Local ecological knowledge and its relationship with biodiversity conservation among two Quilombola groups living in the Atlantic Rainforest, Brazil

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Abstract

Information on the knowledge, uses, and abundance of natural resources in local communities can provide insight on conservation status and conservation strategies in these locations. The aim of this research was to evaluate the uses, knowledge and conservation status of plants in two Quilombolas (descendants of slaves of African origin) communities in the Atlantic rainforest of Brazil, São Sebastião da Boa Vista (SSBV) and São Bento (SB). We used a combination of ethnomedical and ecological survey methods to ask: 1) What ethnomedical knowledge do the communities hold? 2) What native species are most valuable to them? 3) What is the conservation status of the native species used? Thirteen local experts described the names and uses of 212 species in SSBV (105 native species) and 221 in SB (96 native species). Shannon Wiener diversity and Pielou’s Equitability indices of ethnobotanical knowledge of species were very high (5.27/0.96 and 5.28/0.96, respectively). Species with the highest cultural significance and use-value indexes in SSBV were Dalbergia hortensis (26/2.14), Eremanthus erythropappus (6.88/1), and Tibouchina granulosata (6.02/1); while Piptadenia gonoacantha (3.32/1), Sparattsperma leucanthum (3.32/1) and Cecropia glaziovii (3.32/0.67) were the highest in SB. Thirty-three native species ranked in the highest conservation priority category at SSBV and 31 at SB. D. hortensis was noteworthy because of its extremely high cultural importance at SSBV, and its categorization as a conservation priority in both communities. This information can be used towards generating sustainable use and conservation plans that are appropriate for the local communities.
Introduction

Brazil is one of the world’s megadiverse countries, and the Atlantic rainforest, which stretches from the northeastern to the southern regions of the country, is the most biodiverse biome of Brazil, with up to 476 plant species found in one hectare [1]. Unfortunately, the Atlantic rainforest is also one of the most threatened forest types in the world, with nearly 90% of its original area devastated [2]. As is the case with the majority of Brazilian protected areas [3], the Atlantic Rainforest is also home to many traditional communities—those that have lived in one location for a long period of time, such as the Quilombolas. According to the Living Report of World Wide Fund for Nature [4], 90% of tropical forests worldwide are not under formal protection and millions of people living both inside and outside of reserves rely on their resources [5].

The Quilombolas are descendants of slaves of African origin who came to Brazil during the colonial (1530–1815), united kingdom (1815–1822) and empire (1822–1889) periods. Some of these slaves fled the farms where they were exploited, organizing communities of refugees, called Quilombolas, in the local forests. Since that time, the Quilombolas have lived in villages where they have made a living from agriculture and use of forest resources. Like other traditional communities, over time they have developed detailed local ecological knowledge systems (LEK) [6, 7]. LEK systems are knowledge practice and belief systems about the relationships of living beings, including humans, with one another and with their environments. LEK is developed through the process of observation and experimentation and is passed down through generations [8, 9]. Research outside of Brazil has shown that communities of freed or escaped slaves, also known as maroons, have high levels of knowledge of plants [10], and strong conservation practices for their natural resources [11].

It is important for communities, such as the Quilombolas, who continue to depend on the local environment as a primary source of resources, to develop the means to maintain and preserve local species. Understanding LEK, including ethnobotanical knowledge and natural resource use strategies, is critical to developing strategies for conservation [12]. Conservation projects that do not include communication with and/or participation of local communities who use the resources can be problematic. In addition, the loss of local knowledge and practices may compromise not only cultural knowledge but also local biodiversity [13]. Surveys of useful plant resources can provide information to help evaluate conservation status and the potential for sustainable use [14]. In Brazil, little is known about the knowledge, use, and conservation of resources of Quilombolas communities. Crepaldi and Peixoto [15] documented species abundance in forests and how they were managed in a Quilombola community in the state of Espírito Santo, Brazil, but beyond this study little information is available. Similarly, França [16], documented the species in Campinho da Independência, Paraty/RJ, and Avila, Zank [17] the species of three communities in Santa Catarina.

This work focused on two Quilombolas communities in the Atlantic forest of Minas Gerais state in Brazil to address the following questions: 1) What ethnobotanical knowledge do the communities hold? 2) What are native plant species most valuable to them? 3) What is the conservation status of the native species used? By developing a list of local forest species and their conservation status, we also aimed to identify species at risk [18], and therefore generate some of the information needed for sustainable management plans.

Methods

Study sites

We carried out our research in two Quilombolas communities located inside the Atlantic Rainforest in Minas Gerais state of Brazil: São Sebastião da Boa Vista (SSBV) (21’31’0.24” S e 43’
39° 30. 26” W) and São Bento (SB) (21° 33’ 39.33 S e 43° 38’ 59. 94” W) (Fig 1). The vegetation in these communities range from grassland to forest to Eucalyptus plantations, as well as farms with crops and cattle. Historically, these farms were run by slave owners, and the Quilombolas are descendants of those slaves. Today, most of the inhabitants continue to raise crops and cattle on their land, but some young people work as wage laborer in eucalyptus farms in the surrounding areas.

Since 2010 both communities have had linkages with the Geosciences department/Geography and Botany department/ICB at the Federal University of Juiz de Fora. The communities of SSBV and SB provide excellent locations to study local ecological knowledge as they have been partially isolated for many years, exclusively using the natural resources around them, and so and have developed much knowledge about the use of the forest surrounding the communities.

Fig 1. Localization of the communities studied, São Sebastião da Boa Vista (SSBV) and São Bento (SB). Santos Dumont city, Minas Gerais state/ Brazil.

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The size of the communities’ territories are: 130 hectares (SSBV) and 8000 hectares (SB). At SSBV, houses are located at the community center, surrounding the church in a radius of at most 300 m. Today the community has 36 houses and 98 inhabitants. At SB, houses are further away from each other, but the church is considered the community center and the meeting point of villagers. Presently, the community has 20 houses and 85 inhabitants; houses are scattered around the woods in a radius of up to 6 km and they have restricted access by trails (Figs 2 and 3).

Catholic churches are the main places of worship for the communities; however, elements of African religions are present, demonstrating religious syncretism.

Ethnography, consent and ethical approval

We made ten trips were made to each community between March and December of 2012. These trips included home visits to all houses in each community for informal interviews with
the inhabitants and participant observation [19]—observing and participating in daily activities with the residents.

