Ethnobotanical Knowledge of *Sarrapia* (*Dipteryx odorata* [AUBL.] WILLD.) Among Three Non-Indigenous Communities of the Lower Caura River Basin, Venezuela

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ETHNOBOTANICAL KNOWLEDGE OF *SARRAPIA* (*DIPTERYX ODORATA* [AUBL.] WILLD.) AMONG THREE NON-INDIGENOUS COMMUNITIES OF THE LOWER CAURA RIVER BASIN, VENEZUELA

Berta E. Pérez and Tamia Souto

Local ecological knowledge (LEK) offers a broad range of information that conservationists, development practitioners, non-governmental organizations, and researchers value greatly. However, LEK has an intrinsic value to its holders; it represents their capacity to adapt and survive in remote areas, while anchoring their cultural continuity within a specific ecological region. The authors set out to describe in this essay the ethnobotanical knowledge of sarrapia (Dipteryx odorata [Aubl.] Willd.) *or tonka bean among the inhabitants of three non-indigenous communities of the Lower Caura River Basin, southern Venezuela. The results of this study suggest that there is a strong association between the livelihood of the Caura's residents and the consecutive annual cycle of this species. This association is demonstrated by how the locals: 1. make interconnections between the biological cycle of sarrapia and climatic and ecological variables; 2. discriminate between wild and cultivated sarrapia tree stands; 3. provide accurate estimates on the total production of sarrapia beans per tree stand every year; 4. implement the appropriate skills throughout the delicate process of extracting and treating the beans; and 5. regulate the access and usufruct rights to the wild and cultivated sarrapia trees.*

Key words: *ethnobotanical knowledge,* Dipteryx odorata, *non-indigenous, Caura River*

El conocimiento ecológico local (CEL) ofrece una gama de información que los conservacionistas, profesionales en desarrollo, organizaciones no gubernamentales e investigadores valoran considerablemente. Sin embargo, CEL tiene un valor intrínseco para quienes lo poseen, ya que representa su capacidad para adaptarse y sobrevivir en áreas remotas, así como también su continuidad cultural en regiones ecológicas específicas. Este artículo describe el conocimiento etnobotánico de la sarrapia (Dipteryx odorata [Aubl.] Willd.) *o tonka bean entre los habitantes de tres comunidades no-indígenas de la Cuenca Baja del Río Caura, al sur de Venezuela. Los resultados del estudio sugieren que existe una fuerte asociación entre los modos de vida de los habitantes del Caura y el ciclo anual consecutivo de esta especie. Esta asociación se demuestra en cómo la gente: 1. realiza interconexiones entre el ciclo biológico de la sarrapia y las variables climáticas y ecológicas, 2. discrimina entre los sarrapiales silvestres y cultivados, 3. proporciona estimaciones precisas sobre la producción total de almendras de sarrapia por sarrapial cada año, 4. aplica los conocimientos apropiados en el proceso de extracción y tratamiento de las almendras de sarrapia, y 5. regula el acceso establecido y los derechos de usufructo en los sarrapiales silvestres y cultivados.*

Introduction

Traditional societies that live close to or within rich, biodiverse ecosystems use a wide range of resources (e.g., wild game, fish, firewood, fodder, wild fruits, and medicinal plants) for securing their physical survival and cultural continuity (Barham et al. 1999; Takasaki et al. 2000, 2001). It is through daily interactions with their environment that these traditional societies acquire and reinforce a

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broad and deep understanding of their natural surroundings. What they learn is not only transmitted orally and through imitation and demonstration across generations at the intra- and inter-ethnic levels, but is also incorporated as part of their language, behavior, livelihood, and worldview. This body of knowledge, termed Local Ecological Knowledge (LEK), offers scholars valuable information about natural resources and local management practices for an understanding of the intricate relationship between humans and their natural environment (Berkes 2008; Zent 1999). But its study also elicits debates that highlight some of the tensions between modern and traditional societies. These tensions arise as scientific, economic, political, environmental, and ethical issues come into play (Ellen et al. 2000; Zent 2005).

This article emphasizes the intrinsic value that local ecological knowledge has to its holders; it represents their capacity to adapt and survive in remote areas, while anchoring their cultural continuity within a specific ecological region. Thus, the authors describe the ethnobotanical knowledge of *sarrapia* (*Dipteryx odorata* [Aubl.] Willd.), or tonka bean, among the inhabitants of three non-indigenous communities known as Aripao, Jabillal, and Las Trincheras located on the east bank of the Lower Caura River, Bolívar State, Venezuela (Figure 1). Whereas Aripao is an Afrovenezuelan community, the inhabitants of Jabillal and Trincheras are *criollos*, people who are racially or culturally mixed from the blending of Spanish, Amerindian, and African populations. Since the middle of the 19th century, the people of these communities have gathered *sarrapia* fruit for its bean (*almendra*). The bean is used locally and is internationally sought for the chemical compound, coumarin, a substance first isolated by a British laboratory in 1846 (Fernández 1995:120–121). It has a vanilla-like odor and has long been used for its adhesive or binding properties in the tobacco, perfume, and gourmet cuisine industries. The best quality coumarin is said to come from Venezuela, followed by that from the Guianas, and lastly, from the Brazilian Amazon (Clay and Clement 1993).

S*arrapia* is one of many non-timber forest products (NTFP), such as rubber (*Hevea brasiliensis* M.) in the Amazon (Barham and Coomes 1994), that international industries in countries like the United States, France, and Japan exploited in the middle of the 19th century. The demand for *sarrapia* beans, like other NTFPs, declined by the early 20th century. Yet, there still is a small-scale international market (e.g., France) served by these non-indigenous communities of the Lower Caura River Basin who continue to supply the majority of the beans. Regardless of the market demand for *sarrapia* beans, these non-indigenous communities have a strong cultural attachment to this NTFP as the forests continue to be central to their livelihoods (Pérez 2002; Souto 2009). Therefore, these communities' ethnobotanical knowledge of the annual cycle of *sarrapia* and its relationship to the different components of the ecosystem, such as climatic conditions, ecological processes, species interaction, and plant phenology, is important to document.

