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Utilitarian and cognitive aspects in the ethnotaxonomy of plants from the Caatinga in two rural communities in Northeastern Brazil

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Abstract. This research sought to contribute to plant ethnotaxonomic studies and aimed to describe cognitive and utilitarian aspects used in communities in the semi-arid region of Brazil. The question asked in the interview was: "What plants do you know?" The interviews were conducted with local specialists, using plant names written on cards randomly placed on a table. The informants were asked to organize the cards according to their understanding. Two hundred and one folk generics were recorded in Cachoeira and 185 in Barrocas, both communities located in the Municipality of Soledade (Paraíba). These generics were divided into 65 trees/shrubs, 138 herbs, 10 lianas/creepers, 7 cacti, and 4 bromeliads. A total of 146 monotypic and 24 polytypic folk generic were identified. The life forms were abundant; some of them had already been recorded in the literature but others were recorded for the first time. The morphological and utilitarian aspects were the most used classification criteria. The informants followed no consensus model to organize their classification.

Keywords: Biodiversity; Caatinga; Ethnobotany; Ethnotaxonomy.

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Resumo. ***Aspectos utilitários e cognitivos na etnotaxonomia de plantas da Caatinga em duas comunidades rurais no Nordeste do Brasil***. Resumo. Esta pesquisa buscou contribuir com os estudos etnotaxonômicos das plantas e objetivou descrever aspectos cognitivos e utilitários utilizados em comunidades do semi-árido brasileiro. A pergunta feita na entrevista foi "Quais plantas você conhece?" As entrevistas foram realizadas com especialistas locais, usando nomes de plantas escritos em cartões colocados aleatoriamente em uma mesa. Os informantes foram solicitados a organizar os cartões de acordo com seu entendimento. Duzentos e um genéricos populares foram registrados em Cachoeira e 185 em Barrocas, ambas comunidades localizadas no Município de Soledade (Paraíba). Esses genéricos foram divididos em 65 árvores/arbustos, 138 ervas, 10 lianas/trepadeiras, sete cactos e quatro bromélias. Um total de 146 genéricos monotípicos e 24 politípicos folk genéricos foram identificados. As formas de vida eram abundantes; alguns deles já haviam sido registrados na literatura, mas outros foram registrados pela primeira vez. Os aspectos morfológicos e utilitários foram os critérios de classificação mais utilizados. Os informantes não seguiram um modelo de consenso para organizar sua classificação.

Palavras-chave: Biodiversidade; Caatinga; Etnobotânica; Etnotaxonomia.

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Introduction

According to Hennig (1966), biological classifications have formed a general reference system on biological diversity and are real deposits of information. In this sense, the local systems (informal) of folk classification are also important, as they contain a high richness of information on biology, ecology, and ethology of several groups of animals and plants.

Carvalho et al. (2018), based on an ethnotaxonomy study involving shark fishermen in Northeastern Brazil, showed that the details in the identification and local classification of this fishery resource may contribute to the management, conservation, and sustainable use of the species recorded in the region.

Amorim (1997) argued that the lack of people's knowledge of biological diversity generates a limited number of classification levels, compared to those produced by technical knowledge. However, little knowledge of the ethnobiology literature by some researchers do not allow them to understand that the few inclusion levels in the folk classification do not necessarily result from the lack of knowledge of local and traditional cultures, but because these often represent a comprehension culturally based on the natural world.

There are cases in which the disappearance of the local name of a taxon in a certain social group may lead to the disappearance of cultural connections, with consequences in the ethnoecological knowledge. For example, the identification and classification of some insects by people from San Miguel el Grande, Mexico, was not possible because they were

little culturally relevant species and due to the influence of the Spanish language (Aparicio et al., 2018).

Comparing the detected patterns in folk systems with the formal biological taxa (academics) to which they refer would be, according to Berlin (1992), one of the steps to understand the analogies between the two classification systems. Thus, ethnotaxonomic studies generally represent comparison attempts between the classification systems of different studied cultures, as well as between these and the so-called scientific classifications.

Some studies on folk classification have been performed over the years aiming to understand how local populations have classified and related to the environment, especially to plants and animals (Berlin et al., 1968; Berlin, 1973; Bulmer, 1974, Berlin, 1976; Hunn, 1982; Hays, 1983; Berlin, 1992; Ellen, 1993; Clément, 1995; Carrara, 1997; Atran, 1998; Jinxiu et al., 2004; Mourão et al., 2006; Farias and Alves, 2007; Souza and Begossi, 2007). Some of the main conclusions refer to an apparent similarity in the way how different people taxonomically classify and organize living beings. For example, artisanal fishermen, on the coasts of Pernambuco and Ceará (Northeastern Brazil), attributed similar names to fish species. This possibly suggests a geographical continuity in the nomenclature pattern along the Brazilian coast (Pinto et al., 2016).

The populations use morphological, ecological, utilitarian, and behavioral aspects in the taxonomic organization (Mourão et al., 2006). Economic criteria have also been recorded, from which the same species can be named according to its local importance (Jinxiu et al., 2004).

Since the beginning of this century, ethnotaxonomic approaches concerning the animal universe have predominated in Brazil (Mourão, 2000; Mourão and Nordi 2002a,b; Araújo, 2005; Mourão et al., 2006; Mourão and Montenegro, 2006; Mourão and Nordi, 2006; Farias and Alves, 2007; Souza and Begossi, 2007; Pinto et al., 2016; Braga, 2017; Carvalho et al. 2018), including few studies on plant ethnotaxonomy (Hanazaki et al., 2006; Haverroth, 2007).

In addition to the lack of studies aimed to understand the relationship between people and plants, few of them have a conservationist approach. Jinxiu et al. (2004) found a high similarity between scientific classification and folk classification (classification performed by local or traditional populations) in the ethnicity “Dai” (Southwest China) and argued that the ethnobiological taxonomy may be used in rapid survey studies on local biodiversity, detecting species in decline that deserve conservation attention.

Given the above, this research sought to contribute to strengthening plant ethnotaxonomic studies and aimed to describe the cognitive and utilitarian aspects adopted by residents of rural communities in the semi-arid region of Brazil. Furthermore, it sought to analyze comparatively and understand how the local ethnotaxonomy has been built, assuming that its comprehension, by scientists and decision-makers, may contribute to providing information for the development of conservation plans for the local diversity, because such ethnotaxonomy may be used in rapid biodiversity surveys. Also, it was verified if there was any relationship between the plant classification criteria used by the informants and the priorities indicated by Lucena et al. (2013) for the conservation of woody species in that same region. Moreover, according to our knowledge, this is the first study on this subject in the semi-arid region of State of Paraíba, Northeastern Brazil.

Material and methods

Regional context and study area

This study was conducted in a semi-arid environment in Northeastern Brazil, specifically in the rural communities of Barrocas and Cachoeira, both located in the Municipality of Soledade, Paraíba State (Figure 1). Soledade was founded by Decree No.

171, of September 24th, 1885. It is located in the "Agreste" Mesoregion and "Curimataú Ocidental" Microregion (7° 03′ 26″ S and 36° 21′ 46″ W), at 521 meters above the sea level and 180 km away from João Pessoa, the state capital (SEBRAE, 1998). This municipality has a territorial area of 560,062 km^2 and an estimated population of 13,128 inhabitants. It has 24,982 hectares of areas covered with native vegetation (SEBRAE, 1998).

Soledade has a hot semi-arid climate (BShs' according to Köppen), annual rainfall around 300 mm, short rainy season, and up to eleven months of drought (Geographical Atlas from State of Paraíba, 1985). This town has one of the lowest precipitation rates in the Northeast Region of Brazil (SEBRAE, 1998). The local vegetation is hyperxerophilous shrub-arboreal, with a high density of cacti, which is currently noticeably predominant, due to the massive tree deforestation for energy production, such as firewood and charcoal to be used in homes (SEBRAE, 1998). The soil is predominantly halomorphic, with a high salinity level, interfering with the development of projects for the use of subsurface water (SEBRAE, 1998).

Characteristics of the study communities

The community of Barrocas, during the fieldwork period, accounted for 12 inhabited houses, predominantly private rural properties, with no clustered houses. Corn and bean were the predominant cultures in the community, mostly for subsistence. Cattle, goat, and sheep rearing was the most recorded livestock practice, with a low frequency of poultry and swine. The study area (Caatinga) comprised different phytophysiognomies with the presence of primary and secondary vegetation areas, and regeneration areas, represented by abandoned cultivation and pasture areas.

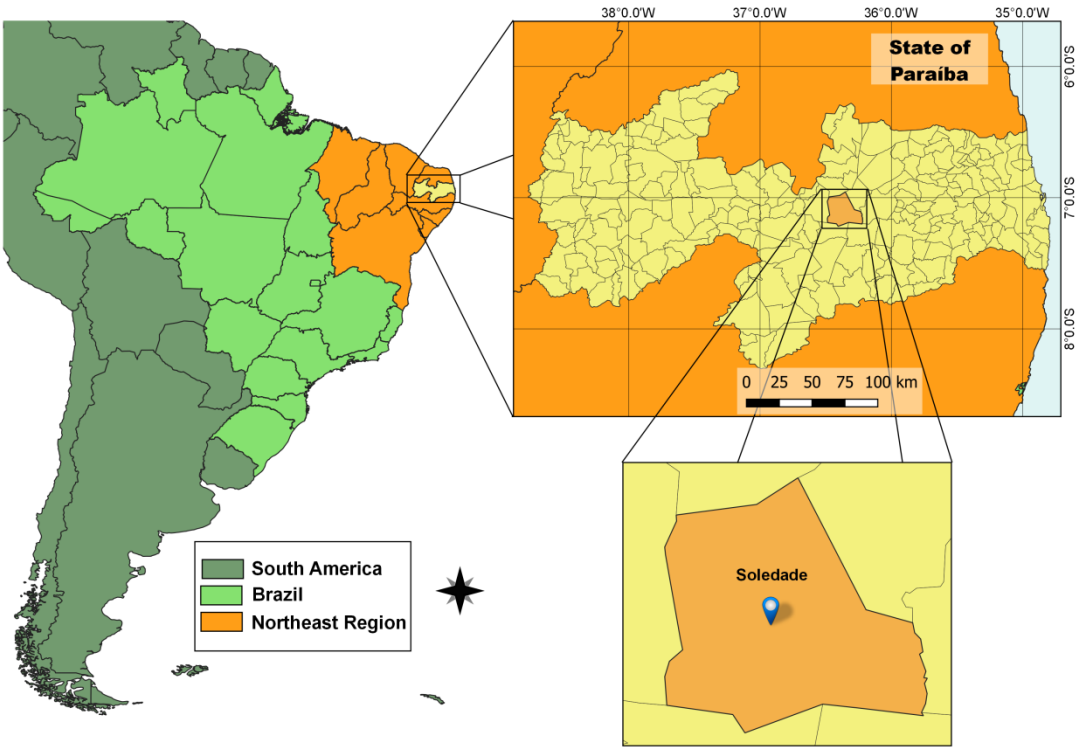

Figure 1. Location of the study area in the Municipality of Soledade (Paraíba, Northeastern Brazil).

The areas bordered by rivers, streams, and ponds were composed of arboreal vegetation, and in other areas, there were shrub/herbaceous-sized species spaced from each other. A predominance of cacti and bromeliads was recorded, which had been widely used for animal feed. The area was crossed by intermittent rivers, which had a large volume of water running during "winter time" (local name for rainy season), mainly in March and June, with the occurrence of sporadic flooding. The areas bathed by rivers had been widely used for the cultivation of cereal and forage species, such as those belonging to the family Poaceae.

