Palm use by the Chachi of Ecuador

(a 30-years reappraisal)

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"Los Chachi el pueblo olvidado"

(Medina 1992)

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Front cover: Edible palm heart of *Bactris setulosa*, Chontilla.

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ABSTRACT

The Chocó belongs to one of the biodiversity hotspots in the world, but also ranks among the most threatened forests in the western Ecuadorian coast and on earth. The Chocó region counted once with the highest concentration and abundance of palm species in Ecuador. Palms are still widely used by different indigenous people and are of great importance for subsistence activities. The Chachi indigenous people are one of the three ethnic groups living in the Ecuadorian Chocó (or coast) and have amassed a wealth of knowledge about their surrounding ecosystems and about the utility of local plant species. However, they are under intense pressure, mostly because of economic drivers related to unsustainable logging, expansion of agriculture and oil palm plantations. As a result, much traditional knowledge is at risk of vanishing rapidly.

This thesis documented the traditional knowledge about palms (Arecaceae) of the Chachi indigenous group in the Chocó. Specifically, this study reappraised Chachi knowledge about palm uses 30 years after the first study on Chachi palm ethnobotany was conducted. To gather information semi-structured interviews and participant observation were done from March to July 2015 in two representative Chachi communities. Palm specimens were gathered and deposited in the National Herbarium of Ecuador (QCNE).

Nine useful palm species, and a total of 457 use reports (UR) were documented. Most UR fall into the categories *Food* (103), *Construction* (76), *Utensils and tools* (19). Stems and fruits are the most often used palm parts. Important and often used species such *as Iriartea deltoidea* and *Wettinia quinaria* are typically versatile, conspicuous, abundant and are often preferred for their highly durable stems. In general, canopy palms are more often used than understory palms, due to their high stems and salient character. The Chachi did not include palms into intensive management systems and did mostly destructive harvesting for six of nine useful species.

This reappraisal concludes that a third of the traditional palm use knowledge documented among the Chachi in 1985 has been eroded, due to several factors such as deforestation, better market access, community building and destructive harvesting. Nevertheless, palms still provide an important natural resource for the Chachi, particularly for house construction and as food supply. Due to increasing population pressure, sustainable use of palms is crucial for the future and for biocultural conservation.

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1. Introduction

Ecuador is one of the most biodiverse countries in the world, with approximately 16'000 vascular plant species (Dodson and Gentry, 1991). Unfortunately, it also suffers the highest deforestation rate in South America (Mosandl 2008). Its megadiversity is attributed to the variety of geographical and climatic environments through the convergence of the four most important South American biogeographic regions: The Chocó in the northwest (specifically, biogeographical Chocó region) and the Tumbesina region southwest (both together are commonly referred to as the Costa), the Andes (or Sierra), and the Amazon lowlands in the east (Dodson and Gentry, 1991). The Chocó as a biogeographical region (Figure 1) runs along the coastal lowland on the Pacific littoral in Panama, Colombia, and in Ecuador between the Andes and the ocean in the Esmeraldas province to the center of Bolivar (Valencia et al. 2013). It is known as one of the wettest regions in the world with extremely high annual rainfall increasing northward from 2’000 mm to 7’000 mm near the Colombian border (Dodson and Gentry 1991). The biogeographical Chocó region is considered one of the most biodiverse regions within the world with around 20% floral endemism (1260 of 6300 native plant species; Dodson and Gentry 1991), and belongs to the Chocó/Darién/Western Ecuador hotspot, one of total 25 hotspots on earth (defined as an area with an exceptional high occurrence of endemism and exceptional 70% original forest cover lost; Gorenflo et al. 2012, Myers et al. 2000).

In the 1960s road building began in western Ecuador, mainly done by the timber industry (Sierra 2003). The region counts as one of the most threatened regions in Ecuador, due to deforestation and other human activities (Dodson and Gentry 1991). This led to unprecedented habitat disturbance and only 4.4% of the original primary forest remains today (Dodson and Gentry 1991). In the biogeographical Chocó region and more specifically, in Esmeraldas (the most northwestern Province in Ecuador), where the study side lies, 15% and 35% of the moist forests have disappeared (Kosmus et al. 2013, Sierra 2010). In the province Esmeraldas main timber production is extracted illegally, mostly done by very low paid local people (Kosmus et al. 2013). But also agriculture and palm oil plantations lead to ongoing massive deforestation in this province (Batallas 2012).

Figure 1. The biogeographical Chocó region extends through three countries in Central America, in Panama, Colombia and Ecuador.

1.1 Chocó history

Until the 1960s commercial land use activities in the Chocó were done by local households with commodities such as *tagua* (also known as "vegetable ivory" or "marfil vegetal" in Spanish), rubber and natural fibers extracted directly from the forests with low-impact on forest cover (Sierra 2003). For the last four decades, commercial *tagua* production changed to banana production, which lead to forests clearing along rivers (Sierra 2003). From the early 1980s commercial logging replaced banana production and started to be the most important commercial activity with a high-impact on forests cover (Sierra 2003). At this time also the chainsaw was imported to Ecuador in great number, making timber exploitation much more easy for both local people and large-scale timber companies (Sierra 2003). Unfortunately, in Ecuador almost none of the forests in the biogeographical Chocó lowlands were protected until 2005, when three Chachi communities confirmed conservation agreements to create a natural reserve, "Gran Reserva Chachi", out of some of the last remnants of the megadiverse natural forests, belonging to their communal territories (Kosmus et al. 2013).

1.2 Palm diversity and palm use in Ecuador

Ecuador has a high diversity of palm species and palms are a dominant element of the landscape (Balslev et al. 2011). In Ecuador there are 32 native palm genera, with *Geonoma* Willd. (33 species), *Bactris* Jacq. (17), *Wettinia* Poepp. Ex Endl. (13) and *Aiphanes* Willd. (12) being the most diverse and representing more than half of the total 136 native species (Balslev et al. 2013, p. IX). In the Ecuadorian coast, there are 61 palm species, and the Chocó region counts with the highest concentration and abundance of species, including two endemics: *Manicaria saccifera*, *Asterogyne martiana* (Balslev 2013).

Palms are often used by humans because they are conspicuous and have suitable ecological, morphological and physiological traits (Cámara-Leret et al. 2011, Macía et al. 2011). Palms occur in many different forest types, soils and altitudes, ranging from 0 to 3300 m. Most occur in the lowland tropical rainforests (<1000 m); few occur in dry- and semidry forests (Balslev et al. 2013, Balslev 2011). Palm stems are straight, mostly unbranched and highly durable, which makes them attractive for construction (Macía et al. 2011). Like the stems, the large pinnate leaves are rich in fibres and sclerenchyma, which make them well suited for construction and tool-making (Barfod and Balslev 1988). Fruits and seeds often contain starch, amino acids, and oils that leads to a great variety of uses for food and food additives (Macía et al. 2011). The palm heart, e.g. of *Prestoea acuminata* is eaten raw or cooked (Macía et al. 2011).

Palms are commonly mentioned in the ethnobotanical literature, as they are important non-timber forest products (NTFPs) for subsistence needs and economic purposes among rural indigenous and peasant populations in tropical areas (de la Torre 2009, Macía et al. 2011). Of the 136 species in Ecuador, 103 are used. Most uses relate to basic human needs, including food, house construction, and utensils and tools (Macía et al. 2011). In Ecuador palms are the native plant group with the greatest diversity of uses per species (Valencia et al. 2013). Many palm species in Ecuador have numerous uses, like *Oenocarpus bataua* and *Mauritia flexuosa* with more than 30 uses, including practically all palm parts with an attributed use (root, stem, leaf, fruit and seed; Balslev 2013).

In Ecuador 30 palm species are commercialized, many of them are sold at local markets, few on regional or even national- and international levels (Bernal et al. 2011). Intensely traded examples are, the introduced *Elaeis guineensis*, cultivated for its palm oil, *Bactris gasipaes* for

its palm heart and *Ceroxylon* spp. for its spear leaves, which are used as bouquets during Easter and for its useful fibers and oil used in cosmetic (Balslev 2013).

Many palms are harvested in their natural habitats with selective harvesting of individuals based on age, size or sex, for example *Astrocaryum chambira* or *Welfia regia* (Bernal et al. 2011). Another management practice is small-scale cultivation near households such as *Bactris gasipaes* or *Astrocaryum chambira*. Unnecessary felling of the whole palm individuals to harvest fruits, palm hearts or leaves is common (Bernal et al. 2011).

1.3 Palm use among the Chachi of Ecuador

The first and only in-depth study about Chachi knowledge of palms documented in 1985 a total of 15 useful palm species and 35 uses (Barfod and Balslev 1988). Fieldwork was done in Zapallo Grande in the Esmeraldas province of Ecuador; the main village of the Chachi people. Two interviewees described palm uses in the community and nearby forests. For example, the wood of *Iriartea deltoidea, Socratea exorrhiza, Wettinia quinaria, Catoblastus aequalis* (now *Wettinia aequalis*), but mostly of *Bactris gasipaes* was used for house posts and floors. *Wettinia quinaria, Prestoea ensiformis* and mostly *Phytelephas aequatorialis* were used for thatching. *Phytelephas aequatorialis* was common along the rivers and the Chachi harvested only the outer leaves, leaving the juvenile leaves so that the whole individual could survive. From *Astrocaryum standleyanum,* even though this species was relatively rare in the study area, they extracted the fibres of unopened spear leaves to make hammocks, fishing nets and baskets. Out of the water resistant fibrous wood of *Iriartea deltoida* and *Bactris gasipaes* they made fish traps, left permanently in the rivers. From the same species the Chachi also made spears and blowguns and from the strong fibres from the leaf base of *Oenocarpus bataua* they made blowgun darts. From the wood of *Iriartea deltoidea* they made keys for the music instrument marimba. They also extracted the fine fibre of *Oenocarpus mapora* for weaving baskets.

The Chachi cultivated *Bactris gasipaes* for its palm heart and nutritious fruits, which were commercialized on a small-scale. The extraction of a palm heart has been a destructive process, as the heart consist of unopened new leaves in the crown shaft, and the whole palm individual has to be cut. The fruits of *Prestoea acuminata* var. *acuminata* and *Geonoma cuneata* var. *cuneata* were collected wild and eaten raw. The watery endosperm of *Phytelephas aequatorialis* was used as refreshment while working or travelling and the young mesocarp was eaten. Palm

hearts were eaten of *Bactris gasipaes, Bactris* sp., *Iriartea deltoidea* and *Socratea exorrhiza*, but preferentially from *Prestoea acuminata* var. *acuminata* and *Prestoea ensiformis*. Often, palm hearts were harvested from trees felled for construction or other purposes. Beetle larvae of *Rhynchoporus palmarum* that live in decomposing stems of *Bactris gasipaes, Iriartea deltoida, Socratea exorrhiza* and *Wettinia quinaria* were collected and were eaten as delicacy raw or cooked.

No medical palm uses were documented among the Chachi. However, it was believed, that many understory palms, such as *Synechanthus warscewiczianus* and *Geonoma* spp. were inhabited by evil spirits. Shamans were able to drive out the spirits and subsequently they used the palms for curing (Barfod and Balslev 1988).

1.4 Aim of the project

The main aim of this research is to document the actual current knowledge about palms (Arecaceae) of the Chachi indigenous group in the Chocó of north-western Ecuador. Specifically, this study aims to reappraise Chachi knowledge about palm uses 30 years after the first ethnobotanical palm study in 1985 among this group was done (Barfod and Balslev 1988).

Research questions are:

1. Which palm species do the Chachi people use?
2. How do they use the species?
3. How has palm use changed among the Chachi since 1985, as compared to Barfod and Balslev (1988)?

This 30-year reappraisal, through repeated observations of Chachi palm use knowledge, will allow understanding the change of Chachi traditional knowledge (TK) and provide new insight about which factors influence the conservation of TK. Additional this project supports the Chachi indigenous culture to engage in participatory ethnobotanical documentation and helps to preserve their traditional knowledge. This could contribute to reverse or mitigate the process of biocultural loss (Gorenflo et al. 2012).

The conservation of traditional knowledge of the Chachi people is important, because it could be disappear soon, but might be useful in the future, as it provides a key to access, manage and use ecosystem services, what is crucial for subsistence activities (Benz et al. 2000, Godoy et al. 2009, Cámara-Leret et al. 2014). Plants play an important role in subsistence activities and are essential for the survival of every human being, as they constitute food supply, health care applications, construction material and many more functions (Heinrich 2001). But, there are often dramatic changes in traditional societies in the early decades after immersion within a larger cash economy, which often lead to a rapid loss of traditional plant knowledge (Hazlewood 2004). Often this new dependence on modern market goods drives small rural communities into poverty, as they are not able to cope or even compete with the modern techniques or societies (Hazlewood 2004).

2. Study area

2.1 Communities

Knowledge of palm use and related socioeconomic variables were studied amongst the inhabitants of two communities in northwestern Esmeraldas, 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) along the riversides of "Rio Cayapas" and "San Miguel" (Figure 2). Historically this area is also called "zona del Cayapas".

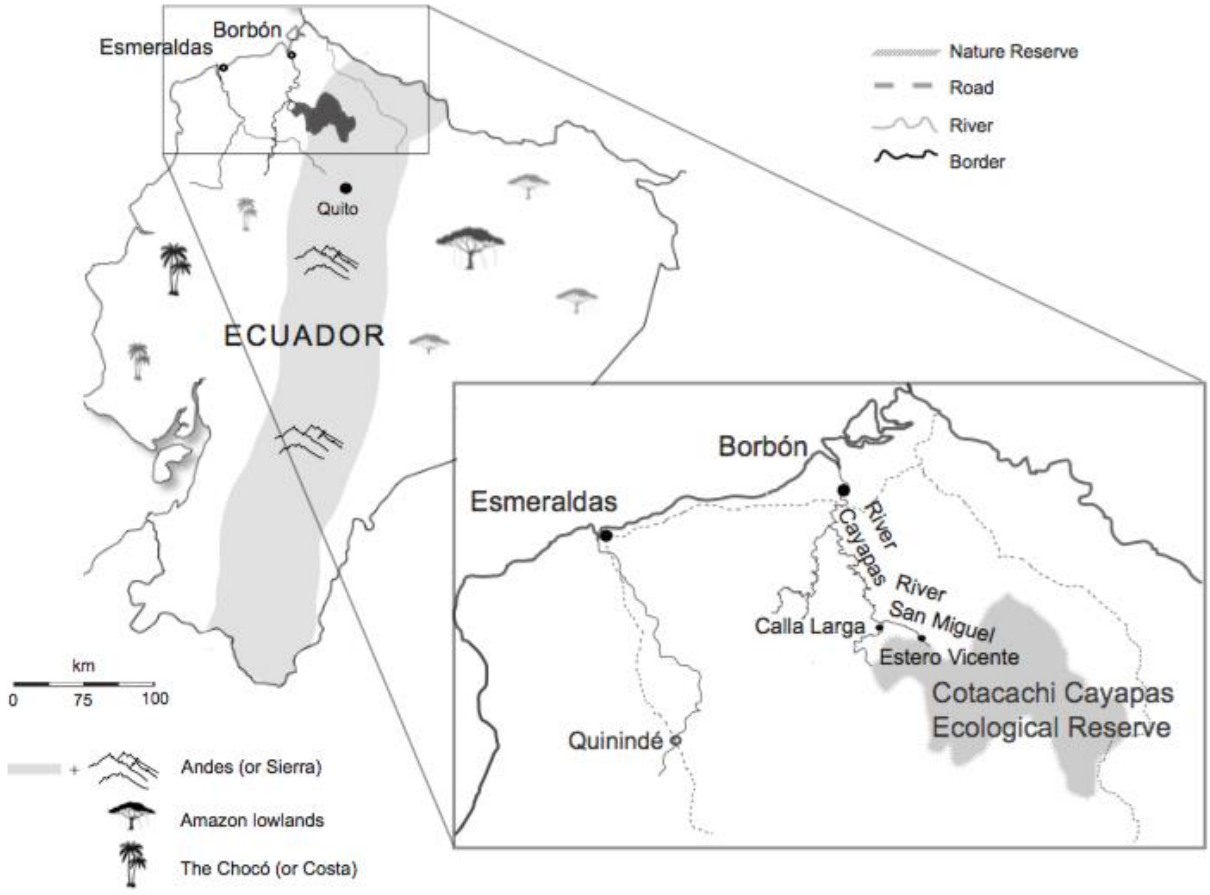


Figure 2. Area map. Ecuadors biogeographical regions from west to east: The Chocó (or Costa), the Andes (or Sierra), and the Amazon lowlands. The two communities are located in the north-western Ecuadorean coast in the province Esmeraldas.

