Chapter 8

Botanical Species as Traditional Therapy: A Quantitative Analisys of the Knowledge Among Ranchers in Southeastern Brazil

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1. Introduction

Human communities around the world have developed health care practices based on their interaction with the components of their natural environment. Thousands of years of observation and experimentation have helped in developing different empirical medical systems that include the knowledge of plants [1-3]. Such knowledge is the subject of ethnobotany, which attempts to understand the perceptions, healing strategies, and natural resources used to fight diseases or maintain health in traditional medical systems.

Medical ethnobotany constitutes an important alternative among many other known therapies that are practiced worldwide. There is growing recognition that people in different parts of the world still use plant-based remedies as primary or complementary medicine (see, for example, [4-10]). Particularly in Latin America, Africa, and Asia, traditional medicine is part of the prevailing health care system [11]. Using plants for medicinal purposes is part of the body of traditional knowledge that is becoming increasingly more relevant to discussions on conservation biology, public health policies, and sustainable management of natural resources, biological prospection, and patents [12,13].

The present study explores the aspect of the empirical medicinal use of natural resources, including the cultural dimensions that influence the extraction of natural products. A quantitative analysis was performed based on the variables used in the study conducted with the ranchers who live in remnants of the Atlantic Forest in the State of Rio de Janeiro (Southeast, Brazil) [14, 15]. This area includes the so-called Rio das Pedras Reserve, which is situated on the Atlantic side of the Serra do Mar, in the Mangaratiba municipality. This study addressed the following questions. 1) Do people residing in preserved areas know

about and/or use medicinal plants? Because these people reside in an environmental preservation area, it is expected that they use plant species therapeutically. 2) How will the triangulation of quantitative techniques be able to better assess the relative importance of plants in a culture? Considering that the wealth of knowledge/use of medicinal plants by a group of people is a complex system, it is believed that the data derived from different quantitative techniques may emphasize a plant's importance in relation to its versatility, quantify the percentage of informants claiming the use of a certain plant for the same major medicinal purpose, and indicate how homogenous the ethnobotanical information is among the informants.

2. Materials and methods

2.1. Study area

The Rio das Pedras Reserve is located in the western region of the State of Rio de Janeiro, in the Mangaratiba municipality on the Atlantic slope of the Serra do Mar, next to the Sepetiba Bay, between the coordinates 22º59' S and 44º05' W. The reserve has an area of 1,360 hectares (13 km^2). The access route to the Reserve is km 55 of the BR-101 highway (Rio/Santos), with a distance of 110 km from the city of Rio de Janeiro (Figure 1).

The area has an annual average temperature of 22ºC, an absolute maximum temperature of 38ºC, and a minimum of 12ºC. The highest rainfall index occurs in the months from December to February. The Grande River Basin is the main drainage basin; the Grande River is located in a valley with steep slopes (greater than 37º), and the elevations vary from 20 to 1,050 meters [16].

The current Reserve area corresponds to the former Goiabal Farm, an enterprise that focused on the cultivation and sale of bananas. The banana shipments were transported by boats bound for Rio de Janeiro. According to the report from the historian Alda Marília Cerqueira de Pinto (personal communication. 2000), after the death of Mr. Otacílio Cerqueira, the owner of the farm, his widow attempted to continue the operation; however, much of the banana production was diverted by the sharecroppers who sold their harvest directly. Therefore, to pay the debts acquired due to the maintenance of the farm and the lack of product requested by the banana buyers from Rio de Janeiro, the farm was sold to the French Club Méditerranée (Club Med) in 1986 for the construction of the Village Rio das Pedras at Praia Grande. Since then, the sharecroppers who planted the bananas and provided half of their production to the owner of the farm as payment for their occupation and use of the land became ranchers and have been paid indemnity to vacate the area.

As the property of Club Méditerranée, the Rio das Pedras Reserve was created in 1992 with the intention of preserving the Atlantic Forest from hunters and palm tree harvesters, in addition to providing ecological tours for its guests through the implementation of ecotourism in its trails [16]. Although Méditerranée Club intended to transform the area into a private natural history reserve, it was not officially included in this type of conservation unit. Many of the ranchers, who were sharecroppers before the implementation of the

Reserve, were compensated and left the region. However, there are still nine families that reside in the Reserve, mostly since birth (91%, with 11 men and 12 women in total), and they continue planting bananas as a form of subsistence.

