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Useful woody species and its environmental availability: the case of artisanal fishermen in Itaúnas, Brazil

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ABSTRACT. Ethnobotanical studies involve research with human societies and their different interaction with plants, and the quantitative approaches from thes estudies are important to select conservation priority of species in natural environment. This research aims to quantify use-values for woody plants mentioned by fishers in Itaúnas, state of Espírito Santo, and evaluate the relationship between use-values and species availability (absolute density and frequency, and importance value) in two distinct *resting* vegetation formations. It also proposes to identify priority species for conservation. It was selected 30 species cited in individual semi-structured interviews with key-informant in fishers' community and who were also on list of structural survey of two vegetation phytophysiognomies in the *restinga* regions. The data used was collected in previously published work. It was performed a correlation analysis between use-values and structural parameters of the mentioned woody species. *Protium heptaphyllum*, *P. icicariba* and *Byrsonima sericea* present the highest use-values. It was not observed relation between use-value and species availability in each vegetation formation. It was classified two and eight species as priority for conservation on shrubby and forest formations, respectively.

Keywords: structural characteristics, ethnobotany, Itaúnas State Park, restinga, use-value (UV).

Espécies lenhosas úteis e sua disponibilidade no ambiente: o caso dos pescadores artesanais em Itaúnas, Brasil

RESUMO. Estudos etnobotânicos envolvem pesquisas com sociedades humanas e suas diferentes interações com as plantas, e abordagens quantitativas deste estudos são importantes para selecionar prioridades de conservação das espécies nos ambientes naturais. Esta pesquisa objetiva quantificar os valores de uso das plantas citadas por pescadores em Itaúnas, Espírito Santo, e avaliar as relações entre os valores de uso a disponibilidade das espécies (densidade e frequência absoluta e valor de importância) em duas formações vegetais distintas de restinga. É também proposto identificar o índice de prioridade de conservação das espécies. Foram selecionadas 30 espécies citadas em entrevistas individuais semiestruturadas com informantes-chave na comunidade de pescadores e que também estavam em listas de levantamentos estruturais de duas fitofisionomias vegetais de restinga na região. Os dados utilizados foram coletados em trabalhos previamente publicados. Foi feita a análise de correlação entre os valores de uso e os parâmetros estruturais das espécies lenhosas mencionadas. *Protium heptaphyllum*, *P. icicariba* e *Byrsonima sericea* apresentaram o maior valor de uso. Não foi observado relação entre o valor de uso a disponibilidade das espécies em cada formação vegetal. Foram classificadas duas e oito espécies para prioridade de conservação nas formações arbustivas e florestais respectivamente.

Palavras-chave: características estruturais, etnobotânica, Parque Estadual de Itaúnas, restinga, valor de uso.

Introduction

Ethnobotany is a science that links anthropology and botany, whose objective is to catalogue plant use by the human species (Prance, 1991) and approach the study of human societies and their cultural, ecological, genetic, evolutionary and symbolic interactions with plants (Fonseca-Kruel, & Peixoto, 2004). Ethnobotany studies make discoveries about plant utility in several instances, such as: medicinal, food and construction (Begossi, Leitão-Filho, & Richerson, 1993) and relate them to the ecological contest of vegetation exploration (Prance, 1991). Thus, one of the objectives of this science is to promote sustainable use and conservation of natural resources, besides approximating scientific research from social needs, since these studies can generate information applied to the environment and local populations (Oliveira, Albuquerque, Fonseca-Kruel, & Hanazaki, 2009).

Vegetal resources are considered very important for same local populations on the Brazilian coast (Hanazaki, 2003). The *restinga,* a vegetation type of the Brazilian coast, presents distinct phytophisiognomies through environmental gradients (Scarano, 2002), with eleven of these formations being described for Espírito Santo state (Pereira, 2003). An expressive floristic diversity has been reported for this state (Assis, Pereira, & Thomaz, 2004, Giaretta, Menezes, & Pereira, 2013), as well as for types of uses for plants occurring on *restinga,* Lopes & Lobão, 2013). However, real estate speculation and touristic demands generate threats to vegetal resources conservation on this ecosystem (Thomazi, Rocha, Oliveira, Bruno, & Silva, 2013).

