Trail system classification of the conservation unit Pau-Ferro Forest State Park, Areia, Paraíba, Brazil

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INTRODUCTION

The implementation of conservation units to safeguard biodiversity constitutes man's main reaction face to the degradation of ecosystems in Brazil and the world (Myers *et al.*, 2000; Primack & Rodrigues, 2001; Aguiar *et al.*, 2013). The main juridical instrument of creation from Conservation Units in Brazil is the Law 9.985, of 2000, which institutes the National System of Conservation Units (SNUC), of which establishes parameters and categories of management with different protection degrees, that is divided into Units of Integral Protection and Units of Sustainable Use.

The category Park is in the group of integral protection units whose basic objective is to preserve nature, being allowed only the indirect use of its natural resources, educational activities, scientific and recreational. In Paraíba state, among the conservation units of the Atlantic Forest, Pau-Ferro Forest State Park, in Areia municipality, shelters one of the greatest fragments, it is one of the most representatives of the Northeast region (Tabarelli & Santos, 2004). It is a fragment of Seasonal Forest Semi deciduous Montana (Ombrophylous Forest), situated on the eastern slope of the Plateau of Borborema, in a condition of refuge or altitude swamp (Veloso *et al.*, 1991; Ab'Saber, 2003; Tabarelli & Santos, 2004; Bétard *et al.*, 2007; Medeiros & Cestaro, 2019).

Although it has such importance, the UC still doesn't have the trails mapping, nor the extension of them, demonstrating the visitation activities happen into informal conditions, i.e., without infrastructure and necessary orientations. This conjuncture prevents measuring and estimating the impacts of the said activity at the unit, considering that is not known for sure where it happens.

Because it is an important touristic place of Brejo Paraibano, the elaboration of such a product will pronounce, in a more assertive way the touristic potential, and will elicit the realization of research and environment educational practices, points that are among the goals pursued by the Park category. Given the above, this article proposes mapping the trails of Pau-Ferro Forest State Park and its difficulty classes, aiming to provide contributions to the survey of touristic potentials and dissemination of the area's importance to protect biodiversity.

METHODOLOGY

The municipality of Areia located at Paraíba state, seated on the wet edge of Borborema Plateau in a condition of altitude swamp. The Pau-Ferro Forest State Park is located in the rural area of the municipality, presenting an area of 607.96 hectares. The protected area was created on October 19, 1992, as an Ecological Reserve and recategorized to the state domain park category, through a State Decree No. 26.098, of August 4, 2005, starting to form the Pau-Ferro Forest State Park (Decree No. 26.098, of August 4, 2005, 2005).

Given the above, for the work development at the Conservation Unit was used the following materials: radar image with a Digital Terrain Model – MDE with a resolution of 12.5 m ALOS/PALSAR; Sentinel-2 satellite image, *MSI* sensor; the cartographic base of Brazil, Northeast, Paraíba and the municipality of Areia; polygon in *shapefile* format of the Conservation Unit; portable *GPS* device model *Etrex Garmin* Vista; Android *GPS Essentials* app version 4.4.27; Photographic camera; and ArcGIS *Software* version 10.2® and Excel.

The fieldwork took place on August 10, 11 and 29, 2019, and March 10, 2020. With aid of a local tourist guide, all trails were crossed and a photographic record of the main attractions along the paths was taken. All the trails, as well as all attractions, were recorded in the portable GPS and also in *GPS Essentials* automatically. The visit in March was accomplished aiming to verify the updates suffered by the trails.

The GPS data were manipulated in *ArcGIS software* to the elaboration of the trail map, while the application's trails were used for their validation. Subsequently, the paths of the trails were superimposed with maps of altitude and declivity generated from the MDE, and, later, was done the extraction of information that was used for the elaboration of graphics.

To map the classes of difficulties presented by the trails, was used the methodology adapted by Silva (2016), Silva, Lima and Panchaud (2016), and Silva and Palhares (2020), which is based on the attribution of grades, overlapping and summation of the environmental variables' declivity, vegetation coverage, terrain conditions and water drainage, with geoprocessing use, to verify the trails degrees of difficulty.