In Cachoeira, differently from Barrocas, there were 18 inhabited houses, particularly like a village, with clusters of houses distributed throughout the community, bordering the local road. The territorial area in this community had been divided between two families, which had given the lands so that other residents could build their homes. Another particularity is that the native vegetation fragment had already been used by all residents, especially because of their kinship ties. Such use may have led certain species to local extinction risks, as *Anadenanthera colubrina* (Vell.) Brenan (angico), according to the oldest residents, had been widely used for charcoal production and sold to tanneries in Campina Grande (regional urban center at 60 km away from Soledade).

Barrocas and Cachoeira have similarities regarding agropastoral activities, such as a predominance of corn and beans cultivation and goat and bovine rearing. To access health units, shopping centers, and schools, people from both communities need to go to the urban center of Soledade or other nearby communities, such as the district of Bom Sucesso.

Local botanical knowledge survey

Before starting the interviews, a conversation was held with each informant, explaining the aim of the study. Afterward, they were asked to sign the consent form required by the National Health Council through the Research Ethics Committee (Resolution 196/1996). Then, the data related to the local botanical knowledge were collected through semi-structured interviews, conducted between 2006 and 2008, with all family heads (men or women) (Albuquerque et al., 2010) in the two communities.

To obtain the date, the following question was asked in the interview: "What plants do you know?" From this question, all folk generics were surveyed (Berlin 1996), including the exotic species which were used in medicine, ornamentation, and animal feeding. All woody, cactus, bromeliad, herbaceous, creeper, liana, and epiphyte species were included in the list.

Through the list of folk generics, a database was prepared and used to make identification cards of folk generics and specifics. Subsequently, these cards were used by the specialists to group the plant species. The criteria used to choose these informants were similar to those used for "native specialists" (Marques, 2001), i.e., all family heads of both communities who were considered experts of the local flora. Such specialists were identified from informal conversations with residents. Each card was made using cardboard, on which each folk generics and specifics were written. Five local specialists were identified in Barrocas (four men and one woman) and 12 in Cachoeira (seven men and five women).

The interviews with the local specialists were performed as follows: all cards were randomly placed on a table; then, the informants were asked to organize the cards containing the plant names according to their understanding. Two hundred one cards were shown in Cachoeira and 185 in Barrocas.

Each specialist was informed that plants could be separated (alone) if their characteristics did not correspond to any group, and that unknown plant cards could be classified into another group. This step was performed with each informant separately. After finishing this first grouping, which resulted in "large groups", the informants were

asked if they could form smaller groups into those previously formed, creating subgroups within each large group. The names of the plants and their respective groups and subgroups were recorded in a notebook. Subsequently, the specialists were asked about the reason for forming each group, in order to infer the classification criteria adopted by each one.

To perform an analysis from a conservationist point of view of woody plants in the communities, using local classification, some species indicated by Lucena et al. (2013) as worthy of conservation, in a research conducted in the same study area, were selected. In this analysis, it was sought to identify species that shared the same utilitarian criteria of those indicated by Lucena et al. (2013) as priorities for conservation, which would be grouped in the same group in the classification performed by the specialists. Identifying (or not) such species, it would be possible to propose their shared use, following a sustainable management system, which would reduce the exploitation pressure on the species indicated to immediate conservation.

The following species were selected: *Aspidosperma pyrifolium* Mart. (pereiro), *Commiphora leptophloeos* (Mart.) J. B. Gillet. (umburana), *Croton blanchetianus* Baill. (marmeleiro), *Myracrodruon urundeuva* Allemão (aroeira), *Poincianella pyramidalis* Tul. (catingueira), *Sideroxylon obtusifolium* (Roem. & Schult.) T. D. Penn. (quixabeira), *Ximenia americana* L. (ameixa), and *Schinopsis brasiliensis* Engl. (baraúna). They were selected through triangulation of results obtained by different research methods, such as the use value, conservation priority index, and inventory *in situ* (Lucena et al., 2013). This triangulation resulted in a list in descending order of the more vulnerable species in the region, from which the abovementioned species were chosen.

Data analysis

The groups were analyzed according to the criteria and justifications proposed by the local specialists. These criteria were compared with those found in the literature, in addition to confirming through specialized literature the names attributed to the obtained categories. In the comparison of the local classification with the formal one (scientific), the hierarchical categories of taxonomic inclusion proposed by Berlin (1992) were considered, as follows: unique beginner (kingdom), life form, intermediate, generic, specific, and varietal (variety). The context of the generics was analyzed dividing them into monotypic (when it had only one member, which could be either simple or compound name), and polytypic (when it was composed by two or more members).

Another comparison between the local and scientific classifications was based on taxonomic correspondence, which can be (1) correspondence 1:1, in which a folk generic corresponded to one species; (2) over-differentiation, in which two or more folk generics corresponded to one species; and (3) sub-differentiation, which was divided into two subtypes: sub-differentiation No. 1, when one folk generic represented two or more species of the same genus, and sub-differentiation No. 2 when it was evidenced a correlation of a folk generic with two or more species of a different genus.

For analyzing and representing the groups formed by the local specialists, it was used the Venn Diagram adopted by Berlin (1992) and the *Pile* Sort Multidimensional Scaling in the ANTHROPAC software (Analytic Technologies & Medical Decision Logic, Inc. version 1.0). This software was used to analyze the consensus degree and cultural competence of the specialists, regarding their classifications, in addition to assessing the proximity regarding the classification criteria used by them. The data analysis of the species, classified by Lucena et al. (2013) as worthy of conservation efforts, was performed based on the groupings obtained from the abovementioned Scaling (Analytic Technologies & Medical Decision Logic, Inc. version 1.0).

For botanical identification, plants were collected through the guided tour method, with the aid of woodsmen and local specialists, after the general interviews with the

community. Afterward, they were identified at a species level, when it was possible, using analytical keys and by comparison with the material deposited in the Herbarium Vasconcelos Sobrinho (PEUFR), of the Federal Rural University of Pernambuco, as well as consulting specialists (scientists).

PEUFR: Herbário Vasconcelos Sobrinho from the Federal Rural University of Pernambuco. * Herbarium of the Agricultural Research Institute of Pernambuco - IPA. ** UFP - Herbário Geraldo Mariz of the Federal University of Pernambuco. *** Herbarium Jaime Coêlho de Moraes (EAN) of the Federal University of Paraíba, at the Center for Agricultural Sciences. Collector: Lucena, R. F. P. Hebrew PEUFR Collector: Almeida, C. Hebário UFP - Geraldo Mariz. Federal University of Pernambuco. Collector: Trajano, A. Hebário IPA Dárdano de Andrade Lima. Pernambuco Agricultural Research Corporation.

Results

Two hundred one folk generics were recorded in Cachoeira and 185 in Barrocas, among which, 158 were shared by both communities. The generics were divided into 65 trees/shrubs, 138 herbaceous, 10 lianas/creepers, 7 cacti, and 4 bromeliads (Table 1). The classification made in both communities consisted of four levels of hierarchical structure, proposed by Berlin (1992), and no intermediate and varietal levels were identified (Figure 2). One hundred forty-six monotypic and 24 polytypic generics were identified among those recorded and named by the informants. From the generics folk which were registered and named by the informants, 146 were monotypic and 24 polytypic.

Table 1. Generic folks cited by local specialists in the communities of Barrocas and Cachoeira, located in the Municipality of Soledade (Paraíba, Northeastern Brazil). Classification criteria: E - ecological, L - linguistic, M - morphological, MR - magic-religious, NU - non-utilitarian, S - separated (alone), and U - utilitarian. Life forms: T - tuberous, G - grass, L - liana, Th - thorny, Lb - large.

Vernacular name	Scientific name	Family	Classification criteria	Life form
Agave	*Agave sisalana* Perrine	Agavaceae	E; M; U	E; Mg; Mm; Mp
Alecrim	*Rosmarinus officinalis* L.	Lamiaceae	M; U	C; Mp
Alecrim de serrote	*Portulaca elatior* Mart. *ex* Rohrb.	Portulacaceae	M; NU; U	C; Mm; Mp
Alfazema braba	*Hyptis suaveolens* (L.) Poit.	Lamiaceae	L; M; U	Mp
Algaroba	*Prosopis juliflora* (Sw.) DC.	Fabaceae	M U	Mg
Algodão de cera	*Calotropis procera* (Willd.) R. Br.	Asclepiadaceae	M; U	Mg; Mm
Algodão preto	*Gossypium hirsutum* L.	Malvaceae	M	C; Mm
Amarra cachorro	*Jacquemontia bahiensis* O'Donell	Convolvulaceae	M; U	Mp; Mr; R
Ameixa	*Ximenia americana* L.	Olacaceae	M; U	A; Mg; Mm
Ameixa	*Ptilochaetabahiensis*Turcz.	Malpighiaceae	M; U	A; Mg; Mm
Amor de veio	*Mentzelia aspera* L.	Loasaceae	U	Mp; Mr

Table 1. Continued.

Vernacular name	Scientific name	Family	Classification criteria	Life form
Anador	*Artemisia vulgaris* L.	Asteraceae	M; U	Mp
Angico	*Anadenanthera colubrina* (Vell.) Brenan	Fabaceae	M; U	Mg
Anil	*Indigofera suffruticosa* Mill.	Fabaceae	M; NU; U	Mp
Aroeira	*Myracrodruon urundeuva* Allemão	Anacardiacea	M; U	A; Mg
Arruda; Arruda da folha azul	*Ruta graveolens* L.	Rutaceae	L; M; U	Mp
Avanço	*Froelichia humboldtiana* (Roem. & Schult.) Seub.	Amaranthaceae	M; U	C; Mp; Mr; R
Avanço	*Alternanthera brasiliana* (L.) Kuntz.	Amaranthaceae	M; U	C; Mp; Mr; R
Bamburrar	*Blainvillea acmella* (L.) Philipson	Asteraceae	M; U	C; Mm; Mp; Mr;
Barauna	*Schinopsis brasiliensis* Engl.	Anacardiaceae	M; U	A; Mg
Barba de bode	*Cyperus uncinulatus* Schrad. *ex* Nees	Cyperaceae	M; U	C; Mp; R
Barriguda	*Ceiba glaziovii*(Kuntze) K. Schum.	Malvaceae	M; U	A; Mg
Batata de purga	*Operculina macrocarpa* (L.) Urb.	Convovulaceae	M; U	B; C; Mm; Ms; R
Beduega	*Portulaca oleracea* L.	Portulacaceae	L; M; U	Mp; Mr
Bom dia branco	*Cantharanthus roseus*(L.) G. Don	Apocynaceae	U	Mp
Bom dia vermelho	*Cantharanthus roseus* (L.) G. Don	Apocynaceae	U	Mp
Boa noite	*Cantharanthus roseus* (L.) G. Don	Apocynaceae	M; U	Mp
Boldo	*Peumus boldus* Mol.	Monimiaceae	U	Mp
Bom nome	*Monteverdia rigida* (Mart.) Biral	Celastraceae	M; U	A; Mg; Mm
Bredo	*Trianthema portulacastrum* L.	Aizoaceae	L; M; U	Mp; Mr
Bredo de Espinho; Bredo de porco	*Amaranthus cruentus* L.	Amaranthaceae	L; M	Mp; Mr
Burra leiteira	*Sapium lanceolatum* L.	Euphorbiaceae	M; U	A; Mg
Cabacinha	*Luffa operculata* Cong.	Cucurbitacea	M; U	Mp; R
Cabeça de nêgo	*Wilbrandia* sp.	Cucurbitaceae	E; M; U	B; C; Mm; Mp; Ms; R
Caibeira	*Tabebuia aurea* (Silva Manso) Benth. & Hook.f. *ex* S. Moore	Bignoniaceae	M	A; Mm
Cama de amancebado	*Gomphrena demissa* Mart.	Amaranthaceae	M; NU; U	Mp; Mr
Cana de macaco	*Maranta divaricata* Roscoe	Maranthaceae	L; M	Mm
Canafistula	*Senna martiana* (Benth.) H. S. Irwin Barneby	Fabaceae	M; U	Mg; Mm

Table 1. Continued.

