ETHNOBOTANY OF THE FIBER PALM *ASTROCARYUM CHAMBIRA* (ARECACEAE) IN AMAZONIAN ECUADOR[1]

OLE HOLM JENSEN AND HENRIK BALSLEV

Holm Jensen, Ole *and* **Henrik Balslev** *(Institute of Biological Sciences, Department of Systematic Botany, Herbarium Build. 137, University of Aarhus, DK-8000 Aarhus, Denmark).* ETHNOBOTANY OF THE FIBER PALM *ASTROCARYUM CHAMBIRA* (ARECACEAE) IN AMAZONIAN ECUADOR. *Economic Botany 49(3):309–319. 1995.* Astrocaryum chambira *Burret is native to the western parts of the Amazon basin where indigenous people use it as a source of fiber. Its use among four different indigenous groups in Ecuador is described here. They extract fibers from the pinnae, mostly of the young leaves. Both men and women twist the fibers into strings in their homes after hunting and work in the fields. The main items produced are woven hammocks, bags, and nets. These products represent the main source of cash income for many indigenous people. The highest value for their products is obtained from sale directly to tourists. The commercial use of* A. chambira *can possibly be increased in extractivism along with better marketing. The variety of ways this palm is used also makes it a valuable species for agroforestry.*

Etnobotánica de la palma de fibra *Astrocaryum chambira* (Arecaceae) en la Amazonía ecuatoriana. Astrocaryum chambira *Burret es nativa de la parte occidental de la cuenca amazónica donde los indígenas la utilizan como una fuente de fibra natural. Aquí se describe su uso por parte de cuatro diferentes grupos indígenas en Ecuador. Ellos extraen las fibras de las pinnas, principalmente de las hojas juveniles. Después de terminar con la cacería y el trabajo en el campo, de vuelta en casa, tanto hombres como mujeres enrollan las fibras para hacer cuerdas. Los productos principales son hamacas tejidas y redes. Estos productos representan el principal ingreso económico para muchos indígenas. El mayor ingreso es obtenido de la venta directa a los turistas. El uso comercial de* A. chambira *posiblemente puede ser incrementado con extractivismo unido a una mejor comercialización. Múltiples usos podrían valorar esta palma para la agro forestería.*

Key Words: *Astrocaryum chambira*; palm fibers; hammocks, bags, nets; ethnobotany; extractivism; Ecuador.

In 1925 Tessmann collected a palm in eastern Peru with the vernacular name "chambira" and first reported on the use of it by indigenous people. This palm was later described as a new species *Astrocaryum chambira* by Burret (1934). He found "chambira" in high densities and described many more ways in which it is used by the indigenous people. Its value to these people is reflected in the names of three rivers and three villages in Eastern Peru which are named for the chambira palm (Burret 1934). Oberem (1974) describes trading of nets made of palm fiber in the 18th and 19th centuries from Amazonian Ecuador. No other palms are known to provide such fibers, and we therefore assume that they were made from chambira. The utilization and high economic importance of *Astrocaryum chambira* was mentioned by Borgtoft Pedersen and Balslev (1992). From Peru, Mejia (1988) briefly reports on the chambira fiber process and the fiber consumption for carrying bags called "shigras." Schultes (1977) describes the fiber utilization of three different *Astrocaryum* species in Colombia. According to the description of the fiber process and to the revision of the genus by Kahn and Millán (1992), these may all be *A. chambira.* Wheeler (1970) gives a short description of the utilization of chambira fiber in an anthropological perspective from southeastern Colombia. From Peru *A. chambira* is reported as having potential for agroforestry on well drained soils (Kahn 1988). Information on

[1] Received 30 December 1994; accepted 26 April 1995.

handicrafts by specific indigenous groups in Ecuador are provided by Bianchi (1982) and Paymal and Sosa (1993).

In this work we report on a study of the use of the fibers of *A. chambira.* The process is described in detail from harvesting of the crude leaves to the creation of finished products. In brief the fibers are formed just below the epidermis on the adaxial (upper) side of the reduplicate pinnae. They are mostly extracted from young spear leaves, heated in water, dried in the sun, and then twisted by rolling them against the thigh. Older leaves which are less flexible may also be harvested but then another technique is used in their processing. Apart from providing fibers, *A. chambira* has several other uses. The immature fruits from the chambira palm are cut open and the fluid endosperm is drunk and the firm part of the endosperm is eaten in the same way as a coconut. The Siona-Secoya bundle the midribs of the pinnae and use them for brooms. The palm hearts of *A. chambira* are edible, and edible larvae are collected from their dead trunks.

Chambira work and the use of this palm fiber is not known by the non–indigenous population in the area; in contrast it is an old tradition and a very important part of the culture of the indigenous people living in Ecuador's Amazon region. As traditional rain forest products the chambira items have in recent time attracted increasing interest among tourists, thus hammocks and carrying bags are sold in many shops and are in great demand. Although the overall economic importance of these fiber products is limited, their sale often is the only source of cash income for the people producing them.

Species Description and Distribution

Astrocaryum, a neotropical genus, comprises 47 species of which four are known from Ecuador. *Astrocaryum standleyanum* Bailey grows west of the Andes and its fibers are used commercially for hats, hammocks, mats, and furniture (Borgtoft Pedersen 1994). *Astrocaryum jauari* Martius and *A. urostachys* Burret, found in the Ecuadorean Amazon, are of minor economic importance, and their uses are limited. *Astrocaryum chambira,* on the other hand, is one of the palms most exploited by the indigenous people in Ecuadorean Amazon.