The literature on the genus *Dipteryx* is rather limited; nonetheless some publications discuss the use of *sarrapia* beans in other South American countries (Bourdy et al. 2000; DeWalt et al. 1999; Duke et al. 2009; Johnston and Colquhoun 1996; Pinto et al. 2008). In Venezuela, *Dipteryx* has been studied primarily in the

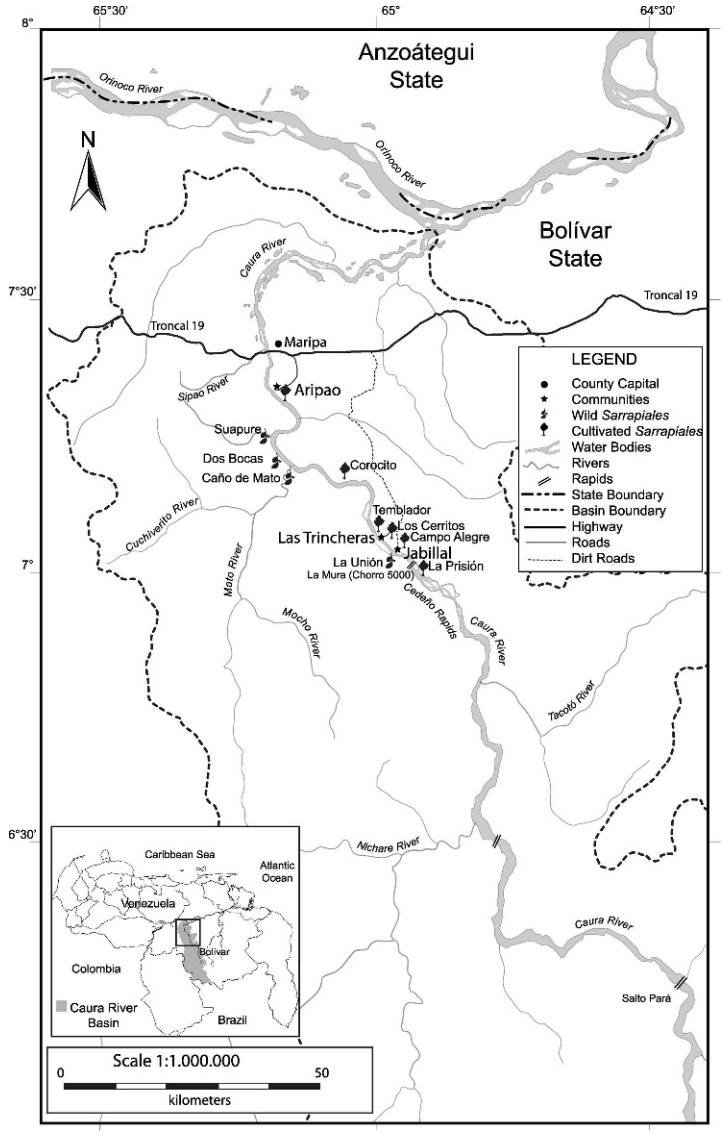

Figure 1. The Lower Caura River Basin: Location of studied communities and *sarrapiales*.

state of Bolívar (Caura and Cuchivero River Basins), even though *D. odorata* also grows in the states of Amazonas and Delta Amacuro. The information available about the genus *Dipteryx* is often brief and dispersed or contextualized within a specialized perspective, such as botanical (Hoyos 1996; Williams 1941 and 1942), ecological (Knab-Vispo et al. 1997; Knab-Vispo et al. 2003), agronomic (Avendaño and Sanblas 1995), ethnographic (Mattéi-Muller and Henley 1978; Wilbert 1966), historical economic (Briceño de Bermúdez 1993; Fernández 1995; Fuentes Guerrero 1980; Oxford-López 1948), or literary (Maldonado 1970). These sources

report little about the ethnobotanical knowledge of the annual cycle of *sarrapia* and its interconnections with biotic and abiotic aspects of the environment. This type of information is also absent in the writings of explorers who visited Venezuela before (e.g., Gumilla, Gilii, Humboldt, and Schomburgk) and during (e.g., André, Appun, Chaffanjon, Crevaux) the international boom of this NTFP in the mid 19th century.

Indeed, further research on this genus in Venezuela is needed. There are discrepancies in the literature on which of the two species, *D. odorata* or *D. punctata* [S. F. Blake] Amshoff, is predominantly used locally and for the market in the Caura region. We also lack information about which of these two species is dominant in any of the zones of Venezuela where they grow. Meanwhile, Ángel Fernández, a Venezuelan botanist at the Venezuelan Institute for Scientific Research (IVIC), asserts that he identified the trees harvested by the Caura's inhabitants as *D. odorata* (Fernández 2010, pers. comm.). Because there are still many unanswered questions regarding the genus *Dipteryx,* the local ethnobotanical knowledge of *D. odorata*, which is critical and complex in its own right, is worth recording. It may contribute, in turn, towards the conservation of the biological and cultural diversity of the Caura region.

Botanical Description of the *Sarrapia* Tree

The genus *Dipteryx* (Schreb.), which belongs to the Fabaceae family, was formerly known as *Coumarouna* (Aubl.). Four species have been identified in Venezuela: *D. odorata*, *D. punctata*, *D. rosea* Spruce ex Benth, and *D. magnifica* (Ducke) Ducke. *D. odorata* is a rainforest tree between 10 and 30 m high, with a trunk diameter reaching a maximum of 1 m. The inflorescence is a terminal panicle with small purple to whitish mauve flowers. The fruit is a drupe, resembling a mango in size (5 to 7 cm long by 3 cm in diameter) and shape (Figure 2). Its initial skin color is dark green. But as the fruit ripens, it changes from a yellowish to a mahogany color that indicates the final stage of its maturation. It has a fibrous yellowish pulp and the pit contains a single black bean. This species is native to the Neotropics, but its highest concentration is found in the Venezuelan Guiana (Bolívar, Amazonas, and Delta Amacuro states), Colombia, Guyana, Suriname, French Guiana, Peru, and Brazil (Berry et al. 1999; Clay and Clement 1993).

Study Area and Communities

Ecological Setting and Characteristics of the Caura River Basin

The Caura River Basin is located in the western section of Bolívar State, in southern Venezuela (Figure 1). Marked by the presence of the immense Para waterfalls, the local people divide the Caura River in two sectors: the Upper Caura, which has headwaters to the south close to Brazil, and the Lower Caura, which starts at the lower portion of the Pará Falls and continues to its confluence with the Orinoco River.

Most of the surface of the Caura River Basin is covered by evergreen forests, in addition to small areas of riverine forest, savannas, and shrublands (Rosales

Figure 2. A *sarrapia* fruit. Photograph by Ildemaro González.

and Huber 1996a, 1996b). Topographically, the Upper Caura consists of elevated terrain that includes isolated table top mountains or *tepuis*, and the Lower Caura is characterized by its descending high hills from the Para Falls to alluvial plains at its northernmost portion. The climate of the basin is bimodal, with a dry season from December to April and a wet or rainy season from May to November.

Due to its varied topography, climate, and geomorphology, the Caura region supports a high diversity of flora and fauna. The most recent data suggest that there are 2,657 plant species in the region (Bevilacqua and Ochoa 2001; Rodriguez et al. 2008). This represents 17% of the flora in Venezuela and 38% of the flora within the Venezuelan Guiana (Rodriguez et al. 2008). There are also about 450 fish species (Balbas and Taphorn 1996), 310 species of birds (Lentino 1996), and approximately 204 species of mammals (Deza 1996). With the aim to preserve its rich ecosystems, most of the Caura territory has been designated a forest reserve, which overlaps four other areas that fall under the Special Administration Regime (*Áreas Bajo Régimen de Administración Especial*—ABRAE).