Vernacular name	Scientific name	Family	Classification criteria	Life form
Canafistula braba	*Senna macranthera* (Collad.) H. S. Irwin & Barneby var. *pudibunda* (Benth.) H. S. Irwin & Barneby	Fabaceae	M; U	Mg
Canafistula do mato	*Senna spectabilis* (DC) H. S. Irwin & Barneby var. *excelsa* (Schrad.) H. S. Irwin & Barneby	Fabaceae	M	A; Mg; Mm
Canela de ema	*Thiloa glaucocarpa* (Mart.) Eichler	Combretaceae	M	Mg; Mm
Capim belota	*Chloris orthonoton* Döll	Poaceae	U	Mm
Capim panasco	*Anthephora hermaphrodita* (L.) Kuntze	Poaceae	M; U	C; Mp
Capim pé de galinha	*Dactyloctenium aegyptium* (L.) Willd.	Poaceae	M; NU; U	C; Mp
Capim santo	*Cymbopogon citratus* (DC.) Stapf	Poaceae	U	Mp
Capitão	*Gomphrena basilanata* Suess.	Amaranthaceae	L; U	Mp
Cardeiro	*Cereus jamacaru* DC.	Cactaceae	L; M; U	E; Mg
Cardo santo	*Argemone mexicana* L.	Papaveraceae	E; L; NU	Mp
Carnaúba	*Copernicia prunifera* (Mill.) H. E. Moore	Arecaceae	U	A
Caroá	*Neoglaziovia variegata* (Arruda) Mez.	Bromeliaceae	M; U	E; Mm; Mp
Carrapateira	*Ricinus communis* L.	Euphorbiaceae	M; NU; U	Mg; Mm
Carrapicho de cavalo	*Cenchrus echinatus* L.	Poaceae	L; M; NU; U	Mp; R
Carrapicho de ovelha	*Tragus berteronianus* Schult.	Poaceae	L; M; NU; U	C; Mp; Mr
Catingueira	*Cenostigma pyramidale* (Tul.) E. Gagnon & G. P. Lewis	Fabaceae	M; U	A; Mg
Chucalho de raposa	*Crotalaria incana* L.	Fabaceae	U	Mp; R
Cidreira braba	*Croton muscicarpa* Müll. Arg.	Euphorbiaceae	L; U	Mg; Mm
Cidreira braba	*Sida cordifolia* L.	Malvaceae	L; U	Mg; Mm
Cidreira braba	*Lippia microphylla* Cham.	Verbenaceae	L; U	Mg; Mm
Cidreira do mato	*Lantana camara* L.	Verbenaceae	L; M; U	Mg; Mm
Cipoeiro	*Euphorbia tirucalli* L.	Euphorbiaceae	E	Mg
Coração de homem	*Hibiscus rosa-sinensis* L.	Malvaceae	U	Mp
Coroa-de-frade	*Melocactus zehntneri* (Britton & Rose) Luetzelb.	Cactaceae	M; U	E; Mp; Mr
Coronha braba	*Chloroleucon mangense* (Jacq.) Britton & Rose	Fabaceae	M	Mg
Cravo	*Tagetes minuta* L.	Asteraceae	L; M	Mp
Cravo-de-urubu	*Heliotropium indicum* (L.)	Boraginaceae	L	Mp

Table 1. Continued.

Vernacular name	Scientific name	Family	Classification criteria	Life form
Crista de peru;	*Heliotropium elongatum* (Lehm.) I. M. Johnst.	Boraginaceae	E; M; NU; U	Mm; Mp; Mr
Fedegoso	*Heliotropium elongatum* (Lehm.) I. M. Johnst.	Boraginaceae	E; M; NU; U	Mm; Mp; Mr
Cristo reis	*Ipomoea* sp.	Convolvulaceae	M; U	Mp
Cumaru	*Amburana cearensis* (Allemão) A. C. Sm.	Fabaceae	L; M; U	A; Mg
Cumbeba	*Tacinga inamoena* (K. Schum.) N. P. Taylor & Stuppy	Cacataceae	M; U	E; Mp; Mr
Endro	*Foeniculum vulgare* Gaertn.	Apiaceae	M; U	Mp
Espinho de cigano	*Acanthospermum hispidum* DC.	Asteraceae	L; M; NU; U	Mp; R
Esterco de passarinho	*Phoradendron mucronatum* (DC.) Krug & Urb.	Viscaceae	U, E	R; Mr
Eva babosa	*Aloe vera* (L.) Burm.f.	Liliaceae	M; U	A; E; Mp
Eva cidreira	*Lippia alba* (Mill.) N. E. Br.	Verbenaceae	M; U	Mm; Mp
Eva doce	*Pimpinella anisum* L.	Apiaceae	L; M; U	Mp
Facheiro	*Pilosocereus pachycladus* F. Ritter subsp. *pernambucoensis* (F. Ritter) Zappi	Cactaceae	M; U	E; Mg
Favela	*Cnidoscolus quercifolius* Pohl	Euphorbiaceae	M; U	A; Mg; Mm
Favela branca	*Cnidoscolus quercifolius* Pohl	Euphorbiaceae	M; U	A; Mg
Feijão brabo	*Cynophalla flexuosa* (L.) J. Presl	Capparaceae	M; U	A; Mg
Feijão de rolinha	*Desmanthus virgatus* (L.) Willd.	Fabaceae	M; U	Mr; R
Girassol	*Helianthus annuus*	Asteraceae	U	Mp
Godião	*Secondatia* cf. *densiflora* A. DC	Apocynaceae	M; U	Mp
Gogoia	*Solanum agrarium* Sendtn	Solanaceae	M; NU	E; Mp
Hortelã do Pará	*Plectranthus barbatus* Andr.	Lamiaceae	L; M; U	Mm; Mp
Hortelã Graúdo	*Plectranthus amboinicus* (Lour.) Spreng.	Lamiaceae	L; M; U	Mm; Mp
Hortelã miúdo	*Mentha piperita* L.	Lamiaceae	L; M; U	Mm; Mp
Icó	*Neocalyptrocalyx longifolium* (Mart.) Cornejo & Iltis	Capparaceae	M	Mg
Imbiratã	*Pseudobombax marginatum* (A. St.-Hil., Juss. & Cambess.) A. Robyns	Bombacaceae	M; U	A; Mg
Ingazeira	*Inga* sp.	Fabaceae	M; U	A; Mg
Jaboticabra	*Myrciaria* sp.	Myrtaceae	M; U	Mg
Jatobá	*Hymenaea* sp.	Fabaceae	M; U	Mg
João mole	*Thiloa glaucocarpa* (Mart.) Eichler	Combretaceae	M; U	A; Mg
Juazeiro	*Ziziphus joazeiro* Mart.	Rhamnaceae	M; U	A; Mg
Jucá	*Libidibia ferrea* (Mart. ex Tul.) L. P. Queiroz	Fabaceae	M; U	A; Mg; Mm

Table 1. Continued.

Vernacular name	Scientific name	Family	Classification criteria	Life form
Jucuri	*Pithecelobium diversifolium* Benth.	Fabaceae	S	Mg
Jurema branca	*Piptadenia stipulaceae* (Benth.) Ducke	Fabaceae	L; M; NU; U	A; Mg
Jurema de imbira	*Mimosa ophthalmocentra* Mart *ex* Benth.	Fabaceae	L; M; U	A; Mg; Mm
Jurema preta	*Mimosa tenuiflora* (Willd.) Poir.	Fabaceae	L; M; U	A; Mg; Mm
Louro	*Cordia trichotoma* (Vell.) Arrab. *ex* Steud.	Boraginaceae	U	Mg
Macambira branca	*Encholirium spectabile* Mart. *ex*. Schult. & Schult. f.	Bromeliaceae	U	E; Mp
Macambira de pedra	*Encholirium* sp.	Bromeliaceae	L; M; U	E; Mp
Macambira roxa	*Bromelia laciniosa* Mart. *ex* Schult. f.	Bromeliaceae	L; M; U	E; Mp
Macela	*Egletes viscosa* (L.) Less.	Asteraceae	U	Mp
Malicia	*Chamaecrista rotundefolia* Greene	Fabaceae	M; NU	Mm; Mp
Malva	*Sida galheirensis* Ulbr.	Malvaceae	M; NU; U	Mp
Malva branca	*Waltheria rotundifolia* Schrank	Malvaceae	M; NU; U	Mp
Mamona	*Ricinus communis* L.	Euphorbiaceae	M	Mm
Malva rosa	*Melochia tomentosa* L.	Sterculiaceae	M; Nu; U	Mp
Maniçoba	*Manihot dichotoma*Ule	Euphorbiaceae	M; NU; U	A; Mg
Manjericão	*Ocimum basilicum* L.	Lamiaceae	L; M; U	Mp
Manjirioba	*Senna occidentalis* (L.) Link.	Fabaceae	L; M; U	Mp
Mão fechada	*Selaginella convoluta* (Arn.) Spring.	Selaginellaceae	M; U	Mp; Mr
Maracujá do mato	*Passiflora foetida* L.	Passifloraceae	E; M; U	Mp; R
Maria de três babados	*Hyptis* sp.	Lamiaceae	M; U	Mp
Maria preta	*Cordia leucocephala* Moric.	Boraginaceae	M	Mg
Marmeleiro	*Croton blanchetianus* Baill.	Euphorbiaceae	L; M; U	Mg; Mm
Marmeleiro branco	*Croton sincorensis* Mart.	Euphorbiaceae	L; M; U	Mm
Mastruz	*Chenopodium ambrosioides* L.	Chenopodiaceae	M; U	Mp
Mata fome	*Serjania glabrata* Kunth.	Sapindaceae	M; NU; U	C; Mp; Mr; R
Mata pasto	*Senna obtusifolia* (L.) H. S. Irwin & Barneby	Fabaceae	M; NU; U	C; Mm; Mp
Mato azul	*Heliotropium procumbens* Mill.	Boraginaceae	M; U	C; Mm; Mp
Maxixe brabo	*Cucumus anguria* L.	Cucurbitaceae	L	Mp
Mela bode	*Herissantia crispa* (L.) Brizicky	Malvaceae	M; U	Mm; Mp; Mr
Meladinha	*Stemodia marítima* L.	Scrophulariaceae	M	Mm
Melancia de vaca	*Richardia grandiflora* (Cham. & Schltdl.) Steud.	Rubiaceae	M; U	Mp; Mr; R

Table 1. Continued.