Home visits were carried out together with a key informant, who contributed actively to the research [20]. The main discussions were about life histories, local daily problems, collective life, and health. We also which community members were experts in health and/or knowledge of plants [21].

At the end of this stage, participants signed the free, prior and informed consent agreement provided by the Brazilian Ministry of Culture.

Permission to conduct this study was obtained from "Instituto do Patrimônio Histórico e Artístico Nacional" (IPHAN—National Institute of Historic and Artistic Patrimony) by permit n°01450.010839/2012-62 (S1 Appendix). To obtain this permission, a meeting with all the community members, recorded in the minutes of the residents’ association, were made at each Quilombola, when all steps of the work were explained, prevising the participation of citizens.
of all age groups. In these meetings the president of the residents’ association signed a Consent Form provided by IPHAN on behalf of the whole community, authorizing the research at the Quilombolas and with their citizens. After that, these Consent Forms were sent to IPHAN and the permission was obtained.

Collection of ethnobotanical data

Ethnobotanical data were collected through interviews with local experts, where the snow ball method [19] was employed, and local experts indicated other possible plant experts. A total of 13 local experts were identified. The group in SSBV was of 7 experts (2 men and 5 women) and in SB was of 6 experts (2 men and 4 women). The age of these specialists ranged from 26 to 84 years, and their social occupations included traditional cooks, builders, craftsmen, spiritual healers, lumberjack and/or bushman (Table 1).

Interviews using semi-structured questionnaires were carried out with local experts [22] where they were asked about the use of plants for all purposes (Table 2).

To triangulate the information collected in interviews, focus group discussions were carried out with the whole community in day-long meetings (1 in each community). We directly invited all households to attend (by going door to door). The focus group in SSBV was made up of 18 teenagers (12–18 years old; ten female and eight male), 16 adults (over 18 and less than 60 years old; nine women and seven men) and nine elders (over 60 years old; five women and four men). In SB there were 20 teenagers (15 female and five male), ten adults (seven women and three men) and eight elders (six women and two men). The ages ranged from 18 to 66 in SSBV and 18 to 75 in SB. Focus group discussions focused on the vernacular names of plants and their use categories (Table 2). Pictures or in vivo specimens were presented and participants openly discussed the plants used. All participants present had the opportunity to participate. Focus groups lasted up to one hour.

Collection and identification of plant specimens

After obtaining ethnobotanical data, fertile species were collected in vivo [24] by the “walk in the woods method” [25] with local experts. Voucher specimens were prepared and identified by experts from Universidade Federal de Juiz de Fora (UFJF) and partner specialists and vouchers were deposited in Leopoldo Krieger Herbarium (CESJ). Scientific names and families of species were checked using the plantlist.org

In cases where the flowering period did not coincide with the field visits, non-fertile species were collected but were identified by comparison with samples of CESJ Herbarium and with image records of Virtual Herbarium of Musém National d’Historie Naturelle, Royal Botanical Gardens, and Missouri Botanical Garden. For those plant species for which it was not possible

Table 1. Gender, age, and number of local specialists with knowledge of different plant use categories in São Sebastião da Boa Vista (SSBV) and São Bento (SB).

| Community                  | Gender | Specialty categories | Average age ± SD |
|----------------------------|--------|----------------------|------------------|
|                            | M  | F  | MP | TC | Bu | Cr | SH | Lu | Bm |          |
| São Sebastião da Boa Vista | 2  | 5  | 7  | 2  | 2  | 1  | 2  | 2  | 2  | 58.7 ± 9.7 |
| São Bento                  | 3  | 3  | 5  | 2  | 2  | 1  | 2  | 2  | 2  | 67.1 ± 3.9 |
| Total                      | 5  | 8  | 12 | 4  | 4  | 4  | 4  | -  | -  | -          |

(M) = Male; (F) = Female; (MP) = Knowledge of medicinal plants; (TC) = Traditional cooks; (Bu) = Builders; (Cr) = Craftsman; (SH) = spiritual healers, that have supernatural power to cures and other spells; (Lu) = Lumberjack; (Bm) = Bushman = main collectors of raw forest material.

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to collect samples, the checklist method was performed [22]. Botanical species photographs from the Ethnobotanical Laboratory of UFJF collection were shown to interviewees so that they could confirm which ones they had cited in the surveys and focus groups.

### Evaluation of origin and conservation status of plants used in the communities

Information about the species named and collected was searched for in the Flora Brasiliensis [26], The Botanical List of Brazilian Species (Reflora) and the Native Species Manual [27]. For evaluation of conservation status, only native species were considered. For Atlantic rainforest species that are harvested, information on the conservation status and threats were searched for using the following databases: Ministério do Meio Ambiente, Biodiversitas Foundation and International Union for Conservation Nature.

### Data analyses

To evaluate ethno botanical knowledge homogeneity and diversity of the study communities, Pielou's Equitability index (EI) and Shannon-Wiener’s biological diversity index (BDI) were used [28]. These indices, commonly used in ecology, have been adapted to ethnobotany to evaluate the uniformity and diversity of ethnobotanical knowledge respectively, of a particular community. These indices were calculated based on every species of the ethnobotanical collection in both communities; native and exotic species were both included. The software PAST v.134 [29] and the equations below were used:

### Table 2. Plant uses by Quilombolas of São Sebastião da Boa Vista (SSBV) and São Bento (SB)–listing by categories adapted from Galeano [23].

| Use category | Use type                                                   |
|--------------|------------------------------------------------------------|
| Food         | Heart of palm                                              |
|              | Leaves, fruits, and flowers eaten raw or cooked             |
|              | Fruits used for production of alcoholic beverages           |
|              | Edible fruits                                              |
|              | Spices                                                     |
| Building     | House found                                                |
|              | Flooring                                                   |
|              | Pillars                                                    |
|              | Crafting                                                   |
|              | Thatched roof                                              |
| Fuel         | Fire production (for multiple purposes)                    |
| Medicinal    | Medicines                                                  |
| Ornamental   | Grown for ornamentation                                    |
| Ritualistic  | Bath to discharge the body of bad energy                   |
|              | Protect the house                                          |
| Technology   | Sarong making                                              |
|              | Fishing tools                                              |
|              | Furniture                                                  |
|              | Cable tools in general                                     |
|              | Stakes and fences                                          |
|              | Handicrafts for decoration                                 |
|              | Kitchenware                                                |

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Shannon-Wiener Index

\[ H' = - \sum_{i=1}^{n} P_i \log P_i \]

Where:

\[ P_i = \frac{n^i}{N} \]

\[ H' = BDI \]

\[ n^i = \text{only citations per species only from the interviews} \]

\[ N = \text{total of citations} \]

Pielou’s Equitability index:

\[ J' = \frac{H'}{H'_{\text{max}}} \]

\[ BDI = H' \]

\[ H'_{\text{max}} = \text{(natural base logarithm) of total species number} \]

These indices were also compared with those found from other studies in Brazil.