Astrocaryum chambira is a solitary palm with a trunk up to 30 meters tall and 25–40 cm in diameter (Fig. 1). All parts of the palm are heavily armed, and on the trunk the flattened black spines can be up to 20 cm long. The 9–16 leaves are up to 12 m long and support as many as 175 pinnae per side, of which the longest are up to 1.7 m long and 6 cm wide. The inflorescenses are monoecious, interfoliar and erect. The fruits are green turning yellow at maturity, obovoid, 6–7 cm long, and 4–5 cm wide.

The chambira palm is widespread throughout the Ecuadorean lowlands east of the Andes, but usually in low densities. It is most common on terra firma up to 350 m above sea level, but it is also found on periodically flooded alluvial soils and in open areas and secondary forest. It is not seriously affected by burning and the stems are very hard to cut (Kahn and Granville 1992).

Study Area

We observed the distribution and local use of *A. chambira* along rivers and roads in Amazonian Ecuador. More detailed observations were done in four villages representing different indigenous groups who exploit the chambira fibers. One was the Quichua community near Ahuano on the Upper Río Napo, and a second was the newly established Waorani community on Río Shiripuno about 75 km south of Coca. In northeastern Ecuador we visited the Cofán village in Dureno on the Upper Río Aguarico about 25 km east of Lago Agrio, and the Secoya village, San Pablo, on the lower Río Aguarico (Fig. 2). Information on marketing of chambira products was collected in these four villages and in shops in Quito and in the Amazonian towns of Puyo, Misahuallí, Coca, Ahuano, Tena, and Lago Agrio.

Methods

Information on uses of *Astrocaryum chambira* and marketing of the chambira products was gathered from February to May of 1994. We visited each of the four indigenous villages for 5–8 days. Information on the exploitation was obtained in cooperation with Spanish speaking informants who knew the forest and the chambira fiber process. In each village we spent 1–2 days participating in the search for, harvesting of, and carrying chambira leaves back to the village. The Quichua near Ahuano showed us the fiber process for old chambira leaves in detail, and this technique was later studied in less detail among the other three groups. We observed fiber extraction from spear leaves and the processing of

Fig. 1. The canopy palm *Astrocaryum chambira* is the most used fiber plant in Amazonian Ecuador.

TABLE 1. VERNACULAR NAMES FOR *ASTROCARYUM CHAMBIRA* BURRET IN ECUADOR.

Language/ group	Common name	Life stage
Achuar	kumai (3)	
	mate (4)	
Cofán	'tuinfa si (7)	Pre-harvestable
	tuinfa (4)	Harvestable
	tuinfa hi (7)	Post-harvestable
	tiinfa"cho (4)	
Secoya	nyu kwa (7)	
	nyu kwa'savapo (7)	Juvenile
	kwe nju kwa (7)	Adult
Shuar	kumái (4)	
	matá (4)	
Siona	be-to (1)	
	nyukwa (6)	
Quichua	chambira (2)	
Waorani	oneongkagi (5)	Seedling
	onempa (5)	Juvenile
	opongengkawe (5)	With trunk

References: (1) Herbarium voucher *Balslev 4812* (AAU); (2) Balslev and Barfod (1987); (3) Bianchi (1982); (4) Borgtoft Pedersen (1993); (5) Davis and Yost (1983); (6) Vickers and Plowman (1984); (7) Pers. obs.

the fibers from the crude pinnae to the finished products. We lived in the house of the informant and his family, and followed their chambira work every day during our stay. In all four villages we conducted observations and interviews with 2–4 additional families who also used the chambira palm. The Waorani and Secoya informants showed us the traditional technique for weaving hammocks. All families visited provided information on the manufacture of carrying bags. Through interviews and direct observation we obtained information on marketing patterns, prices, and economic importance, among the producing families and shop keepers who sell the fiber products.

RESULTS

HARVESTING

Young unopened spear leaves of *Astrocaryum chambira* are the main source for fiber extraction. Harvest of leaves can begin when the palm is old enough to start forming a trunk, which, according to our informants is at an age of four years. At this stage the spear leaf can be reached from the ground using machetes. Harvesting may continue until the palm reaches a height of 6–8 m, which several informants estimated to be 10 years old. Taller palms are usually not harvested for leaves but left for fruit production. Some groups use different names for *A. chambira* depending on its life stage which indicates its importance to the traditional life (Table 1).

Only every second spear leaf is harvested. The informants believe that this ensures survival and normal development of the individual, and maintains non-destructive utilization of the palm. There is no specific season for harvesting. The chambira palm is said to produce 4–6 new leaves per year, which would make harvesting from each palm possible 2–3 times per year.

Searching for and harvesting leaves from the palm is often done among other activities in the forest, for instance while gathering fruits and medicinal plants, or returning from hunting. Depending on the height of the palm, harvesting of one leaf may take 15–45 min, which is often much less than the time spent searching for a plant.

