Landscape changes of the Environmental Protection Area of Iguacu in Curitiba, Paraná, Brazil

Patrícia Costa Pellizzaro, Marissa Malanski Magalhães, Letícia Peret Antunes Hardt, Carlos Hardt

Postgraduate Program in Urban Management (Programa de Pós-Graduação em Gestão Urbana, PPGTU), Pontifical Catholic University of Paraná (Pontifícia Universidade Católica do Paraná, PUCPR), Curitiba, Paraná, Brazil, and Department of Architecture and Urbanism, Alto Vale do Rio do Peixe University (Universidade do Alto Vale do Rio do Peixe, UNIARP), Caçador, Santa Catarina, Brazil

Department of Architecture and Urbanism, Architecture and Design School (Escola de Arquitetura e Design, EArdD), Pontifical Catholic University of Paraná (Pontifícia Universidade Católica do Paraná, PUCPR), Curitiba, Paraná, Brazil

Postgraduate Program in Urban Management (Programa de Pós-Graduação em Gestão Urbana, PPGTU), Pontifical Catholic University of Paraná (Pontifícia Universidade Católica do Paraná, PUCPR), Curitiba, Paraná, Brazil

Postgraduate Program in Urban Management (Programa de Pós-Graduação em Gestão Urbana, PPGTU), Pontifical Catholic University of Paraná (Pontifícia Universidade Católica do Paraná, PUCPR), Curitiba, Paraná, Brazil

Correspondence Author: Patrícia Costa Pellizzaro, Postgraduate Program in Urban Management (Programa de Pós-Graduação em Gestão Urbana, PPGTU), Pontifical Catholic University of Paraná (Pontifícia Universidade Católica do Paraná, PUCPR), Rua Imaculada Conceição, 1.155, Bloco 2, 2º andar, Prado Velho, Curitiba, Paraná, Brazil, ZIP code 80215-901
E-mail: patricia.pellizzaro@gmail.com

Received date: 15 April 2018, Accepted date: 15 June 2018, Online date: 5 July 2018

Copyright: © 2018 Patrícia Costa Pellizzaro et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

Background: Natural landscape patches are in risk of deleterious effects due to population growth and rapid urbanization process. To minimize those environments degradation, legal instruments were instituted, such as protected areas, which are defined as spaces physically bounded that are mainly designated to conservation and preservation of their natural and cultural resources. This paper studies the Environmental Protection Area (Área de Proteção Ambiental, APA) of Iguacu, located on the shore of THE namesake river in Curitiba, Paraná, Brazil. Objective: Given this context, the research aims to assess landscape interferences in physic, biotic and anthropic aspects, both inside and in the surrounding of the searched region, by classifying them based on their coherence with guidelines present on plans, programs and projects directed to this conservation unit. Methods: Preliminarily, there was a bibliographic review so that it was possible to comprehend the concepts associated to the subject. Subsequently, studies were performed on the land uses regarding the years 2000 and 2017, by satellite images interpretation, as well as photographic registers and carrying out on surveys. After that, pertinent plans, programs and projects were analysed. Results: By the assessed data, it is possible to conclude that changes of uses inside the APA were less expressive when compared to the surroundings. It is also verified that irregular occupations were not appropriately controlled, as well as that there are other socioenvironmental inadequacies in the region. Nevertheless, the municipality has been creating several guidelines for these issues resolution, although disconnected to each other. Examples of such initiatives include the creation of parks and the land regularization. Conclusion: Consequently, it is concluded that the establishment of a protected natural area is not sufficient on its own for the adequate management of such spaces, being necessary implementation of specific management plan, integrated to intervention projects for the appropriated APA administration.

Keywords: Planning, Management, Conservation units, Urban Landscape, Land uses.

INTRODUCTION

Due to population growth and rapid urbanization process, natural environments in urban areas are exposed to a variety of negative effects. Consequently, intending to minimize this degradation, laws and other instruments for their administration were created. According to information of International Union for Conservation of Nature (IUCN, 2008), “a protected area (PA) is a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values”. Its conception can be considered an important mean of territorial control since it stabilishes specific dynamics and parameters of land use. Such criteria are normally applied pursuing the valorisation of natural resources or even derived of the necessity of protection of biomes, ecosystems and rare or at risk of extinction species (Medeiros, 2004).

