Ure (*Colocasia esculenta*-Araceae): An Edible Aroid of the Warao

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Research

Abstract

The Warao are the original inhabitants of the Orinoco Delta and the second largest indigenous group in Venezuela. The relatively recent transformation of the Winikina Warao sub-tribe from semi-nomadic swamp foragers to swidden-fallow agriculturists has led them to forsake traditional sustenance foods such as **yuruma** (palm starch from *Mauritia flexuosa* Mart.) for various introduced crops such as the tuber **ure** (*Colocasia esculenta* (L.) Schott). This paper describes the origins and taxonomy of **ure** including its secondary metabolites and uses, a description of swidden (**daukaba**) selection and preparation, and planting, harvesting, and consumption of **ure** by the Winikina Warao. It closes with a brief discussion of the impact of **ure** cultivation on the contemporary Winikina Warao.

Los Warao son los habitantes originales del delta del Río Orinoco y el segundo grupo indigena mas grande de Venezuela. La reciente transformación del subtribo Winikina Warao de una vida seminómada a una de agriculturador hizo que abandonen su comida tradicional de subsistencia como la **yuruma** (almidon de la palma *Mauritia flexuosa* Mart.) para cosecha introducida como el tubérculo **ure** (*Colocasia esculenta* (L.) Schott). Este artículo describe los origenes y taxonomía de **ure** incluyendo sus metabolitos secundarios y usos, selección de un terreno demontado (**daukaba**), y sembra, cosecha y consunción de ure por los Winikina Warao. Concluimos con una breve discusión del impacto de la cultivación del **ure** entre los Winikina Warao.

Introduction

The Warao are the second largest autochthonous indigenous group in Venezuela. Today the majority of Warao reside in the southeastern region of the Delta (Wilbert 1992). The Orinoco Delta is situated in the northeastern corner of the South American continent in the country of Venezuela, south of Trinidad and north of the Guyana highlands. It is a coastal plain built by the flow of the Orinoco River into the Atlantic Ocean (Muller 1959, van Andel 1967, Vasquez and Wilbert 1992). The Delta proper lies east of the Manamo River and north of the Orinoco River (Figure 1). It is from the Manamo and Orinoco Rivers that smaller **caños** (rivers) branch off, splitting the deltaic forest into islands.

Since prehistoric times, the Warao have shared with the Arawak and Carib people the region from Isla Margarita in the Caribbean Sea south to the Imataca Mountains of Guyana (Heinen 1992, Wilbert 1979, 1980a, 1980b, 1996). Their movement into the inner Delta was prompted by the need to escape the barbarity of the Caribs and Arawaks. They moved deeper into seclusion to escape enslavement by the early Europeans who were in pursuit of gold and other valuables. The success of the Warao in

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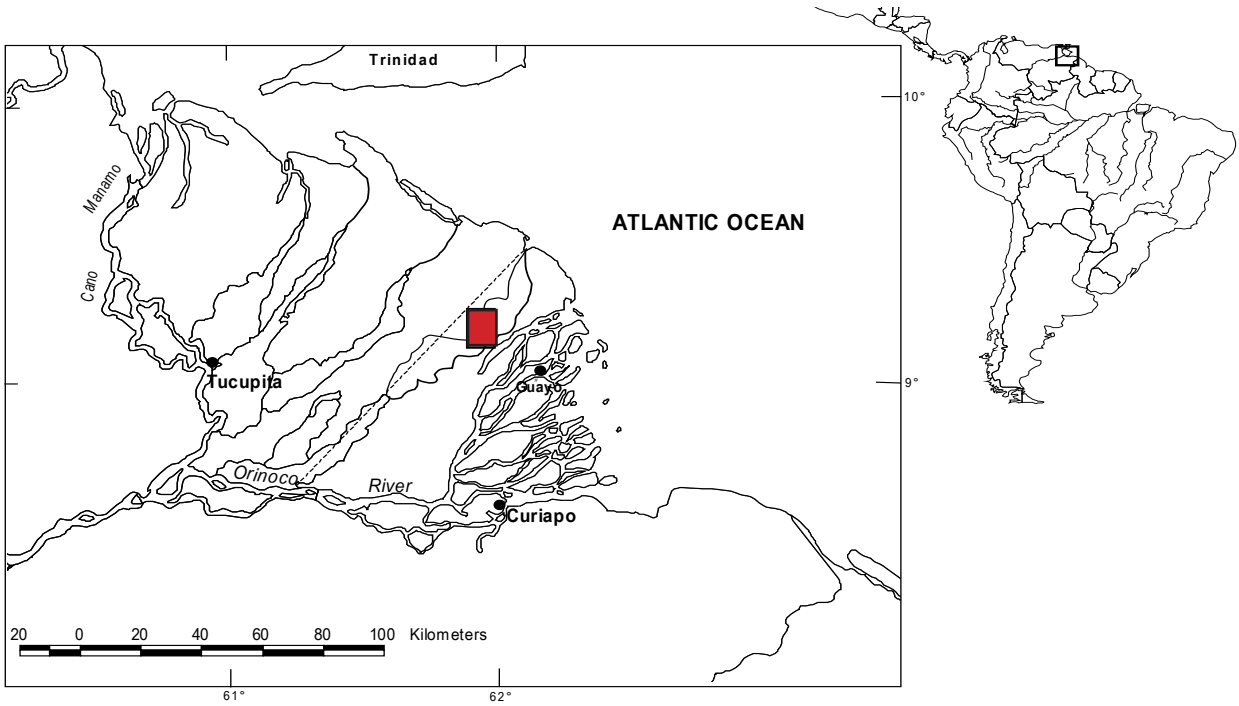