Today, the Caura region has a population of approximately 15,000 of which 3,500 are indigenous peoples belonging to five distinct ethno-linguistic groups: the Carib (Ye'kuana, Kari'ña and Pemon), Yanomamö (Sanema), Hodï (Hoti), Arawakan (Piapoco), and Guahiboan (Jiwi) (Silva 1996). Although there are some small indigenous settlements in the Lower Caura, the great majority of the indigenous population inhabits the Upper Caura River Basin. The remaining 11,500 non-indigenous inhabitants are *criollos* and descendants of maroons (escaped African slaves) who live within the boundaries of the Lower Caura River Basin and are the subjects of this paper.

Three Case Studies of the Lower Caura River Basin

Our research focused on the Afrovenezuelan and *criollo* cultural groups from three communities located in the Lower Caura River Basin. Aripao is an

Afrovenezuelan community, and Jabillal and Las Trincheras are *criollo*. These communities were chosen for having a strong relationship with the forests and its natural resources, characterized by such traditional subsistence activities as the harvesting of *sarrapia* fruits.

Aripao

Research (Pérez 1997, 2000, and 2002) shows that Aripaeño ancestors were maroons of the colonial plantations in Dutch Guiana, known today as Surinam. Sometime after the mid 18th century, they fled from the conditions of slavery in the plantations and reached the Upper Caura River, where they gained their freedom. From there, Aripaeño forebears founded several settlements before reaching present-day Aripao at the end of the 19th century.

After the 1960s, the Aripaeños changed from a semi-sedentary to a sedentary lifestyle. The construction of a 4 km asphalt road, which intersects a main highway, provided an efficient gateway between the Aripaeños and the outside world. As a result, they gained access to many goods and services, such as government sponsored housing, modern healthcare, a primary school, a Catholic church, and a connection to an electrical grid. Government employment opportunities opened up for some Aripaeños, while others were integrated as small-scale entrepreneurs. Today, Aripao has a population of 296. Despite these changes, the Aripaeños continue to practice traditional subsistence activities such as fishing, hunting, shifting agriculture (*agricultura itinerante*), and the harvesting of *sarrapia* and *moriche* (*Mauritia flexuosa,* L.) fruits.

Jabillal and Las Trincheras

Jabillal was established in the 1950s by the people who moved from Campo Alegre, a community farther inland from the Lower Caura, in response to public policies issued to strengthen the agrarian sector. Las Trincheras was possibly founded in the 1860s, like Campo Alegre. The people from these two communities, who identify themselves and are locally known as *criollos*, maintain strong relationships with each other. Attracted by the international boom in the demand for *sarrapia* beans, they migrated from the higher elevation plains (*llanos altos*) located north of the Caura watershed, to the Caura region between the late 19th and early 20th centuries (Perez 2002; Souto 2009; Vispo 1998).

Today, Jabillal is a one street town, with approximately 100 inhabitants who occupy government sponsored housing (Souto 2009). Las Trincheras is a smaller community of only 40 residents who live in traditional adobe houses. The communities are 2.4 km apart by water or 9 km by dirt road, and in contrast to Aripao, they are located 40 km south of the main highway down an often deteriorated dirt road. They are connected to an electrical grid and have state supported health services and a primary school. The main economic and subsistence activity in Jabillal is agriculture, while in Las Trincheras it is primarily tourism, followed by fishing and hunting. Yet, the people of both communities have traditionally been *sarrapieros*, those who gather *sarrapia*, and continue even today.

Overall, the Lower Caura River Basin is a landmark of cultural heritage, identity, and territory for these non-indigenous communities. Although the Jabillalenses and Trincherenses do not share a common history with the

Aripaeños, they have created and established strong inter-cultural alliances with each other (Pérez 1997, 2000, and 2002; Pérez and Perozo 2003), and together they continue to rely, physically and culturally, on the biodiversity offered by the forests.

Methods

The data collected for this article comes from two larger projects. ''History, Culture, and Ethnodevelopment of Aripao, an Afrovenezuelan Community in Northwestern Bolívar State,'' was begun by Berta E. Pérez in 1993 and continues with the collaboration of her research team. ''Ethnobotanical knowledge and forest reliance of three rural non-indigenous communities that reside in the Lower Caura River, Southern Venezuela,'' Tamia Souto's dissertation work, included fieldwork from 2007 to 2009.

Both projects collected data from participant observation as well as semi-structured and open-ended interviews. All participants were informed about the objectives of the study and how the information would be used. They provided oral consent since many of them are reluctant to write and some cannot read or write. Both types of interviews were conducted among 14 men and 14 women, for a total of 28 *sarrapieros* from each of the three non-indigenous communities. A total of 84 participants were asked about the biology of *D. odorata*, the cycle of pre-harvesting, harvesting, and processing of the fruits, the bean extraction process, the local uses of the species, the history as well as the cultural significance of this traditional subsistence activity and the changes perceived in the gathering process from their remembered past to the present-day. Semi-structured interviews were also carried out with two of the local *sarrapia* buyers who serve as intermediaries between the *sarrapieros* and representatives of the international industries. Their questions were related to their involvement in the *sarrapia* industry, their relationship with the communities, the final destination of the beans, and the fluctuation of the *sarrapia* market/price over time.

Both authors were present in the pre-harvesting or harvesting period during their visits in 1997, 1998, 2008, and 2010. During their travels, various field trips were made to several of the wild and cultivated *sarrapiales* (*sarrapia* tree stands) in the company of *sarrapieros*. A cultivated *sarrapial* is formed when a *sarrapiero* propagates the tree by planting whole *sarrapia* fruits directly into the soil. While the majority of the cultivated *sarrapiales* were accessible by car or by foot, the wild *sarrapiales* we visited could only be reached by a dugout canoe and then on foot through the forest. The cultivated *sarrapiales* as well as the wild *sarrapia* stations and substations visited are identified in Table 1. During the *sarrapia* boom in the 1880s to 1930s, the Venezuelan government divided the wild *sarrapia* forests into administrative areas based on the natural contours of the region's topography, such as mountain ridges and river channels. Each administrative area enclosed many *sarrapiales*, which are separated from each other by natural (e.g., streams, hills, and corridors of other species of trees) and anthropogenic boundaries (e.g., trails). These *sarrapia* tree stands were organized by selecting some as stations to serve as access points, in turn, to other *sarrapiales*, their substations. Stations were *sarrapiales* near the Caura's riverbank that served as transfer points for

Table 1. *Sarrapiales* where data were collected for this article. See Figure 1 for landmark references (*).

