biome have increased by creating PAs and reforestation [38].

In Rio de Janeiro State, Cunhambebe State Park (PEC, in its Portuguese acronym) represents an important remnant of the Atlantic Forest, more than 38 thousand hectares in size [39]. The PEC has great relevance for the water security of more than 12 million people, since the springs protected by this park supply Ribeirão das Lajes dam. To improve forest protection, there is also a marginal area (called Buffer Zone—BZ), 85,000 hectares in size, that includes sites of ecological, economic and archaeological importance. These are areas that mix rural, urban and industrial uses, also established by the municipal Master Plans [39].

Despite the fact that Brazilian legislation (Law 9.985/2000) establishes that human activities in the BZ are subject to specific rules and restrictions to minimize negative impacts on the PAs [40], the BZ of the PEC presents many challenges for better land use planning and protection of the PA surroundings. In a previous study, the authors reported that the expansion of grassland and urban areas represent the main threats to

PEC's management [41]. In addition, the lack of guidelines for land use surrounding the PEC in the municipalities' Master Plans makes the problem even more challenging [41].

To tackle these challenges and better understand the values of the PEC among local people, we conducted this study based on the framework presented by Arias-Arévalo [15,16], exploring the plural values of ecosystem services in the PEC and its effects on the management process. We take as our premise that understanding the plural values associated with the PEC by local communities can help address socio-environmental conflicts supporting management strategies. First, we assessed the local people's general knowledge about the PEC. Second, we assessed the importance to them of the PEC and its management. Third, we assessed people's values related to the PEC and its landscapes. In summing up our findings, we also discuss the implications for PEC management which could flow from addressing the plural values of ecosystem services most valued by local people.

2. Material and Methods

2.1. Study Area

The Cunhambebe State Park (PEC) is a protected area (IUCN category II), located in four municipalities in Rio de Janeiro State, of 38,053.05 hectares (Figure 2). It includes parts of the Tinguá-Bocaina Ecological Corridor, important for protecting the Atlantic Forest, and it is a biodiversity hotspot. In the international context, PEC is part of the Atlantic Forest Biosphere Reserve (RBMA), a project linked to the United Nations Educational, Scientific and Cultural Organization (UNESCO) [42].

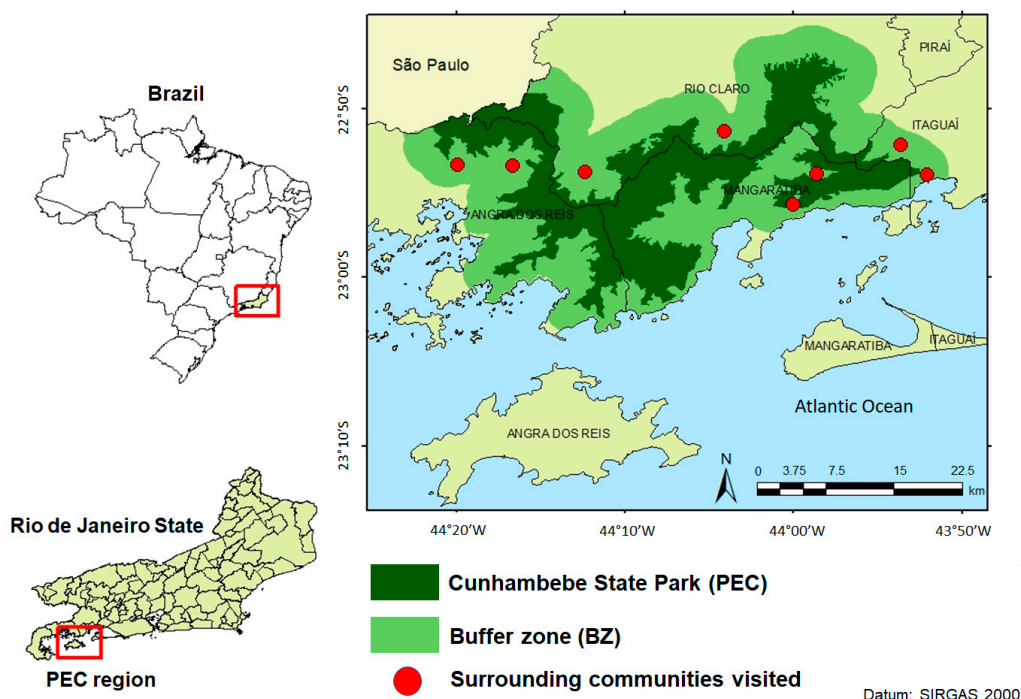


Figure 2. Study area map indicating the location of the surrounding communities visited.

