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Article

Changes in medicinal plant knowledge among the Waorani society, Ecuador

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Abstract: This paper explores how the medicinal plant knowledge of the Waorani indigenous society in Ecuador varies in accordance with both socio-economic and demographic factors. Medicinal plant knowledge was compared at both individual and community levels. Fifty-nine semi-structured interviews (men n=30, women n= 29) were performed with people between fifteen and seventy years old in five Waorani communities located within the Yasuní Biosphere Reserve. Results show a positive correlation between an individual's medicinal plant knowledge and age, a negative correlation between medicinal plant knowledge and the years of schooling, and differences among isolated and easily accessible communities. Reasons behind these findings are seen in the rapid socio-cultural changes of the Waorani society due to globalization processes. Increased accessibility to health centers, improved transportation infrastructure and changes in how knowledge is transmitted to young people all result in a loss of ethnobotanical knowledge. Policymakers need to take action in order to ensure the maintenance of ethnoecological knowledge among the Waorani.

Keywords: Ethnobotany; Traditional Ecological Knowledge; Waorani; Indigenous Communities; Ecuadorian Amazon; Medicinal plants; Loss of Knowledge; Globalization; Global Change; Acculturation; Socio-cultural Changes

1. Introduction

Paradoxically, academic interest on ethnobotany, and specifically medicinal plants, is increasing while rural and indigenous people's knowledge about the use of plants for medicinal purposes is declining [1]. Studies around the world have shown that elders, in general, tend to know more about medicinal plants than younger generations [2-11]. Voeks and Leony [10] explain the phenomena of finding a greater knowledge within older generations in that people acquire more knowledge with age. Nevertheless, other authors claim that the majority of acquisition of traditional skills, including knowledge on plants, happens before the age of 15 [12-15]. However, the differences in knowledge might not be explained by the longer experience of life of the elders, but by other socio-economic factors.

Studies show that, in general, women know more about medicinal plants than men [8, 10, 16] and others say that this is because men are at greater risk for losing ethnobotanical plant knowledge than women [17]. Women´s work activities in backyards, gardens and as primary family health caregivers might explain this finding [18-19]. On the other hand, in some indigenous societies men are more likely to leave their communities in order to find new economic activities [17]. However, Hanazaki et al. [20] discovered that in some communities in the Atlantic rainforest of Brazil, men

know more medicinal plants than women, which might mean that men in those communities have a closer relationship with the forest.

Also, individual schooling has been negatively associated with persistence of traditional ecological knowledge [10, 21, 22]. Traditional ecological knowledge (TEK) is defined as the body of knowledge, beliefs, traditions, practices, institutions, and worldviews locally developed and sustained by indigenous and rural communities in interaction with their physical environment [23]. Even if the curriculum promotes a conceptual learning of TEK, the absence of direct contact with nature can change the traditional transmission and acquisition ways [24]. Beyond such individual conditions, the many facets of modernization of rural societies may lead to a loss of traditional ecological knowledge [21, 25-26]. Community location and infrastructure, such as proximity to urban areas, accessibility, and the presence of public healthcare, may account for medicinal plant knowledge loss [11, 27]. For instance, in Manus Island, Papua New Guinea, the presence of public health systems contributed to local acculturation and the loss of knowledge about useful plants [28]. Vandebroek et al. [29] found that people inside Isiboro-Sécure National Park have a greater knowledge about medicinal plants when they live in the communities that are furthest from the closest village and primary health care service.

