Importance of Ethnobotanical Studies in Protected Areas: a Case Study in Brazil

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ABSTRACT – Ethnobotanical studies in Brazil indicate a strong relationship between local Communities that detain Traditional Ecological Knowledge and the plants used by them. Brazilian protected areas (PAs) may be operating as refuges for these populations due to the providing of non-timber forest products used for subsistence. Here we aimed to explore the current state of ethnobotany research in brazilian PAs by exploring their geographical scope (regions and biomes), the populations involved and their occurrence in different PAs categories. For that, we did a bibliographic survey of studies published in journals between 2006 and 2019, totaling 67 studies. Our results showed that Atlantic Forest was the most studied biome and the northeast region was the most studied region. In addition, the most studied traditional populations are were the artisanal farmers and rural communities. The data also revealed that the Sustainable use PAs contain the most studies, but Parks were the most studied category. Finally, we also found that surveys on the knowledge of medicinal plants use was the main studied theme.

Keywords: Biodiversity conservation; traditional ecological knowledge, plants use; ethnoconservation.

Importância dos Estudos Etnobotânicos em Áreas Protegidas: um Estudo de Caso no Brasil

RESUMO – Estudos etnobotânicos no Brasil indicam uma forte relação entre comunidades locais detentoras de conhecimento ecológico tradicional e as plantas utilizadas. As áreas protegidas (AP) brasileiras podem funcionar como refúgios para essas populações, através do fornecimento de produtos florestais não-madeireiros de subsistência. Nosso objetivo foi explorar o estado atual das pesquisas etnobotânicas nas APs brasileiras para explorar seu escopo geográfico (regiões e biomas), as populações envolvidas e a ocorrência em diferentes categorias de AP. Para isso, realizamos um levantamento dos estudos publicados entre 2006 e 2019, totalizando 67 estudos. A Mata Atlântica é o bioma mais estudado, e a região nordeste é a principal região estudada. As populações tradicionais mais pesquisadas são agricultores artesanais e comunidades rurais. As APs de uso sustentável contêm a maioria dos estudos, mas a categoria Parque foi a mais pesquisada. O conhecimento sobre uso de plantas medicinais é o principal tema pesquisado nos estudos.

Palavras-chave: Conservação da biodiversidade; conhecimento ecológico tradicional; uso de plantas; etnoconservação.

Importancia de los Estudios Etnobotánicos en Areas Protegidas: un Estudio de Caso en Brasil

RESUMEN – Los estudios etnobotánicos en Brasil indican una fuerte relación entre las comunidades locales poseedoras de conocimientos ecológicos tradicionales y las plantas utilizadas. Las Áreas Protegidas (APs) brasileñas pueden actuar como refugios para estas poblaciones, mediante el

suministro de productos forestales no maderables de subsistencia. Nuestro objetivo fue explorar el estado actual de la investigación etnobotánica en APs brasileñas para explorar su alcance geográfico (regiones y biomas), las poblaciones involucradas y la ocurrencia en diferentes categorías de AP. Para eso, realizamos un levantamiento de estudios publicados entre 2006 y 2019, totalizando 67 estudios. La Mata Atlántica es el bioma más estudiado y la región noreste es la principal región estudiada. Las poblaciones tradicionales más investigadas son los agricultores artesanales y las comunidades rurales. Las AP de uso sustentable contienen la mayoría de los estudios, pero la categoría Parque fue la más investigada. El conocimiento sobre el uso de plantas medicinales es el tema principal investigado en los estudios.

Palabras clave: Conservación de la biodiversidad; conocimiento ecológico tradicional; uso de plantas; etnoconservación.