To measure the importance of each native species, we used the Cultural Significance index (CSI) [30]:

\[ CSI = \sum (i \times e \times c) \times CF \]

i = species management (ranging between 1 and 2. Being 2 = cultivated or managed)

e = preferential use (ranging between 1 and 2. Being 2 = preferential for a particular use)

c = use frequency (ranging between 1 and 2. Being 1 for rarely cited—cited by less than two people or under 10% of citation)

CF = correction factor (citations of species \(x\)/citations of the most cited species)

* \((i \times e \times c) = \text{must be calculated for each use category}\)

To assess the conservation status of native forest plant species used by SSBV and SB communities, we adapted the Conservation Priority Index (CPI) [18], which considers the following criteria: sampled density, risk based on collection type, local importance and diversity of uses. The forests area for each community was large (40,000 m² in SSBV and 150,000 m² in SB), therefore plots were established to obtain species densities. As suggested by Espírito-Santo, Shimabukuro [31], 10 plots of 10 m x 10 m (totalizing 0.1 hectare) were established in the forests surrounding each community. Plot locations were chosen by “preferential sampling” [32], where local experts identified the sites with the highest collection pressure (Fig 4). These local experts were invited to participate in the “walk in the wood” method [25] through the selected plots, where they named known and useful species. All the sampled species [15] were collected in vivo [24] and an image record was produced [33] for subsequent identification by comparison with CESJ Herbarium specimen [22].
The CPI was scored according to Table 3 and calculated using the formula below:

\[
CPI = 0.5(B) + 0.5(RU)
\]

B = Biological Value
RU = Risk of use

Where:

\[
B = Dr \times 10
\]

\[
Dr = \left(\frac{N}{ni}\right) \times 100
\]

N = individuals of the x species
ni = individuals of all sampled species

\[
RU = 0.5(C) + 0.5(U) \times 10
\]

(C) Collection Risk = Points attributed per collected botanical parts
(U) Use-value = determined by the highest value between L and Div

Fig 4. Aerial overview of the communities. A: São Sebastião da Boa Vista; B: São Bento.

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Analyzed species were categorized into three groups:

**Category 1** (species with score ≥ 85); they have conservation priority and should not be collected until appropriate precautions or for further conservation plans are implemented;

**Category 2** (species with score between 85 and 60); they are suitable for moderate collection;

**Category 3** (species with score ≤ 60); they are suitable for collection.

As another indicator of potential pressure on native species, the Use-Value Index (UVI) [25, 34] was calculated with the formula:

$$ UVI = \frac{\sum U}{n} $$

Where:

U = Number of mentioned uses of species X.

n = Total number of interviewees.

Lucena, Lucena [35] state that CPI is the most effective index to identify locally rare and impacted species, however, UVI can be additionally used to identify the most known and used species.

Finally, we classified species into their ecological succession stage by dividing them into three groups, according to the classification of Gandolfi, Leitão Filho [36]:

1) Pioneer (species that develop in clearings, in forest edges or in the open, dependent on light and not occurring generally in the understory);
2) Early secondary (species that develop in small clearings in the understory under conditions of some shading and can also occur in areas of old clearings);
3) Late secondary (species that develop exclusively in the permanently shaded understory, including small or large tree species that develop slowly and may reach the canopy or are emerging; and
4) Climax (species that have slow growth, germinate and develop in the shade, and produce large seeds).

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**Table 3. Scoring criteria used to determine conservation priority species.** Adapted from [18].

| Criteria | Score |
|----------|-------|
| (Dr) Relative density | Occurrence between 0 and 1, then is considered too low | 10 |
| | Occurrence between 1.1 and 3.5, then is considered low | 7 |
| | Occurrence between 3.6 and 7, then is considered average | 4 |
| | Occurrence above 7 | 1 |
| (C) Collection risk based on the botanical part collected | Removal of specimen, of descendants, excluding possibility of species perpetuation | 10 |
| | Removal of perennial structures without death, but actively influencing vegetative growth or flowering and perpetuation of species | 7 |
| | Ex: botanicals structures that fall naturally and periodically | 4 |
| (L) Use location based on the reference frequency | For over than 20% of population, its use is considered high | 10 |
| | Between 10 and 20%, its use is considered moderately high | 7 |
| | Up to 10%, its use is considered moderately low | 4 |
| | Only mentioned in interviews | 1 |
| (Div) Diversity or plurality of use assigned to the species | For each use, add 1.42 to Div value | Up to 10 |

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To compare our ethnobotanical indices to those in the literature, we searched for Ph.D. theses and Master dissertations on Biblioteca Digital Brasileira de Teses e Dissertações (http://bdtd.ibict.br/vufind/) and for papers on Scientific Electronic Library Online (http://www.scielo.org/php/index.php) and Scopus (http://www.scopus.com/home.url) databases.

**Results and discussion**

**Sociocultural characteristics**

Based on experts at both communities, knowledge about local plants was predominantly among the older generation, with a mean of age of 58.7 ± 9.7 years in SSBV and 67.1 ± 3.9 in SB of the experts interviewed. Lima, Silva [37], Hanazaki, Tamashiro [38] and Galeano [23] have found similar results. This may indicate expertise takes many years, or that knowledge may be decreasing in the younger generations [23]. In our focus group discussions, it was noted that the decreasing isolation of these communities has resulted in changes in lifestyle, through the incorporation of urban elements into the local culture. This is also evidenced by the increase of households with TV and telephones and the education of 7 teenagers from SSBV and 5 from SB in Santos Dumont city. Participants in the focus group discussions also commented that young people are no longer interested in learning traditional knowledge.

In terms of gender, there were more female than male experts (Table 1), and all the women are medicinal plant experts and 4 of them are traditional cooks. All male experts are lumberjacks, bushman and builders—these knowledge categories are exclusive to men. These data demonstrate a social allocation of labor as the men are responsible for resource extraction from the forest and other jobs that require heavy labor, such as construction. Women are responsible for food preparation and health of their families. These results coincide with other studies of Quilombola communities [39, 40].