Harvesting of the spear leaf with a machete may be done without damaging the mature leaves around it. Because of the spiny trunk it is difficult to climb the palm, so the leaves are cut from the ground. Two long poles, often of bamboo (*Guad-*

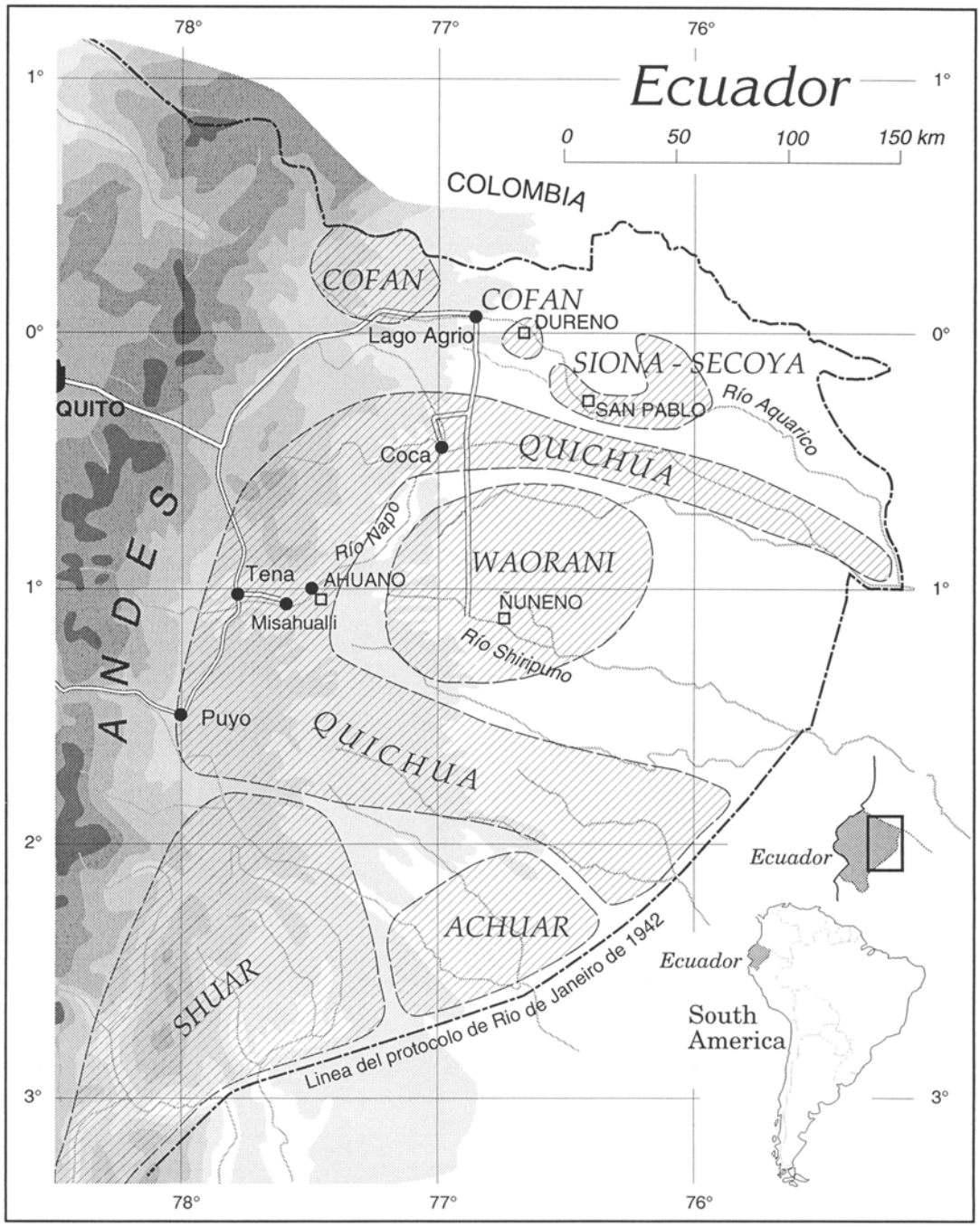

Fig. 2. Amazonian Ecuador indicating location of villages visited, towns and rivers mentioned in the text and traditional territories of ethnic groups.

