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Criteria for Native Food Plant Collection in Northeastern Brazil

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Abstract Different criteria are used by human populations around the world in the selection of preferred natural resources. In this study, the following hypotheses were tested: 1) the preference for food native species is related to the number of uses for which the species are cited; 2) the categories of food and medicinal use equally influence the selection of a species as preferred; 3) the preference among native food species is related to its frequency and abundance in the areas of collection. Data collection on species preference was conducted in communities located near the Araripe National Forest (FLONA) in Ceará, Northeastern, Brazil. Both the hypothesis that the preference would relate to the number of uses attributed to species and the hypothesis that food and medicinal categories equally influence the selection of species as preferred ones were corroborated. It was concluded in this study that people optimize both use and collection of native resources using criteria such as the versatility of uses for species and the abundance of the resource in the preferred collection areas. It is believed that this trend may be an adaptive strategy adopted by local communities for the exploitation of native resources.

Keywords Ethnobiology · Ethnobotany · Human ecology · Medicinal plants · Plant extractivism · Brazil

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Introduction

The knowledge and use of native species is not homogeneous. Rather, people tend to use certain species according to their preferences (Ghorbani *et al.* 2012; Cruz *et al.* 2014). Research on native plants highlights the importance of ecological factors such as accessibility, availability and abundance as influential in the selection of species (Phillips and Gentry 1993; Ladio and Lozada 2003; Ladio *et al.* 2007). Some researchers assume that common species that are frequently found near residences are more likely to be chosen (Albuquerque and Lucena 2005; Ladio *et al.* 2007).

In addition to environmental factors, versatility of species, i.e., the number of uses it can be put to, influences selection (Etkin 1997; Ogle *et al.* 2003; Termote *et al.* 2011. For example, studies conducted in Spain and Vietnam found that the use of a species for food is often continued because it is also used for medicinal purposes and/or as a source of income (Ogle *et al.* 2003; Rivera *et al.* 2007). Moreover, studies evaluating the overlap between food and medicinal uses have found that the use of food species for the prevention and treatment of illnesses is the result of biocultural adaptations (Etkin and Ross 1982).

Despite evidence of the importance of local availability and versatility of use in selecting a species, it remains unclear how the overlap between certain uses, such as food and medicines, can influence selection. Accordingly, our study focuses on preferred food species for three communities in northeastern Brazil to test the following hypotheses: *1)* the preference for native food species is related to the number of uses for which species are cited; *2)* the categories of food and medicinal use equally influence the selection of a native food species; and *3)* the frequency and abundance of native food species in the collection area relate to the level of preference.

Study Area

This study was conducted in three rural communities near the Araripe National Forest (FLONA), in the southern region of Ceará, northeastern Brazil. The FLONA covers an area of 38,493.00 ha, distributed among the following vegetation types: cerrado (*stricto sensu*) and cerradão (Ribeiro and Walter 2008), carrasco (dry forest) and seasonal semi-deciduous forest (rainforest) (IBAMA 2004). Founded in 1946, the FLONA was the first conservation unit of sustainable use in Brazil. According to the Koppen classification system, the climate is humid tropical, with an average annual rainfall of 1090.9 mm, an average temperature of 24–26 °C and rainy seasons between December and April (Cavalcanti and Lopes 1994; INMET 2013).

The FLONA includes the municipalities of Barbalha, Crato, Jardim, Missão Velha and Santana do Cariri (IBAMA 2004). Near the municipalities, around the Araripe National Forest, are a number of communities that, although they practice agricultural activities and migrate at certain times of year to different regions of the country in search of work opportunities, have a strong link with native flora, which remain important in their diet, in the treatment of certain diseases and as sources of income (Sousa-Júnior *et al.* 2013; Lozano *et al.* 2014).

