

Vulnerability and Management of Protected Areas from the State of Espírito Santo, Brazil

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ABSTRACT

This research presents the state-of-the-art related to the management of conservation units in the State of Espírito Santo, characterizing the conditions for management and infrastructure. The analysis carried out at the units, which were created in 2009, counted on the participation of all sixteen units' managers, considering factors inherent to the prevention and combat actions impacting the units. Results indicated that 'Duas Bocas REBIO' holds the best conditions for management and infrastructure (82%) and 'RDS Concha D'ostras', the worst (5%). 'PARE Itaúnas' showed the greatest deficit of staff. Regarding the availability of operational equipment, it was possible to observe that 75% of the fully protected units are operationally deficient. As for tools to combat forest fires, 'PARE Cachoeira da Fumaça' presented the largest deficit, with no individual protection equipment (IPE). Inadequate infrastructure (14%) and hunting (12%) are the main threats to the units. These results will subsidize the planning and management of protected areas in the State of Espírito Santo.

Keywords: conservation units, management indicators, infrastructure.

Vulnerabilidade e Manejo de Áreas Protegidas do Estado do Espírito Santo, Brasil

RESUMO

Esta pesquisa apresentou o estado da arte relacionado ao manejo das unidades de conservação estaduais do Espírito Santo, caracterizando as condições para gestão e infraestrutura. A análise contou com a participação dos gestores das 16 unidades, criadas até 2009, considerando-se os fatores inerentes às ações para prevenir e combater as ações impactantes nas unidades. Os resultados indicaram que a REBIO Duas Bocas possui melhores condições para gestão e infraestrutura (82%) e a RDS Concha D'Ostra, as piores (5%). O PARE Itaúnas apresentou maior déficit de pessoal. Na disponibilidade de equipamentos operacionais, observou-se que 75% das unidades de proteção integral estão com déficit operacional. Em relação às ferramentas de combate aos incêndios florestais, o PARE Cachoeira da Fumaça apresentou o maior déficit, onde não há equipamentos de proteção individual. A infraestrutura inadequada (14%) e a caça (12%) são as principais ameaças às unidades. Esses resultados subsidiarão planejamento e gestão das áreas protegidas do Espírito Santo.

Palavras-chave: unidades de conservação, indicadores de gestão, infraestrutura.

1. INTRODUCTION

The Convention on Biological Diversity (CBD), which Brazil is a signatory and figures prominently for its mega-diversity, provides the most important structure for the conservation of Brazilian biodiversity (Mittermeier et al., 2005; Silva, 2005). Based on this, a series of public policies within the definition of priority areas for conservation has been established in the past 20 years, such as the creation of the National System of Protected Areas in 2000 (Law 9985/00) (Rylands & Brandon, 2005; Silva, 2005). In this sense, the protected areas are the main administrative tools to preserve or conserve the remnants of the Brazilian biodiversity, especially the populations of endangered species (Bruner et al., 2001).

The rapid loss of biodiversity has led to priority actions to assess vulnerability and the survival of endangered species to extinction, either through the INCU Red List - *International Nature Conservation Union* (Baillie et al., 2004) or lists of areas, e.g. *Hotspot* and *Hotpoint* (Myers et al., 2000; Martini et al., 2007), thus proposing the creation of territorial protected areas (Rylands & Brandon, 2005). The establishment of these protected areas is a major global strategy for the conservation of natural environments.

The Atlantic Forest is among the biologically richest and the most endangered environments of the planet (Myers et al., 2000). Since colonization, the Brazilian Atlantic Forest has been suffering with constant processes of forest fragmentation from different economic cycles (Dean, 1995), where the landscape changes promoted by the early human being is thousands of times greater than the dynamic disturbance of the natural ecosystem (Tabarelli & Gascon, 2005). Consequently, this process of fragmentation has reduced the original area of the Atlantic Forest biome to the current 11.7% (Ribeiro et al., 2009). The State of Espírito Santo is entirely inserted in the Atlantic biome (Pereira, 2007), and it has only 11% of original vegetation (Fundação SOS Mata Atlântica & Instituto Nacional de Pesquisas Espaciais, 2009). Therefore, the remnants inspire greater attention in relation to conservation policies, especially those relating to the implementation and management of protected areas.