Name of sarrapial	Location of sarrapiales	Cultivated/Wild	Times visited
Aripao	Several lots in town*	Cultivated	More than five
Corocito	36.02 km SE from Aripao*	Cultivated	Three
Los Cerritos	NE from Las Trincheras*	Cultivated	Two
Temblador	N from Las Trincheras*	Cultivated	Two
Campo Alegre	NE from Jabillal*	Cultivated	More than five
Suapure	Station*	Wild/Cultivated	Six
Tres Moriches	1.8 km SW from Suapure	Wild/Cultivated	Five
Santa Elena	2.2 km SW from Suapure	Wild/Cultivated	One
La Hermosura	4.4 km SW from Suapure	Wild	Two
Los Chácharos	8.8 km SE from Suapure	Wild	One
Paují	8.9 km SW from Suapure	Wild	One
Los Morocotos	10 km SW from Suapure	Wild	One
Dos Bocas	Station*	Wild	One
Caño Mato	Station*	Wild	Two
El Aceite	20.5 km SW from Caño Mato	Wild	One
Cucurital	22 km SW from Caño Mato	Wild	One
Las Marías	27.3 km SW from Caño Mato	Wild	Two
La Prisión	Station*	Wild	One
La Unión	Station* (Chorro 5000)	Wild	Two
Dufrumi	La Mura Rapids (Chorro 5000)	Wild	More than five
Platanillal	8.75 km S from Chorro 5000	Wild	Three
El Chaparro	26.25 km S from Chorro 5000	Wild	Three
El Merey	35 km S from Chorro 5000	Wild	Seven
El Quinal	37 km S from Chorro 5000	Wild	Two

middlemen to distribute provisions, assign the substations to the *sarrapieros*, receive the harvested *sarrapia* beans, and transport the beans by boat back to the market. While some *sarrapieros* harvested and processed the fruits from the *sarrapial* at the station, others hiked into the mountain and forest to reach their designated *sarrapia* tree stands or substations. This classification system is still used in the Lower Caura.

The goal of these field expeditions was to obtain a better perspective of the geographical distribution of the *sarrapiales* and the activities involved throughout the annual cycle of *sarrapia*. By witnessing the processes from the inflorescence to the fruit maturation, and from the harvest of fruits to the treatment of beans, both authors were able to cross-check the information and fill in the gaps from the data gathered from the interviews. The information collected was documented through written field notes, digital voice recording, videos, and photographs. These documents are the source of the quotes that appear in this article and are kept on file with the authors.

Results and Discussion

This section focuses on three aspects of *sarrapia* LEK: 1) the distinction between wild and cultivated *sarrapiales*, 2) the cycle of pre-harvesting, harvesting, and processing of the fruit for the extraction of the bean, and 3) the many uses of the *sarrapia* trees.

Local Ecological Knowledge of *Sarrapia* Forests

According to the inhabitants of these non-indigenous communities, *sarrapia* forests in the Lower Caura River Basin only grow in an area bounded by the Sipao River to the north, the basin divide to the west, the Nichare River to the south, and the east bank of the Caura River (Figure 1). This region is renowned for the quantity and quality of *sarrapia* beans it generates in comparison to other parts of the country and South America as a whole (Avendaño and Sanblas 1995; Fuentes Guerrero 1980; Oxford-López 1948).

The locals distinguish between two types of *sarrapia* tree stands, wild and cultivated. The wild *sarrapiales* are part of the natural forests and are mostly located along the west bank of the Lower Caura River. Some examples are the *sarrapia* stations of Suapure, Dos Bocas, Caño de Mato, and La Union (Figure 1) and their respective substations (refer to Table 1 for a few examples of substations). These wild *sarrapiales* are concentrated in areas that are often interrupted and bounded by other species of trees, such as *quina* (*Angostura trifoliate* [Willd.] T. S. Elias), but we do not have quantitative studies of these clusters. In addition, the local communities distinguish between two types of wild *sarrapia* trees: ''bad'' and ''good.'' The former yield few and poor quality fruits in comparison to the latter, which are the ones they harvest. Furthermore, they divide the wild *sarrapiales* into those close to the *raudales* (rapids) south of Jabillal, such as the *raudales* of Cedeño, and those in the mountainous region, such as Suapure (Figure 1).

The cultivated *sarrapiales* are located within and around former or current human settlements as well as in people's *conucos* (agricultural fields). Many of these *sarrapiales* were planted during the peak of the international boom of *sarrapia* beans in the 1880s (Fuentes Guerrero 1980). A cultivated *sarrapial* belongs to the nuclear or extended family members of the single household who planted the trees. Any member of the household can gather the *sarrapia* fruits, but the head of the household must authorize anyone else to harvest the *sarrapial*. The cultivated *sarrapial* is a family heirloom. If there is no longer anyone from the unilineal family line alive or interested in claiming it, the cultivated *sarrapial* becomes a historical reference to the locals in that they remember it and refer to it by the last name of the family to whom it belonged. The abandoned *sarrapial* can either be harvested by the people of the community or appropriated by one of the local families. Some of the cultivated *sarrapiales* are Aripao, Corocito, Temblador, Los Cerritos, and Campo Alegre (Figure 1).

Participants claim that cultivated *sarrapia* trees differ from wild ones in that they are shorter (with a maximum height of 20m), have larger and greener fruits with more pulp, and the beans have a lighter brown color and are less fragile. Another difference mentioned is that cultivated *sarrapiales* need more care and maintenance because they must constantly be cleared of lianas (*Ficus* spp.) and other vines to become and remain productive. It takes up to five years before a sapling yields fruits, and continuous maintenance of the tree is required to insure fruit production. However, the quality and composition of coumarin extracted from the wild and cultivated *sarrapia* beans is said to be the same.

Local Ecological Knowledge of *Sarrapia* and Its Annual Cycle

From February through May, the *sarrapieros* of the Lower Caura River Basin are busy harvesting *sarrapia* fruits and extracting the beans. But their ethnobotanical knowledge of *sarrapia* transcends these activities. Monitoring *sarrapia* trees is a cyclical annual task that begins in July and finishes in June of the following year, thus completing what is defined in this article as the annual cycle of *sarrapia*. Figure 3 shows how *sarrapieros* associate different ecological markers, such as presence of fauna and plants species as well as climate, temperature, soil, and drainage conditions, with crop productivity. The figure provides a hypothetical example for visualizing a three-year cycle of *sarrapia,* with column '1' representing a current *sarrapia* annual cycle, column '0' the preceding cycle, and column '−1' the one before that.

Throughout the annual cycle of *sarrapia* (Figure 3, column '1'), the *sarrapieros* look for ecological clues to predict the amount of fruit that the trees will yield for the upcoming harvest. This information is compared to the previous annual cycle of *sarrapia* (Figure 3, column '0'). Subsequently, the *sarrapieros* interconnect those biotic and abiotic signals that are critical to and form part of their ethnobotanical knowledge of *sarrapia*. The *sarrapieros* know that the trees are characterized by mast fruiting every three years and that masting frequency varies with environmental conditions. Hence, *sarrapieros* always forecast the yield of *sarrapia* fruit for every harvesting period as the trees do not follow a precise masting cycle.

