Management of the Spiny Palm *Astrocaryum malybo* in Colombia for the Production of Mats

Néstor García
Departamento de Biología, Facultad de Ciencias, Pontificia Universidad Javeriana, Bogotá, Colombia.
nestor.garcia@javeriana.edu.co

María Claudia Torres,
Rodrigo Bernal,
Gloria Galeano
Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Apartado 7495, Bogotá, Colombia.

Natalia Valderrama
School of Forest Science and Resource Management, Technische Universität München, Am Hochanger 13 D – 85354, Freising, Germany.

AND

Victoria Andrea Barrera
School of Biology, Institute for Research on the Environment and Sustainability, Devonshire Building, University of Newcastle, Newcastle upon Tyne NE1 7RU, UK.

The palm *Astrocaryum malybo*, endemic to Colombia, is the base of an important handicraft industry in some towns of the Caribbean lowlands. We provide information about fiber harvesting and processing and discuss the sustainability of its current management.

In Neotropical ecosystems, rural communities obtain fibers from an enormous variety of wild plants, including a large number of palms (Macía 2006, Linares et al. 2008). In Colombia, for example, about 20% of all fiber-producing species are palms (Linares et al. 2008). In other South American countries, widespread palm fiber extraction has also been documented (Borgtoft Pedersen 1994, Holm Jensen & Balslev 1995, Borgtoft Pedersen 1996, Vormisto 2002, Coomes 2004, Macía 2006, Hubschmann et al. 2007, Kronborg et al. 2008, Isaza 2011).

Fibers are obtained from different parts of palms, such as stems, leaf sheaths, petioles and, more frequently, the unexpanded leaves (Linares et al. 2008, Isaza 2011). They are used for making baskets, bags, hats, hammocks, mats, brooms and furniture. These items are mainly produced for local use, but some of them have gained great commercial value, and in some areas their trade has a strong impact on local communities (Borgtoft Pedersen 1994, Holm Jensen & Balslev 1995, Borgtoft Pedersen 1996, Castaño et al. 2007, Linares et al. 2008, Isaza 2011, Valderrama 2011). For this reason,

1. *Astrocaryum malybo* growing in fallows in Chimichagua, Colombia.

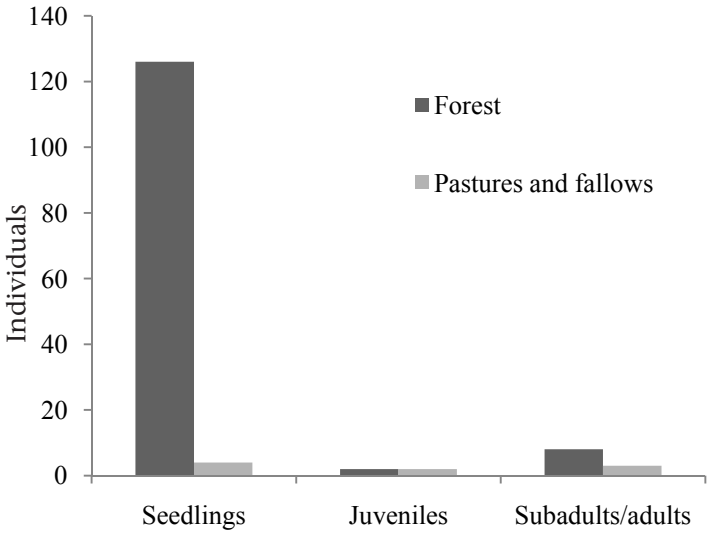
some wild populations of some species have been overexploited and depleted (Castaño et al. 2007, Linares et al. 2008). In other cases, harvest has a low impact, as a result of a low demand, as is the case with *Mauritia flexuosa* L. f., *Mauritiella macroclada* (Burret) Burret, and *Welfia regia* H. Wendl. ex André (Bernal et al. 2011). A more complex scenario occurs when the transformation of ecosystems, especially deforestation for agricultural expansion, causes the reduction of populations, thus increasing the pressure on the surviving palms, modifying traditional harvest practices and causing a greater impact.