Internationally, PAs management is discussed since the creation of Yellowstone National Park (USA), in 1872. However, it’s concept has evolved in the last decades. The first protected natural spaces aimed the avoidance of anthropic degradation, that meaning recluse places. After, those spaces was planned associated to tourism and their surroundings. In addition, the fact that a great part of those areas, by being utilized massively, could be deteriorated if not subjected to restrictions by defining zones and parameters that secure the nature preservation was recognized (Araújo, 2007).
In 1994 a PAs classification system was proposed by the General Assembly of IUCN, in Buenos Aires, Argentina. The categories established according to environmental features and anthropization levels of each environment are: Ia - Strict Nature Reserve, Ib - Wilderness Area, II - National Park, III - Natural Monument or Feature, IV - Habitat / Species Management Area, V - Protected Landscape / Seascape, and VI - Protected Area with Sustainable Use of Natural Resources (IUCN, 2018). The studied object, Environmental Protected Area (Área de Proteção Ambiental, APA) of Iguaçu in Curitiba, Paraná, Brazil, can be classified in V, which is applicable for broad spaces and has as main purposes: maintaining terrestrial and marine landscapes; conserving values of iteration between anthropic and natural agents; providing leisure and environmental education to population (IUCN, 2008).

In the beginning of the current century, in Brazil, the National Conservation Units System (Sistema Nacional de Unidades de Conservação, SNUC), was created through the Federal Law 9.985, of June 18th, 2000 (Brasil, 2000), considering two main groups of conservation units (CUs): integral protection and sustainable use. In the first one, the anthropic uses are restricted, being allowed only activities designated to management and recuperation of natural environments, scientific researches and, in some cases - such as the national parks - public visitation and environment education activities. In the second one, a bigger human interaction with the natural resources is expected, based on sustainability principles.

The last division includes the APAs, which are defined as generally broad areas, with a considering level of human intervention, holding biotic, abiotic, aesthetic or cultural aspects that are relevant for the life quality and wellbeing of human populations, aiming to protect the biodiversity, to guide the occupation process and ensure sustainability in the use of the natural resources (Brasil, 2000, Art. 15). SNUC also determines that CUs must provide management plan, which is a technical document by which it is established the zoning and the rules for uses and protection of natural resources (Brasil, 2000, Art. 2°, § XVII).

Meanwhile, by the Municipal Law 9.804, of January 3rd, 2000 (Curitiba, 2000c) the Curitiba’s Municipal Conservation Units System (Sistema Municipal de Unidades de Conservação, SMUC) established seven categories: Conservation Parks, Linear Parks, Leisure Parks, Biologic Reserves, Relevant Native Groves, Conservation Groves, Leisure Groves and the Environmental Protected Area itself. This one includes public and private properties onto which restrictions are imposed for activities or land uses, addressing the protection of water bodies, vegetation or any other environmentally valued asset (Curitiba, 2000c, Art. 3º, § I).

As per the above considerations, this study’s main objective is to assess the interferences on landscape related to physical, biotic and anthropic aspects, both in the interior and surrounding of the given APA, classifying them according to their coherence with guidelines of plans, programs and projects related to this UC category. From this purpose and exposed concepts, the multiples methodologic procedures of this research are detailed below.

**MATERIALS AND METHODS**

Found in the Iguaçu River margins, in the eastern portion of Curitiba city, the APA was instituted by the Municipal Decree 192 of April 3rd, 2000 (Curitiba, 2000a) with the following objectives: regulate and to ordinate the land use and occupation of the water source region of the river, aiming the preservation, improvement and recuperation of environmental quality; to conserve genetic resources with scientific and ecological purposes; to avoid and control soil and landscape degradation, as well as the river silting, related to exploration of mineral and vegetal resources; protect populations and properties of inundations along the river course; and to provide places for recreation and environmental education for local and regional populations.

The research was initialised by composing a theoric referential, summarized in the introduction of this article with bibliographic review intended for comprehension of appropriate concepts and legislation. The second stage was to determine the configuration of the land uses for the years of 2000 and 2017, being defined as the studies’ specific spaces the interior of the APA and it’s immediate surrounding. Thus, the environmental components were evaluated - physical (water bodies and exposed soil), biotic (tree cover and non-arboreal vegetation) and anthropic (land uses - agriculture, urbanized areas, dispersed occupation, industrial areas and mining, besides the main road system - highways). For the year 2000, the studies were based on data of Paraná’s Water Institute (Instituto de Águas do Paraná, IAP, 2000) for Alto Iguaçu watershed. For the year 2017, the assessment considered the interpretation of satellite images provided by Microsoft Bing Maps (Microsoft, 2017), in high resolution layer. Subsequently, a field survey was performed, visiting the six sectors of the APA defined by the Municipal Decree 174, of March 13th, 2008 (Curitiba, 2008), as well as in the surrounding areas, considering the zoning of Municipal Law 9.800, of January 3rd, 2000 (Curitiba, 2000b) (Figure 1).