Figure 1. Study area in the Orinoco River delta of Venezuela marked in red.

this ecologically hostile and isolated region was in strong measure due to their ability to extract palm starch (sago/ **yuruma**) from the **ohidu** palm (*Mauritia flexuosa*), and to a lesser extent the **yaha** palm (*Manicaria saccifera* Gaertn.) (Wilbert 1974). **Ohidu** has been referred to as the tree of life by the Warao because, in addition to **yuruma**, it provided most products they needed for survival.

The Winikina Warao were one of the most isolated Warao sub-tribes. They were semi-nomadic and lived in island forests or traveled to the ocean, depending on the season which determined food availability. In the 1920s and 1930s the Winikina Warao were convinced to move from their seclusion deep inside the deltaic island of Mariusa to permanent village settlements along the edges of the Winikina caño, a large river that forms the eastern boundary. This move was facilitated by the introduction of **ure** (*Colocasia esculenta* (L.) Schott) by Capuchin missionaries. Although these Warao were one of the last to accept this as a food crop, other Warao sub-tribes who lived and worked in neighboring Guyana in the late 19th and 20th Centuries were already familiar with this plant (Heinen *et al*. 1994-96, Wilbert 1996). This aroid was readily accepted in the Orinoco Delta because of its tolerance to flooding and tidal effects, an essential criterion for any crop to successfully grow in this intermediate region of the Delta.

The transformation from semi-nomadic foragers to swidden-fallow agriculturists meant the adoption of swidden agriculture with **ure** as the main food source. Replacing **yuruma** with **ure** as the primary sustenance crop has been one of the primary reasons for changes in the socio-religious practices of the Warao. Although **yuruma** continues to be consumed today, it does not play as important a role as it did in the past for the survival of the Winikina Warao. No longer are annual excursions with elaborate rituals made to the **morichales** (**ohiduna**), oligarchic forests of **moriche** palm (*Mauritia flexuosa*) to collect it (Heinen & Ruddle 1974, Heinen et al. 1994-96, Wilbert 1996). Instead swiddens (daukabas) are prepared for **ure**, their main food source today.

The science of ethnobotany goes beyond making a list of plants used by a group of people. It is an interdisciplinary science that involves botany and anthropology and other disciplines as needed to better understand the interrelationship between people and plants (Balick 1996, Balick & Cox 1997, Gomez-Beloz 2001). The adoption of **ure** by the Winikina Warao as a sustenance crop is one example of the dynamic association between people and plants. This paper describes the origins and taxonomy of **ure** including its secondary metabolites and uses, a description of swidden (daukaba) selection and preparation, and planting, harvesting, and consumption of **ure** by the Winikina Warao. It closes with a brief discussion of the impact of crop cultivation on the contemporary Winikina Warao.

