




Can socioeconomic factors explain the local importance of culturally salient plants in a social-ecological system?

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Received: September 25, 2018

Accepted: February 28, 2019

ABSTRACT

The aim of this work was to determine whether socioeconomic factors explain the importance of culturally salient plants to social-ecological systems. Extractive communities of the Araripe-Apodi Environmental Protection Area in Northeast Brazil were studied, and a random sample of the population was selected. Quantitative variables (education, age and income) were analyzed using Spearman correlations, while categorical variables (gender and occupation) were analyzed using Mann-Whitney tests. Relationships between socioeconomic factors and the importance of culturally salient plants were all weak. Nevertheless, age influenced the local importance of the largest number of species. Other factors not considered in this study (historical, cultural, ecological, and psychological) may be outstanding predictors of the importance of culturally salient plants and should be studied in future investigations.

Keywords: culturally salient plants, ethnobiology, ethnobotany, plant extraction, socioeconomic factors

Introduction

Social-ecological systems have for a while been described by simple models resulting in solutions that are not feasible for evaluating resource overexploitation (Ostrom 2007). Social-ecological systems are complex and composed of multiple subsystems, different elements included in these subsystems, at multiple levels (Pennisi 2003; Ostrom 2009). For example, for Ostrom (2009), each subsystem is composed of different variables that affect the organization and function of these systems. In this article, we evaluated the role of culturally salient species in social-ecological systems structured around extractivism of non-timber forest products, as well as the effect of socioeconomic variables on people's relationships with these species.

The influence of socioeconomic factors on the knowledge and use of plant species has been the focus of

several ethnobotanical studies. These studies assessed this association in different ways, including from useful plants in general (see Reyes-García *et al.* 2005; 2007; Souto & Ticktin 2012; Beltrán-Rodríguez *et al.* 2014) to certain types of uses, such as food plants (see Ladio & Lozada 2004), medicinal (see Voeks 2007; Vandebroek & Balick 2012) and timber (see Ramos *et al.* 2008; Medeiros *et al.* 2012).

The findings of these studies varied depending on the approach taken by each investigator. Specifically, for medicinal plants, Case *et al.* (2005) affirmed that older people had more knowledge than younger people. However, Hanazaki *et al.* (2000) did not find this association when they considered the totality of the useful species. As for education and income, studies on useful plants (in general) suggested that knowledge decreased with the increase of education (see Benz *et al.* 2000; Saynes-Vásquez *et al.* 2013) and income (see Varughese & Ostrom 2001; Holmes 2003). Regarding gender, research on medicinal plants indicated

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that women knew more than men (see Caniago & Siebert 1998; Voeks & Leony 2004); nonetheless, when the entire local knowledge system was considered, it was found that men knew more than women (see Hanazaki *et al.* 2000; Kristensen & Balslev 2003; Saynes-Vásquez *et al.* 2013). Analyses that included useful plants also demonstrated the influence of the type of occupation on local knowledge and argued that the most dependent activities of the natural environment were the most associated with the maintenance of local ecological knowledge (see Martínez-Ballesté *et al.* 2006; Saynes-Vásquez *et al.* 2013).

To the best of our knowledge, most of the research conducted so far focused on the relation between socioeconomic factors and the number and diversity of plants that were known or used by people for various purposes. Therefore, there is a lack of studies that relate these factors to the importance that people attach to species. In addition, all studies focused on the totality of the species considered useful or on use categories, for example, medicinal plants. However, authors stated that in certain social-ecological systems, there were species that played a unique role in the culture, and they were essential for people's relationship with and adaptation to the environment (Cristancho & Vining 2004), for cultural identity (Garibaldi & Turner 2004) and for the maintenance of the system (Platten & Henfrey 2009). In this study, we focused on the effects of socioeconomic variables on culturally salient species, a group of prominent species of the social-ecological system. Hence, an analysis that checks the influence of socioeconomic variables on a different set of species would be able to show how certain elements of a social-ecological system can behave.

As a scenario of study, we use two extractive communities of the Brazilian northeast that depend on plant resources to meet their most basic needs and that have a long history of forest resource use (IBAMA 2004). Our main question is: do socioeconomic factors influence the importance of culturally salient species? Our hypothesis is that culturally salient species have their local importance influenced by socioeconomic factors.