**Figure 1:** Location maps of Environment Protection Area (Área de Proteção Ambiental, APA) of Iguaçu and sectors and zones studied in its inner and surroundings


The photography registers were organized in charts, relating the parameters of land use of each zone with the images and their specific locations in maps. The mapping was done by geoprocessing in ArcGis 10.1 tools. Finally, plans, programs and projects were evaluated, specially the Municipal Decree 174/2008 (Curitiba, 2008), intending to identify guidelines for the APA’s interior, and the Municipal Law 9.800/2000 (Curitiba, 2000b), for analysing the region’s surrounding zoning. The data tabulation in spreadsheets of Microsoft Excel software allowed the composition of charts that provide appropriate interpretation of the results found, which are presented in the following section.

Australian Journal of Basic and Applied Sciences

ISSN: 1991-8178, EISSN: 2309-8414
RESULTS AND DISCUSSION

From the comparative study of the land uses of the two timeframes assessed (2000 and 2017), it is possible to verify 1.5% reduction of vegetation cover in the inner of the APA and 2.1% in its surrounding (Figure 2). The increment of 2.1% of water bodies in the CU is possibly due to sand extraction activities. A significative difference on the urbanized areas can be verified, since they remain relatively stable inside the perimeter of the APA (increasing 0.9%), while in the surrounding there was an increase of 5.1%. For Gambino (2009), despite the differences that exist for valuing protection of the nature - more objective - and the landscape - more subjective - there are intrinsic values in both systems, and they can be combined based on ecological concepts and urbanistic principles.

<table>
<thead>
<tr>
<th>Inner</th>
<th>Surroundings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inner</strong></td>
<td><strong>Surroundings</strong></td>
</tr>
<tr>
<td>Water bodies</td>
<td>15.5%</td>
</tr>
<tr>
<td>Exp. soil</td>
<td>6.4%</td>
</tr>
<tr>
<td>Tree cover</td>
<td>17.8%</td>
</tr>
<tr>
<td>Agricultural</td>
<td>6.4%</td>
</tr>
<tr>
<td>Non-arboreal vegetation</td>
<td>10.0%</td>
</tr>
<tr>
<td>Urban and coastal</td>
<td>6.0%</td>
</tr>
<tr>
<td>Dispersed occupation</td>
<td>0.5%</td>
</tr>
<tr>
<td>Mining</td>
<td>0.5%</td>
</tr>
<tr>
<td>Physical environment</td>
<td>45.0%</td>
</tr>
<tr>
<td>Biotic environment</td>
<td>40.0%</td>
</tr>
<tr>
<td>Anthropic environment</td>
<td>15.0%</td>
</tr>
</tbody>
</table>

Source: Based on IAP (2000) and Microsoft (2017).

From the field surveys and its confrontation with municipal legislation, it can be observed that in the inner Iguazu APA, in its High Restriction Sector, there is predominantly low density residential use (Figure 3 - upper left division: left), as required by the laws, not being found significant changes in the assessed timeframe. It is remarkable the presence of forest remaining’s (Figure 3 - upper left division: right), reducing ecological risks of fragmentation of vegetation resources (Harvey et al., 2008). It is important to account that this region is less subjected to urbanization process influence due to its proximity to the Controlled Occupation Zone in its surrounding.

In the Medium Restriction Sector, it is allowed single-family housing, retail and vicinal services, agriculture and mineral extraction. However, irregular occupations were observed in the place (Figure 3 - upper right division: left). Among the main interferences found is the ampliation of the Caximba landfill and increase of floodable areas (Figure 3 - upper right division: right), possibly due to mining activities of sand extraction. Those irregular occupations and the mining activities have been governmental projects targets for their control (SMMA, 2018).
The Transition Sector presents differentiated features. In central neighbourhoods of the APA, it can be perceived coherence to the legislation, being predominant residences, retail and vicinal services (Figure 3 - middle left division: left). Although, at some particular places, there are irregular occupations, mainly close to the train track, sand caves and Permanent Preservation Areas (Áreas de Preservação Permanente, APPs) in river borders, resulting, sometimes, environmental degradation, especially due to insufficiency of infrastructure provision. Furthermore, it can be verified the presence of housing of two or more stories (Figure 3 - middle left division: right), that not being regarded to the existent law. In this sector, according to comparative study for the timeframe, is located the major increment of urbanized areas. In this context it is valid to point out that Brueckner (2000) alerts that the urban expansion without appropriate ordination produces uncountable undesirable socioenvironmental consequences.

