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Notes on the Ethnobotany of Costa Rica's Palms

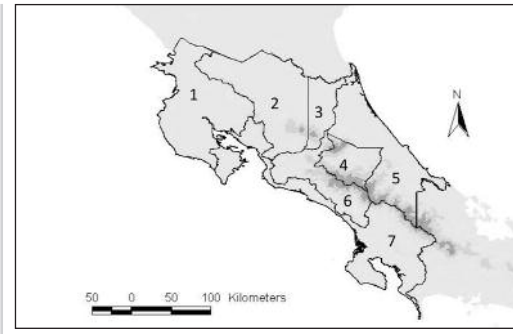
To support the implementation of policies that recognize human uses of wild plants, we documented palm ethnobotany within or bordering eight protected areas in Costa Rica. Through participant observation and semi-structured interviews with 37 participants from 18 communities, we documented the cultivation and harvest of 32 palm species from 21 genera. We also reported uses of five palms (*Cryosophila warscewiczii, Bactris gasipaes, Desmoncus costaricensis, Elaeis oleifera, Pholidostachys pulchra*) that, to our knowledge, were previously undescribed in the literature.

Twenty-nine genera and 109 species of palms are native to Costa Rica (Grayum 2003). The Costa Rican palm flora consists of a diversity of life-forms, ranging from understory shrubs and lianas (*Desmoncus* sp.) to canopy and sub-canopy trees (Grayum 2003). This plant family is an important structural component of Costa Rican lowland forests. For example, at La Selva Biological Station, palms were found to represent 25.5% of stems over 10 cm in diameter (Lieberman et al. 1985). In Costa Rica, palms also persist at high elevations. Some

species are found near the highest mountain peaks in the country; for example, *Geonoma edulis* is found up to 2500 m above sea level (Grayum 2003). The ubiquity of palms in Costa Rica was demonstrated by Lieberman et al. (1996), who found that this group comprised 14.9% of all stems over 10 cm in diameter across an elevation gradient spanning four tropical life zones.

Given that palms are such an important part of Costa Rican flora, it is not surprising that their ethnobotanical use is widespread. The most well-known example is the edible heart-of-palm harvested from *Bactris gasipaes*. When Costa Rica began exporting *B. gasipaes* in 1978, it became the first country to export any cultivated palm species (Brazil opened the heart-of-palm market with the export from wild *Euterpe* spp. in the 1950s (Mora-Urpí 2002)). Although considerable attention has been given to this commercially important palm species, the harvest of other wild Costa Rican palms has been widely overlooked. Joyal (1994) presented a detailed description of the ethnobotanical uses of palms in one region (Sarapiquí) of Costa Rica, but a larger scale description of palm use is absent.

Many wild palm species are used in rural communities in Costa Rica (e.g., Sylvester & Avalos 2009, Sylvester 2009, Avalos 2007, Ocampo 1994). These wild species are often harvested from forests within protected areas, such as national parks. The Wildlife Conservation Law 7317 (Ley de Conservación de la Vida Silvestre 7317 1992) restricts wild palm harvest within protected areas, and as a result, many palm species are harvested illegally (e.g., Sylvester & Avalos 2009). Although palm harvesters and park managers have expressed interest in developing alternatives to illegal harvest, such as cultivation outside of protected areas, such alternatives are precluded by lack of basic information concerning which palm species are harvested and for what purposes (Sylvester 2009). Because of local interest in better understanding palm ethnobotany, we documented the use, harvest and cultivation of wild palm species. Our study was not comprehensive; rather we worked with key participants identified for their expertise in forest palm harvesting or cultivation within or bordering eight protected areas. By documenting which forest palm species are harvested within protected areas, our research will 1) support efforts to recognize people's traditional practices in forest management (IUCN 2012, MA 2005), and 2) identify key species for which alternatives to illegal harvest are needed.



1. Provinces of Costa Rica: 1. Guanacaste, 2. Alajuela, 3. Heredia, 4. Cartago, 5. Limón, 6. San José, 7. Puntarenas).

Methods

Our research was undertaken between April 2006 and April 2010. The information presented here was gathered from 37 participants residing in 18 communities. Eleven of these communities are located on the border of one of eight protected areas in Costa Rica (see Table 1 for an overview of locations). Because we were interested in describing the use of forest palms, rather than documenting the frequency of use, we chose a qualitative research design (Creswell 2009).