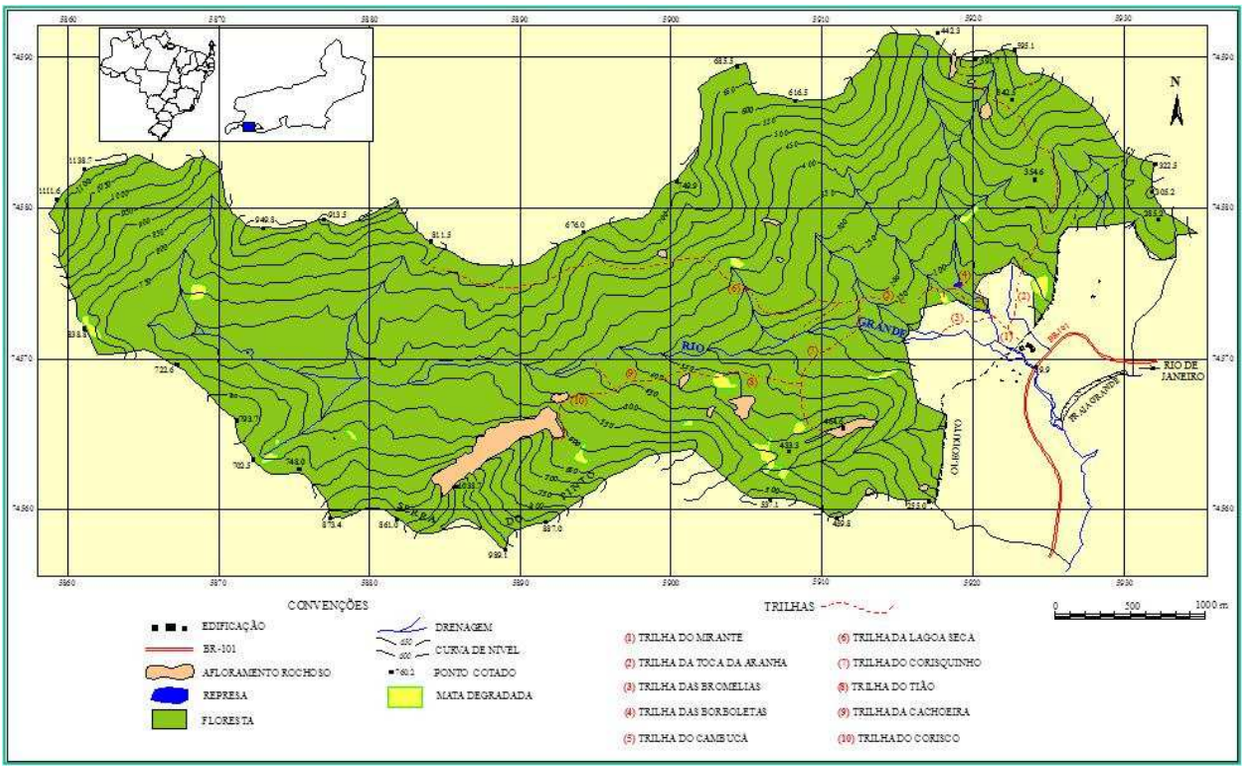

Figure 1. Location of the Rio das Pedras Reserve, Mangaratiba, RJ. Modified from a previous publication [17].

The ranchers from the Reserve are concentrated into two distinct areas: one where six families reside, with houses structurally made of bricks, and the other represented by three families who live in wattle and daub houses. There is no sewage system or electricity, and food is cooked using a wood stove. Water from the waterfall is transported to the houses through PVC pipes, but bathing occurs at the source of this water. The garbage produced is at times incinerated near the homes, as there is no specific location for this practice. Basic provisions, such as salt and sugar, are acquired in the supermarkets of Mangaratiba.

The banana cultivation is performed by the adults who receive R $3.00 to R $4.00 per box, comprising two to three bunches of bananas, and two of the individuals work in the Reserve, one as a guide and the other as a gardener.

2.2. Collection of data and botanical material

Field expeditions were conducted over one year and five months between November 1999 and August 2001 in the Rio das Pedras Reserve. During this period, the fieldwork was accomplished by visiting all of the resident ranchers in the area of the Rio das Pedras Reserve and included participant observation, the application of the free-listing technique, interviews, and guided tours. At the beginning of the study, the members of the community

were informed about the purpose of the work proposed and were invited to participate in the study.

The free-listing technique helped with the initial approach of the research subject in which each collaborator was invited to list the medicinal plants for which they had knowledge/use. After this first survey, the key collaborators were intentionally selected because they were the "experts" in the use of plants with therapeutic purposes; these key collaborators had cited the largest number of plants during the free listing. A sample group composed of six collaborators, with an age range from 37 to 60 years of age, including two males and four females, was then selected.