Introduction

The study of the people's knowledge about use of plant species is called ethnobotany, a field of ethnobiology that studies the usefulness of plants and the relationship between human populations and their environment through interactive factors (Albuquerque 2005, 2009; Albuquerque *et al.,* 2019). Among the fields of study on ethnobiology, ethnobotany is the one that has most contributed to scientific publications in Latin America (Albuquerque *et al*., 2013), addressing important issues, such as: the discovery of plant substances with medical and industrial applications; preservation of potentially important plants in their respective ecosystems; and programs for the conservation of natural resources and traditional knowledge (Albuquerque, 2005). Ethnobotany's contributions to conservation programs raise relevant questions about *in situ* conservation: What are the main objectives of ethnobotanical studies being carried out in protected areas (PAs) with the presence of human populations? Are there gaps that need to be filled? Which social groups are mainly involved? What is its geographical distribution?

Traditional ecological knowledge (TEK) is the result of the cultural evolution process of social groups in interaction with nature, which evolves through an adaptive processes (Berkes *et al.,* 2000), established in "socio-ecological systems" (Berkes & Folke, 1998). Such processes reflect the techniques and strategies of using resources use from biotic and abiotic environments, such as in the management of soil and water, in the use of plant and animal species, in the diet and in the use of medicines for health treatments and in the construction of houses. and other facilities, such as fences and tools (Posey, 2002; Ghimire *et al.,* 2004; Berkes, 2010; Alves *et al.,* 2016). Ethnobotanical studies in brazilian natural areas indicate that interaction between local communities with TEK and plants use results in a vast knowledge about their applications and conservation strategies. Examples are the Caiçaras in the brazilian Atlantic Forest, which are recognized as key specialists for the conservation of protected areas (PAs) in this biogeographic domain region (Hanazaki *et al.,* 2009; Britto & Senna-Valle, 2012). This knowledge is reflected in low-impact extraction strategies, methods and techniques, such as local domestication of native and exotic species for medicinal, nutritional and ornamental purposes; use of wood from trees that fall naturally; knowledge of natural cycles and identification of suitable times for logging, for various purposes, in order to avoid over-logging and to keep the sustainability (Trivedi, 2006).

The establishment of legally protected natural areas is a widespread strategy for the conservation of natural resources, and its use is an important mark in the evolutionary process of societies (Chape *et al.,* 2008). However, their objectives in the past were different from the observed in modern PAs. In the former, access to protected resources was limited to only a few privileged members, as in sacred forests in India (Wild & Mcleod, 2008; Ormsby *et al.* 2010). On the other hand, currently PAs are legally recognized and instituted, and in several of which the use of biological resources by human groups is permitted and also encouraged. This is the case of the categories of PAs V – Protected landscape/seascape/area and VI – Protected area with sustainable use of natural resources provided by the International Union for the Conservation of Nature – IUCN (Dudley, 2008), which follow the Convention on Biological Diversity (CBD) signed in 1992 by more than 160 countries, and in its Article 10 deals with the sustainable use of components of biological

diversity (CBD, 1992). Brazil is a signatory to the CBD, and most of its PAs are defined by Law 9.985, which established the National System of Nature Conservation Units (SNUC). According to the SNUC, PAs are divided into two groups, integral protection (IP) and sustainable use (SU). In the first, in which only the indirect use of natural resources is allowed, there are five categories, and in the second, in which the direct sustainable use of natural resources by human groups is allowed, there are seven categories (Brasil, 2000). These PAs can be compared to those listed by IUCN (1994), as demonstrated by Pellizzaro *et al.* (2015) and Silveira Junior *et al.* (2021) (Table 1).

Table 1 – Categories and groups of brazilian protected areas by National System of Nature Conservation Units (SNUC) and their correspondence with the protected areas of the International Union for Conservation of Nature (IUCN).

PAs groups in Brazil	PA categories in Brazil by SNUC	Corresponding PA by UICN
Integral protection	Ecological station (ESEC) Biological reserve (REBIO)	Ia - Reserva strict nature
	National park (PARNA) Wildlife refuge (REVIS)	II - National park
	Natural monument (MONA)	III - Natural monument or feature
Sustainable use	National Forest (FLONA) Extractive reserve (RESEX) Fauna reserve (REFAU)	IV - Habitat/species management area
	Environmental protection area (APA) Area of relevant ecological interest (ARIE)	V- Protected landscape/seascape/area
	Sustainable development reserves (RDS)	VI - Protected area with sustainable use of natural resources
	Private natural heritage reserve (PNHR)	