Participant Selection: We used purposive sampling to identify palm-harvesting participants. Purposive sample is a non-random sampling technique where participants are selected deliberately based on their expertise of the given research topic (Bernard 2010, Tongco 2007). We relied on the following criteria to identify participants that fit the objectives of our study: 1) people that engaged in forest palm harvesting or cultivation within or bordering protected areas and 2) people who were willing to participate in interviews and/or allow the authors to accompany them during palm harvesting.

We began the participant selection process by working with protected area managers and national park rangers from eight protected areas (Table 1). We worked with protected area staff that previously participated in projects related to palm cultivation and harvesting (e.g., Sylvester 2009, Sylvester & Avalos 2009, Avalos 2007). With the help of the protected area staff, we drafted a list of communities where palm harvesters resided (Table 1).

Table 1: Communities involved in palm harvesting within national parks or in their associated buffer zones. Where national parks are not mentioned, harvesting was reported on private land. Numbers of participants are given in parentheses.

Province	Communities	National Parks and Protected Areas
Guanacaste	Santa Cruz (2)	
Alajuela	Bajos del Toro Amarillo (3), Cariblanco (4), Cinchona (1), San Miguel (1),	Poás Volcano National Park
	Carrizal de Alajuela (1), San José de la Montaña (2) Atenas (1), Orotina (2)	
Heredia	Barva (2), San Rafael de Vara Blanca (2) and Vara Blanca (3)	Braulio Carrillo National Park
Cartago	Orosí (2)	Tapantí National Park
Limón	Las Colinas (3)	Barra del Colorado Wildlife Refuge and Tortuguero National Park
Puntarenas	Santa Elena (3)	Reserva Bosque Nuboso Santa Elena, and The Monteverde Cloud Forest Reserve
	Turrubares (2)	Carara National Park
	San Vito (1), Puerto Jiménez (2)	

Within the communities, we approached the local community-level development associations (viz., Asociación de Desarrollo Integral, ADI) and asked their members to provide us with names of people known to have experience in palm harvesting or cultivation. Additionally, some palm harvesters approached us directly and volunteered to participate in the study.

Once we drafted a list of potential participants, we contacted these individuals in face-to-face meetings and asked them to participate in our study. We also asked these individuals to direct us to other participants that fit our criteria (i.e., snowball-sampling; Bernard 2010). We approached a total of 37 potential participants, all of whom volunteered to participate in the study; the number of participants from each community is summarized in Table 1. Informed consent was solicited from each participant verbally or in writing. The informed consent process included a detailed explanation of the study objectives, methods, benefits and risks of participation, and how the results would be used. Because palm harvesting often occurs in protected areas where it is illegal, participation in our study was anonymous.

Data Collection Techniques: Our primary data collection method was face-to-face semi-structured interviews. When possible, interviews were triangulated with participant observation, i.e., the authors' participation in people's harvesting activities (Bernard 2010). Participant observation was possible in the following communities: Bajos del Toro Amarillo, Barva, Cariblanco, Cinchona, Las Colinas, San Miguel, San Rafael de Vara Blanca, Santa Cruz and Vara Blanca. Semi-structured interviews occurred primarily in the field. Specifically, we accompanied participants to places where they knew a given palm species occurred, or we asked participants to talk to us on their palm harvesting routes (i.e., transect walks; De Leon & Cohen 2005). When field interviews were not possible, participants

identified palms using photographic field guides (e.g., Thomas et al. 2007). Semi-structured interviews covered the following themes: nomenclature, use, harvesting technique and the extent of palm cultivation. Interview responses were hand-written. Interviews ranged from approximately 30 minutes to 60 minutes. The duration of participant observation was variable because it depended upon the time to reach palm species (e.g., home gardens versus remote montane habitats), as well as the techniques involved in harvesting. Upon return visits to the communities, we held workshops to check our results on palm species names and uses with participants.

In Las Colinas, we worked with and interviewed three members of an association involved in the harvest and cultivation of forest palms, viz., Asociación Mixta de Productores y Artesanos Las Estrellas del Carmen (AMPALEC). Because palm cultivation within this organization is a group activity, group interviews were used as a data collection method to explore members' collaborative palm cultivation efforts (Dunn 2005). Group interviews occurred in the field or at AMPALEC's plant laboratory in Las Colinas and did not exceed one hour. We triangulated these interviews with participant observation during individual members' harvesting activities either in patches of community-managed forest or in members' home gardens.

When possible, voucher specimens were collected and deposited in the Herbarium of the Universidad de Costa Rica (USJ). In some instances, participants did not permit collection of palms; in these cases pictures of palms were taken and deposited in the Herbarium USJ. We collected one voucher specimen and/or photograph per location of harvest or cultivation of each species.