Individual interviews were conducted to obtain greater detail about each of the plants mentioned in the free listing and with the possibility of other plants being included. Therefore, new meetings were arranged with the key collaborators for structured interviews using direct and closed questions and semi-structured interviews using open questions [18]. These events were focused on obtaining relevant information about the medicinal use of the plants.

At the end of each interview, the medicinal specimens were collected with the aid of the collaborators through a guided tour to the places where the specified plants grow. At this point, new plants could also be incorporated into the list of plants already mentioned during the interviews.

The collected botanical material was identified, herborized in accordance with the usual botanical techniques, and were deposited in the ICBA herbarium of the Santa Úrsula University (Universidade Santa Úrsula – RUSU), with duplicates in the Herbarium of the Botany Department of the National Museum (R), both located in the city of Rio de Janeiro (Brazil).

2.3. Data analysis

The quantitative techniques that were applied examined the importance of each use of plant species according to two principal categories: the total number of uses for each category and taxa and the informant consensus. For the total number of uses, the total number of species and the uses for each family cited by the ranchers were summed, according to a previous report [19]. The techniques included in the consensus among the informants are specified below.

The Relative Importance (RI) emphasizes a plant's importance in relation to its versatility. It was calculated based on the number of properties attributed to a species and the number of organ systems on which this species acts, as follows [20]: RI = NCS + NP, where 2 is the maximum value obtained by a species for RI (Relative Importance); NCS = the relative number of corporal systems, calculated by dividing the number of corporal systems treated by a given species [NCSS] by the total number of corporal systems treated by the most versatile species [NCSV]; and NP = the relative number of properties, calculated by dividing the number of properties attributed to a given species [NPS] by the number of properties attributed to the most versatile species [NPSV].

The therapeutic indications cited during the interviews were grouped by body systems according to the disease categories proposed by the International Classification of Diseases [21]. By means of the consensus of the informants, the importance of a species for a determined purpose and the categories that present greater importance to the ranchers could be obtained by the calculation of the Fidelity level (FL) and from the Informant Consensus Factor (FIC), respectively [19].

The Fidelity Level (FL) is calculated by the ratio of the number of informants that claim a use of a plant species to treat a particular disease (N_p) by the number of informants that use the plant as a medicine to treat any given disease (N), as expressed by the formula: FL(%) = $N_p/Nx100$ [22].

The Informant Consensus Factor (ICF) is calculated as follows: ICF = n_{ur} - n_t/n_{ur} - 1, where 1 is the maximum value of the ICF when there is a complete consensus between the informants; n_{ur} = the number of use-reports in each category; and n_t = the number of taxa used [2].

3. Results and discussion

3.1. Plant resources known/used as therapy by ranchers residing in the conservation unit area

The pharmacopeia of the ranchers is composed of a list of 36 species of plants (Table 1). These species belong to 25 families of which five (Asteraceae, Lamiaceae, Araceae, Moraceae, and Rutaceae) comprise 46% of the total list (Figure 2). The Asteraceae, Lamiaceae, and Rutaceae families are among those with the greatest pharmacopeia representation in various regions of the world and include species with ample occurrence [20, 23, 24]. They also constitute important families from a cultural point of view and in relation to the chemical efficiency of their species; these are factors that, when combined, influence and determine the selection of species for medicinal purposes by the local populations [25].

A poorly differentiated overview can be observed when considering the sum of the medicinal uses for each family. A more significant ranking of families was obtained and included the following: Asteraceae, Lamiaceae, Caricaceae, Araceae, and Crassulaceae (Figure 2). From this perspective, the analysis shows that, although Caricaceae and Crassulaceae present only one cited species, these species are used for more than one medicinal purpose. These families can thus be considered more versatile with regard to the range of therapeutic applications, according to the indications from the ranchers.

Evaluating the medicinal flora in terms of the number of citations per species, the ranchers use a large number of species with only one citation (17 spp.) (Figure 3). Therefore, this fact can be an indicator that there are species with exclusive uses for certain therapeutic purposes, species that are not well known in the community, or even species that face the process of deletion from or insertion into the local pharmacopeia.

