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Dynamics of knowledge and the biocultural heritage of indigenous people in the Amazon

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ABSTRACT

In this ethnobotany study carried out in the Tenharim indigenous territory, located in the interior of the State of Amazonas, Brazil, it was verified, through interviews, the rich biocultural heritage of this indigenous people, which uses hundreds of plant species for different purposes, such as medicinal, food, crafts, firewood, tools and buildings in general. The objective of this study was to survey the knowledge that the Tenharim have about the existing vegetation in their territory, and how this information is transmitted. The wide variety of registered plant species demonstrated that the use of plants is very comprehensive. This biocultural heritage is held collectively, and the survival of knowledge depends on the quality of communication. The knowledge acquired by the ancients continues to be transmitted to new generations orally and, more recently, through writing, guaranteeing the maintenance and preservation of traditional Tenharim culture.

Keywords: indigenous, Amazon rainforest, ethnobotany, biocultural heritage

1. INTRODUCTION

Traditional ecological knowledge is a knowledge system that reflects the adaptation of human populations to their environments. Throughout history, human beings have accumulated information about the environment that surrounds them, and this collection was based on the constant and systematic observation of phenomena and characteristics of nature and the empirical experimentation of these resources [1].

Ethnobotanical studies have focused on documenting the role of particular plants in traditional human cultures. These studies generally only include species relevant to traditional peoples. The exact numbers of these species are not known, nor do traditional populations know the total number of these species, as the dynamics of knowledge depend on the importance of plant species, the abundance and frequency of distribution in their natural habitat, the level of interest and the quality of the passing of information between generations [2, 3].

The cultural significance of a plant species can be defined as the importance of its role in a given culture [4]. Plants that are used by traditional people, such as indigenous and quilombola populations, whether as food, medicines, in making handicrafts and religious objects, or in some other way, or even those not used, must be considered important to that culture. "Furthermore, the more widely or intensively a plant is used, the greater its cultural significance" [5].

The cultural significance of anything varies in quality, intensity, and exclusivity, and these factors must be considered in assessing the importance of a plant species. The cultural significance can change over time.

A certain plant species, which has been used by many people for many years, may, at a given time, be known by few people or simply have been forgotten. Furthermore, individual variation in the perception of the cultural importance of a plant species must also be considered, that is, a certain plant species can have significant importance for a person in a community, due to exclusive use and at the same time being unknown to most of the population of that same community. In indigenous populations, for example, herbal specialists recognize and use a wider variety of medicinal plants than the population at large. Hunters, shamans, extractivists, artisans, and others all may have particular and restricted knowledge about certain plants. Therefore, in some cases, such plants may have greater cultural importance than the population at large might realize. "Hence, even plants known to few members of a culture must be considered significant" [5].

The use of plants by traditional communities may be linked to the availability of these species, which is directly related to a physical distance from the home or village, seasonality, and abundance. Therefore, most available plants tend to be more used by people, and thus, susceptible to being incorporated into the local culture, i.e., increasing a given species' abundance implies an increase in its local relative importance [6].

"Rare plants, or plants that are hard to gain access to because of their remoteness to the centers of living, do not necessarily have low cultural significance, but they must usually possess other important or distinctive features that offset their low availability". Some factors may influence the cultural significance of a plant species: recognition, lexical marking, and reputation.

"The reputation of a plant, the extent of its recognition, naming, and use by other, neighboring cultural groups is a long-term outcome of its cultural significance". Transmission of information about a given plant species is a result of its level of importance, and therefore, a plant species of great importance must be one known by a greater number of people [5].

2. MATERIALS AND METHODS

Location of the indigenous territory covered in this study.

The indigenous group studied is the Tenharim. Tenharim is the name given by non-indigenous peoples to one of several Kagwahiva indigenous groups that live in the extensive basin of the Madeira River, in the Amazon biome. These groups, even though they live in geographically distant regions, recognize themselves as Kagwahiva and have in common, the Tupi-Kagwahiva language [7].

The indigenous territory contemplated in this study is that of the Marmelos River group (*Ytyngy'hu*), formed by ten villages. In the past, before the opening of the Transamazônica highway (BR-230), they lived together in a single village on the banks of the Marmelos River, in the area where the Transamazônica highway currently crosses the river [7]. Following the very social dynamics of fusion and fission of groups, there was a process of emergence of new villages. All of them were built where there were ancient villages. The legal situation of this indigenous land is consolidated since its regularization process was completed with its homologation on January 05, 1996 [8].

The Tenharim Marmelos Indigenous Land has an official area of 497,521 hectares and is located entirely in the State of Amazonas, in the municipalities of Humaitá and Manicoré, between geographic coordinates 7°48' and 8°53' south latitude and 61°35' and 62°10' west longitude (Figure 1).



Figure 1. Localization of the Tenharim Marmelos Indigenous Land.

According to the sensing carried out in this study, through information collected in the villages, the Tenharim Marmelos Indigenous Land counted, in November 2014, had 710

indigenous people, distributed in eight villages located on the banks of the Transamazônica highway: Vila Nova, Marmelos, Bela Vista, Trakuá, Kampinhu, Taboka, Mafuí and Kastanheira and two villages located on the Estanho highway: Jakuí and Karanaí.

Characterization of the landscape in the study region

The Tenharim Marmelos Indigenous Land is inserted in the Amazon biome, with the following ecosystems: Open Ombrophilous Forest with vines in the northwest portion; Dense Ombrophilous Lowland Forest with emergent canopy associated with Submontane Open Ombrophilous Forest with palm trees in the north and midwest portions; Submontane Dense Ombrophilous Forest with emergent canopy in the northeast portion; Contact Savannah with Ombrophilous Forest associated with the Open Ombrophilous Lowland Forest with palm trees and Forested Savannah in the central and south-central portions following the Marmelos River from its headwaters to the vicinity of the Transamazon Highway; Savannah Park with gallery forest associated with the Wooded Savannah with gallery forest in the southern and central-eastern portions [8].