This study was carried out in the BZ of the PEC, where we selected 8 communities as sites for our survey (Community names: Mazomba, Itimirim, Assentamento Fazenda Rubião, Sahy, Ariró, Serra D'água, Lídice, and Macundu—see Figure 2). The communities visited belonged both to urban and rural areas of the counties within the PEC areas. Therefore, communities in urban neighbourhoods and rural villages were visited, aiming to cover the diversity of local communities. The communities visited were selected for their proximity to the PEC boundaries and due to the fact that they have local leaders who

participate in the Advisory Council, where it was possible to establish the first connections, as described in the previous study [41].

These communities reflect the social, environmental, and economic conditions of their municipalities. The municipality of Angra dos Reis is the area with the highest concentration of households, many low-income communities (called “favelas”) in the immediate surroundings of the PEC, and also many areas susceptible to mass movements (landslides) [39]. The municipality of Mangaratiba also has favelas in the boundaries of the PEC, but also has rural villages that include small rural properties and agrarian reform settlements [39]. The municipality of Itaguaí includes the smallest part of the PEC and the BZ, with both urban and rural communities around it [39]. On the other hand, the BZ areas in the municipality of Rio Claro are widely in rural lands, imposing new challenges for the PEC management since conflicts are of a different kind [39].

Although the restrictions imposed in the BZ are not established in the Management Plan [39], we provide a set of conflicting activities within BZ of the PEC with direct implications for the management, conservation of biodiversity and surrounding communities (Table 1). The main issue causing social and environmental problems in this region is the fragmentation of the Atlantic Forest, due to the resulting rupture in the main ecological interactions and changes in taxonomic, functional, and phylogenetic diversity of the plant communities [43,44]. In addition, local drainage basins experience soil erosion and loss of water quality [39]. We used this table to set up our initial survey.

Table 1. Activities that conflict with the delimitation of PEC’s area and the potential impacts to be considered.

| Conflicting Activity | Potential Impacts |
|---|--|
| Introduction of exotic species (flora and fauna) | Change in the composition, structure, or function of native ecosystems. |
| Hunting of fauna and bird catching (sale and trapping) | Environmental crime, causing changes in the food chain and imbalances in populations. |
| Gathering of plant specimens | Illicit extraction of heart-of-palm and ornamental plants (bromeliads and orchids). |
| Roads and accesses | Facilitation of access and transit of hunters, palm workers and irregular occupations. |
| Vandalism at historical sites | Destruction of the historical and archaeological heritage. |
| Trails | Increase erosive potential on slopes |
| Fires | Constant risk of fires in the park, especially on the north face. |
| Towers, power transmission lines and rights of way | Interference in natural landscapes with vegetation’s suppression, in addition to the little-known effects of magnetic fields on the fauna and flora, with the increase of the potential for lightning. |
| Water catchment for public supply and by residents of the surrounding areas | Decrease in water flows and modification of hydrodynamic and hydro-sedimentological processes. Informal water collection for domestic use constitutes a type of non-approved use and a frequent social practice. |
| Agricultural and Livestock Activities | Edge effects on vegetation; invasion of exotic species of flora; use of fire in pasture and agricultural management and use of pesticides. |
| Urban expansion | Unauthorized use with potential densification of irregular occupations generating land problems. |
| Waste disposal | The area suffers from problems with the regularity of the public garbage collection service and visitors usually leave waste in the areas. The wild fauna can change their eating habits, incurring the risk of suffocation due to the ingestion of plastic packaging. |

Developed from analysis of the Management Plan.

2.2. Data Collection and Analysis

This study used multiple methods including Participant observation, documental analysis, and interviews to investigate answers to our research questions. The Participant observation [45,46] was an appropriate technique to establish initial contact with the communities because it allowed us to explore the relationship of local leaders with the management of the PEC in the Advisory Council meetings. Thus, the first author became a volunteer member of PEC’s Advisory Council, to be able to attend all meetings where local leaders reported on the challenges and problems between management and their

communities. This method is also helpful to learn about the social context for data obtained by other methods.

The Advisory Council is made up of different stakeholders, following Federal Law 9.985/2000 that establishes the participation of social actors linked to “full protection” protected areas. The presidency of this council is held by the public agency responsible for the administration of the PA and the other representatives are from public agencies, civil society organizations, landowners whose properties overlap with the PA, and traditional communities living in and around the PA [40]. Nevertheless, park management usually takes place through a top-down approach [41], often more linked to political motivations than to conservation [47]. Therefore, local community members’ insights are very helpful in addressing our research questions related to socio-environmental conflicts, values and management implications.

In the document analysis, the PEC Management Plan and the municipalities’ Master Plans that cover the PEC were among the main documents examined. We conducted seventy-five face-to-face interviews (mix of open-ended and semi-structured) with local people, with an average duration of 50 min, from February 2017 to November 2018. To find participants, we used the snowball sampling method; and we asked local leaders attending Advisory Council meetings to suggest others who might be appropriate for the study. The interviewees (see Table 2 for details) were first informed about the aim of the study, and we obtained written informed consent from interviewees before they took the survey.