For this study, we selected three extractive communities located in three different municipalities. Baixa do Maracujá, in the municipality of Crato, lies approximately 5 km from the Araripe National Forest, and has a population of 357 among 120 households, generally engaged in agroforestry. Horizonte, in the municipality of Jardim, has a population of approximately 1120 people among 210 households, and is located approximately 10 km from the FLONA. Horizonte is a purely extractive community. Macaúba, in the municipality of Barbalha, has a population of 610 among 180 households, generally engaged in the extraction of babaçu palms (*Attalea speciosa*). The community is located 2 km from the FLONA (Fig. 1). The three communities are organized around social institutions, including churches, schools, health centers and Residents Associations.

Methods

A total of 317 informants for this study were identified from a previous study of native food plants in the three communities (80 in Baixa do Maracujá, 122 in Horizonte, and 115 in Macaúba) (Campos *et al.* 2015). Individuals were then selected based on their knowledge of native food plants, which we assessed from the quartile distribution of the number of food plants cited by each respondent, adopting the third quartile as a reference. Thus, respondents who cited eight plants or more were selected to participate in this research, for a total of 78 informants among the three communities (20 in Baixa do Maracujá, 31 in Horizonte, and 27 Macaúba).

The species selected for this study were those identified with the Anthropac program (Borgatti 1996) as having greater cultural salience in a previous study (Campos *et al.* 2015). From the salience analysis results, 18 food native species were selected among the three communities (Table 1).

We prepared cards with images showing the size, flowers and fruits of all 18 species selected (Fig. 2), which were used primarily to confirm that the researcher and the respondent were referring to the identical taxonomic unit (Medeiros *et al.* 2014). During interviews, the specialist informants were asked to rank the species according to their preferences. They were then questioned about the motives for their choices and the chief uses for a species (Albuquerque *et al.* 2014). The preference for a species is linked to its utility; therefore, all categories and specific uses were recorded (Table 2).

To refine the data collected and to determine the most important criteria for the classification of the 18 preferred species, a participatory workshop was conducted using the technique of "matrix of criteria and options" (Sieber *et al.* 2014). Participants assigned values on a scale from zero to 10 to the different categories of use identified for each species according to its importance, with the most important receiving the maximum value of 10. The workshop was conducted independently for each of the three communities, and all local specialists previously interviewed were consulted (14 from Baixa do Maracujá, 27 from Horizonte, and 12 from Macaúba).

Data on Vegetation Structure

The areas selected for the survey of vegetation structure were those indicated by informants as important locations for gathering. To verify whether the frequency and abundance of food species correlated to their preference status, 2 ha of vegetation, classified as "core-areas of collection," were sampled. Within this area, 1 ha was cerradão, 0.5 ha was cerrado *stricto sensu*, and 0.5 ha was humid forest. In these core-areas, four plots of 0.5 ha were demarcated, and all plants with diameter at ground level (DGL) ≥ 3 cm were measured. The frequency and relative density for all species sampled in the study were calculated (Araújo and Ferraz 2014). All species in the plots were collected for later botanical determination and incorporation in the collection of the Herbarium Vasconcelos Sobrinho (PEUFR) of the Federal Rural University of Pernambuco (*Universidade Federal Rural de Pernambuco* -UFRPE).

Data Analysis

To determine the most preferred food species, a quantitative analysis of salience was conducted using Anthropac