The Dense Ombrophilous Forest is characterized by phanerophytes, in addition to vines and epiphytes in abundance. Its main ecological feature resides in the rainforest environments that greatly mark the “floristic forest region”, with large trees, often over 50 meters in height, which stand out in the uniform arboreal stratum, between 25 and 35 meters in height. The Open Ombrophilous Forest has a forest physiognomy composed of more widely spaced trees, with a low-density shrub layer and frequent groups of palm trees, such as babassu (*Attalea speciosa*) in the interfluves and buriti (*Mauritia flexuosa*) in the valleys [8-12].

The Forested Savannah has a predominance of woody vegetation, with a maximum height of 20 meters, and crooked trunks with irregular branches. The Wooded Savannah is characterized by a sparse shrubby physiognomy and continuous herbaceous layer, with a floristic composition similar to the Forested Savannah, but with dominances that characterize the environments. Savannah Park consists of a herbaceous layer with isolated trees up to 5 meters high [8].

Use and occupation of Indigenous territory.

The modes of use and occupation of the indigenous land by Tenharim cover various aspects of the group's modes of social organization and are expressed through knowledge of the indigenous area based on its social, economic, political, and socio-cosmological classification. This classification ends up permeating the various spaces that makeup what is now known as the Tenharim Marmelos Indigenous Land.

The Tenharim distinguish different physical spaces in the landscape, and each of these units allows the manifestation of different techniques for the use and management of natural resources. The main unit, as it is the most representative of the landscape and source of much of the resources, knowledge, and traditions of the Tenharim, is the forest, known in the Tupi-Kagwahiva language as *ka'gwyra*. “The forest is the main provider of the Tenharim life, with the imaginary intrinsically linked to the animals, trees, and entities that inhabit it” [13].

Other subdivisions fit into the view of the Tenharim over the forest, determined not only by physiognomic aspects of the vegetation, such as natural fields or forests but also by cultural aspects, which end up implying different uses or handling. In this line, *ka'gwyrahuhava* is part of the forest where a lot of time is spent [14], located close to each village, where hunting,

fishing, fruit, and medicinal plant gathering activities are practiced. Generally speaking, it is the part of the forest inhabited and used by the Tenharim.

Ka'gwyrauhava is crisscrossed by numerous paths and trails that lead to the main points of interest of Tenharim, such as places with fruit trees, mud pits, chestnut groves, old villages, and gardens, cemeteries and especially to the Marmelos river, which provides the reference base for the construction of a spatiality within the Tenharim Marmelos Indigenous Land.

In contrast, there is the virgin forest or large forest, known as *ka'gwyrauhu*, which is beyond the daily use of the Tenharim, since “contact” happens “only during festivals”, notably in *Mboatawa*, when hunters look for places rich in fauna, as a way to look for food to be used in the party [7]. *Ka'gwyrauhu* is considered “the management plan”: “*It's virgin forest there. We only go there to get our food. It's for nature to reproduce there*” (D. Tenharim, 55 years old, ♂, Vila Nova village, November 19, 2014).

Some forests are under the influence of river floods, known in the Amazon as Igapó Forest. These are partially flooded in the rainy season (*ypopeva*). The igapó is very frequented during the flood season for fishing activities, as many fish enter these flooded forests in search of food.

With physiognomic characteristics completely different from the forest, there are natural fields of savannah called *nhuhũ*, which, in addition to being easily differentiated in the landscape, provide the practice of other activities and knowledge.

The clearing of the forest also makes possible other uses of the land, but, mainly, the institutionalization and organization of social life. In this logic is the grouping of family nuclei in different villages, each with its dwellings, fields, and extensions that penetrate the forest, such as the chestnut groves.

The swiddens, called *koho*, are the ideal places for the cultivation of different plant species, mainly edible ones. The dwellings, on the other hand, are composed of houses, called *onga*, and the open and clean space around it, called *okara* (yard), where medicinal herbs and trees are planted, mainly fruit trees and/or for shade and shelter for domesticated animals. However, it is not just the set of houses and yards that make up the village. Asked what the spatial limit of the village would be, one interviewee replied: “*It is the black earth. The roça is part of the village. Mata is no longer part of the village, it belongs to everyone, they use it for hunting and fishing (nhande ka'a gwyra)*” (J. Tenharim, 76 years old, ♂, Taboka village, November 09, 2014).

The old swiddens, which without maintenance were taken over by regenerating secondary vegetation, becoming capoeiras, indicate the ancestral use of the land by the ancients, being called *kohogwera*. Interesting to note that *gwera* is defined as something, state, or action that existed, but stopped, leaving only a trace of its form [14]. In the case of old swiddens, these vestiges are recognized through certain species of plants and animals that only occur in these places.

Therefore, the capoeiras are seen not as an initial stage of regeneration of the natural forest, but as ancient gardens of the ancestors, established in places of terra preta with rich soil and conducive to cultivation, which can be resumed at any time in case of need. They also act as food deposits, both for tubers and fruit species, which continue to be produced for many years [3].

The Tenharim Marmelos Indigenous Land is located in a well-preserved region of the Amazon Rainforest, and the cultivation and extraction practices of the indigenous people have not caused damage to the natural environment.

Data collection

The studies in the Tenharim Marmelos Indigenous Land were carried out in November 2014, after authorization by the Tenharim and FUNAI (Indigenous Communities and National Indigenous People Foundation, a Brazilian governmental protection agency for Amerindian interests and their culture). People of different ages and genders from all villages were interviewed. The choice of the interviewees took place with their indication in the villages based on knowledge about plants.