Materials and methods

Study area

Two of the 20 human communities that are located around the Araripe-Apodi National Forest, in Araripe-Apodi Environmental Protection Area (EPA), northeastern Brazil, were selected: Horizonte and Macaúba. These communities were selected because one of their main activities, besides subsistence agriculture, is the extraction of forest resources in the Araripe National Forest (FLONA Araripe) (IBAMA

2004). Other criteria for choosing these communities were their proximity to the EPA (IBAMA 2004) and the availability of ethnobotanical and socioeconomic data.

Both Horizonte and Macaúba have a long and intensive history of plant species extraction. In Horizonte the extraction of “pequi” (*Caryocar coriaceum* Wittm.) (Cavalcanti *et al.* (2015a) and “faveira” (*Dimorphandra gardneriana* Tul) are the most conspicuous. The fruits of *C. coriaceum* are mainly marketed for food and medicinal purposes. The fruits of *D. gardneriana* are sold to pharmaceutical industries due to the high content of the flavonoids rutin and quercetin (see Silva *et al.* 2017). The extractivism of these two species generates different productive chains distinct models of commercial appropriation: *C. coriaceum* is related to local traditions and *D. gardneriana* meets industrial demands (Silva *et al.* 2017). The community of Macaúba, besides using these two species, notoriously extracts the palm “babaçu” (*Atallea speciosa* Mart. ex Spreng), whose resources have high commercial importance for community members, especially for women (Campos *et al.* 2015b).

Horizonte had 1,120 people and Macaúba, 1,110 (unpublished data from the Population Census of the Family Health Strategy¹). Each of these communities has a nursery and a primary school, and the other levels of education are only offered in the surrounding towns. These communities also have a health center, where medical care is given on a weekly basis.

This research was approved by the System of Authorization and Information on Biodiversity (authorization no. 27093-1) because it was conducted in the Protected Area. The project was also approved by the Research Ethics Committee of the University of Pernambuco (authorization No. 139.813 and Certificate of Presentation to Ethics Assessment no. 02187512.8.0000.5207). In addition, the community members selected for the study were asked to participate and sign the Free and Informed Consent Term after being given the purpose and methods of the project. This allowed for the collection and publication of information, as established by current legislation (Resolution 466/12 of the National Health Council).

Selection of informants

We selected informants of 18 years of age and over in the communities of Horizonte and Macaúba. We conducted a gender and age group stratification with 10-year intervals (18-28, 29-38, 39-48, 49-58, 59-68, 69 on wards). From the sample of the total number of people, the proportional sample size of each stratum was defined by means of a probabilistic sampling (see Albuquerque *et al.* 2014a for calculations). A random sample (without replacement) with the names of people to be interviewed was performed in BioEstat 5.0 (Ayres *et al.* 2007).

¹ According to the National Primary Care Policy of the Ministry of Health, the Family Health Strategy (ESF), formerly the Family Health Program (PFS), “aims at reorganizing primary care in the country [as well as] increase the resolution and impact on the health situation of individuals and collectivities” (Brasil 2012).



It was noteworthy that in the recognition of the area, health agents of the communities reported that some people had migrated for temporary work to other states. Thus, the sample was composed only by people who were living in the communities at the time of the data collection. In Macaúba, from the total of 249 people to be interviewed, only 193 were found. The other informants (56) were traveling (38), working in neighboring municipalities and were not at home on weekends (seven), sick (mental problems, deaf and dumb) (six), deceased (three) and refused to participate (two). However, the representativeness of the study was guaranteed by the sample size, which was higher than the acceptable value of 330 people, considering a margin of error of 5 % and a confidence interval of 95 % (177 people in Horizonte and 193 in Macaúba, a total of 370 people).

The monthly income among those interviewed ranged from zero to 2262,00 USD (1 USD = 3,90 BRL, April 2013). This discrepancy also occurred in education because there were people from illiterate to post-graduates. Approximately 50 % of people interviewed were concerned with family farming, others worked in the educational sector, trade, health and other activities. Others were unemployed (4 % in Horizonte and 9 % in Macaúba), students (5 %) or housewives (approximately 15 %). The variation in the monthly income, education and occupation occurred for both men and women. It was also noteworthy that many of the communities (approximately 50 %) received benefits from the federal government, such as retirement, pension, family support and crop insurance.