Quantitative approaches and methods in Ethnobotany studies have been getting more frequent in the last decades (Phillips & Gentry, 1993a, 1993b, Begossi, 1996, Dzerefos & Witkowski, 2001, Oliveira, Lins-Neto, Araújo, & Albuquerque, 2007, Lucena, Lucena, Araújo, Alves, & Albuquerque, 2013). Some studies evaluated species use-value for local populations, for showing which plants are preferred for each population (Phillips & Gentry, 1993b, Galeano, 2000, Crepaldi & Peixoto, 2010). Studies also related use-values with species availability in their natural ecosystems (Phillips & Gentry, 1993b, Torres-Cuadro & Islebe, 2003, Ferraz, Albuquerque, & Meunier, 2006), testing the hypothesis of the ecological appearance (Phillips & Gentry, 1993b) and making possible to identify over-exploration of plants (Luoga, Witkowski, & Balkwill, 2000). However, Phillips and Gentry (1993b) calculated the use-values index based in the knowledge of local informants about useful species (potential utilization value) and Lucena et al. (2013) adapted this index, using the frequency of collection of the vegetation species by local informants (real utilization value).

Other quantitative method used is the conservation priority index (Dzerefos & Witkowski, 2001, Oliveira et al., 2007, Crepaldi & Peixoto, 2010), in which species more threatened by possible human use intensity are pointed out (Dzerefos & Witkowski, 2001). This index provides information about the sustainability of harvesting of the plants considered useful to local population (Oliveira et al., 2007) and support best discussion about conservation priorities this vegetation species (Crepaldi & Peixoto, 2010).

The present study aimed to: 1. Quantify the use-value (potential utilization value) of woody species mentioned by fishers and sampled in structural surveys of two phytophysiognomies (shrubby and forest) of *resting* vegetation; 2. Evaluate the relation between use-value and their respective structural parameters (importance values, absolute density and frequency) in the ecosystem; 3. Verify the proportion of useful species occurring in shrubby and forest formations, quantity of useful species exclusive to each environment and species with higher conservation priority index in each formation.

It is expected to be found positive relations between use-values and structural parameters of the woody community, indicating that the highest availability of the plant in its natural environment, the higher its use-value for the population is likely to occur (Phillips & Gentry, 1993b).

Material and methods

Study area

This research was carried out in 2009 and 2010, with Artisanal fishers that lived around (Itaúnas village) and inside in the Itaúnas State Park, belonging to the municipality of Conceição da Barra, northern Espírito Santo, Brazil (Figure 1). Conceição da Barra was raised to municipality status in 1891 and the Itaúnas village was acknowledged in 1911 (Instituto Brasileiro de Geografia e Estatística [IBGE], 2014).

The Itaúnas State Park (*Parque Estadual de Itaúnas*: PEI) was created in 1991, has a 3.450 ha area and a 90.204.971 m perimeter (*Centro de Pesquisa do Mar* [Cepemar] & *Instituto Estadual do Meio Ambiente e Recursos Hídricos* [Iema], 2004) (Figure 1). Since implementation of PEI, there are several conflicts with local residents regarding pre-established dwellings and use of natural resources in Park areas. PEI encompasses several ecosystems of the Atlantic domain: *restingas,* dunes, mangroves and lowlands tropical rain forest (Ricco & Júnior, 2007).

Itaúnas village has approximately 2.000 inhabitants (*Instituto de Apoio à Pesquisa e ao Desenvolvimento* [Ipes], 2001), from different ethnological groups (indigenous people from several tribes, Africans and Portuguese), resulting in a high cultural diversity (Ricco & Júnior, 2007). Afro-descendants are predominant in the village, due to the intense slave trade in the beginning of the nineteenth century in northern Espírito Santo (Ricco & Júnior, 2007). Artisanal fishers in Itaúnas are organized in an Association with approximately

350 members, and is considered one of the best-articulated entities in the village. This study had the approval of the director of the fishers' community of Itaúnas and of the Ethics Committee of the *Universidade Federal do Espírito Santo* (Ufes).