Modernization of rural and indigenous societies is also influencing the Waorani, an indigenous group who were originally hunter-gatherers with a semi-nomadic lifestyle and now are settled in communities within the Yasuní Biosphere Reserve in Ecuador, which includes the Yasuní National Park and the Waorani Ethnic Reserve. They have been embedded in a strong modernization process during the last 50 years, which may have affected their knowledge about medicinal plants. In the Yasuní National Park, a road and a free bus system allow Waorani community members to get to urbanized areas in a short amount of time. Free health care is available at the medical center of a closely located oil company. Further, inhabitants have the opportunity to attend public school. Given the potential impacts of modernization in the knowledge of the Waorani's traditional livelihood, many studies have focused on collecting the wide knowledge about plant use in the Waorani society [30-33]. Little emphasis, however, has been on how such knowledge is being affected by the continuous changes of the socio-cultural environment in Waorani society. To better understand these dynamics and determining factors that play a role in the maintenance and loss of ethnobotanical knowledge, a cross-case analysis was conducted with three communities in the Yasuní National Park, which have access to health care and markets, and two communities outside the national park, at the Waorani Ethnic Reserve, which lack such access. This paper explores how Waorani medicinal plant knowledge varies in accordance with both socio-economic and demographic factors, using indicators of cultural change and modernization. Medicinal plant knowledge is compared not only at the individual level, but also between different communities. To have a meaningful measure and to avoid bias, the theoretical dimension of knowledge about plants is combined with measures of the practical dimensions [27]. Further, this paper makes use of an easy methodology to capture viable information about ethnobotanical knowledge in a relatively short amount of time and without substantial economic expense.

The Waorani livelihoods

The Waorani are an indigenous society of hunters and horticulturists living in the eastern part of Ecuador, in the provinces of Napo, Orellana and Pastaza. Unofficial estimates count the Waorani population around 3800 individuals, which make up about 47 communities in an area over Waorani Ethnic Reserve and Yasuní National Park that is limited by the river Tiputini in the North, the river Curraray in the South, the foothills of the Andes and the border of Peru [34]. Until missionaries made the first peaceful contact in 1958, the Waorani lived isolated as hunter-gatherer groups and led a semi-nomadic lifestyle in the lowlands of the Amazon forest [35]. The contact with missionaries brought them closer to mainstream society, introducing them to formal education, suspending activities of traditional medicine and shamanism and establishing modern medicinal practices, such as vaccination [34, 36-37]. Oil exploitation in the Waorani territory had further repercussions in the socio-cultural dynamics of the Waorani [34]. The co-existence with oil companies and their workers

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brought western culture into the Waorani societies. However, not every Waorani community lives under the same conditions. While some communities neighbor oil companies and have easy access to health centers or market towns via the roads the companies built, others are only accessible by foot, boat or plane. Some communities maintain self-sufficiency, while others have developed a paternalistic dependency on the oil companies in their territory or have been involved in the tourism industry. These differences in livelihood conditions make the Waorani communities an interesting case to research as to why cultural goods, such as ethnobotanical knowledge, are declining in some cases, while being maintained in others.

2. Materials and Methods

The study was conducted from April to June 2015 in five Waorani communities located inside the area of the Yasuní Biosphere Reserve, which includes the Yasuní National Park and the Waorani Ethnic Reserve (Figure 1.).