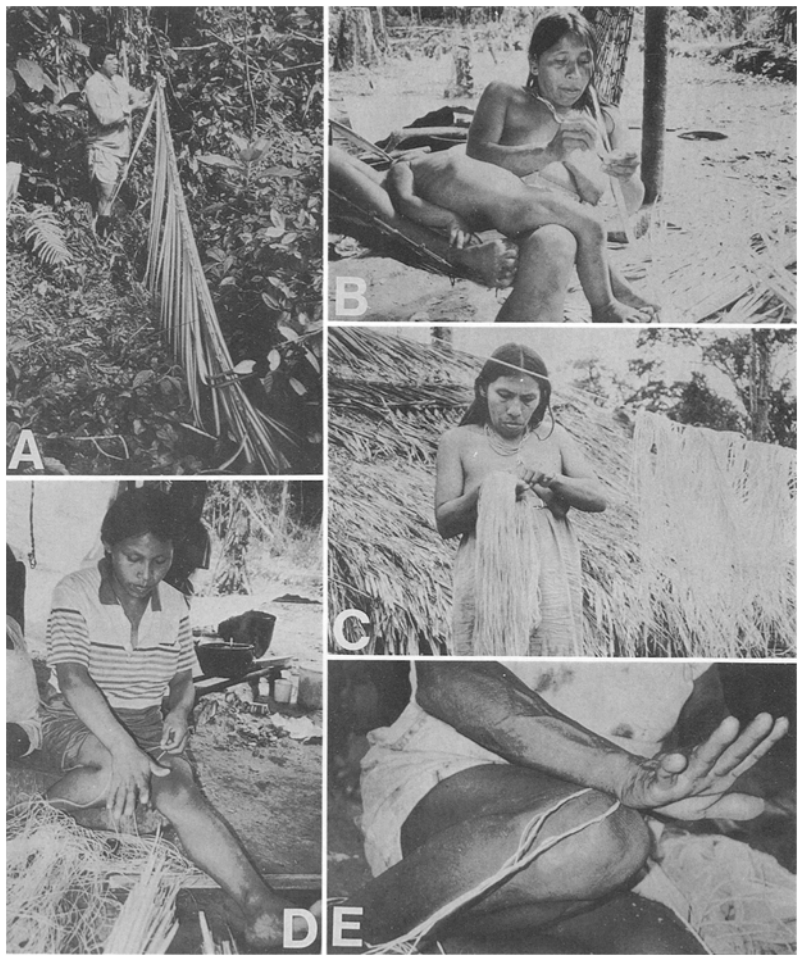

Fig. 3. Processing the fiber. A. Harvesting of chambira leaves. The pinnae which contain the fibers are separated from the rachis of a spear leaf. B. Chambira fiber work has been done by indigenous people for generations. Here Waorani in Ñuneno extract fiber from pinnae. C. The fibers are dried and bleached in the sun. D. Waorani twisting the fibers into a string. E. Detail of twisting against the thigh.

ua angustifolia Kunth), are used to cut leaves from taller palms. A piece of liana or a petiole of *Carludovica palmata* Ruiz & Pav. (Cyclanthacae) is used to fasten a cross stick to one of the poles and a machete to the other. The first is used as a long hook to separate the spear leaf from the rest of the crown, and the other to cut the leaf petiole.

The young leaf is 3–6 m long depending on the stage of development. The highest quality fibers are obtained from unopened spear leaves. The number of usable pinnae usually ranges from 150–200, but we have observed up to 230 usable pinnae in a leaf, all with lengths of 90–150 cm. The pinnae near the leaf apex are not used, because they are too short. Before unfolding, the pinnae of the spear leaf are positioned close together pointing towards the leaf apex. They are loosened from each other by shaking the leaf, and then separated from the rachis by pulling bundles of 10–20 towards the base of the leaf (Fig. 3A). The pinnae are then assembled in bigger bundles and tied together with a couple of pinnae. A chambira carrying bag is often used for transporting the bundles back to the village where further processing is done.

PROCESSING

The chambira fiber work employs the families during bad weather, in the afternoon after finishing other daily work, and as a leisure time activity for both men and women. The pinnae are stripped off and the fibers made into strings in the following process:

1. A piece of midrib near the base of the pinna is separated from the lamina by hand. The base of lamina is softened by repeated bending of the area from which the midrib has already been removed (Fig. 3B). Then the entire lamina is bent at the softened area, and the apex of the pinna is held under the foot. By using both hands the epidermis and the fibers are removed all along the lamina towards the apex of the pinna (as can be seen for older leaves on Fig. 5C). The extracted fibers are collected in bundles. In this process a skilled person can strip up to 100 pinnae per hour.

2. The fibers are bleached by heating them in pure water for 20–30 min, which at the same time softens the material. They are then rinsed in pure water in the nearest river. Afterwards they are put up for drying and further bleaching in the sun for one or two days (Fig. 3C).

3. Twisting of the fibers to strings is done by both men and women. Women twist the thinner strings which are used for carrying bags, while the men produce the thicker ones used for hammocks. The twisting is done in two steps. First, the fibers, which are about one meter long, are put in line with each other with an overlap of about 20 cm. One hand holds the fibers tight while the other is twisting the fibers on the thigh until they form a continuing and uniform cord. The two cords twisted the same way around are continuously being extended into an endless string. As the second step the two cords are twisted together. This is done by twisting the cords the other way around so that they form a 2-cord string (Fig. 3D,E). Twisting of the fibers is the most time consuming part of the entire chambira work. Waorani informants told us that a person working full time could make about 50 m per day.

The strings may be colored with natural dyes which are made from other forest plants or those cultivated in home gardens. Red dyes can be obtained from the seeds of *Bixa orellana* L. (Bixaceae) which are boiled for about two hours together with the chambira string. According to Waorani informants a more persistent red color is prepared in the same way from the bark of *Haematoxylum campechianum* L. (Leguminosae). *Renealmia thyrsoidea* (R. & P.) P. & E. (Zingiberaceae), which is widely consumed by the Cofán and Secoya, is also used for coloring. The black fruits are rubbed into the string, which produces a purple color. The use of dyes is dependent on local traditions, and varies from one indigenous group to another. Thus the Quichua rarely dye their chambira products, while the Waorani often use red colors, and the Shuar and Achuar often use dark colors. The Siona and Secoya and especially the Cofán use several different dyes.

PRODUCTS

Chambira strings are used for weaving or tying carrying bags. The basis of most of the techniques is a series of identical loops which are tied together. These series of loops form the bottom of a bag. The string is now looped around a smooth stick, and each loop is tied to a loop in the former row. The diameter of the stick determines the size of the mesh. As tying proceeds a couple of rows of dyed string may be added (Fig. 4A).