Pre-harvesting Period

The pre-harvesting period of *sarrapia* begins with flowering during July, August, and September. This is the first and most important indicator for the *sarrapieros* to predict fruit production of the upcoming harvesting season. They combine their observation of the abundance of flowering trees, with their knowledge of biological and climatic conditions from the previous cycle to make this estimate. For example, if the *sarrapia* trees show an abundance of blossoms in the current annual cycle ('1'), then it was preceded by an extended dry period during the previous annual cycle of *sarrapia* ('0') and subsequently, by a short rainy season that spans the two cycles ('0' and '1'). So fruiting predictions are based upon *sarrapieros'* knowledge gained from past experiences and from observing the ecological conditions during at least the last two *sarrapia* annual cycles. It is important to mention however, that the flower is very sensitive to an extended rainy season ('−1' and '0'), which causes the fragile flower to fall, as well as to a small insect locally named *purgon* that appears when the rainy period begins and eats the flowers.

The same principle applies to the production and size of *sarrapia* fruits. That is, more fruits have time to finish the maturation process and reach normal size (cycle '1') when the trees have been subjected to a longer period of stress caused by an extended summer and extreme heat conditions during the preceding harvesting period (cycle '0'). But a long rainy season can damage fruits by slowing down their maturation, leaving them too green, rotten, or small. Following the same logic, the cycle subsequent to a normal or shorter dry period should yield fewer and smaller fruits compared to the current cycle.

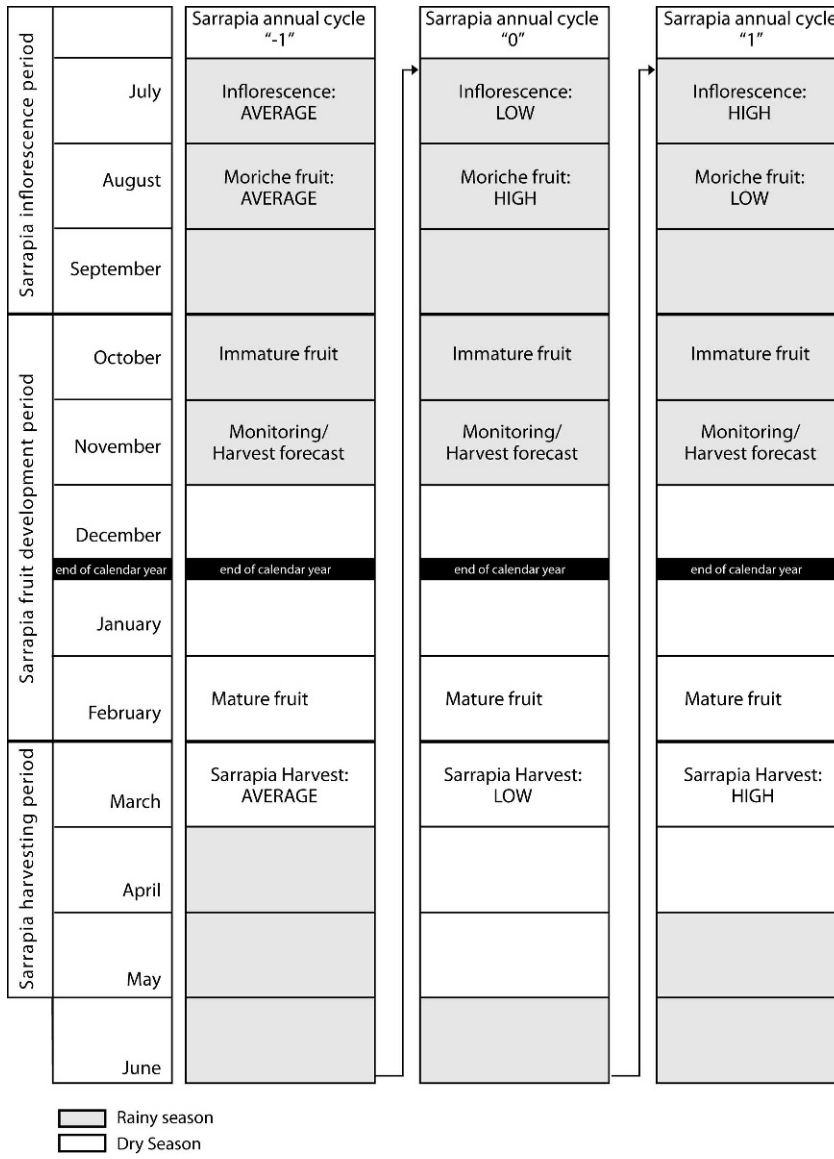

Figure 3. The ethnobotanical knowledge of the *sarrapia* annual cycle and its association with different components of the ecosystem (climate conditions, ecological processes, species interactions, and plant phenology). This hypothetical example shows a three-year cycle with column '1' representing a current *sarrapia* annual cycle, column '0' the preceding cycle, and column '−1' the one before that.

Moreover, the Aripaeños negatively correlate the production of wild *sarrapia* with the production of the *moriche* fruits, another NTFP they widely and traditionally harvest. They claim that when there is a low yield of *moriche* fruits, it would be followed by an increased production of wild *sarrapia* fruits, and when there is a high yield of *moriche* fruits, it would be followed by a poor yield of wild *sarrapia* fruits. This pattern repeats itself every other calendar year. Hence, if the

moriche palm fruit harvest following a long hot dry season is low then the next *sarrapia* harvest should be high (Figure 3). While *moriche* yields are average following normally dry and wet seasons, and higher after a longer wet period, *sarrapia* yields are lower under these conditions.

Once the fruit of the wild *sarrapia* begins to reach its full size, the *sarrapieros* can more precisely estimate the size of the harvest. This activity, known as *exploraciones* (monitoring and harvest forecast), is carried out by experts during November and December. The yield of *sarrapia* fruit per *sarrapial* is calculated by using an antique unit of mass called *quintales* (centner), which is equivalent to 46 kg. The fruit yield of each *sarrapial* is estimated by observing one particular tree per *sarrapial*, called ''*palo e' la regla*'' (a tree gauge). The average yield per tree can vary between 10 and 20 kg of fruit depending on the tree's age and size (Fernández 1995:120). *Sarrapieros* need to have a keen or very trained eye, because the fruit, not yet mature and still green colored at that point, easily blends in with a tree's leaves. They use the branches of the trees as an indicator, because many of the locals claim ''if the branches are weighed down, then these are filled with fruits; the mass of the fruits weighs down the branches.''