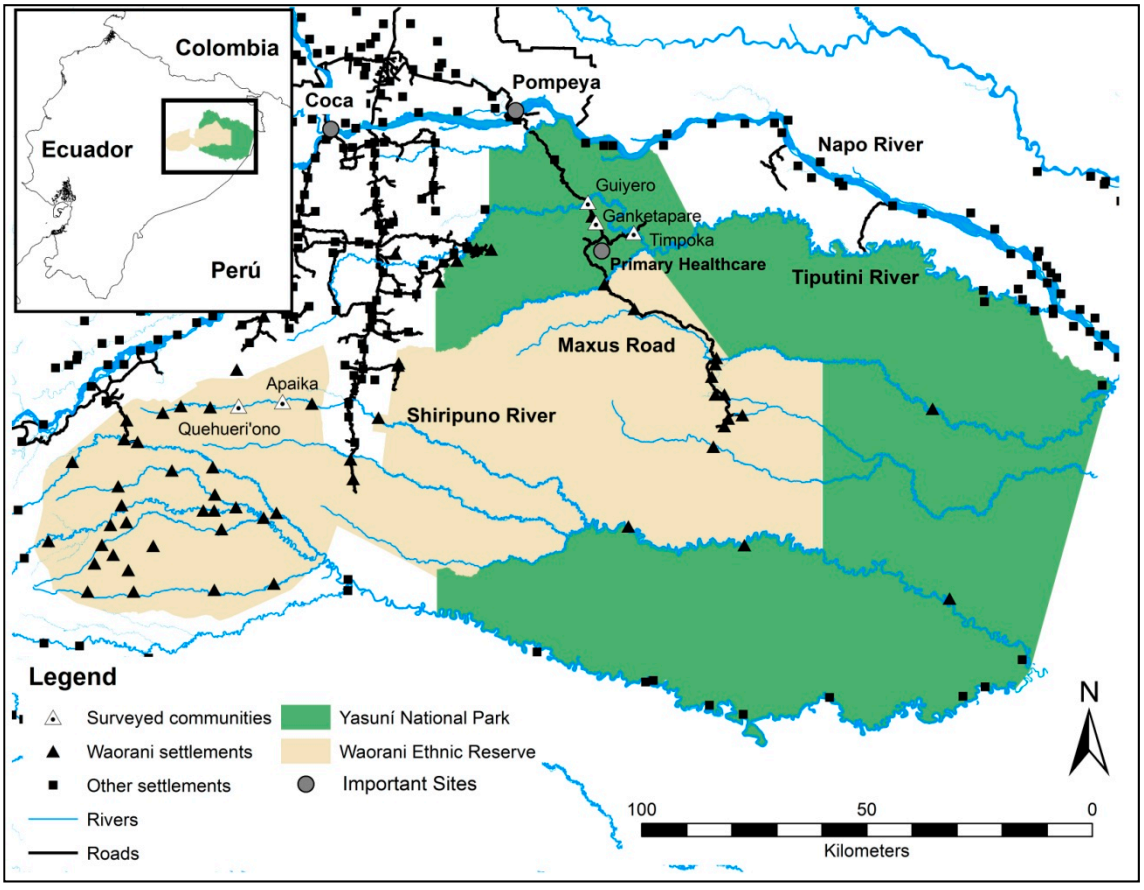

Figure 1. Study area with the location of Waorani communities. (Map by Santiago Espinoza).

For comparative purposes, fieldwork was conducted in three communities located within the Yasuní National Park (Guiyero, Ganketapare, Timpoka) and two communities inside the Waorani Ethnic Reserve (Quehueri'ono and Apaika). Communities within the park have easy access to free health care at the medical center of a closely located oil company by the road *Via Maxus* and a free bus system provided by this company. Further down the road is the Napo River where the Waorani can leave Yasuní National Park via ferry and access the closest small market town of Pompeya. Timpoka is the community nearest to the health center and Guiyero is the most distant. Furthermore, Guiyero has a school and is closer to the market town than Ganketapare and Timpoka.

Quehueri'ono and Apaika are located 35 and 50 km away from the Yasuní National Park, next to the Shiripuno River. Differently from those communities situated inside the Park, Quehueri'ono and Apaika are not connected with any roads, nor do they have easy access to a health center. The

communities are accessible by foot, boat, or in the case of Quehueri'ono, by airplane. The closest health center is located in the city of Coca, a four hour motorboat and two hour bus ride far from Apaika and two hours further by motorboat from Quehueri'ono. Quehueri'ono has a landing strip for small airplanes which is used to bring food, school material to the village or tourists to the close situated *Waorani Ecolodge*. Quehueri'ono has a school whereas Apaika does not (Table 1).

Table 1. Waorani's Community characteristics.

				Access			Distances		
Community	**households**	**households participated**	**n**	**river**	**aviation**	**street**	**travel time to health center**	**travel time to school**	**travel time to closest mark**
Guiyero	12	10	18	yes	no	yes	<0,5h by bus	0h	<1h by bus
Ganketapare	2	2	6	no	no	yes	<0,5h by bus	<0,25h by bus	1h by bus
Timpoka	7	6	17	yes	no	yes	<0,5h by bus	0,5h by bus	1,5h by bus
Quehueiri-Uno	12	10	16	yes	yes	no	6h by motorboat + 2h by bus	0h	6h by motorboat
Apaika	1	1	2	yes	no	no	6h by motorboat + 2h by bus	2h by boat	4h by motorboat

Data collection

Semi-structured interviews were used to gather information on ethnobotanical knowledge about medicinal plants and socio-economic characteristics. To design the ethnobotanical knowledge questions and select the plants, a previous bibliographic review was done at the library of the Pontificia Universidad Católica de Ecuador (PUCE). Every book or paper related to both topics, plants and Waorani, was selected. Correspondingly eight documents were reviewed [30-33, 38-41]. The number of times each plant appeared in the sources was counted in order to find out the most studied plants in the literature, which were assumed to be the best known among the Waorani. With the help of academic experts in Waorani ethnobotany, ten medicinal plants with their main uses were chosen. The criteria were that the chosen plant had to be a popular species that was easy to find. Every plant had at least one medicinal use and a proper way to be prepared, which was the second selection criterion (Table 2). Two of the plants appeared between the most cited plants of the bibliographic review. The others were less cited but fulfilled the latter criterion.