Taxon [Family]	Medicinal use	N_p	N	FL
Achyrocline satureioides (Lam.) DC. [Asteraceae]	for toothache during eruption	1	1	100
Alpinia zerumbet (Pers.) Burtt & Smith [Zingiberaceae]	as a sedative	1	3	33
	for high blood pressure	2	3	67
Baccharis trimera (Less.) DC. [Asteraceae]	for stomach ache	2	2	100
	for flu	2	2	100
Bidens pilosa L. [Asteraceae]	for hepatitis	2	2	100
Carica papaya L. [Caricaceae]	for bronchitis	1	2	50
	for flu	1	2	50
	for constipation	2	2	100
	for warts	2	2	100
Cecropia hololeuca Miq. [Moraceae]	for bronchitis	1	1	100
Chamaesyce prostrata (Aiton) Small [Euphorbiaceae]	for kidney stones	2	2	100
Chenopodium ambrosioides L. [Chenopodiaceae]	for a wound	1	5	20
Citrus aurantium L. [Rutaceae]	for flu	1	1	100
Citrus medica var. *limonum* L. [Rutaceae]	for cough	1	1	100
Coffea arabica L. [Rubiaceae]	for headache	1	1	100
Colocasia esculenta (L.) Schott [Araceae]	for anemia	2	2	100
Costus spiralis (Jacq.) Roscoe var. *spiralis* [Costaceae]	for kidney stones	2	2	100
Cymbopogon citratus (DC.) Stapf [Poaceae]	as a sedative	2	3	67
	for high blood pressure	1	3	33
	for flu	1	3	33
Desmodium triflorum (L.) DC [Leguminosae]	for internal inflammation	2	2	100
	for external inflammation	1	2	50
Elephantopus mollis Kunth. [Asteraceae]	for contusion	1	1	100
Eugenia uniflora L. [Myrtaceae]	for flu	4	4	100
Euterpe edulis Mart. [Arecaceae]	for stomach ache	1	1	100
Foeniculum vulgare L. [Apiaceae]	for diarrhea	2	2	100
Gossypium hirsutum L. [Malvaceae]	for internal inflammation	1	1	100
Jacaranda jasminoides (Thunb.) Sandwith [Bignoniaceae]	for itchiness	1	1	100
Kalanchoe brasiliensis Cambess. [Crassulaceae]	for bronchitis	1	3	33
	for flu	2	3	67
	for a wound	2	3	67
Matricaria chamomilla L. [Asteraceae]	as a sedative	1	1	100
Melissa officinalis L. [Lamiaceae]	as a sedative	1	1	100
	for high blood pressure	1	1	100
Mentha x *piperita* L. [Lamiaceae]	for flu	1	1	100
	as a dewormer	1	1	100
Mentha x *villosa* Huds. [Lamiaceae]	for bronchitis	1	2	50
	for flu	2	2	100
	as a dewormer	2	2	100
Musa paradisiaca L. [Musaceae]	for wound healing	3	3	100
Piper mollicomum Kunth. [Piperaceae]	for back pain	2	2	100
Pistia stratiotes (L.) Schott [Araceae]	as eye drops	2	2	100
Plectranthus barbatus Andr. [Lamiaceae]	for the liver	2	2	100

Taxon [Family]	Medicinal use	N_P	N	FL
Schinus terebinthifolius Raddi [Anacardiaceae]	as an antiseptic	1	1	100
Sechium edule (Jacq.) Sw. [Cucurbitaceae]	for high blood pressure	2	2	100
Solanum capsicoides All. [Solanaceae]	for skin boils	1	1	100
Sorocea guilleminiana Gaudich. [Moraceae]	for ulcers (gastritis)	1	1	100
Stachytarpheta cayennensis (Rich.) Vahl [Verbenaceae]	for stomach ache	1	1	100
	for toothache	1	1	100
Vernonia scorpioides (Lam.) Pers. [Asteraceae]	for bronchitis	1	1	100
	for flu	1	1	100
TOTAL: 25 families/36 taxa/28 therapeutic indications				

Table 1. Relationship of the taxa and their respective fidelity level values for medicinal use according to the pharmacopeia of the ranchers of the Rio das Pedras Reserve, in the Mangaratiba municipality, Rio de Janeiro state, Brazil. Legend: N_P = the number of informants that suggested the use of a species for the same purpose; N = the total number of informants that mentioned a plant for any use; FL = the fidelity level.