Origins

Colocasia esculenta originated from Southeast Asia and is reported to be one of the first crops cultivated by humans (Bown 1988, Coursey 1968, de la Pena 1970, Doku

1981, León 1977, Morren & Hyndman 1987, Onwueme 1978, Plucknett 1976). It spread from India eastward to Japan and the Pacific (including Hawaii, New Zealand, New Guinea, and Polynesia). It moved westward from the Mediterranean across Africa and into Europe. Colonists and slaves eventually introduced it to the New World (Greenwell 1947, Plucknett 1976) where it has become an established food crop throughout Latin America, including México (Alcorn 1984), Panama, Costa Rica (Hazlett 1986), and Nicaragua (Coe & Anderson 1996). It is reported to be used by the Pumé of southern Venezuela (Gragson 1997), the Ka'apor of Amazonia (Balée 1994) and the Siona-Secoya of Eastern Ecuador (Vickers & Plowman 1984). It is a widely accepted crop due to its tolerance for high amounts of water (Coursey 1968, Plucknett 1970). The plethora of common names for *C. esculenta* in different languages attest to its worldwide distribution and use. It is most widely known as taro, eddoe, dasheen, and cocoyam.

Colocasia esculenta Taxonomy

Colocasia is one of five genera (with *Alocasia*, *Amorphophallus*, *Cyrtosperma*, *Xanthosoma*) of economic importance in the Araceae (Coursey 1968, Doku 1981, Ghosh et al. 1988, Plucknett 1983). All of these are vegetatively propagated (Plucknett 1977). *Colocasia esculenta* is one of at least 10 species of *Colocasia*. Many varieties of *C. esculenta* are also known (Coursey 1968, Plowman 1969, Plucknett 1970, 1983).

Linnaeus first described this edible aroid in 1753 as two distinct species, *Arum colocasia* and *A. esculentum*. In 1832 Schott established the genus *Colocasia* and renamed the two as *Colocasia antiquorum* and *C. esculenta*, respectively. In 1856 Schott reconsidered and used one name, *Colocasia antiquorum*, to describe a single polymorphic species and reduced other *Colocasia* that had been described as separate species to varieties of *Colocasia antiquorum*. This convention was retained by Engler who added four varieties to *C. antiquorum*. In 1939 Hill felt that if one polymorphic species is to be recognized as outlined in the International Rules of Botanical Nomenclature, then the name *Colocasia esculenta* should take precedence over *C. antiquorum* because *Arum colocasia* and *A. esculentum*, the first names used by Linnaeus to describe this genus, include the specific epithets *colocasia* and *esculentum* (Hill 1939).

Because of variance within *Colocasia*, a debate continues today whether there are two distinct species of the aroid, namely *Colocasia esculenta* and *C. antiquorum*, or one polymorphic species, either *C. esculenta* or *C. antiquorum*, with several varieties (Plucknett 1983). This variability is common among crops that have been cultivated for a long time. Owing to their polyploidy nature, there is a wide variety of *Colocasia* making Linnean taxonomic application difficult at best (Doku 1981, Leon 1977). For now, *C. esculenta* can be considered the major species with two varieties, *Colocasia esculenta* var. *esculenta* and *C. esculenta* var. *antiquorum*.

Following this convention, **ure** used by the Warao is *C. esculenta* var. *esculenta* because this variety is known to produce one large corm with few cormels, a feature observed by the authors in the field. A voucher specimen has been collected from the Winikina region and deposted at NY (1055480). The common name used to describe this tuber by all Venezuelans is "**ocumo chino**," a reference to its Chinese origins (Coursey 1968, Onwueme 1978, Plowman 1969, Plucknett 1983). *Colocasia jacquinii* Schott, which has reddish petioles, is another species reported from Venezuela and is known by the common name "**ocumo bravo**" (Steyermark & Agostini 1966).

Secondary Metabolites

Almost all members of the aroid family contain minute crystals of calcium oxalate distributed throughout their tissues which may be implicated in the irritating quality found in many Araceae species. These compounds are found in the *C. esculenta* corm. Boiling the corm for approximately two hours is a requirement for consumption (Bown 1988, Greenwell 1947, Plowman 1969, Plucknett 1983). Other secondary metabolites found in *Colocasia esculenta* include alkaloids, alkyl-resorcinols, glycosides, phenolics, saponins, sterols, essential oils, resins, numerous sugars and organic acids (Coursey 1968, Dring et al. 1995, Fox & French 1988, Ghosh et al. 1988, Plowman 1969).