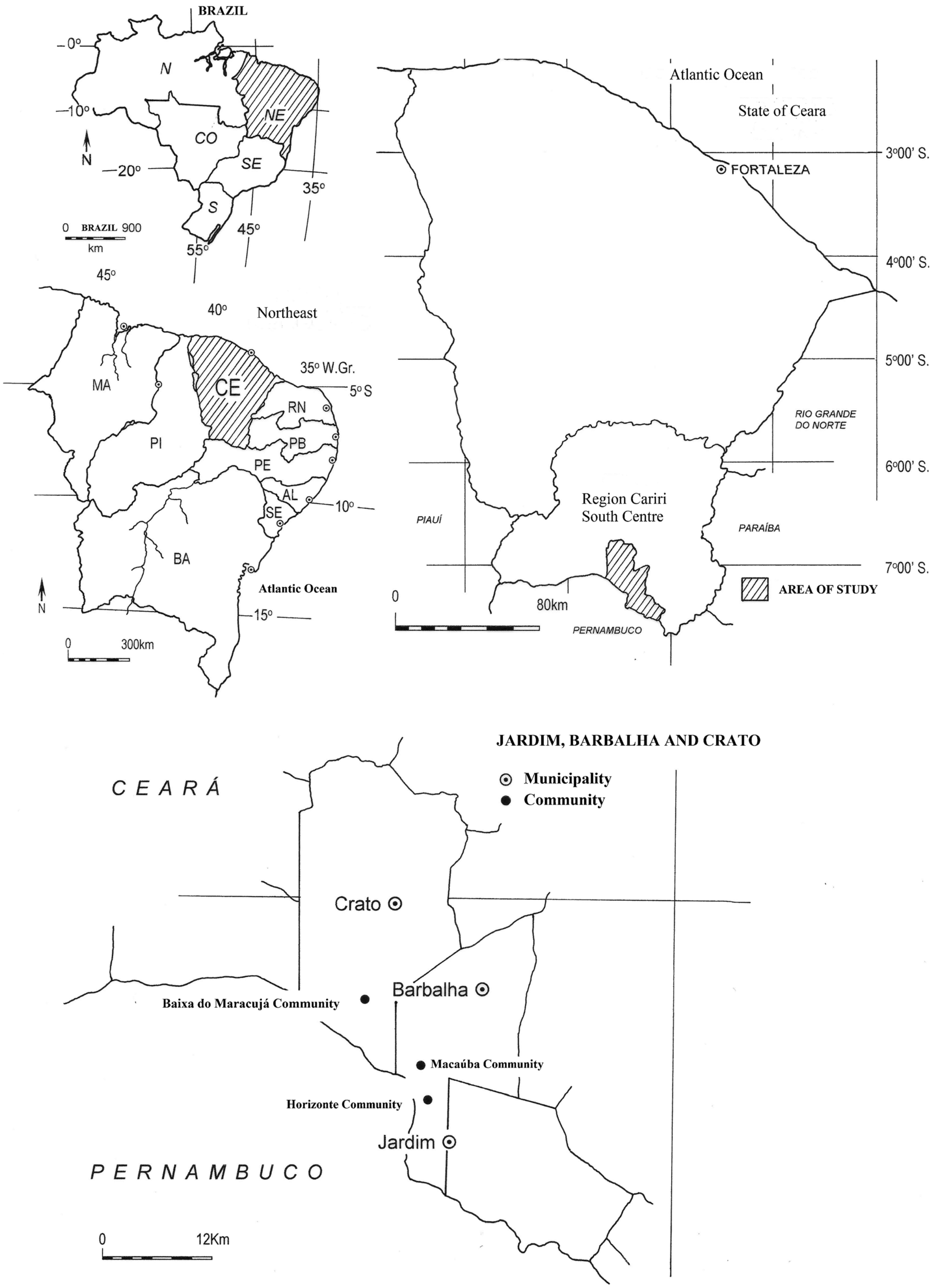

Fig. 1 Map of the study sites Baixa do Maracujá, Horizonte and Macaúba adjacent to the Araripe National Forest, Northeast Brazil

4.0 software (Borgatti 1996). In this study, the most salient species were considered the most preferred. The salience results were used to perform the analysis of the main factors that influence the selection of these species. Using the vegetation structure measures, the data collected were processed and the basal area, frequency and relative density calculated for all species sampled in the study (Table 3).