Estero Vicente is the last village upriver at the river "San Miguel", bordering the biggest natural reserve in northwestern Ecuador, the Cotacachi-Cayapas Ecological Reserve with 243'638 hectares (Ministerio de Ambiente del Ecuador 2007). Estero Vicente was built around

1980 at the riverside, but in 2008, after a big flood, the whole village had to be rebuilt further up the hill. The rebuilding was done with timber and zinc from architects of Quito, financed by the government (*pers comm*. community leaders of both communities). Calle Larga was established in 1985 and at this time houses were built with local palm woods. Between 1985 and 2015 the number of the inhabitants of the indigenous Chachi people seem to have increased tremendously, according to literature from around 7000 people to more than double (Barfod & Balslev 1988, http://www.politica.gob.ec/una-radio-une-a-comunidades-chachi-en-esmeraldas/ 2014). Both communities differ very little in terms of environmental features (rainfall, humidity, temperature, topography, soil quality). The proximity to the river differs slightly by 100 meters, as Estero Vincente lies upon a hill, where inhabitants have to walk hundreds of stair steps daily to reach the river (Plate I).

The territory of the Chachi people is divided into three different zones: the southern zone (Muisne) with three Chachi centers, the central zone (Quinindé) with 6 centers and the northern zone (the river "Cayapas") with 19 Chachi centers (Figure 3). The two communities are located in the northern region and are accessible only by boat; from the nearest market Borbón to Calle Larga. This is a four-hour journey on average, whereas Estero Vincente takes six hours on average. The river Cayapas and its tributaries represent to the Chachi, and the other inhabitants of the region, the only way of inter-communal communication and contact with the "outside", Borbón (Medina 1992).

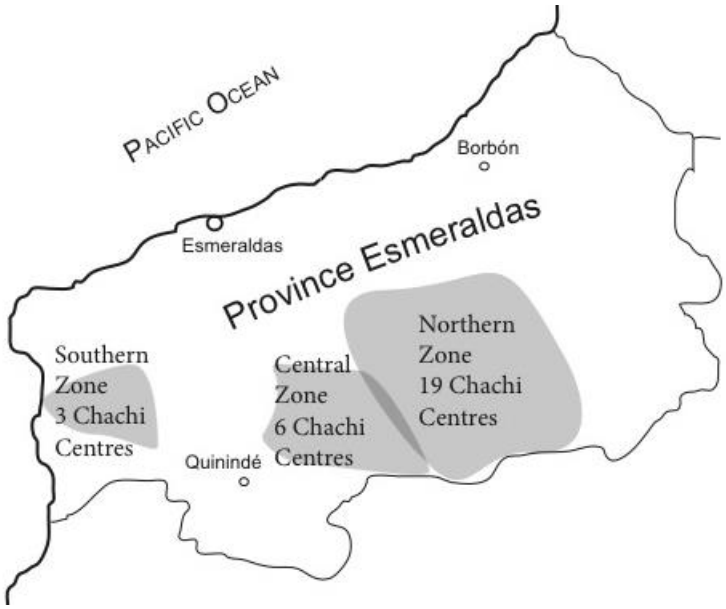


Figure 3. The three Chachi centers in the north-western Ecuadorian coast at the border to Colombia in the north.

2.2 Climate and vegetation

The area of "the Cayapas" lies in the province Esmeraldas, where the climate is very warm and moist, with a mean of 25.6°C (Climate-Data.org 2014). In the northern zone of the Chachi annual rainfall are estimated between 4'000 and 8'000 mm with a three-month rain-less period from November to January (Bjorholm et al. 2005, Hazlewood 2004). The strong tropical rainfall, often from the afternoon until dawn, exceeds the evapotranspiration (Medina 1992). But it is also said that the climate is becoming much drier with deforestation in the last decades (Hazlewood 2004).

The composition of the vegetation varies, due to soils, topography and moisture availability (Medina 1992). The typical vegetation is moist and tropical wet forest with rich volcanic and alluvial soils, making them attractive for agriculture and logging (Dodson and Gentry 1991).

Heavy rainfall and the strong sun promote fast, dense and evergreen vegetation, with tall canopy trees usually at least of 30 meters high (Hazlewood 2004). The moist and tropical wet forest contains three strata; first the top or canopy stratum with trees of around 40 meters, dominated by families like Myristicaceae, Moraceae, Arecaceae, Fabaceae and Meliaceae (unpublished data, Marchan); the second strata or sub-canopy, dominated by two very abundant palm species with stilt roots *Iriartea deltoidea* and *Wettinia quinaria* and some species of *Matisia* spp. (Bombacaceae; unpublished data, Marchan); the third strata or understory, which is densely composed by species of the family Rubiaceae and small palms, like *Geonoma* spp., *Synechanthus warscewiczianus* or *Pholydostachys dactyloides*. The stems of trees or palms are densely covered by abundant mosses, lichens and epiphytes (Hazlewood 2004).

2.3 Chachi history and plant use

The Chachi culture represents a recent adaptation to the Chocó lowlands. There are different versions of Chachi history and it is unknown when exactly they began identify themselves as a cultural distinct group from the Chibchas (Hazlewood 2004). Uncertain is also how long it took to migrate from rainforests of Nicaragua and Panama to the Amazon, the Andes and finally to the Ecuadorian Chocó (Hazlewood 2004). The Chachi people lived in the Andes in scattered settlements, where they could use the natural resources without facing resource scarcity (Kosmus et al. 2013). For an unknown reason, they migrated around two hundred years ago from the north-western Andes, near Ibarra (2250 meter above sea level) to the Ecuadorian lowland Chocó area (Hazlewood 2004, Fadiman 2003, 2008). It is possible that they had to flee because of the

Spanish colonialists (DeBoer 1996, Hazlewood 2004). In the lowlands they spread among the river Cayapas, where they got also their more generally known name "the Cayapas". Some minor groups also migrated to the regions of Muisne and Quinindé (Medina 1992). In the "Cayapas" they amassed a wealth of knowledge about their surrounding ecosystems and about the utility of local plant species in times of a rich surrounding ecosystem (Barfod and Balslev 1988). More than a thousand useful plants were documented among the Chachi, mainly for medicinal and ritual uses (Kvist et al. 1987). Plants were also used for hunting, birth control, as hallucinogens and stimulants. For hunting they used many different plant species for arrow and fish poisons (Kvist et al. 1987). To control birth a species of *Ombrophytum* (Balanophoraceae), which women had to drink to stop the periods or *Cocos nucifera* were claimed to have a sterilizing effect (Kvist et al. 1987). Chachi shamans used "ayahuasca", a strong hallucinogenic plant mixture. Additionally, they used plant leaves of different species to hit the patient's body softly (Holm-Nielsen et al. 1983, Kvist et al. 1991). Many Gesneriaceae were used against snake bites, but also species of Piperaceae or ferns (Holm-Nielsen et al. 1983). Medicinal plants were used as vermifuges, in odontology, ophtalmology and against fungal diseases (Kvist and Nielsen 1987). Fungal diseases are very common in the moist and humid tropical areas and the Chachi are using at least nine species for fungal treatment (Kvist et al. 1987).

But in the lowlands they also encountered new diseases and difficulties (Medina 1992). Many members of the Chachi community started to suffer from various diseases, e.g. malaria, tuberculosis, child malnutrition and often onchocerciasis (30% of the population in 1980). Chachi healers "Micurus" were familiar with curing snakebites or biopsychological problems but not with the new diseases (Medina 1992). The serious health problems could not be solved due to the difficult economic situation with scant resources for buying medicine and because of insufficient governmental help (Medina 1992). One factor of the bad health situation has also been the use of contaminated or dirty river- and rainwater without boiling it. Therefore, they struggled with endemic health problems (Medina 1992).

Furthermore, conflicts regularly occurred with migrating groups, like the Afro-Ecuadoreans and later the colonists, or timber companies, entering their territories (Medina 1992). During the colonial time the Afro-Ecuadoreans migrated in large numbers to the area of the "Cayapas". The Chachi permitted the Afro-Ecuadoreans (and a few colonists) to use their lands and forests (Medina 1992). The Ecuadorian Institute for Agrarian Reform and Colonization (IERAC) started

around 1990 to assign territories to the Chachi communities, as many Chachi families urgently wanted to have legal land rights. But the adjudication process has not been completely finished, due to many invasions, complaints and bureaucratic problems (Medina 1992). Nowadays, the Chachi and the Afro-Ecuadoreans own traditional communal and individual land, which can be purchased by the colonists, but only for individual land tracts (Sierra 2003).

Up to the 1960s the province of Esmeraldas, and in particular the region of the "Cayapas", were face serious educational problems with approximately 35% illiteracy (Medina 1992). Building of primary schools has been one of the basic mechanisms of the catholic and evangelic church to get access to the Chachi villages from the 1960s onwards (Medina 1992). The first primary school was built in Santa Maria in 1961 and the second, years later, in Zapallo Grande by the protestant missionaries. Twenty years later the Ministry of Education took charge of 12 schools for the Afro-Ecuadorean and Chachi communities and later the Chachi started an intercultural bilingual education program in spanish and chapalaa, their local language. Due to lacking resources the program, however, faced restrictions (Medina 1992). Today, most people have completed primary school education, but possibilities for higher study levels still show a significant deficit (Yépez Montúfar 2013).

The Afro-Ecuadoreans, the colonialists, and Chachi have similar livelihood strategies, based on subsistence farming, supplemented by gathering forest products and fishing (Hazlewood 2004). But the massive deforestation by the timber industry caused the extinction and expulsion of almost all animals the Chachi hunt; species of rodents, deer, felines, peccaries, armadillos, and birds (Medina 1992, Mora 1945). Waste from the timber industry together with the use of dynamite to hunt fishes of the local people led to contaminated river water and caused the extinction of many fish species and crustaceans (an important food of the Chachi). The extinction of mammals and fishes strongly affected the inhabitants of "Cayapas", especially the Chachi, and increased problems of poverty and marginality (Medina 1992). Subsequently, the Chachi began to cultivate more crops. This is done on small holdings "pequeñas chacras", not exceeding one hectare, where they cultivate mainly plantains, yuca, maize and fruits (Medina 1992). For a small cash income coffee and cacao have been planted (Medina 1992).

As consequence of the various disadvantages and socio-political problems, the Chachi people reinforced themselves by building confined communities instead of scattered households and founded a political organization in 1978, the Federación de Centros Chachi Esmeraldas (FE.E.CH.E) (*pers comm*. expert first community, Hazlewood 2004). The Chachi also started to

migrate into cities and to work for timber companies. Especially young women migrated to cities like Esmeraldas, Quininde, Guayaquil, Borbón or Quito to earn a living as domestic workers (Medina 1992). Chachi men are often employed as day laborers in the wood industry, often under very bad and exploitative working conditions (Medina 1992).

In socioeconomic terms, the region still counts among the poorest in Ecuador (Kosmus et al. 2013). The better access to the regional and global market through timber companies caused a shift from subsistence agriculture to increased cash economy with an associated acculturation process (Hazlewood 2004, Batallas 2012).

But, a recent unpublished ethnobotanical study from Loma Linda (15 min. with the boat from Calle Larga) done in 2001 documented the use of a surprising large number of 205 plant species in 128 genera and 54 plant families (unpublished data, Marchan). Five families Melostomataceae, Lauraceae, Mimosaceae, Moraceae and Rubiaceae contained the highest numbers of useful species (42%). And after the family use value index (FUV) Arecaceae, was the fourth most important family after to the Chachi people. There were documented eight useful palm species, *Astrocaryum standleyanum, Euterpe oleracea, Geonoma* sp., *Iriartea deltoidea*, *Pholidostachys dactyloides*, *Socratea exorrhiza*, *Synechanthus warscewiczianus* and *Wettinia quinaria*, where the latter palm species showed the highest use value (UVs), followed by *Iriartea deltoidea* and *Socratea exorrhiza* and all were used mainly for construction.

2.5 Chachi culture

The Chachi culture is influenced by different ethnic groups, for example from the Colorado's or "Tsa'chila " and the Coaiqueres or "Awá" (Sierra 1999). The three indigenous groups Chachi, Tsa'chila and Awá all belong to the Barbacoa language group (Fabre 2005, Kosmus et al. 2013). Many cultural elements in curing rituals or music are shared between the Tsa'chila, Chachi and Afro- Ecuadoreans (Barfod et al. 1996). During the last century, also missionaries have strongly influenced the Chachi culture (Sierra 2003). The Chachi identify themselves strongly with their language Chapalaa. Spanish is only spoken with other ethnic groups (Hazlewood 2004).

Political organization – Traditionally the Chachi have always lived in strong social structures, where political authorities regulated the behavior of the Chachi, e.g. "Unís and Chaitalas" or medicinal healers "Micurus" (Medina 1992). The president or governor (Uní in

Chapalaa) of a community has to provide social support to the community and educate morality, as he knows the traditional law and can resolve conflicts between the Chachi (*pers. comm* Uní Zapallo Grande).

The traditional law is not written down and is passed orally from generation to generation (Hazlewood 2004). Example according to the traditional law "ley traditional" it was forbidden to have relationships with an Afro-Ecuadorean or other ethnic groups (Medina 1992). But young Chachi, who left their territory to study, started to mistrust and change the traditional law (Medina 1992).

Households – The Chachi lived mostly isolated along rivers in houses built on stilts and operated as single-families in terms of subsistence activities and agriculture (Hazlewood 2004).

Since the Chachi migrated from the Andes, they did not have a clan organization and the family household was the basic social unit (Murra 1948). During daily activities the Chachi did not wear cloths. Today the Chachi live more in clustered communities and wear modern cloths (Hazlewood 2004).

Healthcare – The Chachi traditionally go to the Micurus (shamans) to cure "the evil eye " or "the shadow of death" caused by believed spiritual beings, during large rituals over nights (Kvist et al. 1991). Community members may use medicinal plants by themselves and only asked shamans for help for serious illnesses, such as those believed to be caused by evil spirits (Kvist 1991). Nowadays the hospital in Zapallo Grande is of great importance for diseases, which are not associated with the presence of spiritual beings or snakebites (Yépez Montúfar 2013).

Music – The traditional Chachi music is influenced especially by the Afro-Ecuadoreans, who introduced self-made instruments, "marimba and drums", to the Chachi. For music and dance events women dressed in colorful skirts and men in long trousers and a nightgown reaching to their knees (Medina 1992). But the music most listened by Chachi nowadays is typical tropical rhythm, like salsa and cumbia (Hazlewood 2004).

3. Methods

3.1 Selection of communities

Fieldwork was done over a time-span of six months from February to August 2015. First, contact was established via email with the President of the Federación de Centros Chachi Esmeraldas (FE.E.CH.E), Jirdo Añapa. He showed interest in the research project and offered his help to accompany me to the Chachi communities for the first visit to guarantee my safety. Selection criteria for the two communities were: (1) high palm use knowledge among community members, (2) different access to markets between the two communities, (3) access to primary forests. My first stay in Chachi territory took place in the main village Zapallo Grande, the Chachi president hosted me. In this village I met Vicente Tapuyo, one of the interviewees of Barfod and Balslev's (1988) study (the second and older interviewee Maclovio Añapa Añapa passed away long before). According to Vicente's opinion and that of three other elder inhabitants of Zapallo Grande, the younger generation lost knowledge about traditional palm use. On the basis of these opinions, the Chachi president invited me to visit a community called Calle Larga, where a trustworthy friend and tourist guide, Alfredo Añapa, lived. Because community selection criteria were fulfilled and first contacts with its members were positive, I decided to work there. Alfredo Añapa was my host, first expert interviewee, and local interpreter when needed. As a second study village we tried to find a community with possibly even higher palm use knowledge among its members, situated in close vicinity to the Cotacachi-Cayapas Ecological Reserve, which is assumed to have higher palm diversity. This also meant a longer travel distance, when compared to the first community, to the nearest market, Borbón. Alfredo Añapa recommended the community Estero Vicente, because his trustful friend Emilio Añapa lived there, who was willing to help me on the project. The methods of the project follow largely a standard protocol, which has been successfully applied in palm ethnobotanical work in South America, including the Chocó (Cámara-Leret et al. 2012).

3.2 Interviews (techniques and informants)

Semi-structured interviews and participant observation were done from March to July 2015. Interviews were done in Spanish or when needed with the local interpreter Alfredo Añapa, who spoke "Chapalaa".