Uses

Colocasia esculenta has a number of medicinal uses. Its corm is used as an abortifacient, to treat tuberculous ulcers, pulmonary congestion, crippled extremities, fungal abscesses in animals, and as an anthelmintic. Its foliage is used as a styptic and poultice. The stem sap is used by the Warao as a treatment for wasp stings (Wilbert 1986). **Poi**, a fermented product made from corm shavings, is used to improve muscle tone by bathing the sickly person in it and allowing the poi to dry on the body (Ghosh *et al*. 1988, Greenwell 1947, Plowman 1969).

Study Site

Base camp was in the village of Ohidu Sanuka, also called Morichitos, located along the west bank of the Winikina **caño** on Mariusa Island. The study site includes a 3 km^2 area surrounding the village. This island, along with others of the intermediate zone, has three distinct sections. The outer section, known as the littoral, begins from the river and becomes slightly elevated. The littoral is exposed to daily tidal affects. It is called **naba a hobahi** (land surrounded by rivers) by the Warao. From the river's edge the land rises to form a levee of 0.5-1.0 meters, a signifi-

cant height in this region. The levee stretches inland for several hundred meters and consists mostly of primary forest (**ina**). It is here that the village and fallows are located. It dips into the inner portion of the island, referred to as the backswamp or savanna (Ruddle & Chesterfield 1977, Wilbert 1986, 1995). During the flooding season, water from the **caño** spills over the levee into the vast savanna, known as the "**morichal**" or **ohiduna** (place of many **moriche** palms). The **ohiduna** is primarily an oligarchic forest of **moriche** palm but may include other tree species such as *Virola*.

The annual mean temperature of this region reaches a high of 26ºC and fluctuates only about five degrees annually (Wilbert 1994-96, Wilbert 1996). A dry and rainy period, rather than temperature, determines the two major seasons of the Orinoco Delta. The dry season (**ihabwaha**) lasts approximately from January to May and the rainy season (**hoida**) from May to December. A brief dry season (**ihabwaha sanuka**) lasts from August to October breaking up the main rainy season. Dispersed throughout the year are downpours lasting only a few minutes during the day.

Methodology

Ethnobotanical expeditions to the study site were made in 1997 and 1998. Single transects were carried out in each of 22 swidden-fallows located within the **naba ahobahi** along five different **caños**. **Caños** Hemuru Akoho Borohoy, Morinoko and Tarasona are smaller branches of the Winikina **caño**. The age of the swidden-fallows, as estimated by the owners, ranged from less than one month (recently cleared) to one which had lain fallow for more than 36 months. All of the swidden fallows had areas much less than one hectare. The swidden-fallows belong to 19 men of two villages, the base camp village and Barranquilla, which are located directly across from each other along Winikina **caño**. These families are closely related as they all belong to the Winikina Warao sub-tribe. The Warao do not hold land deeds in the Delta but consider themselves owners of the land behind their village homes and the swidden-fallows. Some of these owners, along with other men of the village, were informally interviewed to learn about **ure** cultivation. Tirzo Rivero, a Warao swidden owner and co-author of this manuscript, was the primary contact person and supplied the Warao terminology. He also accompanied AGB on all swidden-fallow visits.