Table 1 Native food species used by the three study communities

Species	Popular name	Extractive communities		
		Baixa do Maracujá	Horizonte	Macaúba
Acrocomia aculeata (Jacq.) Lodd. ex Mart	Macaúba	X		X
Anacardium microcarpum Ducke	Cajuí		X	X
Annona coriacea Mart	Araticum	X	X	X
Attalea speciosa Mart. ex Spreng	Babaçu	X		X
Caryocar coriaceum Wittm	Pequi	X	X	X
Eugenia sp.	Fruta bola		X	
Hancornia speciosa Gomes	Mangaba	X	X	X
Hymenaea courbaril L.	Jatobá mirim	X	X	X
Hymenaea stigonocarpa Mart. ex Hayne	Jatobá de veado		X	X
Mouriri pusa Gardner ex Hook.	Puçá		X	
Myrciaria sp.	Cambuí	X	X	X
Passiflora cincinnata Mast.	Maracujá do mato	X		
Passiflora silvestris Vell.	Peroba		X	X
Psidium guineense Swartz	Araçá verdadeiro	X	X	X
Psidium laruotteanum Cambess.	Araçá preto	X	X	X
Psidium myrsinites Mart. ex. DC.	Araçá vermelho		X	X
Psidium sobralianum Landrum & Proença	Goiabinha		X	
Syagrus cearensis Noblick	Catolé	X		X

X indicates the citation of the species as a preferred food

Results

In relation to our first hypothesis that preference for a food species is related to the overall number of uses, and we found highly significant correlations between the preference for a food species and the number of individual uses listed for that species for each community: Baixa do Maracujá (rs = 0.6, $p = 0.04$), Horizonte (rs = 0.68, $p = 0.01$) and Macaúba (rs = 0.63, $p = 0.01$) (Table 4). Our results also supported our second hypothesis that the use categories Food and Medicinal have equal influence on the selection of a preferred species (Table 5).

For the third hypothesis, we found that the preference for a food species is strongly correlated with its relative density (RD) and relative frequency (RF) in the communities for which the primary collection site is the FLONA: Horizonte (rs = 0.6, $p = 0.03$) and (rs = 0.62, $p = 0.03$) and Macaúba (rs = 0.8, $p = 0.0008$) and (rs = 0.78, $p = 0.02$), respectively. For Baixa do Maracujá, a community with agroforestry plantations as the main collection site, no correlation was found between preference and relative frequency (rs = 0.4 $p = 0.15$) or relative density (rs = 0.4 $p = 0.1$).

Discussion

Our results confirmed our hypothesis that preference for a food species relates to the number of uses for it. It is important to note that medicinal uses are the most common after food. We argue that two processes may be important to explain this finding. Firstly, the more uses a species has the more likely it is to be remembered and the knowledge passed down over generations. Secondly, the more easily a species is located and the more abundant it is, the more likely it is to be collected. Ladio and Lozada (2003) observed that a cost-benefit ratio would account for this. Thus, the collection of species with multiple uses can be seen as an adaptive strategy. We refer to these processes as the optimization of uses and the optimization of resource collection.

Studies conducted specifically with medicinal plants have found that in arid and semi-arid environments people generally access a set of highly versatile species, i.e., species that can be used to treat a range of ailments (Albuquerque and Oliveira 2007; Cartaxo *et al.* 2010; Ribeiro *et al.* 2014). Further, Albuquerque *et al.* (2009) argue that this multiplicity of uses may be the result of an optimization process in response to the significant climatic variations in these environments that affect the temporal and spatial distribution of many species. Some researchers have argued that individuals tend to remember information with potential adaptive value (Lavie 2005; Nairne *et al.* 2009; Broesch *et al.* 2014), and there is also evidence that humans tend to classify natural resources according to their utility (Hunn 1982).

