Palm Use by Two Chachi Communities in Ecuador: a 30-Year Reappraisal

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This study reappraised traditional knowledge (TK) about palms (Arecaceae) by the Chachi indigenous group in northwestern Ecuador, 30 years after the first study in 1985 on Chachi palm ethnobotany (Barfod and Balslev 1988). We wished to gain insight about which palm species the Chachi people use today, and how palm TK has changed among the Chachi since 1985. In 2015, using semi-structured interviews and participant observation, we documented nine useful palm species and 457 use reports. The 1985 methods were less formalized, based on open-ended interviews and recorded 14 palm species with 38 use descriptions. Most uses fell into the categories Food (13 use descriptions), Utensils/Tools (10), and Construction (7). In 2015, most of the use descriptions similarly fall into the categories Food (38), Construction (20), and Utensils and tools (19). As in 1985, the most important species harvested today are *Iriartea deltoidea* and *Wettinia quinaria*. Four understory palm species reported as useful in 1985 were not recorded in 2015. Still, most of the uses documented among the Chachi in 1985 were also registered in 2015. Knowledge about blowguns, blowgun darts, and marimba keys, however, seems to have vanished. Although palms still provide important ecosystem services for the Chachi, (e.g., food and construction), better management of natural resources and land-use is pivotal to meet the Sustainable Development Goals that Ecuador is committed to through their participation in the United Nation's Sustainable Development Knowledge Platform. This is particularly complicated because of the rapid human population growth in the coastal lowland of Ecuador and the impending threats from climate change.

En este estudio reevaluamos el conocimiento tradicional (CT) sobre las palmeras (Arecaceae) del grupo indígena Chachi en el noroeste de Ecuador, 30 años después del primer estudio de 1985 sobre etnobotánica de palmeras Chachi (Barfod and Balslev 1988). Deseamos conocer qué especies de palmeras utiliza el pueblo Chachi hoy en día y cómo ha cambiado el conocimiento tradicional entre los Chachi desde 1985. En 2015, mediante entrevistas semiestructuradas y observación participativa, documentamos nueve especies de palmeras útiles y 457 registros de uso. En 1985 los métodos fueron menos formales, se basaron en entrevistas abiertas y registraron 14 especies de palma con 38 descripciones de uso. La mayoría de los usos fueron en las categorías de Alimentación (13 descripciones de uso), Utensilios y herramientas (10) y Construcción (7). En 2015, la mayor parte de las descripciones de usos también fueron en las categorías de

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Alimentación (38), Construcción (20) y Utensilios y herramientas (19). Al igual que en 1985, las especies más importantes cosechadas hoy en día son *Iriartea deltoidea* y *Wettinia quinaria*. Cuatro especies de palmeras de sotobosque reportadas como útiles en 1985 no se registraron en 2015. No obstante, la mayoría de los usos documentados entre los Chachi en 1985 también se registraron en 2015. El conocimiento sobre cerbatanas, dardos de cerbatana y teclas de marimba, sin embargo, parece haber desaparecido. Aunque las palmeras todavía proporcionan servicios ecosistémicos importantes para los Chachi, (por ejemplo, alimentos y construcción), es fundamental mejorar la gestión de los recursos naturales y uso de la tierra para cumplir los Objetivos de Desarrollo Sostenible que Ecuador se ha comprometido a cumplir a través de su participación en la Plataforma de Conocimiento de Desarrollo Sostenible de las Naciones Estados. Esto es particularmente complicado debido al rápido crecimiento de la población humana en las tierras bajas de la costa del Ecuador y las inminentes amenazas del cambio climático.

Key Words: Chachi, Chocó, Ethnobotany, Palms, Traditional knowledge.

Introduction

Ethnobotanical studies often address loss of traditional knowledge (TK) and it is widely stated that its erosion occurs by acculturation processes that are driven by expanded infrastructure, better market access and monetarization, migration, and new education opportunities or changes in species distributions (e.g., Byg and Balslev 2004, Byg et al. 2007, Godoy et al. 2009, Paniagua-Zambrana et al. 2014). Studies measuring erosion of TK have used single cross-sectional data (e.g., Godoy et al. 2009) or comparative data (space-for-time substitution) (e.g., Byg et al. 2007). Inferring erosion indirectly by comparing TK across age groups in a single time slice or by using surrogate measures for acculturation such as distance to nearest road is problematic because of the effects from confounding factors that are difficult to control. In this study, we resampled a 30-year-old dataset on palm-related TK. Although it is a more direct method to reveal erosion of TK, it is also prone to error due to the variation in palm expertise across informants. To remedy this, we used community consensus metrics.

We focused on the Chachi people who inhabit the northwestern part of Chocó biodiversity hotspot in Ecuador (Fig. 1). The diversity of palm species in Ecuador ranks among the highest in the world, and palms form a dominant element in the landscape (Balslev et al. 2011). Many palm species in Ecuador are used for multiple purposes. Most uses relate to basic human needs such as food, house construction, and utensils (Cámara-Leret et al. 2014a; Macía et al. 2011, Valencia et al. 2013). Bjorholm et al. (2005) and Valencia et al. (2013) reported a high species richness of palms in the area that represents the Chachi territory in the Province of Esmeraldas.

Many products derived from palms were mentioned in Barrett's (1925) elaborate treatise on the physical culture of the Chachi (called Cayapas) without reference to scientific botanical names. In the beginning of the 1980s, several ethnobotanical studies were conducted by Danish Botanists in the coastal lowlands of Ecuador under the auspices of Museo Antropológico in Guayaquil and the Danish National Research (cf. Barfod and Kvist 1996). One of these studies compared the use of palms by the Awá in the Carchi province and the Chachi in the Emeraldas province (Barfod and Balslev 1988). The study formed part of a nationwide palm taxonomical project and all palm species recorded were documented with voucher specimens deposited in Ecuador (QCA) and in Denmark (AAU).

This study focuses on palm use among the Chachi and how their palm knowledge has changed over the last 30 years. The research questions were: What palm species do the Chachi use today? Have palm use patterns changed during the 30 years, and which aspects of knowledge about palm use have been lost or gained?