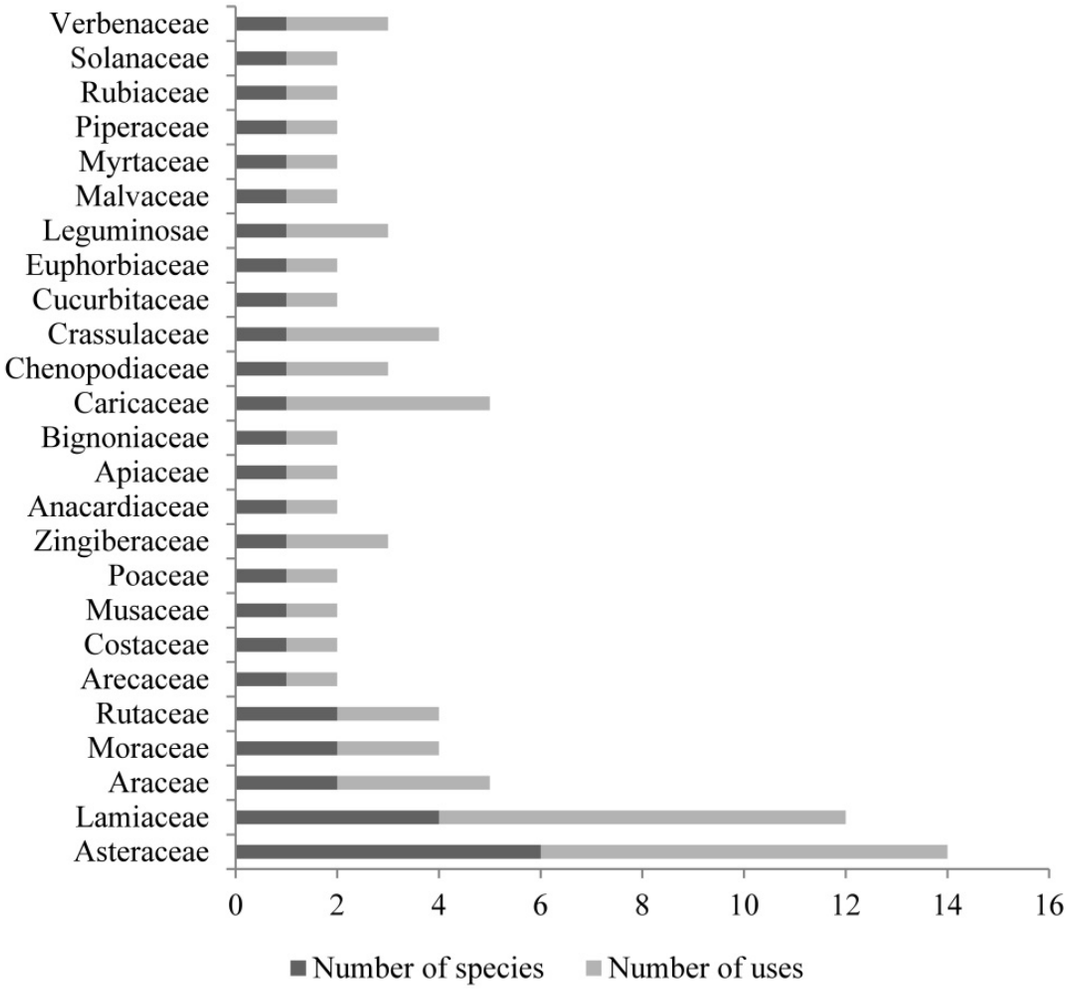

Figure 2. Distribution of the number of species and their respective therapeutic uses for each botanical family of the pharmacopeia of the Rio das Pedras Reserve ranchers, Mangaratiba municipality, Rio de Janeiro state, Brazil.