A well-known source of palm fibers is the genus *Astrocaryum*. At least 12 species have been reported as fiber-producing plants (Isaza 2011); among these, the most frequently used are *A. chambira* Burret (*chambira*), *A. standleyanum* L.H. Bailey (*mocora* or *güérregue*), and *A. malybo* H. Karst. (*palma estera*) harvested in the Caribbean lowlands of Colombia (Borgtoft Pedersen 1994, Holm Jensen & Balslev 1995, Velásquez 2001, Vormisto 2002, Barrera et al. 2007, Kahn 2008, Linares et al. 2008, Isaza 2011, Valderrama 2011). Fibers from *Astrocaryum* are obtained from the leaflets of the spear leaves. These fibers are processed in two ways: the epidermis of the leaflets is peeled off and twisted to produce strong strings, as in *A. chambira* and *A. standleyanum,* or the leaflet midvein is removed and the whole leaflet blades are used as fiber, as in *A. malybo*. In the last species, which is endemic to Colombia, the leaflets are used to weave mats, an important handicraft industry in some towns of the Caribbean lowlands.

This paper presents information about harvest and processing of *A. malybo* fibers, and discusses the sustainability of its management and the current state of its populations. Data originate from a two year study at the Caribbean lowlands of Colombia, in the towns of Chimichagua and Tamalameque (Cesar), and El Banco (Magdalena), between 8°51′–9°16′N, 72°49′–73°58′W, the area where use of this palm is most important. We studied the state and use of the palm through field observations and interviews with local people; we also considered socioeconomic aspects associated with the use of the fiber and tried to define some bases for its management.

Methods

Study species: *Astrocaryum malybo* is a solitary and usually acaulescent palm, although stems occasionally grow up to 2 m; its leaves reach 5–6 m in length and they are armed with strong spines (Fig. 1). It is a monoecious palm, with female and male flowers in the same inflorescence. Fruits are elliptic or rounded, up to 4 cm long and 2–3 cm in diameter



2. Average number of individuals/ 0.1 ha of seedlings, juveniles and sub-adults/adults (harvested palms) of *Astrocaryum malybo* in secondary forest, and pastures and fallows at Chimichagua, Colombia.

(Henderson et al. 1995, Galeano & Bernal 2010). It is endemic to northwestern Colombia, although it might just reach eastern Panama (Galeano & Bernal 2010); it inhabits wet or dry tropical forests, mainly in the valleys of the Magdalena, San Jorge and Sinú rivers in the Caribbean lowlands, and at the northern end of the Pacific Coast (Galeano & Bernal 2005, Kahn 2008, Linares et al. 2008, Galeano & Bernal 2010). Currently this species is mostly found in small forest fragments, along river margins, or isolated in pastures, due to the deforestation and fragmentation of its natural habitat, especially for agriculture and cattle farming. Natural regeneration is abundant within the forest but limited in pastures, due to the action of cattle. For these reasons, *A. malybo* has been listed as endangered (Galeano & Bernal 2005, Galeano & Bernal 2010).

Field studies: We carried out field observations and interviews to characterize the whole process of *A. malybo*, from harvest to marketing. In order to assess the state of the resource for handicraft use, we established ten 50 × 20 m transects in a patch of secondary forest, and 47 transects in five areas of pastures and fallows. We counted seedlings in plots of 2 × 2 m placed at the beginning, middle and end of each transect. Palms were classified according to their size as: seedlings (first leaf bifid), juveniles (pinnate leaves, leaf length ≤ 2 m), sub-adults (leaf length > 2 m, and suitable for harvesting) and adults (reproductive individuals). In addition, thirty harvested adult palms were followed during one year, in order to determine the spear leaf production rate.

Results

Figure 2 shows the average number of individuals per size classes in 0.1 ha in secondary forest and in pastures and fallows. There were on average eight harvested palms (subadults and adults) in 0.1 ha in secondary forest (range 4–12, n=10) and three in pastures and fallows (range 0–10, n=47) (Fig. 2). In secondary forest, 92.% of the palms were seedlings, 1.4% juveniles, and 5.9% sub-adults and adults, whereas in pastures and fallows 53% were seedlings, 19% juveniles and 28% were subadults and adults.