The hypothesis that food and medicinal categories equally influence the selection of species as preferred was also

Fig. 2 Images of the 18 native food species. **a** *Psidium laruotteanum*; **b** *Psidium guineense*; **c** *Psidium sobralianum* (Photo: Alejandro Lozano); **d** *Psidium myrsinites*; **e** *Eugenia* sp; **f** *Myrciaria* sp.; **g** *Mouriri pusa*; **h** *Hancornia speciosa*; **i** *Caryocar coriaceum*; **j** *Anacardium microcarpum*; **k** *Attalea speciosa* **l** *Anonna coriacea*; **m** *Hymenaea courbaril*; **n** *Syagrus cearensis*; **o** *Acrocomia aculleata*; **p** *Hymenea stigonocarpa* (Photo: Marcelo Kuhlmann); **q** *Passiflora silvestris* (Photo: Maria Clara Cavalcanti) **r** *Passiflora cincinnata*

confirmed by our results. Several studies have addressed the overlap between these two use categories (Etkin and Ross 1982; Ogle *et al.* 2003; Rivera *et al.* 2007; Cruz *et al.* 2014). Although these studies do not provide information to explain the factors that may be linked to this overlap, we argue that it occurs mainly because both food and medicines are closely linked to human survival. The same species can be treated as food or medicine simply depending on the amount and/or parts consumed and the method of preparation. Certain species, when added to the diet, are important not only in providing nutrients but also in the maintenance of health. For example, Jennings *et al.* (2014) observed that the seeds of a species of Fabaceae, widely used in food as a spice, are also used *in natura* to treat stomach problems and control diabetes.

While Etkin (2006) notes the difficulty of ascertaining the initial use of a species, some studies, using both historical and current data, describe how some native plants were first used

Table 2 Criteria for classification of a native food species

Use categories	Justification
Food	Includes those species in which the flavor and nutritional value are the criteria of preference
Craftwork	Used in the manufacture of bio-jewelry and utensils
Trade	Species extracted (regardless of the part) to trade
Fuel	Includes species primarily used in cooking food
Construction	Species whose wood is used for making battens, fences and fence posts
Cosmetic	Groups those species in which by-products are manufactured, as oil, which are used as moisturizers of skin, hair and for preventing greying hair
Medicinal	Groups species mentioned for the treatment of some disease
Ornamental	Includes species considered beautiful and/or decorative

as medicines in certain communities (Jennings *et al.* 2014; Toletin 2014). Our results found that *Hancornia speciosa*, popularly known as mangaba, is currently more widely used as a medicine to prevent the onset of diseases related to circulatory and gastrointestinal systems than as food. However, in the past mangaba was an important source of fruits used for *in natura* consumption and for vitamin-rich juices. The current predominantly medicinal use of *H. speciosa* is because of the latex extracted from the stem. This reported change might be evidence of local adaptation to the seasonal availability of mangaba (Albuquerque 2006; see also Molares and Ladio 2009).

Table 3 Statistical analyses used to test the hypotheses regarding the criteria linked to the preference for native food species

Hypotheses	Variables	Test used
1. The preference for food species is related to the overall number of uses for which the species are cited;	Salience values of each species versus the number of uses listed for the species, regardless of the category	Spearman correlation test
2. The categories of food and medicinal use equally influence the selection of a species as preferred;	For each species, values between zero and ten were allocated by informants, relating to the importance of the species in each of the mentioned categories of use. Then, the marks given for each species in each category of use were compared.	Kruskal-Wallis Test. The ornamental category was removed from the analysis, since it has only one species, not meeting the prerequisites of an analysis of variance.
3. The frequency and abundance of native food species in the collection areas relate to their preference level.	Relative Frequency (RF) and Relative Density (RD) versus salience	Spearman correlation test

The hypothesis that the most preferred species are also the most frequently occurring and abundant was confirmed by the two study communities most engaged in native resource extraction in the FLONA - Horizonte and Macaúba (see also Phillips and Gentry 1993; Ladio and Lozada 2004; Albuquerque and Lucena 2005). Other researchers have also noted that communities will favor preferred species through active landscape management (Voeks 1996). However this hypothesis was not supported for the agroforestry community of Baixa do Maracujá, since residents rarely collect native plants in the forest but rather cultivate favored species in their home gardens (see Kumar and Nair 2004).