Presentation of Results: We presented our results as an alphabetical list of palms. Palm vernacular names are presented in Spanish. A separate list was created for the palm species cultivated by members of AMPALEC in Las Colinas (Limón Province) in the buffer zone of Tortuguero National Park and Barra del Colorado National Wildlife Refuge. A separate list was created because many of the palm uses were found to be unique to this region. When applicable, we reported the national parks where harvesting occurred (Table 1). In national parks, harvesting may have occurred within the park or outside of the park boundaries but within its buffer zone; we do not distinguish between these two potentials in our study. Finally, we limited ourselves to describing the social and cultural uses of Costa Rican native palm species. For context, some natural history information was gleaned from Grayum (2003). The reader is encouraged to consult this and other works (e.g., Dransfield et al. 2008) for a detailed discussion of palm natural history and distribution.

Palm Ethnobotany

Acrocomia aculeata (Jacq.) Lodd. ex Mart. – *Coyol*

Acrocomia aculeata is a large solitary palm reported as harvested to make palm wine in Atenas and Santa Cruz. Participants reported that many small towns within the vicinity of Santa Cruz harvest this palm for wine-making. *Acrocomia aculeata* is harvested to extract the sap, which is locally referred to as coyol wine (*vino de coyol* in Spanish). The harvest of coyol wine was reported in March and April and was described as associated with lunar cycles. If a palm is not felled within three days before or after a full moon, participants reported the palm would not produce much sap. To extract the sap, a palm is felled and is left horizontal on the ground. A hole is cut out in the stem where the sap concentrates and accumulates. The sap is then placed into bottles and allowed to ferment naturally. In Santa Cruz, nothing was reported as added to the sap, whereas in Atenas participants reported to add a small amount of sugar to speed up the fermentation process. Depending upon the harvester, the wine may be chilled with ice and refrigerated before sale or consumption. The methods used to extract coyol wine in Costa Rica are similar to those observed around San Pedro Sula, Honduras (for a detailed description see Balick 1990).

In Santa Cruz, harvest of *A. aculeata* was reported on private lands and cultivation was not reported. Participants reported that cattle disperse the seeds of this palm. Palm fruits are reported as a source of cattle feed. The exocarp of the fruit may also be used as chicken feed.

The heart-of-palm of this species was harvested in Las Colinas. In this town, one participant suggested that the use of heart-of-palm from *A. aculeata* was undervalued. For example, palms must be felled when palm wine is extracted, but the heart-of-palms is left unused. The spines on *A. aculeata* were reported as one challenge to harvesting its heart-of-palm.

Attalea rostrata Oerst. – *Palma Real*

Attalea rostrata is a large solitary palm harvested in Las Colinas and Puerto Jiménez. In land patches around Las Colinas, *A. rostrata* was reported as uncommon. Leaves of *A. rostrata* are used for thatching houses and ranches in both towns. Roofs are constructed by overlapping the leaves with their mid-vein in the horizontal position. Layering leaves horizontally was reported to prevent rain from entering a dwelling. A roof made from *A. rostrata* leaves is reported to last between five and eleven years before replacement is needed. Smoking of the underside of the roofs, as a result of smoke emitted by wood ovens, was reported to preserve the leaves and enhance the duration of these palm roofs. Participants from Puerto Jiménez reported to have reduced the harvest of *A. rostrata* after it was prohibited (Ley de Conservación de la Vida Silvestre 7317, 1992); these participants did not know of any cultivation efforts to supplement wild harvest. Palm fruit and heart-of-palm were also reported as harvested in both towns. Palm fruits were reported as a source of pig feed because of their high fat content.

In Las Colinas, heart-of-palm from this species was reported for human consumption and was described as providing the largest quantity of heart-of-palm from all palms harvested for this purpose in Costa Rica.

Bactris gasipaes Kunth – *Pejibaje*

Bactris gasipaes is a clonal palm that is cultivated in plantations for the sale and export of its heart-of-palm and palm fruits for both national and international markets (e.g., Mora-Urpí 2002). A pre-Columbian Chibcha civilization from South America may have introduced *Bactris gasipaes* to Costa Rica (Stone 1951 in Mora-Urpí et al. 1997). It was suggested this could have occurred 1700 to 2300 years ago (Corrales-Ulloa & Mora-Urpí 1990).