However, PAs around the world that were established before the CBD (sometimes until today) or are still established with restrictions in relation to biological resources use (fortress conservation) (Brockington, 2002; Silveira Junior *et al.*, 2020), limits the access of human populations to the natural resources of areas they inhabit and deny their ancestral territorial rights (West *et al.,* 2006; Lele *et al.,* 2010; Brondo & Bown, 2011; Torri, 2011; Vedeld *et al.,* 2012). It is undeniable the role of PAs in conserving the biodiversity present in the last natural areas of the world (Mittermeier *et al.,* 2003) against the anthropic actions of the current model of society (Anderson & Mammides, 2019). However, it's importance should also extend to protect the cultures of local groups with traditional knowledge. Certain human groups historically manage natural areas using low impact activities, and therefore ensure the current state of nature conservation (Albuquerque *et al.,* 2018) and that the resources are not permanently depleted (Berkes, 2010).

Considering the context presented and the need of studies in the world and in Brazil about the current scenario of ethnobotanical researches in protected areas and their surroundings, we aimed here to analyze the current state of research on ethnobotany in Brazilian PAs that harbor populations with TEK. To do so, we sought answer the following questions: (i) How is the geographical distribution of the studies? (ii) What the populations involved? (iii) what the biomes and categories of PAs were main studied? and (iv) which the aims of the studies? We expected with this work to characterize the current context of scientific knowledge about ethnobotany in Brazilian PAs, identifying knowledge gaps to be fulfill and possible efforts by the scientific community to enhance the construction of knowledge on the subject.

Material and Methods

We carried out the study through a bibliographic survey on the Google Scholar platform (https://scholar.google.com.br/) and Science Direct (https://www.sciencedirect.com/), looking for studies published between 2006 and 2019. For the research, we used the portuguese key words "etnobotânica", "unidade de conservação", "conhecimento tradicional", "Brasil", and their corresponding terms in English "ethnobotany"," traditional knowledge, "protected areas" and "Brazil". At the end of this stage, we found 115 studies.

We selected studies carried out in or around Brazilian PAs, which harbor human populations that use plant species and have traditional knowledge about them. Studies that did not clearly present information related to the objectives of the study were excluded. Finally, of the 67 selected studies we extracted the information of interest through content analysis, which is a technique for the objective, systematic and qualitative description of the evident content of the communication (Lakatos & Marconi, 2002).

We explored and selected the information based on topics: year of publication, language of publication, research objectives, federal unit, political region, biome, type of PA, category of use of the PA and type of traditional population involved. The categories of PAs were defined according to what was established by the Law 9.985/2000, which created in Brazil the National System of Nature Conservation Units (SNUC) (Brasil, 2000).

We also classified the Brazilian PA typologies comprised by SNUC according to the PA categories proposed by IUCN (Pellizzaro *et al.,* 2015; Silveira Junior *et al*., 2021) (Table 1), also defining its category of use. According to SNUC, the PAs are divided based on resources uses in integral protection and sustainable use, which refers to the objectives of PAs. In the first group only the indirect use of natural resources is allowed, and the second group allow the permanence of communities and the sustainable use of natural resources directly by human groups (Table 1) (Brasil, 2000).

In order to investigate the patterns related to traditional populations, we defined the following denominations: farmers, artisans, indigenous people, among others. The biome identification of PAs followed the following criteriums order: (i) location or information provided by the study; (ii) decrees or laws of PA creation, or information on their institutional websites; and (iii) websites of the public authority responsible for the PA creation and management. For this, we consider the classification of biomes adopted by the Brazilian Institute of Geography and Statistics (IBGE) (2019) and by the Chico Mendes Institute for Biodiversity Conservation (ICMBio) (2020), in which they list as brazilian biomes, Amazon, Cerrado, Pantanal, Caatinga, Atlantic Forest, Pampa, and Coastal Marine. We performed the analysis of the results in a descriptive way, seeking to understand the possible factors that contribute to the results found and their consequences for the conservation and for the human groups involved, guided by the theoretical framework, composed mainly by the results of the studies raised.