Table 2. Sample characteristics of the interviewees (local people) in communities surrounding the PEC, from the survey forms.

| Sociodemographic Variables | Features | N | Frequency (%) (n = 75) |
|----------------------------|-----------------------------------|----|---------------------------|
| Age group | Between 18 and 38 years old | 13 | 17.33 |
| | Between 39 and 59 years old | 37 | 49.33 |
| | 60 years old or more | 25 | 33.33 |
| Gender | Male | 38 | 50.67 |
| | Female | 37 | 49.33 |
| Education level | Elementary school | 39 | 52.00 |
| | High school | 28 | 37.33 |
| | Higher education | 8 | 10.67 |
| Origin | Native (born in the local) | 33 | 44.00 |
| | Non-native | 42 | 56.00 |
| Residence time on local | Less than 12 years | 15 | 20.00 |
| | Between 13 and 25 years | 17 | 22.67 |
| | 26 years or more | 43 | 57.33 |
| Occupation | Activities related to land use | 17 | 22.67 |
| | No activities related to land use | 58 | 77.33 |

The survey used to guide the interviews consisted of questions regarding the importance of the PEC in their lives, knowledge about the PEC, what the area was like before the PEC was created, suggestions on how the PEC could improve its social participation in management, enhancing interactions between PEC and local communities, and lastly the individual values that people felt towards the PEC and its ecosystem services. For the first part of the survey, we used a Likert scale (1–5) [48] for structured questions. The answers could vary: no importance/satisfaction (1), little importance/satisfaction (2), moderately important/satisfied (3), very important/satisfied (4), and extremely important/satisfied (5).

To analyze the answers obtained through open-ended questions we applied the perspective of plural values of ecosystem services from Arias-Arévalo et al. [15,16]. Thus, we based our analysis on three value typologies: gaining from nature (instrumental), living for nature (intrinsic in the sense of the direct moral consideration of nonhuman subjects of a life), and living in nature (relational). Finally, we performed a Kruskal–Wallis test [49,50] to analyze the correlation between the interviewees’ sociodemographic variables

and their perception scores on Likert scale. The Kruskal–Wallis test is the nonparametric equivalent of a one-way ANOVA. This test assumes that the observations in each group come from populations with the same distribution shape and that the samples are random and independent. In this case, the values of $p < 0.05$ were considered statistically significant. This statistical analysis was carried out using Statistical Package for the Social Sciences (SPSS) version 21.0 software.

3. Results and Discussion

3.1. Overall Findings

We found that the PEC has meaning for local community members related to nature's non-material benefits. Based on the plural values framework [15,16], we found that the two main value domains were intrinsic and relational (fundamental) (Figure 3). We identified 20 articulated values and suggest four new types of ES to be associated with plural values of ecosystem services (Table 3). In general, the values associated with cultural ecosystem services were the most mentioned (81.74%), followed by regulating (9.59%) and provisioning (8.68%). In relation to the articulated values, we highlight the two in the intrinsic value domain "Moral duties towards nature" (62.67%) and "Life (26.66%), and in the relational value domain "Mental and physical health" (26.67%).

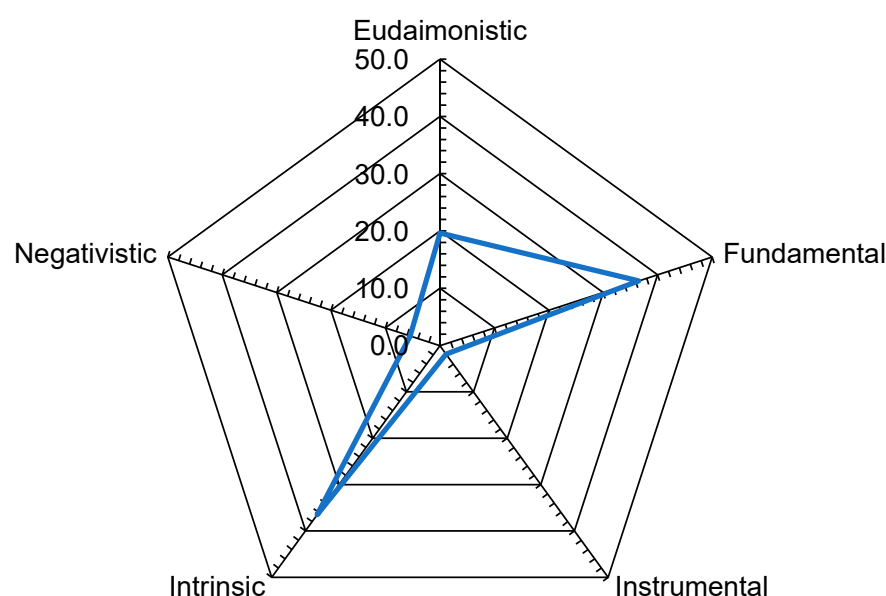


Figure 3. Frequency (%) of five value domains from the plural values framework of ecosystem services related to Cunhambebe State Park (PEC).