Data collection

Between September 2011 and August 2013, semi-structured interviews were conducted (see Albuquerque *et al.* 2014b) to collect socioeconomic data, such as age, gender, education, occupation and monthly income. The free listing technique was also used (see Albuquerque *et al.* 2014b) to access culturally salient species. Such plants were cited when the following question was asked: "Suppose that for some reason you will live in a place far from here, what are the ten plants you would surely take?" This question was asked in an attempt to separate a set of culturally salient species from the other species of the social-ecological system. As informants cited the plants, it was also asked why they chose each plant, and finally, it was requested for them to order the plants according to their importance. Ten plants were chosen so that ordering was not tiresome and exhausting for the informants.

The botanical material was collected through the guided-tour technique (see Albuquerque *et al.* 2014b). The species were herborized using standard techniques of preparation, drying and mounting of exsiccates (see Santos *et al.* 2014). The identification of the samples was conducted by experts and comparisons with exsiccates deposited in herbaria. After identification, the species were included in the collection

of the Herbarium Professor Vasconcelos Sobrinho of Universidade Federal Rural de Pernambuco.

Data analysis

The Cultural Saliency in Anthropac 4.0 (Borgatti 1996), was calculated using the list of plants obtained through the free listing technique which considered the number of times and the order in which the plants were mentioned. The ten plants with the highest cultural saliency were selected. Informants cited plants that were not among the ten most salient, these plants were not analysed; therefore, the species on the original list of each respondent were separated by those species that were among the ten most salient and their respective positions in the ranking given by the interviewee. Thus, for each informant, there was a list with only the salient species and the ordering of each one given by the respondent in the original list. Then, the local importance value of each plant for each informant was calculated by assigning a value/score from 1.00 to 0.1 for each of them, based on the order of the original list of each respondent.

For example, for an informant who cited the ten most salient plants, if he put species B first, its importance value was 1:00; if species A was second, its value was 0.9, and so on, until reaching species F, which came in tenth place with a value of 0.1. In the case of an informant who cited only three species out of the ten most salient, if he put species A in the first place, the importance value of it was 1:00; if species C was second, its value was 0.9; and if species B was third, its value was 0.8.

In order to verify if the socioeconomic factors influence the value of local importance each species, the Spearman Correlation was used for quantitative variables (age, education and monthly individual income) and Mann-Whitney tests for categorical variables (gender and occupation), using the software R Studio (R Development Core Team 2013). For the education variable, the data were classified in ascending order considering the lowest level of education (not literate: 1, incomplete elementary school: 2, complete elementary school: 3, incomplete secondary school: 4, incomplete higher education degree 6, complete higher education degree: 7).

Results

Table 1 shows the ten culturally salient species in each community studied. Seven species were shared by the two communities, three species were only mentioned in Horizonte and three in Macaúba. This table also has the value of cultural saliency and the variation range of the value of the local importance of each species in each community, as well as the arithmetic mean and standard deviation of this value. The most culturally salient species in both communities were *C. coriaceum*. Only in Horizonte were *D. gardneriana* and in Macaúba were *Attalea speciosa*, all of which are tree species.



Table 1. Culturally salient species for communities of Horizonte (H) and Macaúba (M), Araripe-Apodi Environmental Protection Area, Ceará, northeast Brazil, with their respective scientific and common names, value of Cultural Salience, variation of the value of the local importance and a mean and standard deviation of this value, the number (N°) of people that cited each species and the register number (N°) at Vasconcelos Sobrinho Herbarium of the Federal Rural University of Pernambuco (PEUFR). (-): No data, since the species was not cited in the referred community.

