MANAGEMENT PLAN OF THE NATURAL PARK OF THE MUNICIPALITY OF MARABÁ-PA

10.56238/edimpacto2025.022-002

Adams Almeida Gomes[1], José Antônio de Castro Silva[2], Sandro Gava[3], Rubens Chaves Rodrigues[4], Antônio Pereira Júnior[5], Cléo Márcio de Araújo Santana[6], Marcos Brabo da Silva[7], Joelma de Oliveira Serra[8]

ABSTRACT

The Management Plan for the Municipal Natural Park of Marabá (PARNAMM), created in March 2024, aims to protect Amazonian ecosystems on the banks of the Tocantins River. With an area of 701.76 ha, the plan establishes guidelines for environmental conservation, environmental education, research and sustainable ecotourism, in line with the National System of Conservation Units (SNUC). The creation of the Plan will promote high ecological relevance, significant biodiversity, and potential for sustainable education and tourism. **Social participation** (local, traditional and riverside community). Zoning — Intangible, Primitive, Extensive Use, Recovery and Special Use. **Institutional support**; Municipal Department of the Environment (SEMMA). **Difficulties encountered**: Urban pressure, city growth, illegal activities, infrastructure deficit, resettlement challenges. **Successes achieved**: Legal creation of the park by Decree No. 7,850 of 2024. Detailed environmental survey. Management plan. Bases for public policies. The **paths for the implementation of the project are**: zoning, training, environmental monitoring, strengthening of inspection, development of education and ecotourism projects, partnerships with universities and NGOs, and periodic reviews of the plan to adapt to socio-environmental changes.

Keywords: Environmental conservation. Environmental education. Management.

[1] Lead author
Degree: Environmental and Sanitary Engineering
Institution: State University of Pará – UEPA
[2] Degree: Master in Mechanical Engineering
Institution: Federal University of Pará – UFPA
[3]Degree: Graduate in Environmental Engineering
Institution: State University of Pará – UEPA
[4] Degree: Master in Water Resources and Environmental Sanitation
Institution: Federal University of Pará – UFPA
[5] Degree: Master in Environmental Sciences
Institution: State University of Pará – UEP
[6] Degree of education: Occupational Safety Specialist
Institution: University of the Amazon – UNAMA
[7] Degree: Master in Industrial Engineering
Institution: Federal University of Pará – UFPA
[8] Degree: Specialist in Occupational Safety Engineering
Institution: Faculdade Educamais

INTRODUCTION

From a historical perspective, it is possible to trace the path by which the unit of integral protection became vital for the Brazilian State. At first, it was thanks to the Industrial Revolution that progress took shape, originating in England in the eighteenth century, in which the advent provided many of the technological advances of that era, also fostering the increase in environmental degradation.

Article 225 of the Federal Constitution of 1988 defines that "Everyone has the right to an ecologically balanced environment, a good for the common use of the people and essential to a healthy quality of life [...]" (Brasil, 1988, art. 225). When we look at the past, it is essential to highlight the mechanisms that permeate certain groups, and one of them is the Federal Constitution of 1988, in which it states which precepts must be followed so that the negative impacts of the environment can be minimized, and possibly solved based on current legislation (View of the Federal Supreme Court of Brazil, n.d.).

For Silva Reis et al. (2021, p. 91043): "The SNUC establishes some instruments, [...], highlighting the conservation of biodiversity, the protection of soil quality, and the maintenance of the hydrological cycle". In line with the guideline proposed by the National System of Nature Conservation Units, it indicates the model to be followed for the creation and protection of these areas and also determines how the organization will take place in this context, based on article 225 of the Federal Constitution of 1988 (Do et al., 9105).

"In Brazil, protected areas created exclusively for nature conservation are known as Conservation Units (UCs)". (Omena, Bernardo, Hanazaki, 2022, p. 56). It is a fact that with industrialization the world can evolve, and with it new legislation had to be created to support progress. In this case, the PAs are resources that cover an entire scope, especially the Integral Protection Unit (Do et al., 2010b).

"The Brazilian government protects natural areas through Conservation Units (UC) - an extremely effective strategy for the maintenance of natural resources in the long term". (Brazil, 2024). In a way, the active participation of the Ministry of the Environment - MMA, as the central coordinating body within the SNUC, supports both the Federal Constitution of 1988 and the norms and legislation that advocate the protection and preservation of this environment can be followed within the legal precepts (Terra Cerezini & Nunes de Castro, 2022).

Brasil (2000, art. 7) determines that the National System of Conservation Units (SNUC) establishes the standards that govern the formation of Full Protection Units, by indicating that it is the obligation of these units to protect the environment, to supervise, and the direct use of this means remains prohibited, being only indirectly, in accordance with the

guidelines established by the legislation of Law No. 9,985. In addition, it is important to highlight the function of the Management Plan (PM), which is required for the creation of all Conservation Units in Brazilian territory. This plan contains the necessary information about the area to be preserved, as well as its physical, biotic and socioeconomic aspects, for management through zoning and preservation and conservation actions (Lopes da Silva & Maria, 2016).

"The Municipal Natural Park is an intricate and complex network of relationships." (Geber, Souza, Farias, 2022, p. 262). That is, it is not limited only to a space of integral protection; Some of the aspects that characterize it, however, are precisely that it is a tool for environmental education, in addition to being a space for public visitation and scientific research. With increasing urbanization and development, conserving and preserving remaining areas of a given biome, even in a small area of a municipality, become of great importance (Educacionais et al., 2023; Geber et al., n.d.). To the southeast of the State of Pará is located the municipality of Marabá, where the Tocantins and Itacaiúnas rivers meet. Therefore, with the inference of the SNUC and the full protection units, the creation of a Municipal Natural Park in this region is available.

