Participative diagnosis for territorial planning of protected areas: subsidies to the Taim Ecological Station management plan, Brazil

Diagnóstico participativo para planejamento territorial de áreas protegidas: subsídios ao plano de manejo da Estação Ecológica do Taim, Brasil

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ABSTRACT

The Taim Ecological Station is a protected area located in the Southern portion of the coastal plain of the Rio Grande do Sul State, Brazil. The station includes areas of the municipalities of Rio Grande and Santa Vitória do Palmar, located between the Mirim Lagoon and the Atlantic Ocean. In spite of having been established 30 years ago, and of its internationally recognized role as an important wetland area devoted to the protection of endangered species, the Taim Ecological Station still lacks an effective management and land use plan. This is due to the complexity of the challenges involved, including cultural and productive patterns that are in conflict with the objectives of conservation. Such conflicting patterns evidenced the importance of the implementation of participatory diagnosis process. The participatory diagnosis was used as a mechanism to increase citizens' awareness about the role of the protected area as well as the scientific community's involvement with the environment. Results of the diagnosis, which were generated through a geographic information system analysis and interpreted in combination with physical, biological and anthropogenic data allowed to characterize territorial threats and opportunities within the conservation area of the unit. Results allowed the design of a land use zoning plan, as well as the identification of management actions to support land planning activities in the area.

Keywords: Participatory Diagnosis. Planning. Protected Areas.

RESUMO

A Estação Ecológica do Taim é uma Unidade de Conservação (UC), localizada na porção Sul da Planície Costeira do estado do Rio Grande do Sul, Brasil. Abrange parte dos municípios do Rio Grande e de Santa Vitória do Palmar, entre a Lagoa Mirim e o Oceano Atlântico. Embora tenha sido estabelecida há trinta anos e seja internacionalmente reconhecida como importante área úmida e de proteção de espécies ameaçadas, essa UC ainda carece de plano de manejo e de ordenamento territorial. Imersa em uma matriz cultural e de atividades produtivas conflitantes com os interesses de conservação, a participação da sociedade na elaboração do plano de gestão é um aspecto fundamental. Desta forma, foi aplicado um diagnóstico participativo como mecanismo para apreender os modos de relacionamento da população local e seus conhecimentos sobre o meio ambiente onde está inserida a UC, bem como para identificar a percepção da comunidade científica envolvida com pesquisas naregião. As informações obtidas por meio do diagnóstico participativo, espacializadas em um Sistema de Informação Geográfica e interpretadas juntamente com dados físicos, biológicos e antrópicos, permitiram caracterizar no território ameaças e oportunidades à conservação na área da Unidade. Tal investigação tornou possível propor um esquema de zoneamento de usos, e a identificação de ações de manejo de forma a subsidiar o planejamento e o ordenamento territorial para essa UC.

Keywords: *Diagnóstico Participativo. Planejamento. Unidades de Conservação.*

1 INTRODUCTION

A measure largely used in order to preserve biologic communities is to establish legally protected areas. However, a commitment to protect biologic diversity and preserve ecosystems in these areas is necessary, ensuring immediate and long-term needs from local population do not compromise such objectives.

From the social point of view, the creation of a preservation unit is a usage conflict, therefore, the local community engagement, as well as the engagement of groups interested in resources management where it is located, is crucial to understand the parts of a complex reality about the populations involved with the unit (D'AMICO, 2013). Such involvement has been possible due to advances obtained in the last decades in Brazil, in democratization processes and increase of social representation channels, providing a bigger citizen participation in planning processes and decision taking about Protected Areas (PA).

Today there are few examples of intact biologic communities, and most existing protected areas are habitats with intermediate levels of disturbance. Even so, due to the fact that these spaces occupy large areas, they are one of the most important challenges and opportunities to biologic protection.

Decisions must be taken in relation to the admissible level of human interference when PAs are planned, taking into consideration that the protected areas are frequently located in a matrix of managed areas. In the specific case of wet areas, such is the case of Taim Wetland (Southern Brazil), where Taim Ecological Station (TES) is located; the effective maintenance of flooded areas is a critic point to the maintenance of species and habitats. In this context, there is the necessity to search for new approaches and instruments for data collection and treatment, including the society participation for planning and management processes of these spaces.