Family/ Scientific Name	Popular Name	Cultural Salience		Variation of the value of local importance		Mean and standard deviation of the local importance value		N° of people		N° of Register at PEUFR
		H	M	H	M	H	M	H	M	
Anacardiaceae										
<i>Anacardium occidentale</i> L.	cajuí	0.13	0.06	0.1 to 0.9	0.1 to 1.00	0.50±0.27	0.58±0.29	44	21	SOUSA,R.(51651)
Annonaceae										
<i>Annona coriacea</i> Mart.	araticum	0.14	-	0.1 to 1.00	-	0.55±0.30	-	51	-	SOUSA,R.(51558)
Apocynaceae										
<i>Himatanthus drasticus</i> (Mart.) Plumel	janaguba	0.30	0.13	0.1 to 1.00	0.2 to 1.00	0.55±0.30	0.62±0.28	84	42	SOUSA,R.(51605)
<i>Hancornia speciosa</i> Gomes	mangaba	0.36	0.12	0.1 to 1.00	0.4 to 0.9	0.55±0.30	0.65±0.19	96	41	CAMPOS,L.(51741)
Arecaceae										
<i>Attalea speciosa</i> Mart ex. Spreng.	babaçu	-	0.47	-	0.5 to 1.00	-	0.75±0.19	-	134	Identified in place
<i>Acrocomia intumescens</i> Drude	macaúba	-	0.12	-	0.2 to 1.00	-	0.62±0.28	-	43	Identified in place
Caryocaraceae										
<i>Caryocar coriaceum</i> Wittm.	pequi	0.98	0.84	0.4 to 1.00	0.4 to 1.00	0.68±0.23	0.70±0.22	163	181	SOUSA, R.S (51606)
Fabaceae-Caesalpinioideae										
<i>Dimorphandra gardneriana</i> Tul.	faveira	0.52	-	0.1 to 1.00	-	0.55±0.30	-	129	-	Identified in place
Fabaceae-Mimosoideae										
<i>Stryphnodendron rotundifolium</i> Mart.	barbatenã	0.28	0.06	0.1 to 1.00	0.3 to 1.00	0.55±0.30	0.65±0.24	83	22	SOUSA, R.S (51575)
<i>Parkia platycephala</i> Benth.	visgueiro	0.15	0.05	0.1 to 0.9	0.2 to 1.00	0.50±0.27	0.60±0.27	56	25	SOUSA, R.S (51569)
Malpighiaceae										
<i>Byrsonima sericea</i> DC	murici	0.21	0.07	0.1 to 0.9	0.3 to 0.9	0.50±0.27	0.60±0.22	83	34	SOUSA, R.S (51564)
Myrtaceae										
<i>Eugenia</i> sp	goiabinha	0.12	-	0.2 to 1.00	-	0.60±0.27	-	43	-	Identified in place
<i>Psidium myrsinites</i> DC	araçá	-	0.06	-	0.1 to 0.9	-	0.57±0.26	-	23	BALCAZAR, A (6700)

Do socioeconomic factors influence the importance of culturally salient species?

It has been found that the influence of socioeconomic factors on the value of the local importance of culturally salient species is weak, although some relationships were significant (Tabs. 2-7). In Horizonte, four species (*Anacardium occidentale*, *Byrsonima sericea*, *C. coriaceum* and *Eugenia* sp.) were not influenced by the factors, other five species (*Annona coriacea*, *D. gardneriana*, *Himatanthus drasticus*, *Parkia platycephala*, *Stryphnodendron rotundifolium*) had the value of local importance influenced by one or two factors, and only *Hancornia speciosa* had the value of local importance influenced by all factors analyzed.

In this community, age influenced the value of local importance of four species. The smaller the age, the greater the local importance value of *A. coriacea*, *H. speciosa* and *H. drasticus*, while the inverse relation was observed for *D. gardneriana*. The occupation factor influenced the value of local importance of three species. Farmers gave greater value of local importance to *H. speciosa* and *H. drasticus*, while those that are not farmers gave greater value to *P. platycephala*. Education influenced the local importance of two species. The higher the schooling level the lower the value of local importance given to *A. coriacea* and *H.*

speciosa. The gender also influenced the local importance value of two species. Men gave greater local importance values to *D. gardneriana* and *H. speciosa*. The income only influenced the value of local importance of *H. speciosa*, the lower the income the greater the value of importance given to this species.

It was worthy to note that the most culturally salient species in this community, *C. coriaceum* (cultural salience = 0.98), whose local importance values were high (0.4 to 1.00) does not have its local importance values influenced by any of the socioeconomic factors analyzed here.

In Macaúba, three species (*A. speciosa*, *B. sericea* and *C. coriaceum*) were not influenced by the factors studied, while other five species (*A. intumescens*, *A. occidentale*, *P. platycephala*, *Psidium myrsinites* and *S. rotundifolium*) had the value of local importance influenced by one or two factors. Another two species were influenced by almost all factors analyzed: *H. speciosa* and *H. drasticus*.

In this community, age influenced the value of local importance of five species. The lower the age, the greater the local importance value of *A. occidentale*, *H. speciosa*, *H. drasticus*, *P. platycephala* and *P. myrsinites*. The income influenced the value of local importance of four species. The lower the income, the greater the local importance value of *H. drasticus*, *P. platycephala* and *P. myrsinites*, while

Table 2. Spearman correlation coefficients (rs) for the ratio between socioeconomic factors (quantitative variables) and values of local importance of the species in the Horizonte community, Araripe Apodi Environmental Protection Area, Northeast Brazil.