Before initiating interviews, a community meeting was organized to present the objectives of the research project. I explained to the community members how the information on palm ethnobotany and related socio-economic variables would be collected: 1) collecting socioeconomic and historic questionnaire data with the community leaders, 2) a complete community census, 3) collecting socioeconomic and ethnobotanical data with two types of interviewees (general and expert interviewees).

After the community members agreed to participate in the project, palm experts were selected. In both communities, community members selected two palm experts thought to possess greater palm use knowledge. Also, a tentative work schedule for the ethnobotanical and socioeconomic interviews was prepared during the community meeting, but it resulted impractical in both communities, because of spontaneity and varying working hours of the people. Before starting with the interviews it was important to familiarize myself with the daily activities and dynamics of the community and to establish confidence with the community members.

Community history and socioeconomic issues

To gain more insight into the community, the leaders in both communities were asked to provide details about community history and socioeconomic issues. To facilitate work a community map was drawn by the community leader or expert interviewee (Appendix 1.1. community map, Appendix 2.1. Socioeconomic and historic questionnaire). In Calle Larga the community leader was a 46 years old man and in Estero Vicente a 67 years old man.

Census

A community census was done to become acquainted with the local inhabitants and the daily activities of each household. In each community a local guide accompanied me to gather information on the number of households, generations, individuals, and gender and age of every individual (Appendix 2.2. Census questionnaire). The researcher recorded additional information on local or external materials employed in house construction and its condition.

Socioeconomic questionnaire

Based on the census data household representatives (general interviewees) were requested by a local interpreter and me. We tried to get equal numbers regarding gender and five different age groups (18–30, 31–40, 41–50, 51–60, over 60 years). Subsequently, the household representatives (general interviewees) were asked socioeconomic questions (Appendix 2.3. Socioeconomic questionnaire).

In Calle Larga 12 household representatives were interviewed (3 female, 9 male, mean age 44 years (± 14 SD)). Because I was working with my local interpreter men were addressed mainly as household representatives and consequently the number of female and male interviewees were not distributed equally. In Estero Vicente I observed that many women gave interviews as household representatives, because interviews were done without the local interpreter, but with help of my female academic counterpart and an Ecuadorian assistant. In Estero Vicente were 13 household representatives selected (7 female, 6 male, mean age 37 years (±15 SD)). In total, 27 socioeconomic interviews were done, including the interviews with the community leaders (10 female, 17 male, mean age 40 years (± 15 SD)). Of all interviewees fifteen (5f, 10m) were born in the study community. Twelve (5f, 7m) Chachi immigrated from other Chachi communities (Calle Nacio, Cooperativa, Corriente Grande, Corriente Seca, El encanto, San Miguel, Tigrillo, Zapallo Grande) to the communities of study, because of new committed marriage. The average residence time in the first community was 24.2 years (±15.9 SD) and in the second 29.4 years (±18.1 SD).

Ethnobotanical questionnaire

Once household representatives were interviewed, ethnobotanical walks in the community's surrounding area and forests were started. In each community two male palm experts were selected in Calle Larga (41 and 46 years) and in Estero Vicente (32 and 67 years). All useful palm species were determined with the *Manual to the Palms of Ecuador* of Borchsenius et al. (1998). Pictures of each useful palm were made and palm parts (fruits, seeds, leaves or juvenile individuals) were selected as showing material to the general interviewees. The most important palm material was retained as voucher specimens for the National Herbarium of Ecuador (QCNE). Back at the village, experts were asked detailed questions about each use of the mentioned palm species (Appendix 2.4. Palm use questionnaire).

The same questionnaire, with less in-depth questions, was asked general interviewees to clarify and crosscheck each use cited by the palm expert. New general interviewees were selected again by the local interpreter and me, in the same way as described previously. Interviews with general interviewees were made to gather information about the variation of palm use knowledge in each community. In Calle Larga 10 general interviews were done (8 women, 2 men, mean age years 43 (± 11 SD)). In Estero Vicente, 11 general interviews took place (8 women, 3 men, mean age years 43 (± 11 SD)). In both communities it was not possible to find more male interviewees, because they were either busy working in the forests or not interested in the project. Women spent more time in the village and were flexible in giving interviews. In total 25 ethnobotanical interviews were completed (16 women, 9 men, mean age 39 years (± 14 SD).

The resulting use reports were categorized into *Food, Construction, Utensils and tools* and *Various* (Appendix 2.5.). *Various* comprises sub-categories with a small number of citations (i.e. less than 10 UR), such as *Adornment, Fodder, Music, Ritual* and *Others.* Uses which could not be classified into previous categories were summarized into the sub-category *Others,* like uses of palms that are part of agroforestry systems (seeds for cultivation for selling; 2 UR) and indirect uses of palms (insect larvae feeding on rotting stems used as food; 2 UR).

Ethnobotanical questionnaire for comparing palm use with Barfod and Balslev (1988)

Additional questions were developed to obtain information about the change of palm uses by the Chachi since 1985, in comparison to Barfod and Balslev 1988 (Appendix 2.6. Change of palm use questionnaire). Because the only living interviewee of Barfod and Balslev's (1988) study left the Chachi territories since the first encounter at the beginning of the fieldwork, it was not possible to interview the original interviewees of Barfod and Balslev's study (1988). Therefore, the two palm experts selected in each community Calle Larga and Estero Vicente, were asked about their knowledge of all 15 useful palm species (six canopy palms, one subcanopy, seven understory and one cultivated palm) and the 35 use reports documented in 1985 by Barfod and Balslev.

3.3 Research permits and plant documentation

Research and plant collecting permits were obtained from the Ministry of Environment in Esmeraldas with the help of our academic counterpart Dr. Olga Carnicer from Pontifica Universidad Católica del Ecuador Sede Esmeraldas (PUCESE).

Voucher specimens of palm species collected during the walks with the experts were deposited at the National Herbarium of Ecuador (QCNE; Appendix 2.7.). Each palm use and palm species was visually documented with a camera, as a backup system for verifying palm taxonomy in case of uncertainty. Several formalities, including researcher permits, had to be collected in order to be allowed to deposit the voucher specimens in the National Herbarium of Ecuador (QCNE).

The research was conducted in accordance with the Convention of Biological Diversity (CBD) and the Bonn guidelines regarding access and benefit sharing (ABS) issues. The project findings were presented to the local communities in a manual "Palmeras Utilizadas Por Los Chachi En Ecuador", where the most used palms are described and in a short movie (https://www.youtube.com/channel/UCqho98A-b5CegFuR7NatlBw). Data collection was permitted in agreement with national and local authorities and with prior informed consent (PIC).

3.4 Challenges

To find a local counterpart and to get all necessary permits (research-, plant collecting-, mobilization permits and other paper work turned out to be a difficult process lasting over two to three months, between February and April 2015. This was largely due to the unclear political and security situation in the study area. Because of safety issues it was not recommended to work alone in the area. At the same time, it was not easy to find a local assistant as Ecuadoreans are afraid of the conflicts in Esmeraldas and especially among the Chachi people.

To both communities I had to bring food, potable water, sleeping pad and mosquito net by myself. During the stay in the first community I was working alone and had to cook and wash by myself, which was extremely exhausting, together with a general acclimatization process. Finally, in the second community an Ecuadorean assistant helped me and simplified the work and arrangements with the Chachi. To make arrangements or talking about salaries for experts and local interpreter was very challenging for me as a woman and much easier together with the

assistant.

In contrast to the first community, in the second one my assistant and I were hosted in a guest house. This was more comfortable for getting privacy and a little bit more sleep. But sometimes some persons listened to music all night long and I could hardly get sleep, anyway.

It has to be mentioned, that the Chachi were not used to find themselves in an interview situation, except politically active men. Many Chachi often were shy and reserved in the beginning, especially women in the first community were uncertain to give interviews in front of my local interpreter. Therefore, it was a challenge to understand the Chachi, when they remained silent, understood or if they did not know or want to give the answer. Besides, some Chachi do not trust each other and were concerned that others would benefit more from the research project.

Additionally, it is important to mention that there was uncertainty in the accurate age of Chachi people estimated over thirty years, since some Chachi declared a different age than it was written in the census data. For instance, it was difficult to know, if they knew their accurate age, as some seemed to be ten years older as they appeared. Furthermore, many did not know their date of birth.

3.5 Data analysis

Each citation by one interviewee of a particular palm part of a particular palm species to be used for a particular use was recorded as one use report (UR). Data from the publication of 1985 (Balslev and Barfod 1988) and from fieldwork in 2015 are comparable analyzed. Past uses were categorized by the Chachi people as past after two years not using it.

The number of UR was used as a proxy for palm use knowledge levels between the two communities and between genders and was compared with the Mann-Whitney test of unpaired t-test. The knowledge of the five different age groups (experts excluded) was compared with the non-parametric Kruskal-Wallis test. These tests were used because of the non-parametric distribution of the data and limited sample size of interviewees.

4. Results

4.1 Socioeconomic and census data

Communities

In both communities most people of both genders were between zero and 20 years old, with a mean of 22 years (±17 SD) in Calle Larga and 22 years (±19 SD) in Estero Vicente (Figure 4).

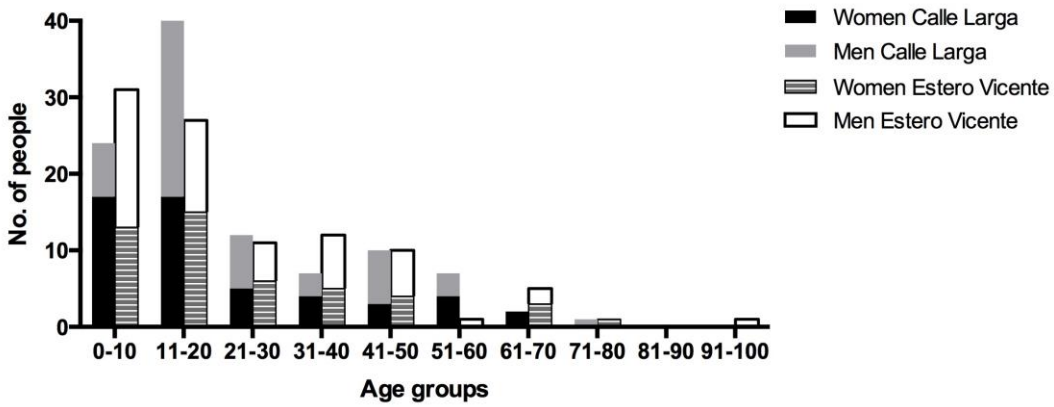


Figure 4. Demography of both communities, left bars Calle Larga and right bars Estero Vincente (n=202).

Calle Larga - In Calle Larga lived 103 inhabitants (52 f, 51 m) of 22 generations in 12 households (hereafter 'HH') within estimated four hectares of total 100 hectares communal land. The community houses were built around a big square used as a soccer field (Appendix 1.1., Plate ll). The field was in a bad condition because of recurrent water pools caused by heavy rainfall. Next to the square were located a children garden, a little community shop, a community- and missionary house. The missionary house stand empty most of the time, except for short visits of missionaries. A few houses are scattered among the neighborhoods. Each house was built on high poles, reached by removable ladders. Most houses were built one-stored. Only few two-storied houses were built, where the ground floor served as kitchen or entrance. No house was completely built with local palm woods. Since the Chachi got the chainsaw, houses and their repairs are done with tree woods, and with few external materials (e.g., zinc for the roof, door latches and nails). Half of houses showed major damages, e.g., broken bars in floors or walls. Free spaces in floors in turn were still traditionally used to wipe away dirt. The community did not possess any communication services, such as radio or a public phone. Intra-communal news or arrangements were transmitted by passing boat drivers and -passengers.

Estero Vicente - In Estero Vicente lived 99 (47 f, 52 m) inhabitants of 24 generations in 17 HH within estimated five hectares of total 50 hectares communal land. The houses were built upon a hill around two small squares used as soccer and volleyball fields (Appendix 1.1.). The community shop was located in middle of the two fields. All houses were built in horseshoe form, which is typical for Chachi villages. Estero Vicente had a children garden and a primary school. Those buildings were with extra toilets built outside the community next to the river or at the most northern point of the village. All houses were one-story and built from hardwood tree. As communication service the village teacher possessed a radio and a public phone, which could be used by request.

In both communities septic tanks are used as toilets and accessed from the houses via bamboo bridges that are raised one to two meters above the ground for when the ground becomes very muddy. The lighting sources were overhead lines with no permanent electricity (five to ten hours per day). When needed, they used candles and a few oil lamps to get light. The source of drinking water was unboiled river- or rainwater. Cooking was done with gas and when needed with firewood.

Households

There lived 1–3 generations per HH, with an average of 6.7 individuals (2.9 ±SD) and 4.3 children (2.9 ±SD) per generation. The mean age was 38 (15.1 ±SD). Typical households had their own animals, mainly chickens, dogs and cats in very different number (Appendix 2.8.). Typical tools are the machete, axe, hammer and shovel. Each HH owns an average 4.5 (± 2 SD) tools (Appendix 2.9.). Of great importance was possessing a boat, since river navigation is the only option to reach other places (Plate lll). On average around every second HHs possessed a one-stem canoe and every third HH a mini motorboat "peque peque" or/and a motorboat. Many households had personal TVs or DVD players with big stereo systems, which were often turned on, when electricity was provided. Normally they did not possess a mattress or a bed. During the day they slept in hammocks and in the night on the floor (Plate lV).

Social structure – For the Chachi the household is the most important social unit.

Cooperation between families or intercommunal often comes after collaborations within families. The authorities are still patriarchal structured with traditional family roles divided strictly of both gender and age (Plate V).

The oldest father of a household represents the family head who makes important decisions about house construction or repairs, education matters of the children or financial administration of the family (*pers comm*. Calle Larga interviewee). But the authority of the men is less strict than in the past and other family members increasingly influence decisions, e.g. if girls want to study at the university (*pers comm*. Calle Larga interviewee). Men are mainly responsible for agricultural activities (cacao cultivation and other crops), for elaborating weapons and fishing nets. And of especial importance is the construction of the one-stem canoe, for which the men may spend the whole day in the forests. Music instruments, like marimba and drums are not made anymore. Boys start helping in men's activities before turning ten years old.

The women were mainly responsible for cooking, household cleaning, looking after the children and animals. Additionally, they helped in agriculture activities, mostly by harvesting plantains. The daily food, smashed and cooked plantains or "*chacras"* are prepare early in the morning and in the end of the afternoon. The smashing of the plantains made strong noises, so that the whole family or neighbors were always informed, when the others were going to eat. If there was time women dedicated their free time into elaborating handicrafts for selling to middlemen or in markets. Girls started to help very young (around 4 years old) to clean clothes in the river and few years later they help women already in other activities e.g. in the kitchen.

Education – School education begins with a phase of pre-kindergarten in each community. Primary and secondary education last twelve years and is provided, for example in Zapallo Grande together with Afro-Ecuadoreans. On average the Chachi interviewees went 7.6 years (± 3.7 SD) to school. All 27 household representatives spoke Chapalaa, which 24 spoke well Spanish, 21 could read and write (both languages), and 6 were illiterate. Higher education on the Chachi varies on their economic conditions. Some students leave the community to study but others follow from home a program of distance education modules. For the professional title, they have to take tests online. The nearest internet access was in Loma Linda or Zapallo Grande with very poor signal and only when electricity is available.

Religion – Inhabitants still go to the ceremonial center called "centro ceremonial", to celebrate “Semana Santa” or for a funeral. Other festivities were not observed. On matrimonial feasts, “Semana Santa” and Christmas still traditional Chachi music is played (*pers comm*. community leader Calle Larga). The belief in spirits living in material or living being was not observed.

Healthcare – The Chachi have often health problems caused by environmental degradation such as water pollution (*pers comm.* Calle Larga expert) and maybe increased consumption of processed foods. Many children’s had eye infections and elder people stomach problems. The diet mostly consisted of banana, cassava, fish and bush meat together with rice, without vegetables or herbs. No harvest time of fruits, except a few e.g. coconuts, could be observed between March and July.

There is no free medical care, except for a small hospital in Zapallo Grande. Chachi healers or "Micurus" are very rarely visited, as they are very few practitioners left and the very experienced healers are living in very remote areas that are difficult to reach.