139 **Table 2.** Selected plants with respective uses and preparations.

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Species	Family	Growth form	Part used	wild/cultivate plant	use	Preparation
Astrocarium chambira	Arecaceae	Tree	young leaves	wild	Produce thread	Cut young leaves, separate outer parts, wash, cook, dry and roll them to a thread
Cecropia ficifolia	Cecropiaceae	Tree	bark, leaf, bud	wild	Shampoo	Smash bark, leaf or bud
Clibadium surinamense	Asteraceae	Bush	leaves	cultivate	Fishing	In a hole in the ground, leaves are smashed and used as posion for fishing
Curare tecunarum	Menispermaceae	Vine	bark	wild	Hunting	'ut scrached bark into funnel made of leaves. Add water and filter. Boil to obtain liquid
Abuta grandifolia	Menispermaceae	Bush	steem, root	wild	Stomacache, diarrhea, stomach parasites	Scrached bark or root boiled in water. Drink the liqid
Croton lechleri	Euphorbiaceae	Tree	sap	wild	Epidermic infections	Apply the sap of the tree directly to skin
Eucharis grandiflora	Amaryllidaceae	Herbaceous plant	bulb	wild	Abcess	Apply smashed bulb directly on the abscess
Euterpe precatoria	Arecaceae	Tree	roots	wild	Influenza	The young red roots are boiled in water. Drink the liquid
Fittonia albivensis	Acanthaceae	Herbaceous plant	fruits	wild	Pimples	Apply smashed fruits directly on the skin
Iryanthera paraensis	Myristicaceae	Tree	sap	wild	Fungus	Apply sap directly on the affected parts
Musa x paradisiaca	Musaceae	Herbaceous plant	sap	cultivate	Diarrhea	Drink sap of the trunk
Neea sp.	Nyctaginaceae	Tree	fruits	wild	Prevent cavaties	Chew fruits
Theobroma subinicarum	Sterculiaceae	Tree	bark	wild	Fever	Cook macerated bark in water. Drink the liquid
Uncaria guianensis	Rubiaceae	Vine	bark	wild	Influenza and cough	Cook macerated bark in water. Drink the liquid

At least one adult per household in each community was interviewed, except in households that did not agree to participate. The interviewee had to fulfill the following criteria: 1) having a Waorani mother and/or father, 2) being fluent in Wao-tededo, the language of the Waorani. 3) being older than 15 years old since at this age the majority of traditional ecological knowledge acquisition already occurred [12, 15, 42-43], 4) not having behavioral or mental disorders, and 5) having lived at least two years in the community.

The total sample included 59 individuals (29 women and 30 men). Eighteen representatives live in the Guiyero community, seventeen in Timpoka, sixteen in Quehueri'ono, six in Ganketapare and two in Apaika. Correspondingly, 18 persons (31%) lived in the no-road/no health center communities outside the Park, 41 persons (69%) in the communities with road and health center within the Park. The average age of the interviewee was 33.1 years.

Interviews lasted between 30 minutes and 2 hours and were conducted in Spanish. If the interviewee did not understand Spanish, the interview was conducted in Wao-tededo with the help of a local translator.

During the 59 interviews, pictures of each selected chosen plant were shown to the interviewee and s/he was asked if s/he recognized the plant, what Waorani people used it for and how it was prepared. Also the following socio-economic questions were asked: 1) years in educational systems (school and university), 2) years living in a city, 3) years working for a company, 4) hours of internet per week, 5) age and 6) gender.

Data analysis

A score was generated for the ethnobotanical knowledge about medicinal plants of each individual by adding a) one point if s/he recognized the main use of the plant identified in the academic literature, b) one point if s/he mentioned the correct preparation for that use. In doing that, ethnobotanical knowledge score for each plant varied from zero (if use and preparation were not correct) to two (if both use and preparation were known). Correspondingly to the 10 plants, the maximum ethnobotanical knowledge score possible to reach would be 20 while the minimum would be 0.