Species	Variable	Spearman (rs)
<i>Anacardium occidentale</i>	Education	0.00
	Age	-0.10
	Income	0.07
<i>Annona coriacea</i>	Education	-0.25***
	Age	0.23**
	Income	0.00
<i>Byrsonima sericea</i>	Education	-0.08
	Age	0.08
	Income	0.07
<i>Caryocar coriaceum</i>	Education	0.05
	Age	-0.05
	Income	-0.06
<i>Dimorphandra gardneriana</i>	Education	0.09
	Age	-0.23**
	Income	-0.13
<i>Eugenia sp.</i>	Education	-0.09
	Age	-0.02
	Income	-0.06
<i>Hancornia speciosa</i>	Education	-0.34***
	Age	0.40***
	Income	0.21**
<i>Himatanthus drasticus</i>	Education	-0.02
	Age	0.17*
	Income	0.07
<i>Parkia platycephala</i>	Education	0.05
	Age	-0.04
	Income	0.13
<i>Stryphnodendron rotundifolium</i>	Education	-0.05
	Age	0.02
	Income	-0.11

*p<0.05; **p<0.01; ***p<0.001

Table 3. Means and results of the comparison of values of local importance of species by gender (categorical variable) performed through the Mann-Whitney test for the Horizonte community, Araripe Apodi Environmental Protection Area, Northeast Brazil.

Species	Mean women	Mean men	Mann-Whitney (W)
<i>Anacardium occidentale</i>	0.12	0.17	3598.5
<i>Annona coriacea</i>	0.18	0.14	4079.5
<i>Byrsonima sericea</i>	0.23	0.27	3625.5
<i>Caryocar coriaceum</i>	0.89	0.91	3745
<i>Dimorphandra gardneriana</i>	0.45	0.63	2809.5***
<i>Eugenia sp.</i>	0.13	0.12	4003
<i>Hancornia speciosa</i>	0.26	0.48	2738***
<i>Himatanthus drasticus</i>	0.32	0.30	4095.5
<i>Parkia platycephala</i>	0.17	0.16	3918
<i>Stryphnodendron rotundifolium</i>	0.31	0.28	4055

*p<0.05; **p<0.01; ***p<0.001

Table 4. Means and results of the comparison of values of local importance of species by occupation (categorical variable) performed through the Mann-Whitney test for the Horizonte community, Araripe Apodi Environmental Protection Area, Northeast Brazil.

Species	Mean Farmer	Mean non-farmer	Mann-Whitney (W)
<i>Anacardium occidentale</i>	0.12	0.17	3849
<i>Annona coriacea</i>	0.16	0.15	4141
<i>Byrsonima sericea</i>	0.25	0.25	4105
<i>Caryocar coriaceum</i>	0.91	0.89	4188
<i>Dimorphandra gardneriana</i>	0.53	0.53	3943
<i>Eugenia sp.</i>	0.13	0.12	4251
<i>Hancornia speciosa</i>	0.47	0.26	5257***
<i>Himatanthus drasticus</i>	0.36	0.26	4527.5
<i>Parkia platycephala</i>	0.11	0.21	3397*
<i>Stryphnodendron rotundifolium</i>	0.36	0.22	4820**

*p<0.05; **p<0.01; ***p<0.001

Table 5. Spearman correlation coefficients (rs) for the ratio between socioeconomic factors (quantitative variables) and values of local importance of the species in the Macaúba community, Araripe Apodi Environmental Protection Area, Northeast Brazil.

Species	Variable	Spearman (rs)
<i>Acrocomia intumescens</i>	Education	0.11
	Age	-0.12
	Income	-0.19**
<i>Anacardium occidentale</i>	Education	-0.04
	Age	0.16*
	Income	0.04
<i>Attalea speciosa</i>	Education	-0.01
	Age	-0.01
	Income	0.02
<i>Byrsonima sericea</i>	Education	-0.05
	Age	0.14
	Income	0.13
<i>Caryocar coriaceum</i>	Education	-0.03
	Age	0.12
	Income	-0.09
<i>Hancornia speciosa</i>	Education	-0.18*
	Age	0.34***
	Income	0.10
<i>Himatanthus drasticus</i>	Education	-0.07
	Age	0.20**
	Income	0.19**
<i>Parkia platycephala</i>	Education	-0.02
	Age	0.22**
	Income	0.21**
<i>Psidium myrsinites</i>	Education	-0.09
	Age	0.17*
	Income	0.14*
<i>Stryphnodendron rotundifolium</i>	Education	0.15*
	Age	0.11
	Income	-0.01