Vernacular name	Scientific name	Family	Classification criteria	Life form
Melão de São Caetano	*Momordica charantia* L.	Cucurbitaceae	M; U	Mp; Mr; R
Mororó	*Bauhinia cheilantha* (Bong.) Steud.	Fabaceae	M; U	A; Mg
Mufumbu	*Combretum fruticosum* (Loefl.) Stuntz	Combretaceae	L; M; U	C; Mg; Mm
Mulungu	*Erythrina velutina* Willd.	Fabaceae	M; U	A; Mg
Mussambê	*Tarenaya spinosa* (Jacq.) Raf	Cleomaceae	E; M; NU; U	Mm, Mp
Neuvagina	*Alternanthera dentata* (Moench.) Stuchlik. *ex*. R.E. Fr.	Amaranthaceae	S	Mp
Oliveira	*Nicotiana glauca* R. Grah.	Solanaceae	M; NU	Mg
Palma	*Opuntia ficus-indica* (L.) Mill.	Cactaceae	M; U	E; Mg
Palmatória	*Tacinga palmadora* (Britton & Rose) N. P. Taylor & Stuppy	Cactaceae	M; U	E; Mg
Pega pinto	*Boerhavia diffusa* L.	Nyctaginaceae	M; U	Mp; Mr
Penicilina	*Alternanthera* sp.	Amaranthaceae	U	Mp
Pereiro	*Aspidosperma pyrifolium* Mart. & Zucc.	Apocynaceae	M; U	A; Mg
Pimenta dágua	*Calliandra* sp.	Fabaceae	L; M; U	C; Mm
Pinhão brabo	*Jatropha mollissima* (Pohl) Baill.	Euphorbiaceae	L; M; NU	Mg; Mm
Pinhão manso	*Jatropha ribifolia* (Pohl) Baill.	Euphorbiaceae	L; M; NU	Mg; Mm
Pinhão roxo	*Jatrophagos sypiifolia* L.	Euphorbiaceae	L; M; MR; NU	Mg; Mm
Pratude	*Mollugo verticillata* L.	Sapindaceae	M	C; Mp
Pratude	*Cardiospermum corindum* L.	Sapindaceae	M	C; Mp
Quebra faca	*Croton heliotropiifolius* Kunth.	Euphorbiaceae	M; U	Mg; Mm
Quebra panela	*Alternanthera tenella* Colla	Amaranthaceae	M; U	Mm; Mp
Quebra pedra	*Phyllanthus* sp.	Euphorbiaceae	M; U	Mp; Mr
Quixabeira	*Sideroxylon obtusifolium* (Roem. & Schult.) T. D. Penn.	Sapotaceae	M; U	A; Mg
Quixabeira branca	*Sideroxylon obtusifolium* (Roem. & Schult.) T. D. Penn.	Sapotaceae	M; U	A; Mg
Romã	*Punica granatum*	Lythraceae	U	Mp
Sabão de soldado	*Microtea paniculata* Moq.	Phytolaccaceae	U	Mp
Saião	*Kalanchoe brasilensis* Camb.	Crassulaceae	M; U	Mp
Salambaia	*Tillandsia bulbosa* Hook. *Tillandsia recurvata* (L.) L.	Bromeliaceae	E; M; NU; U	Mm; Mp; R
Salambaia do pinhão brabo	*Tillandsia streptocarpa* Baker	Bromeliaceae	U	C
Tamiarana	*Tragia volubilis* L.	Euphorbiaceae	M; NU	Mp
Turco	*Parkinsonia aculeata* L.	Fabaceae	M; U	Mg
Ubaia	*Eugenia pyriformis* Cambess.	Myrtaceae	M	A; Mg

Table 1. Continued.

Vernacular name	Scientific name	Family	Classification criteria	Life form
Umburana	*Commiphora leptophloeos* (Mart.) J. B. Gillet.	Burseraceae	M; U	A; Mg
Umbuzeiro	*Spondias tuberosa* Arruda	Anacardiaceae	M; U	A; Mg
Urtiga	*Cnidoscolus loefgrenii* (Pax & K. Hoffm.) Pax & K. Hoffm.	Euphorbiaceae	M; NU	Mp
Urtiga branca	*Aosa rupestris* (Gardner) Weigend	Loasaceae	M; U	Mp
Vá moura	*Aureliana fasciculata* (Vell.) Sendtn.	Solanaceae	M; NU	Mg
Velame	*Crotonheliotropii folius* Kunth.	Euphorbiaceae	M; U	Mg; Mm
Xiquexique	*Pilosocereus gounellei* (F. A. C. Weber) Byles & Rowley	Cactaceae	M; U	E; Mm
Zazumba	*Leonotisnepetifolia* (L.) R.Br.	Lamiaceae	S	Mp

The local specialists proved to have a wide knowledge of plant diversity in their communities; however, none of them were able to identify all plant species cited in the interviews, despite most of them belonging to an ordinary domain. On average, 60.5% of the folk generics mentioned in the general interviews were identified in Cachoeira, but three specialists individually identified more than 90% of the 201 folk generics. Barrocas accounted for an average of 43%, and one specialist identified 97% and another 85.5% of folk generics. All woody species were identified by local specialists. There were distinctions regarding the small herbaceous, such as in the case of species belonging to families Poaceae and Lamiaceae. This knowledge contributed to elaborating a representative taxonomy of the studied human populations.

The criteria used by the local specialists to classify and group the plants were based on utilitarian, morphological, ecological, linguistic, and non-utilitarian aspects. In Cachoeira, morphological criteria were used by 100% of the local specialists, utilitarian by 83%, linguistic and non-utilitarian by 67%, and ecological by 42%. In Barrocas, 80% of them used morphological and utilitarian criteria (although they have not necessarily been used by the same people), 60% used non-utilitarian and 20% linguistic criteria. In addition to these groups, some folk generics were isolated because they shared no characteristics which could include them in the abovementioned groups. Such groups were formed as follow: (1) “jurema branca”, “jurema preta”, and “jurema de imbira” because they have similar leaves and stems (morphological criterion) (Figure 3); (2) “pinhão brabo” and “pinhão manso” because they have the same name “de boi” and because they grow on other plants (ecological); (5) “vá moura” and “urtiga” for having no utility to people or animals (non-utilitarian); and (6) “língua de vaca”, “agulha braba”, and “pinhão roxo” classified as isolated generics because they shared no characteristics with other plants. “pinhão” (linguistic) (Figure 4); (3) “hortelã miúda”, “hortelã graúda”, and “lemongrass”, used for medicinal purpose (utilitarian) (Figure 5).

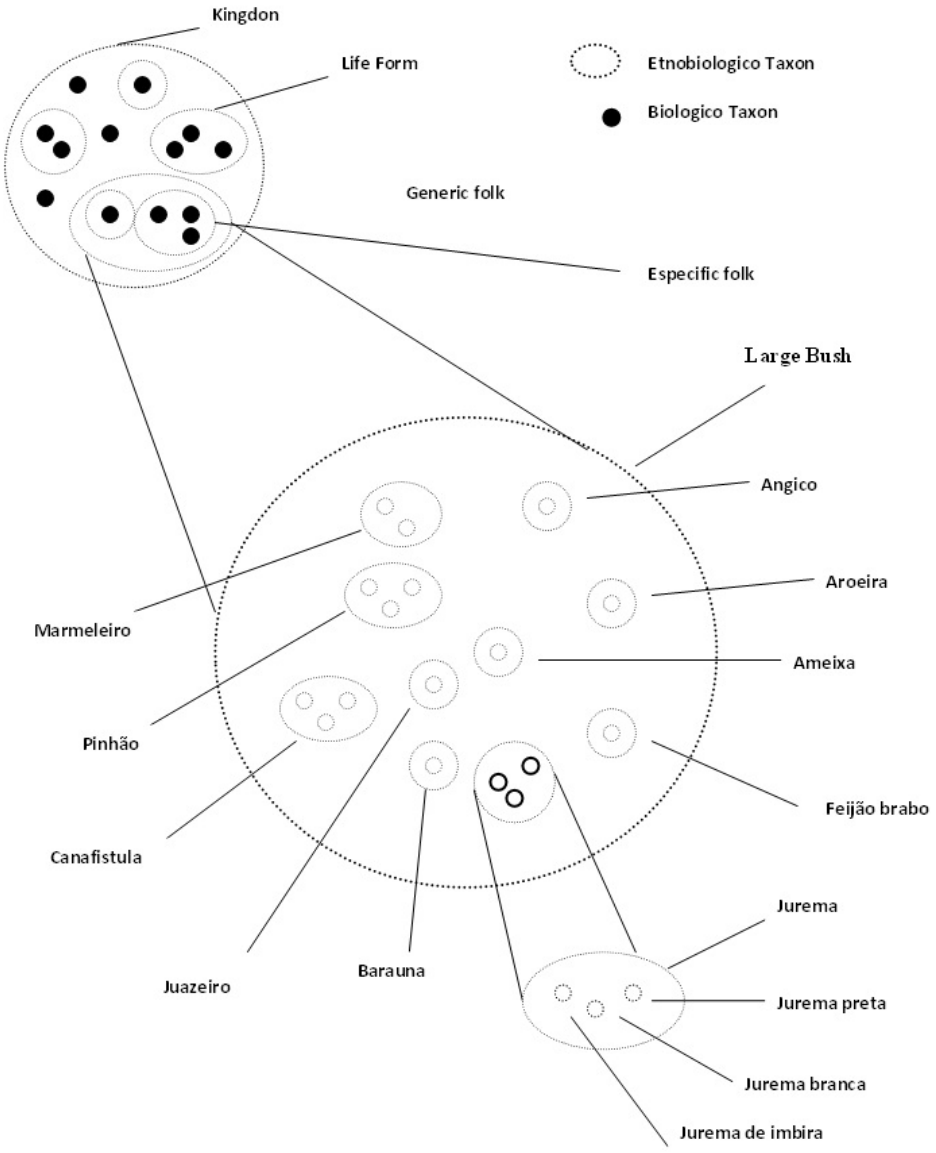

Figure 2. Schematic representation of the four classification categories and their ethnobiological taxa in concurrent use with the hierarchical classification in rural communities of Soledade (Paraíba, Northeastern Brazil), following the model proposed by Berlin (1992).

Forty-five percent of the folk generics were classified based on two criteria, and 28%, 23%, and 4% used one, three, and four criteria, respectively. These results were obtained by considering all classifications together of all specialists in Barrocas and Cachoeira. The fact that a folk generic has been identified based on more than one criterion is because larger groups were divided into sub-groups and because all the above-mentioned information was considered together. Thus, Cactaceae and bromeliad species were grouped in the same group, as they are used as animal feed; however, the division into sub-groups adopted morphological criteria such as leaf type, thorn shape, and plant height. The criteria choice used to define the larger groups and sub-groups varied among the informants and within the classification made by the same specialist. One moment morphological criterion was chosen as the general guide for classification, using the others

as secondary criteria, the next the utilitarian criterion was chosen as the general guide, and the others were used as secondary criteria.

From these groupings, different species and botanical families shared the same group, such as the generics "capim panasco" (Poaceae) and "barba de bode" (Cyperaceae) because they are animal feed, accounting for 40% presence in the classification performed in Barrocas and 42% in Cachoeira, and "caroá" (Bromeliaceae) and "agave" (Agavaceae), which are used to produce handmade ropes, which had 20% and 25% presence in the classifications made in Barrocas and Cachoeira, respectively. There were cases in which species belonging to the same family were classified in the same group, similar to scientific classification, such as "hortelã miúda" and "hortelã graúda", which belong to the family Lamiaceae (morphological and utilitarian criteria - medicinal), with 100% presence in the classification made in Barrocas and 75% in Cachoeira, and "baraúna" and "aroeira" of the family Anacardiaceae (morphological criterion - leaves, wood, and height similarities) with 100% presence in the classification performed in Barrocas and 75% in Cachoeira.