Methods

Study Area

The Chachi adapted relatively recently to the Chocó. First, their oral traditions recount a migration from the western Amazon basin into the Andes (Barriga-López 1987; Carrasco 1983) and then a flight from Ibarra into the lowland jungles to escape first Inca and finally Spanish enslavement (Barrett 1925). They mainly inhabit the river valleys of the Muisne, Canandé, and Cayapas rivers in the Esmeraldas Province of Ecuador (Fig. 1). They were formerly known as the Cayapas. In the 1960s, the

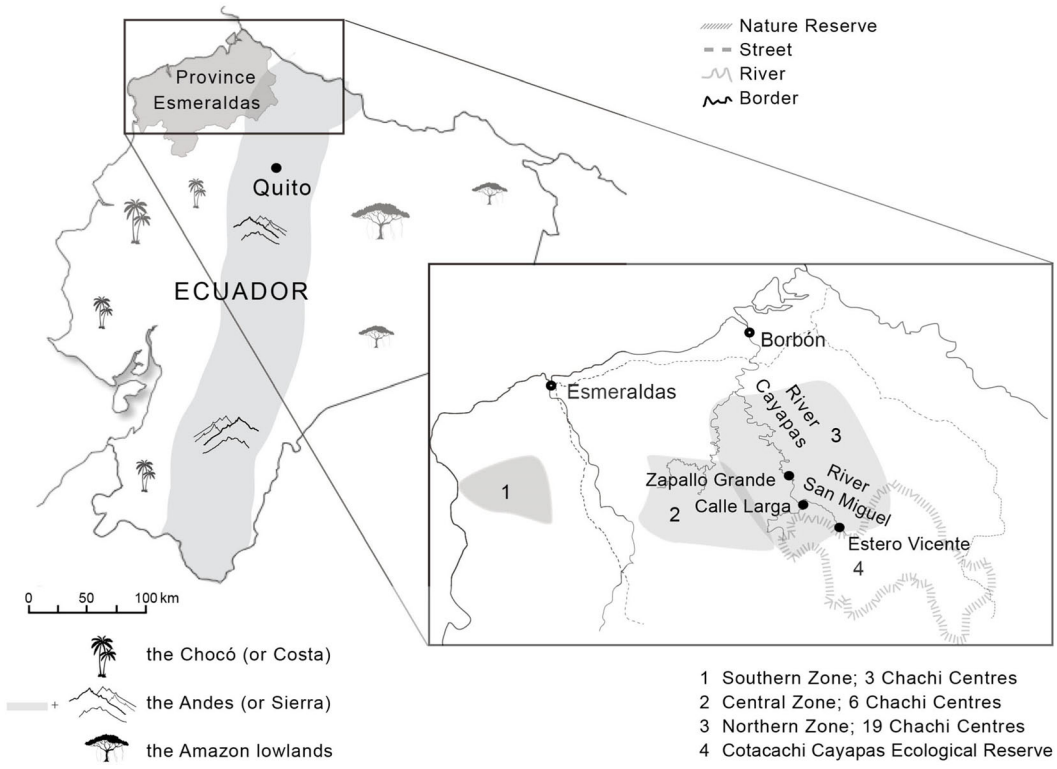

Fig. 1. Map of the study area showing Ecuador's three main biogeographical regions: Chocó, Andes, and the Amazon. Chachi communities are located in the northwestern Ecuadorean coast, in the province Esmeraldas.

Chachi were already affected by road construction (Sierra et al. 2003). As a consequence of the rapid expansion of the infrastructure in the late 1980s, land-use changes accelerated, particularly deforestation due to logging, agriculture, and oil palm plantations (Batallas 2012; Dodson and Gentry 1991; Kosmus et al. 2013). Between 1985 and 2015, the number of Chachi people seems to have doubled from about 7000 people to more than 14,000 (Barfod and Balslev 1988, Gobierno Nacional de la República del Ecuador 2015).

The climate throughout the Chachi territory is warm and humid, with a mean temperature of 25.6 °C (Climate-Data.org 2014) and an annual rainfall between 4000 and 8000 mm. From November through January, there is less rainfall compared to the other months (Bjorholm et al. 2005; Hazlewood 2004). The typical vegetation is tropical evergreen forest, which grows on fertile volcanic and alluvial soils (Dodson and Gentry 1991). Barfod and Balslev (1988) and Barfod and Kvist (1996) provided a thorough description of the traditional plant knowledge of the Chachi and documented a deep knowledge of the new surrounding ecosystems. Since colonial times, socio-political conflicts have been reported between the Chachi and other ethnic groups (Medina 1992; Whitten 1974). Previously, the Chachi lived in family units scattered along the tributaries of the main river where they relied on subsistence farming and hunting (Hazlewood 2004). Because of the pressure from outside and the influence of missionaries, they now mostly settle in villages (Medina 1992). In 1978, the Chachi founded a political organization named the Federación de Centros Chachi Esmeraldas (FECCHE; Hazlewood 2004; Yépez Montúfar 2013).

The Chachi identify strongly with their language, which they call Cha'palaachi (Cha'palaa). It is classified in the same Barbacoan language family as the languages of the neighboring indigenous groups, Awa Pit (Awa or Coaiquer), and Tsafiki (Tsachila or Colorado; Fabre 2005, Kosmus et al. 2013). Spanish is mainly used for communication with outsiders (Hazlewood 2004). The Chachi share many elements, e.g., in curing rituals and music

with other Barbacoan speaking groups as well as with African Ecuadoreans, who migrated in large numbers to the area of the Cayapas rivers during the colonial time (Medina 1992; Hazlewood 2004).

Fieldwork

The community studied by Barfod and Kvist in 1983–1985 was revisited in company of the president of the Chachi Jirdo Añapa. One of the two main informants, Vicente Tapuyo was still alive; Maclovio Añapa had passed away. According to Vicente Tapuyo and three other elders, TK is at risk of disappearing. They recommended that we visit the villages Calle Larga (00° 44′ 36.2″ N and 78° 55′ 47.3″ W, 40 m) and Estero Vicente (00°44′ 49.03″ N and 78° 55′ 48.95″ W, 200 m), where a high level of TK has been maintained (Fig. 1).

Estero Vicente is the last village upriver before arriving at the Cotacachi Cayapas Ecological Reserve. It was established around 1980, but after a big flood, it was rebuilt at a higher elevation. The nearby village of Calle Larga was established in 1985. The inhabitants of both communities are mostly 20 years of age or younger. Calle Larga is spread over ca. four hectares and surrounded by approximately 100 ha of communal land. The houses are built on posts of palm or hardwood. Estero Vicente is spread over ca. five hectares and surrounded by approximately 50 ha of communal land. The houses are built with hardwood on grade. In both villages, the houses are arranged in a horseshoe design, typical of Chachi villages. The sewage system consists mainly of septic tanks. Electricity is produced by generators and available to most villagers from five to ten hours per day. Drinking water collected from house roofs or from the river is untreated. For cooking, either bottled gas or wood fires are used.

Prior to starting interviews, a community meeting was organized to present the objectives of the research project and to obtain prior informed consent (PIC). Methods followed largely a standard protocol used in other palm ethnobotanical studies in South America, including the Chocó (Cámara-Leret et al. 2012). After obtaining PIC, a community census was made visiting all households in both communities (17 in Estero Vicente, 12 in Calle Larga) to obtain information from household representatives and other family members about the gender and age of household members, daily activities of household members, and information about the house and the materials employed in house construction. All interviews were conducted in Spanish or when needed in Cha'palaa with the help of the interpreter. Based on the community census, we planned socioeconomic interviews in detail. Representatives from as many households as possible were questioned: 12 in Calle Larga (3 female, 9 male, mean age = 44 years, SD = 14 years) and 13 in Estero Vicente (7 female, 6 male, mean age = 37 years, SD = 15 years).