While the women produce carrying bags, the men twist and collect huge bundles of string for making hammocks. The weaving is done in a frame made of two vertical poles (Fig. 4B). The distance between the poles is about two meters, and this distance determines the length of the hammock. A shuttle, made of a stick about one meter long, is wrapped with chambira string and used for weaving the hammock. Hangers about one meter long are fastened to each end and the product is finished (Fig. 4C,D). Also, the chambira string is used for weaving landing-nets that reach sizes up to 100 × 200 cm. They are mounted at an oval frame made of a flexible branch and used for catching fish in rivers and lakes (Fig. 4E).

Chambira strings are employed for various other purposes and products including lines for clothes, combs, necklaces and other adornments. Strings and straps are made for musical instruments, children's toys, and household products. Fiber strings are used for the manufacture of hunting gear, for traps in the forest, and in innumerable other objects of everyday life (Bianchi 1982; Paymal and Sosa 1993).

The design and size of hammocks and carrying nets vary between the different localities and

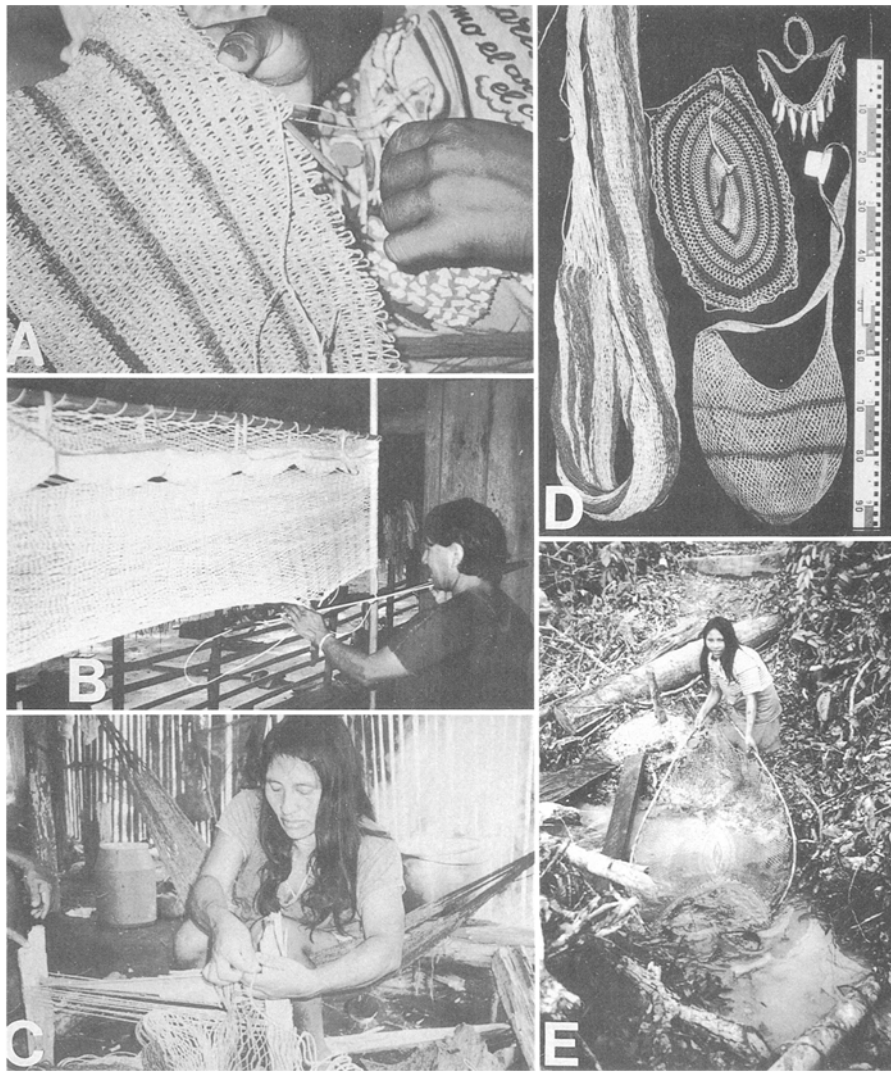

Fig. 4. Main products are chambira hammocks and bags. A. Various weaving and tying techniques are used for production of carrying bags. B. Secoya showing the weaving technique for hammocks (here using artificial nylon string). C. Waorani making hangers for a chambira hammock while sitting in an older one. D. Chambira products from Ñuneno: Hammock, necklace, small landing net, and carrying net. E. Waorani showing the use of a chambira landing net.

groups because of local traditions, and results in variations in the time and fiber required for manufacturing each product (Table 2). Thus the volume of carrying bags ranges from 5–25 liters, and the weight of the entire bag varies from 80–200 grams. For a hammock 500–1100 m of string are required, and the weight of the product varies from 900–1600 grams. Many Waorani hammocks are smaller than those made by other groups, and the string employed is stronger, heavier, and gives these products a more crude finish.

Observations and interviews were made about the fiber and time consumption (Table 2). Leaf consumption for small bags varies from 1–2 leaves, fewer than the three leaves, which Mejia (1988) reports for small bags from the Peruvian Amazon.