In our study, we found *Bactris gasipaes* was cultivated in rural agroforestry systems for both the heart-of-palm and palm fruits from all participants. Heart-of-palm was reported to be eaten raw or cooked and prepared in diverse recipes, including "*picadillo*" (chopped heart-of-palm mixed with spices, and possibly other vegetables or eggs) and casseroles, such as rice with heart-of-palm. In Las Colinas, the immature inflorescences of *B. gasipaes* were harvested for consumption; these inflorescences were roasted or prepared in *picadillo*. Also in Las Colinas, *B. gasipaes* palm stems were reported to be polished and used for making lamps and small pieces of furniture.

Chamaedorea tepejilote Liebm. – *La Disciplina, Pacaya*

Plants from the genus *Chamaedorea* are understory palms commonly found in lowland and montane forests throughout the country. Heart-of-palm was reported as harvested from *Chamaedorea tepejilote* in Cariblanco, Cinchona, San Miguel, Santa Elena and Vara Blanca. It is likely that other *Chamaedorea* species are harvested because one of its vernacular names "*pacaya*" refers to many species (Grayum 2003). Participants reported that *pacaya* heart-of-palm is consumed raw; for example, participants from Santa Elena, Cariblanco and San Miguel mentioned that *pacaya* was common source of food during lengthy hunting or other field expeditions.

The male inflorescence of *C. tepejilote* was also reported for consumption from forest and from cultivated palms in Las Colinas, Orotina and Turrubares (Fig. 2). *Chamaedorea tepejilote* inflorescences can be roasted or prepared with ingredients such as eggs or vegetables (Fig. 2). Cultivation of *Chamaedorea* species for personal inflorescence consumption was found in home gardens.

Chamaedorea tepejilote was also found in home gardens as ornamental plants in towns within the Limón, Heredia and Alajuela provinces. Although not reported by participants in our study, in the literature young *Chamaedorea* leaves are reported as livestock feed (González 2012).

Cryosophila sp. – *Palma de Escoba, Súrtuba, Guágara*

Two species of *Cryosophila* were reported as useful in our study: *Cryosophila guagara* P.H. Allen and *Cryosophila warscewiczii* H. Wendl. (Fig. 3). *Cryosophila warscewiczii* and *C. guagara* are understory palms that are found in the Caribbean and Pacific regions of Costa Rica respectively (Grayum 2003). These species were harvested for heart-of-palm and inflorescence consumption in Las Colinas (*C. warscewiczii*), Orotina and Turrubares (*C. guagara*). *Cryosophila* heart-of-palm harvest occurred during Holy Week celebrations (corresponding to Easter) within Tortuguero and Carara national parks. Eating the inflorescence of *C. warscewiczii* was reported to increase one's energy levels. Cultivation of *C. warscewiczii*

2. Immature inflorescences of *Chamaedorea tepejilote* (A) are harvested for consumption (B, here cooked with chayote squash).

was reported in Las Colinas with the intention of selling this species in local markets. Participants also reported using *C. warscewiczii* as material to make brooms (Fig. 3).

Elaeis oleifera Kunth – *Corozo, Palmiche*

Elaeis oleifera is a solitary understory palm harvested for its heart-of-palm in Las Colinas; participants reported this heart-of-palm as bitter. Palm fruits of this species were also valued in Las Colinas for their high oil content (similar to the fruits of the introduced African oil palm, *E. guineensis*). Because *E. oleifera* is a native species, one participant suggested that harvest of the oil from this plant would be a more ecologically sustainable practice than the current use of the introduced African oil palm cultivated in Costa Rica for the same purpose.