*p<0.05; **p<0.01; ***p<0.001



Table 6. Means and results of the comparison of values of local importance of the species by gender (categorical variable) performed through the Mann-Whitney test for the Macaúba community, Araripe Apodi Environmental Protection Area, Northeast Brazil.

Species	Mean women	Mean men	Mann-Whitney (W)
<i>Acrocomia intumescens</i>	0.2	0.14	4950.5
<i>Anacardium occidentale</i>	0.06	0.09	4344
<i>Attalea speciosa</i>	0.63	0.59	4251
<i>Byrsonima sericea</i>	0.09	0.14	4159.5
<i>Caryocar coriaceum</i>	0.88	0.94	4273.5
<i>Hancornia speciosa</i>	0.11	0.22	3962*
<i>Himatanthus drasticus</i>	0.11	0.23	3860**
<i>Parkia platycephala</i>	0.07	0.08	4449
<i>Psidium myrsinites</i>	0.05	0.12	4163
<i>Stryphnodendron rotundifolium</i>	0.09	0.08	4594

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

the opposite relation was observed for *A. intumescens*. The occupation influenced the value of local importance of three species. Farmers gave greater value of local importance to *H. speciosa*, *H. drasticus* and *S. rotundifolium*. Education influenced the value of local importance of two species. The lower the schooling level the higher the local importance value of *S. rotundifolium*, the inverse relation was observed for *H. speciosa*. The gender factor also influenced the value of local importance of two species. Men gave greater value of local importance to *H. speciosa* and *H. drasticus*.

Interestingly, *A. speciosa* and *C. coriaceum*, the species that achieved greater cultural salience (0.84 e 0.47) in this community did not present their local importance values influenced by the socioeconomic factors.

Discussion

The influence of socioeconomic factors on the value of local importance of culturally salient species is not as strong as it has been recorded for the influence of these factors on the knowledge and use of useful plants in general in the two studied communities, it was observed that most of the species (nine in Horizonte and eight in Macaúba) either did not have the local importance value influenced by the factors or were influenced by a maximum of two. This indicates that culturally salient species may have other predictors that best explain their local importance, in addition to socioeconomic ones.

Historical, cultural, ecological, psychological factors may be predictors of socioeconomic factors to explain the importance of culturally salient plants. In our scenario, some of these coadjutant predictors were studied. Silva *et al.* (2019) claim that the comparison of historical and current aerial images of the landscape indicates that the

Table 7. Means and results of the comparison of values of local importance of species by occupation (categorical variable) performed through the Mann-Whitney test for the Macaúba community, Araripe Apodi Environmental Protection Area, Northeast Brazil.

Species	Mean Farmer	Mean non-farmer	Mann-Whitney (W)
<i>Acrocomia intumescens</i>	0.14	0.2	4315
<i>Anacardium occidentale</i>	0.08	0.07	4823.5
<i>Attalea speciosa</i>	0.65	0.58	4970.5
<i>Byrsonima sericea</i>	0.14	0.09	5017.5
<i>Caryocar coriaceum</i>	0.95	0.88	5080.5
<i>Hancornia speciosa</i>	0.21	0.12	5165*
<i>Himatanthus drasticus</i>	0.21	0.12	5173*
<i>Parkia platycephala</i>	0.06	0.08	4637
<i>Psidium myrsinites</i>	0.09	0.08	4749.5
<i>Stryphnodendron rotundifolium</i>	0.14	0.04	5276.5**

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

density of plants increased in managed forested areas where agricultural practices were interrupted; this study also shows that phytosociological data for the managed areas present a greater abundance of the more salient useful species compared to useful species that present less local importance. Cavalcanti *et al.* (2015a) described the extraction of oil from the fruit of *C. coriaceum* as an important traditional activity in the local economy and culture.