For this purpose, with the *ArcGIS* use, the variables' declivity, vegetation coverage, terrain conditions and water drainage were divided into classes, later received grades from 1 to 4 and were reclassified as very easy, easy, moderate and difficult - according to the difficulties that offer to the trails' accomplishment. The declivity and drainage were obtained from the MDE processing in *ArcGIS* software, the latter was generated from the curves of the terrain level.

The vegetation coverage information was obtained from the supervised classification of a Sentinel-2 satellite image, in the ArcGIS software, using the *Maximum Likelihood* classifier, where the following classes were found: high vegetation, medium vegetation, and lower vegetation. The terrain conditions, in turn, were obtained from the vegetation coverage, given that the obstacles found on the surface of the trails refer, in the study area, to fallen trees, which are more frequent in areas with high vegetation.

All the environmental variables were generated in raster format, in which, after assigning grades, it was realized their summation using *ArcGIS.* Subsequently, the product obtained from the summation was reclassified based on the final grades and converted to *shapefile* format. Finally, the *shapefile* archive, with the difficulty classes, was used to cut out the mapped trails, allowing to verify the difficulty levels found in them.

235

MAIN RESULTS

In total, were mapped 4 trails, 2 integrations that connect the trails, and 4 main points of the landscape that works as tourist attractions (map 2). The mapped trails were Trilha Inicial, Trilha do Cumbe, Trilha das Flores and Trilha da Barragem, while the mapped integrations are named Integração 1 and Integração 2. The attractive points, therefore, are Munguba, Cachoeira, Barragem and Casarão.

Throughout the trails, most of the time, the visitors' field of vision is limited by the stalks and crowns of the trees, being common the sighting of birds and mammals. The soil, in turn, appears without vegetation coverage for most of the path and is also verified stretches with organic covers, such as seedlings, leaves, branches, fruits, and animal waste that inhabit the area. Open-air sections also occur, where the field of vision

is expanded, these, however, are situated in clearings located in the central portion of the Park, as well as in the southern portion, where the vegetation is smaller.

In relation to the classes of difficulty presented by the trails, it was found that the highest percentage of the Park's trails is classified as "easy", given that the class comprises 67.41% of the trail system. The "very easy" class occupies 16.49% and manifests itself significantly in the northern and southeastern portions. The routes classified as moderate occupy 15.96% and occur mostly in the central and southern parts of the area. On the other hand, the routes classified as "difficult" have the lowest representation in terms of distance, occupying only 0.13% of the system, having their occurrence restricted to the central portion, where is located Integração 2.

The predominance of the easy difficulty class also reveals the non-requirement of physical conditioning for the traffic. However, as the class is distributed in fragments on the trail system, it is necessary to observe whether the difficulty classes that are present in between them do not constitute obstacles to visitors. The recommendation is strengthened when dealing with the central portion of the Park, where is found the difficult class, although in a smaller percentage.

CONCLUSION

The Pau-Ferro Forest State Park has a system consisting of 4 trails, 2 integrations, and four points in the landscape that works as main tourist attractions, in which most of the routes are classified as easy, i.e., they do not require greater physical effort for their realization. In addition, the Park is surrounded by residents who develop sustainable economic activities associated with the Conservation Unit, such as ecotourism, with the possibility of expansion to a greater number of people.

This conjuncture reinforces the tourist potential of the Conservation Unit to receive several groups of visitors at the same time, as well as consolidating itself as one of the most appropriate spaces for the achievement of visiting and of interpreting trails in the state of Paraíba, in addition to contributing to the income of local residents. These aspects are reinforced by the fact that it is one of the greatest remaining Atlantic Forest in the state in altitude swamp, and is home to endangered species. In this way, the dissemination of the area's importance, the increase in number of visitors, and the implementation of adequate structures to maintain visitation can raise financial resources and new perspectives for protecting the area.

236