Based on information obtained from local people and artisans in Chimichagua and Tamalameque, about 158 ha of palm-harboring pastures and fallows and only about 10 ha of secondary forest (several scattered fragments) were harvested in 2009–2010. Although this figure probably underestimates the real abundance of the palm in the area, artisans claim that there is a shortage of the resource. Community inhabitants claim that deforestation and devastation of native vegetation where *Astrocaryum* grows have been a steady activity during the past 15 years.

Harvest: According to artisans, palms can be harvested for the first time when they are 6–8

Table 1. Natural dyes used in *Astrocaryum malybo* mats in Chimichagua, Colombia.

Dye	Color
Jagua (*Genipa americana* L., Rubiaceae)	Blue or green (depending on hour of day)
Bija (*Fridericia chica* (Bonpl.) L.G. Lohmann, Bignoniaceae)	Brown-red
Dividivi (*Caesalpinia coriaria* (Jacq.) Willd., Fabaceae)	Black
Achiote (*Bixa orellana* L., Bixaceae)	Orange-red
Totumo (*Crescentia cujete* L., Bignoniaceae)	Green
Sangregao (*Croton* sp., Euphorbiaceae)	Red
Calostrodiendro (*Cochlospermum vitifolium* (Willd.) Spreng., Bixaceae)	Pale yellow
Uva playera (*Coccoloba uvifera* (L.) L., Polygonaceae)	Purple
Majuagüito (*Senna reticulata* (Willd.) H.S. Irwin & Barneby, Fabaceae)	Pale-green
Mango (*Mangifera indica* L., Anacardiaceae)	Gray
Tuy (*Vismia baccifera* (L.) Planch. & Triana, Hypericaceae)	Terracotta
Peralejo (Byrsonima crassifolia (L.) Kunth, Malpighiaceae)	Pink
Mud	Pale brown
Bija + *sangregao*	Red
Bija + mud	Brown
Dividivi + *achiote*	Orange
Dividivi + ash	Mustard
Majuagüito + lemon (*Citrus limon* (L.) Burm. f., Rutaceae)	Pale yellow
Mud + *bija*	Black

years old and have leaves reaching ca. 2–3 m long. This age estimation, however, may underestimate the duration of the establishing phase, and needs additional long term studies. Harvested palms growing in secondary forest had on average 12 leaves (X=11.57, sd=2.06), 4.7 m long (X=4.68, sd=0.75), and produced three spear leaves/year (X=3.09, sd=0.31). Spear leaves are selected based on their size (≥2 m) and degree of maturity (when they start to expand at the tip and the pinnae are yellow). When the pinnae turn green, the spear leaves are too old to be collected and are useless as a fiber source. Harvesters usually beat the spear leaves to check if the leaflets are loose, indicating that they are ready for harvest. A long wooden hook is used to pull the spear leaves, since *A. malybo* has abundant sharp spines up to 20 cm long. When mature leaves are tightly packed and do not allow easy access to the spear leaf, they are bent or sometimes are cut, causing an extra damage to the palm.

Once the spear leaf is held in one hand, the middle leaflets (measuring up to 1.2 m long) are striped off with the other hand (Fig. 3A). About 100 pairs of leaflets are obtained from a spear leaf, depending on its size. The artisans try to reduce damage by leaving the leaf in its original position and not removing the basal and apical leaflets. In practice, some spear leaves break in the process and eventually die, but most of them survive and continue their natural cycle. It is common to find palms with healthy and fully expanded leaves showing evidence of this kind of selective harvest (Fig. 3B). Occasionally harvesters cut the spear leaf in order to manipulate it in a more comfortable place, to avoid the hazard of being hurt by the spines.

Some artisans believe that it is not appropriate to harvest during the days around full moon, perhaps because a higher water content could make the fiber more vulnerable to pests. However, in practice harvesters and artisans usually collect the spear leaves from the palm at any time, regardless of the moon phase.