OBJECTIVE

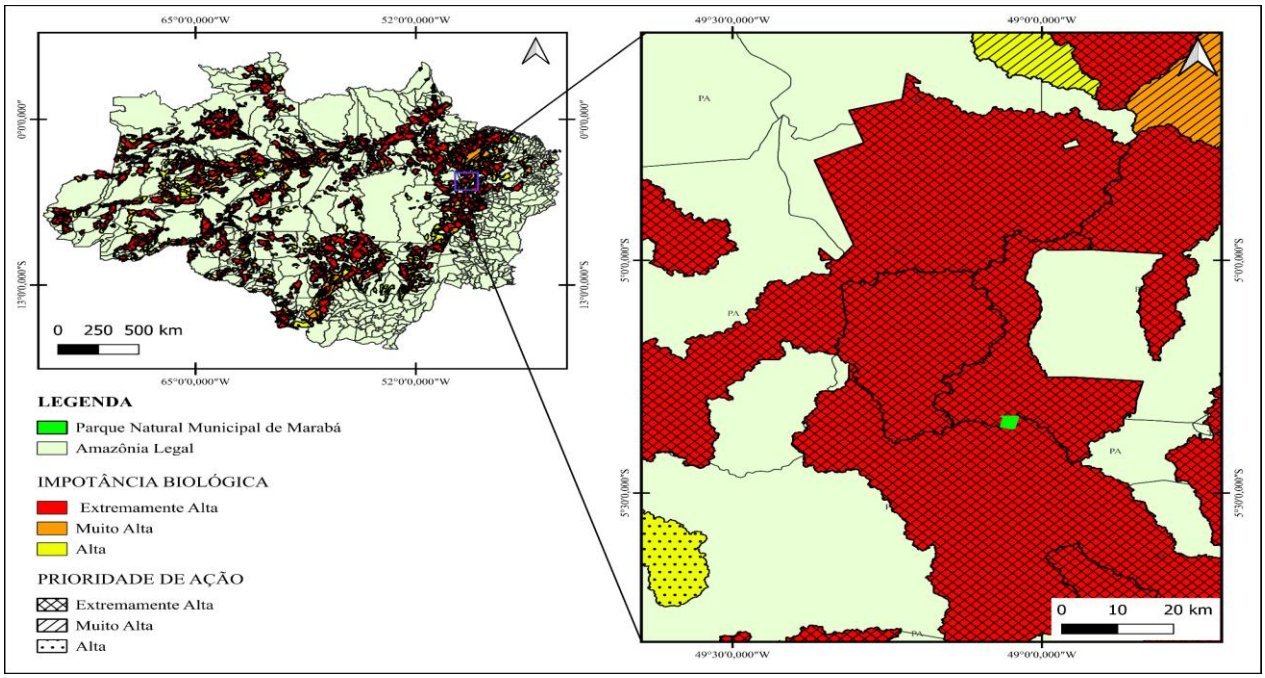
Create a Management Plan for the Conservation Unit of Full Protection of the Municipal Natural Park (PARNAMM), located in the municipality of Marabá-PA, in accordance with the National System of Conservation Units (SNUC).

LITERATURE REVIEW

The Priority Areas for the Conservation, Sustainable Use and Sharing of the Benefits of Biodiversity are characterized as a public policy instrument that aims to assist in decision-making, in an objective and participatory manner, on the implementation of appropriate measures for the conservation, recovery and sustainable use of Brazilian ecosystems. The definition of priority areas is based on the Systematic Conservation Planning (CSP) methodology, carrying out surveys of spatial information on the occurrence of species and ecosystems for the conservation of large biomes (Silva, 2012).

According to the National Plan for Protected Areas, present in the map of Priority Areas for Conservation, prepared by the Ministry of Environment and Climate Change, PARNAMM is a protected area, classified as of extremely high biological importance, whose priority for action is the conservation of the Amazon biome (Figueira et al., n.d.), (Figure 1).

***Figure 1**: Priority Areas for Conservation.*



Source: Authors.

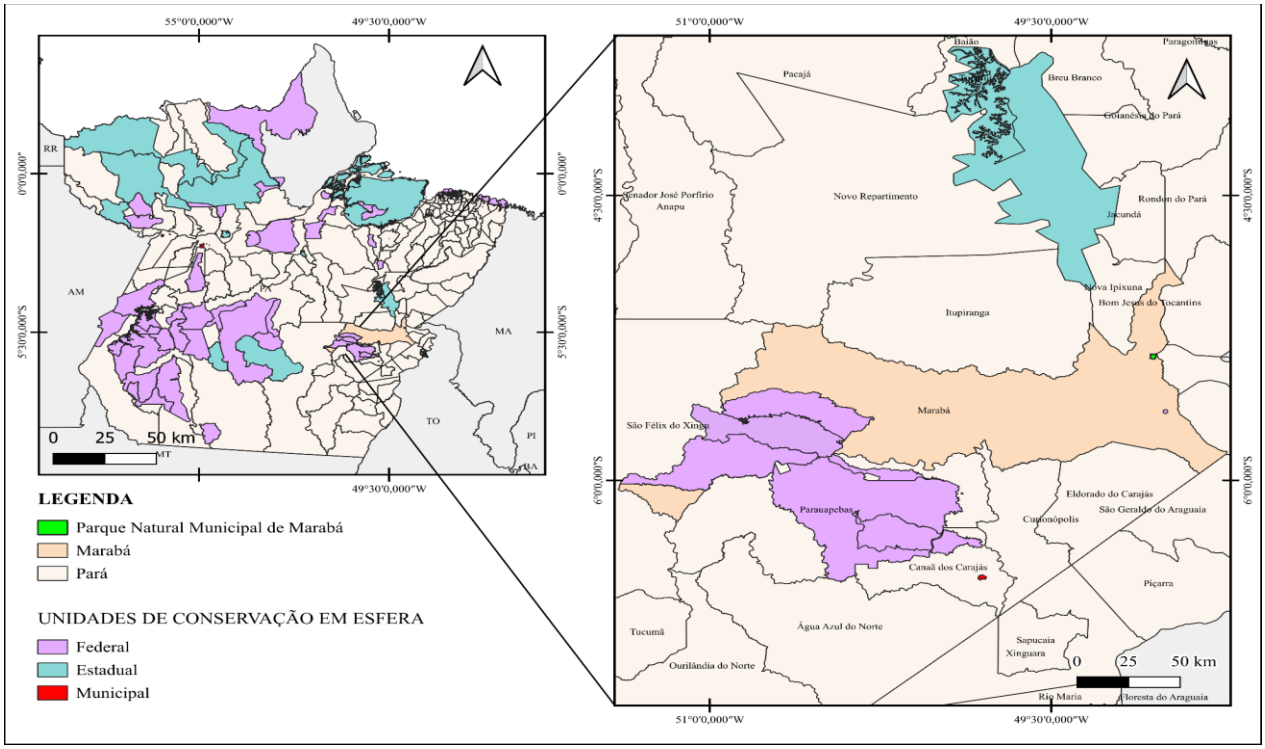
The Municipal Natural Park of Marabá is an important area for the conservation of the Amazon, not only because it is in an area of high biological importance, but also because of the anthropic pressure that tends to increase in its surroundings. As a UC of full protection, it ensures that ecological processes occur without anthropic interference, preserving the rich biodiversity present in its interior, thus ensuring the continuity of the environmental services it provides to the region, highlighting the protection of the banks of the Tocantins River.

In short, in the territory of Marabá, irregular occupation processes have been responsible for the high rates of deforestation recorded. Currently, there are several impacts generated by human activities in the region, essentially the opening of areas for urban advancement, with the excessive removal of Permanent Preservation Areas (APP) from the Tocantins and Itacaiunas Rivers, in addition to the opening of pastures and gardens, fishing and predatory hunting, logging and land grabbing.

This general context of imminent potential threats is no different in the PARNAMM region, with its borders limited by urbanization areas. Thus, the preservation of PARNAMM is strategic, ensuring the conservation of local biodiversity and promoting incentives for the sustainable development of its surroundings. The municipality of Marabá has 04 (four)

conservation units on a federal scale: Flona do Tapirapé-Aquiri, Flona do Itacaiunas, Rebio do Tapirapé and Private Reserve of Natural Heritage Fazenda Pioneira. There are no conservation units at the state and municipal scales, so the creation of PARNAMM is essential for bringing the population of Marabá closer to these conservation units and for the implementation of environmental education and awareness actions, (Figure 2).