Plate ll

Plate lll

Plate lV

Plate V

Livelihood activities

The main occupation and main income in both communities was agriculture (n= 24; Plate V), primarily cacao production (2kg– 4800kg harvest per year, mean 563kg ±1376 SD). Additional income derives from logging. The minimum income per month was 50-80 USD, mostly from selling cacao in nearby communities or in the nearest regional market Borbón (*pers comm*. palm expert Calle Larga; Appendix 3.1.). They sell 50 kg of fresh cacao "babao" or processed, respectively for 45 USD and 100 USD. As an additional income women make handicrafts (e.g., weaving baskets or mats), selling them at a very low price. In the opinion of the community members their self-sufficiency (crop production and wild collection) is 50% (n= 22).

On average, people own in Calle Larga 2.9 (± 2 SD) hectares and in Estero Vicente 3.0 (± 1 SD) hectares of land. For their own household consumption they cultivate more than 22 different crops, but mainly plantain, maize, sugar cane and coconut palms. The harvest sizes vary considerably between households, for example 50 – 770 plantains branches per year with a mean of 295 branches (± 25 SD), or 3 – 90 kg of cassava per year with a mean of 35 kg (± 29 SD) (Appendix 3.2.).

A so-called "women's group" is responsible for the community shop, where rice, sugar, oil, fish, meat and eggs together with basic household goods are sold. For buying goods 58% of the respondents are visiting the village shop daily and 13% travel monthly to Afro-Ecuadorean (e.g. San Miguel) or Chachi shops in nearby communities (e.g. Zapallo Grande). Chachi men travel with different frequency to Borbón for business or to buy special goods (e.g. cloths or boots). Chachi women travel monthly to Borbón, where they receive direct monetary subsidies "bono solidario" (for poor mothers and elderly or disabled persons for one household) from the government.

Both communities were asked about which goods in the village shop they buy the most and most respondents (n= 15) answered rice (Appendix 3.1.). They also were asked to name the most important food, oils, thatches or walls in general and in Estero Vicente the same respectively, but for palm species only. The first rank for food was; plantains and *Iriartea deltoidea* (for the palm heart), for oil; "El Cocinero" and "La Favorita", for thatch; zinc and *Phytelephas aequatorialis* and for walls; *Iriartea deltoidea* and hardwood timber (Appendix 3.3.).

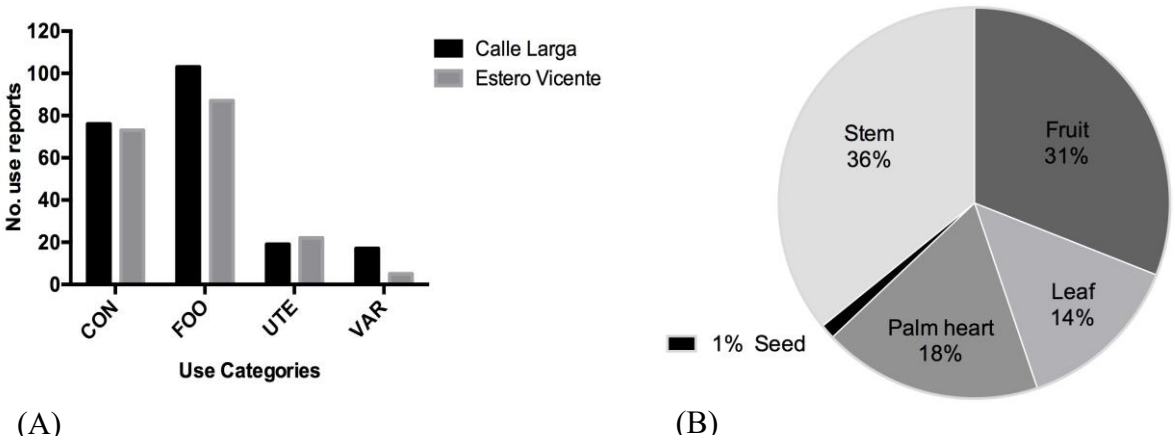
4.2 Ethnobotanical data

Palm use

During the ethnobotanical interviews in the two communities nine useful palm species, 54 different use reports and a total of 457 UR were reported (Table 1). Most use reports were listed in the category *Food* (103 UR), followed by *Construction* (76 UR), *Utensils and tools* (19 UR) and *Various* (17 UR; Figure 5A).

Most use reports were about *Iriartea deltoidea* (68 UR; 11 different uses) and *Wettinia quinaria* (67 UR; 10 uses), followed by *Socratea exorrhiza* (49 UR; 6 uses), *Oenocarpus bataua* (45 UR; 4 uses), *Phytelephas aequatorialis* (41 UR; 4 uses), *Bactris gasipeas* (37 UR; 4 uses), *Euterpe olearacea* (36 UR; 7 uses), *Bactris setulosa* (35 UR; 4 uses) and *Astrocaryum standleyanum* (21 UR; 4 uses).

The Chachi classified more use reports as actual uses, than as past (past is categorized as more than 2 years ago). All Chachi agreed that the use of *Iriartea deltoidea* leaves for thatching forest huts and of *Phytelephas aequatorialis* seeds sold for cultivation and personal adornment were no longer practiced (Table 1). The most used palm parts were the stem (35%), fruit (31%), palm heart (18%), leaf (14%) and the seed (2%; Figure 5B). Chachi people say that the most important useful palm species was *Phytelephas aequatorialis* (n= 15), because of the useful leaves for house thatching. The leaves of the species are also used by shamans to remove evil spirits in the patient's body. The second most useful palm species are *Iriartea deltoidea* and *Phytelephas aequatorialis* (n= 4) used for house construction (Figure 6).



(A) (B)

Figure 5. (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.

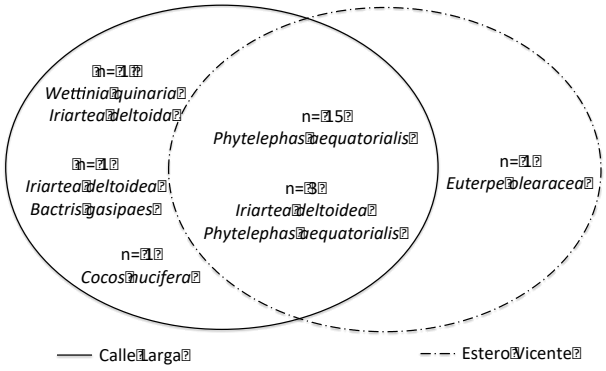


Figure 6. Ranking of the most important palm species.

Table 1. Useful palms described by the Chachi indigenous people in Calle Larga and Estero Vicente, in the Province Esmeraldas, Ecuador. UR = use reports, n= number of reports.

***Species*, specimen number**	***Chapalaa* and Spanish name**	**Community interviewees**		**Collection (n)**	**Palm part (UR)**	**Use Category**	**Use description (UR)[P]**	**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 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). Palmheart eaten raw in salads (6). A juice is used to make *masato* or *chicha* (8). Edible larvae collected of decomposed 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).	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 Various	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 cooked as e.g. *panda* (5).	One can is sold in Borbón for 1 USD every 15–20 days (6).
		Estero Vicente	11 f 8 m	cultivated (9) primary- (10) and secondary forest (10)	fruit (13) palm heart (3) leaf (2) stem (1)	Food Construction Various	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). Leaves for thatching (1) or making baskets with cover (1). Stem very rarely used to make walls (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 Larga	10 f 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)[P]. Stem for banana struts (2), fish hooks and fish traps (2), furniture (1), *marimba* keys (2), *house construction* e.g. walls (2), floors (9), main pillars (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 Vicente	20 f 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 to make baskets, tools for grinding the sugar cane and for banana struts (6), used for house floors, walls and trunks (16).	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 Larga	13 f 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 minutes 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 communitie*s or in Borbón twice a year for 2 USD (1).
		Estero Vicente	13 f 11 m	cultivated (9) primary- (12) and secondary forest (12)	fruit (12) palm heart (5) stem (4)	Food 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 for *house construction* (2), for grinding sugar cane and banana struts (2)	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 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 9 m	cultivated (22) primary- (9) and secondary forest (9)	fruit (5) seed (2) palm heart (5) leaf (13)	Food Construction Utensils/tools Various	Endosperm eaten raw and its water is drunken (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)[P].	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 Utensils/tools	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 *(Mart.) 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).	One stem is sold in Calle Larga for 2–10 USD on demand. The price depends on the height (6).
		Estero Vicente	11 f 15 m	primary- (17) and secondary forest (17)	seed (1) leaf (1) stem (20)	Construction Utensils/tools	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. Its sold on demand, once or twice a year in Borbón. One sack of seeds were sold in the past 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 fishing tool *catangas*, furniture e.g. chairs and benches, keys of *marimba* and for house pillars, walls and floors (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)	fruit (3) leaf (1)	Food Construction	Fruits eaten raw with salt and sugar (3). Leaves for thatching houses (1). Stems for	One stem of 1 m and 4 m height is sold for 3–5 USD and 10 USD in

	and secondary forest (24)	stem (24)	Utensils/tools	struts of banana (8) and for house walls and floors (16).	Borbón twice a year (8).

[a]Specimens were collected by Eliane Schneider (ES) and members of the Chachi communities. (Appendix 2.7.) [b]Pictures available only. [P]Past palm use (last use more than 2 years ago). *Italic font*: see glossary and explanations.

Glossary and explanations:

Asado: Soup with rice.

Bolones: A small pie prepared with cooked plantains or "asado", cheese or butter.

Catanga: Fish trap of the Chachi and Afro–Ecuadoreans.

Ceviche: Rice with typical sea food.

Chachi communities: Communities like Estero Vincente or Calle Larga, Loma Linda, Zapallo Grande, San Miguel, Kumani.

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: Chapalaa name for boiled plantains, smashed with a flat river rock into a sticky mass (Hazlewood 2004)

Stem processing of *Iriartea deltoida, 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 axe. This process is also necessary for construct the floor

Palm Species Information

Information on each palm species is presented below, including the scientific name (in bold), the Spanish and Chapalaa names, the botanical description, national uses, and photographs.

The nine useful palm species are listed in alphabetical order:

1. *Astrocaryum standleyanum* L.H.Bailey
2. *Bactris gasipaes* var. *gasipaes* Kunth
3. *Bactris setulosa* H.Karst.
4. *Euterpe oleracea* Mart.
5. *Iriartea deltoidea* Ruiz & Pav.
6. *Oenocarpus bataua* Mart.
7. *Phytelephas aequatorialis* Spruce
8. *Socratea exorrhiza* (Mart.) H.Wendl.
9. *Wettinia quinaria* O.F.Cook & Doyle

Astrocaryum standleyanum L.H.Bailey
Mocora, Guinul, *Poca'chi Pukatchi*

Botanical description[1,3]

Subcanopy palm, solitary, stem 8–15 m tall, densely covered with long black spines (Figure A). Semicircular crown with 8–20 leaves also covered with numerous spines. Pinnae up to 7 m long (Figure B). Infrafoliar inflorescences, up to 3 m long, erect or arched to 150 cm long. Infructescence pendulous with 400 ovoid orange fruits when ripe, 5–6 cm long (Figure A and C). Flourish and fructify time during the whole year, with a flowering peak in December and January and fruiting peak between August and November.

Distribution and abundance[3]

Common in W Ecuador from 0 – 900 m elevation in seasonal, tropical moist forest (Central America to Ecuador).

Uses in Ecuador[1, 2]

Plant part	Use	Ethnic group
Fruit	Fresh food	Chachi, Tsáchila
Seed	Fresh food, when immature. Personal adornment, when mature.	
Palm heart	Fresh	Chachi, Tsáchila
Leaf	Domestic utensils, e.g. weaving mats (see Figure D)	Chachi

Commercialization[1]

Plant part	Product use	Market	Quantity	Price
Leaf	Domestic utensils	National	One necklace	1–100 USD

[1] Valencia et al. 2013
[2] www.palmweb.org (accessed in 24.04.2016)
[3] Borchsenius et al. 1998

***Bactris gasipaes* var. *gasipaes* Kunth**
Chonta-duro**,** *Caimbi, Jaki, Canuchi*

Botanical description[1,3]

Supcanopy palm, solitary or caespitose, stem 2–18 m tall, with numerous spines (Figure A, B and C), arched and several flat sheets (Figure D). Infrafoliar multiple inflorescences on each stem (Figure B and C), persistent peduncular bract of inflorescence covered with spines (Figure B). Large fruits, 3–6 cm in diameter, yellow to red at maturity (Figure C and E).

Distribution and abundance[1,3]

Planted or naturalized, always near human settlements. In Tropical – subtropical forests from 0–1300 m elevation, mostly in the range of 800 m with 2000–5000 mm/year precipitation. Widely distributed (most common in E lowlands)

Uses in Ecuador[1, 2]

Plant part	Use	Ethnic group
Fruit	Beverages, fresh and cooked food, oil and as fodder, others	Chachi
Palm heart	Fresh or cooked food	Chachi
Stem	House and thatch, Domestic utensils, hunting and fishing, labor tools	Chachi

Commercialization[1]

Plant part	Product use	Market	Quantity	Price
Fruit	Fresh or cooked, others; larvae	Local, national		
Fruit	Flour	Local		
Palm heart	Food fresh and cooked	National		
Stem	Domestic utensils	Regional		

[1] Valencia et al. 2013
[2] www.palmweb.org (accessed in 24.04.2016)
[3] Borchsenius et al. 1998

***Bactrim setulosa* H. Karst.**
Chontilla**,** *Picanuchi Picanobuca Traimbidillo*
Picanuchi says "with spines"

Botanical description[1,2]

Understory palm, caespitose (Figure A), stem 4–15 m tall, covered with numerous black spines (Figure B and C). Sometimes it has aerial roots (Figure D). Pinnate leaves 3 m long and regularly inserted in different planes (Figure A). Globular infrutescencia 30–60 cm long, fruits from green to red at maturity and 2 cm in diameter (Figure B).

Distribution and abundance[1]

In tropical moist forest and premontane wet forest up to 1000 m altitude (rarely to 1700 m). Common (in W and E Ecuador). Also in Andean region Venezuela, Colombia, Ecuador, Surinam, Trinidad.

Uses in Ecuador[2]

Plant part	Use	Ethnic group
Fruit	Beverages, fresh and cooked food (see Figure E)	Chachi, Tsáchila, Shuar
Palm heart	Fresh or cooked food (see Figure F)	Chachi, Tsáchila, Shuar
Stem	House construction	

Commercialization[1,2]

Plant part	Product use	Market	Quantity	Price

[1] Valencia et al. 2013
[2] www.palmweb.org (accessed in 24.04.2016)
[2] Borchsenius et al. 1998

***Euterpe oleracea* Mart.**
Palmiche, Palmito, *Sambuchi, Sanchi*

Botanical description[1,3]

Canopy palm, caespitose with 4–8 stems up to 20 m tall (Figure A). Red aerial roots (Figure B). Leaves 8–14 pinnate, up to 4 m long, arranged in a plane and pendulous (Figure C). Numerous rachillae, 40–100 cm long, covered with whitish, brown hairs. Infrutescence with an erect main shaft. Spherical fruits purple to black when ripe, 1–2 cm in diameter. Stem and leaf texture smooth (Figure D).

Distribution and abundance[1]

Wild population in Ecuador grow only in estuaries of the Santiago or Cayapas rivers. Also found in Amazon floodplain forest, pastures or in white sand areas below 350 m and on Andean slopes 1100 –1800 m. Patchily distributed in E of Venezuela, Colombia, Ecuador, Peru, Brazil.

Uses in Ecuador[1,2]

Plant part	Use	Ethnic group
Fruit	Beverages, fresh food, fodder	Chachi
Palm heart	Fresh food (see Figure D)	Chachi
Leaf	Domestic utensils, house thatching	Chachi
Stem	House construction, domestic utensils, labor tools, fuel	Chachi

Commercialization[1]

Plant part	Product use	Market	Quantity	Price
Fruit	Food, cosmetics, medicinal products	International		
Palm heart	Food	International	Can of 500 g	1 USD
Leaf	Thatch	International		
Stem	Construction, domestic utensils, fuel	International		

[1] Valencia et al. 2013
[2] www.palmweb.org (accessed in 24.04.2016)
[3] Borchsenius et al. 1998

***Iriartea deltoidea* Ruiz & Pav.**
Pambil**,** *Bunchi, Boa*

Botanical description[1,3]

Canopy palm, solitary, thick stem 20–25 m tall, often swollen in the middle (Figure A). Dense black stilt roots cone (Figure C and D). Pinnate leaves 4–7 m long, erect and in several planes (Figure A), leaflets with notched margin that resembles a fish tail (Figure E). The inflorescence is infrafoliar and hangs up to 2 m below the leaves and is covered by a curved sheath, which looks like a giant horn when it is immature (Figure A and B). Globular fruits brown color, ca. 3 cm in diameter (Figure A).