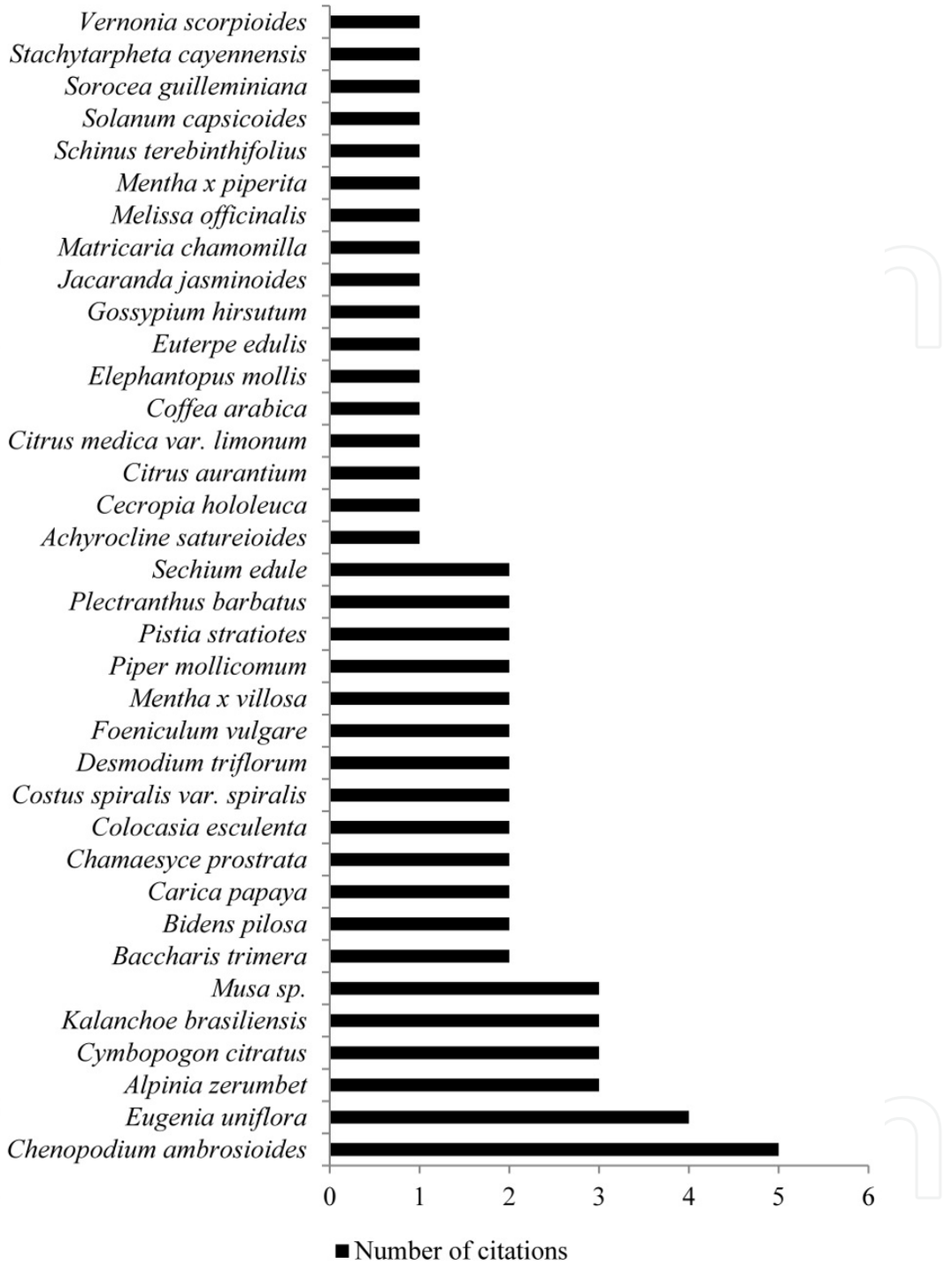

Figure 3. Number of citations per species of the pharmacopeia of the Rio das Pedras Reserve ranchers, Mangaratiba municipality, Rio de Janeiro state, Brazil.

In general, the species used by the ranchers are widely used even in other regions of Brazil, as indicated by such studies as those conducted in the Amazon Basin [26], Roraima State [27] the Maranhão Lowlands [28], Acre State [29], São Paulo State [30-32], Bahia State [33], and Rio de Janeiro State [10, 34]. These data reveal that, although the ranchers geographically inhabit the Atlantic Forest biome, their knowledge/use of species for

medicinal purposes was formed based on the species cultivated in their backyards (around their houses). Furthermore, these plants, which primarily occur in anthropogenic zones, are characterized by species with ample occurrence and distribution in Brazil and have also reached different parts of the world in the most differentiated biogeographic regions of the Americas, Africa, Europe, Asia, and Oceania. Among these, there are some species that are not native to the Brazilian flora yet have a wide distribution in the Brazilian territory, for example, the *Mentha* species, *Citrus* species, *Arabian* Coffea L., *Colocasia esculenta* (L.) Schott, *Cymbopogon citratus* (DC.) Stapf, and *Matricaria chamomilla* L.

However, on the issue of the use of non-native species that have wide geographic distribution in detriment to the native species of Brazil, it is believed that this choice by the ranchers may be a consequence of the involuntary displacement and resettlement process that the families face when they leave the region as the result of the area becoming a conservation unit.