We asked each community to appoint two palm experts. This resulted in two men from Calle Larga aged 41 and 46 years and two men from Estero Vicente aged 32 and 67 years. In comparison, one of Barfod and Kvist's (1996 and pers. com.) informants was in his twenties, the other in his late forties. Ethnobotanical field walks were undertaken in the vicinity of the villages either on the communal land or in the surrounding forests. Palms were identified with the *Manual to the Palms of Ecuador* (Borchsenius et al. 1998). The useful species were documented with a combination of digital images and collection of voucher specimens. The latter are deposited at the National Herbarium of Ecuador (QCNE) in Quito. The information provided by expert informants in the field was compiled with images of palms and served as basis for interviews with household representatives in Calle Larga (8 women, 2 men, mean age = 43 years, SD = 11 years) and Estero Vicente (8 women, 3 men, mean age = 43 years, SD = 11 years). Expert informants and general representatives were asked to rank the most important species for them, and to provide an explanation about their choice.

Research and plant collecting permits were obtained from the Ministry of Environment in Esmeraldas. The research was conducted in accordance with the Convention of Biological Diversity (CBD) and the Nagoya Protocol regarding access and benefit sharing (ABS) issues. A manual with the collected data was prepared for use by the inhabitants of Calle Larga and Estero Vicente.

Data Analysis

Quantitative analysis of the 2015 data was based on use reports. Use reports (UR) were defined as a report by an informant of a specific palm part of one taxon for a certain use. Each use report was referred to one of the following use categories (modified from Macía et al. (2011): Food, Construction, Utensils and tools, Ritual and Various. Uses with

TABLE 1. USEFUL PALMS DESCRIBED BY THE CHACHI INDIGENOUS PEOPLE IN CALLE LARGA AND ESTERO VICENTE, PROVINCE ESMERALDAS, ECUADOR.

Species, specimen number	*Cha'palaa* and Spanish name	Community interviewees	Collection (*n*)	Palm part (UR)	Use category	Use description (UR)	Commercialization (UR)
Astrocaryum standleyanum L.H.Bailey, ES 2015–02 [a]	*Poca'chi* *Pukatchi* Guinul	Calle Larga 13 f 11 m	Cultivated (10) primary- (8) and secondary forest (8)	Fruit (8) palm heart (7) leaf (4)	Food utensils/tools	Fruits and palm heart eaten raw (13). Spear leaf and leaflets used for brooms and for braiding mats (1).	
		Estero Vicente 11 f 5 m	Cultivated (2) primary forest (2)	Fruit (3) palm heart (2) leaf (1)	Food utensils/tools	Fruits and palm heart eaten raw (3). Spear leaf and leaflets used for furniture and for braiding mats (1).	One mat costs 30 USD (1).
Bactris gasipaes var. gasipaes Kunth,ES 2015–04[a]	*Caimbi* *Jaki* *Canuchi* Chonta duro	Calle Larga 15 f 5 m	Cultivated (19) primary- (1) and secondary forest (3)	Fruit (14) palm heart (6) stem (2)	Food	Fruits eaten cooked (6). Palm heart eaten raw in salads (6). A juice is used to make *masato* or *chicha* (8). Edible larvae collected of decomposing stems (2).	One infructescence costs 1–4 USD in *Chachi communities* or in Borbón. Sold every 3 months or once a year (6).
		Estero Vicente 11 f 6 m	Cultivated (15) primary- (5) and secondary forest (5)	Fruit (12) palm heart (5)	Food	Fruits and palm heart eaten cooked (17).	One to three infructescences cost 2–5 USD in *Chachi communities* or in Borbón. Sold once to twice a year or on demand (11).
Bactris setulosa H.Karst., ES 2015–05 [a]	*Picanuchi* *Picanobuca* *Traimbidillo* Chontilla	Calle Larga 17 f 5 m	Cultivated (10) primary- (17) and secondary forest (18)	Fruit (13) palm heart (6) stem (1)	Food various	Fruits are smashed, milled, cooked and eaten with sugar (4) or raw in salads (5). A juice is produced from the cooked, peeled and milled fruits for making e.g. *masato* or *chicha* (6). Palm heart eaten cooked (1) or raw in salads (5). Stems as *marimba* keys (1).	One to three infructescences are sold in Afro–Ecuadorean and *Chachi communities*, once a year in Borbón for 1–1.5 USD every two months (4).
		Estero Vicente 6 f 9 m	Cultivated (4) primary- (11) and secondary forest (11)	fruit (8) seed (1) palm heart (6)	Food	Fruits eaten cooked or raw in salads (6). A juice is produced from the fruits e.g. *masato* (2). Palm heart is eaten in salads (5).	
Euterpe oleracea Mart.[b]	*Sambu'chi* *Sanchi* *Vincara* Palmito Palmiche	Calle Larga 8 f 9 m	Cultivated (11) primary- (4) and secondary forest (4)	Fruit (10) palm heart (5) leaf (1) stem (1)	Food construction	Fruits used to make ice cream, *bolones* or oil and serve as food for birds (5). A juice is produced from the peeled and cooked fruits for making e.g. *masato* or smoothie with milk and water (5). Palm heart eaten raw or	One can is sold in Borbón for 1 USD every 15–20 days (6).

(Continued)

TABLE 1. (CONTINUED).

Species, specimen number	*Cha'palaa* and Spanish name	Community interviewees	Collection (*n*)	Palm part (UR)	Use category	Use description (UR)	Commercialization (UR)
						cooked as, e.g., *panda* (5). Leaves for thatching (1). Stems for *house construction* (1).	
		Estero 11 f Vicente 8 m	Cultivated (9) primary- (10) and secondary forest (10)	Fruit (13) palm heart (3) leaf (2) stem (1)	Food construction utensils/tools	Fruits eaten cooked as e.g. *bolones* or ice cream (7). A juice is produced from the fruits for making e.g. *chucula* (7). Palm heart eaten raw (3). Stem very rarely used to make walls (1). Leaves for thatching (1) or making baskets with cover (1).	One filled can with fruits is sold for 4–5 USD, in *Chachi communities* and Borbón. The palm heart is sold in Borbón and the leaves in Esmeraldas for 10 USD, twice a year (8).
Iriartea deltoidea Ruiz & Pav.[b]	*Bunchi* *Boa* Pambil	Calle 10 f Larga 19 m	Cultivated (2) primary- (4) and secondary forest (26)	Palm heart (6) leaf (2) stem (21)	Food Construction Utensils/tools Various	Palm heart eaten cooked or raw as salads (5). Leaves for thatching *forest huts* (2)[c]. Stems for *house construction* e.g. walls (2), floors (9), main pillars (2). Stems for *banana struts* (2), fish hooks and fish traps (2), furniture (1), *marimba* keys (2).	One stem of 1 m height is sold in Afro- Ecuadorean communities, Borbón or to middlemen for 5–8 USD on demand only (8).
		Estero 20 f Vicente 19 m	Cultivated (6) primary- (36) and secondary forest (36)	Palm heart (9) leaf (8) stem (22)	Food Construction Utensils/tools	Palm heart eaten cooked in soups or raw as salad (9). Leaves to thatch *forests huts* or the roof of the kitchen (8). Stems used for house floors, walls and trunks (16), to make baskets, tools for grinding the sugar cane and for *banana struts* (6).	One 14 m stem is sold for 15–30 USD in *Chachi communitites*, Borbón and to middlemen, once or twice a year or on demand, sometimes together with the fruit and palm heart (18).
Oenocarpus bataua Mart., ES 2015–06[a]	*Colapoca* *Culapuca* *Culachi* *Culapuchi* Chapil	Calle 13 f Larga 8 m	Cultivated (4) primary- (10) and secondary forest (13)	Fruit (13) palm heart (7) stem (1)	Food Utensils/tools	Fruits eaten cooked. Fruits are boiled in water for 20 min and the juice obtained from the fruits is used for making e.g. *chicha* with milk (9). Palm heart eaten cooked or raw (7). Fibers extracted from leaves used for brooms (1).	One can of fruits is sold in *Chachi communities* or in Borbón twice a year for 2 USD (1).
		Estero 13 f Vicente 11 m	Cultivated (9) primary- (12) and secondary forest (12)	Fruit (12) palm heart (5) stem (4)	Food Construction Utensils/tools	Fruits eaten raw or cooked e.g. as *bolónes* or as ice creams (10). Palm heart eaten in salads (5). Leaves for thatching (3). Stems	One fruit is sold for 1 USD, 1 kg can for 20 USD and 50 kg for 50 USD in Afro–Ecuadoreans- and *Chachi communitites*, in Borbón