Despite the weak influence of the socioeconomic factors analyzed, age was the factor that affected the value of local importance of a greater number of species (four in Horizonte and five in Macaúba). The younger people in the communities gave more importance to certain species. The possibility of generating income through the collection of resources may be the explanation for the younger members to give greater importance to some species, since the species most cited by the young people have commercial potential. *D. gardneriana*, for example, is a species whose fruits are commercialized in Horizonte for pharmaceutical companies, forming a local productive chain (see Silva *et al.* 2017). *H. drasticus*, besides having latex used for medicinal purposes in both communities, is also marketed in the region (see Baldauf & Santos 2013). In addition to the commercial potential, the younger people of the communities value the species by the organoleptic properties (flavor and smell) of their fruits, such as *A. occidentale*, *A. coriaceae*, *H. speciosa* and *P. myrsinites*, whose collection occurs together with other resources of local preference: *B. sericea* wood (see Cavalcanti *et al.* 2015b), fruits of *C. coriaceum* (see Campos *et al.* 2015a) and *A. speciosa* (Campos *et al.* 2015b). This indicates that even if the search for work and industrial goods in urban areas reduced local knowledge (Hanazaki *et al.* 2000), it was observed that young people still recognized the importance of the trade of some plant resources for the acquisition of goods and services.



The occupation influenced the value of local importance of three species both in Horizonte and in Macaúba. The farmers gave more local importance values to the species, except in the case of *P. platycephala*. Farmers were responsible for most of the local importance of *H. speciosa* e *H. drasticus* in both communities and *S. rotundifolium* in Macaúba. In the case of *S. rotundifolium*, such local importance was motivated by the medicinal use and the commercial potential (Feitosa *et al.* 2014). Therefore, we suggested three reasons why farmers gave it more importance: (1) the difficulty of generating income through subsistence farming contributed to this social class to value species that can be used to treat diseases and/or be traded; (2) even if they had little income from agriculture, farmers, who had access to wild resources, preferred to save this income and use these resources to meet basic needs (food and medicine); and (3) farmers also acted as extractors and commissioned the collection of resources for both medical use and for sale, as there was a strong local credibility for the medicinal effectiveness of this species, just as there was for *H. drasticus* (Baldauf & Santos 2013). It is known that the greatest involvement in agriculture can lead to the loss of local knowledge, as a result of environmental change and the loss of biodiversity (Martínez-Ballesté *et al.* 2006). On the contrary, it is also known that people who develop more activities dependent on the natural environment know more species than those that specialize in other activities (see Arias-Toledo *et al.* 2007; Beltrán-Rodríguez *et al.* 2014). The fact is that farmers need to use more accessible and viable sources of income and resources, whether native or cultivated, because they do not have professional training for other activities, and in addition, they have a life story directly related to agriculture.

We might expect income to influence the local importance of a higher number of species, as one of the main activities for income generation in the communities is the extraction for commercial purposes, especially in Horizonte. Nonetheless our findings did not corroborate this idea. *H. speciosa* was the only species that received greater local importance from people with lower incomes in Horizonte. Thus, in the Macaúba, the lower the income, the greater the local importance of *P. myrsinites* (food species), *H. drasticus* (medicinal species) e *P. platycephala* (animal feeding species). The most financially dependent members of this community observed in this species a good alternative to supply their most basic needs (food and medicine) to the acquisition of products and services.

On the contrary, organoleptic, nutritional and medicinal properties of some wild resources, as well as their versatility, may be the reasons that people with higher incomes people give greater local relevance to certain species (*A. intumescens* in our case). The characteristic flavor of the fruit and the medicinal efficiency of *A. intumescens*, explained why people with higher incomes valued this species.

Regarding gender, it was observed that men gave greater importance to the species in both communities

(two species in each community). This male appreciation may be associated with two factors. The first appeared to be related to the fact that men have greater local knowledge of wildlife areas resources, as suggested in other studies (see Hanazaki *et al.* 2000; Kristensen & Balslev 2003; Arias-Toledo *et al.* 2007; Saynes-Vásquez *et al.* 2013). It is possible that women gave greater local importance only to certain species or only to one species because they know less about native species than men. For example, in the study by Campos *et al.* (2015b) conducted in Macaúba, women had limited local knowledge on native food species because they were dedicated to the management and marketing of a single species (*A. speciosa*); or because they are more involved in caring for the family and have a greater affinity with health and spirituality practices, as Zank & Hanazaki (2016) observed when conducting a study in this same community. However, this species was not influenced by gender (and by none of the analyzed factors), and this could be explained because men also act, even if to a lesser extent, in the management and marketing of this species. The second explanation was linked to the division of space and work between genders. Such variables that influenced the number of species known or used (see Caniogo & Siebert 1998; Voeks 2007; Camou-Guerrero *et al.* 2008) may have also interfered with the local importance of the species. As men are responsible for family support, they are the ones who see the more accessible financial alternative to keep the wild resources. Women are strongly involved in the management of the species *A. speciosa*, as described in the study by Campos *et al.* (2015b). Perhaps, for this reason they have not given so much importance to the other species when compared to men. Some studies claim that women take care of the home, so they have greater local knowledge of plant resources of anthropogenic areas, such as backyards (Caniogo & Siebert 1998; Voeks & Leony 2004; Zank & Hanazaki 2016). However, this might not be the case of this community.