Since the beginning of civilization, people around the world have recognized the existence of geographic sites with special features as relevant historical facts or a way to protect water sources, hunting, medicinal plants and other natural attributes, thus trying to save them (Diegues, 2004). The model of protected area (in Brazil: *Conservation Units - UC*), put the government task to plan, create and manage these spaces. Therefore, protected areas are a way of protecting important natural resources, under a special administration to which they apply appropriate protection, besides taking responsibility for their managers to administer these areas (Brasil, 2000).

The term management indicates a task to manage, changing the objectives into tools for planning, organization, direction and control (Chiavenato, 2003). The first aim to proper management is the planning, which begins with the creation of the protected area and establishment of your management plan, required by law when setting the area up to five years. This mechanism or technical document (*management plan*) is applied by 'IEMA' - *Environmental State Institute* - to evaluate the effectiveness of Conservation Units in the present and future (IEMA, 2009, 2010). This technical document establishes the zoning and rules that should govern the use of the area and its natural resource management, including the implementation of the physical structures necessary to manage the unit (Brasil, 2000).

Currently, one of the main causes of impact on protected areas is the forest fire (Bonfim et al., 2003). In Brazil, fires in protected areas grew 275% in 2010 compared to 2009 (Setzer & Sismanoglu, 2010). In the State of Espírito Santo, in the last five years, there were more than 2,500 ha of burned area within and around protected areas (IEMA, 2010). Therefore, to promote better control and decrease the impact caused by burning is necessary in order to evaluate the mechanisms to prevent and fight forest fires under management. To this end, the purpose of this research was to present management and infrastructure conditions to conservation units in the State of Espírito Santo, presenting a diagnostic methodology linked to the management, prevention and fighting of forest fires.

2. MATERIAL AND METHODS

The protected areas managed by the State of Espírito Santo government cover 18 municipalities and a territory of 4,570 km² distributed over 1,160 km² of full protection and 3,410 km² of sustainable use. 'IEMA' (*Environmental State Institute*), through the *Natural Resource Management* ('GRN'), manages 16 protected areas, namely, one Biological Reserve (REBIO), six State Parks (PARE), one Natural Monument (MONA), one Sustainable Development Reserve ('RDS'), one Area of Relevant Ecological Interest ('ARIE') and six Environmental Protection Areas (APA), distributed throughout the state (Figure 1).

The methodological procedures of this study incorporated field data and structured interviews (Santos & Person, 2009) with the managers of the protected areas. In addition, they incorporated secondary data from information provided by the institutions for public documents. Additional techniques were used – the Participant Observation (Carvalho & Souza, 2009; Borges, 2009), of the daily practices of administration at 'IEMA' and Content Analysis (Santos & Ramires, 2009), on the understanding of the public documents of the institution.

The selection of protected areas was made by personal trial and not through probabilistic method. The managers selected were chosen according to the criterion of participation and the degree of importance within the process, besides the willingness to provide information.

In order to assess the management conditions and infrastructure of the protected areas, a series of variables with a scale from 1 to 10 were defined, which took into account the existence of each element analyzed. With that, weights were settled as parameters to identify the degree of significance for each question examined (Table 1). The assigned weights were set according to the degree of importance of each element analyzed, regarding management, prevention and fighting of forest fires. The ones directly related to preventing and fighting fires received greater weights. The highest weight was placed to fires, because they are believed to be the major factor associated with impacts on protected

areas. Factor that was confirmed by the managers of the units evaluated.