Twelve life forms were recorded, as follows: trees, grass, liana, thorn, large bush, medium bush, small bush, squat bush, underground bush, forage cactus, parasite, and foliage. The life form "tree" was identified by 50% of the informants in Cachoeira and 40% in Barrocas; grass by 17% only in Cachoeira; liana by 50% in Cachoeira and 20% in Barrocas; thorn by 83% in Cachoeira and 60% in Barrocas; large bush by 83% in Cachoeira and 100% in Barrocas; medium bush by 75% in Cachoeira and 100% in Barrocas; small bush by 100% in both communities; squat bush by 16% in Cachoeira and 20% in Barrocas; underground bush by 20% in Barrocas; forage cactus by 8% in Cachoeira; parasite by 20% in Barrocas; and foliage by 33% in Cachoeira and 40% in Barrocas. From a quantitative point of view, these data indicated large bush, medium bush, small bush, and thorn as the main life forms in both communities.

The results from taxonomic correspondences were obtained by the analysis of 136 species of which collected specimens were identified, indicating 127 correspondences 1:1, four over-differentiation and, one sub-differentiation No. 1.

The pile sort analysis showed no consensus classification system among specialists in the community of Cachoeira because there was no distinction of specific groups (Figure 6). Moreover, the specialists had distinct positions and were separated during the analysis (Figure 7). Even in this context, there was a tendency to group the species following the principles related to the life forms, highlighting a group of woody plants, another of herbaceous, and the third group of cacti and bromeliads, which was classified by the specialists as "thorn" (Figure 8). The other species, which were represented by lianas, epiphytes, and tuberous plants, one moment they were bordering these groups, the next were overlapping them.

In Barrocas, there was a strong tendency to group the species based on morphological and utilitarian characteristics (Figure 9a,b), resulting in groups of plants used for veterinary, medicinal, fodder, and ornamental (utilitarian criteria) purposes, and groups including the folk generics "cabeça de nêgo" and "batata de purga", and "salambaia" and "esterco de passarinho" (morphological criteria). Woody plants were grouped in one group, and cacti, bromeliads, creepers, tuberous plants, and herbaceous were distributed into small groups according to their utilitarian characteristics. The analysis of the species selected based on a conservation point of view in Barrocas showed two distinct groups. The first was formed by *M. urundeuva* and *S. brasiliensis* and the second one comprised species in the marginal zone of the large group of woody species, e.g., *C. leptophloeos*, *A. pyrifolium*, *X. americana,* and *S. obtusifolium. P. pyramidalis* remained apart from the other species, and *C. blanchetianus* was the only one next to the general group center (Figure 10). The woody species identified in Cachoeira remained located and dispersed in a long strip, without forming a larger and more concentrated group. The species selected for observation showed different behavior in Cachoeira in comparison with those

recorded in Barrocas, because two groups were formed in this latter community: one composed of *S. brasiliensis*, *X. americana,* and *S. obtusifolium*, and another including *C. blanchetianus*, *M. urundeuva*, *A. pyrifolium,* and *P. pyramidalis*. *C. leptophloeos* shared no group with the other species, appearing isolated (alone) in the analysis.

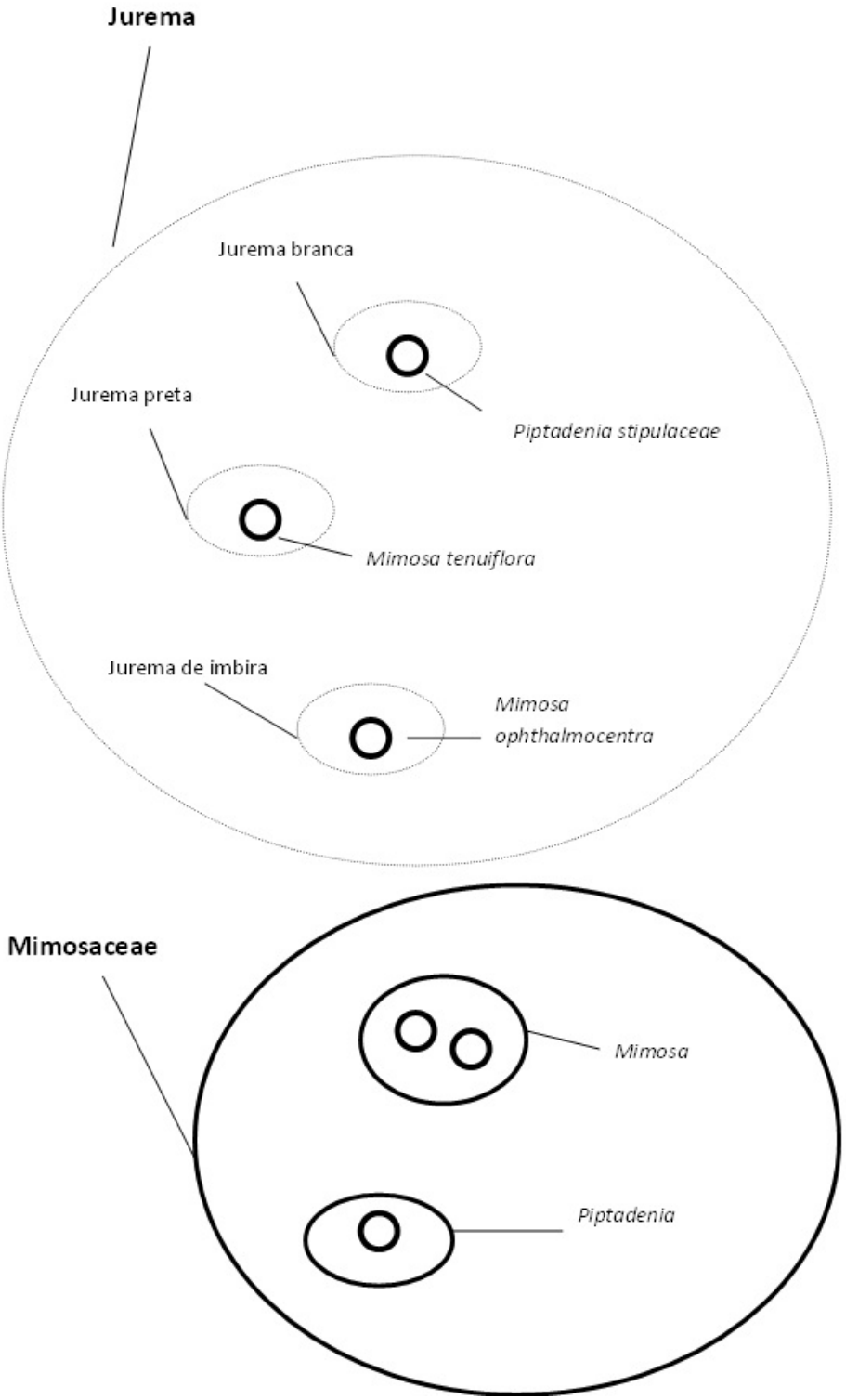

Figure 3. Specific folk generic "Jurema", cited by local specialists in rural communities of Soledade (Paraíba, Northeastern Brazil), and its equivalent names in scientific classification.

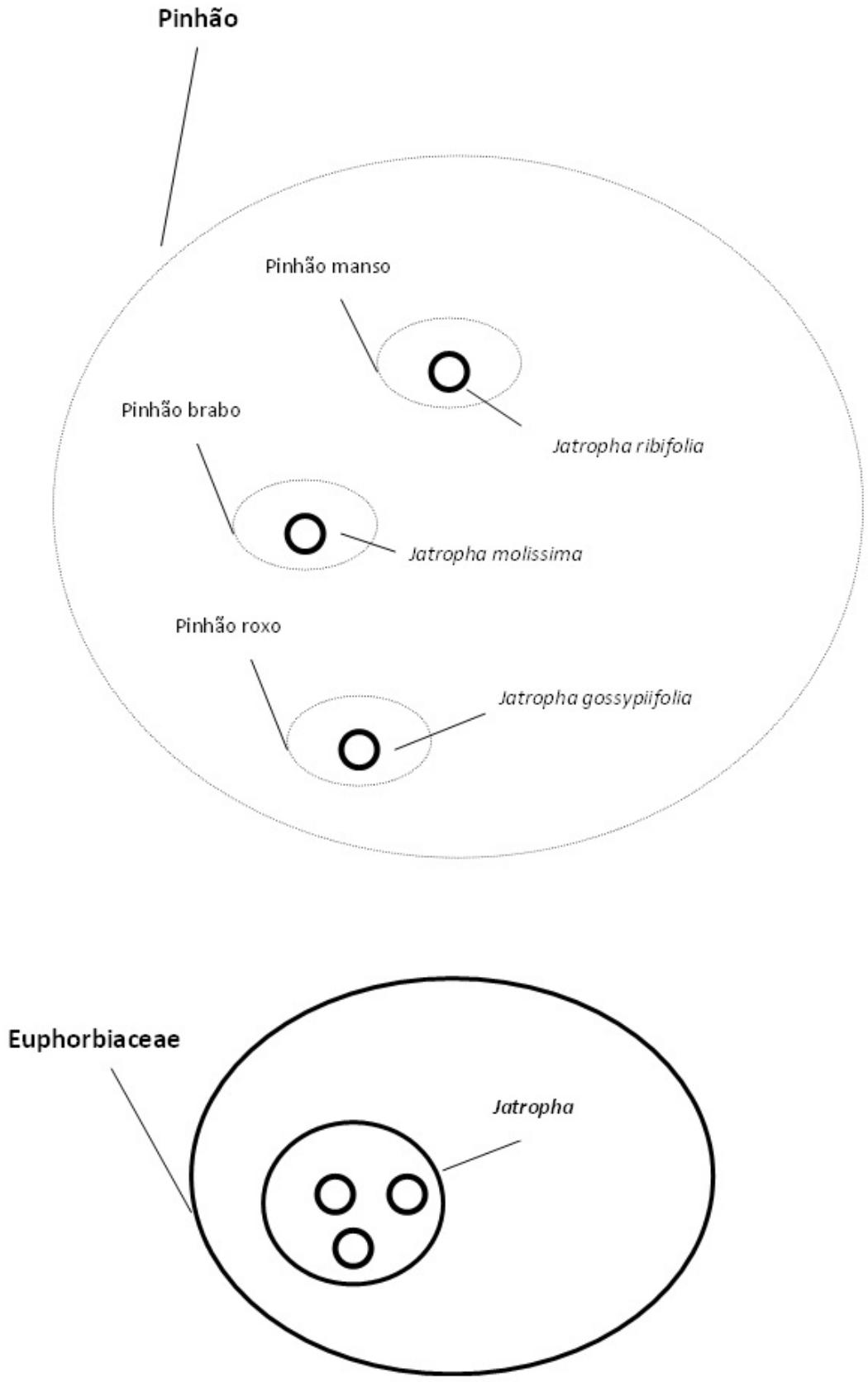

Figure 4. Specific folk generic "Pinhão", cited by local specialists in rural communities of Soledade (Paraíba, Northeastern Brazil), and its equivalent names in scientific classification.