Fifty-four indigenous people were interviewed, through individual dialogues and in groups (workshops), usually on walks through the forest, with the indication of the plants, their uses, and their importance for the Tenharim culture. Plant materials such as leaves, flowers, and fruits were photographed for later identification through comparison in herbariums.

The ages of interviewees varied, with the youngest being 14 years old and the oldest 95. Just under 42% of interviewees were over 50 years old, 32% were between 30 and 50 years old and 26% were under 30 years old. It was observed that some children and teenagers who followed the walks through the woods, listened attentively to the information that the adults were passing on about the uses of plants and some knew the names of plants and their uses, which shows their interest in the subject and which information is transferred.

At the end of each interview, the interviewee was asked to indicate the names of people they thought they knew about the subject related to plants, to build the social network and carry out the next interviews. This sampling technique, known as “Snowball” is used in the creation of social networks, where it is possible to observe the levels of communication and interaction between people [15].

The information collected in the interviews is presented in this text, followed by the informant's data, in a generic way, for example, (D. Tenharim, 28 years old, ♀, Mafuí village), to avoid any kind of embarrassment. A textual transcription (without alterations) of the interviews and the translations of the testimonies given by some elders in the Kagwahiva language was carried out.

Some names of the plants in the Kagwahiva language were kindly spelled by interviewees during the research and checked in the Kagwahiva Dictionary [14]. Confirmation of the spelling of the scientific names was obtained by consulting the plant species index on the Flora Brasiliensis project website [16]. The botanical classification system adopted was the APG IV [17]. It is a modern taxonomic classification system for flowering plants (angiosperms), essentially based on molecular phylogeny studies, developed by the Angiosperm Phylogeny Group.

The plants were classified into the following categories of use, according to information from the indigenous people:

- Leaves, bark, inner bark, sap, resin, roots, seeds, fruits and flowers for medicinal use;
- Seeds, fibers, and wood for making crafts and dyes for body painting;
- Fruits and seeds for food;
- Wood for building construction, manufacturing of household utensils and firewood;
- Leaves for covering houses.

The evaluation of the cultural significance of plants in ethnobotanical studies is an essential step in various types of investigations, including research on lexical retention of plant names in diverging languages, trade, material exchange between groups, subsistence strategies,

and folk classification. An Index of Cultural Significance (ICS) was used, based on ethnobotanical data from this study, adapted from the index used by Turner [5], using the formula $ICS = \sum (C \times P \times F) \times CF$, where C = use categories of the species, with a value of 2 for species present in three or more use categories and 1 for species present in one or two categories of use; P = use preference, with a value of 2 for species preferentially used for a given proposal, prioritized in relation to others available and 1 for species not preferentially chosen for a given purpose; F = frequency of use, with a value of 2 for widely used and well-known species, listed among the ten most cited for certain purposes, and 1 for little-known species; and CF = correction factor, whose value is the number of citations of a given species divided by the number of citations of the most cited species.

The plants were characterized on three value scales: high, moderate, and low cultural significance. These scales are better than no attempt to gauge cultural significance, however, even those species judged to be "culturally insignificant" can be shown to have some significance.

The more "use" requirements are directed toward a specific type of plant, the greater its importance. Thus, a plant species that is sought specifically for the specific treatment of disease should be considered of greater significance than one used for the same purpose because it is there and could be easily replaced by another kind.

For a given plant taxon, the index is a composite of a wide variety of potential applications of a plant, ranked according to the contribution of each separate application to survival in traditional culture in the study, together with estimates of intensity and exclusivity of use for each.

3. RESULTS AND DISCUSSION

When asked an interviewee about the relative importance of plants in the traditional life of Tenharim, the answers were generally linked to their activities, with diverse answers, depending on the species, for the artisans, the house builders, the extractivists, or the herbal specialists. Some plants of obvious traditional significance were omitted in some accounts, though when asked about them often recognized their importance.

How knowledge is acquired and spread

Human beings take from their environment what they need and, in the case of collection, assume that they have knowledge and mastery of the species. Mastery of the environment is only possible thanks to the culture that designates the savoir-faire set of practices, knowledge, attitudes, and ideas that each individual receives, internalizes, modifies, or elaborates during their existence [18].

Traditional knowledge can contribute to maintaining the biodiversity of ecosystems. In numerous situations, this knowledge is the "result of a co-evolution between societies and their natural environments, which allows the conservation of a balance between both" [19].

Knowledge of the properties of plants for certain uses and the complex relationships that exist between the indigenous people and nature are not passed on or learned systematically and formally among the Tenharim. Apparently, there has to be some interest in acquiring such knowledge and most of the interviewees said they had learned about the "bush remedies" from

their parents and grandparents: “*Before he died, my grandfather passed on the information to me*” (I. Tenharim, 45 years old, ♂, Karanaí village, November 21, 2014).

“The knowledge came from our ancestors [...] There are people who have to study a lot with their relatives, to research and learn, to get to know the plants. Our children, not all of them know. That's why you have to hang out with the old people, the traditional ones, to find out what fruit it is, what it's for [...]. Those who commit themselves have a greater chance of having more knowledge. Many things I learned from my grandfather, from my father. If you don't care, things will get lost... In twenty or thirty years, people will ask me and if I didn't care about my culture, I won't know how to answer [...]. Each plant has its own resistance organism in each place. And each place... There are places where it works more naturally, to develop and there are places where it doesn't [...]. Very rare plants have to be taken care of more because if you don't take care of them they become extinct [...]. When mothers don't care, children don't learn. They only learn when mothers teach. But we, we got together to talk to these mothers [...]. It is important today to study, but you also have to be together, with your own mind, listening and teaching about our origin, our customs and also knowing the customs of the white people” (M. Tenharim, 52 years old, ♀, Mafuí village, November 07, 2014).