Sarrapieros look to additional clues to plan for harvesting beginning in January and February, while they engage in traditional activities such as fishing and hunting near the wild *sarrapiales*, and clearing the forest to make *conucos* near cultivated *sarrapiales*. In February, the *sarrapia* fruit begins to mature and the skin slowly changes color to a pale brown. It is around this time that men observe scattered *sarrapia* fruits on the ground, either whole or already nibbled by animals, such as wild pigs (*Tayassu pecari*) and tapirs (*Tapirus terrestris*). Because the fruits of the cultivated *sarrapiales* mature and fall much sooner (February and early March) than the fruits in the wild *sarrapia* forests, the maturation of the cultivated fruit signals that the wild *sarrapiales,* many of them located days away from their homes, are almost ready to be harvested. Furthermore, informants state that if the cultivated *sarrapiales* yield more fruit than usual, then the yields of wild *sarrapiales* in the mountains will be low and those in the *raudales* will be high. One explanation provided to understand this difference is that when the rainy season is longer, *sarrapiales* in the *raudales* fare better than those in the mountains because the *raudales* area has better water drainage.

Harvest Period

Most of the people from Jabillal and Las Trincheras nowadays prefer to gather from the cultivated *sarrapiales*, such as Campo Alegre and Temblador, since these are close to their homes. Only a few *sarrapieros* from these two communities go to the wild *sarrapiales*. In Aripao, however, the majority of the people leave for the mountains after they have gathered the fruit and completed the bean extraction process from the cultivated *sarrapiales*.

The members of each nuclear or extended family household are responsible for acquiring the provisions needed for their stay in the wild *sarrapiales*. They take camping equipment (e.g., hammock and mosquito net), food (e.g., oil, salt, rice, cassava bread, pasta, and salted fish or meat), and tools (e.g., machete, hammer, large bags, rope, and metal bucket), in addition to fishing and hunting gear (e.g., hooks, nylon thread, and rifle).

The residents of these communities explain that in the past, entire families moved as single independent units to the mountains for several months, from February to May, to harvest the fruit and extract the beans. Today, those who go to the wild *sarrapiales* stay for shorter periods (up to four weeks) at different times. Although the families continue to organize themselves according to single independent units, not all the members of a household are required to participate if they have other responsibilities (e.g., school and work).

Each family unit knows which wild *sarrapial* is theirs to harvest. For example, the Montañez family of Aripao has always gone to La Hermosura, El Pauji, and Los Morocotos, which belong to the *sarrapial* station of Suapure, while the Sierra family has traditionally harvested in Las Marías and Caño Fístalo del Cerro de Mato, which belong to the main station of Caño de Mato. Their claim to particular wild *sarrapiales* derives from the Venezuelan government's decree in 1882 that was enacted to monitor and control the export of *sarrapia* beans by dividing the wild forests into administrative areas. Each exporting company was required to obtain a license to exploit the beans in a particular area, and they, in turn, allocated specific substations to the same families every year. Even though the decree ceased to be in effect in 1890, the Caura inhabitants continue to this day to harvest *sarrapia* in their family designated *sarrapiales* in the same way as it was implemented then. The difference is that these *sarrapiales* have been culturally appropriated and transformed in ways where implicit cultural rules come into play (e.g., the prohibition of harvesting *sarrapia* fruits in another family's wild *sarrapial*). For example, names of cultural significance are given to different *sarrapiales* based on historical events, real or imagined sensory experiences, human-animal interactions and natural characteristics of the landscape. El Gallo (the rooster), a *sarrapial* substation, is named after a rooster that is constantly heard singing while people are harvesting, and Las Mujeres (the women), a *sarrapial* substation in the *raudales*, was named after two women who drowned nearby.

The *sarrapieros* often set up camp in the area formerly used as a *sarrapial* station. The day after camp set-up, the group heads out to their corresponding *sarrapia* substation. In most cases, they must re-open the trails left from the monitoring and harvest forecast done in November and December. As the *sarrapieros* walk through the forest in an east-west direction, the sun, wind, and clouds are used to guide them to the correct *sarrapial*.

Once at the *sarrapial*, they gather *sarrapia* fruit by picking them up directly off the ground and placing them in a plastic bucket or bag (Figure 4). They only collect fallen fruit because it must be mature enough to easily separate the husk from the seed. The *sarrapieros* follow an organized system to gather the greatest amount of fruit in the least time possible. Once the plastic bucket or bag is full, a *sarrapia* tree is chosen within a set radius of the working zone where they will pile the fruits against its trunk. The *sarrapia* fruits are safeguarded from the rain under the crown canopy. As the group moves farther away from their working zone, the procedure is repeated by choosing another *sarrapia* tree as a shelter space and by setting up a new radius for their working zone. Each person can gather up to 75 kg of fruit a day and carry up to 2 bags of 46 kg of fruits back to camp. However, if the *sarrapial* is too far from the main camp, the beans are

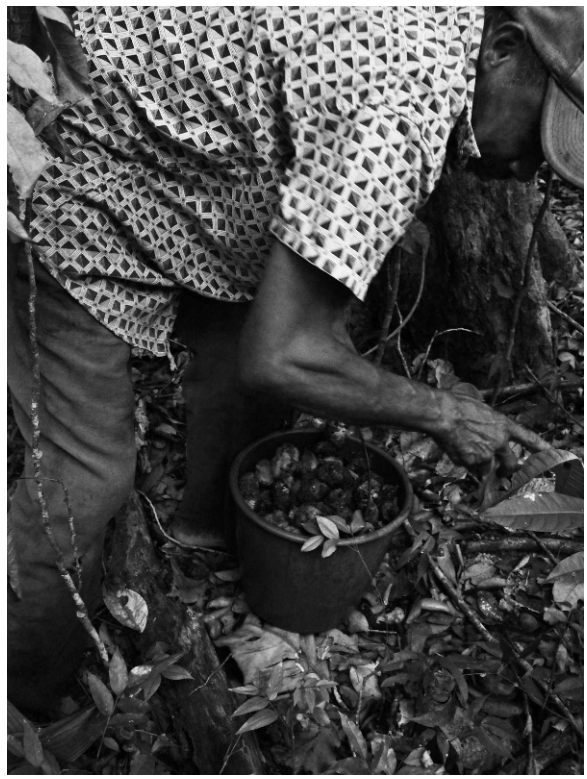

Figure 4. A man harvesting *sarrapia* fruits in a wild *sarrapial*. Photograph by Ildemaro González.

immediately extracted from the fruit in order to decrease the weight and facilitate transport.

In the camp, the *sarrapia* fruits are immediately thrown into a pile and covered with broad leaves of *yagua* (*Attalea butyracea* [Mutis ex L. f.] J. G. W.Boer) or *San Pablo* (*Geonoma deversa* [Point.] Kurth.) to provide shade, to allow evaporation, and to prevent fermentation. In most cases, the pile is placed below a small, aired shelter that protects the fruits from the rain and lets them dry before extracting the bean. This protection is necessary because the fruit is very delicate, as *sarrapieros* point out, and only a good quality seed, one that has its entire seed coat, is brown (not black) and wrinkled (Figure 5a), is suitable for local and international markets.