Conclusions

This study provides evidence that the process of selecting a native food plant may be influenced by other uses of the species and by its abundance and ease of harvesting. Our results indicate that human populations tend to optimize both their ecological knowledge and their time and effort in harvesting and that these considerations lead to preferences for particular species. In addition, different livelihood strategies can

Table 4 Number of food species, and their other uses for the study communities

Use categories	Number of food species mentioned in each category of use		
	Baixa do Maracujá	Horizonte	Macaúba
Food	11	15	15
Medicinal	10	13	9
Fuel	3	3	3
Cosmetic	2	1	3
Construction	3	2	3
Trade	5	4	4
Craftwork	2	1	2
Ornamental	0	1	1

Table 5 Average scores of the different categories of use determined with the "decision-matrix" method to rank the food species preferred by informants

Use	Baixa do Maracujá	Horizonte	Macaúba
Food	9.18 ± 1.6^{a}*	5 ± 3.13^{a}	8.13 ± 2.44^{a}
Medicinal	7.8 ± 3.48^{a}	4.53 ± 3.04^{a}	5 ± 4.08^{a}
Fuel	0.63 ± 1.56^{b}*	0.66 ± 2.58^{b}	1 ± 2.15^{b}
Cosmetic	0.72 ± 2.41^{b}	0.66 ± 2.58^{b}	1 ± 2.36^{b}
Construction	1.81 ± 4.04^{b}	1.8 ± 3.78^{b}	1.86 ± 3.4^{b}
Trade	4.18 ± 4.93^{b}	1.85 ± 3.88^{b}	3.66 ± 4.8^{b}
Craftwork	2.09 ± 3.75^{b}	–	2.83 ± 3.76^{b}

* Different letters indicate significant differences in accordance with the Kruskal-Wallis test, $p \leq 0.05$. The ornamental category was removed from the analysis, since it has only one species, not meeting the prerequisites of an analysis of variance

influence the choice of a preferred species. The use of native plants may change over time, but medicinal use consistently has a strong association with food use, as reported elsewhere in the literature.

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References

Albuquerque, U. P. (2006). Re-examining Hypotheses Concerning the Use and Knowledge of Medicinal Plants: A Study in the Caatinga Vegetation of NE Brazil. Journal of Ethnobiology and Ethnomedicine 2: 30.

Albuquerque, U. P., and Lucena, R. F. P. (2005). Can Apparency Affect the Use of Plants by Local People in Tropical Forests? Interciencia 30: 506–511.

Albuquerque, U. P., and Oliveira, R. F. (2007). Is the Use-Impact on Native Caatinga Species in Brazil Reduced by the High Species Richness of Medicinal Plants? Journal of Ethnopharmacology 113(1): 156–170.

Albuquerque, U. P., Araújo, T. S., Ramos, M. A., Nascimento, V. T., et al. (2009). How Ethnobotany Can Aid Biodiversity Conservation: Reflections on Investigations in the Semi-arid Region of NE Brazil. Biodiversity and Conservation 18(1): 127–150.

Albuquerque, U. P., Lucena, R. F. P., and Lins Neto, E. M. F. (2014). Methods and techniques used to collect ethnobiological data. In Albuquerque, U. P., Cunha, L. V. F. C., Lucena, R. F. P., and Alves, R. N. N. (eds.), Methods and Techniques in Ethnobiology and Ethnoecology. Springer, New York, pp. 15–37.

Araújo, E. L., and Ferraz, E. M. N. (2014). Analisys of vegetation in ethnobotanical studies. In Albuquerque, U. P., Lucena, R. F. P., Cunha, L. V. F. C., and Alves, R. R. (eds.), Methods and Techniques in Ethnobiology and Ethnoecology. Springer, New York, pp. 141–160. 480 p.