Euterpe precatoria Mart. – *Palmito Mantequilla*

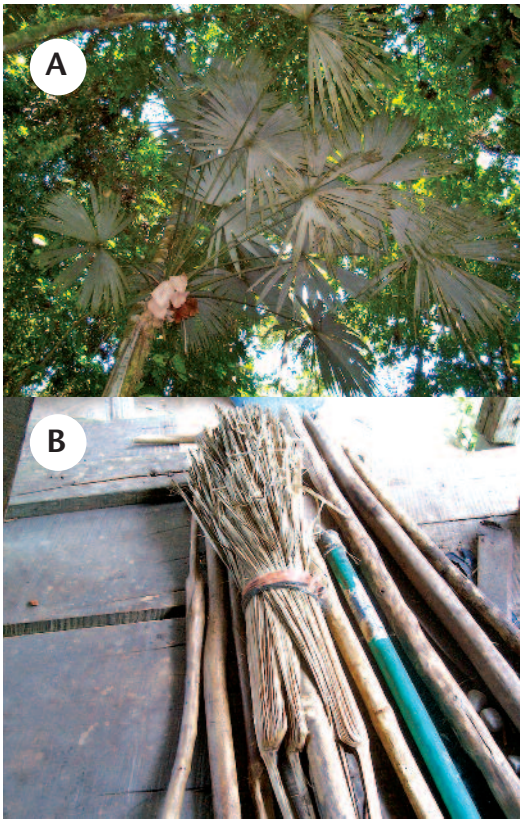
Euterpe precatoria is a solitary sub-canopy palm found in the Costa Rica lowlands and mid-elevations. Heart-of-palm from this species was harvested by participants from Cariblanco, Las Colinas and San Miguel. Its illegal harvest is particularly pronounced in Braulio Carrillo National Park (Avalos 2007). The vernacular name of this palm name signifies 'butter,' which describes the flavour of this heart-of-palm. This butter flavour was reported to make this heart-of-palm species more favourable than the *Bactris gasipaes* heart-of-palm. The heart-of-palm of this species may be eaten cooked or raw. Small-scale cultivation for local consumption of this palm was observed on private land in Las Colinas and Cariblanco in the buffer zones of the Tortuguero and Poás Volcano National Parks.

Geonoma congesta Wendl. ex Spruce – *Suita*

Geonoma congesta is a clonal palm, and its leaves are selectively harvested from a cluster of palm ramets. Participants from Las Colinas reported that *G. congesta* leaves are harvested to thatch roofs. After leaves are harvested, they are hung to dry. To construct roofs, leaves are tied to wooden rods and overlapped to produces roof panels (Fig. 4). The reported duration of roofs was variable (i.e., 2–4 years).

Geonoma edulis H. Wendl. ex Spruce – *Súrtuba*

Geonoma edulis is a solitary understory palm found in montane cloud forests of the Central and Talamanca Mountain Ranges (Figs. 5 & 6). *Geonoma edulis* harvest was reported only within protected areas, including the Braulio Carrillo, Poás Volcano and Tapantí National Parks and the La Amistad International Park. Participants reported harvesting this species from towns bordering protected areas (e.g., Bajos del Toro Amarillo, Barva, Cariblanco, Carrizal de Alajuela, Cinchona, Orosí, San José de la Montaña, San Miguel, San Rafael de Vara Blanca, Santa Elena, San Vito and Varablanca), and other participants reported travelling to protected areas to harvest these palms (e.g.,



3. *Cryosophila warscewiczii* in the forest (A) and a broom made from four leaves of *Cryosophila warscewiczii* (B).

from Carrizal de Alajuela, San José de la Montaña or San Vito). From towns bordering protected areas, walking distances of 4 or 5 hours were reported as common to reach the montane habitats where this species is found.

The heart-of-palm of *G. edulis* was reported to have high nutritional value; for example, participants believed it to be high in iron because it grows in the fertile soils of montane forests. The nutritional value of this palm was reported to make it a good substitute to meat consumption when religious holidays prohibit eating meat (e.g., Holy Week). Participants reported that in the past *G. edulis* was primarily harvested during Holy Week (*Semana Santa*). Although consumption still peaks during Holy Week, a study in 2007 found that *G. edulis* was harvested year round (Sylvester & Avalos 2009). Cultivation of *G. edulis* was not reported. Participants reported that *G. edulis* requires cloud forests (located within protected areas) to germinate and grow. Because *G. edulis* was reported to require cloud forests to grow, people reported a hesitancy to plant palms in areas outside of protected forests.

Grayum (2003) described the epithet of this species – meaning edible – as deceiving because the flavor of this heart-of-palm is uniquely bitter. Surprisingly, participants reported that this flavor drives some of the appeal of consuming this palm. Participants also reported medicinal properties associated with this species. For example, it is consumed to help treat rheumatism, fatigue, digestion and muscular pain (Sylvester & Avalos 2009). Diverse cooking styles were reported, but the species is traditionally roasted in a wood oven.

Iriartea deltoidea Ruiz & Pav. – *Palmilera, Chonta Negra, Palmito Dulce*

Iriartea deltoidea is a solitary canopy palm. It was reported as harvested for its heart-of-palm, which has a sweet flavor; the stem was also reported as used as a construction material for walls, floors and pipes (Bajos del Toro Amarillo, Cariblanco, Cinchona, Las Colinas, San Miguel, San Rafael de Vara Blanca, San Vito, Santa Elena, Turrubares and Vara Blanca). In Las Colinas, the seeds were used for artisanal crafts, such as making curtains.