Distribution and abundance[1]

Perhaps most common native tree species in Ecuador occurring in all provinces with moist lowlands forests. Central America to Ecuador west of the Andes, and western part of Amazon from Venezuela to Bolivia.

Uses in Ecuador[1,2]

Plant part	Use	Ethnic group
Fruit	Food, fodder, cosmetics	Awá, Huaroni, Quichua, Shuar
Seed	Adornment, food	Chachi, Cofán, Quichua, Shuar
Palm heart	Beverages, food	Chachi, Quichua
Leaf	House thatching, domestic utensils	Awá, Quichua, Secoya, Shuar, Siona
Stem	House construction, domestic utensils, fuel, hunting-, fishing and labor tools (see Figure F), medicinal, ornamental, personal adornment, ritual, rope, recreational, various	Awá, Chachi, Cofán, Huaroni, Quichua, Secoya, Shuar, Siona

Commercialization[1]

Plant part	Product use	Market	Quantity	Price
Seed	Personal adornment, e.g. necklace	National, international	One	
Palm heart	Food	Local		
Stem	Bars (7 x 3 x 150 – 400 cm), pieces of parquet (1 square meter) posts (2.5 square meter)	National, national, local	One unit	1 USD 5 USD 6–10 USD
Stem	Furniture, e.g. chair	National, international	One	50 USD

[1] Valencia et al. 2013
[2] www.palmweb.org (accessed in 24.04.2016)
[3] Borchsenius et al. 1998

***Oenocarpus bataua* Mart.**
Ugurahua, Chapil, *Culapuca, Colapoca, Culachi*

Botanical description[1,3]

Canopy palm, solitary, stem 10–30 m tall (Figure A). Erect 8–20 leaves in a single plane 10–20 m long (Figure B and C), forming a funnel shaped crown. Linear fiber sheath with brown to black (Figure D). Infrafoliar inflorescences once branched, born on very short axis, to 1 m long and shaped like a horsetail (Figure A, B and E). Elongate ovoid fruits, purple or black when ripe, 2.5–4 cm long (Figure F).

Distribution and abundance[3]

In Ecuador in all provinces with moist forest below 1000 m. Widespread in Neotropical lowlands. Occasionally up to 1350 m.

Uses in Ecuador[1,2]

Plant part	Use	Ethnic group
Fruit	Beverages, fresh and cooked food, fodder, fuel, cosmetic and edible oil, dyes, medicinal uses, rituals	Achuar, Awá, Chachi, Cofán, Huaroni, Secoya, Shuar, Siona, Quichua
Seed	Domestic tools, Fuel, medicinal uses, oil, personal adornment, recreational, ritual	Huaroni, Siona, Quichua
Palm heart	Fresh or cooked food	Huaroni, Shuar, Quichua
Leaf	Thatch, domestic and hunting tools, fuel, medicinal and veterinary use, recreational	Awá, Chachi, Cofán, Huaroni, Secoya, Shuar, Siona, Quichua
Root	Cosmetics, medicinal and veterinary use	Huaroni, Secoya, Shuar, Quichua
Stem	House construction, domestic tools, fuel, various	Huaroni, Shuar, Siona, Quichua

Commercialization[1]

Plant part	Product use	Market	Quantity	Price
Fruit	Cooked	Regional, national	One plastic sack	1 USD
Fruit	Cosmetic oil	National, international	Shampoo, cosmetic oil, soap	2–4 USD
Seed	Personal adornment	National	One necklace	3 USD
Leaf	Hunting	Local		
Stem	Hunting and fishing tools	Regional, local		

[1] Valencia et al. 2013
[2] www.palmweb.org (accessed in 24.04.2016)
[3] Borchsenius et al. 1998

***Phytelephas aequatorialis* Spruce**
Tagua**,** *Dinchi, Tinbu'chi, Ginjaki,*
Tinbuchi means "comes in every generation or it has already years"

Botanical description[3]

Solitary, stem 5–15 m tall, but often only a few meters (Figure A). Erect leaves arranged in groups in various levels (Figure A and B), often with several dead leaves. Male and female inflorescences in different individuals (dioecious). Female inflorescence 35–40 cm long (Figure C). Globular infructescence with 7–22 fruits, each fruit with 5–8 seeds (Figure D). The nutritional tissue around the unripe endosperm is gelatinous and gets solid and white when mature. This mature tissue is the vegetable ivory or also called "tagua".

Distribution and abundance[1]

Endemic to W Ecuador. Common in moist forests up to 1500 m elevation.

Uses in Ecuador[1,2]

Plant part	Use	Ethnic group
Fruit	Fresh (endosperm immature and mesocarp mature), oils, fodder, domestic utensils, medicinal and veterinary	Chachi, Tsáchila
Seed	Handicraft (seed of female individual, only), fodder	Tsáchila
Palm heart	Fresh and cooked	Chachi
Leaf	Thatching (leaf of male individuals, only; see Figure E and F), domestic utensils	Chachi, Tsáchila

Commercialization[1]

Plant part	Product use	Market	Quantity	Price
Seed	Handicraft, e.g. buttons,	National, local	18 kg	11 USD
Seed	Fuel (subproduct of buttons)	Regional	15–20 kg	2 USD
Seed	Fodder (powder a subproduct of buttons)	Regional	25–30 kg	2–6 USD
Leaf	Thatching	Regional	100 pieces	30–50 USD

[1] Valencia et al. 2013
[2] www.palmweb.org (accessed in 24.04.2016)
[3] Borchsenius et al. 1998

***Socratea exorrhiza* (Mart.) H.Wendl.**
Zancona, *Pillachi, Pinlla*

Botanical description[1,3]

Canopy palm, solitary, stem 7–20 m tall (Figure A and B). Erect leaves and in various planes (Figure B and C). It has a few thick and brown stilt roots at the base up to 1 m high and with numerous short, white spines (Figure D and E). Infrafoliar inflorescences with 30–60 cm long axis (Figure B). Infrutescence with black elongate, smooth fruits, 1.5–2.5 cm long (Figure B).

Distribution and abundance[1]

Common in Ecuador in moist forest on both sides of the Andes from 0 – 1200 m altitude. Widespread in Central America and South America.

Uses in Ecuador[2]

Plant part	Use	Ethnic group
Fruit	Fresh and cooked food, fodder, others	Awá, Chachi, Cofán, Huaroni
Seed	Food, Utensils and tools	Quichua, Huaroni
Palm heart	Beverages, fresh and cooked food	Chachi, Shuar
Leaf	House thatching, cosmetics, ornamental	Chachi, Huaroni, Quichua, Shuar
Stem	House construction (see Figure F and G), utensils and tools, handicraft, hunting and fishing, fuel, ritual uses, others	Awá, Chachi, Cofán, Huaroni, Secoya, Shuar, Quichua
Root	Domestic and labor tools, medicinal and veterinary uses	Chachi, Cofán, Huaroni, Shuar, Quichua

Commercialization

Plant part	Product use	Market	Quantity	Price

[1] Valencia et al. 2013
[2] www.palmweb.org (accessed in 24.04.2016)
[3] Borchsenius et al. 1998

***Wettinia quinaria* O.F.Cook & Doyle**
Bísola, Walte**,** *Yanbucca, Yanchi, Yanlachi*

Botanical description[2,3]

Canopy palm, solitary, 7–20 m tall (Figure A and B). Stilt roots cone, up to 1 m tall (Figure C). Leaves 4–9 pinnate, 3 m long and in a plane (Figure B). Persistent peduncular bract of inflorescence (Figure D). Infructescence a cylindrical shaped ear, 40cm x 8.5 cm large (Figure A). Globular fruits with brown color and 2–3.5 cm large, with whitish, dense, persistent long hairs growing next to the fruits (Figure A).

Distribution and abundance in Ecuador[1,2,3]

In humid forests up to 1000 m elevation. Often a dominant species with more than 4000mm precipitation e.g. in the Chocó forests. Widely distributed (W Colombia and Ecuador).

Uses in Ecuador[2,3]

Plant part	Use	Ethnic group
Fruit	Food and fodder	Awá, Chachi, Tsáchila
Seed	Personal adornment (see Figure E)	Chachi
Palm heart	Food	Chachi
Leaf	Thatching of houses and ropes	Awá, Chachi
Stem	House construction (see Figure F) and thatching, domestic utensils, hunting-, fishing and labor tools, fuel	Awá, Chachi, Tsáchila, Quichua

Commercialization[1]

Plant part	Product use	Market	Quantity	Price
Stem	Posts for construction of warehouses and power lines	National	stem of 9 m height	10 USD
Stem	Furniture as pedestals	Local		
Stem	Handicraft as flower vase	Local		5 USD

[1] Valencia et al. 2013
[2] www.palmweb.org (accessed in 24.04.2016)
[3] Borchsenius et al. 1998

Cultivation and harvest practices

The Chachi indigenous people agreed on the cultivations of only few palm species, like *Astrocaryum standleyanum* and *Euterpe oleracea* in Calle Larga and *Bactris gasipaes* in both communities (Figure 7A). Mainly they harvested palms directly from the forests and community surroundings. In the past *Phytelephas aequatorialis* was the most cultivated palm species, but in Calle Larga they lost the knowledge on how to cultivate it (*pers comm.* palm expert Calle Larga). In Estero Vicente the elders still knew, but were not interested in cultivate it anymore or passing the knowledge further (*pers. comm* Uní Estero Vicente).

The Chachi people did not agree on, whether palm management is taking place or not, except for *Phytelephas aequatorialis,* where all interviewees agreed, that management is necessary (17 UR). For all palm species, except *Bactris setulosa* and *Socratea exorrhiza,* the Chachi people more often said they do cleaning around the wild and cultivated species (to let the palm individual grow better) or dispersion of the seeds and fruits (79 UR). Others do not manage any palm species (37 UR).

Palms are either harvested destructively or non-destructively, but most interviewees reported destructive harvesting (56 UR), only a few non-destructive (15 UR) or both (18 UR) (Figure 7B). Destructive harvesting depends on the palm part harvested. For palm hearts and stems, the entire palm has to be cut necessarily and the individual dies (except in caespitose species, e.g. *Bactris setulosa*). In contrast, fruits, leaves or seeds can be harvested without damaging the palm by using a stick (30 UR) or a ladder (8 UR).

The Chachi were asked about their emic perspective of whether, palm uses and the abundance of useful palm species in the community are decreasing, increasing or staying the same, since the last ten years. They said the use of seven palm species has decreased, no palm species increased and two species, *Astrocaryum standleyanum* and *Euterpe oleraceae* remained the same (Figure 7C). Reasons for the decreasing uses include; less interest in harvesting and using palms, because palms have been replaced by other materials, like trees and zinc (66 UR), and because palm harvesting was mainly destructive in the past and fewer palm individuals are available (32 UR). These findings match well with the emic perspective on changes in abundance; seven of nine useful species decreased, none of them increased, and two species, *Astrocaryum standleyanum* and *Euterpe oleraceae* remained the same in

abundance (Figure 7D). The greatest decrease in use frequency were for palms previously cultiaved like *Bactris gasipaes* and *Phytelephas aequatorialis*, which the Chachi have lost interest in cultivating. Reasons for all palms were destructive harvesting (111 UR) and overuse of the palm species by the rapid growing Chachi population (n= 49).

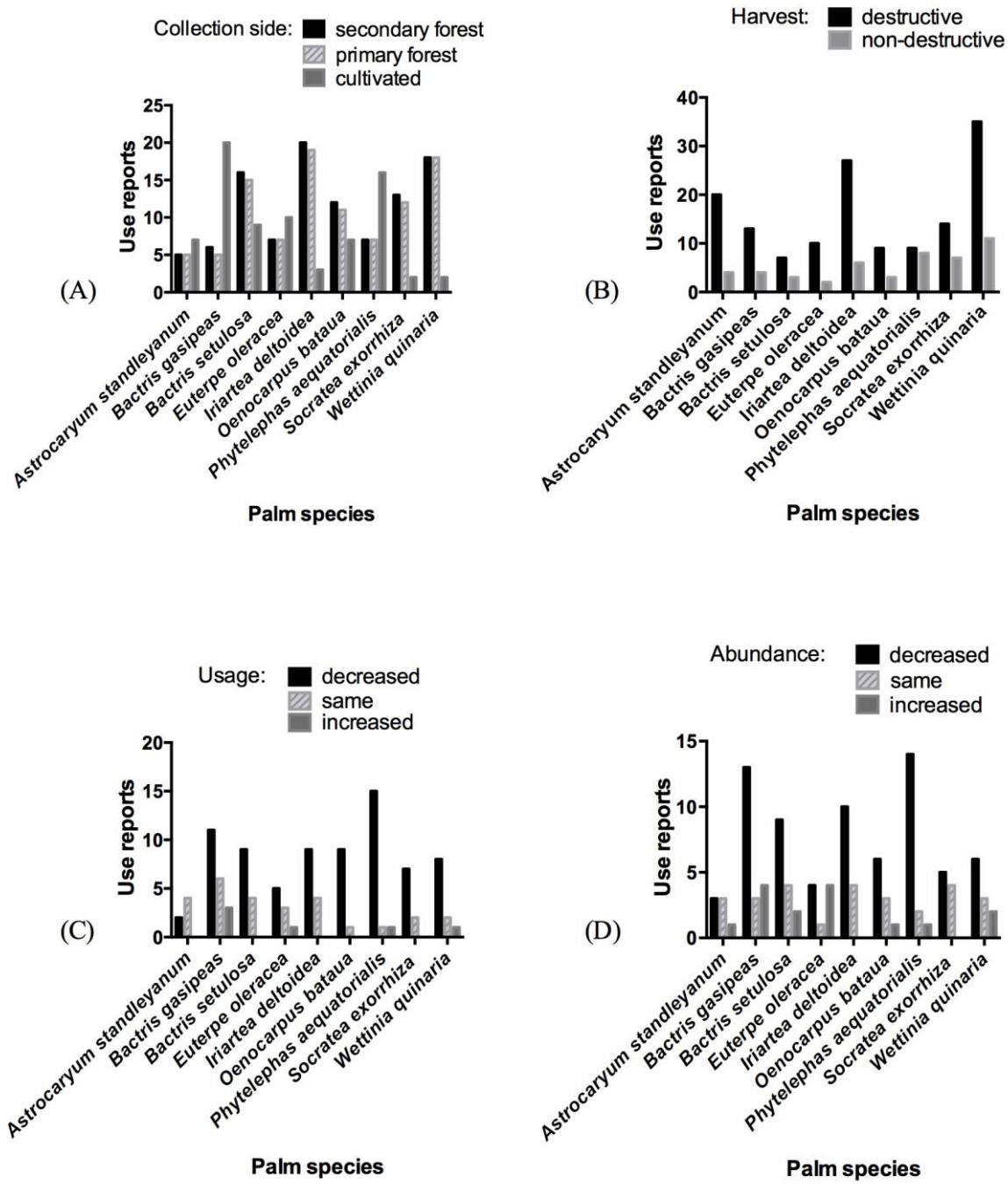


Figure 7. (A) Reports of collection site per each palm species in both Chachi communities. (B) Number of reports of destructive or non-destructive harvesting for each useful palm species in both Chachi communities. (C) Use frequency of palms as perceived by community members in both Chachi communities. (D) Abundance of palms in forests as perceived by community members in both Chachi communities

Comparing data to Barfod & Balslev 1988

In 1988 Barfod and Balslev did an investigation about the palm use of the Chachi people in the main village Zapallo Grande, along the river Cayapas. The 30 years reappraisal of the palm use knowledge of the Chachi show that nine of 15 useful palm species are still known and have been used within the last two years.

Of those nine species community members mentioned six useful canopy palms, five of six documented by Barfod and Balslev 1988 (*Astrocaryum standleyanum, Iriartea deltoidea, Socratea exorrhiza, Oenocarpus bataua, Wettinia quinaria*), with the only exception of *Oenocarpus mapora* and one new species (*Euterpe olerace*; Figure 8). They mentioned all subcanopy and cultivated palms documented by Barfod and Balslev 1988 (*Phytelephas aequatorialis* and *Bactris gasipaes* var. *gasipaes*, which is not growing in the wild forest, respectively) and one understory palm (*Bactris setulosa*). Interestingly, interviewees did not recognize or mention as useful six of seven understory palms documented by Barfod in 1988 (*Prestoea acuminata* var. *acuminata, P. ensiformis., Geonoma cuneata* var. *cuneata, G. cuneata* subsp. *linearis, Pholiostachys dactyloides, Synecanthus warscewiczianus*), except for *Bactris setulosa*. Two canopy palm species *Attalea colenda* and *Cocos nucifera* were mentioned only by one expert in Calle Larga, who was asked explicitly about the use of the species and declined them as useful palms at the same day. Therefore, they are not listed as useful palm species.