In Brazil, the Management Plan for Protected Areas is, so far, the main management instrument. The law 9985 from July 18 2000 instituted the National System for Nature Protected Areas (Sistema Nacional de Unidades de Conservação da Natureza - BRASIL, 2000). It defines the Management Plan as: "technical document that establishes the zoning and norms that must govern the usage of the area and the management of natural resources, including the installation of physical structures needed in order to manage the unit."

Although TES is internationally recognized as an important area for environmental preservation and established 30 years ago, it has so far lacked a management plan and territorial planning.

With this perspective, this research aims to increase the knowledge about the reality of this complex Protected Area, based on the experience and the perception of local population and scientific community involved with TES, as a way of getting subsidies to plan and zone the unit territory and influence area.

The TES is located in the Southern portion of the Coastal Plain of Rio Grande do Sul, between Mirim Lagoon and the Atlantic Ocean and covers the municipalities of Rio Grande and Santa Vitória do Palmar, and Taquari Island near the border between Brazil and Uruguay in Mirim Lagoon (Figure 1). Around TES there are three rural communities, called Capilha, Anselmi and Serraria.

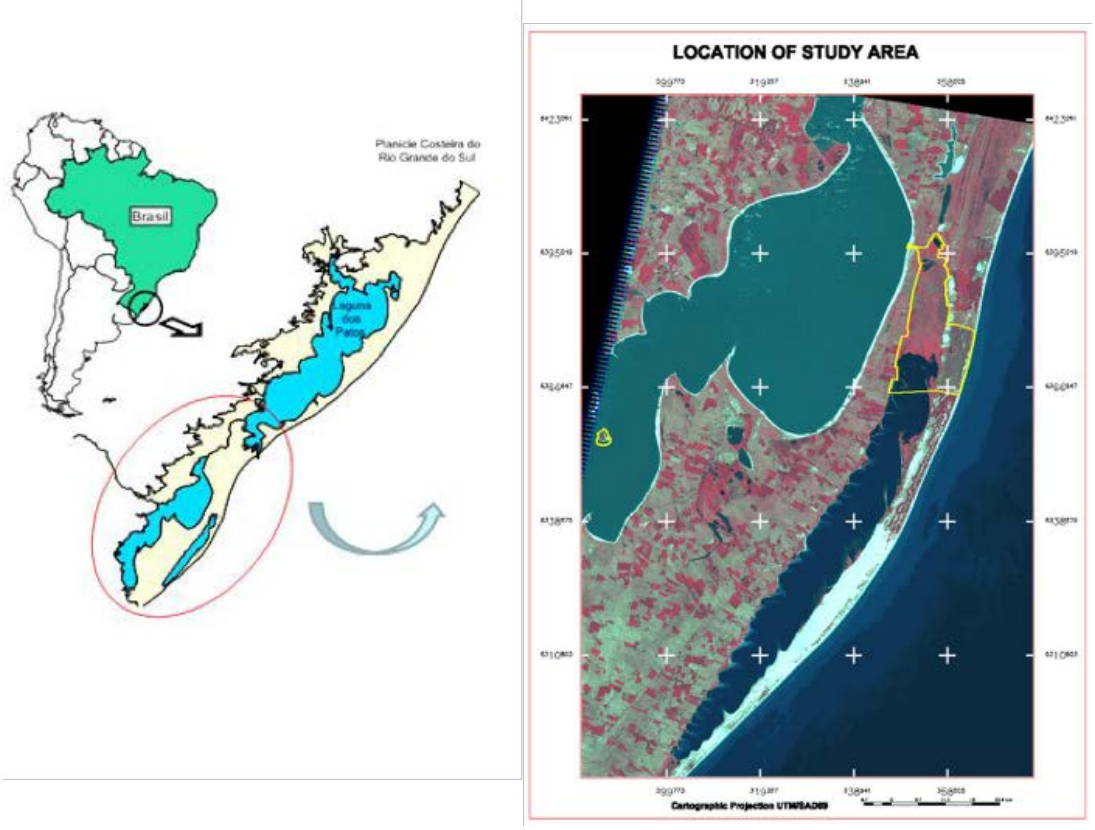

Figure 1 – Location of study área.

Source: EICHENBERGER (2015).

2 METHODOLOGY

2.1 PARTICIPATIVE DIAGNOSIS

The research adopted on qualitative approach, based on interviews with the communities around TES and with researchers who develop their studies in the area. Two questionnaires were prepared with opened questions, one for the local community and another for the scientific community. The questions directed to the local community tried to identify their knowledge on local biodiversity and habitats, their perception of the territory and their conflict with the preserved area. The questions directed to the scientific community aimed at identifying the most important habitats for biodiversity, the main threats and the possible management solutions.