Figure 2: *Map of Protected Areas in the state of Pará, focusing on the municipality of Marabá.*



Source: Authors

Thus, through Decree No. 7,850, of March 12, 2024, the Municipal Natural Park of Marabá was created with the objective of protecting samples of Amazonian ecosystems, especially the region on the banks of the Tocantins River. PARNAMM is important for the balance of the ecosystem and biodiversity, ensuring a source of food for several species of animals and protection of water bodies.

The proposed zoning aims to spatialize the technical-scientific considerations that guide each of the management actions proposed in this Plan. Such actions, related to the specific management zone, ensure that its objectives can be achieved, in the strictest ecological sense, so that the environmental integrity of the area continues to justify its protection.

Following the definition of zoning identified by Law 9.985/2000 (Geographic & 2021, n.d.), it is about defining sectors or zones, in a CU, through specific rules with the purpose of promoting the means and conditions so that the unit's objectives can be achieved in a

harmonious and effective way. In addition, in the quest to maintain the ecological balance of the CU, it is important to try to predict the possible environmental effects resulting from this process. With the objective of territorial planning with a view to planning, zoning seeks to encompass the constituent elements of the landscape (biotic, biophysical and anthropic), spatializing them, correlating them and, above all, considering their inherent potentialities and weaknesses. The zoning was built according to the information from the surveys, surveys and analysis of the scope of the Management Plan (field campaigns, participatory workshops, inserts and technical reports).

The process for defining the zoning of the Municipal Natural Park of Marabá (PARNAMM) was carried out through the use of three criteria. The first dealt with measurable or spatializable physical criteria, which took into account the degree of conservation of vegetation and environmental variability. The second covered the criteria indicative of the uniqueness of the CU, such as its representativeness, environmental susceptibility and the richness or diversity of species. The third and last is related to the indicative criteria for the vocation of use of the PARNAMM, based on the potential for environmental awareness and the presence of infrastructure.

Regarding zoning, we can highlight:

a) Intangible Zone (ZI) – it is where the primitiveness of nature remains as preserved as possible, not tolerating any human alterations, representing the highest degree of preservation. Dedicated to the integral protection of ecosystems, genetic resources, water resources and environmental monitoring. It works as a genetic matrix for the repopulation of other zones where human activities are allowed and its basic management objective is the preservation and guarantee of natural evolution. The Intangible Zone was determined according to the degree of environmental fragility of certain environments, state of conservation of vegetation and accessibility, in order to protect the banks of the Tocantins River. Currently, the area occupies about 154.6 ha.

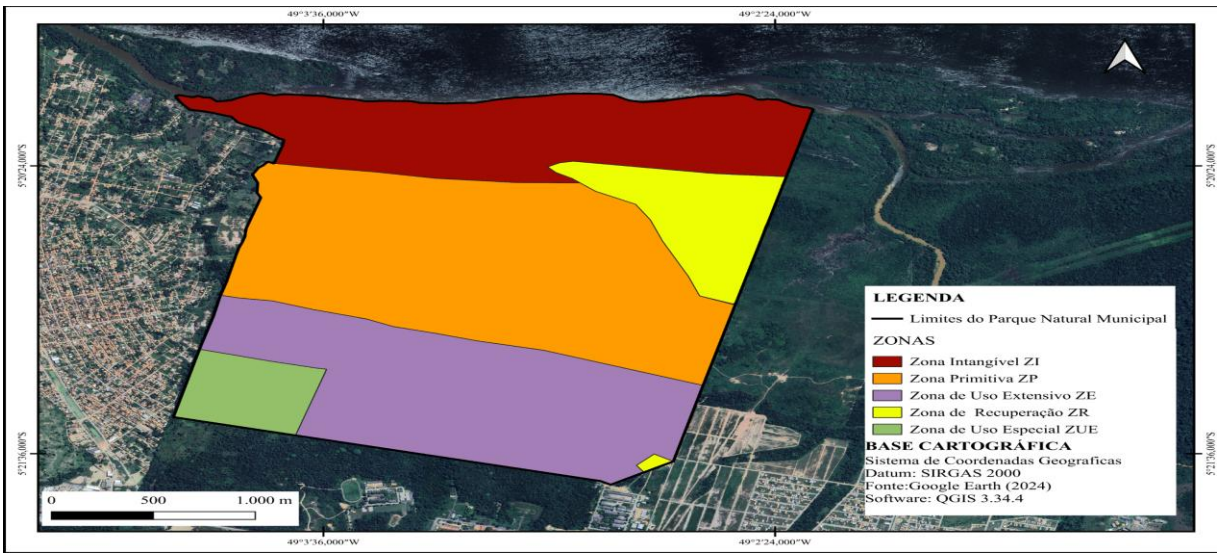
b) Primitive Zone (ZP) - is the one inserted in areas where there has been little or minimal human intervention, containing species of flora and fauna of great scientific value. It must have transition characteristics between the Intangible Zone and the Extensive Use Zone. The overall objective of the zone is the management and preservation of the natural environment, while facilitating scientific research and environmental education activities. This zone was pre-delimited according to the need for research and inspection associated with the existing infrastructure and trail, covering approximately 266.7 ha.

c) Extensive Use Zone (ZE) - is the one constituted mostly by natural areas, where there are little human alterations. The objective of the management is to maintain a natural environment with minimal human impact, although it offers easy public access, where the interpretation of the natural environment in its physical-biological conditions can be carried out through environmental education activities. The zone is strategically located near the access points to the 52nd Jungle Infantry Battalion. The Extensive Use Zones cover an area of about 189.1 ha. These zones will serve as support for the Special Use Zones and Support Points, considering that there should be areas for research related to the diversity and ecology of the species that make up the fauna and flora, for visitation for Environmental Education activities with communities, for monitoring the processes of regeneration of the vegetation in the area and for inspection.

d) Recovery Area (AR) - is the one that contains areas considerably altered or degraded by man. It is a transitory area, which, once recovered, will be incorporated into one of the areas pertinent to preservation, or permanent areas, to natural restoration, or naturally induced. The general objective of management is to retain the expansion of degradation and occupation, or to restore the structure and function of the CU. In PARNAM, two Recovery Areas were determined, where branches were opened for urban expansion. In total, the AR covers an area of about 57.8 ha. The protection of these areas in an area aims to recover the intention of promoting practices that aim to return natural ecosystems to their original stage.

e) Special Use Zone (ZUE) - contains delimited and restricted areas, intended for the administration, maintenance and services of the UC. These are areas chosen and controlled in such a way as not to conflict with their natural character and should be located, whenever possible, on the periphery of the unit. Only in this zone can laboratories, housing for employees, workshops, accommodation, lodging and other service facilities be implemented. The general objective of management is to minimize the impact of the implementation of the structures or the effects of the works on the natural environment of the unit. A SEZ1 with about 33.4 ha was established. (Figure 3).