Regarding the socio-economic variables, if the interviewee attended school or lived less than three months in a city at the moment of data analysis, the time was considered zero. A person working less than 3 month for a company or using internet less than 30 minutes per week was also scored 0. Years living in a city, years working for a company and hours of internet per week, due to weak numbers, were not considered in later data analysis.

The name of the plant was not considered in the analysis of ethnobotanical knowledge because it was not possible to determine the "correct" names of each plant since they vary between different communities and even between families of the same community [30-31]. Also, the Waorani can name a plant by the different stages of growth [32] making difficult to determine if the name mentioned was correct or not.

To analyze the gathered data, the statistical program R was used. A linear regression model was used to understand relations between ethnobotanical knowledge, age and time in schooling systems. Differences in the knowledge between gender or different types of communities were determined by Welch two sample t-tests. Also to find if potential differences between those interviewees with both parents Waorani and those with only one parent Waorani a Welch two sample t-test was used.

3. Results and discussion

Medicinal plant knowledge among the Waorani

The range of medicinal plant knowledge was between 0 and 16 points and the average was 7.8 points. The maximum value that each person could reach was 20 points. All plant uses and preparations were recognized at least once, only the preparation of *Theobroma subinicarum* was not

recognized by anyone. Considering the sum of all interviews, 39 % of the questions about medicinal plants use and preparation were correctly answered (Table 3). In the more isolated communities, the mean of medicinal plant knowledge was 10.0 points, while lower in the more market-integrated ones (6.8 points).

Table 3. Frequencies of correct answers about use and preparation of selected plants.

Variable	Minimum	Maximum	Absolute frequency	Relative frequency
Total of communities	0	1180	460	0,39
Medicinal ethnobotanical knowledge	0	360	180	0,5
More marked-integrated communities	0	820	280	0,341
Interviewees with both Waorani parents	0	940	372	0,396
Interviewees with one parent Waorani	0	140	88	0,629

Gender and knowledge

No significant relation has been discovered between gender and medicinal plant knowledge ($p>0.05$). This finding is inconsistent with many other studies, which indicate that generally in rural societies, women have greater ethnobotanical knowledge than men, at least considering medicinal plants [8, 10, 16]. The cases of higher medicinal plant knowledge among women might be explained by their role as primary family health caregivers [18, 19]. However, Hanazaki et al. [20] discovered that in some communities in the Atlantic rainforest of Brazil, men know more medicinal plants than women, which might mean that men in those communities have a closer relationship with the forest. The equal knowledge between Waorani men and women might be caused by the close connection of the community members with the forest. Even if hunting is a man´s domain, it is usual to see women accompany their husbands during this activity. Besides, women habitually stay in the forest for gathering activities. Among the Waorani, healthcare is not the responsibility of only a few persons or of the housewives, rather almost all interviewees, independent of their age, claimed that the last time they used traditional medicine, it was themselves who gathered the plant and prepared the medicine.

Cross-cultural marriages and knowledge

The analysis shows that there is no significant difference in the medicinal plant knowledge between people with one or both Waorani parents ($p>0.05$), which was on average 7.9 points in people with both parents and 7.3 in people with only one parent Waorani. A study about the botanical knowledge in Manus Island, Papua New Guinea had different results. Cross-cultural marriages caused reduction in botanical knowledge [28]. The authors conjecture that this is explained by reduced cultural pride due to the intermarriages between groups. Waorani communities do not show this trend because all participants, even if they only have one Waorani parent, grew up in Waorani communities surrounded by Waorani culture. Further, as these communities have not been isolated from deep socio-cultural changes, another way of understanding this result might be that cross-cultural marriage does not have any relevant effects in ethnobotanical knowledge, when it is already low, as the low general average score of the studied Waorani communities indicates.