Seventy-three personal interviews were conducted from February until April in the three villages near TES. In total, fishermen (14), employees from a forest company (16), rural workers (8), cattle ranchers (5), small business men (7) and a variety of professionals from other areas (23) were interviewed. Sixteen professionals answered the questionnaire applied to researchers from the following institutions: public universities (9), non-governmental organizations (2), environmental consultancy companies (2), and governmental agencies (3).

The researchers were selected through their file at the Biodiversity Information System, which is a system to authorize research with scientific purposes at TES, and consulted via e-mail. From seventy questionnaires sent to the researchers, sixteen were accepted and answered.

A total number of eighty-nine questionnaires were answered. The methodology for Textual Discursive Analyses (MORAES AND GALIAZZI, 2011) was utilized for the interpretation of interpret the interviews.

2.2 GUIDELINES FOR SPATIAL PLANNING

A databank in Geographic Information Systems (SPRING software v. 4.3). (CAMARA, G, et al, 1996) was organized in order to elaborate a proposal for spatial planning of the TES. Information on vegetal coverage, hydrography, land use and access ways, was obtained through RapidEye satellite images. The images were digitally processed through statistic algorithms with automatic and semi-automatic classification. The usage classes and the land coverage were mapped and edited after the classification. The definition of classes followed the proposal created by SCHÄFER (2009) with modifications (Table 1). Based on measurable and spatial information obtained during the interviews in relation to physical and biological aspects, it was possible to identify threatens and opportunities proposing a classification and a framework for these according to the National System for Conservancy Units.

Classes	Ground Cover description
Pastures areas and fallow field	Includes native fields, pastoral farming and rice planting fallow areas
Aquatic environments	Includes all waterbodies, without vegetation cover
Marshes	Includes permanent or seasonal wet areas, covered by macrophytes
Dunes/Lagoon and oceanic beaches	Includes mobile and sessile dunes, with predominance of sand and sparse vegetation as well as lagoon and oceanic beaches
Silviculture	Includes areas for plantation, mainly, *Pinus spp.*
Farming	Includes areas occupied by rice and other kind of crops
Native forests	Includes areas with native tree cover

Table 1 – Description for land use classes and ground cover

Source: Based on SCHÄFER (2009) and modified.

3 RESULTS AND DISCUSSIONS

3.1 THEORETICAL REFERENCE

The Taim Ecological Station was established in 1986, as “strict natural reserve”, whose purpose is to conserve nature and support scientific research. This protect area presents a complex mosaic of habitats, as marine beaches, lagoons, marshes, meadows, lagoon beaches, sand dunes and littoral fields, supporting a high diversity of species, including gators, turtle, rodents, fox, and birds. The

flora is also very diverse, featuring some emblematic species as *Ficus spp, Erythrina crista-galli and Tibouchina sp*, among others.

Information about origins and motivations to create protected areas, their planning, legal instruments and policies to protect biodiversity and participative diagnosis was based on SCHREINER (2012), BENSUSAN (2006) and FERREIRA (2010). Discussion concerning social participation in management of protected areas was based on D´AMICO (2013) and NEIVA (2013).

Description related to genesis and geologic evolution of the Coastal Plain of Rio Grande do Sul, was referenced in TOMAZELLI and VILLWOCK (2000). The flora characterization was based on FERRER E SALAZAR (2004), MOTTA MARQUES E VILA NUEVA (2001) and GRINGS (2011). The fauna description was grounded on MÄHLER (1996) to birds, GARCIA (2006) and CORREA (2011) to fish, GAYER (1986) to amphibians, GOMES AND KRAUSE (1982) to reptiles and AZAMBUJA (2010) and SPONCHIADO (2012) to mammals. In relation to anthropic aspects, works of MOTTA MARQUES AND VILANUEVA (2001), HENTSHEL (2009) and BAGER (2003) are used.

3.2 PARTICIPATIVE DIAGNOSIS ON SOCIO-ENVIRONMENTAL ASPECTS RELATED TO TES

Territory

It was observed that communities have a deficient community structure, with no drinking water supply and sewage treated through a system of septic tanks, or dumped *in natura* into ditches.