(Continued)

TABLE 1. (CONTINUED).

Species, specimen number	*Cha'palaa* and Spanish name	Community interviewees	Collection (*n*)	Palm part (UR)	Use category	Use description (UR)	Commercialization (UR)
						for *house construction* (2), for grinding sugar cane and *banana struts* (2).	every three months or five times a year (5).
Phytelephas aequatorialis Spruce, ES 2015–03[a]	*Dinchaki Dinchi Dinbu'chi Ginjaki Dinbuca* Tagua	Calle Larga 16 f. m	Cultivated (22) primary- (9) and secondary forest (9)	Fruit (5) seed (2) palm heart (5) leaf (13)	Food Construction Ritual Various	Endosperm eaten raw and its water drunk (3). The endocarp is used to make ear- and finger rings (2). Palm heart eaten cooked or raw in *ceviche* or salad (5). Leaves of juveniles (3 years old, 10–15 m height) used for thatching (8). Leaves are dried at least 1 day–2 months and then split in two parts. A roof requires 200–1000 leaves and 4 weeks of work (4). For curing rituals the leaves are used to hit the body of a patient softly, while singing curing songs with el *San Cipriano* (2). Seeds are sold for cultivation and personal adornment (2)[c].	50 kg fruits are sold for 4–5 USD in Borbón, every 1–6 months, depending on the production. One leaf costs 0.5–1 USD and 50 kg of leaves 3–5 USD are sold to middlemans or Afro-Ecuadorean and *Chachi communities* every 1–6 months or on demand. Seeds were sold in the past for personal adornment (12).
		Estero Vicente 10 f 7 m	Cultivated (12) primary- (6) and secondary forest (6)	Fruit (5) seed (1) palm heart (1) leaf (10)	Food Construction Various	Fruits eaten raw, ripe or unripe (4). Fruits and seeds sold for cultivation or as handicraft (2). Palm heart eaten raw (1). Leaves for thatching houses (9).	One leaf cost 0.5 USD and 50 kg of leaves are sold for 5 USD in Borbón twice a year. Fruits of 50 kg are sold for 10 USD in Borbón. Seeds are sold in Borbón (13).
Socratea exorrhiza H.Wendl. ES 2015–07 [a]	*Pinlla'chi Pinlla* Zancona	Calle Larga 15 f 8 m	Primary- (2) and secondary forest (21)	Palm heart (1) leaf (3) stem (23)	Construction Utensils/tools	Leaves used for thatching *forest huts* (2) or for chicken and pig huts (3–4 leaves) (1). Stems for house walls, floors, pillars (17) or for chicken and pig huts (7 year old palm individuals) (4) and for *banana struts* (1).	One stem is sold in Calle Larga for 2–10 USD on demand. The price depends on the height (6).

(Continued)

Table 1. (Continued).

Species, specimen number	*Cha'palaa* and Spanish name	Community interviewees	Collection (*n*)	Palm part (UR)	Use category	Use description (UR)	Commercialization (UR)
		Estero Vicente 11 f 15 m	Primary- (17) and secondary forest (17)	Seed (1) leaf (1) stem (20)	Construction Utensils/tools Various	Leaves for thatching houses (1). Stems for *banana struts*, fishing spears, and for house walls, floors, pillars or for pig huts (20). Seeds used to make personal adornment e.g. necklaces (1).	One stem is sold for 15–30 USD. A 4 m height stem costs 20 USD. Sold on demand, once or twice a year in Borbón. One sack of seeds sold in the past in Esmeraldas for 20 Sucres (5).
Wettinia quinaria O.F.Cook & Doyle, ES 2015–08[a]	*Yanbucca Yanlachi Yanchi* Walte	Calle Larga 17 f 22 m	Cultivated (6) primary- (6) and secondary forest (24)	Fruit (3) seed (1) leaf (6) stem (30)	Food Construction Utensils/tools Various	Fruits eaten raw (2) and seeds are used to make personal adornment (1). Leaves for thatching houses or *forest huts* (6). Stems for house pillars, walls and floors, for fishing tool *catangas*, furniture e.g. chairs and benches, keys of *marimba* (15).	One stem is sold in Afro–Ecuadorean communities, Borbón and San Lorenzo for 5 USD on demand only (8).
		Estero Vicente 14 f 14 m	Cultivated (4) primary- (24) and secondary forest (24)	Fruit (3) leaf (1) stem (24)	Food Construction Utensils/tools	Fruits eaten raw with salt and sugar (3). Leaves for thatching houses (1). Stems for house walls and floors (16) and struts of banana (8).	One stem of 1 m and 4 m height is sold for 3–5 USD and 10 USD in Borbón twice a year (8).

Italic terms are explained in glossary. *Asado*: Soup with rice. *Bolones*: A small pie prepared with cooked plantains or "asado", cheese or butter. *Banana struts*: Support heavy banana infructescences. *Catanga*: Fish trap of the Chachi and Afro–Ecuadoreans. *Ceviche*: Rice with typical sea food. *Chicha*: Fermented or unfermented drink, preparation possible with milk and different fruits. *Chucula*: Juice with sugar. *Cocada or coco juice*: Coconut juice with milk and sugar. *El San Cipriano*: A wooden statue with the meaning of the chief of cedro who shows the shaman how to cure patients with social or financial problems or injuries e.g. to cure these patients a ritual is done at night, when the shaman takes a drink with a special root and herbs to heal and clean the person together with the San Cipriano. This Santo guides throughout the ritual. Cleaning may take 10–15 days and depends on the severity of the patient. For example, the shaman can unify the separated couples with the holy San Cipriano (pers. comm a Chachi shaman apprentice in the occult sciences). *House construction*: Since the arrival of the chainsaw, the Chachi replaced palm species mainly with timber like *Guaiacum officinale*, guayacán and others. *Huts in the forest*: This little hut allows men to work in the forest, break for lunch, and store tools. *Kumani*: Missionary community of the Christian Church, where they built some traditional big Chachi houses using a lot of palm material. *Marimba*: Traditional music instrument of the Chachi and Afro–Ecuadoreans. *Masato*: Fruit juice, e.g., of banana mixed with water and sugar. *Panda*: Cha'palaa name for boiled plantains, smashed with a flat river rock into a sticky mass (Hazlewood 2004). *Stem processing of Iriartea deltoidea, Wettinia quinaria*: When stem is cut, it has to be split in parts, so it is more comfortable for carrying the stem parts home. The stem is cut in different pieces with the machete or ax. This process is also necessary for floor construction