In 1985 and 2015, the most cited category was *Food*, but there were differences in the second and third most cited categories (Table 2). The most commonly used palm part in 1985 and 2015 was the stem (Table 2).

Experts in 1985 and 2015 mentioned a similar number of different use reports for *Astrocaryum standleyanum, Bactris gasipaes* var. *gasipaes, Bactris setulosa* (mainly used for *Food*) and *Phytelephas aequatorialis* (Figure 8). More different use reports were mentioned in 2015 for *Iriartea deltoidea, Socratea exorrhiza* and *Wettinia quinaria* (mainly used for *Construction*) and *Oenocarpus bataua* (Figure 8). Palms, like *Bactris gasipaes,* were less used in 2015 to make utensils and tools, e.g. fish traps, spears or the music instrument marimba (Figure 8, Table 3).

All experts in 2015 agreed that 12 of the 38 use reports documented in 1985 are still being used, that 14 UR are still known, but not used anymore, and that 12 UR of 1985 are not known anymore (Table 3).

Table 2. Comparison between fieldwork data between two experts (n= 2) of 1985 vs. four experts (n= 4) of 2015: use categories and palm parts used.

Categories (UR)	1985	*Food* (15)	*Utensils/tools* (10)	*Construction* (7)	*Various* (6)
	2015	*Food* (35)	*Construction* (33)	*Utensils/tools* (10)	*Various* (5)
Palm parts (UR)	1985	Stem (14)	Fruit (9) and leaf (9)	palm heart (6)	
	2015	Stem (38)	Fruit (24)	Palm heart (16)	Leaf (7)

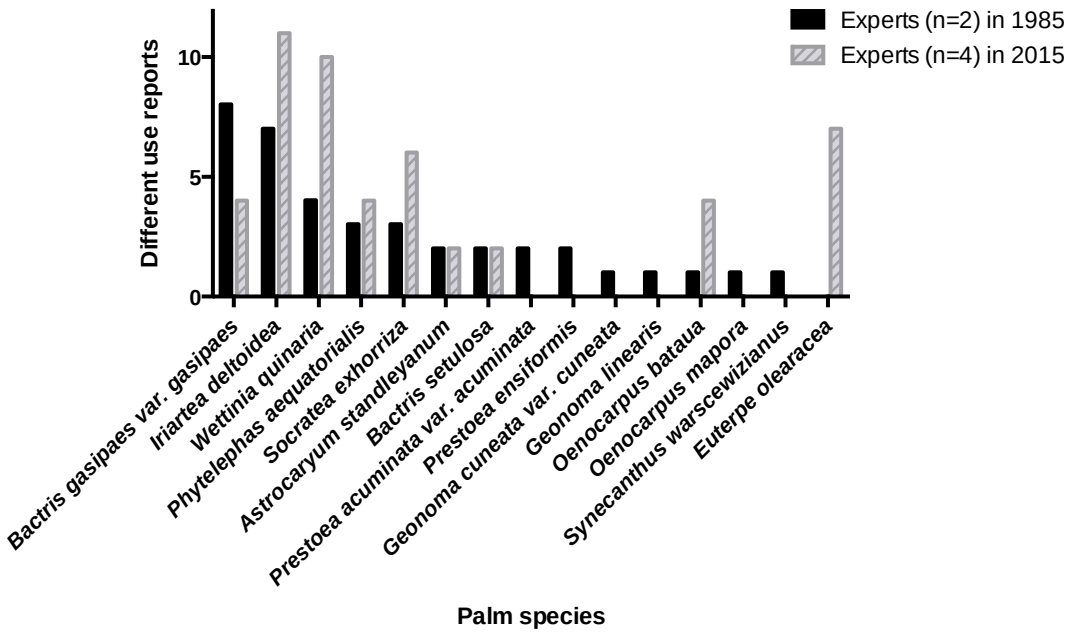


Figure 8. Comparison of number of different use reports between two experts (n= 2) of 1985 vs. four experts (n= 4) of 2015.

Table 3. Comparison between fieldwork data of 1985 and 2015 of the palm use by the Chachi people.

Palm species; *Scientific*, Spanish and (Chapalaa)	**Use in 1985 according to experts (n=2)**	**Uses in 2015 according to experts (n= 4)**
Astrocaryum standleyanum Mocora (Poca-chi)	Raw fruits edible Fibers for hammock etc. extracted leaf	yes (4) yes (1), no (2)
Bactris gasipaes var. *gasipaes* Chonta duro (Cano-chi	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 of decomposed stems	yes (4), yes (4) no (4) no (4) no (4) no (4) no (4) yes (4)
Bactris setulosa	Palm heart edible, cooked fruit edible	yes (3), no (1), yes (3), no (1)
Prestoea acuminata var. acuminata (Mamba-san-chi)	Palm heart edible, raw fruit edible	no (4), no (4)
Geonoma cuneata var. cuneata (Ya-ha-chi)	Raw fruits edible	no (4)
Geonoma linearis (Yullpo-pi-chui-tape)	Ritual plant	yes (2), yes_no (2)
Iriartea deltoidea Pambil (Boun-chi)	Timber for blowgun Timber for house construction Timber for fish trap Timber for spear Timber marimba keys Palm heart edible Edible larvae collected of decomposed stems	no (2), yes_no (2) yes (3), no (1) no (2), yes_no (2) yes (2), no (2) yes (2), yes_no (2) yes (4) yes (4)
Oenocarpus bataua Chapil (Cola-pa-chi)	Fibers of the leaf base for blowgun darts	no (1), yes_no (3)
Oenocarpus mapora Cinamillo/Ciamba/Pusuy (Uin-ga-chi)	Fibers of the leaf petiole for basketry	yes (2), no (2)
Phytelephas aequatorialis Tagua (Din-chi)	Leaf for roof and fibers Edible endosperm and mesocarp	yes (4) yes (4)
Pholidostachys dactyloides (Ah-casta-ya-ha-chi)	*No uses. Chachi name only*.	no (4)
Prestoea ensiformis (Chapin-sa-chi)	Edible palm heart Leaf for the roof	no (4) no (4)
Socratea exorrhiza Zancona (Pin-ua-chi)	Stem for house construction Edible palm heart Edible larvae collected of decomposed stems	yes (4) yes (2), no (2) no (4)
Synechanthus warscewiczianus (Bo-chui-cano-chi)	Inhabited by evil spirits	no (4)

Wettinia quinaria Walte (Yan-chi)	Leaf for the roof Stem for house construction Edible fruits Edible larvae collected of decomposed stems	yes (2) yes_no (2) yes (4) yes (4) no (2), yes_no (2)

yes = still in use; the interviewee knows and practices (within the last ten years) the use .
yes_no = the interviewee knows the use, but does not practice it anymore (within the last ten years).
no = not known and not used anymore (within the last ten years).

Palm knowledge

Both communities had similar levels of total ethnobotanical knowledge (number of use reports: 238 vs. 219 with an average per person of 20 (8 ±SD) vs. 16 (±4 SD); useful palm species: 9 in both communities). Men cited significantly ($p < 0.05$) more use reports than women (Figure 9 and Figure 10A). There was no significant difference between the communities and age groups (Figure 10B and C), the latter supporting the prevalent opinion of the Chachi, that knowledge is transferred between generations (n= 15).

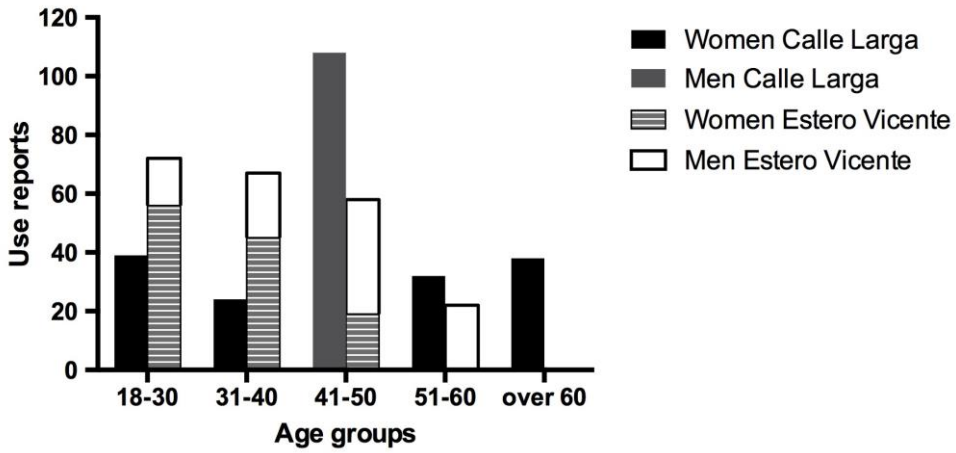


Figure 9. Comparison of palm use knowledge among age groups.

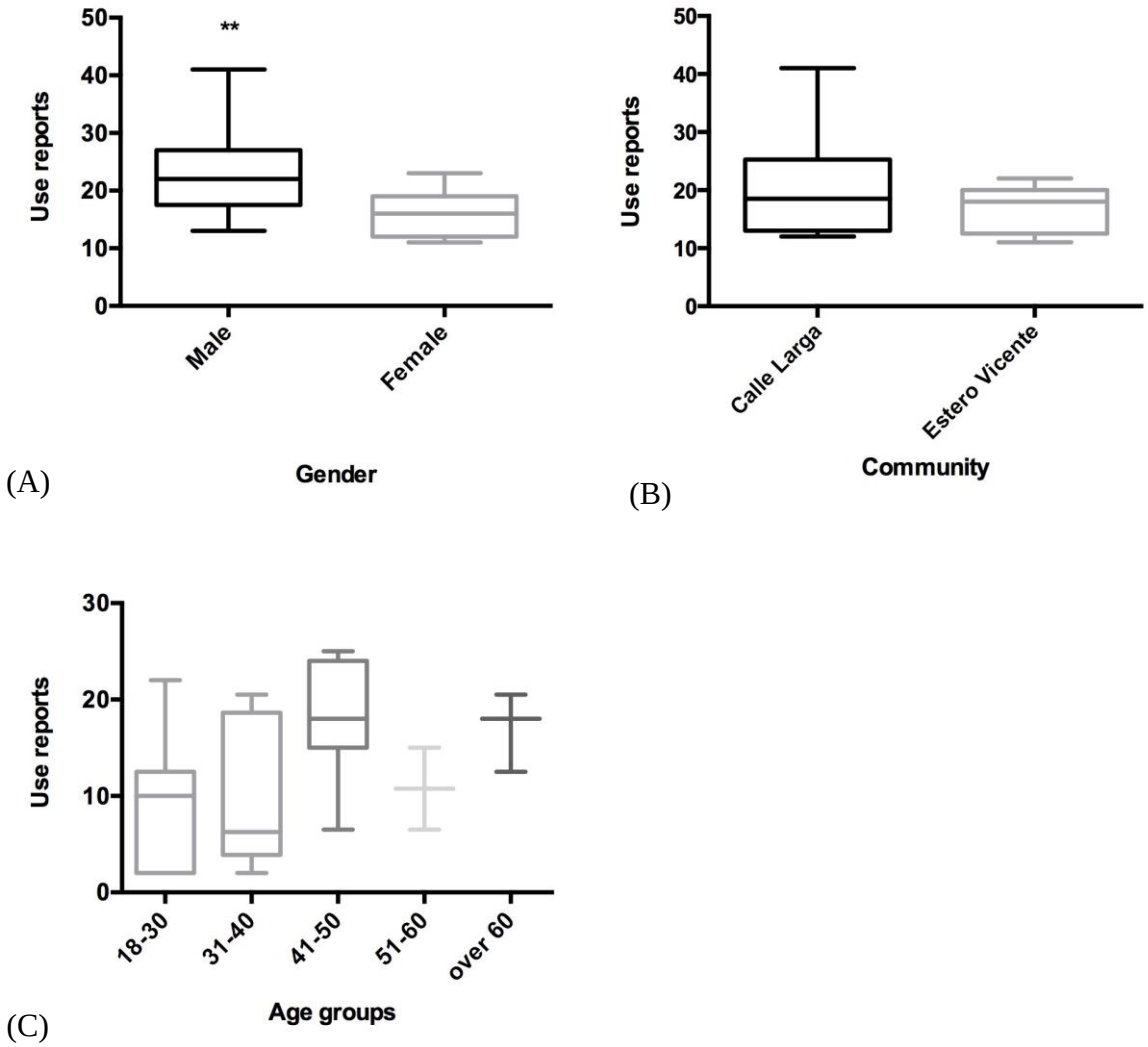


Figure 10. Comparison of palm use knowledge. Knowledge among; (A) gender (B) communities (C) age related.

6. Discussion

6.1. Which palm species do the Chachi people use?

The Chachi people use nine palm species: *Astrocaryum standleyanum, Bactris gasipaes, Bactris setulosa, Euterpe oleracea, Iriartea deltoidea, Oenocarpus bataua, Phytelephas aequatorialis, Socratea exorrhiza,* and *Wettinia quinaria*. Seven of those nine palms are canopy palms (*Astrocaryum standleyanum, Euterpe olerace, Iriartea deltoidea, Socratea exorrhiza, Oenocarpus bataua* and *Wettinia quinaria*). And only one subcanopy (*Phytelephas aequatorialis*), one cultivated (*Bactris gasipaes var. gasipaes*) and one understory palm (*Bactris setulosa*) was mentioned.

The most mentioned species are typically versatile and/or easy accessible, such *as Iriartea deltoidea* and *Wettinia quinaria* which are conspicuous, abundant, have numerous uses and are preferred for their highly durable stems (Valencia et al. 2013, Anderson 2004, unpublished data, Marchan, Borchsenius et al. 1998). Palms with easily reachable palm parts are preferred, e.g., fruits of *Bactris gasipaes var. gasipaes* with a stick or leaves of *Phytelephas aequatorialis* with a ladder. Palms which need further processing after being harvested, e.g., taking off spines from stem or leaf, are less likely used. In general canopy palms are more used than understory palms, due to their high stems and salient character e.g. *Iriartea deltoidea* and *Wettinia quinaria* (Cámara-Leret et a. 2014, Macía et al. 2011).

In other Chachi communities five of all nine useful palm species were documented, i.e., *Astrocaryum standleyanum, Euterpe oleracea, Iriartea deltoidea, Socratea exorrhiza* and *Wettinia quinaria* (unpublished data, Marchan, and Fadiman 2003). Interestingly, Marchan did not document *Bactris gasipaes, Bactris setulosa, Oenocarpus bataua* and *Phytelephas aequatorialis*. However, all of the nine useful palms are used by other ethnic groups in Ecuador, and except *Bactris setulosa* all belong to the most important useful palms in the Chocó (Macía et al. 2011).

Interestingly, the two canopy palms *Attalea colenda* and *Cocos nucifera* were not mentioned in the interviews, although they are available and maybe even cultivated. However, uses of *Cocos nucifera* fruits were observed, e.g., using the liquid endosperm as beverage or the solid endosperm for food and fodder. Both species were planted in front of the houses at the riverside, maybe also for ornamental purposes. Some individuals were left growing so tall, that fruits were not reachable anymore. But in general *Cocos nucifera* counts as the most used palm species in the Chocó region (Macía et al. 2011) or even in the whole Pacific and Indo-

Atlantic oceanic basins (Gunn et al. 2011). And *Attalea colenda* was a valuable resource between 1950–1970 for vegetable oil in Ecuador and was important for oil industries at the coast side, until it was replaced by the African oil palm, *Elaeis guineensis* (Valencia et al. 2013). Therefore, the Chachi most likely encountered the uses of this palm species outside their culture, because of their popularity. Thus, the not mentioning of those palm species is very probably because they are introduced species and not traditionally used by the Chachi culture (Gunn et al. 2011, Barfod and Balslev 1988).

6.2 How do they use the species?

Of 457 use reports (UR) collected among the Chachi, most belong to the categories *Food* and *Construction,* followed by *Utensils and Tools.* Most often used palm parts were stems (35%), fruits (31%), palm heart (18%) and leaves (14%). This finding agrees with palm use studies in north-western South America, which show the same order in the most-cited use categories and palm parts used (for stems and fruits only; Macía et al. 2011).