We propose that the perceptions of ES following "Improving natural capital", "Ecological values", "Body, mind and spirit", and "Subsistence values"; be classified as cultural ecosystem services according to the non-material benefits that people obtain from the ecosystem (Table 3). Also, we suggest that the value "Negativistic" is a relational value in value domain, from the works by Kellert [51,52]. These local values differed from all others already described in key documents, such as the MEA (2005) and Arias-Arévalo et al. [16]. As argued by Cuni-Sanchez et al. [53], many ES assessments identify the ES values using established methods rather than identifying services that are truly valued by a given community. This can make it harder to find trade-offs solutions in protected area management related to ecosystem services.

Table 3. Classification of plural values in Cunhambebe State Park across different metaphors of human-nature relationships and examples of interviewees' articulated values related to ecosystem services.

| Human-Nature Relationship | Value Domain | Articulated Values | Related ES | N | Examples |
|---------------------------|--------------------------|-----------------------------|--|----|--|
| Gaining from nature | Instrumental | Monetary value | Improving natural capital * | 4 | <i>"income for the town"; "enhancing of my rural property's value"; "land valuation"; "economic use of nature in a sustainable way"</i> |
| Living for nature | Intrinsic | Moral duties towards nature | Ecological values * | 47 | <i>"nature conservation"; "protection of animals"; "extremely important for nature conservation"; "forest monitoring"</i> |
| | | Life | Ecological values * | 20 | <i>"alive forest"; "the park is life"; "environment conserved"; "life maintenance"</i> |
| | | Ecological elements | Ecological values * | 13 | <i>"tall trees"; "waterfalls"; "river springs"; "stone walls"; "fauna"</i> |
| Living in nature | Relational (Fundamental) | Mental and physical health | Body, mind, and spirit * | 20 | <i>"wellness"; "natural enjoyment"; "tranquility"; "feeling of peace"; "quality of life"; "enhanced mental health"; "body and soul relaxation"</i> |
| | | Livelihood | Biochemicals and natural medicines; Food; Fresh water | 15 | <i>"I prepare teas with materials I collect in the woods"; "I use herbs"; "I've already picked up a small plant there to treat a problem in my stomach"; "improves my banana production"; "fresh potable water"; "water sources".</i> |
| | | Cultural heritage | Cultural heritage values | 4 | <i>"history of the Green Coast"; "protection of the indigenous people"; "here is the Cunhambebe, a green coast, due an indigenous man who lived in the region and gives the park its name"; "ruins of ancient buildings".</i> |
| | | Social cohesion | Social relations | 12 | <i>"good living"; "safest place"; "a more peaceful place of good living"; "good for living"; "good for rearing children"; "around here we don't hear much of the shooting noise like in the city. Much safer here"; "some of the park rangers guide us".</i> |
| | | Sense of place | Sense of place | 5 | <i>"nostalgia"; "childhood memories"; "[...] this area close to the dam makes me miss my childhood and my family. My brothers and I used to go riding horses. It was incredibly good. I miss those times".</i> |
| | | Recreational, leisure | Recreation and ecotourism | 3 | <i>"waterfalls"; "leisure for children"; "nature walk"</i> |
| | | Environmental justice | Social relations | 3 | <i>"right to have a home"; "housing rights"; "being able to live better in this house"</i> |

Table 3. Cont.

| Human-Nature Relationship | Value Domain | Articulated Values | Related ES | N | Examples |
|---------------------------|----------------------------|-------------------------------------|--|----|--|
| | | Ecological resilience | Air quality regulation; Climate regulation; Water purification | 19 | <i>“pure water”; “[...] our water is a lot better, cause sometimes you think the water of public water supply company in the region is good, but it is full of chlorine, medicine and there are people who even feel a stomachache, right? On the other hand, our water is a blessing”; “[...] the PEC is important to me because if it didn’t exist, I’d run out of water”; “[...] look at the water volume during the drought. Greatly Increased. Why? Because of the forest above (PEC); “cooler air”; “here I feel that the weather is better”; “the air is much better than the air outside or in city”; “even to breathe an air free of this pollution from outside, here everything is better; “I don’t cut off any tree branch where the water flows. When it’s hot we see the change in the water”.</i> |
| | Relational (Eudaimonistic) | Aesthetic | Aesthetic values | 17 | <i>“paradise”; “beautiful forest”; “wonderful green mountains”; “[...] here is better than a movie set. I will not sell it for anything. It’s a paradise I’ll leave to my grandchildren”.</i> |
| | | Education and cognitive development | Educational values | 9 | <i>“used for research”; “curiosity for ecology”; “awareness and knowledge”; “to know the species”; “traditional ecological knowledge by Indigenous people”</i> |
| | | Inspiration | Spiritual and religious values | 2 | <i>“meditate”; “make an offering to my spiritual guides”; “If I wish to have peace, I come here in the backyard and I stare at the forest of Cunhambebe”</i> |
| | | Meaningful occupation | Recreation and ecotourism | 1 | <i>“Every holiday I come here to have a good time and rest. I love hiking in Cunhambebe.”</i> |
| | | Subsistence, dependency | Subsistence values * | 6 | <i>“Without Cunhambebe, my life would be worse. We depend on him to survive”; “It was the best thing to protect our life and survive”; “Essential for survival and our horticultural garden”</i> |
| | | Altruism | All ecosystem services | 4 | <i>“We have to take care of nature because it is for our future generation”</i> |
| | | Nature-based tourism | Recreation and ecotourism | 3 | <i>“community-based tourism”; “tourist attraction”; “visits”</i> |