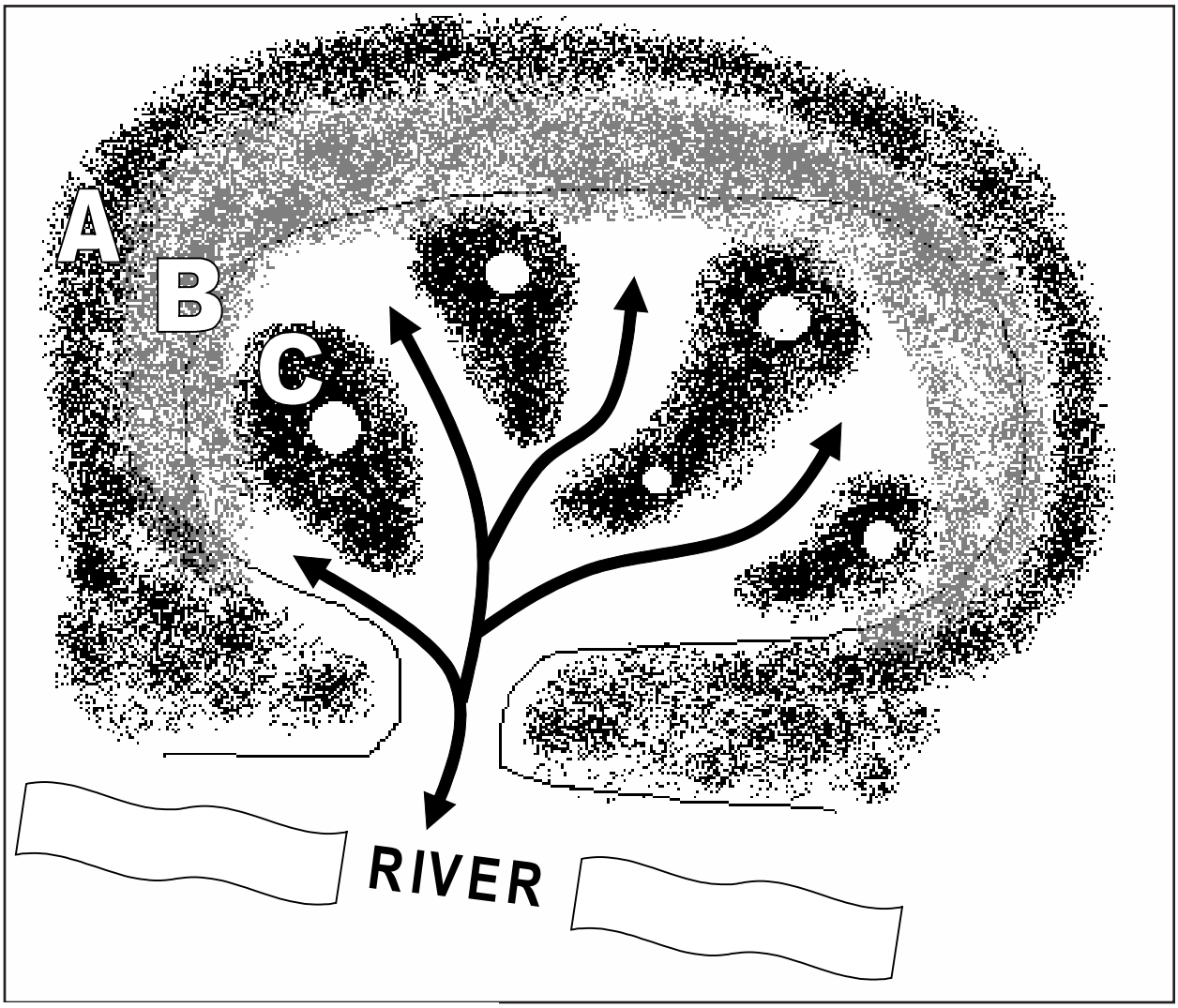
Daukabas

Agroforestry has been defined is "a sustainable management system that combines agriculture and/or livestock with tree crops and/or forest plants on the same unit of land, either simultaneously or sequentially" (Denevan & Padoch 1987). The Winikina Warao of today practice agroforesty to some extent, primarily growing **ure** in swiddens which they call **daukabas**. For the most part they do not intentionally select crops to grow in the forests of the Delta. Some Warao believe that the forest has an endless supply of raw material to meet their needs so a sustainable management system is not carried out. Some Warao families may have small home gardens with mango (*Mangifera indica* L.) trees and small herbal plants grown in boxes.

The selection of a **daukaba** depends on the amount of raised land that is able to drain regularly and resist flooding for most of the **ure** growth cycle. Water flows from the **caño** into the surrounding forest and **daukaba** during high tide and flows back into the **caño** during low tide (Figure 2). A good location for a swidden is higher on the levee where there is much primary forest growth (**dauna**) because the larger trees offer more raised ground for cultivation. If **dauna** is not available, then a fallow covered by secondary forest growth (**daukabanobo**) is the next best site selection. A **daukaba** which has a number of **yaha** palms (*Manicaria saccifera*) or other large trees such as **bihibihidu** (*Pentaclethra macroloba* (Willd.) Kuntze) is preferred because the higher elevation of land around the base of the trunk makes this patch of land drainable on a daily basis and flood-resistant for most of the **ure** growth season. The section of raised ground around a large palm or tree is called **hobahi** (land surrounded by water). This term is the same to describe the island of land surrounded by the **caños**. The raised land around **temiche** palm surrounded by water is called **yaha ahobahi** (**temiche** palm surrounded by water). There are sections of the **daukaba** that may be permanently saturated with water, making them unsuitable for **ure** cultivation. They are called **hobotoboto**. The word **ho** means water. Wilbert (1995) states that the Warao word **boto** comes from the word **botonai** which means "rotten," a description appropriately describing the smell of rotting vegetation rising from the **hobotoboto**.