UR use report, *n* number of reports

[a] Specimens were collected by Eliane Schneider (ES) and members of the Chachi communities

[b] Pictures available only

[c] Past palm use (last use more than 10 years ago)

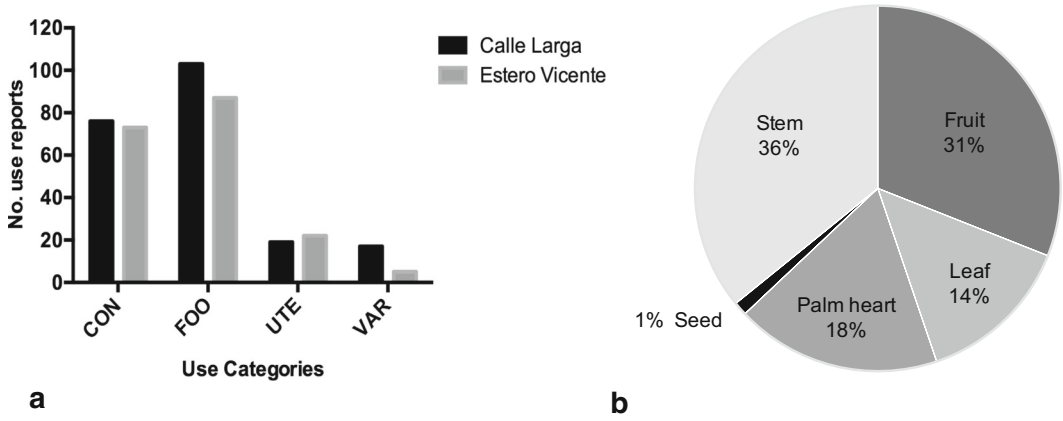

Fig. 2. **a** Use reports per palm use category. *CON* construction, *FOO* food, *UTE* utensils and tools, *VAR* various. **b** Distribution of use reports (UR) among the different palm parts used (n_{UR} = 457).

fewer than ten UR such as adornment, fodder, music, and edible larvae feeding on decomposing palm stems were merged into the use category Various.

Uses were logged as "past uses" if the household representatives interviewed generally agreed that it was more than ten years since a given palm use had been practiced (Cámara-Leret et al. 2012).

The number of UR was used as a proxy for palm use knowledge. Significant differences in knowledge between the two communities and between gender groups were tested using the Mann-Whitney test for unpaired samples. Because of non-normal distribution of the data and small sample sizes, differences in knowledge levels between five different age groups (18–30, 31–40, 41–50, 51–60, over 60 years) were tested using the non-parametric Kruskal-Wallis test. All analyses were performed in the program PRISM 6.0c.

Data from 1985 were less formally collected and, in contrast with 2015, classifying these data at UR level was unfeasible. Therefore, we relied on "use descriptions" as the basic unit for comparison and refer them to the aforementioned use categories. A use description documents a specific palm part of one taxon for a certain use. It contains no information about the frequency of citation.

Results

Overall, nine useful palm species and 457 URs were recorded in the villages of Calle Larga and Estero Vicente in 2015 (Table 1). The use category Food comprised more URs (103), followed by Construction (76), Utensils and tools (19), Various (17), and Ritual (2) (Fig. 2a). With only two exceptions, all uses were mentioned to be practiced today. The most versatile species were *Iriartea deltoidea* Ruiz & Pav., with 68 URs, and *Wettinia quinaria* O.F.Cook & Doyle with 67 URs. The most versatile palm parts were stems with 35% of all URs, fruits with 31% of all URs, followed by palm heart with 18%, and leaves with 14% (Figs. 2b and 3a–h). The palm species perceived as most important by the greatest number of interviewees was *Phytelephas aequatorialis* Spruce, followed by *Iriartea deltoidea*. *P. aequatorialis* is mainly used for thatching whereas *I. deltoidea* is used for house construction, i.e., poles, floors, and walls (Fig. 4a–h).

Cultivation and Harvest Practices

People usually harvest palms growing on the communal land and in the surrounding forest. Only *Astrocaryum standleyanum* L.H.Bailey, *Bactris gasipaes* Kunth, and *Euterpe oleracea* Mart. are grown in home gardens (Fig. 5a). In the past, *P. aequatorialis* was largely cultivated too, but knowledge about the cultivation techniques has diminished. Management practices include clearing around wild and cultivated species to support growth and forest enrichment by planting of seeds. Palms are harvested both in destructive or sustainable ways (Fig. 5b). For harvest of palm hearts and palm timber, the entire stem is killed. Fruits, leaves,

Fig. 3. Example of the most frequently used palm parts. Stems of *Socratea exhorriza* for **a** floors, and **b** house posts. **c** Stems of *Wettinia quinaria* for floors. **d** Fruits of *Astrocaryum standleyanum* for food. **e** Fruits of *Bactris setulosa* to make juice, **f** *Bactris gasipaes.* **g** Palm heart of *Bactris setulosa.* **h** Mat made from *A. standleyanum* leaves.