The data on time consumption are given for a typical family involved in production. This

TABLE 2. COMMON CHAMBIRA ARTICLES. DIMENSIONS, MEASUREMENTS AND CONSUMPTION OF FIBER AND TIME FOR PRODUCTS FROM DIFFERENT GROUPS.

	Carrying bags		Hammocks	
	Small	Large	Small	Large
N = # items	8	3	4	4
Dimensions (m)	0.3 × 0.3*	0.4 × 0.4*	2.9–3.2**	3.1–3.5**
Volume (l)	5–15	15–25	–	–
String required (m)	–	–	500–800	800–1100
String weight (g/m)	–	–	1.5–1.8	1.3–1.5
Product weight (g)	80–130	130–200	900–1200	1200–1600
Leaf consump./product:				
Pers. obs.	1–2	2–3	5–10	10–15
Mejia (1988)	3	–	–	–
Time consumption (days):				
Production time	7	7–21	180	240
Effective time	1–2	2–3	10–15	25–30
Main producers	All groups	Quichua	Waorani	Secoya/Cofán

* Measurements of length and width.
** Measurements of only the length.

often includes two adults and 2–3 children working with chambira fiber. Time consumption is measured in two ways. Production time is the period spent at chambira work at the same time as ordinary everyday activities. Effective time indicates the time consumed specifically at chambira work. The largest difference is found for small hammocks, where the effective time, according to our informants, is 10–15 days and the production time is 180 days.

OLDER LEAVES

Fully developed and older leaves of *Astrocaryum chambira* are harvested occasionally and used for special purposes. These leaves are bigger and the pinnae often longer, but they are harvested in the same way as the spear leaves. The fresh pinnae are woven into a mat which dries in the sun for 2–3 days, whereby the green color turns into grey or yellow. In rainy periods they are dried under the roof in the huts near the fire place. Mats are disassembled and bundles of about 20 pinnae are heated for 15–20 min in a pot. This process softens the pinnae and makes the fiber extraction earlier.

For stripping the fibers from the crude leaves two bamboo pieces are used. A thin one (l × w × h): 25 × 1.2 × 0.3 cm and another thicker one: 20 × 2 × 0.4 cm. The pinna is bent over near its base, and here a piece of midrib is removed. The thicker stick is then placed under the bent pinna, and the thinner one is moved rapidly along the pinna and against the edge, whereupon the fibers are exposed (Fig. 5A). Now the whole pinna is stripped off. The pinna apex is held against the floor with a foot, the left hand thumb and forefinger hold the pinna at the bend and the right hand pulls the exposed fibers against the apex of the pinna. The fibers are often attached to parts of the epidermis, which is subsequently removed by rubbing it with ashes (Fig. 5B,C).

After drying in the sun, these fibers must be carded before they are spun. From balsa (*Ochroma pyramidale* (Cav.) Urb.) a conical block is made. Around this, the very fine fibers are laid, covered with a layer of paper and tied with a piece of string. The yellow greenish fibers are then carded. A spindle is made of bamboo and the fibers are now spun into a thin thread (Fig. 5D). This is the basic material for products made out of fully developed leaves.

Fishing nets which are used in small rivers and lakes are the main product of these chambira threads. They have a mesh size of about 45 × 45 mm, a height of one meter and a length of 10–30 m. Stones from the river are used as sinkers and small pieces of balsa wood serve as floats. Sinkers and floats are tied to the net with a piece of 2-cord chambira string. This very thin chambira thread is preferred for fishing nets because it has less resistance in the river current (Fig. 5E).