In terms of religion, 100% of the members of both communities are Catholic, demonstrating the great influence of Catholicism in historical and social process of the formation of Brazilian Quilombola communities’, as pointed out by Santos [41]. Historically this influence occurred due to the presence of large estates which were producers of coffee and milk, and where farmers imposed European culture on their slaves. This was confirmed through reports in both communities, that religion was one of the conditions imposed on them to keep the local peace. According to participants, in the case of SSBV, the most important historic milestone was the construction of the Church with the local farm owners help, in 1930 and the existence of a slave known as "Pai Tudo" (which translates to “father of everything”), who died in the same decade. He was considered a healer, spiritual healer, and sorcerer, who made magic for good and for evil and a local disseminator of religious and ethnobotanical knowledge. This highlights the religious syncretism and cultural changes that occurred as a result of imposed religious elements [42]. The local historic milestone in SB is similar to that of SSBV, where the Catholic Church was also constructed by farm owners.

**Ethnobotanical data**

A total of 212 useful species were recorded from SSBV and 221 from SB. This included 105 and 96 native species from the Atlantic forest, respectively, totaling 139 native species (out of a total of 299) (Table 4). The substantial proportion of exotic species demonstrates the influence of diverse cultures and ethnic groups on plant knowledge formation at both communities.

In general, those plants used in the two communities were used in the same ways in both places. However, a few species had different uses, such as *Dalbergia hortensis* (used for medicinal, construction, ritualistic and technological uses in SSBV and only technological uses in SB) and *Merostachys* sp.¹ (employed in ornamental, construction, fuelwood and technological uses
in SSBV and only used for construction in SB). A possible explanation is that they were influenced by different farmers in their respective areas, which possibly resulted in different knowledge about the same plants. Although Quilombolas knowledge includes knowledge brought from Africa, it also includes knowledge learned from Amerindians and Europeans living in Brazil. This influence can be observed in the vernacular names of plants, which are distinct in many cases between the two communities (Table 4).

Medicinal and technological uses were the most important uses in both communities (Fig 5). The predominance of plants used for medicinal purposes was also described for other Quilombolas communities, including Campinho da Independência in Paraty/RJ, Brazil [16] and in Espírito Santo state, Brazil [15], both in areas of Atlantic Rainforest. Hanazaki, Souza [43] similarly described the main use of plants for medicinal purposes for rural communities in the Boundaries of Carlos Botelho State Park in São Paulo, Brazil. In this study construction/technological uses included construction of houses and furniture, manufacturing of handles, canoes, fence posts and wooden wagons. This is similar to another Atlantic forest community (Rio Formoso/PE, Brazil) where technology and medicine were identified as the two most important use categories [44].

We found that herbaceous plants are predominant among medicinal species, and that leaves are the plant part most commonly collected from herbaceous species. Trees were mostly employed for technological uses and therefore stems were the plant part most commonly used. In Rio Formoso, the plant part most frequently collected part was wood (78.5%), followed by fruit, bark, resin, inner bark, seed, leaf, and flowers [44]. Albuquerque and Andrade [45], Oliveira, Lins Neto [46] and Meyer, Quadros [47] showed the predominant use of stems and trees in the Caatinga; however, it is important to note that this biome has different characteristics to the Atlantic Rainforest, as it is much drier.

The Shannon-Wiener biological diversity index and Equitability index were 5.14 and 0.96 respectively for SSBV and 5.20 and 0.96 for SB. These are considered high according to [29] and as compared to other studies in Brazil (Table 5). These values may indicate homogeneity of ethnobotanical knowledge. However, Meyer, Quadros [47] state that high values can also demonstrate a common ethnobotanical knowledge origin of plant knowledge. This is consistent with the fact that among the 63 species that were used in both communities, 42 species have the same vernacular name (Table 4). The high evenness may also be a result of the fact that only experts were interviewed in each community. However, our value for the diversity of ethnobotanical knowledge is similar to that found for another Quilombolas community (Table 5). The high diversity of knowledge could potentially be a result of the fact that Quilombolas ethnobotanical knowledge includes a combination of African, Amerindian and European knowledge of plants.

The forest species used in both communities are, in general, categorized as low risk based on international (International Union for the Conservation of Nature (IUCN), and national (Biodiversitas and Ministério do Meio Ambiente—MMA) assessments (Table 6). At SSBV, A. angustifolia and E. edulis are classified as “in danger” according to Biodiversitas and “endangered” according to MMA and M. villosum is “vulnerable” according to IUCN. At SB, only O. odorifera is classified as “in danger” according to Biodiversitas and Endangered according to MMA.

Unfortunately, locally these species appear to be at much higher risk. The results of our conservation priority index show that, of the 59 species at SSBV in Table 6, 56% are classified in Category 1 (highest risk), 37% of Category 2 and 7% in Category 3. Among the 61 forest species of SB, 52% were classified in Category 1, 38% in Category 2 and 10% in Category 3. This indicates that more than 50% of the forest species are under threat and would benefit from conservation plans. Although the Quilombolas do not harvest plants for commercial purposes,
| Family          | Scientific name (Family) | Vernacular name | Hab. | Use categories | Part | Voucher |
|-----------------|--------------------------|-----------------|------|----------------|------|---------|
| **Alismataceae** | Echinodorus grandiflorus (Cham. & Schltdl.) Micheli | Chapéu de couro | Hb   | M              | Le   | 61724   |
| **Amaranthaceae** | Alternanthera brasiliana (L.) Kuntze | Amoxilina | Antibiótico de horta | Hb | M | Le | 60495 |
| **Anacardiaceae** | Anacardium occidentale L. | Caju | | | | |
| **Annonaceae** | Schinus terebinthifolius Radd | Aroeira | | | | |
| **Araceae** | Xanthosoma sagittifolium (L.) Schott. | Taioba | | | | |
| **Araucariaceae** | Araucaria angustifolia (Bertol.) Kuntze | Pinheiro | | | | |
| **Arecaceae** | Euterpe edulis Mart. | Palmeira | | | | |
| **Aristolochiaceae** | Aristolochia sp. | Milhomí | | | | |
| **Aspleniaceae** | Asplenium sp. | Samambaiazinha | | | | |
| **Begoniaceae** | Begonia sp. | Azedinho | | | | |
| **Bignoniaceae** | Handroanthus chrysotrichus (Mart. ex A. DC.) Mattos | Pau mulato | Ipê comum | Ar | T | Fw | St | 62972 |
| **Boraginaceae** | Tournefortia paniculata Cham. | Marmelinho | | | | |
| **Brassicaceae** | Brassica rapa L. | Mostarda | | | | |
| **Cactaceae** | Cactaceae | Chuveiro | | | | |
| **Compositae** | Achyrocline satureioides (Lam.)DC. | Marcela do campo | | | | |
| **Cynanchaceae** | Aegopodium podagraria L. | Erva de São João | | | | |
| **Dilleniaceae** | Davilla rugosa Poir. | Cipó-cabuco | | | | |
| **Dioscoreaceae** | Dioscorea sp. | Inhame | | | | |
| **Dilleniaceae** | Croton urucurana Baill. | Adergo | | | | |
| **Euphorbiaceae** | Manihot esculenta Crantz | Mandísica | | | | |
| **Hypericaceae** | Hypericum brasiliense Choisy | Ruílo | | | | |