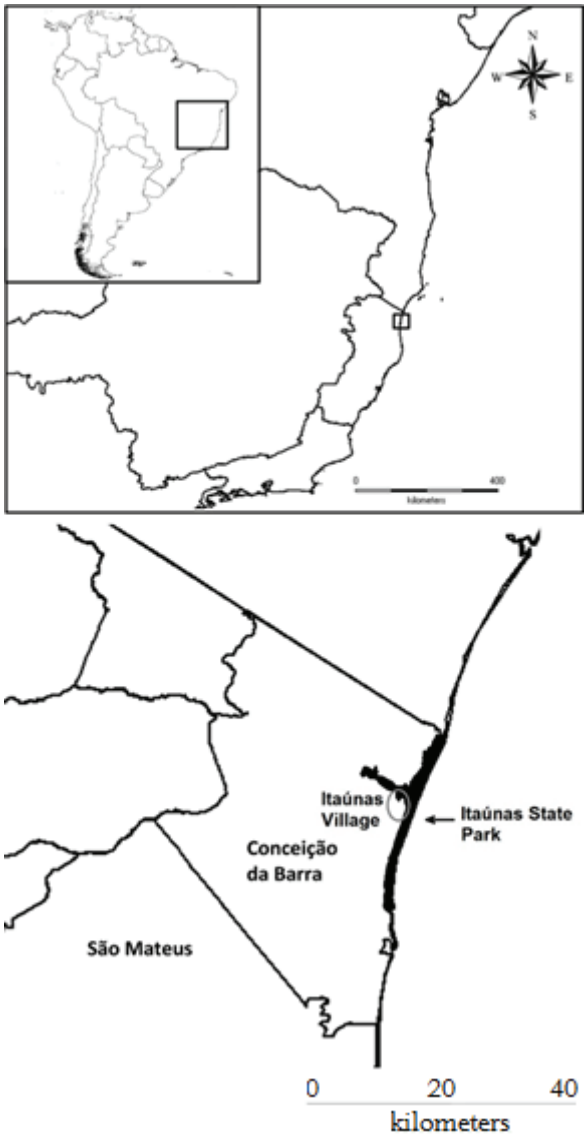

Figure 1. Location of Itaúnas State Park (Black drawing) and Itaúnas Village (Gray circle), Conceição da Barra, Espírito Santo, Brasil.

Itaúnas economy was based on hunting, fishing, subsistence agriculture and commerce. After 1970, part of the vegetation was replaced by eucalyptus monocultures, which suppressed the inhabitants' natural subsistence source. Currently, the village's economy is focusing in artisanal fishing and mainly in tourism (Ricco & Júnior, 2007). This is the major income source for inhabitants and has been promoting ecological conscience to several of them, since the natural beauties of PEI are among the main touristic attractions (Ricco & Júnior, 2007).

Data collection and analysis

It was used data from a previous ethnobotanical survey (Lopes & Lobão, 2013), which obtained information about useful plants of *resting* vegetation through semi-structured interviews and collection of plants mentioned by artisanal fishers of Itaúnas village. From the total of species mentioned in the ethno botanical survey (Lopes & Lobão, 2013), 38% (30 species) were also sampled in structural surveys of the vegetation in Itaúnas region: in forest in 2009 and 2010, in which the authors used the permanent plots methods (Giaretta et al., 2013), and open shrubby formations in 2010, in which the authors used the line intercept methods (Monteiro, Giaretta, Pereira, & Menezes, 2014). A total of 30 species were selected for this study's analysis. More detailed information about interviews and plant collections can be found in Lopes and Lobão (2013), and about the structural survey in Giaretta et al. (2013) and Monteiro et al. (2014).

The use-values were calculated as per Phillips and Gentry (1993b), modified by Rossato, Leitão-Filho, and Begossi (1999), for the 30 selected woody species. Use-value is an index in which the ratio between amount of species citation and number of interviewed informers is calculated (Rossato et al., 1999). For the same plants, absolute density and frequency, and importance value in sampled environments were also verified (Giaretta et al., 2013, Monteiro et al., 2014). Importance value is an index resulting from the sum of relative density, relative dominance and relative frequency values of the species in the ecosystem.

The relation between the use-value and structural parameters (importance value, absolute density and frequency) was evaluated in both phytophysiognomies, through non-parametric linear Spearman correlation, using the software Past (Hammer, Harper, & Ryan, 2001).

It was calculated the priority conservation index for useful species of each vegetation formation, according to Dzerefos and Witkowski (2001), modified by Crepaldi and Peixoto (2010), in which the density measure is individual 0.1 ha. The conservation priority index was calculated through weighted values of species density, collection risk, local importance and/or diversity of use (Dzerefos & Witkowski, 2001) (Table 1).

Table 1. Scoring criteria used to identify species with conservation priority (Dzerefos & Witkowski 2001), in which the scale of the individuals density was modified according to Crepaldi and Peixoto (2010).