Within this context, the use of species in nearby locations would be adequate due to the lower energy expended for the collection of material and also due to the monitoring of the land use in the region. According to a previous report [35], the decrease in traditional botanical knowledge is related to the distancing of human populations from areas of native vegetation, which, in a way, is similar to the reality experienced by the ranchers, given that they were no longer able to move freely around the preserved forest areas.

Another factor to be considered is the proximity of the ranchers to the urban center of the city of Mangaratiba. In this sense, a previous report [36] affirms that it would not be the proximity to the native vegetation that would interfere with the knowledge and use of medicinal plants but the social factors, such as the proximity to urban centers, which would exert a negative influence on the knowledge and utilization. According to these authors, a proximity to urban centers permits a greater offering of western, academic medicine, which competes strongly with the use of plant resources and leads to the reduction of their use by traditional communities.

3.2. Triangulation of quantitative techniques as a tool to determine the relative importance of the plants used in traditional therapy

The medical system of the ranchers is composed of 28 therapeutic indications. The main therapeutic indications, i.e., those that constitute the greatest wealth of referred plants, are the use of plants for the flu and for bronchitis (Table 1). These medicinal applications are also among the main applications in certain previous studies [37-39].

The evaluation of the fidelity level (FL) showed that the species that obtained 100% agreement among the informants with regard to their use add up to 74%, which is equivalent to 39 reported uses for 30 species (Table 1).

Four species showed great versatility with regards to their use, with RI > 1; these plants are indicated for as many as four organ systems: *Carica papaya* L., *Cymbopogon citratus* (DC.) Stapf, *Kalanchoe brasiliensis* Cambess., and *Mentha x villosa* Huds. (Table 2). The use of these species also occurs in other locations, as is shown, for example, by the study of popular

medicine [40] in the municipality of Rio Claro, State of São Paulo in which the authors cited the use of the male papaya (*Carica papaya* L.) against cough, flu, and catarrh.

Taxon	NCSS	NCS	NPS	NP	RI
Carica papaya	4	1	4	1	2
Cymbopogon citratus	3	0.75	3	0.75	1.5
Kalanchoe brasiliensis	3	0.75	3	0.75	1.5
Mentha x *villosa*	3	0.75	3	0.75	1.5
Alpinia zerumbet	2	0.5	2	0.5	1
Baccharis trimera	2	0.5	2	0.5	1
Chenopodium ambrosioides	2	0.5	2	0.5	1
Esculenta Colocasia	2	0.5	2	0.5	1
Desmodium triflorum	2	0.5	2	0.5	1
Melissa officinalis	2	0.5	2	0.5	1
Mentha x *piperita*	2	0.5	2	0.5	1
Stachytarpheta cayennensis	2	0.5	2	0.5	1
Vernonia scorpioides	2	0.5	2	0.5	1
Achyrocline satureioides	1	0.25	1	0.25	0.5
Pilosa Bidens	1	0.25	1	0.25	0.5
Cecropia hololeuca	1	0.25	1	0.25	0.5
Chamaesyce prostrata	1	0.25	1	0.25	0.5
Citrus aurantium	1	0.25	1	0.25	0.5
Citrus medicates to var. *limonum*	1	0.25	1	0.25	0.5
Arabian Coffea	1	0.25	1	0.25	0.5
Costus spiralis to var. *spiralis*	1	0.25	1	0.25	0.5
Elephantopus mollis	1	0.25	1	0.25	0.5
Uniflora Eugenia	1	0.25	1	0.25	0.5
Euterpe edulis	1	0.25	1	0.25	0.5
Foeniculum vulgare	1	0.25	1	0.25	0.5
Gossypium hirsutum	1	0.25	1	0.25	0.5
Jacaranda jasminoides	1	0.25	1	0.25	0.5
Matricaria chamomilla	1	0.25	1	0.25	0.5
Paradisiacal muse	1	0.25	1	0.25	0.5
Piper mollicomum	1	0.25	1	0.25	0.5
Pistia stratiotes	1	0.25	1	0.25	0.5
Plectranthus barbatus	1	0.25	1	0.25	0.5
Schinus terebinthifolius	1	0.25	1	0.25	0.5
Sechium edule	1	0.25	1	0.25	0.5
Solanum capsicoides	1	0.25	1	0.25	0.5
Guilleminiana Sorocea	1	0.25	1	0.25	0.5

Table 2. Values of the relative importance of each taxon used as medicine by the ranchers of the Rio das Pedras Reserve, Mangaratiba municipality, State of Rio de Janeiro, Brazil. Legend: NCSS= the number of corporal systems treated by a given species; NCS = the relative number of corporal systems; NPS = the number of properties attributed to a given species; NP = the relative number of properties; RI = the relative importance.