Likewise, dominance over other productive activities such as hunting, fishing, and farming can only be reproduced between generations with the appropriate transmission of management techniques. These, occur, depending on the appropriate physical space, such as the existence of a forest with its wealth of natural resources, the interest of the apprentice, and the wisdom of the “instructor”.

One of the Tenharim leaders (C. Tenharim, 74 years old, ♂, Marmelos village, November 10, 2014), possessing an incredible knowledge of the relationships between plants and animals, presented songs of various animals and their respective stories, rich in fantasy and poetic touches, emphasizing many times the diversity of the mysterious forest. According to some interviewees, the plants that the Tenharim know and use were the birds that indicated:

“The tangara *pyainhi* [a species of bird] has a strong shaman. And if he has a disease, he will seek the cure. He lives at the head of the Marmelos and is black with blue stripes. He is the one who tells where the medicine is and points with his beak where the medicine is. It was he who recommended *tymoatã* [Senna sp]. Each bird indicated a type of food. The juriti [*Leptotila* sp] gathered the birds that taught the Tenharim what to eat. The macaw indicated the flour” (J. Tenharim, 76 years old, ♂, Taboka village, November 09, 2014).

Knowledge transfer was also a theme investigated in this study. Many children and adolescents know the names of the main plant and animal species and their biotic interrelationships, but the mythical interrelationships are preserved only among the elderly.

Ethnobotanical knowledge is also present in the daily life of the children who live in these villages, who know most of the plants used as medicine and in food.

The oldest ones are, currently, the best references and the greatest holders of the traditional Tenharim knowledge. In this sense, the main interlocutors designated to deal with plants with medicinal properties, in addition to other subjects such as hunting and gardening, were, for this study, the oldest. A Tenharim figure with knowledge about medicinal plants and healing processes was the pajé or pajywegá, who no longer exists among the Tenharim. In this way, one of the main sources of the traditional knowledge of the Tenharim disappeared and new illnesses, such as tuberculosis, acquired after contact with non-indigenous people, remained untreated.

“My father's grandfather was the last shaman of the Tenharim. After him, there was no other shaman. His name was *Ukareju*. It is not by the person's will that he becomes a shaman, the shaman is as if he were appointed [...]. The shaman sees everything. Just like God. God, he knows everything, right? Because the shaman... the shaman was like the sorcerer. He was like that... half good, half bad. I don't know how to explain this, I don't have much knowledge [...]. In fact, each village had one, two, or three shamans. There were also two brothers... Here in Taboka, there was a shaman, who was my father's grandfather. *Ukareju* was one of the shamans. He had it on my mother's side too, my mother's grandfather was also a shaman. On the other side, there was also... They got along well with each other. They were older, and then they passed it on to their children [...]. My father's grandfather didn't pass it on to my father because the shaman is usually like that, the shaman generates the person. He passes on his teachings even when the child is in the woman's womb. So, he is born with the teaching. He already comes with the power of a shaman [...]. As he grows up, he gets his power. So, the shaman generates another shaman [...]. The shaman's thinking is divided: into good and evil. He pleases the person and at the same time, he displeases another, with whom he doesn't get along, right? [...] The shaman ended because he pleases the person and at the same time, he displeases another, with whom he doesn't get along, right? [...] The shaman ended because He pleases the person and at the same time displeases another, with whom he doesn't get along, right? [...] The shaman ended, because he had no chance to resist, had no chance to resist. One went to live in a place, the other in a place and there was no way for one to resist the other [...]. The end of the strength of the shaman, besides him there was his spirit that gave him strength. In addition to the spirit, some people supported him [...]. These people were dying, those who gave him strength and he weakened [...]. The shaman was very good for us, he made medicine, but he also did spells [...]. In the old days, the shaman called all the animals to sing and heal people” (J.C. Tenharim, 33 years old, ♂, Taboka village, November 10, 2014).

The most important plant species

Among the forms of life considered, trees seem more available, and thus more used, especially in traditional medicine, than shrubs and other smaller life forms. Of the 180 plant species cited by Tenharim as having some cultural importance, 106 species (around 60% of the total) are trees. Afterward, the most important forms of life were herbs and vines, with 20 species each, 15 species of palm trees, 13 species of shrubs, one epiphyte, and five species that it was not possible to identify. Table 1 lists the 50 most important plant species for the Tenharim, according to the Index of Cultural Significance (ICS).

Table 1. List of the 50 plant species most important plant species for Tenharim, and their respective Index of Cultural Significance (ICS).

Species	Portuguese name	Tenharim name	Forms of life	ICS
<i>Attalea speciosa</i>	Babaçu	<i>Indatau, Indatahu, Datauhu, Pindoeté</i>	Palm tree	8,00
<i>Bertholletia excelsa</i>	Castanha-do-pará	<i>Nhayva, Nhahã'yva, Ñayba</i>	Tree	6,89
<i>Euterpe oleracea</i>	Açaí	<i>Jygy'vauhua</i>	Palm tree	6,67
<i>Astrocaryum aculeatum</i>	Tucumã	<i>Yvahua</i>	Palm tree	5,56
<i>Hymenaea courbaril</i>	Jatobá	<i>Jutayva, Jutapevi</i>	Tree	4,89
<i>Copaifera multijuga</i>	Copaíba	<i>Mbakupa'yva</i>	Tree	4,67
<i>Genipa americana</i>	Jenipapo	<i>Nhandypava</i>	Tree	4,00
<i>Mauritia flexuosa</i>	Buriti	<i>Juzy'viuhua</i>	Palm tree	3,56
<i>Heteropsis flexuosa</i>	Cipó-titica	<i>Ipoeté</i>	Vine	3,11
<i>Mezilaurus itauba</i>	Itaúba	<i>Agwarayva'yva</i>	Tree	3,11
<i>Couma guianensis</i>	Sorvão	<i>Turua, Turuete, Jugwa, Iwyhyga, Turuwa, Juvaywa</i>	Tree	2,67
<i>Philodendron goeldii</i>	Cipó-imbé	<i>Ambé</i>	Vine	2,22
<i>Theobroma speciosum</i>	Cacauí	<i>Kakawi, Yvitawy, Nhumbytahuma, Nhumbitá</i>	Tree	2,11
<i>Aspidosperma carapanauba</i>	Quina-quina	<i>Yvapopema</i>	Tree	2,00
<i>Himatanthus sucuuba</i>	Sucuúba	<i>Sukuuba, Yravadigauhu</i>	Tree	2,00