(Continued)
| Family     | Scientific name (Family) | Vernacular name | Hab. | Use categories | Part | Voucher |
|-----------|--------------------------|-----------------|------|----------------|------|---------|
| Lamiaceae | Aegiphila sellowiana Cham. | Papagaio | Ar | Fw | St | 62984 63312 |
| Aegiphila sp. | Papagaio pequeno | Ar | Fw | St | 62975 |
| Hyptidendron asperimum (Epling) Harley | Cinzeiro | Ar | Fw | St | 62971 |
| Petalodon radicans Poli. | Hortelã do mato | Hb | M | Le | 60479 63258 |
| Salvia splendens Sellow ex Wied-Neuw. | | | | | 62992 |
| Lauraceae | Endlicheria paniculata (Spreng.) J.F.Macbr. | Capoeira branca | Ar | Fw | St | 62784 |
| Nectandra oppositifolia Nees & Mart. | Canela branca | Canela | Ar | C; Fw | St | 62782 |
| Ocotea odorifera (Vell.) Rohwer | | Sassafrás | Ar | Fw | St | |
| Ocotea puberula (Rich.) Nees | Canela de rego | Ar | C; T | St | |
| Ocotea sp. | | | Ar | Fw; T | St | |
| Leguminosae | Andira anthelmia (Vell.) J.F.Macbr. | | | | | |
| Dalbergia hortensis Hering & al.| | | | | | |
| Machaerium isadelphum (E.Mey.) Standl. | Muchoco | Ar | T | St | 62731 |
| Machaerium myrtifolium Benth (Vell.) | | | | | | |
| Machaerium dimorphanthum Hoehne | Angú-seco | Ar | T | St | |
| Machaerium scleroxylon Tul. | Cavalião | Ar | C; Fw | St | |
| Piptadenia gonoacantha (Mart.) J.F.Macbr. | Pau jacaré, Jacaré | Ar | C; Fw; T | Fw; T | St | 62789 63287 |
| Platypodium elegans Vogel | Jacarandá branca | Ar | T | St | 62778 |
| Senna macranthera (Collad.) H.S.Inein & Barneby | | Pau de cachimbo | Ar | C; T; O; T | St | 62751 63298 |
| Styphnodendron polyphyllum Mart. | Barbatimão | Ar | M; Fw; R | M; Fw; R; T | St; Ba | Le | 6520 |
| Lygodaceae | Lygodium volubile SW. | | | | | |
| Cuphea sp. | Vassoura canela de saracura | Hb | R; T | E | 62738 63291 |
| Cyathea sp. ¹ | Samambaiaçu | Ar | M; O; T | E | St; Le | 62776 63280 |
| Malpighiaceae | Malpighia glabra L. | Acoreia | Ar | M; F; F | Fr | |
| Malvaceae | Luehea divaricata Mart. | Apoita cavallo | Ar | M; R | Le | 62980 |
| Pseudobombyx sp. | Imbiria | Ar | F; T | Fr; Se | |
| Sida acuta Burm.f. | Vassoura babosa | Hb | M; O; R; T | E | 62745 |
| Sida rhombifolia | | | | | | |
| Melastomataceae | Leandra nianga Cogn. | Quaresminha | Ar | O; Fw | E | |
| Leandra sericea DC. | Quaresminha | Ar | T | St | |
| Leandra sp. | Quaresminha | Ar | Fw | St | |
| Miccionia albicaria (Sw.) Steud. | Quaresminha | Ar | O; Fw | E | |
| Miccionia cinnamomifolia (DC.) Naudin | Murici | Ar | C; Fw; C; Fw; T | St | |
| Miccionia sp. | Zumbi | Ar | C; Fw; T | St | |
| Miccionia sp. ² | Murici cabeça de boi | Ar | C; Fw | St | |
| Miccionia sp. ³ | Zumbi | Ar | Fw; T | St | |
| Miccionia cubatanensis Hoehne | | | | | | |
| Tibouchina granulosa (Desr.) Cogn. | Chorão | Ar | C; Fw; T | T | St | 62786 63257 |
| Tibouchina semidecandra (Mart. & Schrank ex DC.) Cogn. | | Quaresminha | Ar | O | |
| Meliaceae | Cabralea canjerana (Vell.) Mart | Tento | Ar | T | St | |
| Cedrela fissilis Veil. | | | C; T | C | St | |
| Eugenia uniflora L. | | | | | | |
| Myrtaceae | Myrcia guianensis (Aucl.) DC. | Goiabinha | Ar | F | Fr | 63269 63271 |
| Myrcia perforata O.Berg | Gomrim | Ar | C; Fw; T | St | |
| Myrcia splendens (Sw.) DC. | Gomrim | Ar | C; Fw; C; Fw; T | St | 63266 |
| Psidium cattleianum Aitzel. ex Sabine | Araça miúdo | Ar | M; F | Fr | 62781 |
| Psidium guineense SW. | Goiaba | Ar | F | Fr | 62757 |
| Passifloraceae | Passiflora edulis Sims | Maracujá | Vi | F; M | Fr | 62786 |

(Continued)
some of their species have high economic value. Some species in the highest category for conservation priority such as *Ocotea odorifera* and *Machaerium scleroxylon*, are used for the production of luxury furniture production and in civil construction [62]. This tends to attract harvesting by people from outside of the communities. This emphasizes the need for a management plan for the biodiversity of the region.