Table 3. Cont.

| Human-Nature Relationship | Value Domain | Articulated Values | Related ES | N | Examples |
|---------------------------|---------------------------|--------------------|------------------|----|--|
| | Relational (Negativistic) | Social cohesion | Social relations | 12 | <i>“Conflicts with land use near housing areas for religious practices of African origin”; “Ruthless opportunity for environmental activism”; “The park only serves to avoid me from rearing my livestock and expanding my pasture area”; “This park is an overstatement. It would not have to be so big and prevent farmers from producing”; “It only serves to disturb me and risk being accused of environmental crime”; “there are people threatened with death because of this park”.</i> |

Classification according to plural values framework [15,16] and ecosystem services framework [3]. * New type of ecosystem services proposed.

In the value typology “Gaining from nature”, the articulated value “Monetary value” implied the association with the ES “Improving natural capital”, related to the valuation of the land and everything that comes from it. The major importance of natural capital, given the proximity of the PEC, was reported for the most part by those who carried out work-related land-use activities, such as small farmers (Figure 4). Monetary values are assumed to be morally neutral from the individual’s viewpoint, and thus to provide a suitable objectification of human valuation [16].



Figure 4. A small farmer who produces crops in the BZ of the PEC and who considers that the proximity of his rural property to the PEC increases the value of his organic food production since the region has better environmental conditions. Source: Personal archive of first author.

From another perspective, used in the context of economic valuation for conservation projects, the instrumental value domain enables the policy of the provider-recipient to be interlinked, which has become a strategy to promote biodiversity conservation and rural development, especially in tropical and subtropical regions [54,55]. This is an essential tool for incorporating ES into agricultural land management decisions [56]. This reaffirms the importance of methodologies for valuing ecosystem services in protected areas such as the PEC and its immediate surroundings.

In the value typology “Living for nature”, we found three intrinsic values associated with ES “Ecological values”. All three relate to the view that humans share the environment with other non-human species that deserve concern for their own sake and have a right to exist [16]. Among the three, we point out the value “Moral duties towards nature” due to its higher frequency. In the studies of Kellert [51,52], this value was indicated as the moral value of nature for humans. References to the importance of the PEC for nature have also integrated two other articulated intrinsic values (“Life” and “Ecological elements”) to maintain the life of people, plants, and animals. People value the ES “Ecological values” that are associated with their environment, including important biotic and abiotic aspects for ecological balance.

In “Living in nature”, fundamental relational values were the most mentioned by interviewees. The relational framing is intended to present value statements such that they facilitate the connection between humans and the natural world [57]. “Mental and physical health” was associated with the ES “Body, mind and spirit”. Contact with nature promotes physical, mental, and psychological well-being [58]. Shanahan et al. [59] showed that people who had more contact with green areas experienced lower rates of depression and high blood pressure, and greater social cohesion. Specifically, some studies have highlighted the importance of nature’s elements for lower prevalence of depression, anxiety, and stress [60,61]. Also, contact with nature contributes to the wholeness of a person’s or community’s identity [62]. Evidence shows that the psychological and physical benefits of contact with nature increase with species richness and habitat diversity [63].

Perceptions of “Ecological resilience” values were present in several narratives. Air and water quality regulation were most often observed by those living in rural communities. The same has been reported in the literature; where forests have been protected water quality standards remained high and need for water treatment is much reduced [64]. Regarding Rio de Janeiro, the declaration of the Atlantic Forest Biosphere Reserve provides a vehicle for the protection of the forests and the city’s water catchment areas [64]. Furthermore, the perception of better water quality is combined with that of health improvement, since drinking water quality is one of the most significant factors affecting human health [65].

Other fundamental relational values such as “Livelihood” and “Recreational, leisure”, also enable us to understand local people’s relationship with the PEC. The act of collecting species for food or teas and domestic medicine, nature walks, and the perception that the forest helps in banana production, strengthen the forest’s non-timber uses and the benefits of keeping the forest standing. To encourage the management of non-timber forest products, social, ecological, and economic aspects must be taken into account [66,67].