To reach the areas where the palm populations are located, artisans need to walk during 15–60

3. Harvesting and processing spear leaves of *Astrocaryum malybo* in Colombia. A. Artisan harvesting spear leaves. B. Palm showing a leaf that was harvested and survives with only some leaflets. C. Artisan processing leaflets. D. Leaflets drying under the sun.

min. They start their journey early in the morning and finish by noon if they find enough material. An experienced artisan harvests up to 20–25 spear leaves per hour, thus obtaining 1.5–2 bundles of leaflets, which are equivalent to an average of 5 kg of dry fiber. Processing fibers is a family activity and includes: removing the spiny margins and the

midribs, splitting each blade longitudinally in two halves, and hanging them to dry under the sun for 3 or 4 hours (Fig. 3C). Spiny margins are thrown away, and midribs are used to make brooms. Leaflets roll up while drying, becoming a rigid material called fiber by artisans. Finally, fibers are left under the sun during some hours every day for at least 2 or 3 days (Fig. 3D).

Craft process: Making mats from *A. malybo* fiber is an ancient tradition, which probably originated from Indians that inhabited the Caribbean region (Andrade 2004), most likely the Chimilas. Although knowledge about fiber use is still preserved among rural inhabitants, only in the south of the departments of Cesar and Magdalena, it has become an economically important activity (Linares et al. 2008). Two types of mats are recognized: traditional and modern mats. Traditional mats, called *petates*, are woven with simple designs, using few colors, and mixing fibers obtained from spear leaves of another palm (*Elaeis oleifera* (Kunth) Cortés, known as *nolí* or *corozo*); among artisans and tourists, traditional mats are little appreciated, resulting in a restricted production and market.

Modern mats, on the contrary, are in great demand, have higher prices, and according to artisans, are more profitable. To a large extent, the great variety of designs in modern mats (Fig. 4) relies on the dyeing process using natural or artificial colors (Table 1). Natural colors are obtained from plants cultivated at home gardens or from wild plants growing in nearby fields or forests. Artisans have been using natural colors since the 1980 s, when they were qualified in this activity as an alternative to improve mat trade.

The first step to make a mat is to build a loom. The loom consists in a wooden frame, frequently made with wood of *lengua de vaca* (*Mabea occidentalis* Benth., Euphorbiaceae), to which two short and sturdy sticks (*balsas*) are tied. The latter support the warp, which is made with polypropylene strings or sometimes with *fique* (*Furcraea cabuya* Trel., Agavaceae) strings. The loom is made depending on the mat size, which is usually up to 1.2–1.5 m tall. After the mat is finished, the loom is dismantled, ant its pieces are put aside for next time.

Before being used, fibers are moistened to prevent breakage. Two aspects determine mat quality: type of weaving, and final touches. High quality mats are considered to be those in which the warp is not easily visible, have no knots or loose ends, the colors are uniform, and the designs are symmetric and sharp. The mat must also be firm, which is proved by rolling it up and standing it on end so that it stays upright. Although mats are made in many sizes, the most common ones are those between 1–2 m^2, that is, small and medium sized mats. Occasionally large mats up 18 m^2 are also made, as well as table mats, coasters and other small handicrafts (Fig. 4A, B).

Productive chain and exploitation of the palm as a source of income: Traditionally, mats were used like utilitarian objects, and their trade was restricted to local markets. They had simple designs and low prices. However, in the last decade, under the auspice of Artesanías de Colombia (the state's firm promoting handicraft production and marketing), Corpocesar (the regional environmental authority) and some NGOs, mats have been promoted as handicrafts with great economic value. Today there is a large demand of *Astrocaryum* mats for the markets of Bogotá, Medellín and other cities. A significant evolution in their design has taken place as a consequence, including geometric figures and plenty of color (Figs. 4A, B).

Artisans usually collect their own raw material. Some harvesters collect the fiber for artisans within their own family or sell it to others. The palms are usually harvested in private lands, with or without permission of the owners, because most of the harvesters are landless peasants or they merely own small plots just large enough for subsistence crops. Although mat-weaving takes place throughout most of the year and incomes are significant, mat production is only a part-time occupation alternated with other economic activities.

In the department of Cesar there are two centers of mat production. The most important one is Chimichagua, where there are seven organizations comprising almost 200 artisans, especially women. The other center is Tamalameque, where there is one organization comprising about 10 artisans. In the department of Magdalena, the activity with *Astrocaryum* is limited to the municipality of El Banco, especially in the village of Hatillo de La Sabana.