Results

We found 67 studies published between 2006 and 2019, corresponding to 62 articles published in 33 journals and five book chapters. We observed an increase in the number of studies between the years 2006 to 2015, and a reduction until 2020 (Figure 1). We identified that there are 15 focuses on the objectives of the ethnobotanical studies compiled. However, there is a large concentration of works with four focuses: (1) knowledge and use of medicinal plants in 32.84% of studies, in which the focus was only on the medicinal uses of plants; (2) knowledge and importance of using families, genera and specific species in 26.86%, in which studies focused on specific species regardless of their use; (3) knowledge and use of plant resources in general, without focusing on an application or taxon by 19.40%, where studies focused on all uses of plant species; and (4) 4.48% of studies approaching the perception of ecosystem resources, vegetation types, biogeographic domains or biomes in which the studies aimed to verify the interactions between the plant species used and their occurrence areas. Objectives that were identified in only one study (11 objectives in total) totalized 16.42% of studies.

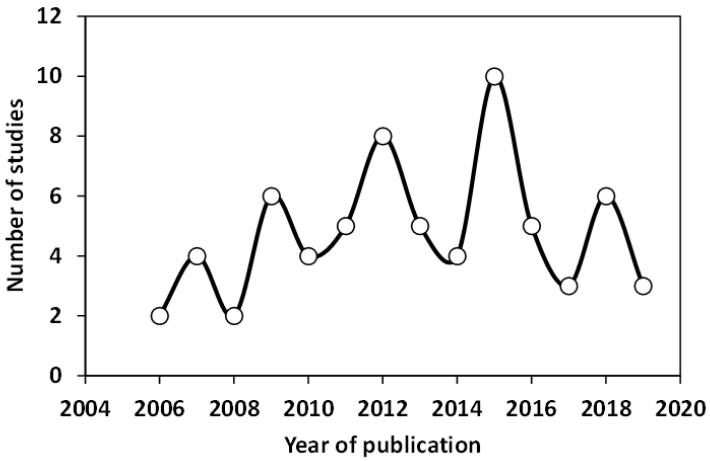

Figure 1 – Temporal trend of the publication of Ethnobotany studies found related to the ethnobotany in brazilian protected areas.

The number of studies between the Federal Units varied from 43.3%, in the Northeast, to 9% in the Midwest region, with great internal variation in the biomes where each study was conducted in the regions (Figure 2). In the Northeast, for example, the studies were carried out in four different biomes (Cerrado, Caatinga, Atlantic Forest and Coastal Marine), while in the South region the studies were concentrated entirely in the Atlantic Forest (Figure 2). The studies were carried out in six different biomes, with the Atlantic Forest being the most studied, corresponding to almost 36% of all the researches, being studied in three of the five political regions of the country. Pampa and Pantanal were the least studied biomes, with respectively zero and one study (Figure 2).