All the communities have electric energy supply and public lighting. There is not any equipment for public leisure. Soccer and swimming in the lagoon during the summer are the main leisure options for the communities. Eventually, there are parties and events at the local cultural center. Some logging companies that were present in the region went bankrupted, while others stopped marketing milled wood; these facts brought difficulties to find jobs. The fishermen reported fishing decrease, but this is still the most important livelihood activity.

They proved to have the best knowledge about the regional environments. The local commerce has been growing and it is composed of small markets, bars and grocery stores. It was observed that there is a great diversity of professionals who came from nearby towns, mainly people who retired and who have a second home for leisure or resting. Most people interviewed have lived in the region for more than twenty years, a great number being native people. There are municipal and elementary schools in the three local villages. There are medical posts in two of them.

The community acknowledges three places as their main historical points in the region: TES, Anselmi House, an old commercial and pastoral farming company from the end of XIX century, and Taim chapel, built in 1832, colonial period, time when the region was part of “Neutral Fields”, a Bufferzone between Portuguese and Spanish realms (OLIVEIRA, O. A., 2011).

Ecosystem and biodiversity

The complete fauna list mentioned by the community population summed up forty-one animals that represent very well the main fauna elements in this area of Coastal Plain of Rio Grande do Sul. Arroio Del-Rey, “Matas das Figueiras”, “Banhado do Taim” and areas of native fields were pointed out as extremely important for fauna (Figure 2). “Mirim”, “Mangueira” and “Flores” lagoons appear as the most important for fishing in the region. “Nicola” and “Jacaré” were also considered important according to fishermen interviewed in “Capilha”, “Serraria” and “Anselmi” villages. However, these two lagoons are located in a protected area where fishing is not allowed (Figure 2).