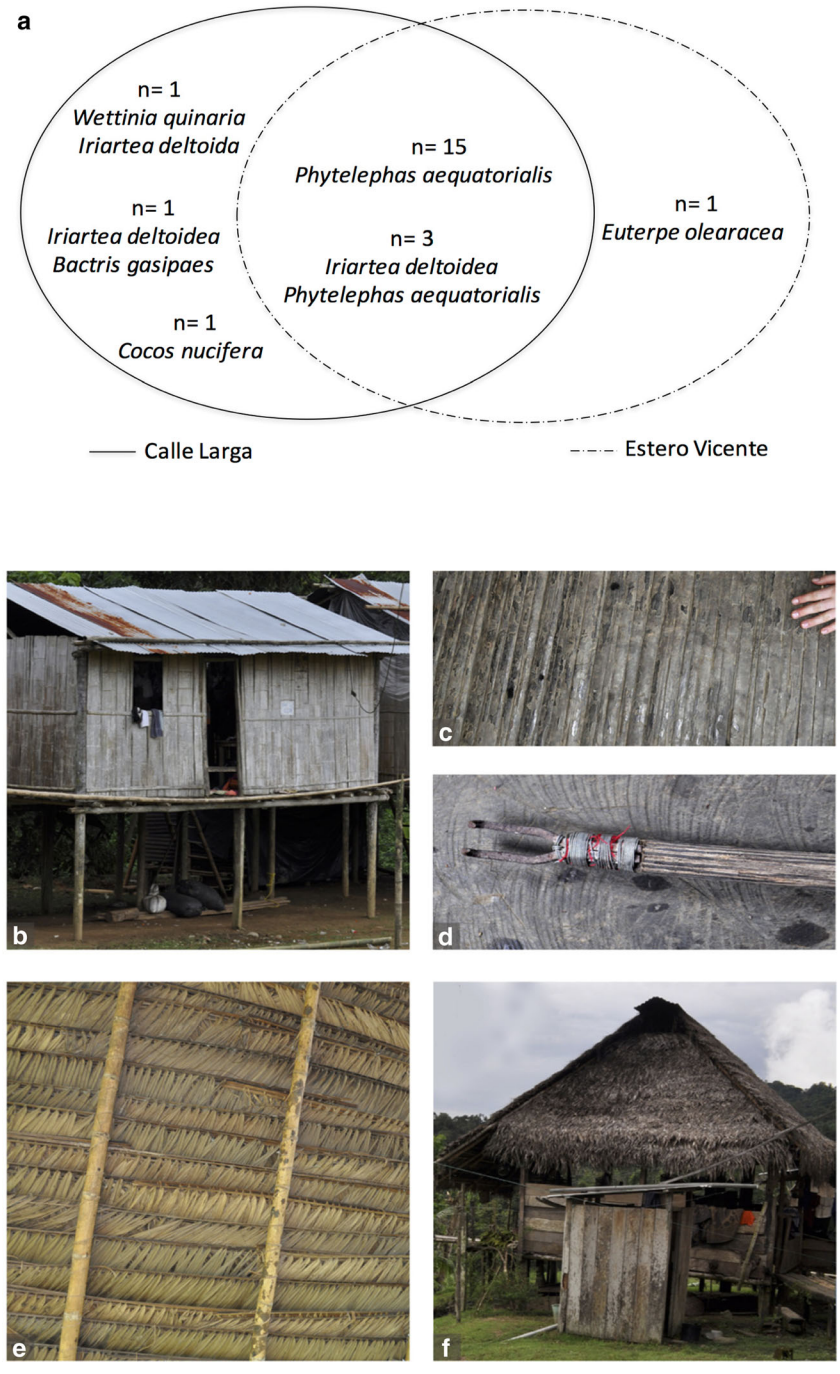

Fig. 4. **a** The most important species according to informants in Calle Larga and Estero Vicente. Most informants (n = 15) cited *Phytelephas aequatorialis* as the most important palm because its leaves are useful for house thatching. For other informants (n = 3) *Iriartea deltoidea* and *Phytelephas aequatorialis* together were the most important because of their use for house construction. (n_{INF} = 25). Uses of *I. deltoidea* stems to make **b** round house posts, **c** house floors, and **d** spear. **e**–**f** Uses of leaves of *Phytelephas aequatorialis* to thatch houses.

or seeds can be harvested in a sustainable way by using tools mounted on a stick or a ladder. Overall, however, the use of palms is decreasing (Fig. 5c). Reasons cited for this decline were replacement by other materials (hardwood timber and corrugated roof) and decline of palm abundance due to destructive harvest and overexploitation (Fig. 5d).

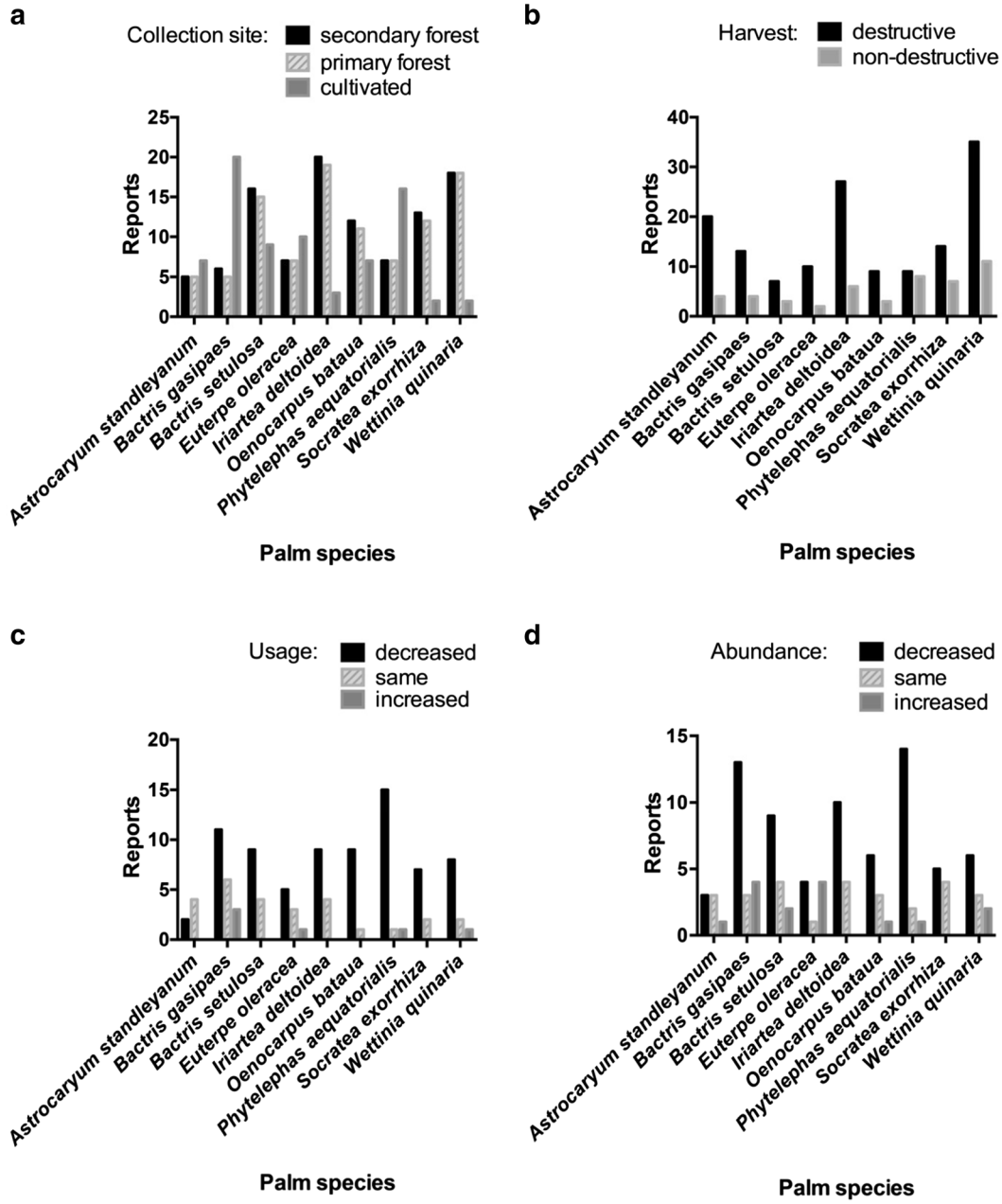

Fig. 5. **a** Reports of sites where palm species are collected in both Chachi communities. **b** Reports of destructive or non-destructive harvesting. **c** Reports of change in the use of palms. **d** Reports of change in abundance of palms in forests.