Another complicating factor is that among species with highest conservation priority (Category 1), 14 (23.7%) and nine (28.1%) were also of high cultural significance (values above 1) in SSBV and SB, respectively. These results show that some of the most culturally important species are also among the most vulnerable locally. Species with both high use value indices and
CSI included *Dalbergia hortensis* (26/2.14), *Eremanthus erythropappus* (6.88/1) and *Tibouchina granulosa* (6.02/1) at SSBV, and *Piptadenia gonoacantha* (3.32/1), *Sparattosperma leucanthum* (3.32/1) and *Cecropia glaziovii* (3.32/0.67) at SB.

By far the species with the highest cultural significance index (CSI) was *Dalbergia hortensis* (CSI = 26 in SSBV) (Fig 6). The use of this species in SSBV was disseminated by “Pai Tudo”. In SB, Pai Tudo was also mentioned, but only *Aureliana tomentosa* was identified to be learned from him, and it does not have a high CSI (0.96). Knowledge related to this species is considered a cultural secret [63] since it was reported by the leader of SB as having a ritualistic power capable of causing harmful effects even to oneself if handled by a non-expert.

**Forest succession stages**

Of the native species identified, 85 were forest trees, including 59 in SSBV and 61 in SB. Thirty-five were common to both communities. Pioneer species predominate in SSBV, while
early secondary predominates in SB (Fig 7), demonstrating that the forest SSBV is in an earlier stage of regeneration than SB. This may indicate that the SB forests are relatively better preserved than those of SSBV, however, further phytosociological study is needed.

According to interviews with local experts in both communities, local forests have sharply declined in the last 50 years due to an increase in grazing lands. According to reports of SSBV, the increase in agricultural activities since the 1960s and the onset of charcoal factories in the 1970s have consumed forest native trees as the main fuel stock. In SB it was reported that historically farmer owners used to lend part of their land to *Quilombolas* in exchange of work on crop and cattle ranches. *Quilombolas* were required to cut down part of their forests to increase land for agriculture and for cattle grazing. Therefore, in the cases of species like *A. angustifolia* and *M. villosa*, where the high use coincides with high conservation threat, it is likely not just harvest but more importantly habitat destruction that is causing decline.

### Table 5. Comparison of ethnobotanical diversity indices compiled from studies of traditional communities in Brazil.

| City/Brazilian state | Reference | Type of community | Biome | Comprehensiveness | EI | N° sp. | N° cit. |
|----------------------|-----------|-------------------|-------|-------------------|----|--------|--------|
| Barcarena/ PA        | [48]      | Rural             | Amazon| Medicinal         | 0.94| 5.07   | 220    | 17     | 365   |
| Xapuri/ AC           | [49]      | Rural             | Amazon| All useful plant species | 0.97 | 4.80 | 145    | 14     | 1284  |
| Ubatuba/ SP          | [38]      | Coastal caçara fisher-men | Atlantic Rainforest | All useful plant species | -  | 4.57 | 162    | 57     | 541   |
| Guaraqueçaba/PR      | [37]      | Rural             | Atlantic Rainforest | All useful plant species | -  | 5.48 | 445    | 90     | 3400  |
| Santo Antônio do Leverger/ MT | [50] | Rural | Pantanal | Medicinal | 0.94 | 5.09 | 228    | 48     | 938   |
| Arraial do Cabo/ RJ  | [33]      | Coastal caçara fisher-men | Atlantic Rainforest | All useful plant species | -  | 4.1  | 68     | 15     | 444   |
| Ingea/ MG            | [51]      | Urban             | Atlantic Rainforest | All useful plant species | 0.76 | 4.84 | 178    | 17     | -     |
| Silva Jardim/ RJ     | [52]      | Rural             | Atlantic Rainforest | All useful plant species | -  | 5.07 | 209    | 19     | 548   |
| Itacaré/ BA          | [53]      | Rural             | Atlantic Rainforest | Medicinal         | 0.92 | 4.21 | 98     | 26     | 379   |
| Mogi Mirim/ SP       | [54]      | Urban             | Atlantic Rainforest / Cerrado | Medicinal | 0.87 | 4.07 | 107    | 50     | 516   |
| Rio Negro/ AM        | [55]      | Caboco river-dwellers | Amazon | All useful plant species | -  | 4.71 | 425    | 33     | 180   |
| Rio Negro/ AM        | [55]      | Caboco river-dwellers | Amazon | All useful plant species | -  | 4.75 | 632    | 48     | 194   |
| Santa Leopoldina/ ES | [15]      | Quilombolas       | Atlantic Rainforest | All useful plant species | -  | 5.12 | 188    | 11     | -     |
| Anchieta/ SC         | [56]      | Rural             | Atlantic Rainforest | All useful plant species | 0.98 | 4.31 | 101    | 78     | 776   |
| Poixim-Açu/ SE       | [57]      | Rural             | Atlantic Rainforest | All useful plant species | 0.73 | 3.9  | 126    | 31     | -     |
| Anastácio/ MS        | [58]      | Rural             | Cerrado          | Medicinal         | 0.94 | 5.03 | 209    | 35     | -     |
| Ascura/ SC           | [47]      | Rural             | Atlantic Rainforest | Medicinal         | 0.92 | 4.23 | 109    | 42     | 314   |
| Paraty/ RJ           | [59]      | Coastal caçara fisher-men | Atlantic Rainforest | All useful plant species | -  | 5.03 | 190    | 12     | 1341  |
| Viçosa/ MG           | [60]      | Rural             | Atlantic Rainforest | Non-conventional food plants | 0.93 | 1.65 | 59     | 20     | 389   |
| Paracambi/RJ         | [61]      | Municipal Natural Park | Atlantic Rainforest | Random sampling | 0.88 | 4.7  | 210    | -      | 749   |
| São Sebastião da Boa Vista/ MG | Present study | Quilombolas | Atlantic Rainforest | All useful plant species | 0.96 | 5.14 | 212    | 7      | 530   |
| São Bento/ MG        | Present study | Quilombolas | Atlantic Rainforest | All useful plant species | 0.96 | 5.21 | 221    | 6      | 476   |

(EI) = Equitability index, (H' B.e) = Shannon index base, (N° sp.) = Number of cited species, (N° infor.) = Number of informants, (N° citat.) = Number of citations.