Criterion score	Points
A. Density in the area (average number of individuals 0.1 ha.) (D)	
Not recorded-very low (0-1)	10
Low (1.1-3.5)	7
Medium (3.6-7.1)	4
High (> 7.1)	1
B. Harvestingrisk (C)	
Destructive collection of the entire plant, bulbs and stalks, removal of cork-tissue, bark, or roots. Represents the removal of the individual and its future offspring from the population	10
Removal of the perennial structures, such as roots and bark without causing individual mortality	7
Removal of the permanent aerial structures such as leaves, stems, and sap, affecting plant energetic investments, survival, and reproductive success	4
Removal of transitory aerial structures, such as flowers and fruits. Population regeneration may be altered in the long-term as these produce or hold seeds but the individual plant, particularly where asexual reproduction is possible, is not affected	1
C. Local use (L)	
High (cited by more than 20% of the informants)	10
Moderately high (10-20%)	7
Moderately low (10% of all citations)	4
Low (only referred to in the literature)	1
D. Use-diversity (Div)	
For each use, add one point to maximum of	10

Biological value (B) = D x 10; Use-risk (RU) = 0.5(C) x 0.5(U) 9 10; U = use-value, determined by the largest value between L or Div (Dzerefos & Witkowski, 2001). Conservation Priority (PC) = 0.5 (B) X 0.5 (RU). Category 1 (species with rating C ≥ a 85) require conservation priority and should not be harvested until a management regime is instituted; Category 2 (species with rating between 85 and 60) can be harvested moderately; Category 3 (species with rating ≤ 60) are appropriate for harvesting Plant density, harvesting risk, local importance and diversity of use (modified from - Dzerefos & Witkowski, 2001).

Results and discussion

It was not detected significant correlation regarding plant UV and their respective structural parameters (absolute density and frequency, and importance value), when evaluating species sets from both formations separately (Table 2). This indicates that there is no interdependence between availability of the plant in the *resting* and the knowledge of informers (potential of use). This result contradicts (Phillips & Gentry, 1993b) and corroborates (Ferraz et al., 2006) other researches. Torres-Cuadros and Islebe (2003) reported that not always plant use-value is related to its availability on the system.

Table 2. Spearman Linear Correlation Values between use-value of useful woody plants and their respective structural parameters (absolute density and frequency and importance value), in two vegetation formations (Shrubby Formation; SF and Forest Formation; FF) in Itaúnas village, Espírito Santo, Brazil.

Structural parameter (vegetation type)	Spearman correlation (P)
Absolute density (FA)	0.86
Absolute density (FF)	0.82
Absolute frequency (FA)	0.9
Absolute frequency (FF)	0.94
Importance value (FA)	0.75
Importance value (FF)	0.4

The highest use-values (UV) were observed for *Protium heptaphyllum* (1.03), *Protium icicariba* (1.03), *Byrsonima sericea* (0.76) and *Anacardium occidentale* (0.69 - Table3). The first three occur in both formations and *A. occidentale* is exclusive to the shrubby formation. *P .heptaphyllum, Ocotea notata* and *Clusia hilariana* had the biggest Importance Values (IV) among woody species from the Shrubby Formation (SF) (Monteiro et al., 2014). *Protium heptaphyllum*, *Ocotea lobi* and *Tapirira guianensis* had the highest IVs on Forest Formation (FF) (Giaretta et al., 2013).

Regarding absolute density (ind./0.1 ha), the highest values belong to *Ocotea notata, Protium heptaphyllum* and *Hirtella corymbosa* in the shrubby formation. However, in the forest formation the highest values were from *Ocotea lobi*, *Unonopsis aurantiaca* and *Protium heptaphyllum*. Highest absolute frequency values from *Ocotea notata, Protium heptaphyllum* and *Clusia hilariana* were detected in the shrubby formation (Monteiro et al., 2014) and from *Ocotea lobi* and *Pouteria caimito* in the forest formation (Giaretta et al., 2013).