<i>Endopleura uchi</i>	Uchi-liso	Wichi, Manduuwa, Manuva	Tree	1,89
<i>Parkia multijuga</i>	Paricá	Yuruarapé, Iwyruwapéuwa	Tree	1,89
<i>Virola multicostata</i>	Sangue-de-dragão	Ajuwari apuranga	Tree	1,89
<i>Brosimum parinarioides</i>	Amapá	Bururehu, Ywapiraçu	Tree	1,78
<i>Costus spiralis</i>	Cana-do-brejo	Bokaja, Tukajara	Herb	1,67
<i>Oenocarpus bacaba</i>	Bacaba	Pindovay	Palm tree	1,67
<i>Abuta grandifolia</i>	Bota	Yrovuhu, Yrovyhu, Dyrobohy, Irawohu, Yroruhu, Yrouwu, Yrauhu, Wyrāju, Wyrohu	Vine	1,44
<i>Bixa orellana</i>	Urucum	Urukua	Shrub	1,44
<i>Attalea maripa</i>	Inajá	Indaja, Indaja iva	Palm tree	1,33
<i>Lecythis pisonis</i>	Sapucaia	Jirima	Tree	1,33
<i>Duckesia verrucosa</i>	Uchi-coroa	Gogorana, Tapenha pégua, Tapunha Pygwa, Wichi kuru	Tree	1,28
<i>Virola calophylla</i>	Sangue-de-dragão	Nhimbitaywa, Joroai wapuaña, Imamu hueté	Tree	1,06
<i>Caryocar villosum</i>	Pequiá	Agwahia, Peki'auhua	Tree	0,94
<i>Senna multijuga</i>	Pau-cigarra	Tapehi, Tapevy, Topehya, Topeiija	Tree	0,89
<i>Andira micrantha</i>	Sucupira	-	Tree	0,67
<i>Oenocarpus bataua</i>	Patauá	Pindowahu	Palm tree	0,67
<i>Apeiba echinata</i>	Apeiba	Apeyba	Tree	0,56
<i>Cedrela fissilis</i>	Cedro-rosa	-	Tree	0,56
<i>Goupia glabra</i>	Cupiúba	-	Tree	0,56
<i>Hymenolobium excelsum</i>	Angelim-pedra	Arapiwyva	Tree	0,56
<i>Naucleopsis ulei</i>	Barbudo	Ydywahauwae, Miratinga, Diwawé, Yndywaha, Jywavaé	Tree	0,56
<i>Minquartia guianensis</i>	Acariquara	-	Tree	0,50

<i>Ampelozizyphus amazonicus</i>	Saracura	<i>Nhangwãpohãgwagwyhua, Sarakura</i>	Vine	0,44
<i>Apuleia leiocarpa</i>	Garapeira	-	Tree	0,44
<i>Clarisia racemosa</i>	Guariúba	-	Tree	0,44
<i>Dipteryx odorata</i>	Cumarú	<i>Kumbaru</i>	Tree	0,36
<i>Metaxya rostrata</i>	Macaco-seco	<i>Anhãkwera mboitahau</i>	Herb	0,33
<i>Euterpe precatoria</i>	Açaí	<i>Jygy'vauhua</i>	Palm tree	0,33
<i>Elaeis oleifera</i>	Caiué	<i>Jarauhu, Jaragwyuhu</i>	Tree	0,33
<i>Bagassa guianensis</i>	Tatajuba	<i>Tata'íwa</i>	Tree	0,33
<i>Couratari stellata</i>	Tauari	-	Tree	0,31
<i>Joannesia heveoides</i>	Castanha-de-arara	<i>Tambutu, Jaywuhu, Karindé Anhã, Araruwu Aenhã</i>	Tree	0,28
<i>Humiria balsamifera</i>	Umiri	<i>Gwayraivay</i>	Tree	0,28
<i>Simarouba amara</i>	Marupá	-	Tree	0,28
<i>Astrocaryum gynacanthum</i>	Mumbaca	<i>Tukuma'ia, Ka'a pukuhu</i>	Palm tree	0,25

The plant species that presented the highest Index of Cultural Significance was the babassu palm (*Attalea speciosa*), cited by most interviewees, which demonstrates that the Tenharim have a certain dependence on this species, relating it to approximately ten uses in six categories: food, crafts, construction, cosmetic, medicinal, and ritual. The babassu palm tree (*indatahu*) has many uses for the Tenharim: the pit or seed produces an oil that the indigenous people use as a hair lotion, leaving it shiny, or to apply as a moisturizer for the skin, and as a black dye (*nhandy*) for body painting; the leaves are used to cover houses; the bark of the petiole and rachis of the leaves is placed in the fire and burned to make salt (*dykyra*), which is used in both food and medicine; the ash from burning the trunk can be mixed with water and used as a syrup for medicinal treatment; babassu pulp is roasted and pounded to produce flour (*indatawi* or *natawy*); the chestnut (*natuay*) is obtained after breaking the pit and is consumed with corn; fish traps can also be made from the rachis of the leaf; and the dried infructescence is used as decoration in meeting houses.