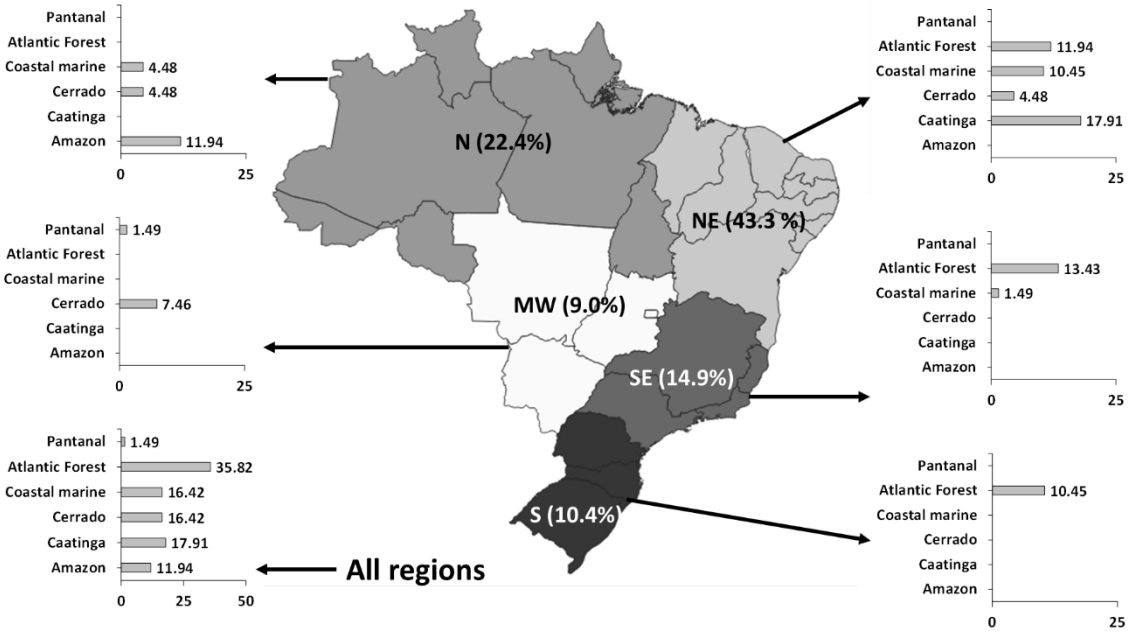

Figure 2 – Number of studies (%) about ethnobotany in brazilian protected areas in the political regions and the number of studies (%) in different biomes inside each political region Note: N: North; NE: Northeast; SE: Southeast; S: South; MW: Midwest.

Most of the studies were carried out in protected areas of sustainable use, which corresponded to more than half of the total (56.7%), however those of integral protection were more than one third (37.3%), in which 28.57% explained that the extraction of plant resources occurred within the PAs of IP, and the rest around it. The studies that present both categories correspond to 6% of the total (Figure 3). The typologies of PAs that have the largest number of researches are: national park (30%), APA (27.1%), RESEX (15.7%), FLONA (11.4%), ESEC (7.1%), RDS (5.7%), and REBIO with the lowest number of researches (2.9%).

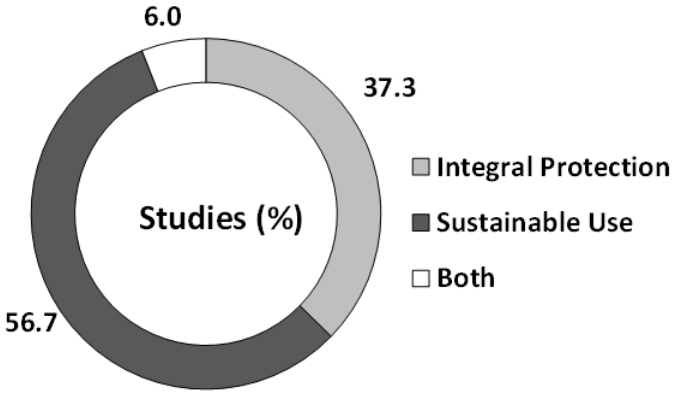

Figure 3 – Number of studies (%) about Ethnobotany in brazilian protected areas groups with different restriction levels. "Both" are related to the studies made performed in territories places where there are protected areas of both PA groups (Integral Protection and Sustainable Use).

Respecting the denominations pointed out by the authors, a wide variety of types of traditional populations was observed, totaling 15. The most found were: rural community (39.2%), artisanal fishermen (17.6%) and traditional farmers (13.5%). It was found that all groups of traditional populations are related to some specific resource, such as fishing or carrying out agricultural or extractive activities. These groups correspond to descendants of Azorean immigrants, rafts and artisanal fishermen with the fishing resource; rubber tappers with rubber extraction, and traditional farmers and rural community with agricultural activities. However, part of these social groups is associated to more than one type of resource, such as 'caiçaras', 'Azoreans', 'jangadeiros' and 'artisanal fishermen', which together make up 25.7% of the studies. These groups of traditional populations need forest resources to develop their fishing activities, such as wood for the construction of rafts, boats and oars.