Preparation of the Daukaba

At the start of the long, dry season in January, the selected site is cleared. If **ure** is not planted in a timely manner, the Warao will lose a window of opportunity. The Delta floods for 2-3 months during the rainy season later in the year, so if not planted early enough, **ure** will not be able to reach maturity before this flooding. Trees are felled and most tall vegetation is cut down. A complete clearing of large plants is necessary to provide enough sun for **ure** to grow properly. As stated by TR, "**ahaka hokohi obonoye**", (air and sun are needed) for good **ure** growth. The debris is left in the swidden until it is dry enough for burning. Primary forest left standing around the **daukaba** is important to prevent fire from spreading to other sites. It also delineates the perimeter of the **daukaba**. A good burn is one in which almost all vegetative matter is burned. Inadequate burning means constant weeding throughout the growth of **ure**, a tedious and time consuming task. The



○	Tree trunk which forms **hobahi**
A	**Dauna** (primary forest)
B	**Daukabanobo** (secondary forest growth) from prior use
C	**Hobahi** around which **ure** is able to grow
→	Direction of water diffusion into and out of **daukaba** which forms **hobotoboto**

entire clearing process usually takes two to three weeks. The remaining large tree trunks, which are too big to be moved, remain in place and serve as bridges to facilitate movement across the **daukaba** and over the **hobotoboto**. The cleared site is now a **daukaba**.

Vegetative propagation is the only method for growing new crops of **ure** in the Delta. **Ure** seedlings (**ure a yaba**) collected from a past harvest are planted in the high ground. Other crops to a much lesser extent may be planted on the elevated land in the **daukaba**. Three varieties of sugar cane (*Saccharum officinarum* L.), three or more varieties of bananas (*Musa acuminata* X *balbisiana* Colla.), two varieties of **yucca** (*Manihot esculenta* Crantz.) and sometimes rice (*Oryza sativa* L.) and corn (*Zea mays* L.) were found growing in some of the **daukabas**. Due to the yearly flooding cycle of this region, these do not grow as well as **ure**, hence, they are represented in the **daukaba** to a much lesser extent than **ure**.

Ure *Harvest*

There are two **ure** harvests available for each annual crop cycle. The first harvest, **ure namona hidu** (metamorphosis of **ure** into a new corm), comes approximately eight to ten months after planting the seedling (**ure a yaba**) in January. Longer cultivation times of up to 15 months are known for various Hawaiian cultivars (Coursey 1968, Onwueme 1978, Plucknett 1970). The largest corms come from the first harvest. The corms range in size from 25-35 cm long and can weigh as much as 2 kg. Corms are harvested on a regular, as needed, basis. The corm is plucked out of the ground complete with stems and leaves. The cormels growing around the primary corm are detached and replanted. The leaves are cut and dropped on site and may serve as fertilizer for the secondary harvest. The petioles remain attached to the main corm.

The secondary harvest usually follows two to three months later. The cormels are smaller than those from the first crop and are known as **ure anaboida** (secondary corm harvest from **ure**). Only these first two harvests give the best yields. Cormels which are not used or missed during the harvest will grow indefinitely in the swidden lain fallow. As secondary forest growth covers the fallow, **ure** plants can be spotted in the vegetation. They may serve as future seedlings by the fallow owner. It is not known how long a swidden should lay fallow until it is ready for the next preparation and cultivation though some Warao suggest from 8-10 years.

The harvested corms, with leafless petioles attached, are taken to the village for preparation. At the **hanoko** (house), the corm is cut at the base of the petiole. The petioles, which serve as seedlings are stored in vivo for future vegetative propagation by planting them around the house where they form **ure** gardens. On the next planting cycle, they may be transferred to the **daukaba**.