The Equation 1 below was created to identify the conservation unit (protected area) with the best management and infrastructure:

$$CGI = \left[\begin{array}{l} (Pn.10Ab) + (Pn.9Ac) + (Pn.9Almo) + \\ + (Pn.9Vu) + (Pn.9Cg) + (Pn.9Pm) + \\ + (Pn.8Via) + (Pn.7Adm) + (Pn.6Pcap) + \\ + (Pn.5Cf) + (Pn.5Cv) + (Pn.5Ep) + \\ + (Pn.2,5Tif) + (Pn.Aud) + (Pn.2Ap) + \\ + (Pn.1Est) + (Pn.1Si) \end{array} \right] \quad (1)$$

where: CGI = Condition for Infrastructure and Management of Protected Areas; Pn = Variable assigned by the existence of the element analyzed, including the management council and management plan for the Conservation Unit; Ab = Accommodation brigade; Ac = Firebreak; Almo = Warehouse; Vu = Vigilance Unit, Cg = Council Manager; Pm = Management plan; Via = Marked access roads. Adm = Administration center; Pcap = Point of water collection, Cf = House officials; Cv = Visitor Centre, Ep = Permanent exposure; Tif = Theme wildfire; Aud = Auditorium, Ap = Accommodation researcher; Est = Parking; Si = Internal signaling.

Therefore, the sum of the final elements multiplied by the respective weights assigned to each element analyzed identifies the best conservation unit (protected area) in management and infrastructure when compared to the others. In order to assess the vulnerability of the protected areas, regarding anthropogenic impacts, the variables that expose them to risk were listed (Table 2).

3. RESULTS AND DISCUSSION

The total percentage of the conditions for management and infrastructure of conservation units (protected area) of the State of Espírito Santo identified that 56% of them are below good management effectiveness (Figure 2). The Sustainable Development Reserve 'Concha D'ostra' had the worst performance (5%), while 'Duas Bocas' Biological Reserve showed the opposite, with the best condition for its management (82%), followed by 'Itaúnas' State Park (75%).