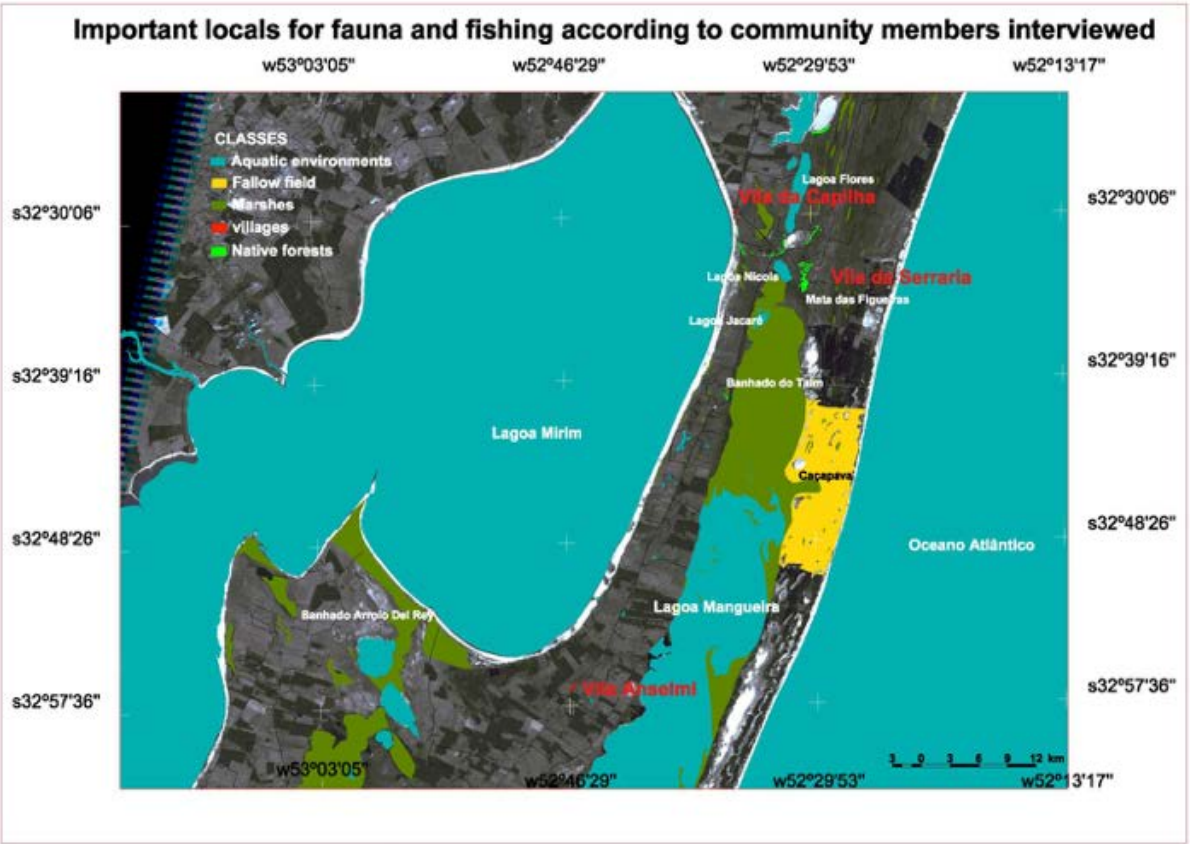

Figure 2 – Important locals for fauna and fishing according to community members.

Source:EICHENBERGER (2015).

Almost all the researchers mentioned the need to preserve ecosystems and their ecological functions, the necessity to identify important areas for reproduction, feeding and resting for resident species as well as migratory ones. Other issues raised were the importance of working with the communities and their feeling of belonging to the local as a vital importance strategy to preserve the unit. It was also mentioned the knowledge about the material and immaterial cultural patrimony and the knowledge about touristic attractions as important aspects for the management plan for the Protected Area. It also mentioned the vulnerability of this hydrologic system and the necessity of its preservation.

Conflicts and problems

According to the local inhabitants, the biggest problem identified in the three communities is the inappropriate waste disposal. In Capilha community this problem increases during the summer months, due to the growth of tourism in the beach located in Mirim Lagoon, and the nonexistence of necessary infrastructure. The second problem is the lack of treatment of drinking water for the local population. The water comes from wells or is directly collected from the lagoons, with low quality for consumption. The third problem is animals being hit by cars and the accidents that take place at the federal road BR 471 that crosses the TES. Another situation mentioned is the amount of domestic animals abandoned in the community streets. The lack of basic sanitation, the fires, illegal hunting and fishing were also reported as a reason for concern. Disorganized occupation and population increase were reported in Capilha village.

When people were asked if TES brought any problem to their community, conflict situations were noted, mainly with fishermen claiming the area was used for fishing before the creation of the Protected Area. Some fishermen attribute the decline of fishing to pesticides that come from rice farming. Some farmers, especially cattle breeders, claim that they have economic losses due to the restrictions

imposed by the creation of the PA and to the lack of land regularization in the Protected Area. Some residents protested because of the inadequate way inspectors from environmental protection agencies behave when they approach local people.

Researchers reported the occurrence of exotic species, mainly Pinus spp as an important problem. Concerning the exotic fauna, was pointed out the presence of feral pigs, a cervid of the gender Auxis, buffaloes and domestic animals with potential to zoonosis to the local wild fauna.

For the researchers, the most impacted locations are: (1) areas influenced by the federal road BR 471; (2) areas close to the silviculture enterprises; (3) pasture areas on Wetland and over nests where birds lay their eggs straight on the ground; (4) areas under influence of energy distribution lines because birds die due to electrocution and/or mechanical crashes; (5) Rice and soybean plantation areas, due to the influence in the quality and quantity of water due to use of fertilizers, pesticides and water pumping, and (6) areas near roads and access canals that cross the Protected Area, because they facilitate the access for hunters, fishermen, domestic animals, and consequently garbage disposal and fires.

Planning

The analyses based on the perception of people interviewed, concerning problems and solutions listed, allow pointing out environmental management proposals and regulations. The interviewees identified the main community conflicts in relation to the Protected Area (Figure 3) and the main threats to the integrity of the ecosystem protected by the TEE, as well as solutions and strategies to mitigate and/or face the identified conflicts and the pressures.