Meal Preparation

Although the petiole and leaves of *C. esculenta* are edible after cooking, the corm is the only part eaten by the Winikina Warao. The woman of the house prepares the corms by peeling away the outer, hard, brown layer with a machete. The white inner portion, the ground parenchymal tissue, is cut into blocks (approximately 2 in X 3 in) for cooking. They are placed in a kettle of boiling water. **Morocoto** (*Piaractus brachtpomus*), or other fish, when available, is cleaned and placed over the **ure** blocks in the boiling water. Cooking takes approximately two hours. During this time the corm changes color from white to a light, creamy purple-blue. The texture and taste are similar to that of a potato although **ure** is sweeter. A serving of **ure** for dinner includes a portion of fish and is distributed to the family and guests and is eaten with the hand. **Ure** with **morocoto** is the “food of life” for many of today’s Winikina Warao.

The relatively higher nutritional value of **ure** makes it an excellent replacement for **yuruma**. The fat content of **ure** is made up of five main fatty acids: palmitic, stearic, oleic, linoleic, and linolenic (de la Pena 1970, Standal 1970). **Ure** also has vitamins A, B, C and E and various essential amino acids. It is comparable in nutritive value to other tuber and root crops such as cassava, yams, potato, sweet potato, and cereal crops such as rice (NAS 1975). The small starch granules (1-3 µ) of the corm make it an easily digestible food source (Coursey 1968, Plucknett 1970).

Discussion

The **moriche** (*M. flexuosa*) palm, and to a lesser extent the **yaha** palm (*M. saccifera*), have been the “tree of life” for the Warao since time immemorial. They provide food, medicine and shelter, elements necessary for survival in the deltaic swamp forests. The Warao are the only South American indigenous group to successfully exploit this food source, allowing them the unique ability to survive in such an ecologically hostile environment (Wilbert 1970, 1972). The establishment of permanent villages forced the adoption of agriculture. This, in turn, has established **ure** as the “food of life” in contemporary Winikina Warao society although **yaha** and **ohidu** palm starch continue to serve as nutritional resources (Wilbert 1994-96).

The recent shift by the Winikina Warao to swidden agriculture offers an excellent opportunity to study the evolution of a recently adopted crop system and its effect on the local flora and fauna as well as its affects on the sociocultural norms of this society. The use of ecological measurement tools over several years are essential to monitor the effect this change will have on the biodiversity of the Orinoco Delta. As the Winikina Warao population grows, more primary forest will be needed to provide the land necessary for more swiddens. This may have a detrimental affect on the ecology of this region of the Delta if not done with an effective extraction management plan which must include the input of the Winikina Warao. As more swiddens are created, less primary forest near the village is available. Thus, desirable land for swiddens is found further from the village. This is not advantageous because vigilance is difficult, making crops vulnerable to predation by wild boars (*Sus* spp.), capybaras (*Hydrochaeris hydrochaeris*), tapirs (*Tapirus* spp.), and other deltaic fauna.

Colocasia esculenta is a major food crop in various parts of the world and may be grown on a large scale (Plucknett 1977). This is not the case in the Winikina region of the Orinoco Delta where it is still primarily a sustenance crop grown in relatively small (<1 hectare) swiddens. However, there has been talk by some Winikina Warao of clearing large **daukabas** on a levee that can produce enough **ure** to distribute among the villagers and sell to **criollos** in Tucupita or Barrancas, the frontier towns of the Delta. Creating large **daukabas** requires more land which may have

a deleterious affect on the forests of the Delta if not done with foresight.

To the Warao it appears that at the present time there is no need to manage the extraction of food plants either in the forest or in the **daukaba** because the forest is abundant. However, a closer look using forest inventories and yield studies as described by Peters (1994), is needed in order to determine if this random method of forest clearing and non-timber forest product extraction is sustainable over a long-term basis. Extraction of non-timber forest products can be sustained with proper management, a noteworthy proposition to the Winikina Warao. If plants are extracted without any thought to sustainability, the Warao may end up depleting their natural resources, forcing them to either move to a new location and start the process all over again, or leaving their original homes and heading for the urban centers of Venezuela as some have already done. This would be a sad end to a people who have survived for thousands of years in this region.

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