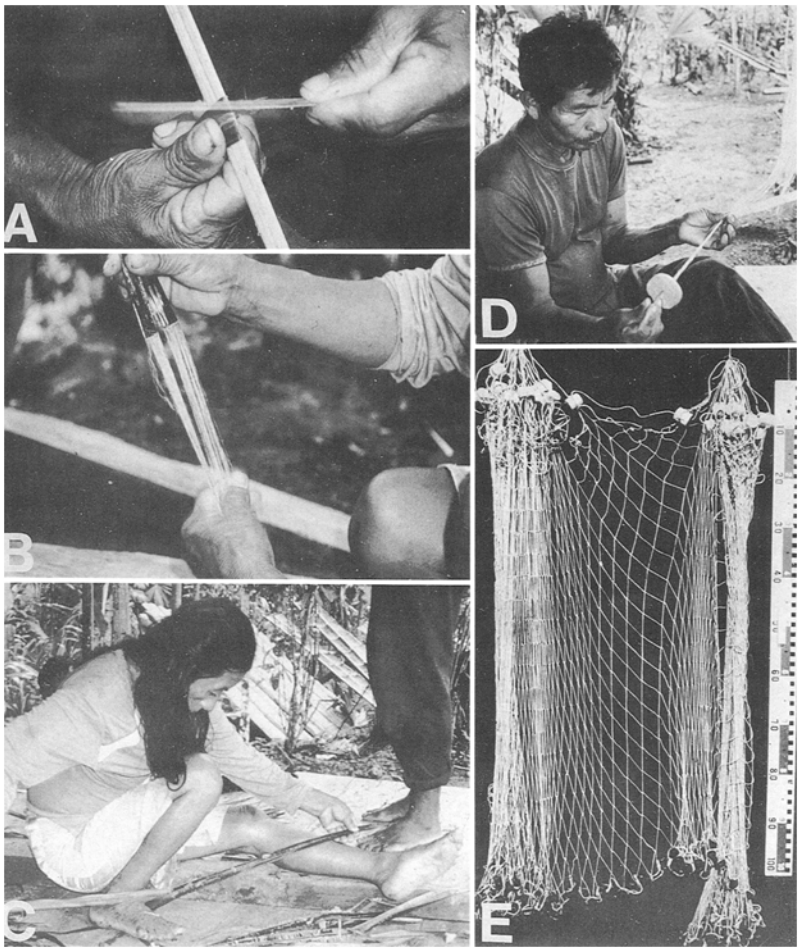

Fig. 5. Fibers extracted from older chambira leaves. A. A skilled Quichua exposes the fibers from an old, crude pinna. B. Older leaves contain very fine fibers. C. Quichua stripping a pinna. D. A thin chambira thread is spun from the fine fibers. E. Fishing net made of fibers from older leaves.

In certain places we have observed the use of coarse chambira fiber for manufacturing fishing lines. For this purpose fibers are extracted from the old leaves, twisted at the thigh, and made directly into fishing lines.

Marketing and Economic Importance

Table 3 shows that the income from each product is up to 4–5 times higher for the Cofán and Secoya living in the northern parts of the Ecuadorean Amazon who usually sell their products directly to tourists, than for the Waorani in the central parts. Few tourists visit the inaccessible and sparsely populated central parts of Ecuadorean Amazon, but it is here the chambira palm is found at highest densities, and here that the most intensive fiber work is done. The chambira products are also the main source of cash for many indigenous people in this part of the country, and for that reason the marketing and the actual prices are very important. Some producers

Table 3. The producers selling price (in US-dollars, 1994).

Group	Waorani	Cofán	Secoya
Carrying bags	2.5–5	10–12.5	5–7.5
Hammocks	10–15	40–50	50–75

TABLE 4. RETAIL TRADING FOR CHAMBIRA PRODUCTS. BUYING- AND SELLING PRICES (IN US-DOLLARS, 1994).

Locality	# shops		Carrying bags		Hammocks	
	Souvenir	Other	Buy	Sell	Buy	Sell
Ahuano	0	3				30–35
Coca	1	0		7.5–9		
Lago Agrio	1	0		6–7.5		40–50
Misahuallí	4	2	3.5–5	5–10		30–35
Puyo	3	3	1.5–2.5	2.5–4	12.5–15	20–25
Quito	c. 50		c. 5	5–10		
Tena	0	1	2.5–3	3–4		

travel to the markets a few times a year and trade their products for machetes, clothes, and hunting gear. Meanwhile, it is often intermediaries who bring the products to the shop dealers in the towns. School teachers often act as intermediaries, when they return in small aircraft to their home towns for vacation. Most producers from remote areas have no marketing skills, which makes them dependent on intermediaries, who often earn more from each product than does the producer.

Chambira bags are sold to the residents of Amazonian Ecuador as well, even though similar products made of nylon are being marketed at a lower price. The greater part of the products are sold by souvenir shops, but many groceries, stalls, and hotels sell the products. In Quito and in the Amazonian towns of Puyo, Misahuallí, Coca, Ahuano, Tena, and Lago Agrio we have investigated the marketing of the fiber products (Table 4). In general the highest prices (both buying and selling) are in towns with more tourists, such as Misahuallí and Quito, and lower prices in Puyo and Tena, which are visited by fewer tourists.

ECONOMIC POTENTIAL

Astrocaryum chambira is one of the most widely used plants in Amazonian Ecuador, and the tourist demands for the fiber products, as for other native crafts from the tropical rain forest, is increasing and has much potential (Bennett, Alarcón, and Cerón 1992; Borgtoft Pedersen 1994; Borgtoft Pedersen and Balslev 1992). As ecotourism rapidly expands for many of the indigenous groups in Eastern Ecuador, this will represent an increasingly important part of their income. The chambira products are the native crafts in greatest demand with these "green" tourists. Marketing of native crafts from cooperative shops run by the indigenous groups themselves is done in southeastern Ecuador and in this way intermediaries are avoided. Such cooperative marketing along with training of the staff in business could ensure better prices for the producers.

Utilization of *A. chambira* in the future will be strongly dependent on the natural populations of this palm. Most indigenous people are now exploiting this wild species in apparently sustainable ways using non-destructive methods for harvesting, only cutting every second spear leaf and sometimes cleaning or weeding away the herbs around juvenile palms. Formerly, the harvest has often been destructive; the trees were felled, lowering the densities considerably in some areas (Davis and Yost 1983). In some indigenous villages we have observed seeds and seedlings being gathered in the forest and later distributed in the home gardens, but in general only minimal management is done.

The exploitation of the chambira palm is a classical example of extractivism. The resource can be collected without damaging the wild populations in the forest. The manufacturing is done without machinery and the products are of high economic value and in great demand. The exploitation is an alternative to paid jobs which are rare. Extractivism will also contribute to conservation of the culture and traditions of the indigenous groups. Utilization of *A. chambira* and other forest resources represent an alternative to deforestation and cattle ranching and they can be a part of conservation programs for tropical rain forests.

In modern and systematic agroforestry systems *Astrocaryum chambira* could be an important component as well. Many indigenous families already protect the juveniles in their home

gardens, and mature individuals serve as shade trees for crops such as banana (*Musa* × *paradisiaca* L.), cassava (*Manihot esculenta* Crantz) and maize (*Zea mays* L.), and sometimes commercial crops like coffee (*Coffea arabica* L.) and cacao (*Theobroma cacao* L.).