Cultural heritage, a sense of place and social cohesion, complement each other in the relations between PEC and local people. All these values strengthen the relationship between culture and the environment (and biodiversity as well), since we note the importance that the PEC forest has for the history of the local people and their well-being. This is an important factor that permeates from the communities’ collective memory to the social relations between neighbours and visitors. Especially, the ES “sense of place” plays a key role in providing and promoting public support for conservation in diverse socioecological contexts [68]. For the PEC management, the sense of place can address the gaps between ecosystem science and environmental management [69].

Eudaimonistic relational values can also solve the dilemma of cultural ecosystem services everywhere and nowhere [10]. That is because eudaimonistic values relate to those entities and processes that are conditions for a “good human life” [16], and do not only refer to a surplus in quality of life that encompasses amenity values or aesthetic experiences [18]. Hence, communities that perceived these values and understood the threats to the cultural services were helpful in reporting on land use planning and identifying places of environmental concern [70]. Aesthetic, inspiration, and meaningful occupation demonstrated values essentially related to landscape perception. Opportunities for appreciation, art, and identity justify the perceived non-material benefits [16].

Regarding the value domain relational “Negativistic”, the interviewees described situations that caused conflicts with the PEC. For example, for one respondent, “PEC is for us not to practice livestock farming (. . .) for us to have less production” (Interviewee 61, 57 years, farmer). Similar results were found by Castilho et al. [71], when they gathered reports such as “people cannot work because it is forbidden to replace the forest with agriculture” or “people must move, but the government does not pay a fair value for the properties”, representing conflicts due to the presence of the PA. These conflicts of overlapping areas are inherent in the legal issues related to PA implementation and maintenance.

According to Federal Law 9.985/2000, the PA concept of “full protection” ends up driving conflicts in cases of overlap, without proper land title regularization: “VI—full protection: maintenance of ecosystems free from alterations caused by human interference,

only the indirect use of their natural attributes being admitted" [40]. So, when addressing ecosystem services, ecosystem disservices also need to be considered, that is ecological processes that affect human well-being in negative ways, causing harm or costs [72,73].

In general, these relational values can be used to structure or enable debates in decision-making processes that connect environmental change to tangible and intangible values [57]. This reflects psychological evidence that suggests the role of group behavior and social norms in influencing behavior, both in general and with specific pro-environmental behaviors [74]. In this context, the PEC administration should seek to better understand the reasons for the negative values and offer solutions for changing this judgment by ranchers in the region around the PEC [41].

3.2. Implications for PEC Management and Social Participation

3.2.1. Insights for Environmental Management

We observed that most meetings of the Advisory Council during 2017 and 2018 were not attended by all registered stakeholders. The Advisory Council consists of 12 stakeholders from public institutions, five from private institutions, and 11 from civil society organizations. However, some representatives were always missing, mainly from the communities farthest from the headquarters of the PEC (at Mangaratiba). Still, our results suggest that an advantage of the meetings was the engagement of those who could attend. Stakeholders were divided into working groups, and from there on they articulated proposals to present to the Advisory Council or to organize events.

However, during the follow-up of the meetings in these two years, we also observed the difficulty of communication among the stakeholders. It was observed that local leaders of the surrounding communities are usually silenced (interrupted) when speaking at Advisory Council meetings, while stakeholders from public and private institutions are privileged at decision-making times. It is one of the problems of participatory spaces that is linked to the top-down approach. Perhaps this is a contextual problem of this area. In our interviews, we found out that over 75.0% of the interviewees could not say if they knew the boundaries of the park areas. 77.3% of the interviewees did not know that they lived in the buffer zone. Most interviewees had never visited the PEC headquarters (52.0%) and 76.0% reported they had never been invited to participate in any meeting or project with the Advisory Council.

The levels of satisfaction regarding the management and conservation of the PEC and the importance of the PEC for the place where people live, and for their family income are presented in Figure 5. Most interviewees (50.7%) were dissatisfied with the PEC's management. Only 4.0% of those interviewed felt extremely satisfied with PEC's management. However, the highest levels of conservation in PEC's area were divided between extremely satisfied and very satisfied, with 37.0% and 32.0%, respectively.

When questioned about the importance of the PEC for the place where they live, 77.30% classified it as extremely important. The reasons for this choice included eudaimonistic values (especially, "Altruism" and "Aesthetic"), associated with perceptions of cultural ecosystem services provided by the area: "I think this is a wonderful thing here. It's so good here (. . .) the people in the city don't know how important this is for us. And for themselves" (Interviewee 13, 52 years, housewife). Another interviewee reported how she appreciates the area: "I love this amazing forest. Every day I look at it during the night (. . .) I feel pleasure in looking at it" (Interviewee 9, 59 years old, shellfish). Some recognized the importance of fundamental values, like ES provisioning and regulating: "The forest is important to me because if the water is not going to run out" (Interviewee 34, 76 years, farmer).