In Cariblanco, harvest of *I. deltoidea* was reported to be a practice of the past in the

4. *Geonoma congesta* (A); leaves used for thatching roofs (B).

5. *Geonoma edulis* in montane cloud forests of Poás Volcano National Park.

Alajuela and Heredia provinces. One participant reported this species as historically abundant such that it could even be found in one's backyard. Participants reported that abundance has drastically decreased and that harvesting has also declined or is no longer practiced.

Prestoea acuminata (Willd.) H.E. Moore – *Palmito, Palmito Dulce, Palmito Morado*

Prestoea acuminata is a subcanopy clonal palm harvested by participants from multiple towns (Bajos del Toro Amarillo, Barva, Cariblanco, Carrizal de Alajuela, Cinchona, Orosí, San Rafael de Vara Blanca, Santa Elena, San Vito and Vara Blanca). Similar to *Geonoma edulis*, *P. acuminata* heart-of-palm is harvested in cloud forests of the Central and Talamanca Mountain Ranges (Figs. 5 & 6). Heart-of-palm harvest was reported within the following protected areas: Braulio Carrillo and Poás Volcano National Parks and La Amistad International Park. In Cariblanco, harvesters were observed to selectively remove stems (ca. 8 cm in diameter) from a cluster of palm ramets. In communities bordering the Poás Volcano National Park (Table 1), this heart-of-palm was prepared in picadillo or roasted in wood oven. The flavour of this heart-of-palm was reported as sweet, unlike the bitter *G. edulis* that co-occurs with *P. acuminata* in montane cloud forests. In Cariblanco, this palm was reported to sell for the highest price in national, informal markets. No cultivation of this species was reported.

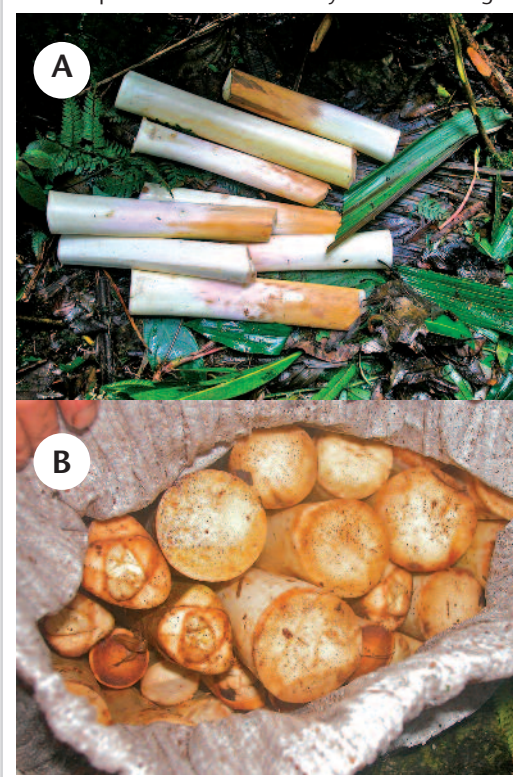
Socratea exorrhiza (Mart.) H. Wendl. – *Maquenque, Chonta, Chonta Dura, Palmito Amargo*

Socratea exorrhiza is a solitary canopy palm. Participants from Cariblanco, Las Colinas and San Miguel reported that this species was harvested in the past for its bitter heart-of-palm; none of these participants reported current consumption of this species. These same communities reported the use of *S. exorrhiza* stems to construct floors and walls of houses; to do so, the stem is split lengthwise into four planks. Similar to *Iriartea deltoidea*, the *S. exorrhiza* stems were reported as highly valued because of their strength and durability. In Las Colinas, participants reported the use of *S. exorrhiza* seeds to make curtains.

Palms Cultivated and Harvested by AMPALEC

In the town of Las Colinas in the Pococí Canton of the Limón Province, members of

6. Heart of palm from *Geonoma edulis* (A) and both *Geonoma edulis* and *Prestoea acuminata* (B). This wild heart of palm is sold fresh directly after harvesting.



AMPALEC reported the following palm species as cultivated and used for ornamental and artisan purposes, as well as occasionally for human consumption. Other palms used by participants from Las Colinas are also reported in the list above.

Asterogyne martiana (H. Wendl.) H. Wendl. ex Hemsl. and *Calyptrogyne ghiesbreghtiana* (Linden & H. Wendl.) H.Wendl – *Suita*

Asterogyne martiana and *Calyptrogyne ghiesbreghtiana* are small understory palm species. The seeds of both species are sold internationally for ornamental use. Participants reported that seeds from *Asterogyne martiana* were in highest demand. Leaves from both of these species were reported as popular to be used to thatch roofs in the Pococí region.