During the extraction of the beans, the family stocks the fruits in the husking area where they sit and work around the pile (Figure 6). The fruits are placed, one at a time, on top of the flat surface of a rock or tree stump. While holding the fruit with one hand, the other hand is used to split the fruit by striking at its bottom apex with a hammer or rock. Most of the time men are in charge of splitting the fruit, while the women and children extract the bean from the partially split *sarrapia*. Each bean is put into a dry bucket.

Some beans are associated with certain beliefs. For example, sometimes when separating the bean from the husk, a double bean may appear; these are called *morochas* (twins) and bring good luck to the *sarrapiero* group. When they

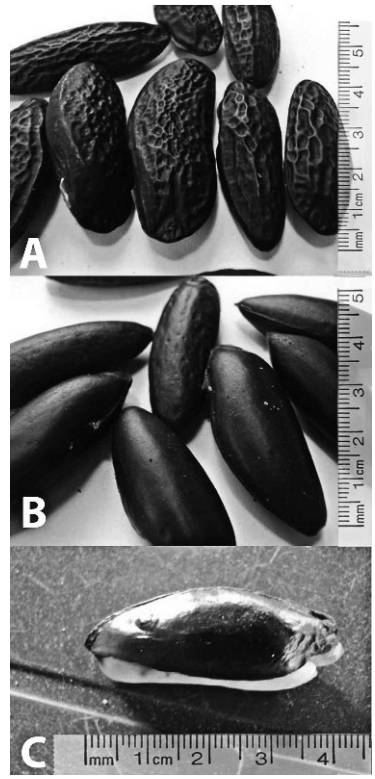

Figure 5. Different types of *sarrapia* beans: (A) complete outer shell or skin, brown, and wrinkled (best quality); (B) *almendra verde* (smooth green almond—undesired characteristic); and (C) *cara de caballo* (no skin over the hilum—very poor quality). Photograph by Tamia Souto.

encounter this double bean fruit, they shout ''one *morocha*, two *morochas*, three *quintales*!'' alluding to their good fortune and a probable good harvesting season.

The entire process is very time consuming and can take many days or even weeks. It becomes a family activity where everyone helps to reduce the pile of *sarrapia* fruits while sharing jokes, games, and stories. If exhaustion has not taken over after a long day's work, it is also common for women to forage for wild fruit, such as *maya* (*Bromelia crysantha* J.) and *piña montañera* (*Ananas paraguazensis* C.), and for men to fish and hunt to bring in additional protein.

People can harvest *sarrapia* as long as the fruit continues to fall or until the rainy season begins, which in both cases is around May. According to our records, each adult extracts between 5 kg and 8 kg of beans per day. It takes approximately 46 kg of fruit (one bag) to produce approximately 2.5 kg of *sarrapia* beans. Working for a total of 30 days, a person can obtain between 150 and 240 kg of beans. The Carías family of Jabillal, for example, said they processed up to 405 kg of *sarrapia* beans during a harvesting season.

The *sarrapieros* identify several types of beans and recognize that their final quality depends on the treatment given to the fruit and bean as well as the expertise of the person who extracts the bean. For example, people in the Caura

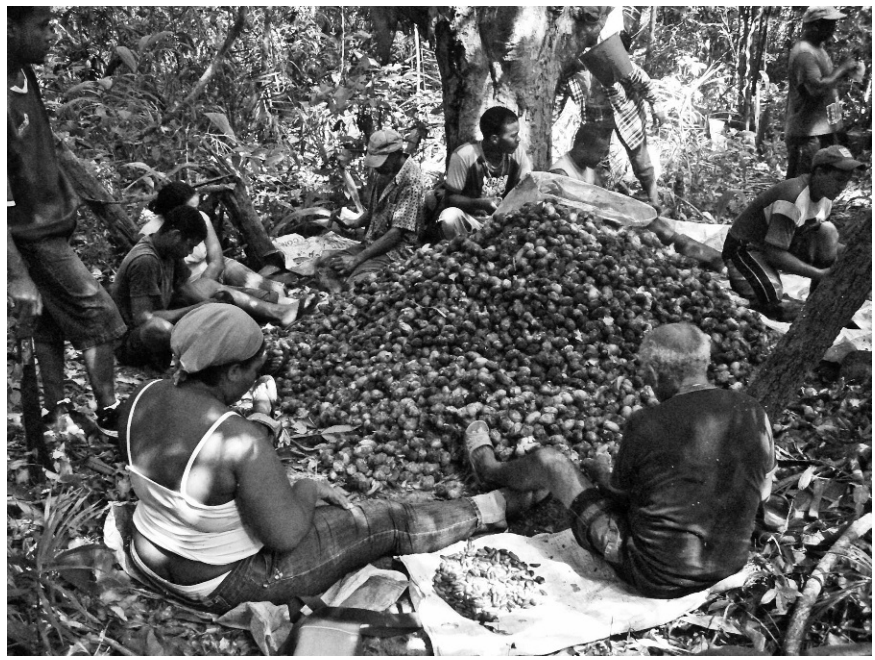

Figure 6. A family extracting *sarrapia* beans in the husking area. Photograph by Ildemaro González.

consider the *sarrapia* fruit to be ''hot.'' This ''hot'' and ''cold'' dichotomy, a common symbolic classification system in Latin America that ensures equilibrium (Foster 1967; Ingham 1970; Lévi-Strauss 1963), also applies to *sarrapia* as food (see below). According to all informants, ''if the fruits are piled or even if these are scattered on the ground and get wet, the beans burn,'' making them black and fragile. *Sarrapieros* also know to pound the fruit only when its skin is entirely dried, otherwise the outer shell of the bean comes out *lisa* (smooth) and looking swollen. This condition is defined as *almendra verde* (green almond), an undesired characteristic (Figure 5b). Moreover, another type of bean called *cara de caballo* is considered very low quality and may not be marketable. It is easy to recognize as the hilum is not covered by the outer shell or skin (Figure 5c).

The beans are sorted according to certain characteristics, mainly color and surface, since not all beans have the same quality nor require the same treatment (Figure 7). Those with a brown-colored and wrinkled coat (Figure 5a) are spread over a cloth or burlap mat that is then placed outside in the shade for one day. The second and third days, they are spread out in direct sunlight to complete the drying process. The beans are then ready for sale and stored in a dry area in large burlap or polyurethane bags of 46 kg. However, *almendras verdes* (Figure 5b) are separated and spread out in a cool, dry room for four to six days to allow them to wrinkle, after which they are exposed to the sun like the others.