Age and knowledge

As expected, interviewees' medicinal plant knowledge and age have a positive significant correlation ($R^2=0.43$, $p<0.001$) (Figure 2). Thus, elders tend to know more about medicinal plants than their younger counterparts. Several other authors found the same tendency in their studies about medicinal plant knowledge in different parts of the world [3-4, 6-11, 28, 44-45]. Reasons for greater knowledge with increasing age could be numerous and have to be interpreted with caution. It might be logical that with progressive age people have more time to accumulate knowledge, and therefore, also show greater medicinal plant knowledge than the younger generation [10]. However, the correlation of knowledge and age does not necessarily mean an increase of ethnobotanical knowledge over time. Other authors see the reason for lesser knowledge in the younger population in ongoing

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socio-economic and cultural changes. Figueireido et al. [16] claims that younger people in an Atlantic rain forest community in Brazil are less interested in homemade medicine and more drawn to modern medicine. In rural communities of Cabo Delgado, Mozambique, such knowledge tends to be lost between generations because the younger people are more receptive to modern health centers than to the medicinal knowledge of their elders [45].

It is interesting to see that the lesser medicinal plant knowledge among young people is a phenomenon that even extends to medical specialist community members, such as is the case with traditional healers in southwestern Ethiopia [9]. As in the prior presented cases, the author gather that a reduced interest to inherit and use ethno medicinal knowledge in younger generations might cause this discrepancy in knowledge between older and younger healers.

The influence of schooling

Although young people's diminished interest in medicinal plants could be a factor for the demographic differences in knowledge among the Waorani society, formal schooling might be having a greater influence. Results show that the amount of years in school has a significant negative correlation with ethnobotanical knowledge about medicinal plants (R^2=0.10, $p<0.01$) (Figure 3).

To understand this finding it is necessary to understand the dynamic of transmission for traditional ecological knowledge. In Waorani society, teaching TEK to the younger generations was and is the role of elders, principally parents and grandparents. During the study's fieldwork it was observed that such knowledge is transmitted during long walks in the forest, for example during hunting or gathering activities.

Other methods, observation and imitation, are fundamental principles of the Waorani TEK learning process. Saynes-Vásquez et al. [21] highlights that among the Isthmus Zapotecs in Mexico, children who attend school forgo the potential to learn about the local flora through outdoor activities. He agrees with other authors [22] that time spent in the classroom reduces the opportunities for learning traditional knowledge in the way it has been learned in the past.

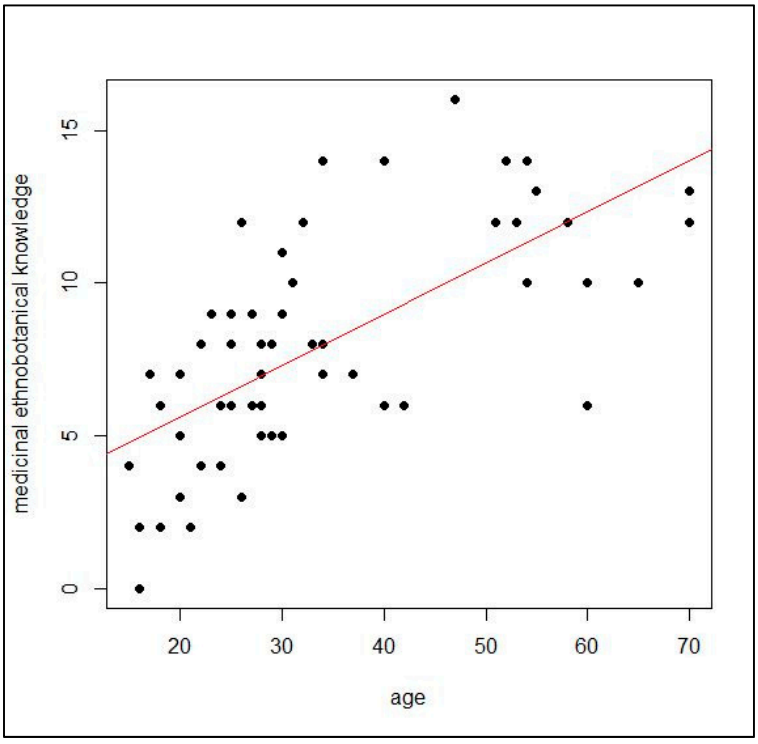

Figure 2. Relationship between medicinal ethnobotanical knowledge and age in Waorani's communities.

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Further, the article states that formal educational programs marginalize local knowledge by encouraging a more urban lifestyle that leads to a disinterest of the local natural environment and related knowledge.