Protium heptaphyllum and *Protium icicariba* are among the species with highest use, importance, absolute frequency and density values. In this case, high use-value may be related to availability on the environment. Both species are known by the same common name, however they are differentiated as different varieties (Lopes & Lobão, 2013). Despite results showing that use value for the plant set is not related with its environmental availability, this may be detected for some species (Ferraz et al., 2006). Besides, *P. heptaphyllum*is frequently cited by different populations for several types of use (Pasa, Soares, & Guarim-Neto, 2004, Cunha & Albulquerque, 2006, Crepaldi & Peixoto, 2010), also being reported its use in pharmacology (Oliveira et al., 2005, Aragão et al., 2006). This species presents wide distribution in Brazil (Daly, 2014) and is reported in vegetation listings as one of the most

abundant species on *restinga* (Assumpção & Nascimento, 2000, Assis et al., 2004). The use of *P. heptaphyllum*by different populations and its elevated distribution and frequency may facilitate this wide knowledge (common sense).

From the 30 woody species mentioned as useful by informers and collected in structural listings, 25 occur in forest formation, representing 22% of the sampled species total in the structural listing of the area (Giaretta et al., 2013), 16 of them being exclusive from this formation. For the open shrubby formation, 14 species were mentioned as useful by fishers, representing 43.75% of the woody species total (32) sampled in this environment (Monteiro et al., 2014), four being exclusive from this formation. The greatest amount of useful species cited exclusively for forest environment may be related with the higher richness of woody taxa in this environment (Giaretta et al., 2013), when compared to the shrubby formation (Monteiro et al., 2014). However, it was detected that the proportion between total useful species/woody species in the environment is superior on the shrubby formation. This may be associated with a closer proximity of this formation to the beach, most likely making it easier for fishers to collect and identify useful plants.

Other studies pointed out a superior percentage of useful species/species sampled in listings ratio, when compared to the present study: indigenous people on Amazon forest (49 to 79% - Prance, Ballee, Boom, & Carnaria, 1987), African descendants in Chocó (62% - Galeano, 2000), rural populations in Tanzania (69% - Luoga et al., 2000) and in the Brazilian northeastern semi-arid (91.3% - Ferraz et al., 2006). This suggests a possible lower dependency from fishers of Itaúnas to the woody *resting* vegetation. This may be due to the presence of a full protection conservation unit in Itaúnas, PEI, where direct use of natural resources is forbidden. Besides, other associated fact is the recent urbanization of the village, probably generating changes on its inhabitants' characteristics, such as access to industrialized products (bottled gas for cooking, pharmaceutical medicines and processed food), leading to a smaller dependence from subsistence natural resources (Ricco & Júnior, 2007). Opinions about establishment of full protection unities in areas where there is previous existence of local inhabitants are controversial (Albuquerque & Andrade, 2002). However, when communities are inserted in activities developed by the Park, it is possible to raise the inhabitants' awareness about the actual activities of the Institution (Albuquerque & Andrade, 2002).

In the open shrubby formation, two species meet the Category 1 of the Conservation Priority Index (CPI) and in the forest formation eight species had high values (Category 1) for conservation priority, *Byrsonima sericea* and *Clusia hilariana* presenting the maximum value (100) (Table 4).

Table 3. List of woody species mentioned as useful by fishers of Itaúnas village, Espírito Santo, Brazil, showing their respective common names, use categories and use values (UV). F: food, H: handicrafts, T: timber, FW: firewood, M: medicinal, R: ritualistic.

Species	Popular name	Use category	UV
Protium heptaphyllum (Aubl.) Marchand	Almescla	AL, C, L, M	1.03
Protium icicariba (DC.) Marchand	Almescla	AL, C, L, M	1.03
Byrsonima sericea DC.	Murici	L	0.76
Anacardium occidentale L.	Cajú	AL, L, M	0.69
Pera glabrata (Schott) Poepp. Ex Baill.	Sete casco	C, L	0.52
Pera leandri Baill.	Sete casco	C, L	0.52
Hancornia speciosa Gomes	Mangaba	AL	0.45
Eschweilera ovata Mart. ex Miers	Biriba	AL, AS, C, L, M	0.45
Clusia hilariana Schltdl.	Abaneiro	L	0.34
Schinus terebinthifolius Raddi	Aroeira	AS, L, M, R	0.31
Unonopsis aurantiaca Maas e Westra	Pindaíba cutia, Pindaíba preta	C	0.31
Emmotum nitens Miers	Faia	AS, C, L	0.31
Xylopia sericea A.St.-Hil.	Pindaíba branca	C, L	0.28
Micropholis venulosa (Mart. eEichler) Pierre	Corrubixá	AL, C	0.24
Tapirira guianensis Aubl.	Cupuba	AS, L	0.21
Inga subnuda Salzm. ex Benth.	Ingá	AL, L	0.17
Tabebuia roseoalba (Ridl.) Sandwith	Ipê	C	0.14
Ocotea notata (Nees e Mart.) Mez	Canela, Canela de velho, Canela branca	C, L	0.14
Aspidosperma pyricollum Müll. Arg.	Pequeá peroba	AL, C	0.1
Ocotea lobi (Meisn.) Rohwer	Canela, Canela prego	C, L	0.1
Himatanthus bracteatus (A.DC.) Woodson	Janaúba	AS	0.07
Andira fraxinifolia Benth.	Juerana	C	0.07
Cecropia pachystachya Trécul.	Embaúba	L, M	0.07
Spondias macrocarpa Engl.	Cajá	AL	0.03
Hirtella corymbosa Cham. & Schltdl.	Suvaco de veia	AL	0.03
Andira nitida Mart. ex Benth.	Angelim pedra	C	0.03
Swartzia apetala Raddi	Grão de galo	C	0.03
Vantanea bahiaensis Cuatrec.	Coquim do mato	AL	0.03
Ouratea cuspidata Tiegh.	Imbira	C	0.03
Pouteria caimito (Ruiz e Pav.) Radlk.	Graicica	C	0.03