In a neighboring Chachi community of Loma Linda, a similar number of different use reports were found (compared to the four equally documented palm species; unpublished data, Marchan).

The Chachi did not include palms into intensive management systems, because they mainly harvested palms directly from the forests and community surrounding. They cultivated four palm species *Astrocaryum standleyanum, Bactris gasipaes* var. *gasipaes, Euterpe oleracea* and *Phytelephas aequatorialis*, which are commonly cultivated palms in South America (Cámara-Leret et al. 2014, Bernal et al. 2011, Fadiman 2003, Runk 1998). To promote palm growth, they did cleaning around palm species or dispersed seeds and fruits. But only for *Phytelephas aequatorialis* all interviewees agreed on cleaning and dispersing seeds as necessary.

But, surprisingly, the Chachi have lost the knowledge of cultivating *Phytelephas aequatorialis* in the first community and did not use the species anymore. Reasons could be the complex management requirements of the species: *Phytelephas aequatorialis* needs up to twenty years to reach sexual maturity (Valencia et al. 2013). And little is known about the vegetative reproduction (Valencia et al. 2013).

Furthermore, it seems that management of wild growing palm species was done occasionally, depending on whether time was left next to agriculture activities or not. Especially for *Bactris setulosa, Socratea exorrhiza, Iriartea deltoidea* and *Wettinia quinaria* management was not absolutely necessary, as seedlings grow without cleaning around (*pers*

comm. expert Calle Larga).

The Chachi people said they did destructive harvesting mostly for *Wettinia quinaria* followed by *Iriartea deltoidea, Astrocaryum standleyanum, Bactris gasipaes* var. *gasipaes, Socratea exorrhiza* and *Oenocarpus bataua*. Destructive palm harvesting is commonly found in the tropics and often no replacement planting of those species is done, therefore harvesting is limited (Bernal et al. 2011). Thus, many palm populations are decimated (Bernal et al. 2011). As a consequence, decreased abundance of species makes it more difficult to encounter them in the forests. Hence, rare species are less frequently used and palm use decreases.

This explanation was given by Chachi people: destructive harvesting led to a decreased abundance and use frequency for seven of all nine useful palms in the forests and community surroundings, except *Astrocaryum standleyanum* which remained the same (since the last ten years).

The perception on no changes in abundance or use frequency in *Astrocaryum standleyanum* can be explained by the fact that very few people used, or even knew it, mainly because it was very rare in the study area, due to destructive use in the past (*pers comm*. expert Calle Larga). Additional non-destructive harvesting of the leaves was observed in 2015. The rarity of some species may also be related to the decrease of animal seed dispersers like rodents, monkeys, birds and bruchid beetles in the study area (Fadiman 2003, Medina 1992).

The Chachi reported that the use frequency of *Bactris gasipaes* var. *gasipaes* decreased because since the last four years the palm has not set fruit. This is probably caused by a serious pest of a new introduced species of weevil (*Palmelampius heinrichi)*, which is infesting the fruits of this palm species in the Chocó (O'Brien et al 2009).

Palms were used less not only because abundance has decreased, but also because the Chachi people have lost interest in using palms. This is because palm products have been replaced by hardwood (for house construction), zinc (for the roof) and imported food and beverages, such as cookies, salty biscuits and sweet drinks.

Palm knowledge

Both communities and all age groups had similar level of total palm use knowledge, i.e., number of UR and useful palm species. But, men mentioned significantly more UR than women. A reason why women reported less uses, could be as they normally were less involved in palm use activities, such as house construction and elaborating utensils and tools (Hazlewood 2004, Medina 1992). Also, women spent less time in forests, and more time at home looking after the children or the household (Hazlewood 2004, Medina 1992).

The Chachi cited more use reports as actual uses, than past uses (categorized as not used since more than two years). But, only on two use reports agreed all as past uses. This reflects a diverse use pattern among Chachi households, and strengthens the theory of household as most important social unit, where every household acts and decides independently from others, e.g., which palm species they cultivate or use (Hazlewood 2004, Mora 1945, Medina 1992). On the other hand, many Chachi agreed that *Phytelephas aequatorialis* is the most important palm species, followed by *Iriartea deltoidea*. This implies most important or useful elements are shared between the Chachi and they also stated that palm knowledge transmission happens within generations and families.

6.3 How has palm use changed among the Chachi since 1985, as compared to Barfod and Balslev 1988?

The traditional knowledge about the useful palm species decreased over the last 30 years since the study of Barford and Balslev (1988). Of the 15 useful palm species documented by Barfod and Balslev, only nine useful palm species were mentioned and used in 2015. And the Chachi used palms less, mainly for making *utensils and tools* in 2015.

Interestingly none of the understory palms were mentioned or recognized anymore, except for *Bactris setulosa.* However, Barford and Balslev (1988) documented three of six understory palms as used for food and one for ritual uses, which are done very rarely nowadays. Of one they only documented a Chapalaa name and for *Synechanthus warscewiczianus* was believed to be inhabited by evil spirits, which could have discouraged the Chachi using them (Barfod and Balslev 1988). In Loma Linda, where Marchan (unpublished data) did her research in 2001, the latter three understory palm species were documented, too; *Geonoma* sp., *Synechanthus warscewiczianus* and *Pholidostachys dactyloides*. But, they showed the lowest use value of all documented useful palm species (unpublished data, Marchan). Thus, it seems that understory palms in general are of decreased interest, very probably, due to less relevant uses.

The decrease of palm use is due to several factors, such as deforestation, better market access, community building and destructive harvesting:

Deforestation

In 1960 different actors of the wood industry started deforestation and clearing of coastal lowland forests for logging and agricultural fields. Timber companies often forced the Chachi to permit them entering and exploit their lands in exchange for income or services (Kosmus

2013). Additional, local people, including the Chachi started to work for logging companies, often legal in secondary forests and illegal protected primary forests (Mosandl et al 2008). All this together led to massive plant and animal biodiversity loss in the past century (Kosmus 2013).

Therefore, many palm species are less abundant and no longer available for the communities (Sierra and Stallings 1998). As ecosystem diversity is the primary driver of plant use diversity (De la Torre et al. 2009), also the use of palms decreased with declining diversity. This was shown in a local comparison of Chachi plant use between primary and secondary forests, where primary forest with higher species richness had more useful plants than secondary forests (unpublished data, Marchan).

Furthermore, the logging companies built new roads in the area of the Cayapas river and provided entry points for new settlers (Anderson 2004). Thereby new colonization settlers increased additional deforestation pressures (Anderson 2004).

Market access

The new required roads created a better market access and led to a shift from traditional to economic dependent lifestyle with cash economy (Batallas 2012, Hazlewood 2004). Many Chachi people started to sell their products in bigger markets and encountered price competition triggered by bigger firms (Hazlewood 2004). Due to competition pressure, they had to sell their products at a very low price, which led to a typical maladaptive process and poverty. Interest about useful palms decreased, especially from younger Chachi people, and particularly costly and time consuming palm use processes are avoided. Since less time is spent in subsistence activities, consequently their own subsistence foundation and internal economy is weakened (Hazlewood 2004). For example, large food corporation increasingly displace local food system with ultra-processed foods (Monteiro et al. 2012). The impact is not only on nutrition and risk of disease, but also the local food culture could be rapidly eroded (Monteiro et al. 2012).

Community building and destructive harvesting

To reinforce themselves and to make a political organization possible, they built 29 Chachi centers, each of which made up of three communities, to form the political Chachi federation (FE.E.CH.E, *Federación Ecuatoriana de Centros Chachis en Esmeraldas*) in 1978 (Yépez Montúfar 2013). Living closer together probably led to a rapid population growth, as connection to other Chachi families and potential partners was easier done. In the past Chachis met only in the ceremonial center during events at religion festivities (*pers comm.*

palm expert Calle Larga). Census data show the Chachi population size increased significantly over the last three decades (http://www.politica.gob.ec/una-radio-une-a-comunidades-chachi-en-esmeraldas/ 2014). Consequently, living in clustered communities led to an increased need of the immediate environment and hence, to more harvesting of the natural resources (Anderson 2004). Since the last 30 years many palms were vastly overused by destructive harvesting. As it seems the Chachi people were not able to cope with the fast growing population in the last decades, because they were not used to communal living and organization since they migrated to the lowlands (Mora 1945).

Outlook

As fieldwork was done in a time span of four months, only two communities could have been studied. A longer stay in the communities could provide deeper comprehension of the importance of the actual and past palm use. More communities could be studied and more data collecting could enable more comprehensive statistical analysis. As palm use knowledge of the Chachi people could soon disappear, more in-depth ethnobotanical studies are needed, not only to protect, preserve and promote this traditional knowledge, but also to preserve the local tropical rainforest ecosystems they are living in (Cámara-Leret 2014, Gosh and Sahoo 2011).

It would be very interesting to make a regional comparison of palm use between the Chachi indigenous people and Afro-Ecuadoreans, as they seem to have similar knowledge and livelihoods (Yépez Montúfar 2013, Fadiman 2003). Furthermore, studies about potential commercialization of palms by the Chachi could be done, related to market integration and value chains. The better market access could play beneficial effects in future, such as increased monetary income for palm products (Yépez Montúfar et al. 2011, Godoy et al. 2005). Palms also could play important roles in tourism, as such is observed in the Ecuadorean Amazonas, where palm products are sold for ecotourism (Anderson 2004), but further investigations on its impact to the Chachi people and their forests is needed. Maybe palms act in future increasingly as "self-insurance" in agriculture so that, if one crop fails palms constitute a saved financial resource, which can be sold when needed (Anderson 2004).

However, it has to be considered that it is very complicated to develop projects in this study area, because of the remoteness, bad infrastructure and political conflicts within the Chachi indigenous people (Altropicos *pers comm*. 2015, Batallas 2012, Mosandl et al. 2008, Hazlewood 2004).

7. Conclusion

A third of the traditional palm knowledge is gone and nine of fifteen useful palms are still used by the Chachi people (Barfod and Balslev 1988). Six conspicuous canopy palm species are still used and only two sub-canopy and one understory palms are among them. Palms still provide an important natural resource for the Chachi people. Due to population growth and rapid increased household numbers, the sustainable use of palms is very crucial in future (Cámara-Leret et al. 2014). Sustainable management should be encouraged, as it may contribute positively to their community economy and knowledge preservation (Byg and Balslev 2001). Furthermore, success in the sustainable use of palms could be also an incentive to further preserve the remaining forests (Byg and Balslev 2001).

In socioeconomic terms, the Chachi count still among the poorest in the country and are at risk of further maladaptive processes, such as culture loss and poverty (Kosmus et al. 2013, Hazlewood 2004). Therefore, it would be favorable for the Chachi people to incorporate changes at low levels and maintain environmental and social resilience (Hazlewood 2004). The Chachi have a long history of changing environments and living conditions, where they always had to adapt to new natural habitats (Hazlewood 2004). But, nowadays new components appeared, such as better market access and the influence of globalization (Hazlewood 2004). Now it is time for the Chachi to face new changes with the abitlity to adapt, transmit and apply knowledge to their current actual needs (Gomez-Baggethun et al. 2013). But also the government and institutions, who changed conditions in the area of the Cayapas river, have great responsibility to preserve the indigenous lifestyle and to help integrate them into modern civilization (Cámara-Leret et al. 2014).

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Appendix 2.1. Socioeconomic and historic community questionnaire. To be filled with the locality leader(s)

GENERAL INFORMATION ON THE COMMUNITY

Date: (dd.mm..yyyy) _____/_____/ 2012 Country/Province/Community:

Name of community leader (s): Position:

COMMUNITY SIZE (*)This information can be filled in detail when there is sufficient information from a community census

N° families: N° males (*) N° boys (*) (<18 yrs)

N° inhabitants: N° females (*) N° girls (*) (<18 yrs)

HISTORY & ETHNIC BACKGROUND

Date of the community's foundation

Principal productive activities

Ethnic background: *Ethnic groups present in the community, their estimated proportion (% E) and estimated proportion of members from each ethnic group who speak their native languate (% S)*

1.		% E		% S		6.		% E		% S	
2.		% E		% S		7.		% E		% S	
3.		% E		% S		8.		% E		% S	
4.		% E		% S		9.		% E		% S	
5.		% E		% S		10.		% E		% S	

BASIC SERVICES AVAILABLE WITHIN THE COMMUNITY

Education

Primary level: _____ years N° students primary level: Secondary level: _____ years N° students secondary level:

Medical attention

Health post: Hospital: Communal health worker: Traditional healer:

Other:

Lighting source

Overland line Public generator

Personal generator Solar panel

Oil lamp/candles Gas

Other

Drinking water source

Public tap, NOT drinkable Public tap, drinkable

Tap in house, NOT drinkable Tap in house, drinkable

Well River/Stream

Other

Sewage system

Yes No Olther

Sanitary system

Toilets Latrine Septic tank Other

Cooking fuel source

Gas Firewood Coal Other

Church/Mosque/Temple

Yes No Other

Communications services

Radio Public phone Celular TV/DVD Other

The questionnaires 2.1. –2.4. are reproduced of an ethnobotanical standard protocol with the permission by Cámara-Leret et al. (2012)

Appendix 2.1 (cont.)

Markets and/or supply sources

Markets: Permanent ☐ Weekly ☐ Monthly ☐ Village shops: Yes ☐ No ☐ Number ☐

Products sold:

SOCIOECONOMIC INDICATORS

Type of tools in the community (and quantity)

Tractor ☐ Plough ☐ Chainsaw ☐ Other ☐

Type of transportation in the community (and quantity)

Truck ☐ Car ☐ Motorcycle ☐ Bicycle ☐ Canoe ☐ Outboard motor ☐ Other ☐

Type of animals in the community (and quantity)

Cows ☐ Horses ☐ Mules ☐ Pigs ☐ Chickens ☐ Ducks ☐ Other ☐

Crops planted in the community

ACCESSIBILITY (Distance registered in Km for terrestial and in hours for fluvial transportation)

Town/market/path:		Transportation type:		Distance:	
Town/market/path:		Transportation type:		Distance:	
Town/market/path:		Transportation type:		Distance:	

LAND

Type of land ownership

Comunal area (ha) | Populated area (ha) | Forest area (ha)

Forest typef found in the comunal area

COMMUNITY MAP (with location of houses)

COMMUNITY AREA MAP (with vegetation types)

Appendix 2.2. Community census questionnaire. All questions to be filled out for each household visited.

COMMUNITY CENSUS

Information provided by the interviewee:

- Number of families in each house. If more than one family is present, establish the relationships among them.
- Number of people in each family, gender and age of those above 18 years.

Other information registerd by the researcher:

- House census number
- Materials employed in the construction
  - Only local material
  - Only external material
  - Local and external material
- Palm species and local material used for:
  - Thatch
  - Walls
  - Floors
  - Structural material (posts, beams, etc.)
- House condition:
  - Good condition
  - Minor defects
  - Major defects
  - Poor condition

Appendix 2.3. Informant socioeconomic information.

N° Informant:_____

Date (dd.mm..yyyy) _____/_____/ 2012 Community/N° house _____/_____

PERSONAL PROFILE

Name: Communal post:

Male Female Age Married Single Widow N° children N° people living in the house

Place of birth Ethnic group

Time of residence in this community

Name of previous community(s) and time of residence

1.			3.		
2.			4.		

Years of schooling Years superior education Other

Language(s) spoken (S), read (R) or written (W)

1.		S		R		W		3.		S		R		W	
2.		S		R		W		4.		S		R		W	

Main occupation

Main income source

SOCIOECONOMIC INDICATORS

Lighting source

Overland line Public generator

Personal generator Solar panel

Oil lamp/candles Gas

Other

Drinking water source

Public tap, NOT drinkable Public tap, drinkable

Tap in house , NOT drinkable Tap in house, drinkable

Well River/Stream

Other

Cooking fuel source

Gas Firewood Coal Others

Sanitary system

Toilet Latrine Septic tank Others

Animals (and quantity)

Cows Horses Mules Pigs Chickens Ducks Other

Crops or plantations (and size in hectares or square meters)

Tools and utensils (and quantity

Appendix 2.3 (cont.).