Astrocaryum alatum H.F. Loomis and *Astrocaryum standleyanum* L.H. Bailey

Astrocaryum alatum is a solitary understory species. *Astrocaryum standleyanum* is a solitary sub-canopy palm. Seeds from both of these species were reported to be polished and used locally in multiple artisan practices, including making handbags and window curtains.

Bactris sp.

Bactris is a genus comprised of a diverse group of spiny palms. The seeds of various *Bactris* species were reported as sold for ornamental plants. These species included *Bactris coloradonis* L.H. Bailey, *Bactris glandulosa* Oerst., *Bactris gracilior* Burret, *Bactris hondurensis* Standi., *Bactris longiseta* H. Wendl. ex Burret and *Bactris militaris* H.E. Moore. Participants described *B. glandulosa* as a popular plant for plant collectors. Many *Bactris* species have edible fruits (e.g., *B. coloradonis*), but participants did not consume them often.

Chamaedorea deckeriana (Klotzsch) Hemsl.

Seeds from *C. deckeriana* were documented as sold because this species is a popular ornamental. Members of AMPALEC reported this species to grow in the driest parts of the tropical wet forest (the most predominant life zone within the Tortuguero National Park; Holdridge et al. 1971). One participant reported that the immature inflorescences of this species are morphologically similar to the edible *Chamaedorea tepejilote* inflorescence; this participant expressed interest in determining whether *C. deckeriana* inflorescences were also edible.

Desmoncus costaricensis (Kuntze) Burret – *Matamba*

Desmoncus costaricensis is a climbing palm with large spines. The stem of this species was used for basket making. *Desmoncus costaricensis* was also reported to have potential to be cultivated as an ornamental plant because of its attractive, red fruits.

Manicaria saccifera Gaertn.

Manicaria saccifera is a clonal species found in swampy terrains. It was reported as a source of leaves for thatching roofs. It is also an ornamental plant whose seeds are exported for this purpose.

Pholidostachys pulchra H. Wendl. ex Burret – *Caña Lucía*

Pholidostachys pulchra is a solitary clustering understory palm. This species was harvested for its heart-of-palm and immature inflorescences, both of which were reported as bitter. Immature inflorescences are harvested before they open and are prepared similar to those of *Chamaedorea tepejilote* (see above). Participants described the heart-of-palm from this species to be small and its extraction uncommon.

Raphia taedigera (Mart.) Mart. – *Yolillo*

Raphia taedigera is a large palm reaching heights of up to 12 meters found in swampy terrain. *Raphia taedigera* was harvested for its heart-of-palm and its fruits, for human and livestock consumption respectively. The heart-of-palm was described as bitter. *Raphia taedigera* was reported as an ornamental plant with an attractive inflorescence. The seeds of this palm – along with those of other angiosperms and pieces of bamboo – were mentioned as used to make window curtains. Participants mentioned that this species is generally found within swampy areas within protected forests; however, one participant was successful cultivating this palm outside of swamps in drier patches of his home garden.

Reinhardtia gracilis (H. Wendl.) Drude ex Dammer and *Reinhardtia simplex* (H. Wendl.) Drude ex Dammer – *Ventanilla* (*R. gracilis*) and *Palma Enana* (*R. simplex*)

Reinhardtia species are small understory palms. Both *Reinhardtia* species were cultivated and their seeds exported for ornamental purposes. Monitoring of seed production by members of AMPALEC revealed that *R. gracilis* produces seeds once every four years.

Synechanthus warscewiczianus H. Wendl.

Synechanthus warscewiczianus is a solitary clustering understory palm. Participants mentioned it was generally found in old

growth forests. This palm was cultivated as an ornamental plant, and its seeds are exported for this purpose. The bright green, unripe fruits of *S. warscewiczianus* (which turn black when mature) were reported to make it an attractive ornamental plant and a source of seeds to make jewelry.

Welfia regia Mast. – *Corozo*

Welfia regia is a solitary canopy palm, and its seeds were exported for ornamental production. Participants also reported *W. regia* as a popular source of heart-of-palm for people living in the Pococí region. This species is often harvested illegally, and its harvest was reported as most common in Holy Week. From data collection during palm cultivation, participants revealed that *W. regia* grows slowly. Such slow growth makes it difficult to cultivate this palm for heart-of-palm production. For example, participants reported that in over 20 years they have not been successful in cultivating palms that reach sizes suitable to extract its heart-of-palm. Because of this observed slow growth, participants highlighted *W. regia* as a species for conservation concern in forests where it is illegally harvested.