In the Sporting Use Sector there is a variety of leisure areas (Figure 3 - middle right division: left), with many sports equipment’s and single-family housing, being many of them classified in social behalf programs. Nevertheless, at several specific places still there are irregular occupations (Figure 3 - middle right division: right). Cole (2004) points our the importance of recreation in PAs, though highlighting the necessity of monitoring such activities for prevention of deterioration of natural resources.

In the Services Sector it is allowed transitory accommodations, retail, vicinal, neighbourhood, sectoral and general service buildings (Figure 3 - bottom left division: left), as well as single-family housing and communitarian use constructions, and industries that do not generate liquid effluents and atmospheric emissions. However, as per field survey, it can be verified that this region is not characterised according to the urbanistic parameters proposed by the law, presenting many spaces that remain unoccupied (Figure 3 - bottom left division: right).

The Park Sector intent is to preserve river basin, as well as vegetation typical of river lowland and native woodlands. Currently, there are the Municipal Zoo in this area (Figure 3 - bottom right division: left), where activities of environmental education are developed, and also a sportive complex, with spaces for practice of soccer, volleyball, baseball and nautical activities. The last ones are specifically designated to rowing, sailing, rowing and canoeing (SMMA, 2018). Though, through the field visits it was verified poor maintenance of the furnishing and equipment’s and also degradation of water courses at a number of spots. (Figure 3 - bottom right division: right). Beyond the contamination by urban residues, those interferences are caused by inadequate agricultural practices, with addition of nutrients, in special nitrogen, affecting also the aquatic fauna (Henle et al., 2008).

Hardt and Hardt (2007) explain that the SNUC represents an important gain for the management of those protected areas. However, the authors also warn about the permanence of difficulties for their administration, including a variety of flaws in its own management structure, mainly relating to private properties, prevalent in APAs.

In the Iguazu APA’s surrounding, for the Residential Zone of Controlled Occupation, it is demanded low density (Figure 4 - upper left division: left), with minimum parcels of 2.000 sqm, mainly due to preserve of forest remaining’s (Figure 4 - upper left division: right). Its main uses are designated to agriculture, single-family housing, multi dwelling units, communitarian, retail and vicinal service buildings, and small sized industries. In this region, it is not observed significant alterations in the land use and occupation in the studied timeframe, which, according to principles of Harvey et al. (2008), ensures that the woodland remains not fragmented and as a result secures the biologic diversity.

The Special Sector of Social Interest Housing holds all the types of uses allowed in this urbanistic compartment, such as single-family housing, retail and communitarian purposes. Its main destination is for formal residences for low income population (Figure 4 - upper right division: left). Although, irregularities are observed in the region, such as higher heights than the maximum allowed by its legislation (Figure 4 - upper right division: right). Among the zones in the surrounding, this hosts the major increment in urbanized areas in the studied timeframe, presenting a potential tendency to fragmentation to natural spaces, which can cause decrease of biological diversity, interferences in the hydric resources and deterioration of water quality (Saunders et al., 1991).

The Residential Zone 3 (Figure 4 - middle division: left) and the special sectors of Linhão do Emprego and of avenues Affonso Camargo and Comendador Franco (Figure 4 - middle Division: right) comprise areas more consolidated of the surrounding, where it was not observed relevant changes between 2000 and 2017. They perform, however, a greater pressure on the occupation process in the interior of the APA, as more spots of irregular occupation are found close to these regions. Concerning this type of conjuncture, Battaus and Oliveira (2016) comment that issues like land regularization in great centres seem to have experienced rising in Brazil.

The Services Zone 2 (Figure 4 - bottom division: left) and the Industrial (Figure 4 - bottom division: right) are in consolidation process, presenting many urban gaps, associated with single-family housings (some of them irregular), retail and vicinal and neighbourhood services, as well as some industry, mostly potteries. A special attention ought to be given to these peripherec metropolitan expansion spaces so that their occupations do not result in disturb anthropically originated (Chen et al., 2001) mainly in PAs.