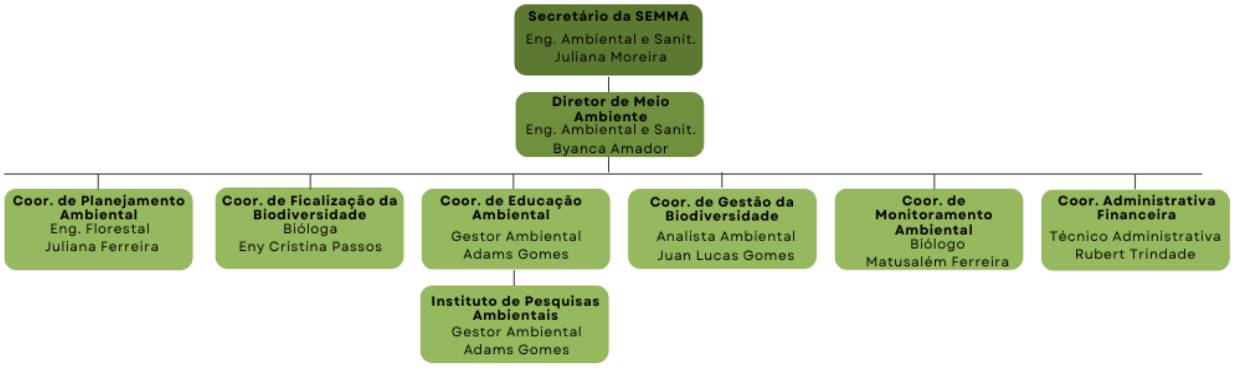
Figure 3: *Zoning of the Municipal Natural Park of Marabá.*



Source: Authors

The municipal conservation units of Marabá are managed by the Municipal Environment Secretariat - SEMMA, through the Environment Directorate. Currently, the technical staff is composed of: Secretary General, Environment Directorate, which, in turn, is subdivided into: Environmental Planning Coordination, Biodiversity Inspection Coordination, Environmental Education Coordination (which includes the Environmental Research Institute), Biodiversity Management Coordination, Environmental Monitoring Coordination and Administrative and Financial Coordination. As shown in figure 4.

Figure 4: *SEMMA organizational chart.*



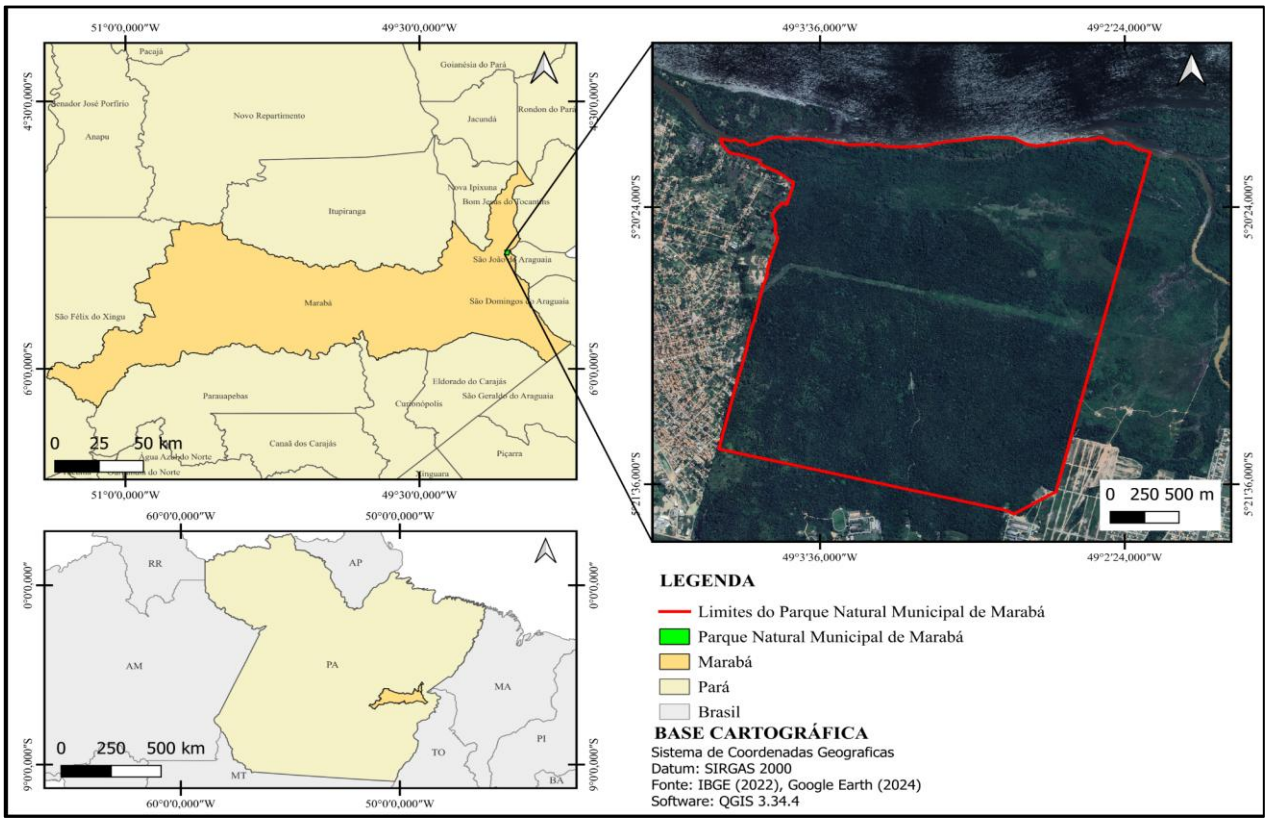
Source: Authors.

MATERIALS AND METHODS

The plan presented here is guided by the principles of sustainable development, regardless of whether or not they are defined by law. Another principle maintained since the

beginning of the data collection and consultation with local actors is its participatory character, a quality that should be maintained in all phases of its implementation, trying to respond to the new community and local realities. Participatory planning converges to enhance the positive aspects of economic and human development, which is why popular consultation was and will be part of the elements of success in its implementation. The Management Plan was carried out for the Conservation Unit of the Municipal Natural Park of Marabá (PARNAMM), (Figure 5). The UC is located between the geographic coordinates of latitude 5° 21' 26.00" South and longitude 49° 3' 23.71" West, with an extension of 701.6 ha, located in the mesoregion of Southeast Pará and in the microregion of Marabá-PA.

***Figure 5**: Location map of the Natural Park of the Municipality of Marabá-PA.*



Source: authors

The methodological procedures were carried out in some stages. The first focused on the study of the legislation and procedures related to the creation of conservation units and the registration of UCs in the SNUC. At this stage, the special object of study was Federal Law 9.985/2000, which established the National System of Conservation Units of Brazil (SNUC), Decree 4.340/2002, which regulates Law 9.985/2000, Ordinance 380/2005, which establishes the procedures for registration of UCs in the SNUC, in addition to the legislation regarding protected areas in Brazil. The objective of this stage was to understand the requirements and procedures necessary to create a UC in Brazil.