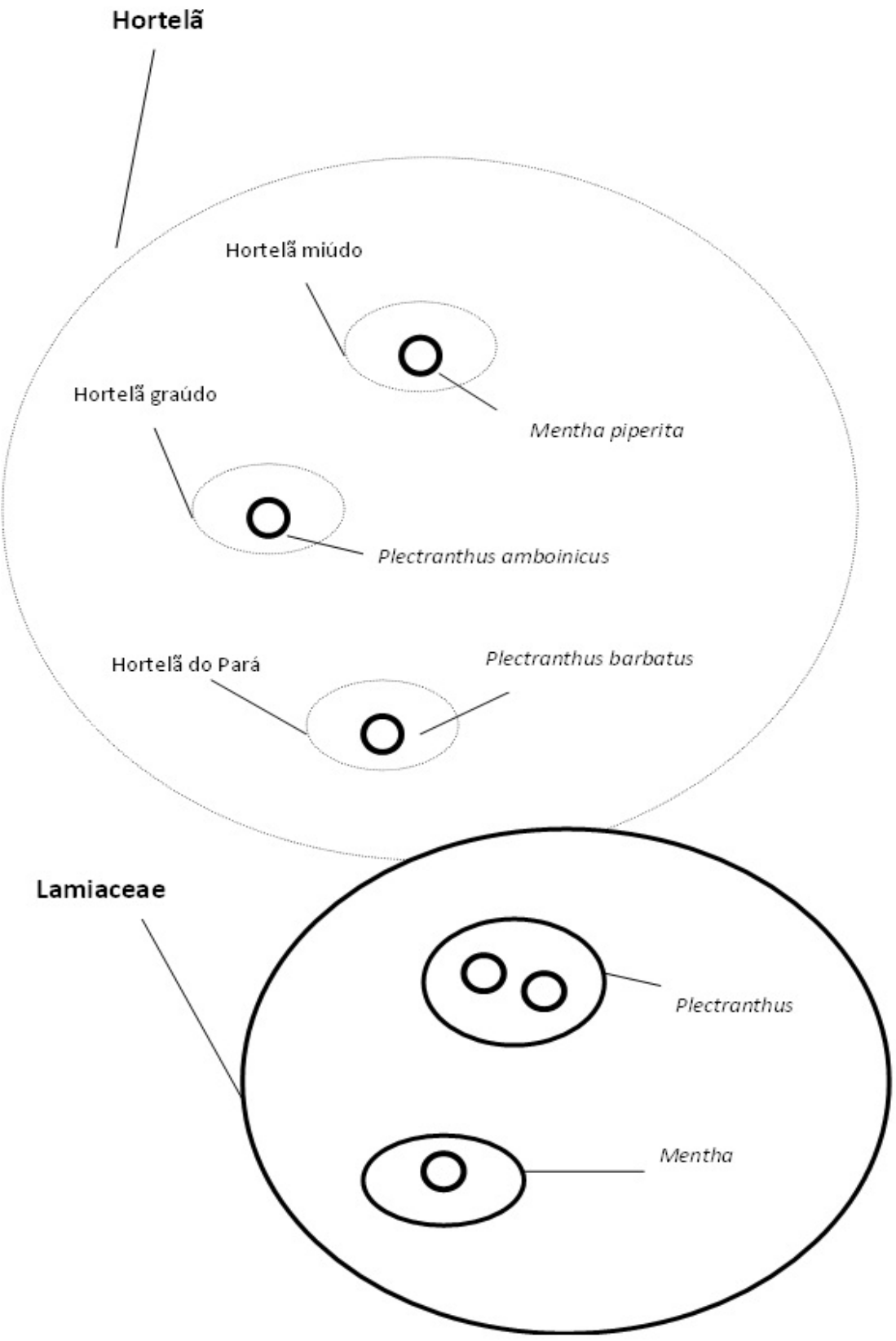

Figure 5. Specific folk generic "Hortelã", cited by local specialists in rural communities of Soledade (Paraíba, Northeastern Brazil), and its equivalent names in scientific classification.

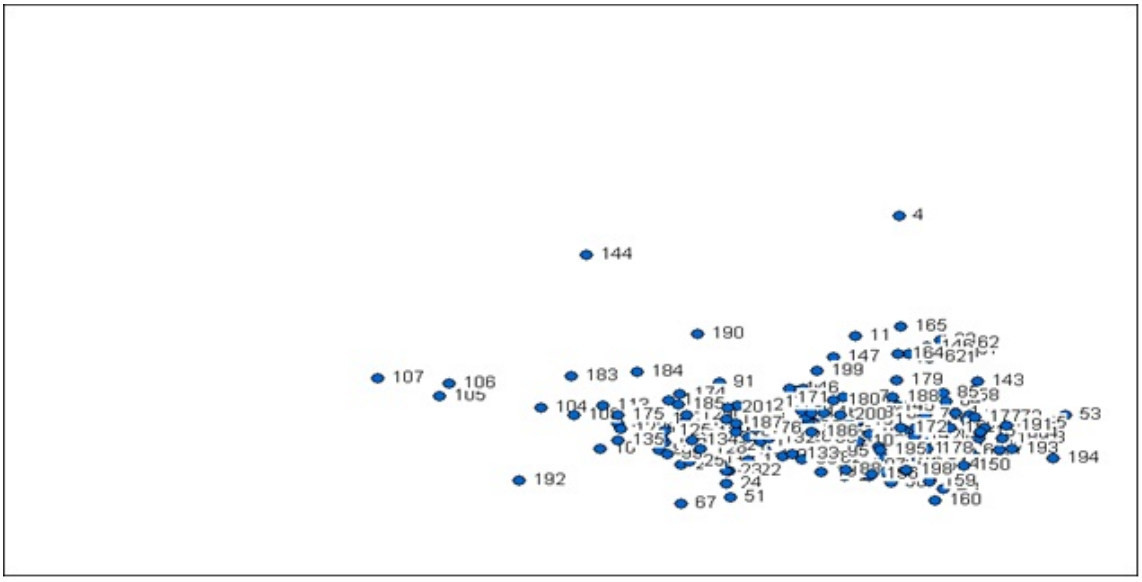

Figure 6. Grouping of folk generics, cited by local specialists in the community of Cachoeira, located in the Municipality of Soledade (Paraíba, Northeastern Brazil), using the pile sort analysis (ANTHROPAC software, version 1.0).

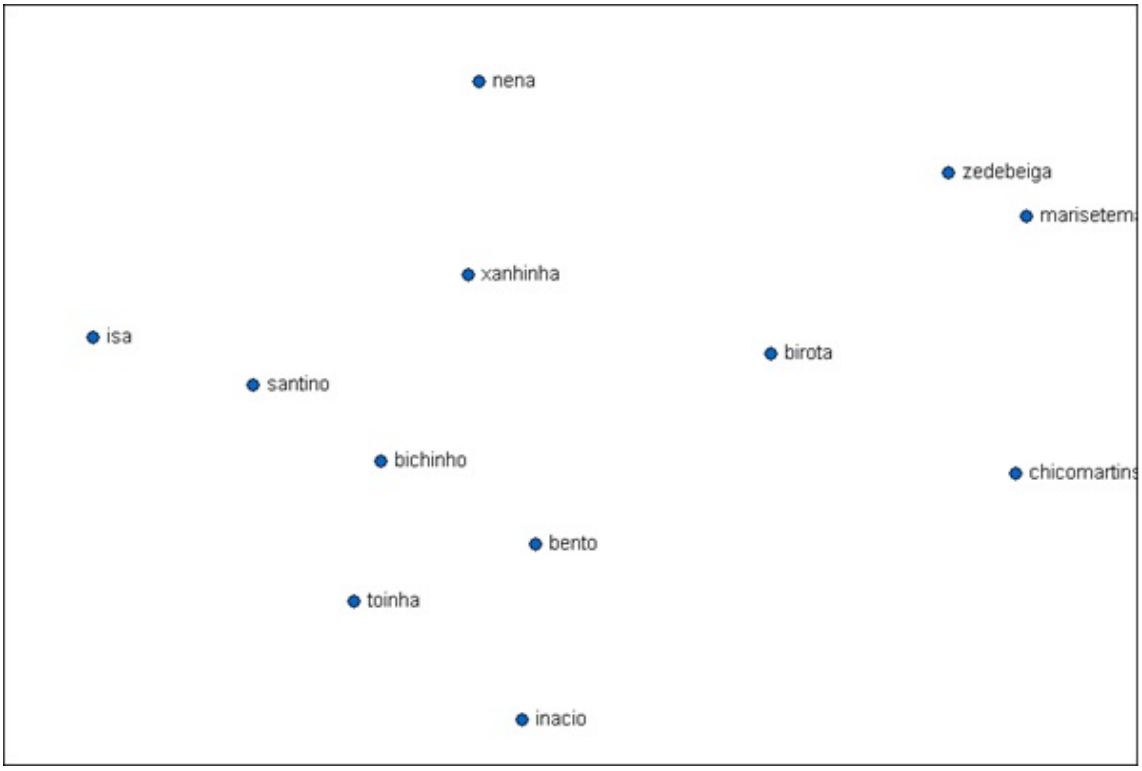

Figure 7. Grouping of local specialists in the community of Cachoeira, located in the Municipality of Soledade (Paraíba, Northeastern Brazil), using the pile sort analysis (ANTHROPAC software, version 1.0).

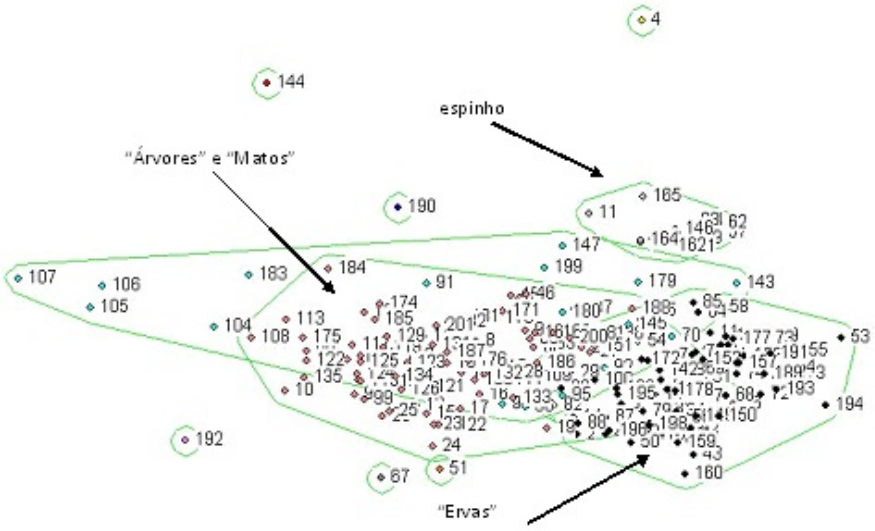

Figure 8. Grouping of folk generics, cited by local specialists in the community of Cachoeira, located in the Municipality of Soledade (Paraíba, Northeastern Brazil), in morphological groups, using the pile sort analysis (ANTHROPAC software, version 1.0).