Tractor ☐ Plough ☐ Shovel ☐ Pick ax ☐ Machet ☐ Planting stick ☐ Ax ☐ Chainsaw ☐

Shotgun ☐ Bow/arrow ☐ Blowgun ☐ Fish-hooks ☐ Fishing-rod ☐ Fishing-net ☐ Harpoon ☐

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Transportation owned by family (and quantity)

Truck ☐ Car ☐ Motorcycle ☐ Bicycle ☐ Canoe ☐ Outboard motor ☐ ☐ ☐

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Number of markets and supply centers attended regularly (city, town, other community)

Place ☐ Frequency (weekly, monthly, etc.) ☐

Products bought ☐

Products sold ☐

Place ☐ Frequency (weekly, monthly, etc.) ☐

Products bought ☐

Products sold ☐

USE INFORMATION

Perception of species quality for certain use categories

Human food	1.	2.	3.	4.	5.
Oils	1.	2.	3.	4.	5.
Thatching	1.	2.	3.	4.	5.
Walls	1.	2.	3.	4.	5.
Framework	1.	2.	3.	4.	5.
Local markets	1.	2.	3.	4.	5.
Regional markets	1.	2.	3.	4.	5.

Of the species known, which one is the most important? Why?

Knowledge Transmission

Is the knowldge on palm uses transmitted within the community? ¿Why? Yes No

Appendix 2.4. Palm use questionnaire for general and expert informants. Options in the questions techniques of harvesting and management systems are based on Bernal *et al.* 2011.

PALM USE QUESTIONARY – GENERAL INFORMANT

1. Vernacular (local) name(s) of the palm

   Language of vernacular name and meaning of the name

2. Are there different varieties of the species? How are they differentiated?

3. What are the uses for this species? For reference use the categories and subcategories of use refer to Annex 5, for plant parts used to Annex 6.

   Which products are obtained?

   What is the palm part used for each case? (specify when possible the local names for the products)

   Which is the frequency of use? Is it a: **a)** Actual or **b)** Past use? If it is a past use, when was the last time it was used?

   Where is the resource collected? **a)** Agroforestry systems, **b)** Garden/courtyard **c)** Primary forest **d)** Plantations **e)** Palm stand **f)** Grasslands **g)** Secondary forest

   What are the techniques of harvesting? **a)** Destructive: necessary felling **b)** Destructive: unnecessary felling **c)** Non-destructive: climbing **d)** Non-destructive: harvest of cespitose palms (felling few or no trunks) **e)** Non-destructive: direct harvest of low palms (also juvenile, sub adults) or acaulescents **f)** Non-destructive: harvest (collection) on the ground **g)** Non-destructive: but without information

4. Abundance of the species in the past 10 years: **a)** Same **b)** Increased **c)** Decreased

5. Use of the species in the past 10 years: **a)** Same **b)** Increased **c)** Decreased

6. Commercialization: Type of product / Market type: (L) local; (R) regional; (N) national; (E) exportation / Frequency (daily, weekly, monthly, etc.) / Quantity / Price

Appendix 2.4 (cont.).

PALM USE QUESTIONARY – EXPERT INFORMANT

1. Vernacular (local) name(s) of the palm:

   Language of vernacular name and meaning of the name:

2. Are there different varieties of the species? How are they differentiated?

3. What are the uses for this species? For reference use the categories and subcategories of use refer to Annex 5, for plant parts used to Annex 6.

   Which products are obtained?

   What is the palm part used for each case? (Specify when possible the local names for the products)

   When is the resource collected? according to age of the plant: **a)** Seedling **b)** Juvenile **c)** Sub adult **d)** Adult **e)** Indistinct

   What are the characteristics of the processing? **a)** Without processing, direct use **b)** With processing (describe). For medicinal use, indicate information on preparation, administration and contraindications (if any)

   Which is the frequency of use? **a)** Actual or **b)** Past use? If it is a past use, when was the last time it was used?

   Where is the resource collected? **a)** Agroforestry systems, **b)** Garden/courtyard **c)** Primary forest **d)** Plantations **e)** Palm stand **f)** Grasslands **g)** Secondary forest

   What are the techniques of harvesting? **a)** Destructive: necessary felling **b)** Destructive: unnecessary felling **c)** Non-destructive: climbing **d)** Non-destructive: harvest of cespitose palms (felling few or no trunks) **e)** Non-destructive: direct harvest of low palms (also juvenile, sub adults) or acaulescents **f)** Non-destructive: harvest (collection) on the ground **g)** Non-destructive: but without information

   Is there a management system? **a)** Cultivation **b)** Enrichment areas of harvest with dispersion of seeds or seedlings planting **c)** Fertilization **d)** Use of fire (to increase the presence of palms) **e)** Rotating the harvest area **f)** Leaving the palms when the forest is cut **g)** Selective harvest by age, size and/or sex **h)** Seasonal restriction (moon phases, phenology or climate) **i)** Individuals or areas left as seed banks **j)** Pruning

Appendix 2.4 (cont.).

k) Transplanting **l)** Clearing other shrubs, trees and lianas (eliminate competition) **m)** They have a formal study (e.g. Management Plan)

4. How is it distributed in the vicinity of the community? **a)** Abundant **b)** Moderate (common) **c)** Rare **d)** Cultivated **e)** Other (describe)

5. Abundance of the species in the past 10 years: **a)** Same **b)** Increased **c)** Decreased

6. Use of the species in the past 10 years: **a)** Same **b)** Increased **c)** Decreased

7. Commercialization: Type of product / Market type: (L) local; (R) regional; (N) national; (E) exportation / Frequency (daily, weekly, monthly, etc.) / Quantity / Price

Appendix. 2.5. In the present study the use reports were grouped into four use categories and thirteen subcategories, following with some modifications Cámara-Leret et al. (2014) and Paniagua-Zambrana et al. (2010).

Use categories	Use subcategories	Description
Construction	*Houses*	Houses and other constructions such as temporary camps, animal yards
	Thatch	House thatching and other constructions
Food	*Beverages*	Elaboration of unfermented or fermented drinks
	Fresh or cooked food; *Fruit, Seed and Palm heart*	Edible, generally with little preparation. Ingredients used in the preparation and processing of foods
	Oils	Edible fats
Utensils and Tools	*Domestic Utensils*	Air freshener, baskets, broomsticks, fans, hammocks, domestic furniture,
	Hunting and Fishing Tools	Arrows, blowpipes, Bows, harpoons, hunting traps, fishing nets,
	Labor Tools	Agricultural or domestic tools like struts of banana
Various	*Adornment*	Personal Adornment (anklets, armbands, bracelets, earrings, necklaces, pectorals)
	Fodder	Food for animals
	Music	Recreational (Musical instruments)
	Ritual	Uses related to myth-religious aspects, including festivals and feasts, sorcery
	Others	**Uses not classifiable within the previous categories;** Agroforestry (Palms that are part of agroforestry systems with different management degrees: seeds for cultivation for selling) Indirect use of palms (insect larvae feeding on rotting stems used as food)

Appendix 2.6. Questionnaire to obtain information about the change of palm uses by the Chachi since 1985, in comparison to Barfod and Balslev 1988.

INFORMACIÓN SOBRE LOS USOS

Fecha: _____/_____/ 2015 Comunidad:

Nombre del dirigente

N° Informante EXPERTO: _____

El uso de la palmeras Barfod y Balslev 1988		SI SI	SI NO	NO NO	Ranking of top 5
1. *Astrocaryum standleyanum*, Guiñul (Poca-chi)	frutas crudas comestible				
	fibras para hamaca etc. extractado de hojas				
2. *Bactris gasipaes*, Chonta duro (Cano-chi)	palmito comestible, fruta cocinada comestible				
	madera para construcción de casa				
	madera para sifón de pez				
	madera para cerbatana				
	madera para lanza				
	madera para teclas de marimba				
	larvas colectadas de tallos descompuesto comestible				
3. *Bactris sp.*	palmito comestible, fruta cocinada comestible				
4. *Prestoea acuminata var. acuminata*, (Mamba-san-chi)	palmito comestible, fruta cruda comestible				
5. *Geonoma cuneata var. cuneata*, (Ya-ha-chi)	frutas crudas comestible				
6. *Geonoma linearis*, (Yullpo-pi-chui-tape)	planta ritual				
7. *Iriartea deltoidea*, Pambil (Boun-chi)	madera para cerbatana				
	madera para construcción de casa				
	madera para sifón de pez				
	madera para lanza				
	madera para teclas de marimba				
	palmito comestible				
	larvas colectados de tallos descompuesto comestible				
8. *Oenocarpus bataua*, Chapil (Cola-pa-chi)	fibras de base de la hoja para dardos de cerbatana				
9. *Oenocarpus mapora*, Cinamillo/Ciamba/Pusuy (Uin-ga-chi)	fibras del raquis de la hoja para cestería				
10. *Phytelephas aequatorialis*, Tagua (Din-chi)	hojas para techo y fibras				
	endospermo y mesocarpio comestible				
11. *Pholidostachys dactyloides*, (Ah-casta-ya-ha-chi)	-				
12. *Prestoea ensiformis*, (Chapin-sa-chi)	palmito comestible				
	hojas para techo				
13. *Socratea exhorriza*, Zancona (Pin-ua-chi)	tronco para construcción de casas				
	palmito comestible				
	larvas colectadas comestible de tallos descompuesto				
14. *Synecanthus warscewiczianus*, (Bo-chui-cano-	Habitada por malos espíritus				
15. *Wettinia quinaria*, Walte (Yan-chi)	hojas para techo				
	tronco para construcción de casas				
	frutas comestible				
	larvas collectadas comestible de tallos decompuesto				

Appendix 2.8. Animals per household (HH) in both communities. Calle Larga had in total 87 animals and Estero Vicente 44.

Household-Nr.															
Calle Larga	**Estero Vicente**	**Chicken**		**Dog**		**Cat**		**Pig**		**Duck**		**Horse**		**Turkey**	
1	14	15		1	1	1									
2	15		6	1	2										
3	16	7	1	1		1									
4	17	2		1			2				2				
5	18		7	2	3	4									
6	19		2						2						
7	20						1								
8	21	1	2	1	4			1							
9	22	5		1								1			1
10	23	3		1		1				13					
11	24	1	5							4	2				
12	25	15													
13	26	3											1		
	27														
Total		**52**	**23**	**9**	**10**	**7**	**3**	**1**	**2**	**17**	**4**	**1**	**1**	**0**	**1**
Average		5.8	3.8	1.1	2.5	1.8	1.5	1	2	8.5	2	1	1	0	1
±SD		5.2	2.3	0.3	1.1	1.3	0.5	0	0	4.5	0	0	0	0	0

Appendix 2.9. The Chachi people used in total 15 different tools. The most common tools they owned per household were the machete and axe.

Calle Larga	**Estero Vicente**	**Total**	**Tools**
19	14	33	Machete
11	12	23	Axe
6	8	14	Chainsaw
4	9	13	Fishing Hooks
6	4	10	Shotgun
5	2	7	Shovel
5	1	6	Hammer
3	1	4	Pickaxe
3	1	4	Saw
2	2	4	Cane/Reed/Stick
1	1	2	File
1	0	1	Snorkeling Mask
1	0	1	Fishing Net
0	1	1	Spit

0	1	1	Awl
67	**57**	**124**	

Appendix. 3.1. Market activity; Shop visiting frequency and most bought and sold goods. Row marked in grey = Calle Larga, row without color = Estero Vicente.

		Buying			Selling	
Shop location	**Visiting frequency**	**1° (UR)**	**2° (UR)**	**3° (UR)**	**1° (UR)**	**2° (UR)**
Calle Larga (10)	daily (8) every three month (2) when needed (2)	rice (10) sugar (1)	sugar (4) fish (2) rice (1) egg (1)		cacao (5) canoe (1) pasta (1) handicraft (1)	ham (1) handicraft (1) cacao (1)
Borbón (2)	every three month (1) when needed (1)	rice (1)	cloths (1) fish (1)	sugar (1)	cacao (2)	
San Miguel* (1)		rice (1)	sugar (1)			
Estero Vicente (10)	daily (8) every 2-3 days (2) monthly (1)	rice (5) oil (1) chicken (1)	egg (2) oil (1) sugar (1)	sugar (1) meat (1) fish (1)	cacao (3)	
Zapallo Grande (2)	monthly (1)	chicken (1)	fish (1)		cacao (2)	
Borbon (1)	monthly (1)				cacao (2)	

*San Miguel is one of the biggest Afro-Ecuadorean communities in the Cayapas area

Appendix. 3.3. Most important food in general (rows in grey = Calle Larga) and only of palms (rows without colour = Estero Vicente).

	1° (UR)	**2° (UR)**	**3° (UR)**
Food	Plantains (5) fish (4), rice (3) shrimp (1), chicken (1)	Fish (7) rice (1), coco (1), banana (1) chicken (1), sugar (1), egg (1)	Meat (5) rice (3), plantains (3) egg (1), pasta (1), shrimp (1)
Food palm species	*Iriartea deltoidea* (5) *Bactris gasipaes* (2) *Phytelephas aequatorialis* (2) *Euterpe olearacea* (1)	*Phytelephas aequatorialis* (2) *Oenocarpus bataua* (2) *Bactris gasipaes* (1), *Euterpe olearacea* (1) *Iriartea deltoidea* (1), *Wettinia quinaria* (1)	*Phytelephas aequatorialis* (3) *Coco nucifera* (2) *Iriartea deltoidea* (1), *Bactris setulosa* (1) *Oenocarpus bataua* (1)
Oil	"El Cocinero" (8) "Palma de Oro" (4) "Alesol" (1), Coco oil (1)	"Palma de Oro" (7) "El Cocinero" (5) "La Favorita" (2), "Alesol" (1)	"La Favorita" (2) "Palma de Oro" (1) "Alesol" (1), "Corona" (1)
Palm oil	"La Favorita" (9) "Palma de Oro" (3)		
Thatch	Zinc (6) *Guaiacum officinale* (timber) (3)	*Phytelephas aequatorialis* (5) timber (4)	*Guaiacum officinale* (timber) (1) timber (1)
Palm thatch	*Phytelephas aequatorialis* (8) *Iriartea deltoidea* (1), *Wettinia quinaria* (1)	*Phytelephas aequatorialis* (1) *Iriartea deltoidea* (2) *Wettinia quinaria* (3)	*Iriartea deltoidea* (1)
Wall	Timber (5) *Guaiacum officinale* (1) *Humiriastrum procerum* (1) *Apeiba aspera* (1), *Iriartea deltoidea* (1)	Timber (6) *Guadua anustifolia* (3)	Timber (4) *Iriartea deltoidea* (1)
Palm Wall	*Iriartea deltoidea* (3) *Phytelephas aequatorialis* (1) *Wettinia quinaria* (1)	*Iriartea deltoidea* (1) *Wettinia quinaria* (1)	-

The oil "el cocinero" contains palm oleins and soya oil, "la favorita" a mixture of 10% soy oils and palm oleins, "palma de oro" is palm oil of unknown palm species. Spanish common names were given for the timber species and here written in scientific names = *Guaiacum officinale,* Guayacan (1), *Humiriastrum procerum,* Chanul (1) and *Apeiba aspera,* Peine de mono (1).

Appendix 3.2. The Chachi 22 different crops for their own household consumption. Only *Theobroma cacao* is used for commercial purposes.

Calle Larga	**Estero Vicente**	**Crops, *scientific* and English name**	**Min – Max. per year**
3	1	*Ananas comosus* (Ananas)	5 – 1460 fruits
1		*Annona muricata* (Soursop, Guanabana)	
1		*Annona cherimola* (Custard Apple)	
1		*Arbutus unedo* (Madrono)	125 – 250 kg
3		*Bactris gasipaes* (Chontaduro)	4 – 8 branches
1		*Carica papaya* (Papaya)	2 Trees
1	1	*Casimiroa edulis* (Zapote)	7 Trees (50 – 150 kg)
2		*Citrus reticulata* (Mandarine)	5 Trees
2	1	*Citrus sinensis* (Orange)	4 Trees
2	1	*Coco nucifera* (Coco)	60 – 120 Coconuts
1		*Guadua angustifolia* (Bamboo)	
3	1	*Laurus nobilis (Bay Laurel)*	
5		*Manihot esculenta* (Cassava)	3 – 90 kg
8	10	*Musa sp.* (Platane)	50 – 770 branches
3	8	*Musa sp.* (Banana)	768 - 4380 branches
1		*Passiflora ligularis* (Sweet Granadilla)	
	1	*Psidium guajava* (Guave)	
	1	*Saccharum officinarum* (Sugar cane)	288 – 720 pieces
	1	*Solanum quitoense* (Naranjilla)	
1		*Spondias purpurea* (Jocote)	1 Tree (300 – 350 kg)
10	11	*Theobroma cacao* (Cacao)	25 – 1080 kg
2		*Zea mays* (Mais)	50 – 100 kg
Total 51	**Total 37**		