The methodology used for this work included the study of Federal Law 9.985/2000, which established the National System of Conservation Units of Brazil (SNUC), and Decree 4.340/2002, which regulates Law 9.985/2000, in addition to the integrated analysis of the physical, biotic and anthropic aspects of the UC, in order to understand the current condition of the environment and natural resources present in this area. In addition, legal-institutional aspects, the preparation of maps through the QGIS software (3.34.4) were analyzed in order to support the understanding of local aspects and the writing of the management instruments provided for in the management plan.

The characteristics of the physical environment (geology, water resources, climatology and pedology), the biotic environment (vegetation and fauna) and socioeconomic environment were surveyed, through primary and secondary information, with the subsequent correlation between them and the production of information, such as zoning and the definition of environmental compartments.

Thus, for the development of the physical diagnosis activities of the PARNAMM, the collection of information was based on secondary data from several institutions, mainly from the Brazilian Institute of Geography and Statistics (IBGE), as well as on a bibliographic survey in various thematic areas, covering aspects such as geology, pedology, climatology and water resources.

For the climatological diagnosis, referring to precipitation, the climatological water balance (BHC) of the region was prepared by the Thornthwaite and Mather method. To represent it, monthly historical data of total precipitation and average temperature in the 10-year period were used, considering the years 2011 to 2021. The data were obtained from the database of the National Institute of Meteorology (INMET) and HIDROWEB. For the soil water capacity (CAD), an average of 125 mm was considered, according to Dias and Gomes (2013). The data were obtained from the database... - Google Scholar (n.d.). And, from the initial data of precipitation (P), annual potential evapotranspiration (ETP) and available water capacity (CAD), it was possible to determine the monthly water balance for the municipality of Marabá-PA (Medeiros et al., n.d.).

The objective of this diagnosis is to provide a detailed and comprehensive understanding of the natural environment present in the protected area, as well as to provide a solid basis of knowledge and characterization about the natural environment of the conservation unit, in order to provide subsidies for the environmental zoning and planning of the Municipal Natural Park. In the diagnosis of the biotic environment, it was based on two moments. Secondary data from bibliographies and research institutions were used, along with a diagnosis elaborated from the collection of primary data carried out

through on-site visits, for the survey of fauna and flora. The diagnosis of secondary data included information obtained for the municipality of Marabá-PA, where the survey and analysis of the main studies carried out were carried out, in order to obtain similar information on the fauna and flora for the Protection region.

For the primary data, first, a visual evaluation of the species obtained by the IBGE was carried out, in order to previously identify the different existing typologies, confirming the terrestrial reality at the time of the field visit. The methodology used to collect information for the anthropic environment was based on a primary survey with on-site visits and interviews with the population, complemented with information in the literature.

RESULTS AND DISCUSSIONS

The creation of the Municipal Natural Park has as its main role to contribute to the minimization of environmental problems, such as the stabilization of the microclimate, protection of fauna and flora, geotechnical stability, protection of water sources, among other aspects that can improve the regional situation. It should also contribute to the improvement of socioeconomic conditions, with the generation of employment and revenue for the municipality through ecotourism. Thus, the unit is seen as an agent that contributes to the development of the municipality.

Regarding meteorological aspects, the State of Pará is characterized by the presence of the Equatorial Climate with a subdrought season, that is, the dry period can vary from one to three months depending on the geographical location. The influence of maritimity and continentality plays a significant role in shaping the state's climatic conditions. Such conditions are influenced by the action of the following equatorial atmospheric systems: Continental Equatorial Mass (MEC), North Atlantic Equatorial Mass (MEAN) and the Intertropical Convergence Zone (ITCZ). The degree of influence of these systems determines the distribution of temperature and average monthly precipitation in this region of the Amazon rainforest.

Figure 6 presents data referring to precipitation in the period from 1961 to 1990 for the municipality of Marabá-PA, where the water balance of the region was carried out by (Dias et al., n.d.). That was observed between the months of January to May and from November to December, the potential and actual evapotranspiration indices coincide, which indicates that the maximum evaporization for the months in the analyzed period, under the observed climatological conditions, was reached, characterized by the high rainfall volume, where the evapotranspiration rate is lower than the water load. For the other months, the actual evapotranspiration is lower than the potential evapotranspiration, a factor due to the

high temperature and low volume of precipitation during the period. It is also noted that the month with the highest water volume in the analyzed period is March, and with the lowest volume is the month of August.

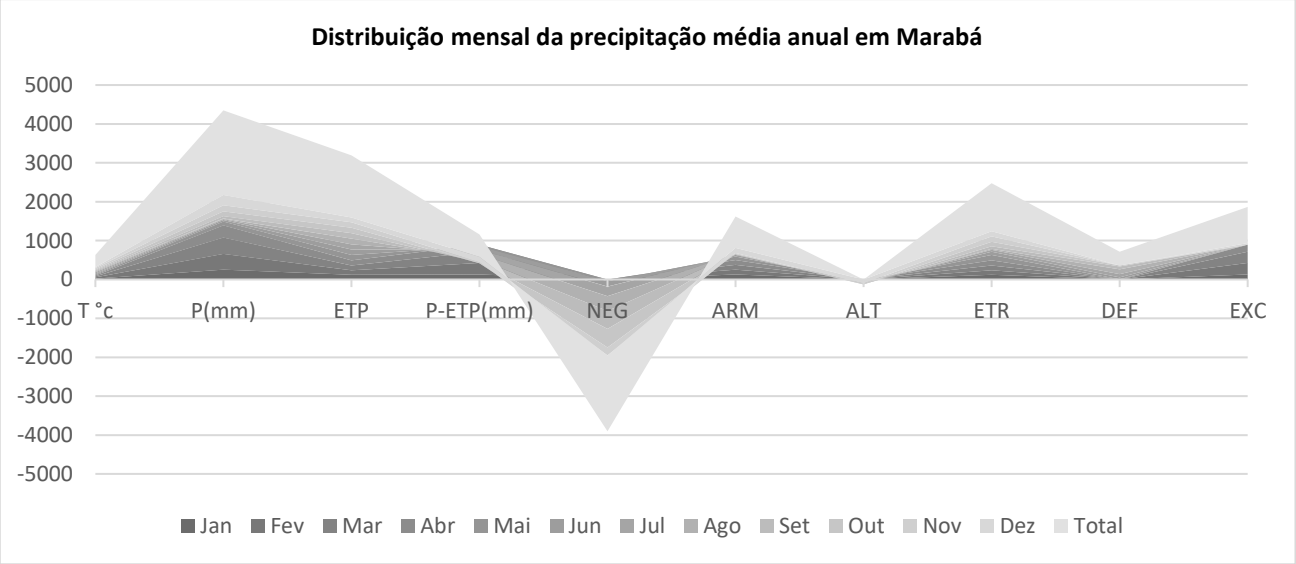
Figure 6: Climatological water balance by the method of Thornthwaite and Mather (1955) for the period from 1961 to 1990 Marabá – PA.