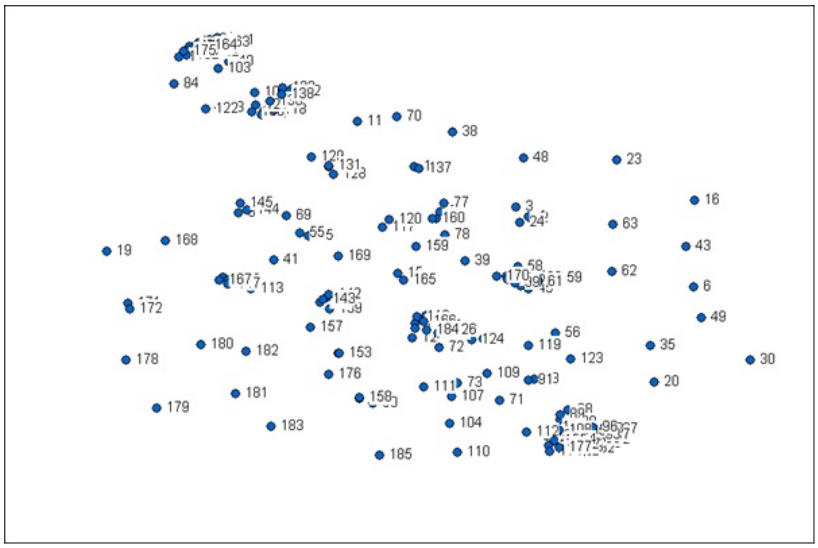

Figure 9a. Grouping of folk generics, cited by local specialists in the community of Barrocas, located in the Municipality of Soledade (Paraíba Northeastern, Brazil), in morphological groups, using the pile sort analysis (ANTHROPAC software, version 1.0).

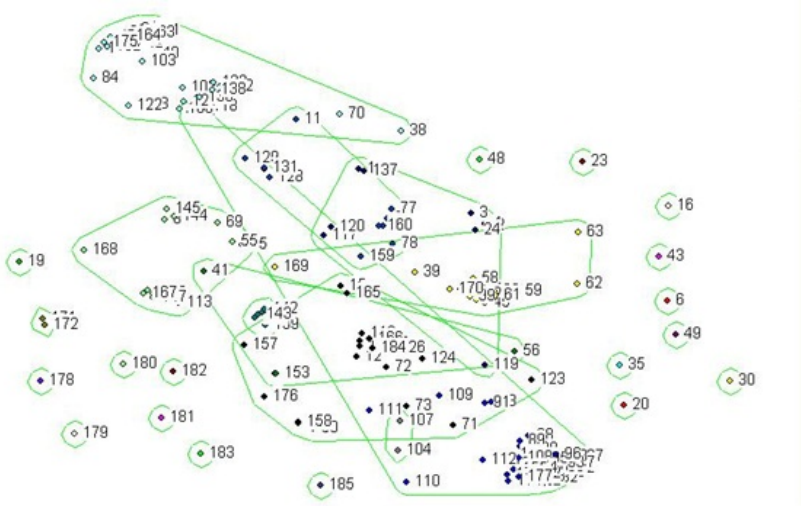

Figure 9b. Grouping of folk generics, cited by local specialists in the community of Barrocas, located in the Municipality of Soledade (Paraíba, Northeastern Brazil), in morphological groups, using the pile sort analysis (ANTHROPAC software, version 1.0).

From the grouping obtained in the pile sort analysis, it was possible to observe different situations regarding the plants indicated by Lucena et al. (2013) for conservation (Figure 10). In Barrocas, a group comprised of *M. urundeuva* and *S. brasiliensis* was isolated with no other species used for similar purposes. This makes it difficult to suggest a substitution or even management of these endangered species for others at a lower risk of local extinction because, in the local classification, the specialists indicated no other species which could share the utilitarian qualities with *M. urundeuva* and *S. brasiliensis*. Another group, formed by *C. leptophloeos*, *A. pyrifolium*, *X. americana,* and *S. obtusifolium*, remained in a position more favorable for possible indications of substitution or shared use by the local population, as these species were in a zone close to the large group of woody plants, which, from the local specialists' point of view, have similar possibilities of use, especially for timber purposes. *C. blanchetianus* was the only species in a position extremely favorable for reducing the exploitation pressure because it was placed in the center of the woody species group, which favors the indication of several species to replace its use. *P. pyramidali* stayed away from the other woody species, similar to what was observed in the first group, also making difficult the development of alternatives for sustainable use.

In the community of Cachoeira, the pile sort analysis showed groupings different from those obtained in Barrocas, because the species indicated by Lucena et al. (2013) as worthy of conservation, formed no group, remaining dispersed in the local classification, which hinders any suggestion of substitution or shared use with other species (Figure 11).

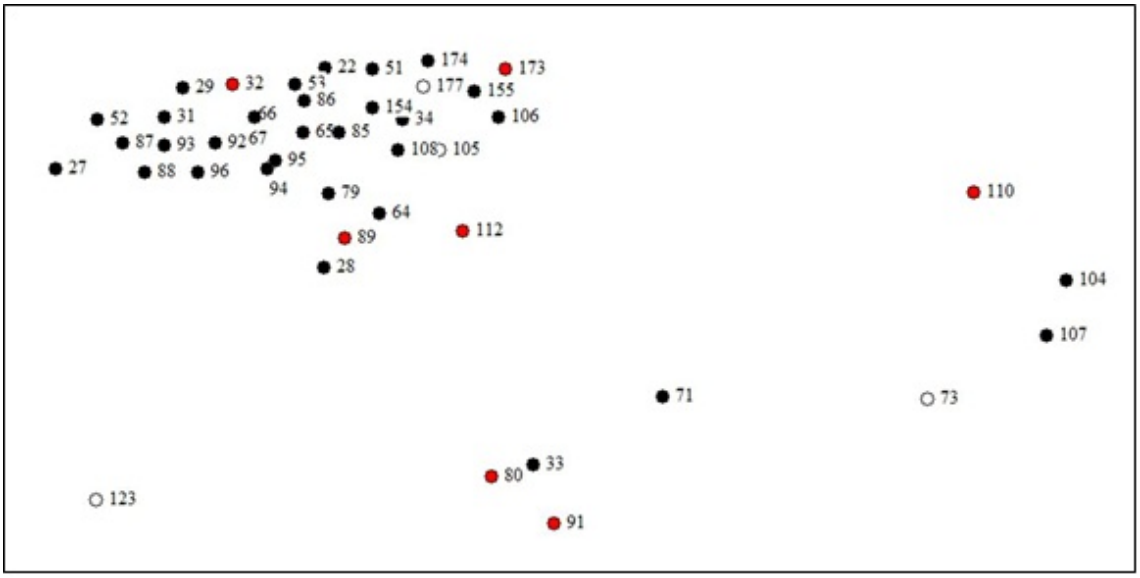

Figure 10. Grouping of woody folk generics, cited by local specialists in the community of Barrocas, located in the Municipality of Soledade (Paraíba, Northeastern Brazil), highlighted in red for species listed by Lucena et al. (2013) as priorities for conservation measures.

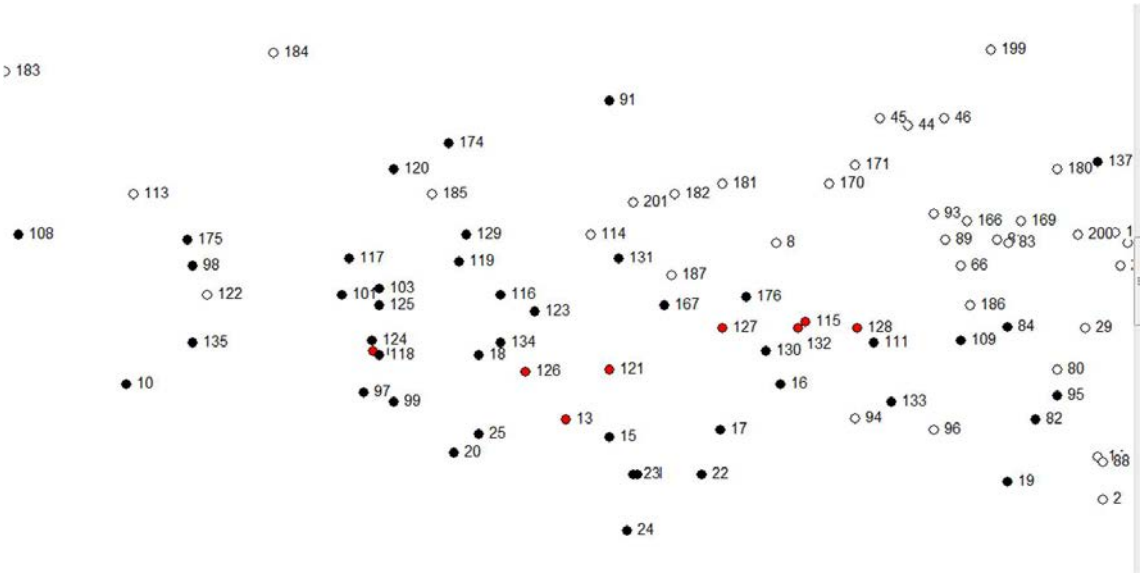

Figure 11. Grouping of woody folk generics, cited by local specialists in the community of Cachoeira, located in the Municipality of Soledade (Paraíba, Northeastern Brazil), highlighted in red for species listed by Lucena et al. (2013) as priorities for conservation measures.

Discussion

The ethnobiological classification obtained in the Municipality of Soledade may be used for rapid surveys of the local plant diversity, mainly of woody species, aiming to identify the species available in the region. In the folk classification made in this study, 65 folk generics of woody species were listed by the local specialists. Lucena et al. (2013), in a plant survey in the same region, recorded 19 woody species in Cachoeira and 29 in Barrocas. Furthermore, there was a high taxonomic correspondence of type 1:1. In other

areas of Caatinga, vegetation surveys had different results, such as in the research by Lucena et al. (2008), who recorded 32 species in an area and 34 species in another, and in other studies by Ferraz et al. (2006), Albuquerque et al. (2005), Pereira et al. (2002), Andrade (2000), Alcoforado et al. (2003), Tavares et al. (1969), Fonseca (1991), Figueredo (2000) and Lemos and Rodal (2002), who recorded 24, 26, 37, 37, 40, 18, 25, 28, and 46 species, respectively. Comparing these results with those obtained from specialists in Soledade, it can be said that the study community has significant knowledge of species diversity from the Caatinga.

The tendency of local specialists to identify more plant categories than the botanical specialists, who have a scientific education, was also verified in field research conducted by Jinxiu et al. (2004), in China. These authors explained that the classification performed by local specialists of the ethnicity "Dai" could be used in rapid assessments of the local biodiversity; as stated in our study. This statement can be strengthened by Haverroth (2007), who studied the Kaingang indigenous people and identified in their traditional taxonomic system almost 200 folk generics, corresponding to 200 botanical species. Kakudidi (2004) emphasized that local specialists have a higher facility for identifying large-sized woody species. This ease may have contributed to the high number of woody species recorded in the present study and in that conducted by Jinxiu et al. (2004).

Berlin et al. (1973) and Berlin (1992), studying local systems of classification, proposed hierarchical ranks for comparisons with the scientific classifications. Nevertheless, this hierarchy cannot always be observed, because the folk classification might be associated with the cultural context and not only with salient characteristics of the biological resource (Ferreira-Junior et al. 2014). In Soledade, four hierarchical levels of those proposed by the abovementioned authors were identified. However, intermediate and variety levels were not found. According to Mourão et al. (2002a), only four of the six hierarchical levels are usually identified in ethnobiological classifications. Nevertheless, Hanazaki et al. (2006) found only three levels, in which "plants" and "trees", e.g., were classified at intermediate levels and the life forms had no identification. Different results were found in Soledade, where these categories were identified at the life-form level, and only the intermediate and variety levels were not identified.