Discussion

The results pointed out that the number of ethnobotanical studies in protected areas (PAs) varied along time, which grew from 2006 to 2015, and fell after that time, making it impossible to say which factors may be affecting this result. However, it is possible to assume that there has been no incentive to conduct ethnobotanical research in PAs, or there has been no interest in researching ethnobotany in PAs. There are also the possibilities that the researchers do not care if the study area is a PA, or that there is still a lack of knowledge about the important and comprehensive role given to PAs in the Convention on Biological Diversity (CBD) (1992). In according with the CBD, the PAs covers the protection of the biodiversity, ecosystem services, the local populations and their traditional ecological knowledge.

In Brazil, PAs sometimes can operate as the last sanctuaries of biodiversity, as is the case of the Atlantic Forest biome, the one that presented the largest ethnobotanical studies in Brazil. Among the motivating factors we can highlight: it is one of the 34 priority global hotspots for conservation, due its biodiversity and threat level (Mittermeier *et al.*, 2003). Furthermore, currently has only 12.4% of its original coverage (Hirota *et al.,* 2018), of this amount only 10.5% are legally conserved in PAs. Nevertheless, the biome presents the highest

number of PAs in Brazil, with 364 units, 449 of integral protection (IP) and 915 of sustainable use (SU) (CNUC/MMA, 2019).

The Atlantic Forest maintains a close relationship with the Coastal Marine biome, once Atlantic Forest covers 17 states of the country and 14 of them are coastal (Hirota *et al.,* 2018). The two biomes together account for more than 50% of the ethnobotanical studies found. However, we must emphasize that the studies in PAs inserted in Coastal Marine biome were carried out in terrestrial or partially terrestrial ecosystems associated with Atlantic Forest (such as sandbank, mangroves and coastal rainforests, considering that it is in these ecosystems that plants are present. Also, both biomes and related ecosystems are used for the subsistence of human groups, such as artisanal fishermen, caiçaras, jangadeiros and Azoreans, who use timber forest resources to build boats and fishing equipment (Hanazaki *et al.,* 2000; Souza *et al.,* 2012), and non-timber, for medicinal purposes (Zank *et al.,* 2012).

The northest region is the only one in which the studies cover all the existing biomes of the region, with emphasis on the Caatinga, the second biome with more ethnobotanical studies, exactly 50% less than the observed for the Atlantic Forest biome. However, it is important to point out that the Caatinga has only 201 PAs, 54 PI and 147 SU, which together protect only 9.1% of its total area (CNUC/MMA, 2019). The northeast region also is stands out for being the region with the largest number of ethnobotanical studies, which demonstrates the commitment of the research centers in the region to this field of study. Comparatively, all northeastern states together have 44 state and federal public centers of research, teaching and extension, the same number as the states in the southeast region (MEC, 2019). Nevertheless, it represents 43.3% of all studies published in Brazil, while the Southeast represents only 14.9%. The northeast region also has the highest proportion of inhabitants in rural areas, equal to 26.88%, (IBGE, 2015), precisely the largest group of traditional populations involved in the studies. Together, "rural communities" and "artisanal farmers" appear in 52.7% of the total.

Two results on the studied biomes need to be emphasized due to their relevance. The first concerns the Cerrado, considered the largest and richest neotropical savanna (Myers *et al.,* 2000), and one of the 34 priority global conservation hotspots in the world (Mittermeier *et al.,* 2003). Covering three brazilian regions, Northeast, Southeast and Midwest, is the second biome in extension in Brazil, with 2,040,285km^2 currently protected by 438 PAs (CNUC/MMA, 2019). However, it has only 16.4% of ethnobotanical studies in PAs, which seems to indicate that, in the case of the Cerrado, the number of state and federal institutions of teaching, research and extension cannot be considerate as a factor that can influence the number of surveys. The biome is present in two of the regions with more universities and federal institutes, Northeast (44) and Southeast (44), and even its largest portion, in the Midwest, harbors 18 institutions. Thus, perhaps there is a lack of concern from ethnobotanical researchers, especially if we consider that no study has been found in the Southeast region, where is situated the state of Minas Gerais, with more than 50% of its territory covered by this biome. On the other hand, this may be related to the fact that the biome, even having a high deforestation rate in 2015 (0.32%), still having 50% of its natural cover (Françoso *et al.,* 2015), which means that research may be taking place outside of the PAs.