Table 1 Climatological water balance.										
Months	**T °C**	**P(mm)**	**ETP**	**P-ETP (mm)**	**NEG**	**ARM**	**ALT**	**ETR**	**DEF**	**EXC**
Jan.	25,9	253,3	123,6	129,7	0	125	0	123	0	129,7
Feb.	25,7	405	112,1	292,9	0	125	0	112,1	0	292,9
Sea.	25,9	421,1	127,7	293,4	0	125	0	127,7	0	293,4
Apr.	26,3	313	130,8	182,2	0	125	0	130,8	0	182,2
Mai.	26,6	97,6	140,9	-43,3	-43,3	88,42	-36,58	134,2	6,7	0
Jun.	26,4	38,5	132,6	-94,1	-137,4	41,65	-46,77	85,3	47,3	0
Jul.	26,3	24	135,1	-111,1	-248,5	17,12	-24,53	48,5	86,6	0
Aug.	26,9	14,6	146,8	-132,2	-380,7	5,95	-11,17	25,8	121	0
Set.	26,9	62,9	142,1	-79,2	-459,9	3,16	-2,79	62,7	76,4	0
Out.	26,6	121,9	140,9	-19	-478,9	2,71	-0,44	122,3	18,5	0
Nov.	26,5	156,3	134,5	21,8	-203,4	24,55	21,84	134,5	0	0
Ten.	26	266	129,6	136,4	0	125	100,45	129,6	0	36
Total	316	2174,2	1596,7	577,5	-1952,1	808,56	0,01	1236,5	356,5	934,2

Source: (Dias1 et al., n.d .)

Figure 7 shows that the municipality of Marabá has water deficit in the months of May to October, due to the arrival of the dry season, characterized by low rainfall volumes, resulting in ETP values higher than rainfall rates. In addition, the seasonal division of rainfall into two periods was verified: a dry season between June and October and the rainy season distributed among the other months.

Figure 7: *Monthly distribution of average annual precipitation (mm) and potential evapotranspiration (ETP) (mm) in Marabá, from 1961 to 1990.*

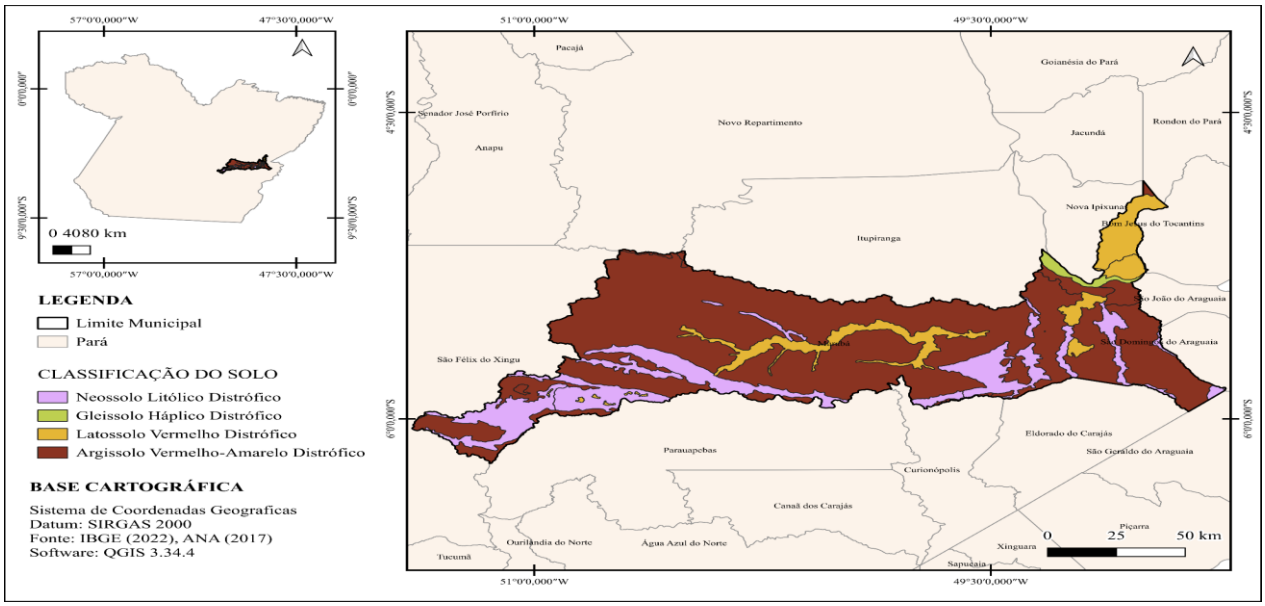


Source:. (Dias1 et al., n.d .)

In the municipality of Marabá, four types of soils were identified, namely: Dystrophic litholic Neosolsol, Dystrophic haplic Gleisol, Dystrophic red Latosol, Dystrophic red-yellow Argisol, distributed throughout the territory.

According to Figure 8, the main type of soil was identified in the area of the Municipal Natural Park: the ultisol, being framed as Dystrophic Red-Yellow Ultisol (PVAd). They are soils with a non-plinthic textural B horizon and distinct individualization of horizons with regard to color, structure and texture, which is lighter in A (sandier) and heavier (more clayey) in B, with colors ranging from red to yellow and Fe2O3 contents, usually small. They are deep to shallow, moderately to well-drained, with a very variable texture, but with a predominance of medium texture in A and clayey in the Bt horizon, with or without the presence of gravel. Soils with sandy texture in A and medium in B, or only clayey or medium along the profile, are less frequent. Occasionally, stones may occur in some of these soils (Felipe, n.d .).

***Figure 8**: Pedology in the municipality of Marabá.*



Source: authors

In general, it can be said that the Podzolics (Ultisols) are soils very susceptible to erosion, especially when there is a greater difference in texture from A to B, presence of gravel and relief with strong slopes. The ultisols have good agricultural suitability since they do not have significant limitations for the sustained production of a given type of use, observing the conditions of the management considered. There are a minimum of restrictions that do not significantly reduce productivity or benefits and do not increase inputs above an acceptable level (Felipe, n.d .).

The geology of the city of Marabá is geologically located in the area of the Araguaia Shear Belt. This geotectonic unit is composed of Neoproterozoic rocks of low metamorphic grade that stand out in the northern central sector of the Tocantins Province, located on the eastern edge of the Amazon Craton. It represents an important crustal segment of the

succession of repeated orogenic events that contributed to the formation of the supercontinent Gondwana at the end of the Neoproterozoic (Felipe, n.d .).

Marabá outcrops geological units of the Neoproterozoic (Couto Magalhães Formation) and the Lower Cretaceous (Itapecuru Formation) as well as Quaternary deposits. More recent studies carried out in the vicinity of Marabá show the outcropping of geological units of the Upper Cretaceous (Ipixuna Formation), Miocene (Barreiras Formation) and Pliopleistocene (Post-Barrier Sediments) (Felipe, n.d .).