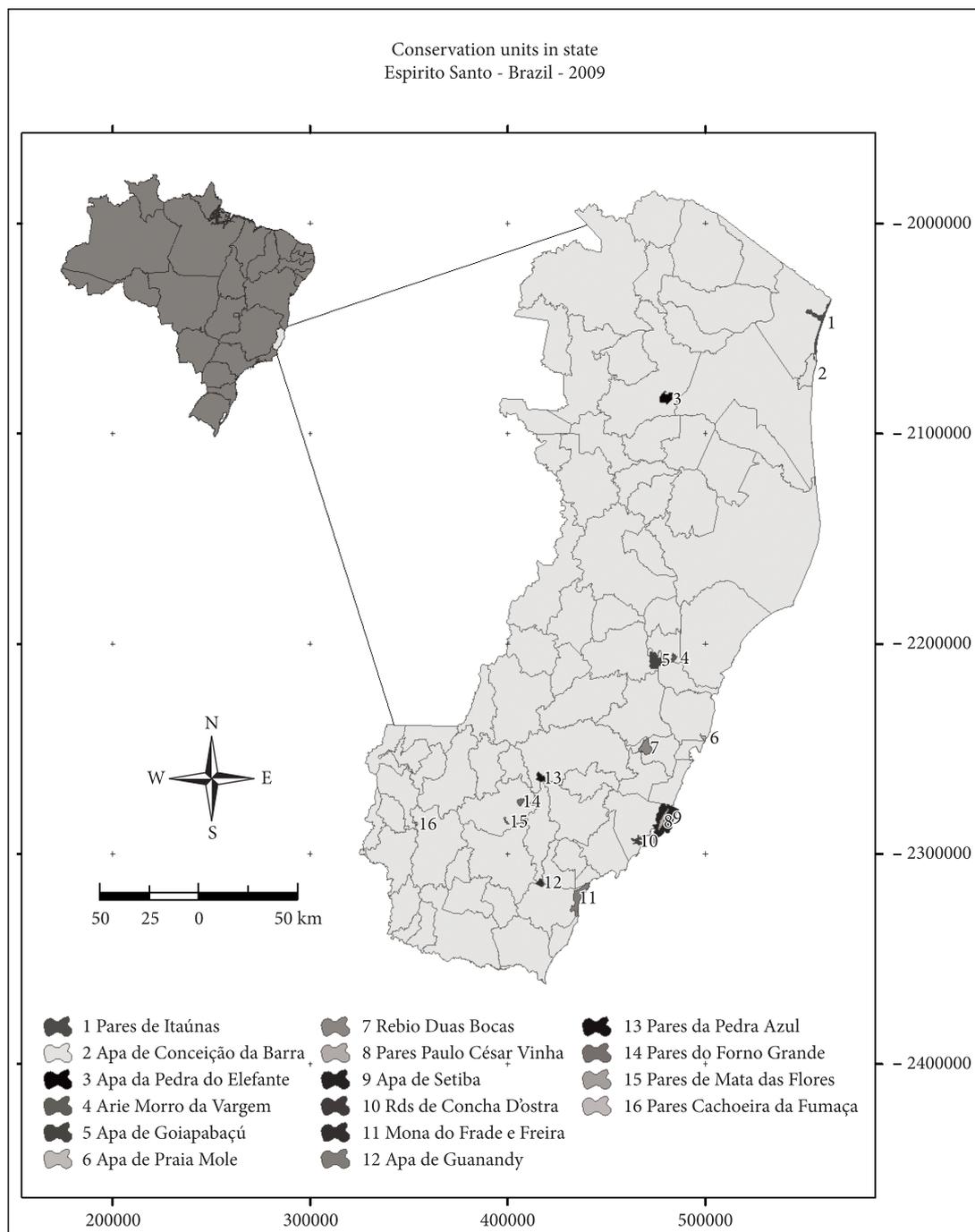


Figure 1. Location of conservation units of the State of Espírito Santo. ('REBIO' – Biological Reserve; 'MONA' – Natural Monument; 'RDS' – Sustainable Development Reserve; 'PARE' – State Park; 'APA' – Environmental Protection Area; 'ARIE' – Area of Relevant Ecological Interest) *Only the ones managed by the State of Espírito Santo government.

Among the 16 conservation units analyzed, only six presented values of management and infrastructure above 50%; all belonging to the category of integral protection: five State Parks and

one Biological Reserve. The first category is a type of protected area management that emphasizes scientific research, educational and recreational activities; all properties are expropriated, where

only indirect use permitted. The second category is even more restrictive, where recreational visitation is forbidden, except for environmental education; it aims to protect biodiversity and ecological processes rigorously (Brasil, 2000; Rylands & Brandom, 2005).

The park is the oldest category of protected areas (Mittermeier et al., 2005), which was created for the first time in Brazil in 1937 (Rylands & Brandom, 2005; Silva, 2005). It is a way of including the protection of biodiversity and encouraging recreation, and it may comprise employment generation and income for the unit and the neighborhoods. To this end, it attracted greater availability of resources for investment in management and infrastructure, activities of interaction with Guest X Conservation Unit, demarcated trails, emergency plans and carrying capacity. Therefore, the effectiveness of management of this category tends to be higher (Bruner et al., 2001) than in the other categories.

According to the results obtained for 'Itaúnas' State Park, the largest deficit in management of this unit is the lack of personnel for the development of activities. In 'Cachoeira da Fumaça' State Park, the deficiency in management is related to the use of tools and personal protective equipment ('EPI') associated with the prevention and fighting of fires.

Bruner et al. (2001) evaluated the effectiveness of 93 parks in 22 countries and found that for an effective

management was needed. The central component of conservation strategies that emphasizes the problem is associated with technical and administrative management. On the other hand, 'Duas Bocas' Biological Reserve, created in 1991, as a category of conservation unit (Rylands & Brandom, 2005), legally prohibited to public access (Brasil, 2000),

Table 1. Management parameters of protected areas of the State of Espírito Santo and their respective weights.

Elements analyzed	Weights %
Accommodation brigade	10
Firebreak in risk area	9
Warehouse for maintenance and storage of equipment to prevent and fight fires	9
Vigilance Unit	9
Council manager	9
Management plan	9
Marked access roads	8
Administration center	7
Point of water collection	6
House officials	5
Visitor Centre	5
Permanent exposure	5
Theme wild fire with theme forest fire	2.5
Auditorium	2.5
Accommodation researcher	2
Parking	1
Internal signaling	1
Total	100