By researching the traditional populations involved, we were able to identify 15 categories. This number reflects the generic character of the legal definition instituted by art. 3, I, of Decree-Law no. 6,040/2007, according to which a large part of the Brazilian population can be included:

> [...] culturally differentiated groups that recognize themselves as such, that have their own forms of social organization, that occupy and use territories and natural resources as a condition for their cultural, social, religious, ancestral and economic reproduction, using knowledge, innovations and practices developed and transmitted by tradition (Brasil, 2007).

We understand that the concept is not mistaken in being comprehensive, on the contrary, it is coherent, since a large part of the Brazilian population still has traditional knowledge and depends on it for their survival and reproduction of the way of life. Especially if we consider that 15.3% of brazilians still live in rural areas (IBGE, 2015). Thus, due to geographical isolation, they are often highly dependent on biological resources

for their survival due to geographical isolation, which explains why these areas have the largest number of traditional populations found in the studies.

On the other hand, there is a difficulty in Brazil in using the classification of traditional populations already recognized, as pointed out by Diegues & Arruda (2001), who point out that these denominations are difficult to be used, even by the populations themselves, because in part of cases, they are not recognized with the denominations attributed to them. This fact was evidenced in this study, in which eight new names were found in addition to those already recognized in scientific studies.

The found result on the objectives of the compiled studies points to the dependence of traditional people on botanical resources, knowledge and use of medicinal plants, which needs to be further investigated. Also points to the dependence of plants for health treatments, as seen in Agra *et al.* (2007) and Abreu *et al.* (2015); multiple uses identified in Poderoso *et al.* (2012) and Rocha *et al*. (2017); the importance of certain species to human groups, such as *Syagrus coronata* (Mart.) Becc. (licuri) in Andrade *et al*. (2015); *Attalea speciosa* Mart. (Babaçu) in Araújo *et al*. (2016); and *Caryocar coriaceum* Wittm. (pequi) in Souza Júnior *et al.* (2013).

The existence of a greater number of ethnobotanical studies in sustainable use PAs (SU) was already expected, as they are typologies created by the Brazilian public authorities, through Law 9.985/2000, to enforce the provisions of CBD. The article 4, Item XIII, of the referred legal act, stipulates the duty: "to protect the natural resources necessary for the subsistence of traditional populations, respecting and valuing their knowledge and culture, and promoting them socially and economically" (Brasil, 2000). However, the results show a significant number of studies taking place in integral protection PA (IP), in which direct use of biological resources is not allowed. We highlight the parks, which despite being configured in Brazil as a category of IP, were the ones that most presented ethnobotanical studies. This result demonstrates that these protected areas conserve not only biodiversity, ecosystem services and scenic beauty, but also that they can represent the last reservoirs of non-wood forest products of multiple uses, being the fundamental importance to maintain the lifestyle of TEK populations.

However, most studies revealed that direct use takes place in the surroundings and not inside the IP. Therefore, the results demonstrate that these PAs are of fundamental importance for the maintenance of traditional knowledge, as they were created in areas where human groups evolved their socioecological systems, in which TEK has developed (Berkes & Folke, 1998; Berkes, 1999). The Law nº 9985/2000 provides for the use of the "term of commitment", a legal instrument that regulates the use of natural resources by traditional populations in PAs as extractive reserve (RESEX) and sustainable development reserve (RDS), also regulates the use in PAs of IP. However, it is a palliative measure, as established in Chapter IX, Art. 39 of the same law, the "term of commitment" will be provided only while the populations are not resettled outside the PAs (Brasil, 2000).