The monotypic generics were the most prominent in Soledade (86%) whereas the polytypic ones represented 14%. This prevalence of monotypic generics has been observed in other studies such as Hays (1974), Berlin et al. (1974), Brunel (1974), Berlin (1976), Mourão and Nordi (2002a), and Farias and Alves (2007), who recorded 14%, 16%, 11%, 18%, 23%, and 23% of polytypic generics, respectively. Berlin (1976) observed that the polytypic generics were bitypic, showing two specific taxa, as found in this study, in which all identified polytypic generics had two names.

In both study communities, morphological and utilitarian were the most prominent criteria, corroborating other studies in the literature (Berlin, 1976; Hun, 1982; Hanazaki et al., 2006; Haverroth, 2007; Pinto et al., 2016). The ecological criterion recorded in the community of Cachoeira, in our research, was also found in other studies on folk classification (Ternes et al., 2016), as well as the linguistic one (Berlin, 1976), which is used based on similarities between plant names or animal names.

The data obtained in this study emphasize the importance of knowing about the dynamic of use of plant species by the residents, due to the high number of plant utilitarian aspects used to organize their classifications. On average, 80% of the specialists highlighted such aspects in both communities. This organization based on utilitarian characteristics was defended by Hunn (1982) and Ellen (1993), who explained that the classification is specifically performed for animals and plants which have some value for the population. Haverroth (2007) also found a strong utilitarian tendency in the classification made by the Kaigangs, in which plants were grouped into different

categories of use. Another example of this trend was recorded by Pinto et al. (2013) among fishermen in Ceará, Brazil. These authors found that fish species of commercial and/or cultural importance were mentioned in a higher number of subdivisions.

In our study, plant species were also classified by local specialists in a "non-utilitarian" category, forming a specific group. This concept of "non-useful" plants was found by Berlin (1976) in his study on the Aguaruna indigenous people, in which one-third of the known plants had no cultural importance, generally classified as monotypic generics. Likewise, in our study, non-useful plants were also monotypic generics.

In the ethnobiological classification performed in this study, species of different families were grouped in the same group, such as Poaceae and Sterculiaceae, which were classified in the same group due to their fodder potential. This was also observed for morphological characteristics, such as in the case of Sapotaceae and Mimosaceae species, which shared the same group. This trend shows that the informants follow their classificatory logic, which, in this case, differs from the scientific classification, as stated by Kakudidi (2004).

In the local classification, some groups were formed based on more than one criterion: one for a larger group and another for dividing such group into smaller groups. For example, the informants gathered several herbaceous species of different families in a huge group, using as criterion their use in the local medicine, and when asked if this group could be divided, the local specialist used the folk generics to form sub-groups based on height as a classification criterion. Similarly, "Dai" ethnicity members, in China, use varied criteria in their classification, in which the same species could receive different names according to their characteristics. *Allium fistulosum*, e.g., classified based on leaf size, received different names. According to the use category, *Alstonia seholaris* also received different names, one for medicinal and another for timber purposes. In the case of *Raphanus sativus*, its name changed according to the color of its flowers. However, the authors did not specify the vernacular names attributed to these species. This taxonomy classification was not performed by the residents of Soledade.

Carvalho et al. (2018) also recorded some variations in folk taxonomy made by fishermen in Rio Grande do Norte, Brazil. In their study, two shark species (*Rhizoprionodon lalandii* and *R. porosus*) were named as "cação rabo-seco". This diversity was observed in Soledade in the way of classifying and grouping the plants, in which the same species was considered, at the same time, a "tree" and a "thorn", such as in the case of "quixabeira", due to the presence of thorns on its stem. Kakudidi (2004) also found these differences in sisal plants (Agavaceae), which was classified in the life forms according to the presence or absence of inflorescences. Regarding aloes, the species were grouped according to their size, one moment in the life form "trees", the next as herbaceous. Differences in the way people perceive and classify plants was also recorded by Assogbadjo et al. (2008), who specifically analyzed the species known as Baobab (*Adansonia digitata*), in different African countries, and verified that the informants' perception of this plant changed from one country to another, as well as the criteria used to determine the types of Baobab.

Hanazaki et al. (2006) found an organization different from that observed in Soledade, despite using the same criteria (morphological and utilitarian). According to them, all cultivated species were classified in a group called "plant", and the arboreal species were divided into "trees with core" and "trees without core".

The life forms recorded in Soledade were named by local specialists based on morphological characteristics, such as height and presence of structures (e.g., thorn), and ecological criteria such as those used to identify the parasite, liana, and underground bush life forms. The use of these characteristics in the determination of life forms was reported by Kakudidi (2004).

The life forms recorded in this research (large bush, medium bush, small bush, squat bush, underground bush, foliage, parasite, thorn, and forage) are probably the first records of this nomenclature in studies on botanical folk classification. Other studies identified different names for these life forms for the same species recorded in Soledade; however, the terms were closer to those used in academic organizations, such as shrubs, herbaceous, lianas, creepers, and epiphytes (Berlin, 1976; Jinxiu et al., 2004; Kakudidi 2004). The life form "tree" was recorded by Berlin (1976), Jinxiu et al. (2004), and Kakudidi (2004), liana by Jinxiu et al. (2004), and grass by Kakudidi (2004). Brow (1977) emphasized that in the local systems of biological classification, "trees" is the most frequent life form, followed by a class of small herbaceous. This justifies the diversity of life forms related to arboreal species in the current study.

In this study, the pile sort analysis showed the local specialists tend to gather plants according to their criteria, with no agreement among them. Another interesting fact in our study is that the folk classification was performed by specialists who had kinship degree, as four couples and a father with his son, residents of Cachoeira, participated in this research; however, they performed different classifications. The most similar classification was made by a couple who used similar criteria to group the plants. In Barrocas, the informants had no direct kinship. The way the local specialists used the classification criteria might have contributed to the wide universe of life form names because different life forms were recorded for arboreal plants (trees, large bush, and medium bush), herbaceous (grass, squat bush, and small bush), cacti and thorny plants (life form "thorn"), tuberous species (foliage and underground bush), and creepers and epiphytes (liana and parasite).

The groupings performed in Cachoeira tended to form the following groups: (1) woody plants, (2) cacti and bromeliads, (3) well known herbaceous, and (4) little known herbaceous. This same tendency was observed in Barrocas; however, the herbaceous were distributed into smaller and spread groups, which were organized based on utilitarian characteristics. Both for Cachoeira and Barrocas, it was found scattered species, away from the groups formed, mostly represented by exotic herbaceous species used to decorate homes, such as "rainha" (No. 144), "arruda da folha azul" (No. 51), and "neuvalgina" (No. 4), in Cachoeira, and "coração de homem" (No. 23), "tambor" (No. 178), and "Benedita" (No. 185), in Barrocas.

There was a consistent relationship between the groupings made in Soledade, regarding the utilitarian and morphological characteristics, indicating the need to consider these two forms as those eventually used by human population to mentally organize the "plants' world": one involving local importance aspects of a species through its use (utilitarian or materialistic chain) and another used to organize the plants' world due to a desire to perform an intellectual systematization (not necessarily academic) of the environment in which the social group lives (cognitive and idealist chain). Hunn (1982) and Ellen (1993) consistently defend the predominance of utilitarian characteristics as a guiding criterion for biological classifications adopted by local or traditional populations. On the other hand, Levi-Strauss (1989) and Berlin (1992) defend that the classification is mainly based on cognitive aspects. However, our study showed that both aspects (intellectual and practical) may be used, in a combined way, in plant classification systems adopted locally by a certain rural human population.

Ethnotaxonomic studies and local conservation

Ethnotaxonomic research has been neglected as a methodological tool in studies focused on local biodiversity conservation, and the classifications found in the literature have mainly sought to understand the dynamic between people and animals (Mourão and Nordi, 2002a,b; Mourão et al., 2006; Farias and Alves, 2007; Souza and Begossi, 2007) or between people and plants, and generally address no conservation considerations.

However, some authors have different approaches. Jinxiu et al. (2004) indicated the importance of the ethnotaxonomic classification for actions focused on local conservation, suggesting that it can be used in rapid biodiversity surveys. Assogbadjo et al. (2008) used the ethnotaxonomic research for a better understanding of the relationship between the informants and a single species, observing its use and possible indications for its conservation. Silva et al. (2017) used the folk classification to show that people name landscapes based on current and past use, finding an efficient strategy to optimize the use of these landscapes by the local population.

A relevant finding regarding the folk classification under study is that, in both communities and by all local specialists, it was guided by the utilitarian criterion, according to which the uses of plants were a central indicator for specialists to realize and organize the whole list of plants they knew. This fact may evidence a strong dependence these people have on plant resources, available in the region. Understanding this dependence may be important for the identification of species under a possible pressure of use, which may require attention and conservation strategies. In a study on useful plants conducted in the same communities, Lucena et al. (2013) indicated *A. pyrifolium* (pereiro), *P. pyramidalis* (catingueira), *C. leptophloeos* (umburana), *C. blanchetianus* (marmeleiro), *M. urundeuva* (aroeira), *S. obtusifolium* (quixabeira), *X. americana* (ameixa), and *S. brasiliensis* (baraúna), e.g., as priorities for conservation.

Analyzing how the informants distributed these species within the classification groups, both in Barrocas and Cachoeira, it was observed an interesting scenario to indicate conservation measures for such species. In Barrocas, e.g., considering only the grouping of woody plants, the species indicated by Lucena et al. (2013) as priorities for conservation were placed at the border of the group, such as in the case of *S. obtusifolium*, *X. americana*, *C. leptophloeos*, and *A. pyrifolium*. *M. urundeuva* and *S. brasiliensis* formed a group apart, and *C. pyramidalis* was isolated and away from the other groups. Only *C. blanchetianus* was located closer to the center of the general group. This scenario seems to indicate a trend toward constant and isolated uses of these species, because assuming that the utilitarian criterion was strongly used in the classifications made by the residents, it was expected that other plants with utilitarian characteristics, similar to those indicated as priorities for conservation, would be close to each other forming a group and sharing utilities. The fact that some species remained at the edge of the group and others away in a more concentrated form, may suggest that they are possibly under local pressure, perhaps confirming the indication by Lucena et al. (2013).

In Cachoeira, the scenario was a little different because the woody plants were distributed in a more spaced manner, without forming groups more defined. Another interesting aspect is that the species indicated by Lucena et al. (2013), in this case, tended to form a group, as observed for *P. pyramidalis*, *C. blanchetianus*, *A. pyrifolium*, and *M. urundeuva*. Another group included *X. americana*, *S. obtusifolium*, and *S. brasiliensis*; in this case, *C. leptophloeos* was apart but sharing a group with *Erythrina velutina* Willd. These groups were formed based on the utility of these species. The first group comprised species used in constructions and as fuel, the second group included those use in local medicine, and the third one was formed base on technological purposes. In Cachoeira, differently from Barrocas, there was a tendency toward a distribution based on plant uses, because the species were grouped according to their uses, close to other species used for similar purposes but different from those indicated by Lucena et al. (2013).

This comparative study on local forms of plant classification proved to be an effective tool for ethnobotanical studies focused on conservation measures, as it allows us to understand, partly, the dynamic of species indicated as priorities for conservation, by understanding how the informants identified and organized such species.

The hierarchical classification levels followed those indicated in the literature, being each one well defined by the informants. The life forms were abundant. Some of

them had already been recorded in the literature and others were identified for the first time. Morphological and utilitarian were the most used classification criteria. The informants followed no consensus model in the organization of their classification.

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Conflict of interests

The authors declare that they have no conflict of interests.

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