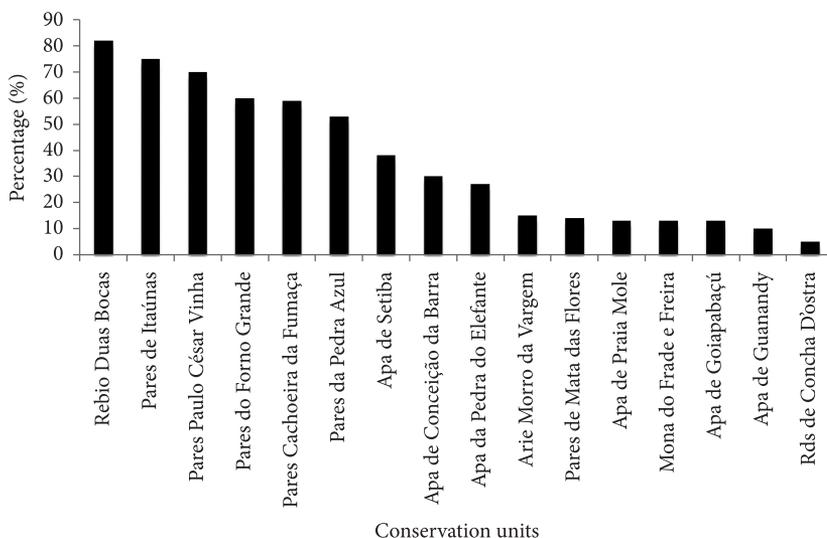


Figure 2. Total percentage (%) of condition for management and infrastructure of the conservation units of the State of Espírito Santo.

tends to have easier management than parks because it is more restrictive.

Out of the ten categories of conservation units remaining, 40% are below the condition of infrastructure and management. Among these, only two are fully protected, 'Mata das Flores' State Park and 'Frade e Freira' Natural Monument. The first, established in 1992, has all the property restrictions, as mentioned above for this category, and the second allows the dwelling of property owners with some restrictions, according to 'SNUC'- National System of Conservation Units (Brasil, 2000).

Among the categories of sustainable use, 'Setiba' Environmental Protection Area ('APA') presented a best quality among its category. However, it should be noted that the administration of this unit is structured along with 'Paulo César Vinha' State Park, the support infrastructure and staff of this conservation unit is extended to the 'APA', including vigilance activities in the areas of sustainable use; this fact masks the result for this unit.

'APA' is an often extensive category of conservation unit that makes its management with owners at substantial level, and it consists of a set of specific biotic, landscape or aesthetic and/or cultural factors (Cabral & Souza, 2002). Its basic objective is to protect the biological diversity, discipline the process of occupation and ensure the sustainable use of natural resources under special administration regime, which will apply appropriate security guarantees (Brasil, 2000). Thus, it is clear that the territorial planning and management are set as necessary to reach those goals. However, due to multiple planning uses, maximized and delimited use of natural resources and poor infrastructure that is difficult to manage, this type of unit holds one of the worst conditions to effective administration.

With reference to infrastructure of state conservation units (Table 3), from the distribution elements analyzed, there was no firebreak record in conservation units, and only one accommodation for brigade, representing 1.2% of the total. Four units with full protection visitor centers with permanent exposure were identified, but according to the interviews with the units' managers, none has addressed the issue as a way of forest fire prevention and fighting. The element of unit vigilance was

identified as the best value regarding frequency (10.7%); however, it is only focused on vigilance of property, not on the prevention and combat of forest fires.

These data are important for policy makers to strengthen firebreak prevention mechanisms by building visitor centers with information about forest fires. One way to mitigate or prevent the occurrence of forest fires in certain areas is associated to the unit's management policy, and to how resources and appropriate technologies are allocated, as well to personnel training on the prevention and combat of forest fires. This should be a priority in areas of greater vulnerability to fire occurrence, focusing on prevention through essential information for developing prevention plans, defining critical areas susceptible to fire risk and training and hiring firefighters (Medeiros & Fiedler, 2004), as well as actions related to the integration around the unit, providing a network of volunteers and partners (Bruner et al., 2001).

Figure 3 shows that inadequate infrastructure, with 14% occurrence, was identified as a major vulnerability for conservation and maintenance of protected areas; followed by hunting activities with 12%, and presence of invasive species with 11% occurrence.