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Table 6. Native forest species cited as useful by the study communities (SSBV and SB), in alphabetical order of botanical species, followed by conservation priority, category, use-value, cultural significance index, risk category.

| Species                  | Conservation Priority | Use Value | Cultural Significance Index | Risk Category |
|--------------------------|-----------------------|-----------|------------------------------|---------------|
|                          | Score | Category | SSBV | SB | SSBV | SB | SSBV | SB | SSBV | SB |
| Acnistus arborescens (L.) Schltdl. | 85    | 1        | 0.32 | 0.32 |
| Aegiphila sellowiana Cham. | 100   | 1        | 0.42 | 0.82 | 0.86 | 1.66 |
| Aegiphila sp.             | 92.5  | 1        | 0.14 | 0.14 |
| Andira anthelmia (Vell.) J.F.Macbr. | 85    | 1        | 0.85 | 1.72 |
| Araucaria angustifolia (Bertol.) Kuntze | 92.5  | 1        | 0.14 | 0.14 | ID, ED |
| Aristolochia sp.          | 92.5  | 1        | 0.71 | 0.67 | 1.71 | 1.5 |
| Aureliana tomentosa Sendtn. | 75    | 2        | 0.32 | 0.96 |
| Cabralea canjerana (Vell.) Mart | 62.5  | 67.5     | 2    | 2   | 0.14 | 0.17 | 0.14 | 0.16 |
| Casearia arborea (Rich.) Urb. | 92.5  | 1        | 0.14 | 0.14 |
| Casearia lasiophylla Eichler | 85    | 1        | 0.32 | 1.32 |
| Casearia sylvetris Sw.     | 62.5  | 2        | 0.42 | 0.67 | 1.72 | 2 |
| Cecropia glaziolvi Smthl.   | 100   | 1        | 0.42 | 0.67 | 0.84 | 3.32 |
| Cedrela fissilis Vell.      | 100   | 1        | 0.85 | 0.5  | 2.85 | 1 |
| Cissampelos pareia L.      | 100   | 1        | 0.17 | 0.32 |
| Croton urucurana Baill.    | 100   | 1        | 0.85 | 1   | 2.84 | 2 |
| Cupania ludwigii Somm & Ferrucci | 100   | 1       | 0.28 | 0.56 |
| Cupania vernalis Cambess.   | 100   | 1       | 0.32 | 0.66 |
| Cuphea sp.                 | 62.5  | 2        | 0.42 | 0.32 | 0.28 | 1.32 |
| Cyathea sp.                | 92.5  | 1        | 0.17 | 0.16 |
| Dalbergia hortensis Heringer & al. | 100   | 92.5     | 1    | 1   | 2.14 | 0.17 | 26 | 1 |
| Davilla rugosa Poir.       | 70    | 2        | 0.42 | 0.32 | 0.86 | 0.66 |
| Endlicheria paniculata (Spreng.) J.F.Macbr. | 92.5  | 100      | 1    | 1   | 0.14 | 0.32 | 0.14 | 0.66 |
| Eremantus erythrophappus (DC.) MacLeish. | 70    | 100      | 2    | 1   | 1   | 0.5  | 6.88 | 2 |
| Euterpe edulis Mart.       | 77.5  | 2        | 0.28 | 0.28 | ID, ED |
| Gochnatia polymorpha (Less) Cabrera | 92.5  | 1       | 0.28 | 0.14 |
| Guatteria villosissima A. St.-Hil. | 85    | 100      | 1    | 1   | 0.57 | 0.67 | 0.56 | 0.66 |
| Handroanthus chrysotrichus (Mart. ex DC.) Mattos | 100   | 77.5     | 1    | 2   | 0.42 | 0.17 | 0.86 | 0.16 |
| Hyptidendron asperImmum (Spreng.) Harley | 92.5  | 1        | 0.14 | 0.14 |
| Jacaranda caroba (Vell.) DC. | 77.5  | 2        | 0.32 | 0.32 |
| Leandra nianga Cogn.       | 92.5  | 1        | 0.32 | 0.16 |
| Leandra sericea DC.        | 100   | 1        | 0.32 | 0.16 |
| Leandra sp.                | 70    | 2        | 0.42 | 0.86 |
| Lobelia fistulosa Vell.     | 77.5  | 2        | 0.14 | 0.14 |
| Luhea divaricata Mart.     | 85    | 1        | 0.57 | 1.12 |
| Lygodium volubile Sw.      | 85    | 100      | 1    | 1   | 0.28 | 0.32 | 3.36 | 0.48 |
| Machaerium sp.             | 70    | 2        | 0.28 | 3.36 |
| Machaerium isadelphum (E.Mey.) Standl. | 77.5  | 2        | 0.14 | 0.28 |
| Machaerium nycittans (Vell.) Benth. | 85    | 1        | 0.32 | 0.66 |
| Machaerium villosum Vogel   | 92.5  | 1        | 0.14 | 0.28 | V |
| Machaerium dimorphandrum Hoehne | 85    | 1        | 0.17 | 0.32 |
| Machaerium scleroxylon Tul. | 100   | 1        | 0.5  | 0.99 |
| Maprounea guianensise Aubl. | 55    | 3        | 0.85 | 1.72 |
| Merostachys sp.            | 85    | 70       | 1    | 2   | 1   | 0.17 | 2.28 | 0.16 |
| Miconia albicans (Sw.) Steud. | 92.5  | 1        | 0.32 | 0.16 |
| Miconia cinnamonifolia (DC.) Naudin | 85    | 70       | 1    | 2   | 0.28 | 0.17 | 1.12 | 0.16 |
| Miconia cubatanensis Hoene  | 70    | 85       | 2    | 1   | 0.42 | 0.5  | 0.56 | 1 |
| Miconia sp.                | 77.5  | 2        | 0.32 | 0.16 |
| Miconia sp.                | 100   | 1        | 0.5  | 0.16 |
| Mikania cordifolia (L.f.) Wild | 77.5  | 2        | 0.14 | 0.14 |