At Hatillo de La Sabana, most families harvest the fibers from wild populations close to the village in order to sell them to traders or to artisans in other towns, but they do not produce mats by themselves anymore.

Apparently, they formerly wove traditional mats, but the business became unprofitable and disappeared. In August 2009, processed fibers were sold for US$0.5 per kg, and brooms made from the midribs, were sold for US$0.5–0.7. Incomes from fiber harvesting and processing were limited and sporadic; therefore, families worked on other activities like fishing or agriculture.

In Chimichagua and Tamalameque most artisans make the whole process from harvesting to weaving. Only elderly or unhealthy artisans, who cannot extract fibers, buy spear leaves from other artisans. Prices in this region are similar to those at Hatillo de La Sabana. Mat weaving is a female activity involving all women in a family, including grandmothers. Although weaving is taught by oral tradition among members of a family, formal training of youths has been promoted recently.

A spear leaf yields ca. 60–310 g of dry fiber (X=184, sd=68), depending on its size. A 1 m^2 mat requires ca. 1.4 kg of fiber, which is obtained from 5–11 spear leaves, and a woman spends about 12 hours to weave it. In August 2009 such a mat was sold in Chimichagua for US$ 13–36. In the highest-selling season, a woman wove mats for up to18 days per month and earned US$ 175–437. Minimum wage in Colombia was US$ 257/month in 2009. Incomes are much lower for artisans producing exclusively traditional mats, which are sold for US$ 5–6 per m^2.

Mat marketing fluctuates throughout the year. Three major selling seasons are recognized: first, March to May, centered around Easter holidays and other festivals such as the Festival de la Leyenda Vallenata, a traditional musical event celebrated in Valledupar (Cesar), the state's capital; second, June to July, due to local and regional festivities; and finally, the most important selling season is during Expoartesanías, an international crafts fair, and the country's largest one, which takes place in December in Bogotá. Participation of artisans in these and other fairs is facilitated by their formal organization in associations. These associations also allow them to reach agreements with specialized stores in Colombia or in other countries, like the United States.

Impact of harvesting and conservation: According to our field observations, fiber exploitation can be sustainable, due to the widespread practice of harvesting only the central leaflets, without cutting the spear leaves or otherwise affecting the palm (Fig. 3B). The origin of this harvesting technique is not clear, but it seems to be an old practice, which otherwise has no precedent in South American palm management (Bernal et al. 2011). In recent years, environmental authorities have encouraged the use of this interesting management practice. Another management practice used by harvesters is to leave two or three unharvested spear leaves between two harvested ones. Apparently, this practice is carried out regularly, as evidenced by the harvested leaves that can be easily identified in the palms. Although some artisans claim that there is a shortage of spear leaves, the fact is that in frequently harvested places it is possible to find palms with all their leaves in good condition, and palms with one, two, or rarely three leaves with signs of harvest. Extraction intensity appears to be reasonable and does not pose an additional threat to *A. malybo* in this region.

The main threat to the populations of *A. malybo* is not harvest, but habitat depletion, since more than 90% of the original forest where the palm used to grow has disappeared (CORPAMAG 2011). Artisans are really concerned about the devastation of the forest where the palm grows. Some land owners even cut down palms to prevent the entrance of harvesters to their farms. On the other hand, some owners are probably aware of the importance of the palm and preserve it on their land to provide raw material for family members.

In terms of habitat, our observations showed that although palms that grow in pastures and fallows are currently an important source of fiber for craft activity, they do not have chances to regenerate, because their seeds often do not germinate and their seedlings and juveniles do not survive. This is the reason of the great disparity in population structure between forest and pasture (Fig. 2). While in secondary forest there are palms of all ages, especially seedlings, in pastures there are just a few seedlings, sub-adults and adults. The latter are palms that have survived deforestation; they are hardy and often tolerate grazing and fire. In view of this situation, palm conservation depends on populations that are growing in secondary forest, which, however, are also being affected by cattle and deforestation. The effective conservation of *A. malybo* requires the establishment of protected areas and the implementation of measures to prevent cattle from entering forest remnants.