The main extractive product of the Tenharim is the fruits of the Brazil nut (*Bertholletia excelsa*), a large tree species, native to the Amazon, whose habitat is the drylands and is irregularly distributed, being able to form dense settlements, known as chestnut groves. The chestnut tree (*Nahã'yva*), a fundamental species in the Tenharim economy, uses its wood for construction. Its nut is consumed and commercialized; inner bark tea is used to treat illnesses; and the bark also has medicinal uses: it is left in water for a certain period, and the liquid is used to wash wounds, acting as a healing agent and treating infections. The importance of the

chestnut tree for the Tenharim is so great that the tree has several names defined according to the criteria adopted, which can be a certain part of the plant combined with the function or condition in which it is presented. Thus, among the names given to the chestnut tree, the following stand out: *nhahã iva* for the chestnut tree, *nhayva* or *ñayba* for the chestnut only, *kataña* for the chestnut hedgehog, *yvotira* or *yvytyra* for the chestnut flower that has fallen and is on the ground, indicating that the tree will soon bear fruit, *ipotyra* for the blossom of the chestnut still on the tree, indicating that there will be annual chestnut production, *nhadyva*, to name someone's chestnut grove, and *iravagwete tuvi juvy* as a generic place where clustered chestnut trees occur [8].

Most of the Tenharim have a broad view of the environment in which they live, they know dozens of plants and the benefits they can offer them, whether through bark, leaves, roots, or sap to cure diseases, fruits for their food or the different species of wild animals, trunks for building houses and various utensils, straw for roofing houses and fibers for building parts for different purposes.

On a walk through the woods near the Marmelos River, J. Tenharim (40 years old, ♂, Jakuí village, November 05, 2014), identified the footprints of several species of animals and told stories about their relationship with the environment in which they live and among a multitude of information, told us that the fruit of the uchi-liso (*Endopleura uchi*) “is the favorite of all Amazonian animals”, with the fruit of the pama (*Helicostylis scabra*) being the second in preference. Other plants, despite having no direct use for the Tenharim, such as the tachi (*Sclerolobium* sp.), are recognized and denominated as a form of protection, since these trees establish associations with other animals, in the case of the tachi, with the aggressive ones. ants of the genus *Pseudomyrmex*, demonstrating that Tenharim has enormous knowledge of the forest and its ecological relationships [8].

Acai palm (*Euterpe oleracea*), a plant with extremely high nutritional importance in the Amazon, also has medicinal properties in the treatment of infection and hepatitis, but the collection of the root to produce the medicine has a “mystery”, explained in this way by I. Tenharim (45 years old, ♂, Karanaí village, November 21, 2014):

“You have to know how to take it. You have to take the roots towards the sun [...] where the sun rises. Because otherwise, it won't have any effect. [Who did you learn this from?]. With the old ones.”

It was observed that the diversity of plant species recognized by the Tenharim for medicinal use is quite large, and this statement was recognized by the interviewees. Confirming the enormous diversity of medicines used, the present study recorded 104 plant species used in prophylactic and curative medicine for these indigenous people.

The origin of Tenharim knowledge about the use of medicinal plants is associated with the ancients or ancestors, who discovered and passed on the acquired knowledge to the generations that followed them. Thus, the elderly are, currently, the best references and the greatest holders of traditional Tenharim knowledge. The knowledge acquired by the ancients continues to be transmitted to new generations orally and, more recently, through writing, guaranteeing the maintenance and preservation of traditional Tenharim culture. In addition to the ancients, another Tenharim figure who held knowledge about medicinal plants and healing processes was the shaman or *pajywega*, as “in the past, the shaman called all the animals to sing and heal people” (J.C. Tenharim, 33 years old, ♂, Taboka village, November 11, 2014).

To designate medicine, the Tenharim use the term *moanga* or *mohã*, according to information obtained in the interviews. However, Betts [14] states that *mohagã* is the general term used for medicine. Among the illnesses treated with plants with medicinal properties, flu, cough, fever, headaches, diarrhea, stomach pain, ulcers, kidney problems, hepatitis, sinusitis, infections in general, wounds and malaria stand out.

The copaíba (*mbakupa'yva*) (*Copaifera multijuga*), a tree with medicinal properties widely recognized in the Amazon, was often mentioned among the Tenharim: “*The best thing that has medicine is this tree there*” (J.M. Tenharim, 40 years old, ♂, Trakuá village, November 13, 2014). The oil is collected “*through a cut in the trunk until it reaches the vein of the tree; let the oil drain, collect it in a bowl, and drink the oil pure or with coffee*” (C. Tenharim, 34 years old, ♀, Mafuí village, November 11, 2014). From copaíba oil, Tenharim treats numerous illnesses such as infection, wounds, rheumatism, headache, migraine, body pain, diarrhea, anemia, malaria, and pneumonia. Tea is made from the copaíba bark that is used to treat diarrhea, headache, and flu.

Traditional populations have in-depth knowledge of nature, which is reflected in the development of strategies for the use and management of natural resources, which preserve their way of life. Therefore, its economic activities are strongly dependent on nature [20]. Throughout these activities, myths, rituals, and symbolism gain relevance [21].

Many plant species are also used to make handicrafts. Most indigenous artisans said they learned the techniques from their parents and grandparents and this information reveals that the art of craftsmanship is characterized by learning within the family. The indigenous art of the Tenharim is mainly related to the manufacture of work utensils, decorative pieces, gifts, and handicrafts with an economic bias. The raw materials are found in nature, such as vines, leaves, inner bark, and seeds from a wide variety of plant species.

In making necklaces (*mboy'ra*), a task generally performed by women, a wide variety of seeds from herbaceous, shrubby, arboreal, and vine plant species are used. The most used seed is the coconut from the tucumã palm or *yvahuá* (*Astrocaryum aculeatum*). In addition to its importance in handicrafts, the fruit, nuts, and palm hearts of the tucumã are also highly appreciated by the Tenharim, “*that's why when the tucumã palm tree dies, people are sad, because it is a palm tree that means a lot to our people*” (A. Tenharim, 50 years old, ♂, Mafuí village, November 07, 2014).