Borgatti, S. (1996). ANTHROPAC 4.0. Analytic Technologies, Natick, MA.

Broesch, J., Barret, C., and Henrich, J. (2014). Adaptive Content Biases in Learning About Animals Across the Life Course. Hum Nature 25(2): 181–199.

Campos, L. Z. O., Albuquerque, U. P., Peroni, N., and Araújo, E. L. (2015). Do Socioeconomic Characteristics Explain the Knowledge and Use of Native Food Plants in Semiarid Environments in Northeastern Brazil? Journal of Arid Environments 115(1): 53–61.

Cartaxo, S. L., Souza, M. M. A., and Albuquerque, U. P. (2010). Medicinal Plants with Bioprospecting Potential Used in Semi-arid Northeastern Brazil. Journal of Ethnopharmacology 131(2): 326–342.

Cavalcanti, A.C., Lopes, O.F. (1994). Condições edafoclimáticas da Chapada do Araripe e viabilidade de produção sustentável de culturas. EMBRAPA – SPI. 42 p.

Cruz, M. P., Medeiros, P. M., Comariza, I. S., Peroni, N. A., and Albuquerque, U. P. (2014). "I Eat the Manofe so it is Not Forgotten": Local Perceptions and Consumption of Native Wild Edible Plants from Seasonal Dry Forests in Brazil. J Ethnobio Ethnomed. 10(45): 1–10.

Etkin, N. (1997). Antimalarial Plants Used by Hausa in Northern Nigeria. Tropical Doctor 27(1): 6–12.

Etkin, N. (2006). Edible Medicines: An Ethnopharmacology of Food. The University of Arizona Press. 3–297 p.

Etkin, N., and Ross, P. J. (1982). Food as Medicine and Medicine as Food. An Adaptive Framework for the Interpretation of Plant Utilization Among the Hausa of Northern Nigeria. Social Science and Medicine 16(17): 1559–1573.

Ghorbani, A., Langenberger, G., Sauerborn, J. (2012). A Comparison of the Wild Food Plant Use Knowledge of Ethnic Minorities in Naban River Watershed National Nature Reserve, Yunnan, and SW China 8: 17.

Hunn, E. S. (1982). The Utilitarian Factor in Folk Biological Classification. American Anthropologist 84(4): 830–847.

IBAMA (2004). Plano de Manejo da Floresta Nacional do Araripe. Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis, Brasília. 323 p.

Instituto Nacional de Meteorologia (INMET). Dados climáticos da estação automática de Barbalha-CE (1973–2013). Disponível em www.inmet.gov.br. Accessed: 05/04/2014.

Jennings, H. M., Merrel, L., Thompson, J. L., and Heinrich, M. (2014). Food or Medicine? The Food–Medicine Interface in Households in Sylhet. Journal of Ethnopharmacology 167(5): 97–104.

Kumar B. M., and Nair P. K. R. (2004). The enigma of tropical homegardens. Agroforestry Systems 61:135–152.

Ladio, A. H., and Lozada, M. (2003). Comparison of Wild Edible Plant Diversity and Foraging Strategies in Two Aboriginal Communities of Northwestern Patagonia. Biodiversity and Conservation 12(5): 937–951.

Ladio, A. H., and Lozada, M. (2004). Patterns of Use and Knowledge of Wild Edible Plants in Distinct Ecological Environments: A Case Study of a Mapuche Community from Northwestern Patagonia: Biodivers. Conserv 13(6): 1153–1173.

Ladio, A. H., Lozada, M., and Weigandt, M. (2007). Comparison of Traditional Wild Plant Knowledge Between Aboriginal Communities Inhabiting Arid and Forest Environments in Patagonia, Argentina. Journal of Arid Environments 69(4): 695–715.