4. Mat woven from *Astrocaryum malybo* in Colombia. A–B. Mats.

Artisan associations are interested in growing the palm in their own lands. Initially, 13 ha of land were given by the municipality of Chimichagua to four artisan associations to cultivate the palm (Barrera et al. 2007), but currently only 2 ha are in use. Cultivation attempts in this area have been a valuable experience for the artisans. For example, noticing the high mortality rate of seedlings in pastures, they have explored what they regard as a better scheme – combining the palm with various crops in different strata, like staple crops and plants used to dye the fiber. With this practice they can keep the area clean of weeds, create hedges to avoid the entrance of neighboring cattle and get some cash income until the palm is ready to be harvested.

Conclusions and recommendations

Although harvesting *Astrocaryum malybo* fibers for handicraft production could potentially reduce growth and eventually decrease population, this impact is low in comparison with the devastation and pressure that the species undergoes as a result of deforestation and land clearing for cattle farming. Actually, the sustainable use of *A. malybo* might be considered as a conservation strategy, not just for this particular species, but for the entire ecosystem. Considering the economic value of the spear leaves, conserving the palm is a relevant issue for land owners. Palms species that are deemed useless are often destroyed by land owners (Bernal et al. 2011). Moreover, the craft activity is an ancient tradition with great cultural and social value and its preservation will help to conserve the regional identity.

Strategies to conserve the palm must be focused on banning palm destruction, and on the enrichment of the lands where the palm grows. Improvement of the artisanal work is also important. If this occupation provides greater income to local communities, conservation policies will find more support. Although estimates of supply and demand of raw material are still rough, the resource will probably become scarce in the near future if the current trends do not change. For this reason, projects encouraging artisanal work must focus on increasing the commercial value of the final product, looking for more attractive designs and more diverse products and improving access to markets. This is a better alternative than increasing the volume of low-quality products, which would cause a higher demand of the resource, with a negative impact on the palm.

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Validation of Laccospadicinae (Arecaceae: Areceae)

John Dransfield[1], Natalie W. Uhl[2], Conny B. Asmussen[3], William J. Baker[1], Madeline Harley[1] and Carl E. Lewis[4].

[1]Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AE, UK
[2]L.H. Bailey Hortorium, Cornell University, Ithaca, NY14853, USA
[3]Dept of Ecology, Royal Veterinary and Agricultural University, Roleghedsvej 21DK1958 Friederiksberg C, Denmark
[4]Fairchild Tropical Botanical Garden, 11935 Old Cutler Road, Miami, FL 33156, USA

Laccospadicinae (Arecaceae: Areceae) is published to replace the illegitimate name Linospadicinae.

In our paper on the suprageneric classification of palms (Arecaceae) (Dransfield et al. 2005) and in the second edition of *Genera Palmarum* (Dransfield et al. 2008) we accepted Linospadiceae Hook. f. in Bentham and Hooker's *Genera Plantarum* 3: 872, 876. (1883), corrected to Linospadicinae, explicitly published at subtribal level, as the name for the subtribe that includes four genera of Areceae – *Linospadix* H. Wendl., *Calyptrocalyx* Blume, *Howea* Becc. and *Laccospadix* Drude & H. Wendl. This subtribe had also been accepted in the first edition of *Genera Palmarum* (Uhl & Dransfield 1987). However, we overlooked the fact that *Linospadix* Becc. (non *Linospadix* H. Wendl.) on which the subtribal name is typified is not legitimate because it was published later than Wendland's name and lectotypified on *Linospadix arfakianus*, now included in *Calyptrocalyx*. As a result the subtribal name Linospadicinae based upon it is also not legitimate. Thus, a new name for this subtribe is required and Laccospadicinae is proposed here.

Laccospadicinae J. Dransf., N.W. Uhl, C. Asmussen, W.J. Baker, M.M. Harley & C. Lewis, nom. nov. Typus: *Laccospadix* Drude & H. Wendl.

Linospadicinae Hook. f. in Benth. & Hook. f., Gen. pl. 3: 872, 876 (1883) ('Linospadiceae') (nom. illeg.). Type: *Linospadix* Becc. ex Hook. f. in Benth. & Hook. f., Gen. pl. 3: 903 (1883) (non H.Wendl. 1875).

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