In the Waorani communities included in this study, the concept mentioned above does not apply entirely. Even if formal education with a nationally organized school system exists, some keen Waorani teachers promote the learning of traditional ecological knowledge in their language, Wao-tededo. Anyway, since this implementation is recent, the field trips and cultural classes cannot yet balance the absence of the traditional transfer of knowledge. Positive effects hopefully might be possible to perceive in the future as it has been observed in other cases [46], but until now, in terms of TEK learning, the formal schooling system was removing children from their traditional cultural context instead of supporting it.

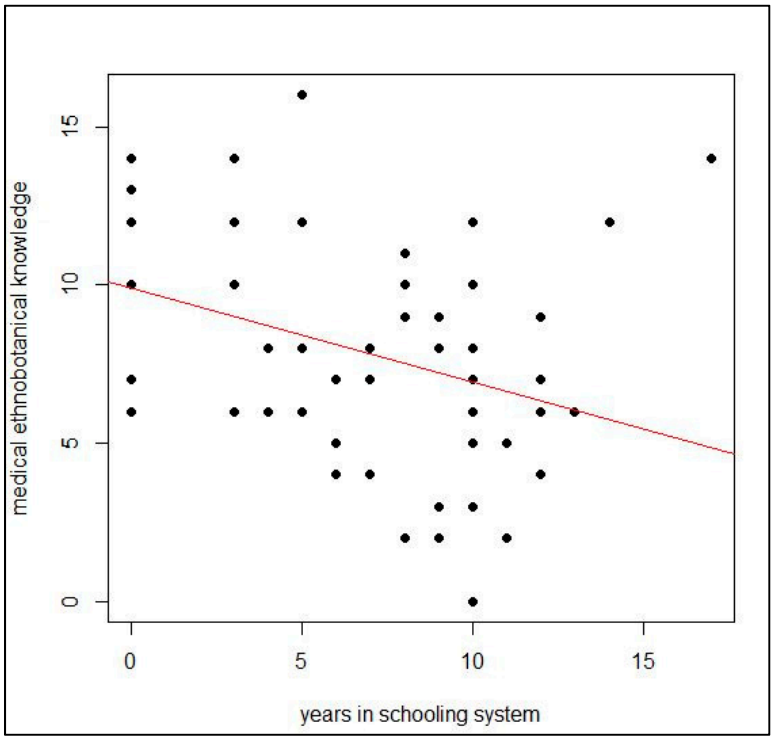

Figure 3. Relationship between medicinal ethnobotanical knowledge and years in schooling system in Waorani's communities.

Community factors affecting knowledge

Comparing the two different kinds of communities, more integrated and more isolated, results show that medicinal plant knowledge varies significantly between the communities with a road and easy access to a health center and the communities inaccessible by road and unable to reach a health center in a short amount of time ($p<0.01$). The communities inaccessible by road and unable to reach a health center in a short amount of time have a significantly higher medicinal plant knowledge with an average score of 10.0, compared with the average score of 6.8 in the other communities. There are two potential explanations for these findings. First, lower knowledge in villages with road and health center access might be due to lack of use since these people can easily obtain medicines. Studies done by Kinman [47] and Stock [48] about the use of primary health care in Bolivian suburban societies and utilization of health facilities in rural Nigeria, respectively, showed that people living close to health care centers tend to visit them more often and thus neglect the use of medicinal plants. Vandebroek et al. [29] comes to the same conclusion in a study about indigenous communities in the Bolivian Amazon. With increasing distances to health care centers the use of western medicine is less likely and medicinal plant knowledge increases with that distance. He concludes that people who are more isolated depend more on traditional rather than western medicine. In any case, distance is not