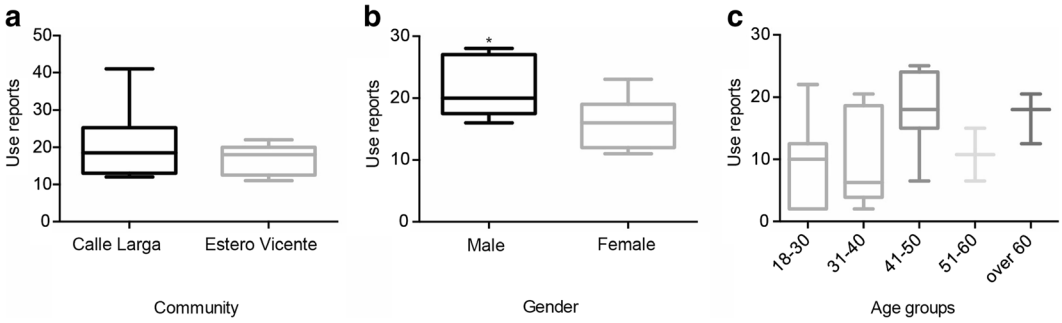

Fig. 6. Comparison of palm use knowledge among **a** communities, **b** gender, and **c** age groups. Significance: ≤ 5%.

Palm Knowledge

Similar levels of palm knowledge were found in both villages (238 UR in Calle Larga vs. 219 in Estero Vicente, with an average of 20 (8 ± SD) vs. 16 (± 4 SD) per person). Men (excluding experts) mentioned significantly more use reports than women ($p < 0.05$; Fig. 6b). Differences between the two communities and between the age groups were not significant (Fig. 6a, c). The latter case supports the prevalent opinion of the Chachi, namely that there is a transfer of knowledge between generations.

Comparison of Palm Knowledge in 1985 and 2015

Chachi people only used nine of 14 palm species recorded as useful by Barfod and Balslev in 1985. However, the five palm species not documented in 2015 had very few, i.e., one or two, use descriptions in 1985. Interestingly, understory palms are no longer used according to our results and three of them are not even recognized by experts anymore (Table 2). In 1985, they were described as being used for their palm hearts and one was used as a ritual plant. The experts agreed that (1) 22 of the total 38 use descriptions recorded in 1985 are still being practiced, (2) four are still known but not practiced and, (3) 12 are lost (Table 2). The use category comprising most use descriptions in both 1985 and 2015 was Food, and the palm part with most use descriptions was the stem. Use descriptions that are still known by experts but were not documented in the survey include stems for blowguns and marimba keys, as well as fibers for blowgun darts (Table 2). Palms with many use descriptions in 1985 are still well known today (e.g., *B. gasipaes*, *I. deltoidea*, *P. aequatorialis*).

Discussion

Palm Species Used by the Chachi

The investigated Chachi households use nine palm species. The species with the most URs are typically versatile and/or easily accessible. This applies in particular to the canopy palms *I. deltoidea* and *W. quinaria* that are mainly exploited for their highly durable peripheral layers of the stem (Anderson 2004; Borchsenius et al. 1998; Brokamp et al. 2011; Cámara-Leret et al. 2014a; Macía et al. 2011; Valencia et al. 2013). Palms that are easily accessible to harvesting are generally preferred. This also applies to palm products that are harvested with simple tools such as the fruits of *B. gasipaes* var. *gasipaes* that is harvested with a knife mounted on top of a stick or the leaves of *P. aequatorialis* that are harvested using a ladder. In other Chachi communities, fewer palm species were documented. Marchan documented in 2001 (Marchan unpubl. data) a surprising large number of useful plants (205 species belonging to 54 families) in Loma Linda, which is situated ca. 15 min downstream from Calle Larga. The list, however, included only five palms. Fadiman (2003) documented multiple uses of *Astrocaryum standleyanum* in the southern part of the Chachi territory and suggests this palm as a candidate for generation of sustainable cash income.

Two canopy palms, *Attalea colenda* O.F.Cook and *Cocos nucifera* L., were not mentioned by the expert or general informants in our study although they are common around the villages and even

TABLE 2. PALM USE BY THE CHACHI: COMPARISON OF FIELDWORK DATA FROM 1985 AND 2015.

Palm species; *Scientific*, Spanish and (Cha'palaa)	Palm type (Growth form[1])	Use in 1985 according to experts ($n = 2$)	Use category	Uses in 2015 according to experts ($n = 4$)
Astrocaryum standleyanum L.H.Bailey Mocora (Poca-chi)	Subcanopy (large tall-stemmed)	Raw fruits edible Fibers for hammock etc. extracted from leaves	Food Utensils/Tools	yes (4) yes (2), no (2)
Bactris gasipaes var. *gasipaes* Kunth Chonta duro (Cano-chi)	Subcanopy (medium-sized)	Palm heart edible Cooked fruit edible Timber for house construction Timber for fish trap Timber for blowgun Timber for spear Timber for marimba keys Edible larvae collected from decomposing stems	Food Construction Utensils/Tools Various 	yes (4) yes (4) no (4) no (4) no (4) no (4) no (4) yes (4)
Bactris setulosa H.Karst.	Understorey (small)	Palm heart edible Cooked fruit edible	Food 	yes (3), no (1) yes (3), no (1)
Geonoma cuneata var. *cuneata* H. Wendl. ex. Spruce (Ya-ha-chi)	Understorey (small)	Raw fruits edible	Food	no (4)
Geonoma linearis Burret (Yullpo-pi-chui-tape)	Understorey (small)	Ritual plant	Ritual	yes (2), yes_no (2)
Iriartea deltoidea Ruiz & Pav. Pambil (Boun-chi)	Canopy (large tall-stemmed)	Palm heart edible Timber for house construction Timber for blowgun Timber for fish trap Timber for spear Timber marimba keys Edible larvae collected from decomposing stems	Food Construction Utensils/Tools Various	yes (4) yes (3), no (1) no (2), yes_no (2) no (2), yes_no (2) yes (2), no (2) yes (2), yes_no (2) yes (4)
Oenocarpus bataua Mart. Chapil (Cola-pa-chi)	Canopy (large tall-stemmed)	Fibers of the leaf base for blowgun darts	Utensils/Tools	no (1), yes_no (3)
Oenocarpus mapora H. Karst. Cinamillo/Ciamba/Pusuy (Uin-ga-chi)	Canopy (large tall-stemmed)	Fibers of the leaf rachis for basketry	Utensils/Tools	yes (2), no (2)

(Continued)

TABLE 2. (CONTINUED).