The bow, arrow (*yvyrapara u'ywa*), and club (*boahawa*), objects traditionally used by the Tenharim in hunting activities, do not have the same importance today as they did until a few decades ago. Almost always replaced in hunts by firearms, these objects began to be venerated as artifacts of ancestors and presented at meetings mainly as decorative pieces. To make the bow, the Tenharim use different types of wood, such as itaúba or *agwarayva'yva* (*Mezilaurus itauba*), pau-d'arco or *ywete* (*Tabebuia spp*), and ameju-preto or *bodyhyva* (*Duguetia flagellaris*).

The large number of palm trees among the most important species in the Tenharim culture is mainly due to the use of their leaves in roofing houses and in making objects, such as panniers (*pandurue'te*), jamanchi (*pandykugwera*), paneiro (*panakyguera*), sieves (*yripema*), fan (*tapepekawa*) and carpets. The paneiro and jamanchi are types of panniers that are carried on the back, held by two handles, generally made of embira (inner bark) and that surround the forehead and chest. The difference between these two baskets is that the paneiro is completely closed and the jamanchi is open. The Tenharim make these two types of baskets to collect Brazil

nuts and açai fruits and also to carry part of the agricultural products grown in the villages, such as corn, cassava, and bananas, in addition to game and fruits.

However, according to I. Tenharim (53 years old, ♂, Kastanheira village, November 06, 2014), the best material for making paneiro and jamanchi is cipó-titica or *ipoeté* (*Heteropsis flexuosa*). The cipó-titica is not a vine but a plant with a hemiepiphytic habit that can survive for some time as an epiphyte, on trees. The part of the plant used is the roots, which grow towards the soil in search of water and nutrients. Once they reach the ground, these roots become highly lignified and hardened. After removing the bark, the root can be used to make handicrafts.

The urucum or *urukua* (*Bixa orellana*) is one of the few plants natives to the Amazon the Tenharim plant produces seeds, which provide raw coloring material for red facial and somatic paints. The juice of the green fruit of the genipap tree or *nhandypava* (*Genipa americana*) is used to obtain the black ink. Burnt coconut oil from the babassu palm (*Attalea speciosa*) is also widely used in body paintings, which leaves a black color on the skin, but, unlike the genipap ink, it is easy to remove. Body painting among the Tenharim represents a way of expressing cosmology, relationships with nature, and social relationships, and is considered an attribute of human nature itself. These paintings are used on special occasions, such as festival days, especially in *Mboatawa*.

The risk of loss of information

Most indigenous cultures transmit knowledge orally, and information can simply be lost over time. The knowledge transmitted by the Tenharim has always been oral, with writing recently introduced. When I asked one of the interviewees if he knew a bush that I randomly pointed out during a walk in the forest, he replied: “*I don't know this plant*”. I asked if it could be a plant of some use to the Tenharim. He replied: “*Yes, it can, but the information was lost along the way, or no one has yet known what it is for.*” So, there is the possibility that a lot of information may have been lost “along the way”, over the generations, due to several factors, which may be related to the cultural meaning of these species, which have variables such as recognition, lexical marking, and reputation of these species [5], that is, the survival of information will depend on the level of importance that a given plant species has for a given people and over time. Figure 2 shows the Index of Cultural Significance (ICS) of the 180 species cited by the Tenharim. It is observed that most of these species have low ICS, with a risk of loss of information.

Indigenous people have a large knowledge about countless plant species, and their uses, that are encoded in their languages. However, indigenous knowledge is increasingly threatened by language loss and the decrease in indigenous knowledge about plant species [24]. The knowledge that Tenharim has about the world of plants reflects the relationship of these indigenous people with the physical, biotic, and cultural environment through time. The development of ecological knowledge is a dynamic process and is linked to the natural and historical conditions of each society. Therefore, if natural and social conditions in a community change, ecological knowledge should also be affected [25].

The Tenharim have a plant classification system based on the therapeutic qualities attributed to the plants, the parts used, the life forms of the species, and the conditions in which each species or part of it is found. These associated characteristics serve to classify a given species taxonomically [7]. However, Tenharim, like most indigenous peoples, has always

transmitted knowledge orally. There are a few written documents listing some of the main plant species used by the Tenharim, such as the Kagwahiva Dictionary [14].

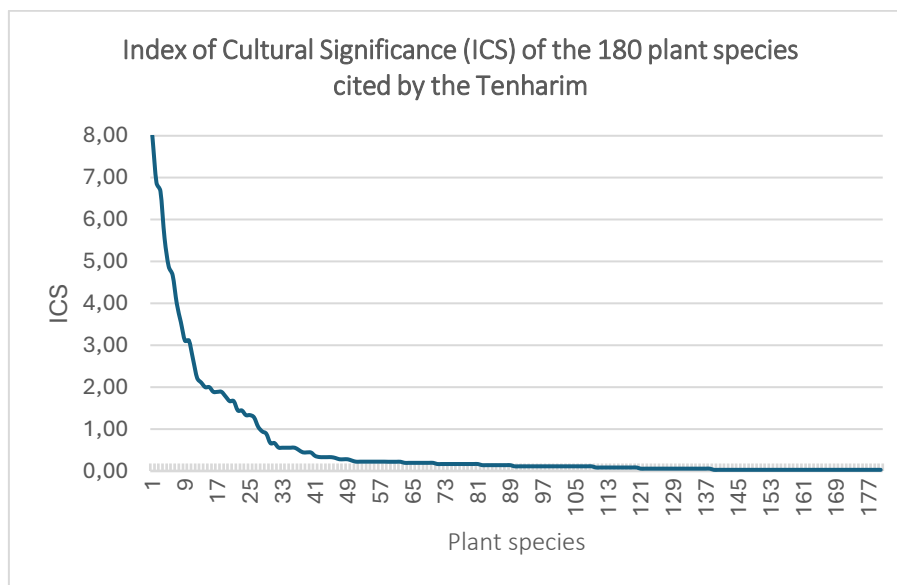


Figure 2. Index of Cultural Significance (ICS) of the 180 plant species cited by the Tenharim.