In the area of the PARNAMM Park, the Tocantins River was identified passing to the west of the protection area. Where, the Tocantins River Basin covers lands in the states of Goiás, Mato Grosso, Tocantins, Pará and Maranhão, in addition to the Federal District. The total drainage area of the Tocantins River Basin is 767,000 km², distributed by Tocantins itself (343,000 km²), Araguaia (382,000 km²) and Itacaiunas (42,000 km²). The total area of contribution to the Tucuruí reservoir is 758,000 km², of which 98% is controlled by the Marabá gas station, on the Tocantins River, and Fazenda Alegria, on the Itacaiunas River

The basin has a monotonous relief, with altitudes ranging from 200 to 500 meters, has a reasonable drainage density and tributaries of considerable size. The dry season occurs from August to October, and the high water period from February to April. Its hydrograph is characterized by large peak flows and, given that the basin is devoid of wetlands, there is a high potential for flooding (CHAVES, 2011).

The hydrography in the area covered by the Municipality of Marabá belongs to the entire basin of the Tocantins/Araguaia rivers, highlighting in the area the basin of the Itacaiunas River that bathes the entire municipal area, entering the Municipalities of Parauapebas, Curionópolis and Eldorado do Carajás. Considering the area of the Municipality, its hydrography can be divided into ten hydrographic basins, namely: basins of the rivers Aquiri, Cinza, Tapirapé, Preto, Itacaiunas, Parauapebas, Vermelho, Sororó, Tauarizinho and Tocantins. The hydrographic basins totally inserted in the area of the Municipality are the basins of the Tapirapé, Cinza and Preto rivers, the others have part of their areas belonging to the Municipality.

Thus, the main river in the PARNAMM region is the Tocantins, which is the relevance of the protection unit for the preservation of APP areas, to ensure the non-degradation of the river bank that interferes with the quality of the water and results in the silting of the river. From the diagnosis of the physical environment, it was possible to obtain an understanding of the potentialities of the natural resources and the environmental sensitivities present in the Municipal Natural Park of Marabá.

Among the main potentialities associated with the physical environment, the following stand out: the excellent availability of water resources, both in quantity and quality, provided by the Tocantins River; the presence of remarkable landscapes with tourist potential; the capacity to generate electricity; the existence of soils with good agricultural suitability; and the availability of timber resources that can be managed sustainably. As for environmental sensitivities in the region, there is a potential risk of soil erosion due to inadequate management.

Based on the thematic areas addressed in the report on the physical environment, we identified the various characteristics that make up the local landscape and the different levels of environmental sensitivity. These particularities served as the basis for the definition of environmental zoning in the Municipal Natural Park.

In the region where the PARNAMM is located, there is a great diversity of vegetation, with forests present in the region of Marabá, maintaining an important stock of these tree species, especially when we take into account the fact that the region surrounding the Natural Park is composed mainly of anthropized areas, with a predominance of houses around the unit.

The park's vegetation is characterized by dense ombrophilous forests, which are characterized by the habits or life forms of phanerophytes, as well as abundant woody and epiphytic lianas, which distinguish them from other classes of vegetation formations. However, the main characteristic for this forest classification lies in the ombrophilous environment, as a climatic factor. When analyzing the vegetation cover of the region, the presence of typical upland forests is observed, which include both dense and open ombrophilous forests.

The dense ombrophilous forest is predominant on hilltops (montania) and in patches of varying size, generally found in forest matrices where open ombrophilous forest predominates, especially in hilly terrains (submontane). The open ombrophilous forest has three distinct typologies, depending on the predominance of lianas, bamboo or palm trees. In the lower areas near watercourses, it is common to find dense alluvial rain forest, which also includes açaí plantations. In addition to these formations, the PARNAMM region and its surroundings are home to areas of secondary forest. Finally, in the surroundings of the Park, anthropized areas with secondary vegetation predominate, with houses in the surroundings.

According to the fauna survey carried out in the area of the Municipal Natural Park of Marabá, it was possible to identify 24 species of mammals and birds present. Of these 24, eight belong to the group of ground birds (inhambus, guans, jacumins), one to birds of prey

(owl) and the remaining 15 to the group of medium and large mammals. Some recorded mammals belong to the group of animals classified as at some degree of threat of extinction, such as the jaguar (Panthera onca), puma (Puma concolor), Moorish cat (Leopardus geoffroyi), tapir (Tapirus terrestris) and white-lipped peccary (Tayassu pecari). It is important to highlight the presence of a critically endangered bird species (Crax fasciolata) or curassow. The fact that so many species belonging to the endangered fauna have been found contributes significantly to the classification of the area as irreplaceable from a conservationist point of view, and it is still possible to infer that this region may be one of the only areas that is still capable of maintaining the fauna of large mammals in the Marabá region.

In the ichthyofauna, the species present in the Tocantins River were identified, namely: the mapará (Hypophthalmus marginatus), the white hake (Plagioscion squamosissimus), the peacock bass (Cichla piquiti) and the jatuarana (Hemiodus unimaculatus). Aspects of fisheries biology are addressed. From the analyzes carried out and the others considered in this diagnosis, they were decisive to support the zoning, its regulation and the management programs.

As observed, the fauna of the PARNAMM region is fundamental for the adoption of conservation strategies capable of ensuring the maintenance of the high diversity of species and the processes that sustain the Amazon region. The global scale, the different landscapes and types of vegetation, and the occurrence of rare species indicate the need to maintain a network of protected areas. In this way, PARNAMM aims to preserve this region, which serves as a habitat for several species of fauna and flora.

In general, the occupation of the region of the Municipal Natural Park of Marabá and its study area is divided between protected areas and urban occupation, and in anthropized areas, there is a growing dynamic related to urban activities. Agricultural activities, in turn, are well developed and with a lot of representation in the municipality, since the economy of Marabá revolves around agricultural activities, industry and services.

Regarding the housing areas around the park, it was foreseen that the city government would assume the commitment to compensate the residents and their resettlement through the creation of the Marabá Housing Cooperative. With regard to compensation, the amounts are sufficient for the acquisition of new housing, however, they are also supported by resettlement by the cooperative.

Below we show the technical sheet of the MUNICIPAL NATURAL PARK OF MARABÁ.

TECHNICAL SHEET OF THE MUNICIPAL NATURAL PARK OF MARABÁ
Manager – Name of the Technical Responsible
Park Area: 701.76 ha
Goals:
Ensure the protection of significant natural areas, promote biodiversity, provide opportunities for research and environmental education, ensuring the sustainable use of natural resources for present and future generations, as well as the realization of ecotourism and leisure for the whole society.
Attributes
Biodiversity and water resources....
Attractive
Trails, leisure and social integration.
Park Staff:
01 Managers 02 Environmental Educational Monitors 03 Maintenance Team 04 Security Guards 05 Administrative Assistants 06 Tour Guide 07 Event Staff
Activities to be developed
Environmental education activities, with an annual programming calendar, with an emphasis on public use; Training of local environmental monitors. Ecotourism.

With this, ensuring the protection of significant natural areas, promoting biodiversity, providing opportunities for research and environmental education, ensuring the sustainable use of natural resources for present and future generations, as well as the realization of ecotourism and leisure for the whole society.

Regarding research, there are guarantees for the protection of significant natural areas, to promote biodiversity, providing opportunities for research and environmental education, ensuring the sustainable use of natural resources for present and future generations, as well as the realization of ecotourism and leisure for the whole society.