Other interviewees reported on intrinsic values: "The park is the reserve of everything: forest, fauna and waterfalls" (Interviewee 36, 76 years, farmer). Those who classified the PEC as not important or of little to moderate importance (12.0%) justified their choices due to overlapping territories' conflicting use. According to one of the interviewees,

the impediment to using land that overlaps the park for agricultural activities leads the community to see this conservation strategy as something problematic and not as a solution.

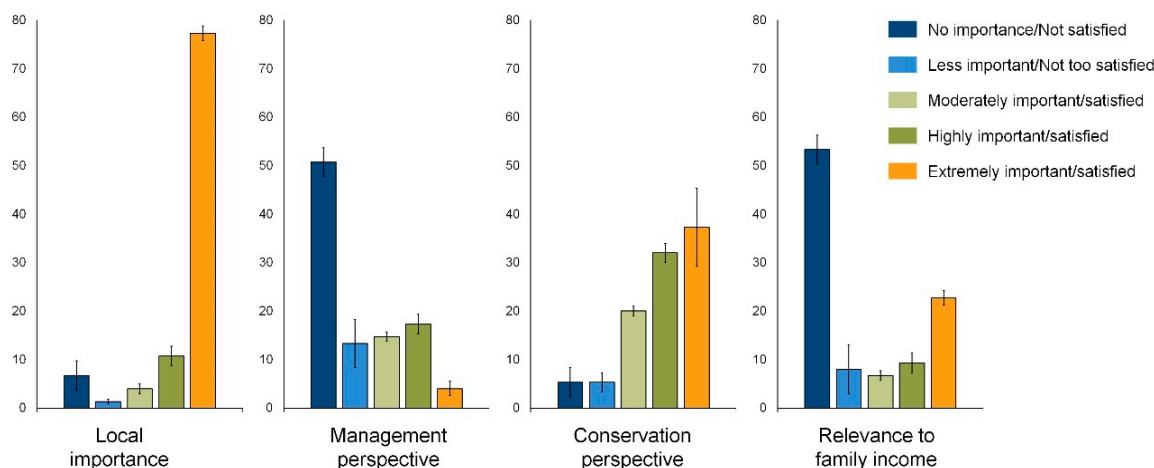


Figure 5. Frequency (%) and distribution of the levels of importance or satisfaction from the questions by Likert scale (n = 75).

As a source of family income, more than 50.0% considered of the PEC of no importance. On the other hand, 22.7% stated that the PEC is extremely important for their own source of income. Many interviewees considered that the PEC did not bring any economic benefit to the community and did not contribute to the personal or family income. Some thought it is the opposite, as the park hinders their income: “The park makes my agriculture difficult (. . .) I can’t cultivate another area” (Interviewee 39, 76 years old, farmer). On the other hand, some of the interviewees related the importance of the PEC for generating income from tourism: “Many come to my inn because of the park. But it is a problem not to know much about it because we can’t give the support that guests need to make trails, get to know the park more (. . .)” (Interviewee 57, 57 years old, retired). These reports show the challenges related to the instrumental value (“Monetary value”) associated with ES “Improving a natural capital”.

When asked about which actions would be the most important to improve conservation of the PEC and social participation, the majority reported the need to raise environmental awareness of the residents: “It would be nice to make residents aware through meetings, lectures or visits to the park” (Interviewee 1, 51 years, teacher). Some of them cited problems that could be reduced if the PEC team sought to be closer to the community: “There are still many people who hunt. There has never been anyone here to talk about the risks of hunting” (Interviewee 9, 59, craftwork shellfish); “Many still start fires, cut down a lot of trees near the waterfall and dump garbage. PEC should intervene, make residents aware” (Interviewee 3, 20 years old, student).

Another interviewee suggested an improvement in the articulation between educational and research agencies and institutions, in order to increase sustainability and reduce conflicts over where to plant or raise animals. “What is missing here is greater integration between management, the Rural University, ITERJ, INEA (public institutions that work on environmental management and rural extension) and farmers” (Interviewee 22, 68 years old, retired). All these reports are mediated by the fundamental values of social cohesion. In a previous study, Coelho Junior et al. [41] argued that PEC requires investments in projects that improve the adequacy of land use in the buffer zone.

Understanding how PAs contribute to society needs to reflect people’s relational values to nature [27]. Relational values provide a pathway to overcoming the dichotomy intrinsic and instrumental values that has guided much environmental management and sustainability [34,57,75]. The nexus between nature, relational values, and human well-

being is essential to the success of PAs management [76]. Thus, to be more than mere marketing, environmental management must reflect on and possibly rethink conservation in the context of local narratives and struggles over a good life [11].