The fruits of *A. chambira* could be used for oil production. Several other species of *Astrocaryum* have high contents of oil in the kernel, and in Brazil *A. aculeatum* Meyer and *A. vulgare* Martius have been exploited for oil production for decades (Balick 1985). As for *A. jauari* and *A. standleyanum* the fruits are eaten or dispersed by many animals including peccaries (*Tayassu* sp.), guatusas (*Dasyprota* sp.), and several other rodents. The fruits therefore have a large potential as fodder for domestic animals such as pigs. Burret (1934) mentions that the palm hearts from chambira are eaten in eastern Peru, and this is also a potential exploitation. Fibers which, at present, are the main utilization of *A. chambira,* could perhaps be more intensively extracted. Cheap machinery which is easy to operate is used for processing the fibers of *A. standleyanum* in coastal Ecuador (Borgtoft Pedersen 1994). Thus invention of simple machinery for the stripping and twisting process of chambira fiber might enhance the rate of fiber production and increase local incomes as well. Further research is required in these fields. The exact ecological demands for this multipurpose palm need to be determined, and research of the use in intercropping systems and interactions with other crops is important for a more intensive utilization of *Astrocaryum chambira* in different land use systems.

ACKNOWLEDGMENTS

We are indebted to many persons for help during our stay in Ecuador. Dr. Alberto Padilla and Finn Borchsenius from Pontificia Universidad Católica del Ecuador in Quito made possible and supported our work in Amazonian Ecuador. Randy Smith helped us in establishing contact with the Waorani, and Angelika Raimann introduced us to the Quichua for which we are grateful. Noenmi Paymal and Héctor Vargas provided much useful information during the fieldwork. In addition we are very grateful to the informants and their families for their cooperation and gracious hospitality. We thank Flemming Nørgaard who skillfully prepared Fig. 2, Pamela Hall for reading and commenting on the manuscript, and Carmen Josse for translating the abstract into Spanish.

We are grateful for financial support from the EEC (grant # TS3-CT91-0004).

LITERATURE CITED

Balick, M. J. 1985. Current status of Amazonian oil palms. Pages 172–182 *in* C. Pesce, ed., Oil palms and other oilseeds of the Amazon (translated and edited by D. V. Johnson). Reference Publications, Algonac, MI.

Balslev, H., and A. Barfod. 1987. Ecuadorean palms—an overview. Opera Botanica 92:17–35.

Bennett, B. C., R. Alarcón, and C. Cerón. 1992. The ethnobotany of *Carludovica palmata* Ruíz & Pavón (Cyclanthaceae) in Amazonian Ecuador. Economic Botany 46:233–240.

Bianchi, C. 1982. Artesanías y técnicas Shuar. Ediciones Mundo Shuar, Quito.

Borgtoft Pedersen, H. 1993. Notes on extractivism in Ecuador with special emphasis on management and economic exploitation of native palms (Arecaceae). Ph.D. Dissertation, University of Aarhus, Aarhus.

———. 1994. Mocora palm-fibers: use and management of *Astrocaryum standleyanum* (Arecaceae) in Ecuador. Economic Botany 48:310–325.

———, **and H. Balslev.** 1992. Economic botany of Ecuadorean palms. Pages 173–191 *in* M. Plotkin and L. Famolare, eds., Sustainable harvest and marketing of rain forest products. Island Press, Washington, D.C.

Burret, M. 1934. Die palmengattung *Astrocaryum* G. F. W. Meyer. Repertorium Specierum Novarum Regni Vegetabilis 35:114–158.

Davis, E. W., and J. A. Yost. 1983. The ethnobotany of the Waorani of eastern Ecuador. Botanical Museum Leaflets 29:159–217.

Kahn, F. 1988. Ecology of economically important palms in Peruvian Amazonia. Advances in Economic Botany 6:42–49.

———, **and J.-J. de Granville.** 1992. Palms in forest ecosystems of Amazonia. Ecological Studies, Vol. 95, Springer Verlag, Berlin, New York.

———, **and B. Millán.** 1992. *Astrocaryum* (Palmae) in Amazonia: a preliminary treatment. Bulletin de l'Institut Francais d'Ètudes Andines, Lima 21(2): 459–531.

Mejia, K. 1988. Utilization of palms in eleven Mestizo villages of the Peruvian Amazon (Ucayali River, Department of Loreto). Advances in Economic Botany 6:130–136.

Oberem, U. 1974. Trade and trade goods in the Ecuadorian Montaña. Pages 346–358 *in* P. J. Lyon, ed., Native South Americans: ethnology of the least known continent. Little, Brown and Co., Boston.

Paymal, N., and C. Sosa. 1993. Amazon worlds: peoples and cultures of Ecuador's Amazon region. Sinchi Sacha Foundation, Quito.

Schultes, R. E. 1977. Promising structural fiber palms of the Colombian Amazon. Principes 21:72–82.

Vickers, W. T., and T. Plowman. 1984. Useful plants of the Siona and Secoya Indians of Eastern Ecuador. Fieldiana Botany New Series 15:1–63.

Wheeler, M. A. 1970. Siona use of chambira palm fiber. Economic Botany 24:180–181.