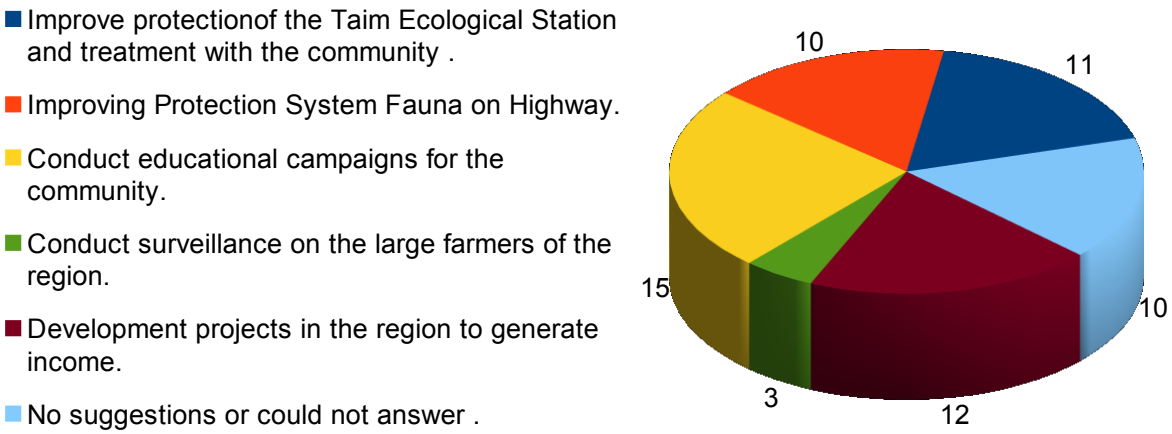

Figure 3 – Suggestions to the conflicts and threats identified by interviewees.

Source: EICHENBERGER (2015).

Land usage and coverage in the TES and surrounding areas Land Usage Zoning of the Protected Area constitutes the most important product of the management plan, because it synthetizes the results of all the study process, comprising the technical, scientific, participative and institutional approaches.

Considering the TES area and the area around 10 Km (law 11.520/2000, State environmental code of Rio Grande do Sul, Brazil), it was verified that the aquatic environment corresponds to an area of 48% (figure 4), reinforcing the importance of monitoring and managing the quality and the quantity of water used by the farms, as well as the necessity to control fishing and to promote the environmental education for fishing communities. The fields with agriculture and cattle raising correspond to 30% of the territory, pointing out a necessity to land regularization and the involvement of cattle breeders to look for the best management for the region. Silviculture and farming remaining inside the TES account for 0, 52% of the area, representing environmental liabilities to be recovered.