Illegal hunting of wildlife is practically a universal problem and occurs in most protected areas, as well as the presence of invasive species (Terborgh & Van Schaik, 2002). Lack of infrastructure happens in countries where conservation policies have not been created as a priority governmental policy, but only remains as a constraint to growth programs in the country or licensing of private activities. However, this scenario has indicated good results and, therefore, there are perceptible advances in the Brazilian environmental policy. Rylands & Brandon (2005) and Silva (2005), when describing the entire history of the creation of the National System of Conservation Units ('SNUC') in Brazil, affirmed that the government have invested heavily in public policies of protected areas over the past 20 years, but there is still a big challenge ahead: some internal to each conservation unit and others associated with the system itself, but they are all being worked out to be properly adjusted.

Analyzing and relating the categories of threats to conservation (Brasil, 2000), Figure 4 shows that the main threat to units of integral protection was hunting (18%), followed by inadequate infrastructure (11%). On the other hand, areas of sustainable use were threatened mainly by inadequate infrastructure (16%), followed by invasive alien species (14%), and disordered mining and tourism with 12% occurrence. Regarding the susceptibility of conservation units

to forest fires, integral protection areas showed 8%, while areas of sustainable use presented 4% occurrence of threats.

Ramos et al. (2003) evaluated the mechanisms that would hamper the good management of protected areas, such as bureaucracy and high costs to implement management plans, fragility of legislation and public environmental institutions, chronic deficiency of human expertise and material resources, and no regularization. Altogether, singly or combined, the ultimate consequence will be the effectiveness of the units.

Although there are limitations in operating equipment, materials and tools, the state conservation units have the minimum requirements for actions to combat forest fires. Inadequate infrastructure and hunting are the greatest threats to these units. Terborgh & Van Schaik (2002) stated that many protected areas in developing countries have historically been threatened by three factors: degradation, reduction in size, and revocation of their creation; thus, the variety of problems faced by units is discouraging. The effectiveness of systems of protected areas as a whole depends on how units can adequately fulfill their mission

Table 2. Threat parameters of protected areas of the State of Espirito Santo.

Threats assessed
Wildlife hunting
Fishery
Extraction of ornamental plants
Land regularization
Removal of vegetation
Exotic and invasive species
Disorderly tourism
Inadequate infrastructure
Fires
Real estate pressure
Mineral extraction
Bio-piracy
Other threats

Table 3. Occurrence distribution of elements analyzed in the condition for management and infrastructure in protected areas. Absolute Frequency (AF).

Elements analyzed	Full protection		Sustainable use		Total in system	
	AF	%	AF	%	AF	%
Accommodation brigade	1	1,5%	0	0,0%	1	1,2%
Firebreak in risk area	0	0,0%	0	0,0%	0	0,0%
Warehouse for maintenance and storage of equipment to prevent and fight fires	5	7,6%	0	0,0%	5	6,0%
Vigilance Unit	7	10,6%	2	11,8%	9	10,8%
Council Manager	4	6,1%	4	23,5%	8	9,6%
Management plan	6	9,1%	2	11,8%	8	9,6%
Marked access roads	6	9,1%	1	5,9%	7	8,4%
Administration center	6	9,1%	1	5,9%	7	8,4%
Point of water collection	4	6,1%	4	23,5%	8	9,6%
House officials	1	1,5%	0	0,0%	1	1,2%
Visitor Centre	4	6,1%	0	0,0%	4	4,8%
Permanent exposure	4	6,1%	0	0,0%	4	4,8%
Theme wildfire with theme forest fires	0	0,0%	0	0,0%	0	0,0%
Auditorium	4	6,1%	1	5,9%	5	6,0%
Accommodation researcher	4	6,1%	1	5,9%	5	6,0%
Parking	6	9,1%	1	5,9%	7	8,4%
Internal signaling	4	6,1%	0	0,0%	4	4,8%
Total	66	100	17	100	83	100