IP protected areas should involve local populations more in conservation, once the restrictions imposed can cause changes in their socioeconomic activities that, in certain cases, will reflect negatively on the culture of local populations and, consequently, on PAs (Silveira-Junior *et al*., 2020). This is exemplified in the case study presented by Albuquerque *et al*. (2018), about the populations inhabiting the region where the Araripe National Forest was created. Prior to the creation of the PA, residents had small livestock as their main socioeconomic activity, calculated to be of low impact and beneficial for heliophilous species that prefer open areas for development, such as *Caryocar coriaceu*m commonly known as "Pequizeiro". Later, when they were removed from the area and their activities were banned, they began to have pequi extraction and oil production as their main socioeconomic activities. This change began to demand the extraction of woody material in the collection time**,** once the extractivists camp in the area to cook it on site, thus increasing the extraction of wood from 28 species for the production of firewood.

Another negative effect presented by the imposition of legal restrictions and the removal of populations was the intensification of socio-environmental conflicts (Silveira Junior *et al*., 2021), which can also make the conservation objectives unfeasible, once the populations can react by causing reprisals and causing impacts on PAs. This is an example of what precisely has happened in Bwindi Impenetrable National Park, in Uganda, where the PA shelters more than half of

the world's gorilla populations. When the PA was created, restrictions imposed without negotiations motivated local populations to cause fires and threats to gorilla conservation (Hamilton *et al*., 2000).

Considering that most studies aimed to investigate the knowledge and use of plant species, especially medicinal applications, we find the following gaps that need to be filled in future studies: the scarcity of studies based on participatory ethnobotany methodologies; few ethnobotanical research carried out as a subsidy for the PAs creation; and studies performed in less studied biomes. We understand that such studies are fundamental for the cultural valorization and promotion of PAs, however it is urgent to expand participatory ethnobotanical research in PAs, in which the human populations involved can also assume the position of researcher, helping to build and carry out the research (Rodrigues *et al.* 2020). Such advances can favor the cultural valorization and the participation of the human populations involved in the co-management processes of PAs (Ericson, 2006).

We highlight the importance of conducting ethnobotanical studies prior to the creation of PAs in order to assist the public authority in choosing which typology should be created regarding the restriction level. Within the studies included here, just Hanazaki *et al.* (2012) was made with this aim. Hanazaki *et al.* (2012) researched two areas in the Atlantic Forest, where the local residents, artisanal fishermen, have requested the local government to create two sustainable use PAs, an RDS and an EXRES. This request was made as a way to protect against an uncontrolled urbanization process that was underway in the region. The result of these ethnobotanical study demonstrated that residents have a vast traditional knowledge of native plant species for medicinal use, and others for their subsistence, thus the creation of PAs could protect both the Atlantic Forest and traditional knowledge (TEK).

Conclusion

Based on our results, we concluded that is urgent to expand ethnobotanical studies in brazilian PAs, particularly in the less studied biomes. In addition, the brazilian government should prioritize PAs of less restrictive categories in territories where the existence of human groups with TEK is evidenced, such as sustainable use PAs (e.g. RESEX and RDS – IUCN categories IV and VI). It is also important that conservationist policies in Brazil be reviewed, especially when it comes to traditional knowledge and use. Considering that parks correspond to a category that has restrictions on the direct use of natural resources, and were identified as the PA category with more studies, the approach on "terms of commitment" should be changed. To be an effective legal instrument in Brazil, in which the purpose is to regulate the activities of traditional populations in SU and PAs of IP, it should lose its palliative character when it comes to full protection PAs, and be established as legal strategy to regulate the extractive activities of populations with traditional ecological knowledge. In this case, must be considered the results of studies of ethnosciences, such as ethnobotany, which may measure the knowledge and uses of natural resources and their consequences for the biota and ecosystems.

Finally, we suggest ethnobotanical studies are legally required as a subsidy for the creation of PAs, in order to subsidize public decisions on which typology of PA should be created, thus avoiding the establishment of restrictive PAs in places where biological diversity and traditional knowledge coexist.

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