Lavie, N. (2005). Distracted and Confused? Selective Attention Under Load. Trends in Cognitive Sciences 9(2): 75–82.

Lozano, A., Araújo, E. L., Medeiros, M. F., and Albuquerque, U. P. (2014). The Apparency Hypothesis Applied to a Local Pharmacopoeia in the Brazilian Northeast. Journal of Ethnobiology and Ethnomedicine 10(2): 1–17.

Medeiros, P. M., Almeida, A. L. S., Lucena, R. F. P., Souto, F. J. B., and Albuquerque, U. P. (2014). Use of visual stimuli in ethnobiological research. In Albuquerque, U. P., Cunha, L. V. F. C., Lucena, R. F. P., and Alves, R. N. N. (eds.), Methods and Techniques in Ethnobiology and Ethnoecology. Springer, New York, pp. 87–98.

Molares, S., and Ladio, A. H. (2009). Ethnobotanical Review of the Medicinal Mapuche Flora: Use Patterns on a Regional Scale. Journal of Ethnopharmacology 122(2): 251–260.

Nairne, J. S., Pandeirada, J. N. S., Gregory, K. J., and Van Arsdall, J. E. (2009). Adaptive Memory: Fitness Relevance and the Hunter-Gatherer Mind. Psychological Science 20(6): 740–746.

Ogle, B. M., Tuyet, H. T., Duyet, H. N., and Dung, N. N. X. (2003). Food, Feed or Medicine: The Multiple Functions of Edible Wild Plants in Vietnam. Economic Botany 57(1): 103–117.

Phillips, O., and Gentry, A. H. (1993). The Useful Plants of Tambopata, Peru: I. Statistical Hypothesis Test with a New Quantitative Technique. Economic Botany 47(1): 15–32.

Ribeiro, J. F., and Walter, B. M. T. (2008). As principais fitofisionomias do bioma Cerrado. In Sano, S. M., Almeida, S. M. P., and Ribeiro, J. F. (eds.), Cerrado: Ecologia e Flora, 1st ed. Embrapa Cerrados/ Embrapa Informação Tecnológica, Brasília.

Ribeiro, D. A., Oliveira, L. G. S., Macêdo, D. G., et al. (2014). Promising Medicinal Plants for Bioprospection in a Cerrado Area of Chapada do Araripe, Northeastern Brazil. J Ethopharmacol. 155(3): 1522–1533.

Rivera, D., Obón, C., Inocencio, C., Verde, A., Fajardo, J., and Palazón, J. A. (2007). Gathered Food Plants in the Mountains of Castilla - La Mancha (Spain): Ethnobotany and Multivariate Analysis. Economic Botany 61(3): 269–289.

Sieber, S. S., Silva, T. C., Campos, L. Z. O., Zank, S., and Albuquerque, U. P. (2014). Participatory methods in ethnoecological research. In Albuquerque, U. P., Cunha, L. V. F. C., Lucena, R. F. P., and Alves, R. N. N. (eds.), Methods and Techniques in Ethnobiology and Ethnoecology. Springer, New York, pp. 39–58.

Sousa-Júnior, J. R., Albuquerque, U. P., and Peroni, N. (2013). Traditional Knowledge and Management of *Caryocar coriaceum* Wittm. (Pequi) in the Brazilian Savanna, Northeastern Brazil. Economic Botany 67(3): 225–233.

Termote, C., Van Damme, P., and Djailo, B. D. (2011). Eating from the Wild: Turumbu, Mbole and Bali Traditional Knowledge on Non-cultivated Edible Plants, District Tshopo, DRCongo. Genetic Resources and Crop Evolution 58(4): 585–618.

Toletin, L. (2014). When Foods Become Remedies in Ancient Greece: The Curious Case of Garlic and Other Substances. Journal of Ethnopharmacology 167(5): 30–37.

Voeks, R. A. (1996). Tropical Forest Healers and Habitat Preference. Economic Botany 50(4): 381–400.