(Continued)
Conclusion

Our interviews showed that together, the two Quilombolas communities of SB and SSVB use 201 native species, and have ethnobotanical knowledge diversity indices of over 5.0—values that are higher than those reported for other traditional groups in Brazil. These data illustrate the rich ethnobotanical knowledge and heritage of the communities. However, our results also

| Species                        | Conservation Priority | Use Value | Cultural Significance Index | Risk Category |
|--------------------------------|-----------------------|-----------|----------------------------|---------------|
|                                | Score     | Category | SB | SSBV | SB | SSBV | SB | SSBV | SB |
| Mikania hirsutissima var. ursina Baker | 77.5      | 55       | 2  | 3    | 0.14  | 0.32  | 0.14  | 0.16  |     |
| Myrcia guianensis (Aubl.) DC. | 70        | 2        | 0.14  |     |       |
| Myrcia perforata O. Berg    | 62.5      | 2        | 0.5   |     |       |
| Myrcia splendens (Sw.) DC.  | 55        | 100      | 1    |     |       |
| Myrsine guianensis (Aubl.) Kuntze | 85        | 1        | 0.32  |     |       |
| Nectandra oppositifolia Nees & Mart. | 100       | 85       | 1    | 1    | 1.14  | 0.32  |     |
| Ocotea odorifera (Vell.) Rohwer | 77.5      | 2        | 0.17  |     | 0.32  | VU, ED |
| Ocotea sp.                     | 92.5      | 1        | 0.17  |     | 0.32  |     |
| Ocotea puberula (Rich.) Nees  | 100       | 1        | 0.28  |     | 0.56  |     |
| Passiflora sp.                 | 70        | 70       | 2    | 2    | 0.28  | 0.17  | 0.14  | 0.16  |     |
| Piper arboreum Aubl.          | 77.5      | 2        | 0.17  |     |       |
| Piper miquelianum C. DC.      | 85        | 1        | 0.28  |     | 1.12  |     |
| Piper sp.                      | 92.5      | 1        | 0.17  |     | 2.5   |     |
| Piper umbelliatum L.          | 77.5      | 92.5     | 2    | 1    | 0.14  | 0.82  | 0.56  | 0.16  |     |
| Piptadenia gonoacantha (Mart.) J.F.Macbr. | 55        | 70       | 3    | 2    | 1     | 4.3   | 3.32  |     |
| Piptocarpa axillaris (Less.) Baker | 77.5      | 2        | 0.14  |     | 1.12  |     |
| Platypodium elegans Vogel     | 85        | 1        | 0.28  |     | 0.56  |     |
| Pseudobombax sp.              | 92.5      | 1        | 0.32  |     | 0.16  |     |
| Psidium cattleianum Afzel. ex Sabine | 77.5      | 2        | 0.28  |     | 0.56  |     |
| Psidium guineense SW.         | 77.5      | 2        | 0.28  |     | 0.56  |     |
| Pyrostegia venusta (Ker Gawl.) Miers | 77.5      | 85       | 2    | 1    | 0.14  | 0.32  | 0.14  | 0.66  |     |
| Rollinia sylvatica (A. St.-Hil.) Martius | 100       | 92.5     | 1    | 1    | 0.28  | 0.17  | 0.56  | 0.16  |     |
| Sapindum glandulosum (L.) Morong | 85        | 77.5     | 1    | 2    | 0.28  | 0.17  | 0.56  | 0.16  |     |
| Schinus terebinthifolia Raddi  | 92.5      | 55       | 1    | 3    | 0.14  | 0.32  | 0.14  | 0.66  |     |
| Senna macranthera (Collad.) H. S. Irwin & Bameby | 100       | 70       | 1    | 2    | 0.42  | 0.32  | 1.12  | 1.98  |     |
| Siparuna brasiliensis (Spreng) A. DC. | 77.5      | 55       | 2    | 3    | 0.42  | 0.67  | 0.86  | 1     |     |
| Siparuna guianensis Aubl.     | 70        | 55       | 2    | 3    | 0.28  | 0.67  | 1.12  | 1     |     |
| Sparattosperma leucanthum (Vell.) K. Schum. | 85        | 70       | 1    | 2    | 0.71  | 1     | 4.26  | 3.32  |     |
| Strychnospermacarpus polyphyllum Mart. | 70        | 2        |     | 0.17  | 2     |     |
| Tibouchina granulosa (Desr.) Cogn. | 70        | 77.5     | 2    | 2    | 1     | 0.32  | 6.02  | 1.32  |     |
| Tibouchina semidecandra (Mart. & Schrank ex DC.) Cogn. | 47.5     | 3        | 0.17  |     | 0.16  |     |
| Vismia brasiliensis Choisy.   | 55        | 47.5     | 3    | 3    | 0.57  | 0.17  | 1.72  | 0.16  |     |
| Xylopia seirea A. St-Hill.    | 92.5      | 1        | 0.14  |     | 0.14  |     |
| Xylopia brasiliensis Spreng.  | 77.5      | 2        | 0.67  |     | 0.16  |     |
| Zanthoxylum rhoifolium Lam.   | 85        | 77.5     | 1    | 2    | 0.42  | 0.5   | 0.86  | 0.16  |     |
| Zeyheria tuberculosa (Vell.) Bureau ex Verl. | 92.5     | 1        | 0.17  |     | 0.16  |     |

(ID) = In danger by Biodiversitas, (ED) = Endangered by Ministry of the Environment, (V) = Vulnerable by International Union for Conservation of Nature, (VU) = Vulnerable by Biodiversitas. Category 1 (Cat 1)—species with score ≥ 85 are of conservation priority and should not be collected if appropriate precautions are not taken; Category 2 (Cat 2)—species with score between 85 and 60 can be moderately collected; Category 3 (Cat 3)—species with score ≤ 60 are suitable for collection.

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suggest that more than 50% of local useful species in both communities (those ranked in Category 1 for conservation priority) may be at risk if there are no plans for the management and replanting of them. Of these plants, *Dalbergia hortensis* is a special conservation priority because of its great cultural significance. Other species such *Sparattosperma leucanthum*, *Lygodium volubile* in SSBV, *Cecropia glaziovii* in SB, and *Croton urucurana* in both communities rank high for cultural significance and conservation priority. Based on our results, the development of a sustainable management plan that considers local knowledge about management and use of plants is essential. Developing programs to increase populations of those species at risk, including agroforestry programs can help meet the needs of producing culturally...
important species and of biological conservation. It is urgent that the government demarcate Quilombolas land for cultural maintenance, quality of life and preservation of nature.

**Supporting information**

S1 Appendix. Permission to the conduction of this study emitted by Instituto do Patrimônio Histórico e Artístico Nacional (IPHAN).

(PDF)

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Fig 7. Successional stages of native forest trees in São Sebastião da Boa Vista (SSBV) and São Bento (SB). Results are expressed in percentage (%).

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