Palm species; *Scientific*, Spanish and (Cha'palaa)	Palm type (Growth form[1])	Use in 1985 according to experts ($n = 2$)	Use category	Uses in 2015 according to experts ($n = 4$)
Phytelephas aequatorialis Spruce Tagua (Din-chi)	Understorey or subcanopy (medium-short)	Edible endosperm and mesocarp Leaf for roof Leaf for fibers	Food Construction Utensils/Tools	yes (4) yes (4) yes (4)
Prestoea ensiformis Ruiz & Pav. (Chapin-sa-chi)	Understorey or subcanopy (small)	Palm heart edible Leaf for the roof	Food Construction	no (4) no (4)
Prestoea acuminata var. *acuminata* H.E. Moore (Mamba-san-chi)	Understorey or subcanopy (medium-sized)	Palm heart edible Raw fruit edible	Food	no (4) no (4)
Socratea exorrhiza H. Wendl. Zancona (Pin-ua-chi)	Canopy (large tall-stemmed)	Palm heart edible Timber for house construction Edible larvae collected from decomposing stems	Food Construction Various	yes (2), no (2) yes (4) no (4)
Synechanthus warscewiczianus H. Wendl. (Bo-chui-cano-chi)	Understorey (small)	Inhabited by evil spirits	Ritual	no (4)
Wettinia quinaria O.F.Cook & Doyle Walte (Yan-chi)	Canopy (medium sized)	Edible fruits Leaf for the roof Timber for house construction Edible larvae collected from decomposing stems	Food Construction Various	yes (4) yes (2) yes_no (2) yes (4) no (2), yes_no (2)

Yes known and still practiced; *no* not known, *yes_no* known but not practiced any more

[1] Growth forms according to Balslev et al. (2011)

cultivated in homegardens. In Ecuador, *A. colenda* was used as a valuable source of vegetable oil until the 1970s. It has since been replaced by the African oil palm, *Elaeis guineensis* Jacq. (Valencia et al. 2013). Ehnic groups in the Ecuadorean Chocó such as the Tsa'chila of Santo Domingo in the coastal plain do use *A. colenda*, for example as food or fodder, for construction or to make tools (Cámara-Leret et al. 2016). However, the palm seems to be less important for the Chachi as it was neither documented by Barfod and Balslev (1988) nor in our study.

The liquid and the solid endosperm (copra) of the coconut fruits are used as beverage or food, as is the case throughout the entire global distributional range of the species (Gunn et al. 2011). But, these uses were not mentioned during the interviews in the study communities. This may be because informants tend to focus more on wild species rather than cultivated or introduced species (Gunn et al. 2011). In ethnobotanical surveys, exotic species are often given less weight mainly because they are considered as crops grown on private land. Nevertheless, they form an integrated part of the surrounding plant resources and new unexpected uses are developed over time because indigenous people constantly experiment with the structural, nutritive, and medicinal uses of plants.

Sustainability of Palm Use

Our findings on the most important use categories (Food, Construction, and Utensils and Tools) as well as on the most frequently employed palm parts (stems, fruits) agree well with other palm studies in northwestern South America (Macía et al. 2011). The Chachi rarely harvested from palms cultivated in their home gardens, but mostly exploited individuals growing in the wild or on communal lands. There was a consensus among the interviewees that good regeneration in *P. aequatorialis* groves must be procured by clearing of the understory vegetation and by replacement planting. In Calle Larga, these management practices have been entirely abandoned since *P. aequatorialis* is no longer used. The exploitation of *W. quinaria* and *I. deltoidea* for boards is destructive because both species are solitary palms with no capacity for vegetative propagation. Destructive palm harvesting is widespread in the South American tropics and because replacement planting is rare, many palm populations are declining (Bernal et al. 2011). The "Chontaduro" (peach palm) *B. gasipaes* var. *gasipaes* provides an example of how knowledge may finally disappear when a resource becomes scarce. The Chachi interviewees told how the "Chontaduro" has lost its importance in the community because it has failed to produce fruits in the last four years. This is the consequence of the recent introduction in the Chocó of a weevil, *Palmelampius heinrichi* O'Brien, which infests the fruits of this economically important species (O'Brien and Kovarik 2000). Not only has consumption of the fruits decreased, but what is more important, the Chachi throughout their centers have lost interest in the "Chontaduro" altogether.

Palm Knowledge

The level of palm knowledge as measured by the number of URs and number of useful palm species was evenly distributed throughout the two communities investigated, and across all age groups. Men mentioned significantly more URs than women, probably because of men's stronger involvement in the extraction of palm products, particularly for house construction and for utensils and tools (Hazlewood 2004; Medina 1992). Overall, only two URs were referred to as past uses. The even distribution of palm knowledge reflects the independence of the households (Cámara-Leret et al. 2014b; Hazlewood 2004; Medina 1992; Murra 1946). The tendency to act and decide independently from other households may be an imprint of the past when family units were scattered and isolated along the tributaries of the Muisne, Canandé, and Cayapas rivers. The interviewees generally agreed that palm knowledge is transmitted within families and passed from one generation to the other. The ranking of the importance of useful palm species was remarkably uniform across all interviewed households, which indicates that TK is shared across the community. The general trend in the area that palm products are replaced by hardwood, corrugated roofs, and various imported food and beverages is probably the single biggest threat against TK.

Palm Use Change Since 1985

Despite methodological differences, our results indicate that palm TK has decreased over the 30 years since the study of Barfod and Balslev (1988). Of the 14 useful palm species documented in 1985, only nine species were mentioned and used in 2015. The Chachi use palms less intensively, and we recorded fewer uses especially in the Utensils and

tools category. Barfod and Balslev (1988) documented the use of five understory palms. Three of these were used for food and two for ritual uses. *Synechanthus warscewiczianus* H.Wendl. was believed to be inhabited by malevolent spirits, which according to the animistic belief of the Chachi would signify that this species should be handled with care (Barfod and Balslev 1988; Barfod and Kvist 1996).

The drivers of a decrease in palm use are many and complex. The most important ones are deforestation, better market integration, congregated households (instead of scattered), and destructive harvesting. Studies among different ethnic groups in Ecuador show that market integration has a negative influence on palm use in the Amazon (Byg and Balslev 2004; de la Torre et al. 2009; Paniagua-Zambrana et al. 2014). In 1960, the wood industry intensified forest clearing in the Pacific lowlands of Ecuador, which has led to massive loss of biodiversity (Kosmus 2013). New roads have opened up the area and provided better access to markets. The Chachi have abandoned their traditional lifestyle based on subsistence farming and hunting, and now rely more or less on a cash economy (Batallas 2012; Hazlewood 2004).

Conclusion

Today, the Chachi living in the study communities use only nine of the 14 palm species recorded in 1985 by Barfod and Balslev (1988), and understory palms have lost their importance as a plant resource. Some uses, especially the preparation of blowguns and darts, have vanished since 1985. Changes in land-use and agricultural practices have decimated the populations of palms and thereby reduced incentives for transferring TK. Palms still provide important ecosystem services for the Chachi, but with population growth and rapid increase in household numbers, the sustainability of resource management and harvesting practices will be critical (Bernal et al. 2011). Sustainable management should be encouraged, as it may contribute positively to community economy and knowledge preservation while encouraging the Chachi to further preserve the remaining forests (Byg and Balslev 2001). The Chachi have a long history of adapting to new environments and living conditions. In comparison to 1985, the Chachi are among the poorest citizens in Ecuador, threatened by acculturation, poverty, and disease (Hazlewood 2004; Kosmus et al. 2013). It appears that the rapid economic development in the coastal lowlands of Ecuador is challenging the Chachi's ability to adapt, transmit, and apply knowledge to their current needs. The rapidly changed living conditions in the Chachi territories have not been accompanied by efforts to assist this group in preserving their traditional lifestyle and improve their livelihoods.

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