The organ systems that these plants act upon were observed by analyzing the contribution of plant species with regard to the functionality of the pharmacopeia of the ranchers. The medicinal species treat diseases grouped into eleven organ systems. Among these systems, six are the main systems with regard to the number of species cited: respiratory system disorders, infectious and parasitic diseases, digestive system disorders, skin and subcutaneous tissues diseases, nervous system disorders, and circulatory system disorders (Table 3). In a study conducted in the municipality of Barra do Piraí, Rio de Janeiro State, reference is made to plants used in rituals, for flu symptoms, and skin and healing problems as the most representative therapeutic indications in terms of the number of species [41]. In a study conducted in Santa Maria, Rio Grande Do Sul State, the flu, digestive problems, and anti-inflammatory uses are the most common indications [42]. In the semiarid region in Northeastern Brazil, a significant number of plants are also used to treat health problems, including circulatory, digestive, and respiratory disorders of organ systems [43-45]. Given that a larger number of species are used for the treatment of flu, bronchitis, skin diseases, and digestive system conditions, there is agreement between the present work and those by the above-mentioned authors.

According to the Informant Consensus Factor (ICF) in terms of the medicinal potential of the species cited by the ranchers of the Rio das Pedras Reserve, the organ system with the most consensus was related to respiratory system disorders (Table 3). Therefore, the results of the ICF point to this medicinal category as the one that the informants are the most confident about. All of the other categories obtained the minimum values expected, as the number of species was equivalent to the uses. In a previous study [44] in which the same index was calculated, respiratory diseases are also among the main disease categories.

Organ system	n_t	n_{ur}	ICF
Respiratory system disorders	11	15	0.29
Certain infectious and parasitic diseases	8	8	0
Diseases of the blood and hematopoietic organs	1	1	0
Nervous system disorders	5	5	0
Sensory system disorders [eyes]	1	1	0
Circulatory system disorders	4	4	0
Digestive system disorders	7	7	0
Skin and subcutaneous tissue diseases	7	7	0
Osteomuscular and connective tissue diseases	1	1	0
Genitourinary disorders	2	2	0
Injuries, poisoning, and other consequences of external causes	3	3	0

Table 3. Consensus for the therapeutic use of plant species among the ranchers of the Rio das Pedras Reserve, Mangaratiba municipality, Rio de Janeiro state, Brazil. Legend: n_{ur} = the sum of uses recorded by each informant for a category; n_t = the number of species indicated in the category; ICF = the informant consensus factor.

4. Conclusion

The ranchers have a knowledge of plant resources that point to a wealth of species that are mostly considered to be non-native to the biome in which they were found: the Atlantic Forest. These plants are generally collected in backyards, which can reinforce the importance of the environment upon the selection criteria of the species in a pharmacopeia. Moreover, when analyzing the list that compiles the pharmacopeia of the ranchers, another factor to be considered is the cultural influences that, throughout the history of this people, many have contributed to the adaptation of their pharmacopeia to the conditions in which they now live, after the creation of the conservation unit.

Considering the triangulation of quantitative techniques, it is important to emphasize that these analyses do not substitute for the careful qualitative analysis conducted with the ranchers from the Rio das Pedras Reserve, but they helped to demonstrate that *Carica papaya* L. is a species with the most effective pharmacological potential because it reached the maximum value for relative importance. With regard to the fidelity level, a large part of the indicated uses for each species achieved the maximum expected value.

The plants used by the ranchers that are included in the respiratory disease category, which is the category that obtained the greatest consensus with regard to use among the informants, are the species that deserves a proper pharmacological study. The following species fit into this category are: *Baccharis trimera* (Less.) DC., *Carica papaya* L., *Cecropia hololeuca* Miq., *Citrus aurantium* L., *Citrus medica* var. *limonum* L., *Cymbopogon citratus* (DC.) Stapft, *Eugenia uniflora* L., *Kalanchoe brasiliensis* Cambess., *Mentha* x *piperita* L., *Mentha* x *villosa* Huds., and *Vernonia scorpioides* (Lam.) Pers..

Finally, because of the value that such information held by the local populations about the plant kingdom represents for humanity, it is suggested that the application of quantitative indices will contribute to a deeper analysis and identification of new inferences in ethnobotany. This research highlights the importance of local perceptions and knowledge as potential information that can contribute to future applications and, therefore, as a new source of medicines from natural products.

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