Combining information on culturally important species' biological conservation status (based on IUCN threatened status), and cultural status, found that more culturally important species are more culturally vulnerable or endangered than they are biologically [24]. This data is quite interesting when we analyze the 180 species cited by the Tenharim where only 27 plant species (15%) have an Index of Cultural Significance (ICS) above 1.0 (Figure 2), and 46 species (25% of the total) were cited on only one occasion. Of these 180 plant species, only three are considered threatened by the IUCN (2012), among them the second with the highest Index of Cultural Significance for the Tenharim: *Bertholletia excelsa*.

Knowledge transfer was a theme investigated in this study with the Tenharim. Many children and adolescents know the names of the main plant and animal species and their biotic interrelationships, but the mythical interrelationships are preserved only among the elderly. Ethnobotanical knowledge is also present in the daily life of the children who live in these villages, who know most of the plants used as medicine and food. The oldest ones are, currently, the best references and the greatest holders of the traditional Tenharim knowledge. A Tenharim figure with knowledge about medicinal plants and healing processes was the shaman or *pajywega*, who no longer exists among the Tenharim. In this way, one of the main sources of the traditional knowledge of the Tenharim disappeared. It is important to highlight that 104 plant species (58% of the total) were indicated with medicinal by the Tenharim, but not all exclusive for medicinal use. The lack of a shaman may have contributed to the disuse of many plants in Tenharim medicine and thus the erosion of information about plant species.

Among the Tenharim, it was observed that medicinal plants were commonly used for the treatment of the most common diseases, seeking complementary allopathic remedies. For Amorozo [23], “the use of allopathic remedies by traditional populations does not destroy preexisting explanatory schemes but adds new possibilities to them”. However, it is noted that

many plants, especially those of more common use, are being neglected from the point of view of their cultural importance and few people know their medicinal importance, as well as their morphological characteristics, the places where they occur, and mainly the preparation of the medicine.



Figure 3. Illustrative examples of the tenharim biocultural heritage: (A) forest is called *ka'gwyra* in the Tupi-Kagwahiva language; (B) Marmelos River (*Yhytinguhua*) is the most important watercourse in the tenharim territory; (C) babassu (*Attalea speciosa*) is one of the most important palm trees in the Amazon; (D) cacauí fruits (*Theobroma speciosum*) are highly appreciated; (E); the pulp of the coconut from the tucumã palm tree (*Astrocaryum aculeatum*) is widely used in tenharim cuisine; (F) detail of fruit with seeds of the Brazil nut (*Bertholletia excelsa*); (G) copaiba oil (*Copaifera multijuga*) is used to treat different types of diseases; (H) the sap of the sorvão (*Couma guianensis*) is sweet and highly appreciated.

Photos by Fabio Rossano Dario.



Figure 4. Illustrative examples of the tenharim biocultural heritage: (A) leaves of the *Uncaria guianensis* vine are used in medicine tenharim; (B) branches of *Costus a spiralis* are used in the treatment of headache; (C) necklace made from coconuts from the tucumã palm tree (*Astrocaryum aculeatum*); (D) canoes are an important means of transport for the Tenharim; (E) pannier made with *Heteropsis flexuosa* vine (cipó-titica); (F) basket made with *Heteropsis flexuosa* vine; (G) house entirely built with babassu leaves (*Attalea speciosa*); (H) ranch structure made with tree trunks and babassu leaves (*Attalea speciosa*).

Photos by Fabio Rossano Dario.

Religion also plays a central role in the Tenharim way of life, influencing the maintenance or abandonment of certain customs or traditional knowledge. There are three evangelical churches in the Tenharim Marmelos Indigenous Land. The influence of religion coming from non-indigenous people results in changes that affect the daily life of the Tenharim, even the use of medicinal plants, as evidenced in the speech of one of the interviewees: “We do not use any

plant against the evil eye, only the Bible itself" (J.C. Tenharim, 33 years old, ♂, Taboka village, November 11, 2014) [8].

4. CONCLUSION

The Tenharim maintain a strong relationship with nature. It is from this that these indigenous people derive their daily sustenance, whether through traditional agriculture or forest extraction, hunting, and fishing. Their life routines are based on the rhythms of nature. The forest's resources lie not only in the potential for exploitation for food subsistence but also in the plants used as medicine and in the quality of the wood that will be used to manufacture houses and various utensils. In this way, the great diversity of recorded species demonstrated that the use of plants by Tenharim is very comprehensive. Knowledge is linked to forests and water resources; traditional knowledge is passed between generations. The knowledge acquired by the ancients continues to be transmitted to new generations orally and, more recently, through writing, guaranteeing the maintenance and preservation of traditional Tenharim culture.

Many of the plant species were presented by the Tenharim by their name *ka'gwyra*. Therefore, the survival of the *ka'gwyra* language is fundamental for the cultural conservation of these species and the maintenance of the natural systems that permeate the Tenharim way of life may depend on the functioning of the cultural system of this indigenous people. The rich biocultural heritage of the Tenharim is directly related to the natural environment where these people live and their history. It includes biological resources, long-standing traditions, the *ka'gwyra* cosmology, and sustainable use of biodiversity. This biocultural heritage is held collectively, and the survival of knowledge depends on the quality of communication expressed in toponymy, the uses of plants, indigenous oral tradition, art, ideas, and culture received and transmitted from one generation to the next.

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