Regarding visits, currently, there is no organized or allowed visitation at PARNAMM. As it is a category of Conservation Units (UC) of full protection that only allows visitation for educational purposes, this activity must be planned seriously and cautiously before its implementation. So far, the unit has received researchers associated with the Institute for Environmental Research. However, the unit has the potential to receive visitation for educational purposes, with the main purpose of stimulating environmental awareness in favor of ecological issues related to PARNAMM or the problems that affect the region. Thus, it awakens in the inhabitants the interest in environmental issues related to the PARNAMM and its surroundings, of which they are an intrinsic part.

FINAL CONSIDERATIONS

In general, it can be considered that the fauna and flora present in the PARNAMM have a good state of conservation; However, to maintain this quality, it is necessary to limit

the use of the place. One of the alternatives will be to maintain more extensive and integral areas of the forest on the margins of the park, reinforcing inspection to avoid human occupation, both for housing and for illegal hunting.

Remembering that the management plan is composed of a series of steps and information that can be subdivided and broken down into different aspects to ensure the creation of the CU; management should be accompanied by comprehensive monitoring of the UC, for example: diagnosing the areas when necessary, meeting proposed goals and objectives, respecting zoning and delimiting the boundaries of management areas, creating new conservation strategies whenever necessary and monitoring the park appropriately.

Management plans should be reviewed regularly in view of changes in environmental conditions and the objectives set. If decisions need to be remade, they should be approved by the competent authorities and made available to the public. The Conservation Unit-UC (Municipal Park) is a complex process that also involves steps such as defining the objectives of the Management Plan before starting the process.

Biodiversity conservation, environmental education, sustainable use of natural resources, data collection, economy and water resources were taken into account. Better understanding the area and its conservation needs, identifying problems and threats, assessing issues related to deforestation, illegal hunting, invasions, illegal mining, environmental pollution, definition of management zones, standards and guidelines, action plan, implementation of training programs, intensification of patrols and inspection, development of ecological restoration projects, ecological corridors, progress of actions, consulting experts, local (traditional) community, non-governmental organizations and traditional knowledge. Remembering that, in article 225 of the Federal Constitution of 1988, it is defined that "Everyone has the right to an ecologically balanced environment, a good for the common use of the people and essential to a healthy quality of life [...]" (BRASIL, 1988, art. 225) (Andreotti et al., n.d.).

The results referenced in this work detail a high potential of environmental goods and services, with the objective of providing an essential public service to the community, preserving the current Conservation Unit (Municipal Natural Park) and respecting future generations. Providing and optimizing opportunities and dynamism to the diversity of fauna and flora in the municipality and region, we present the Plan for the creation of the Municipal Natural Park of Full Protection located in the Municipality of Marabá-PA, in accordance with the National System of Conservation Units – SNUC (Terra Cerezini & Nunes de Castro, 2022b).

REFERENCES

1. Andreotti, R., et al. (2023). The reflections of Article 225 of the Constitution of the Federative Republic of Brazil of 1988 in the creation of the Serra Azul State Park. *Interfaces: Revista de Extensão e Pesquisa*. https://periodicos.unicathedral.edu.br/index.php?journal=revistainterfaces&page=article&op=view&path%5B%5D=783

2. Chaves, P. (2011). *Observational study on meteorological and hydrological drought events in the region of Marabá-PA in the southeast of Eastern Amazonia* [Unpublished dissertation or thesis]. Federal University of Pará, Belém. http://repositorio.ufpa.br/handle/2011/6857

3. Dias, J., et al. (n.d.). Study of the climatological water balance and Thornthwaite climate classification for the city of Marabá-PA. In *Annals of [Name of Event Not Specified]*. SBAgro. http://www.sbagro.org/files/biblioteca/3008.pdf

4. Do, M., et al. (2021). Collection of telecommunication structures located within full protection conservation units, within the scope of Minas Gerais. *Brazilian Journal of Development*, *7*(9), 91041–91056. https://doi.org/10.34117/bjdv7n9-320

5. Educacional, C., et al. (2023). Governador Valadares Municipal Natural Park, leisure and body practices: Case report in interface with physical education training. *Brazilian Journal of Physical Education, Sport, Leisure and Dance*, 1–20. https://doi.org/10.5281/zenodo.14183066

6. Felipe, L. B. (n.d.). *Geology, geomorphology and morphectonics of the region of Marabá-PA*. [Publisher not specified].

7. Figueirôa, A. C., Eymael, M., & Scherer, G. (n.d.). Planning for conservation. In *Reflections on conservation biology* (pp. 35–[final page not specified]). Belém: Museu Paraense Emílio Goeldi. https://repositorio.museu-goeldi.br/jspui/bitstream/mgoeldi/1508/1/reflexoes-em-biologia-da-conservacao_v1.pdf#page=35

8. Geber, F., et al. (2022). Educational potential in a conservation unit: The case of the Municipal Natural Park of Governador Valadares (MG). *Journal [Name of Journal Unspecified]*. https://pdfs.semanticscholar.org/d766/2779c66a5c756240d100872b13ea81902472.pdf

9. Geographic, H. S. F. (2021). Evolution of environmental zoning in national parks in the state of Rio de Janeiro. *Acta Geográfica*. https://revista.ufrr.br/actageo/article/view/3414

10. Google Scholar. (n.d.). [Data from 2011 to 2021 obtained from the database of the National Institute of Meteorology (INMET) and HIDROWEB]. https://scholar.google.com/scholar?hl=pt-BR&as_sdt=0%2C5&q=2011+a+2021%2C+os+dados+foram+obtidos+no+banco+de+dados+do+Instituto+Nacional+de+Meteorologia+%28INMET%29+e+HIDROWEB&btnG=

11. Lopes da Silva, E., & Maria, S. (2016). *Born in Serra do Segredo (Caçapava do Sul, RS, Brazil): A dialogue between geoconservation and the National System of Conservation Units (SNUC)* [Unpublished dissertation or thesis]. Federal University of Santa Maria, Santa Maria. https://repositorio.ufsm.br/handle/1/9469

12. Medeiros, B., et al. (2016). Climatic analysis in São João do Cariri-PB, based on the climatological water balance. *Brazilian Journal of Physical Geography*, *9*(3), 842–852. https://www.redalyc.org/pdf/4675/467547716027.pdf

13. Silva, C. (2012). *The use of systematic conservation planning in the zoning of conservation units in Amazonas* [Unpublished dissertation or thesis]. National Institute of Amazonian Research, Manaus. https://repositorio.inpa.gov.br/handle/1/11889

14. Terra Cerezini, M., & Nunes de Castro, C. (2022). The national system of nature conservation units (SNUC) and the preservation of the Caatinga. *Boletim Regional, Urbano e Ambiental*, *27*. https://doi.org/10.38116/brua27art4

15. View of the Federal Supreme Court of Brazil. (n.d.). *Observatory: Electronic Journal of Public Law*. https://www.portaldeperiodicos.idp.edu.br/observatorio/article/view/282/222.