Figure 3: Views of the sectors in the surrounding of Environment Protection Area (Area de Proteção Ambiental, APA) of Iguazu
Source: Survey data collection (2017)
It is imperative to highlight that the surrounding of the APA is subjected to regulation of Articles 182º and 183º of the Brazil’s Federative Republic Constitution (Brasil, 1988), of Cities Statute (Estatuto da Cidade - Federal law 10.257, of July 10º, 2001) (Brasil, 2001), which, stabilising general guidelines for urban policy, has a variety of general principles, being among those the protection, the preservation and recuperation of the natural environments, as well as landscape heritage (Brasil, 2001, Art. 2º, § XII). These assumptions are also reiterated by the Metropolis Statute (Estatuto da Metrópole - Federal law 13.089, of January 12º, 2015) (Brasil, 2015).

Considering the inexistence of specific management plan of the studied APA, it is detected that the lack of programs with specific means of feasibility of internal and external zoning is one of the remarkable incoherence’s found. Considering this scenario, it is appropriate to point out that Carreiro (2008) explains that the maintenance of the environmental quality of protected natural areas in urban centres depends of adequate management process, with strategies based on local scientific studies. This fact requires an interdisciplinary approach, especially with interaction between ecological, territorial and socioeconomic planning. Esteves and Souza (2014) even recommend that the APAs’ ordination should be linked to strategic environmental assessment, as necessary strategy for safeguarding the biodiversity maintenance (Bruzzessi, et al., 2003).

Unconnected governmental projects along Iguaçu River, aiming primarily the control of irregular occupations, the mitigation of environmental liabilities of sand caves and the regularization of APPs, offer alternatives of spaces for environmental education and leisure to population, but those propositions are not sufficient for the appropriate solution of the studied matter. Concerning APAs, Cabral and Souza (2002) point out the importance of the relation between society and nature, specially referring to the construction of models linked to regional and local realities, incorporating social, temporal, and spatial dimensions in the process of planning of this conservation unit category.

CONCLUSION

From the landscape alteration assessment in Iguaçu APA, firstly, it is verified the relation among a variety of legal instruments that aim the protection of natural environments. Through the comparison of CU’s systems - international (IUCN), national (SNUC and municipal (SMUC)) - it is noted that two categories (V- IUCN - and APA - SNUC and SMUC) are highly similar considering their management objectives. For both, some degree of human occupation is admitted and they have as purpose to process in a sustainable way, securing the sustainability of its natural resources. Particularly in Curitiba, APAs are destined to conservation of hydric resources and remaining vegetation, as well as control of floodable areas and irregular occupations.

Secondly, from interpretation of land uses, it is verified, as expected, that the alterations in the interior of the APA are less impacting when compared to the surroundings3. However, the study clearly indicates that the occupation standards on the region that bounds the place cause a strong pressure onto the PA. Therefore, it is inferred the significant relation between natural landscape protection and the urban society organization.

Finally, despite of the existence of municipal projects related to nature conservation, it is concluded that there are insufficient governmental programs for management of the studied area, which should be broader and integrated as well as having close association to urbanistic guidelines and to communitarian participation. Such flaw in the government has being causing difficulties to the accomplishment of the paramount objectives of the Environmental Protection Area of Iguaçu. Furthermore, conflicting conceptual approaches referring CUs, particularly related to environmental and urban aspects of APAs, have being causing critical consequences in its management process.

Even considering the remarkable political and institutional improvements concerning conservation units in Brazil, a practical reality that does not correspond to the legal and normative expectations is detected, showing a scenario of stagnation, and, sometimes, regression. This conjuncture leads to imperative recommendations about the development of a reflexive approach and a constructive set of questionings about the subject, extrapolating the studied case.

ACKNOWLEDGEMENTS

We acknowledge the continuous support from the Pontifical Catholic University of Paraná (Pontifícia Universidade Católica do Paraná, PUCPR). The study is supported by the grants 401085/2008-5 and 4169/10019, respectively from the National Council for Scientific and Technological Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico, CNPq) and the Aracuíra Foundation for Support to Scientific and Technological Development of the State of Paraná (Fundação Aracuíara de Apoio ao Desenvolvimento Científico e Tecnológico do Estado do Paraná, FA).

REFERENCES


Note: All the authors contributed equally to this work.

Author’s biographies

Patrícia Costa Pellizzaro

Marissa Malanski Magalhães

Letícia Peret Antunes Harding

Carlos Hardt

environment and conservation units fields.