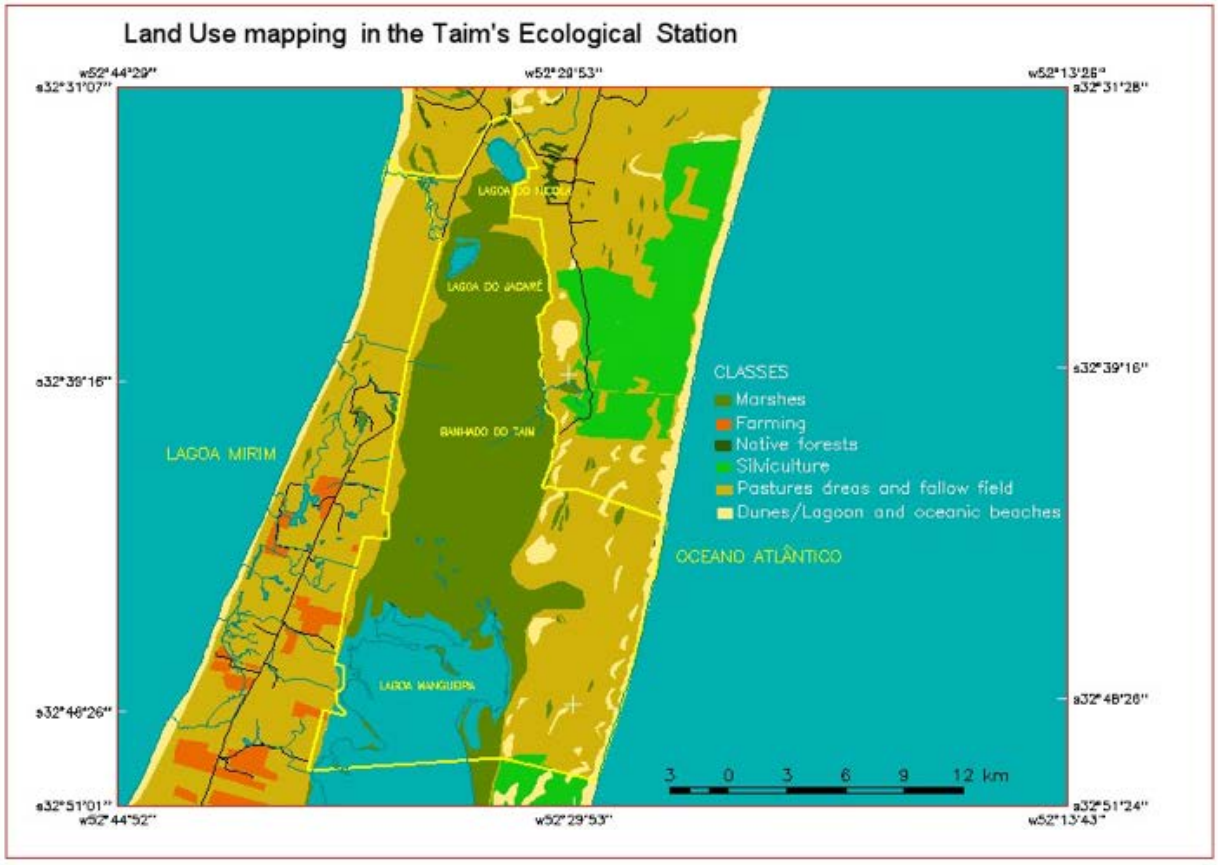

Figure 4 – Land Use mapping in the TES.

Source: EICHENBERGER (2015).

3.3 PRELIMINARY MAPPING OF PRESSURES AND THREATS TO TAIM'S ECOLOGICAL STATION

The environmental threats and impacts identified and used to delimitate zones (sections) to the proposed spatial planning were the federal road BR-471, areas with the occurrence of fires, forestry, cattle raising, and transmission lines.

The federal road BR 471 is a public infrastructure that crosses and borders the TES for about 17 kilometers. According to Perello (2011), the proximity of PA to highways is related to loss of biodiversity.

In this proposal, an arbitrary line of 1500 meters of road influence was marked to observe the loss of biodiversity. It was categorized as Conflictive Zone, because this road is conflicting with the TES objective.

The pines silviculture (Pinnus spp) immediately around the TES promotes the decharacterization of natural environments due to the spontaneous spread of this specie that assumes the characteristics of a plague. Bearing in mind the local context, a 1,000 meters' line was marked around the areas where exotic forests are cultivated; this area is more prone to spread of species and consequently the natural environment to lose natural characteristics. These areas were classified as Recovering Zones, considered as temporary zones that must be recovered and incorporated to one of the permanent zones from the unit.

In the TES region, the utilization of pesticides with aircrafts has become a more and more widespread practice. The Brazilian legislation that rules aerial spraying is the "Normative Instruction Nº 02/2008

Ministry of Agriculture". This directive forbids aerial spreading of pesticides in areas located less than 500 meters from settlements, cities, towns, villages, districts, water supplies catchment. In order to identify areas more prone to pesticides contamination, an area of 500 meters around plantations was framed as Recovering Zone, a temporary zone that must be recovered and incorporated as a permanent class in the Spatial Planning of the TES, even though these enterprises are private.

Concerning the impact of cattle raising on the wetlands areas, a study made by NEOCORP Company (2012) pointed out that those areas under TES domain are less prone to impacts provoked by cattle raising because these areas are regularly supervised; cattle raising is mainly located in non-regularized properties. These mapped areas were used in order to compose a zoning proposal called Recovery Zones, a temporary zone that must be recovered and incorporated to one of the permanent zones of the Protected Area.

In relation to the impact of fires in this preserved area, it was verified that during the latest years there were two fires with major threats, one in 2008 and another in 2013. They reached about 4,700 hectares and 5,600 hectares respectively. Since these major threat fires are directly related to the habitat loss, areas damaged by these impacts were identified with information based on satellite images, they were obtained at the time the fires took place (MODIS Rapid Response System Real-Time) and these areas were used to compose the territorial zoning proposal. The areas were classified as Recovery Zone that means a temporary zone aimed at natural recovery and incorporated to one of the permanent zones from the PA.

In order to map the impact of the project of Transmission Line of 525 KV, a public utility enterprise, an arbitrary zone of 600 meters wide was established along the line. This area corresponds to impact monitoring area on birds along the transmission line. It was incorporated in the zoning as Conflictive Zone. It is worth emphasizing that the characterization of this impact demands long-term studies to understand the main causes of mortality in different birds taxa, and also to identify and locate the birds' main migration routes, the different groups' movements to feeding and resting areas and other unknown processes.