Uses of the *Sarrapia* Tree

The Caura's inhabitants do not waste any part of the *sarrapia* tree. Its wood is only used when the tree is too old or rotten to produce fruits, even though the

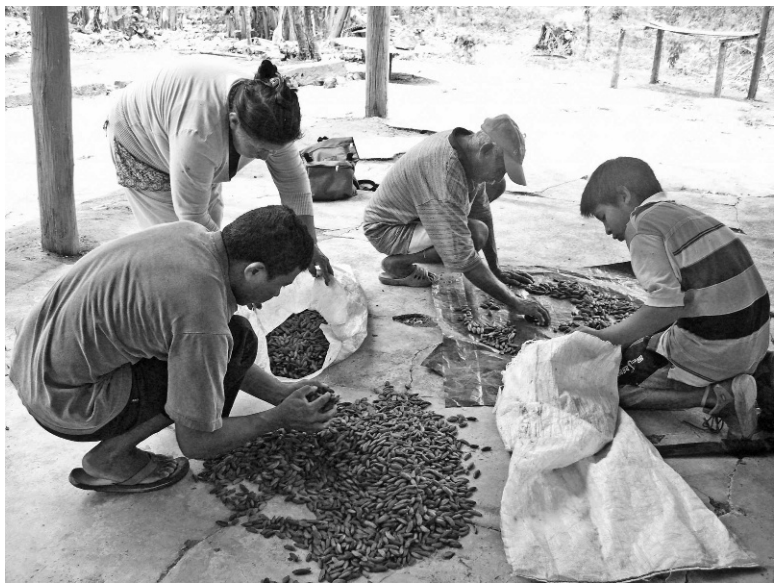

Figure 7. A family sorting out the dried *sarrapia* beans. Photograph by Ildemaro González.

timber quality is high because it is heavy and resistant to rot with a minimum life expectancy of 25 years (Prance and Silva 1975). But once a tree is cut down, locals make many items from its wood, such as rustic cutting boards, board tables, shelves, tree stumps for chairs, and house poles.

In addition, the residents from these three communities plant their own *sarrapia* trees in their *conucos*, communities, or backyards as a conservation strategy and a cultural symbol. In Aripao, the local festival is named after this tree and the government of Bolívar State issued a decree in 1952 in which *sarrapia* was named the emblematic tree of the region (Fernández 1995:122). Moreover, the flowers are picked by some Aripaeña women to decorate and perfume the local church or their homes. Some young girls even use the flowers to adorn their hair.

The fruit is also a delicacy to the Caura's residents who make a heavy and concentrated juice (*carato*) out of the pulp of the fallen fruit, or more commonly, eat it. However, since the fruit is considered to be ''hot'' and even an aphrodisiac, the elderly recommend a person consume no more than three fruits per day. Otherwise, the person can become feverish or develop body aches (*cuerpo malo*). Both hunters and fishermen use the fruit as bait. The fruit that remains after the bean is extracted is burned in the hearth to repel mosquitoes or other insects. The husks can also be used as lanterns since people claim that the fruit contains an oil that burns green. Additionally, the ashes produced by these remnants can be further processed with lye to make *sarrapia* soap (*jabón de tierra*).

All *sarrapia* beans, regardless of their type or quality, are used to make vanilla extract and homemade medicine for the treatment of stomach ailments. Moreover, some adult men use the beans as natural cologne by putting a couple of kernels inside their coat pocket and the adult women perfume their homes by placing bunches of *sarrapia* beans into small receptacles.

Conclusion

The Caura River Basin has become environmentally and socially impacted since a variety of development programs began to be implemented in the region by the Venezuelan government in the 1960s. Furthermore, illegal logging in the Lower Caura and gold mining in the Upper Caura have had devastating consequences to the environment and its residents (i.e., the pollution of water resources, the clearing of the forests, and the increase of several diseases, such as malaria and leishmaniasis) (Bevilacqua et al. 2008; Rodríguez 2008). Therefore, studies of Local Ecological Knowledge are important because they can offer innovative ecological alternatives for the protection and conservation of ecosystems before irreversible environmental damage occurs.

As a source of information, LEK can provide options for the replacement of top-down Western conservation strategies that have proven to be inefficient in many cases, or provide appropriate management plans through the combination of both traditional and Western practices (Zent 2005). Along the same lines, this study of the ethnobotanical knowledge of *sarrapia* may very well contribute to the development of ecological alternatives for the conservation of the Caura's fragile ecosystems and the socio-economic well-being of its peoples through sustained development.

Based on this study, there is no doubt that the residents from Aripao, Las Trincheras, and Jabillal have an extraordinary cognitive construct of their ecosystem and *sarrapia's* place in it. This has been demonstrated by their remarkable ability to handle *sarrapia* over multi-year cycles. They preserve their ethnobotanical knowledge of it, not only as a NTFP for local use, but also in its connections to other plant and animal species as well as climate, temperature, soil, and drainage conditions. Hence, the people of these non-indigenous communities not only acquired and shared their ethnobotanical wisdom about *sarrapia* in a historical past, but they also continue to cherish it today as well as its praxis. Following the accepted premises of how LEK is acquired and transmitted (Ellen and Harris 2000; Jovel et al. 1996; Seijas and Arvelo-Jiménez 1978; Turner et al. 2003), the authors posit that the Afrovenezuelans and *criollos* most likely acquired this knowledge from the transmission of ecological information by other cultures or ethnic groups at different historical time intervals, as well as from their own interactions and experiences with their natural surroundings through processes of experimentation, trial and error. Aripaeño forebears most likely learned about the intricacies of *sarrapia* from Carib-speaking ethnic groups, such as Kari'ña and Ye'kuana, who inhabited the Caura region upon their arrival in the mid 18th century. Similarly the *criollos* acquired this knowledge when they migrated from the higher plains into the Caura region for the exploitation and extraction of various NTFPs in the mid 19th century. This expertise, in turn, has perhaps prevailed among the Caura's residents in that it has likely been passed on from one generation to the next and exchanged with neighboring communities.

One possible reason for the maintenance of this knowledge today is that *sarrapia* harvesting has not lost its importance as a traditional subsistence activity.

The market for *sarrapia* still exists and even though it is considered a marginal economic activity, people continue to harvest it as part of a tradition and a way to make some extra money. For example, the selling of *sarrapia* beans can represent between 5 and 19% of the total household income in Las Trincheras and Jabillas, respectively (Souto 2009). Thus, communities keep each other constantly informed about its cyclical annual conditions through their continuous monitoring of ecological indicators (abiotic and biotic). This ecological consciousness is further filtered down not only in their harvesting of the fruits in a sustainable manner, but also in their efficient use of every part of the tree. It is important to mention, however, that *sarrapia* is not merely a plant from which they only obtain one particular and exclusive benefit. In fact, it has been a crucial part of their culture for about 170 years, at the very least, since there is no available information prior to the period of the international boom of *sarrapia* beans in Venezuela. The constant interactions of Aripaeños, Trincherences, and Jabillalenses with *sarrapia* at the socio-cultural and ecological level throughout the recurrent annual cycle of pre-harvest, harvest, and post-harvest period have made it integral to their culture.

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