One participant in Las Colinas revealed that *Welfia regia* leaves were harvested for thatching roofs, and its leaves produce the most resistant roofs (compared to leaves from *Asterogyne martiana* or *Attalea rostrata* also harvested for thatching). Thatching using *W. regia* leaves was reported as similar to the process described above for *A. rostrata*.

Discussion

Within and bordering protected areas, we found that palms provided multiple sources of food, medicine and construction material. The sale of palm products within organized international markets (seeds) and local informal markets (heart-of-palm) also provided sources of income for palm harvesters. In total, we documented the cultivation and harvest of 32 palm species from 21 genera. Of these species, only *Bactris gasipaes* is cultivated on large-scale palm plantations (Mora-Urpí 2002). This reflects the underdevelopment of the cultivation of forest-palm species as alternative food sources and as a potential income-generating activity for rural communities. We herein report the previously undocumented consumption of heart-of-palm from *Cryosophila warscewiczii* and *Elaeis oleifera*, the consumption of immature inflorescences from *Pholidostachys pulchra* and *Bactris gasipaes* and basket-making from *Desmoncus costaricensis*. Some examples of alternative food sources identified here and reported elsewhere in the literature for Latin America include heart-of-palm from *Acrocomia aculeata*, *Attalea rostrata, Euterpe precatoria*, *Iriartea deltoidea*, *Prestoea acuminata*, *Socratea exorrhiza* and *Welfia regia* (Bernal et al. 2011, Balslev et al. 2008, Brokamp et al. 2011, Van Looy et al. 2008, Haynes & McLaughlin 2000, Svenning & Balslev 1998, Joyal 1996), and immature palm inflorescences from *Chamaedorea tepejilote* (Castillo Mont et al. 1994).

Palms were harvested from both cultivated sources (e.g., community-managed forests, home gardens) and from forests within protected areas. Similar to findings compiled from a review of the management of palms in South America (Bernal et al. 2011), few participants reported the cultivation or organized management of forest palms. The exception was the cultivation of a suite of palms (26 species) on private lands for artisan, commercial and reforestation purposes in Las Colinas by members of AMPALEC. Within our study, AMPALEC was the only association reported to have created a community-based enterprise for the cultivation, sale and export of palm products. Although AMPALEC was focused on palm seed export, members of this association are working to sell other palm products (e.g., heart-of-palm from *C. warscewiczii*, N. Chavez *pers. obs.*).

We recorded the illegal harvest of heart-of-palm from nine different species. Elsewhere in Latin America, some of these species were reported as illegally harvested (e.g., *P. acuminata* in Colombia; Gamba-Trimiño et al. 2011) or harvested for sale in local and international markets (e.g., *E. precatoria* in Venezuela and Bolivia; Van Looy et al. 2008, Stoian 2004). To our knowledge, the cultivation potential or the available markets for these nine species has been overlooked, with one exception, i.e., a thriving local market for *G. edulis* heart-of-palm exists in the Costa Rican Central Valley (Sylvester & Avalos 2009).

Palm harvesters expressed the knowledge and expertise related to cultivating some of the palms reported as illegally harvested. For example, AMPALEC members were found to propagate and cultivate five of the nine illegally harvested species (e.g., *C. tepejilote, C. warscewiczii, E. precatoria*, *I. deltoidea* and *S. exhorrhiza*). Through cultivation and monitoring of palm growth, AMPALEC

members were also able to determine which palms would be more practical to cultivate and sell. For instance, *Welfia regia* is illegally harvested for its heart-of-palm, but participants reported this would not be a viable business for palm harvesters because they observed this species to grow slowly relative to other species. On the other hand, participants revealed that species such as *Chamaedorea tepejilote* or *Cryosophila warscewiczii* could be cultivated to reproductive stages relatively quickly; thus, the sale of these species could result in a viable business option.

Although it is mandatory for Costa Rican national parks to recognize people's traditional practices in forest management (e.g., Ley de Biodiversidad 7788), there are few policy directives on how to do so (Cajiao Jiménez 2002). We expect that our results may be useful when developing more informed forest management strategies that consider traditional palm use. Our study also documented palm species that have been successfully cultivated outside of protected areas. The sale of cultivated palms is one palm management option that may support the continuity of cultural practices while helping decrease the frequency of illegal harvest.

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