The BufferZone adopted in this study was based on information granted by TES's management organ. It was the one proposed to enlarge TES, and designed by a working group created with the scope of being an advisory board for the PA, having as a reference point the technical work by SCHEINER (2012).

The integration map of the spatial information through a Geographical Information System had resulted in a preliminary zoning proposal for the TES (figure 5). The Table 2 summarizes the classes and criteria that subsidized the choice for the proposal framing are also presented there.

Figure 5 – Preliminary zoning proposal for Estação Ecológica do Taim.

Source: EICHENBERGER (2015).

3.4 FRAMEWORKING CRITERIA AND USE INDICATION

Conflictive Zone: Are those areas where activities occur in disagreement with the objectives of the Protected Area, as areas under the influence of road (BR 471) and area under influence of the transmission line of electric energy; Monitoring and mitigation actions are recommended.

Recovery Zone: These are private areas within the Protected Area, where economic activities are carried out, such as farming and forestry. These areas must be bought by the government and restored. In this class, are those areas affected by forest fires in 2008 and 2013 wich are *in natura*l recovery; It is a temporary zone that, after recovery, must be incorporated in the other areas present in the Protected Area.

Primitive Zone: They are preserved areas such as wetlands, native forests and coastal dune fields present in the Protected Area. They are intended for the protection and preservation of natural environments and scientific research.

The Intensive Usage and Special Usage Zone: Are areas where the administrative infrastructure of PA is located, such as the headquarters, lodgings, museum, garages, inspection bases and intern road.

Buffer Zone: Areas adjacent to a protected area where land use is partially restricted, providing an additional layer of protection to the Protected Area itself, while providing valuable benefits to neighboring rural communities.

Use Indication	Criteria	Framing
Monitoring and mitigation impact actions;	Influence Area of BR 471 Road and energy transmission line.	Conflictive Zone and Conflicting Activities with the PA objectives
Land regularization; Cattle raising, silviculture and farming removal: monitoring of the recovering of areas reached by fires; fire control measures.	Areas influenced by Farming, Silviculture and Cattle Raising, private areas, that must be recovered or are recovering naturally, as the areas reached by the major threat fires in 2008 and 2013	Recovery Zone (temporary zone that must be recovered and incorporated to one of the permanent zones.
Measures related to protection and preservation of natural environments and scientific research with the objective of identifying areas intended to be Intangible Zones for the PA .	Áreas with minimum intervention: wetlands not affected by fires, headlands in Mangueira Lagoon, Taquari lagoon Island; native fields areas in public land, native forest, coastal and inland dune areas.	Primitive Zone
Minimize negative impacts for activities that take place around the PA.	Área related to the TES's BufferZone	BufferZone
Establishment of a visitor's center and improvement at the facilities: museum, researchers support structures. Establishment of an environmental education program and support to research at the unit.	Areas intended to offer educational activities, the construction of a museum, and visitors center and support place for scientific research: lodges and bases: Sede, Caçapava, Santa Marta and Costeira.	Intensive Usage Zone
Maintenance, structure repair and equipment acquisition, qualification and hiring human resources.	Areas intended to logistic support.	Special Usage Zone

Table 2 – Framing proposal for TES Zoning.

Source: EICHENBERGER (2015).

4 CONCLUSIONS

This research has demonstrated the complexity and challenges that involve the planning of Estação Ecológica do Taim, amid the economic growth of the region. The main challenge is to guide the management of the unit properly, in such a way that it is possible to articulate and mobilize the agents and the social forces in its management process. In this context, the use of information gathered through the participative diagnosis is fundamental in order to subsidize the planning of Estação Ecológica do Taim, as well as the identification of possible potential sources for socio-environmental, economic, and cultural conflicts concerning the usage of natural resources and the different ways usage and appropriation of local territory

The engagement with the local community allowed the identification of some possible conflicts in relation to the usage and occupation of local territory and the evaluation of some alternatives to mitigate these conflicts, as well as less impacting alternatives in order to use this space.

The use of Geographic Information System and Remote Censoring, correlated with the data obtained through the participative diagnosis allowed the spatial representation of important environmental and anthropic information. These made possible to identify usage criteria and vocation in order to frame some areas for zoning, as well as identify management measures to this preserved area.

In order to identify the areas intended to be Intangible Zones, it is suggested that a fast ecological evaluation should be carried out in the total area of the unit in a way to integrate biological data to the process of zoning the TES.

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