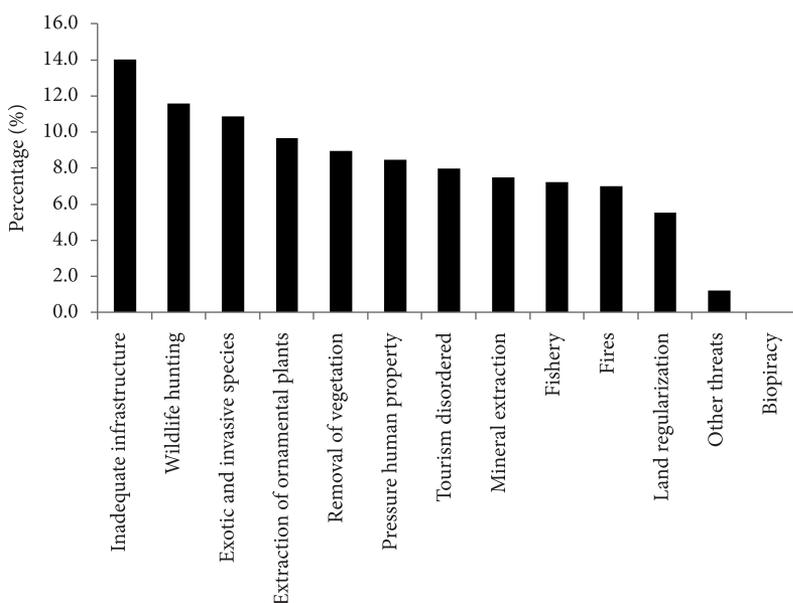


Figure 3. Overview (%) of major threats to ecosystems from 2005 to 2009.

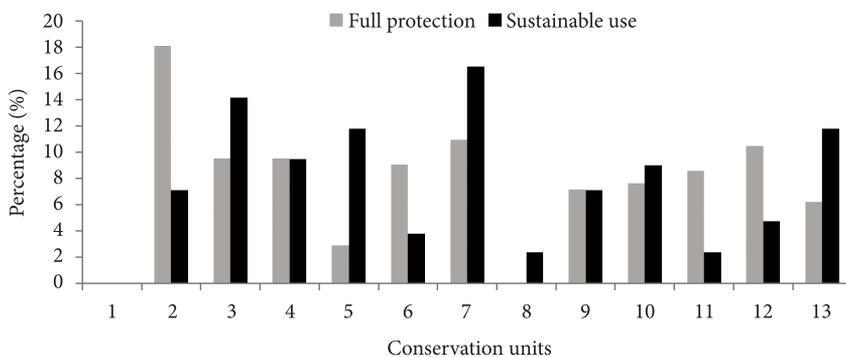


Figure 4. Main threats to protected areas by management group (Integral Protection; Sustainable Use). 1) Biopiracy; 2) Wildlife Hunting; 3) Exotic and invasive species; 4) Extraction of ornamental plants; 5) Mineral Extraction; 6) Fires; 7) Inadequate Infrastructure; 8) Other threats; 9) Fishery; 10) Real Estate Pressure; 11) Land Regularization; 12) Removal of vegetation; 13) Disorderly Tourism.

and collectively safeguard the biodiversity of a country (Rylands & Brandom, 2005). According to Silva (2005), even lacking staff, infrastructure and management, protected areas are effective barriers to the disarrangement and destruction of natural environments by human occupation. Public policies that strengthen the ability to plan, implement, and manage protected areas appropriately with society and government representatives at all levels, would represent an important step towards the protection of natural property.

Moreover, the planning of protected areas, where the management plan and the plan to prevent and combat forest fires are basic tools for their definition, is indicated for the recognition of the multiple use of the territory. Thus, unit's territory, which is part of the environmental planning process, will be realized with its priorities, which set use standards based on local conditions. Therefore, the allocation of funds, materials and staff is the main way of structuring, planning and managing state conservation units and it will also be the only strategy for natural resources management in the long run.

4. CONCLUSION

In the State of Espírito Santo, integral protection units have better conditions for infrastructure and management when compared to those of sustainable use.

Despite the limitations in operating equipment, materials and tools for working in the land, it was possible to identify that the conservation units from the State of Espírito Santo do have the minimum conditions required for forest fire fighting actions.

Even though some units have good conservation to combat impacts, actions are still required within the scope of prevention associated to the community around each protected area (conservation unit).

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