the only factor. Secondly, ethnobotanical knowledge can be maintained in villages far from health centers because they do not have transportation facilities nor economic resources to access to medical assistance. Vandebroek et al. [29] further explains that one of the reasons for this fact is the lack of opportunities to sell agricultural products, due to low market integration. This makes pharmaceutical products less affordable for inhabitants of more isolated areas. Therefore, the use of medicinal plants for primary healthcare plays a more important role in these areas. These arguments might apply partly to the people living in Quehueri'ono and Apaika. The absence of a health care center in these communities means that people who want to visit a public health care center have no choice but to take long boat and bus rides and pay the correspondent traveling costs. Consequently, for community members, it might be preferable to use traditional medicine instead of shouldering the physical and economic strains linked with the travel to a primary health care center. On the other hand, inhabitants of the communities in the Yasuní National Park can use free buses and reach free primary health care in less than half an hour. It is likely that this convenience encourages them to visit the doctor and use modern medicine instead of spending their time searching for the adequate plant and preparing the medicine, as some community members stated in the interviews. When traditional medicine is neglected, the practice falls into oblivion. Once again, this absence affects the dynamics of the traditional knowledge transmission process because children do not have the chance to observe which plants have to be gathered and how they have to be prepared.

Also, the arrival of ecotourism to the communities of Quehueri'ono and Apaika has to be considered through the lens of conservation and loss of ethnobotanical knowledge. In the studied communities inside Yasuní National Park, ecotourism is not present due to the restricted access imposed by the oil company. Some interviewees from Quehueri'ono and Apaika stated that it is important to maintain traditional knowledge and habits because this attracts tourist to visit their community. Due to the communities´ physical isolation, it takes more effort to sell agricultural or handicraft products in market towns. Therefore, tourism provides an important source of economic income for the society. With regard to such trends, Voeks & Leony [10] see a disengagement of plant knowledge from its cultural context and have doubts about the success of this marked-based motivation for conservation of traditional plant knowledge. Even though it might not conform to an outsider´s romantic vision that the conservation of traditional knowledge and habits within indigenous communities could rely on economic motivation, the use of their cultural intellectual goods is a legitimate way for the groups to adapt to changes in an increasingly globalized society. Therefore, it is not beyond the bounds of possibility that in some cases, ecotourism could act as an element in the conservation of traditional ecological knowledge.

Globalization and acculturation process

The variances in ethnobotanical knowledge between age, between different communities and the negative correlation of formal education can be explained as a result of earlier and current socio-economic and cultural changes affecting Waorani society. Missionaries started this process by introducing western values while suppressing traditional ones. The activity of the oil companies brought infrastructure and employment inside the Waorani territory. Waorani working with the oil company personnel have been confronted with new realities and have developed an interest in the materialistic and ideological novelties, which are now finding their way into Waorani culture. Roads built by the companies broke down barriers of physical isolation and enabled traveling and trading options that used to be unimaginable. Therefore, as the Waorani entered the globalized world, they were simultaneously captivated by all of its materialistic facets. The unavoidable adaptions to the new reality caused drastic socio-economic and cultural changes, as well as in the knowledge of ethnobotanical plants. Traditional knowledge is abandoned as it no longer seems to fit with current realities [17]. For example, medicinal plant knowledge used to be a survival skill, but health problems can now be solved with modern medicine. Additionally, formal education programs follow a nationally mandated curriculum that does not emphasize traditional ecological knowledge as part of the training that prepares students for the realities of a globalized world [10].

4. Conclusions

The factors influencing medicinal plant knowledge among the Waorani society include both demographic and socio-economic traits. Older people tend to have a greater knowledge about medicinal plants than their younger counterparts. Also formal education, community location and infrastructure correlate with the ethnobotanical knowledge of the Waorani, whereas the potential interference of ecotourism with the conservation of traditional knowledge requires further investigation. Above all, medicinal plant knowledge is very vulnerable and is in danger of more erosion in the future.

Not every Waorani community is subject to the same physical and socio-economic circumstances, which results in differences in medicinal plant knowledge. Communities that are more physically isolated, inaccessible by road and without easy access to primary health care, have a significantly higher knowledge than those communities with a road and easy, free access to a Western doctor. It also seems that cultural change affects individuals differently, depending on the demographic profile of the person.

Hence, elders have greater medicinal plant knowledge than the younger generations. This shows an erosion of traditional knowledge and reveals the vulnerability of this exceptional cultural good. On the other hand, it indicates that this knowledge is still part of the Waorani society, which means it has the potential to be conserved. With prompt and appropriate policies, the loss of this valuable knowledge might be minimized or even recovered. Policymakers are advised to take action quickly before this unique set of knowledge fades away.

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Conflicts of Interest: Declare conflicts of interest or state.

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