3.2.2. Sociodemographic Variables and Local Perceptions

Evaluating the questions about people's knowledge of the PEC showed statistically significant differences for some sociodemographic variables. The Kruskal-Wallis test revealed the effect of occupation on knowing the PEC boundaries ($\chi^2(1) = 6.337$; $p = 0.012$) and about having already been invited to some Advisory Council meeting ($\chi^2(1) = 16.308$; $p < 0.01$). Having land-related occupations was also decisive in answering how people felt about the PEC management ($\chi^2(1) = 4.798$; $p = 0.028$). The Kruskal-Wallis test also showed an effect of gender on satisfaction levels with PEC's management ($\chi^2(1) = 9.598$; $p = 0.026$). Another question showed that gender variable had effect for increasing family income ($\chi^2(1) = 5.776$; $p = 0.016$). All other correlations presented the same distribution between the question and the categories of sociodemographic variables, accepting the null hypothesis (Supplementary Material).

These values found from the Kruskal-Wallis test were significant when considering the p-value 0.05. In other words, in the first result presented, knowing the boundaries of the PEC, and consequently the implications of this for the relationship between local people and the PEC management was directly related to the type of occupation of the interviewee (whether she/he had activities related to land use or not). In addition, the type of occupation is also decisive for having already received an invitation to attend a meeting with the PEC team. This shows that the PEC administration is more committed to this specific public, but it cannot avoid getting involved with local people who do not correspond to this type of occupation, since they are certainly also key local actors in improving the management of the area and minimizing conflicts. Similar interpretations on Kruskal-Wallis test values can be done from the results presented. Thus, actions priorities can be developed that take into account these demographic variables.

One interesting finding is that gender can shape the perception of plural values of ES. Women reported the PEC giving more focus to affective issues (sense of place) and scenic beauty (aesthetic values). On the other hand, men sought to describe the forest's relationship in a more utilitarian way (provisioning and regulating). According to Fortnam et al. [77], the reason for this trend is that the values reflect the social construction of ES and the critical importance of the social mechanisms that sustain the relationships between people and ecosystems.

Many people with land-related occupations knew the PEC boundaries and had already been invited to participate in meetings with the Advisory Council. This illustrates the effort by the PEC management team to seek dialogue with surrounding people, especially small farmers who had part of their properties overlapping the boundaries of the PEC. However, most were dissatisfied when questioned about the management, showing that this effort may not have been effective. Our result complements the findings of Coelho Junior et al. [41], who presented the expansion of pasture areas and urban areas as the greatest threats to the PEC. Local people's perception of dissatisfaction with management may be emphasized due to land use restrictions. Therefore, the PEC administration should invest in more participatory management, and explore ways to integrate local farmers in the benefits of the protected area, while also maintaining monitoring, enforcement, and recruitment of skilled staff [41].

The Convention on Biological Diversity (CBD), through Aichi Target 11, requires PAs to be managed effectively and equitably [78]. Hence, protected areas conservation goals are most often met when they empower the local people, improves cultural benefits, and reduces subsistence costs [79]. The association between the social and natural sciences in conservation planning can be used to better understand the complexity of human nature dynamics to develop better public land use policies [80]. Furthermore, exploring power

relations by mediating access, use and the ecosystem services management is essential for good decision making towards environmental sustainability and social justice [81].

4. Conclusions

We argue for the need to include local perceptions in PECs' environmental planning, aiming for protected area management that is both effective and committed to equity. Although this thinking is already consolidated in the literature, we present a cultural appreciation of PEC for local communities through plural values (especially fundamental and relational values). This finding exposes the direct relationship between culture and environment, helping legitimize the relevance of studies on socio-biodiversity for PA management. People's engagement depends not only on individual experiences, but also on the context in which they are inserted. Therefore, our findings indicate that it is important to improve the social relations and education programs promoted by PEC, to work to restore trust and cooperation among stakeholders (social participation).

Our results can support decision making by PEC managers, local stakeholders, and researchers, as well as contribute to the international debate on environmental / forest conservation projects based on the cultural value of the areas for sustainable use. The use of plural values of ecosystem services in PEC management enables dialogue with communities and the valuation of priority areas for biodiversity conservation. We suggest that socio-environmental conflicts can be understood and managed through involvement with the community, considering its desires and visions, and not through a top-down approach as is the standard for park management policy in Brazil.

Based on this study of plural ecosystem values, we recommend five ways to advance and improve sustainable, equitable management of protected areas in general, and the PEC in particular: (1) strategic planning for the use and occupation of land in rural and urban areas in order to reduce conflicts and improve local protection of the park; (2) include the infrastructure and development departments of the counties that surround the protected area in operational planning; (3) sponsor environmental education projects in the educational institutions of all surrounding jurisdictions, as well as other civil society organization activities; (4) foster and support community-based tourism projects to involve local people in ecotourism related to the protected area; and (5) undertake participatory mapping of ecosystem services (local perceptions, valuation, access and distribution) to improve the equitable sharing of the financial benefits of the protected area with local communities.

Supplementary Materials: The following are available online at <https://www.mdpi.com/2071-1050/13/3/1019/s1>, Tables S1 and S2.

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