Table 4. Conservation priority index and priority categories of woody species cited as useful by artisanal fishers, in two *resting* vegetation formation in Itaúnas, Espírito Santo, Brazil. CPI FF: Conservation priority index of species on forest formation, CPI SF: Conservation priority index of species on shrubby formation.

Species	CPI FF	Category	Species	CPI SF	Category
Byrsonima sericea	100	1	*Byrsonima sericea*	85	1
Clusia hilariana	100	1	*Anacardium occidentale*	85	1
Emmotum nitens	97.5	1	*Hancornia speciosa*	77.5	2
Xylopia sericea	97.5	1	*Himatanthus bracteatus*	65	2
Schinus terebinthifolius	90	1	*Protium heptaphyllum*	55	3
Inga subnuda	87.5	1	*Protium icicariba*	55	3
Pera glabrata	85	1	*Clusia hilariana*	55	3
Pera leandri	85	1	*Emmotum nitens*	52.5	3
Cecropia pachystachya	80	2	*Ocotea notata*	40	3
Andira nítida	77.5	2	*Andira nitida*	32.5	3
Protium icicariba	70	2	*Swartzia apetala*	32.5	3
Eschweilera ovata	70	2	*Ouratea cuspidata*	32.5	3
Tabebuia roseoalba	70	2	*Hirtella corymbosa*	10	3
Aspidosperma pyricollum	67.5	2	*Vantanea bahiaensis*	10	3
Micropholis venulosa	65	2			
Andira fraxinifolia	65	2			
Swartzia apetala Raddi	62.5	2			
Protium heptaphyllum	55	3			
Ocotea notata	55	3			
Unonopsis aurantiaca	52.5	3			
Ouratea cuspidata	47.5	3			
Tapirira guianensis	45	3			
Spondias macrocarpa	40	3			
Ocotea lobi	37.5	3			
Himatanthus bracteatus	35	3			
Pouteria caimito	32.5	3			

The Maximum conservation priority values for *Byrsonima sericea* and *Clusia hilariana* in the forest formation were due to their low density in this formation and to the use of their trunks for firewood. This type of use possibly generates total removal of the individual, which increases collection risk (Dzerefos & Witkowski, 2001) and it is among the most destructive and impacting activities for plant communities (Luoga et al., 2000). *Clusia hilariana* is facilitator species in the ecological succession process in the *restinga* (Dias, Zaluar, Ganade, & Scarano, 2005) and has several morpho-physiological attributes related to assimilation of water and nutrients that differentiates it from other species of this environment (Rosado & Mattos, 2010), indicating the need to conserve *C. hilariana* for better ecosystem functional. However, *B. secicea* is frequently observed at the edge in ecosystems (personal communication), local not quantified in the evaluated structural work, fact that may hold for their high value as the index of conservation priority.

Conclusion

Therefore, the data showed a null correlation between use-values and species structural parameters. *Protium heptaphyllum* and *P. Icicariba* were the most cited by fishers, apparently due to their high availability in the *resting* and by the widespread use of *Protium heptaphyllum* in several communities.

Species classified in category (1) (Table 4), according to conservation priority values, must be protected from exploration and could be cultivated in areas outside PEI for fishers' use.

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