As for education, it was noted that the higher the schooling level the lower the local importance value of *A. coriacea* and *H. speciosa* in the two communities, except in the case of *S. rotundifolium* in Macaúba, whose relationship is the opposite. In the communities studied, the low income generated by the trade in plant resources, the distance from temporary jobs (cane cutting in the south and southeast regions) and the low value of the benefits provided by the government stimulates the search for an increase in the level of schooling, since this is normally, a prerequisite for salaried work. This may be the reason for some people move away from forested areas, and consequently, not give so much importance to native resources, although they recognize their importance for the local community. Studies ensured that increased education reduced the chances learn about different native resources (see Benz *et al.* 2000; Hedge & Enters 2000; Blancas *et al.* 2013; Saynes-Vásquez *et al.* 2013). However, with *Sal rotundifolium* it is the opposite,



the lower the level of schooling the higher the value of local importance. Both in Macaúba and Horizonte, people with lower levels of schooling tend to be involved in the management of native forest resources, especially those that generate income and present medicinal use (see Feitosa *et al.* 2014).

Our finding that the importance of the most salient species (*C. coriaceum* in Horizonte and *A. speciosa* and *C. coriaceum* in Macaúba) was not explained by socioeconomic factors is somehow expected. Since most people attributed high values to these species, data on species importance did not vary enough to be explained by socioeconomic factors. Therefore, they can be seen as consensual species to what concerns cultural importance.

Limitation of this study

The ordering given to plants by informants at the time of data collection did not give a chance for different species to be in the same position. Thus, it was possible that some relations between socioeconomic factors and the value of local importance were not identified.

For the data to remain as close as possible to reality, it was necessary to consider two possibilities: (1) no plant could relate to any socioeconomic factor or (2) all plants could relate to all socioeconomic factors. However, in the way the information was collected, it was impossible to match such prerogatives. Some significant relations were achieved, but other probable relations may have been underestimated. As each species had its position in the set of relations, others could not have assumed the same place, i.e., the same values of local importance. Hence, this work identified only the stronger relations of factors with the local importance. Therefore, we suggest that other studies require the informants to give notes to the plants, instead of using the ranking. Therefore, the different plants cited by the same person may be able to obtain the same note.

Conclusions

It has been recorded that socioeconomic factors exert influence over local knowledge of plants. Most of the species did not have their local importance influenced by socioeconomic factors. Although, for the small number of remaining species, age was the factor that most explained the importance of culturally salient species. Younger people motivated primarily by the commercial potential of native forest resources tend to attach greater importance to species.

Our results showed that socioeconomic factors exert a weak influence on the local importance of culturally salient plants. This indicates that other factors that also interfere in the functioning of the social-ecological system, such as historical, cultural, ecological and psychological factors, can better explain the local importance of this group of species. However, it is important to clarify that some factors, such

as income, may have a weak or null impact because their influence can occur indirectly through interaction with other variables, which could not be detected in the tests adopted. We suggest that later studies should perform a multivariate analysis to verify the level of interaction between the variables, and the influence power of isolated and combined variables. It may be possible to verify whether income would not be a factor of indirect significance in the local importance of culturally salient species.

Acknowledgements

The authors thank the members of the Horizonte and Macaúba communities for the receptivity and effective participation in all stages of this work; the FACEPE and CNPq; the Instituto Chico Mendes de Conservação da Biodiversidade for their support during the development of this research; and the members of the Laboratório de Ecologia e Evolução de Sistemas Socioecológicos (LEA), especially Dr. André Borba and Dr. Washington Ferreira Junior, for the fruitful discussions on the idea of this work.

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