Principes, 40(1), 1996, pp. 16–23

Natural History and Uses of Tagua (Phytelephas seemannii) in Panamá

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Seeds of palms from the subfamily Phytelephantoideae were among the principal forest products of northwestern South America and Panamá at the turn of the century. These seeds, known as "tagua" in Latin America, were of comparable importance to cacao, rubber, cinchona, and balsa as export commodities (Acosta Solís 1944; Barfod 1989; Barfod 1991b; Bernal 1992). From the mid-19th century to the early 20th century, tagua was primarily used as a raw material in the manufacture of buttons. Following World War II, tagua, or "vegetable ivory" as it was known in the United States, was replaced by synthetic materials and its exploitation was greatly diminished in Ecuador and Colombia, and extraction essentially ceased in Panamá (Acosta Solís 1944; Barfod 1989, 1991b).

The economic importance of South American and Panamanian tagua is again on the rise. In South America, the increase is largely due to demand from foreign clothing manufacturers, although some Ecuadoran and Colombian tagua is carved into figurines, chessmen, and keyrings (Barfod et al. 1990). In contrast, all Panamanian tagua is carved into figurines and jewelry for sale to tourists within Panamá. This domestic market has developed rapidly during the last 10 years.

In this paper we briefly describe the natural history, distribution, and uses of Panamá's tagua palm, *Phytelephas seemannii*, in Panamá. We wish to highlight differences between the tagua-producing palm of Panamá, *P. seemannii*, and the main tagua species of Ecuador, *P. aequatorialis*. Anders Barfod and colleagues (Barfod 1989, 1991b; Barfod et al. 1990; Borgtoft Pedersen 1993) have written excellent overviews on the history and current status of tagua use in South America, especially Ecuador. We wish to compare and contrast the biology and uses of *P. seemannii* in Panamá with the Ecuadoran endemic *P. aequatorialis*. We also wish to emphasize the current lack of demographic data from which to make sound sustainable management decisions for the harvest of wild tagua in Panamá. It is unknown to what extent many demographic and life-history parameters can be extrapolated from the better studied *P. aequatorialis*. Finally, we address the status of *P. seemannii* within the Darién National Park and the future prospects of tagua as a non-timber forest product in Panamá.

Natural History

Although several species of phytelephantoid palm are utilized in Panamá and South America, the only species found in Panamá is *Phytelephas seemannii*, where two subspecies are recognized (Barfod 1991a). All phytelephantoid palms are dioecious (Barfod 1991a). Little is known of the pollination biology of this group of palms, although cantharophily has been suggested to be important (Henderson 1986; Barfod et al. 1987; Ervik 1993).

P. seemannii can be reproductive in sub-caulescent form, and as a fully mature tree has a trunk generally less than 1 m in height (Fig. 1), although Barfod (1991a) reports that some may attain trunk heights of 4 m. In contrast, Barfod et al. (1990) report that *P. aequatorialis* (formerly referred to as *Palandra aequatorialis*) can attain a height of 15 m. During the peak pre-WWII exploitation of tagua, many *P. aequatorialis* individuals in Ecuador were cut down in order to harvest their mature seeds (Acosta Solís 1944). Since trunks of *P. seemannii* generally do not reach >2 m in height, the palm is never sacrificed in order to collect seeds. Julie Velásquez (pers. comm.) informs us that *P. aequatorialis* is also currently not harvested by felling.

1. *Phytelephas seemannii* growing along a stream near the Cerro Pirre station of the Darién National Park, Panamá. Photo by Kyle E. Harms.

Fruits of *P. seemannii* are found in large club-shaped infructescences borne on interfoliar stalks that project from between the leaf bases and are usually less than 0.5 m above the ground (Fig. 2). The coarsely-spined infructescences consist of several fruits, each of which contains an average of 5 seeds. A single infructescence can contain up to 8 fruits and, therefore, 40 seeds. In the Darién, we found palms with over a dozen infructescences developing simultaneously. Individuals of *P. aequatorialis* may have >40 infructescences at any one time (Julie Velásquez, pers. comm.). Seeds of both *P. seemannii* and *P. aequatorialis* are initially protected from seed-predators by the thick (ca. 1 cm), fibrous fruit wall.

During early development, seeds contain a liquid endosperm similar to coconut. As the seeds ripen, the endosperm progressively hardens, until at full seed maturation the fruit wall softens and eventually disintegrates. At this point the seeds become accessible to foraging rodents, since the infructescences are near the ground, or seeds simply spill onto the ground. Members of Wounaan and Embera villages in the Darién told us that squirrels and agoutis have been seen feeding on the fleshy inner mesocarp surrounding the endocarp, but are unable to consume the rock-hard endosperm.

Unlike other large-seeded palms in Panamá, *P. seemannii* appears to be impenetrable to native insect pests. Seeds of two large-seeded, often co-occurring palms, *Scheelea zonensis* and *Astrocaryum standleyanum*, are routinely infested by larvae of beetles from the family Bruchidae (Wright 1983, 1990; Smythe 1989). We have been unable to locate reports—even anecdoctal reports—of insect damage specifically to seeds of *P. seemannii*. However, given the limited quantity of published information on the natural history and ecology of *P. seemannii* we cannot rule out the possibility that *P. seemannii* is host to insect pests. Acosta Solís (1944) reported that the larvae of a coleopteran attack seeds of *P. aequatorialis*. Bright (1981) reported that *Coccotrypes dactyliperda* (Scolytidae) has been collected from seeds of a species of *Phytelephas*, although this scolytid is

2. Infructescence from *Phytelephas seemannii* growing along the same stream as in Fig. 1. Photo by Kyle E. Harms.

an insect introduced to the Americas with date palms (Wood 1982). Johnson et al. (1995) report a collection of a bruchid beetle (Bruchidae) from seeds of a species of *Phytelephas*. The previous two reports did not identify the palm to the species-level. Finally, Borgtoft-Pedersen (1993, 1995) reports that a bruchid beetle, *Caryoborus chiriquensis*, is a serious seed-predator on *P. aequatorialis* in parts of that palm's range.

Given the apparent absence of insect seed predators, and the inability of rodents to consume the mature endosperm, *P. seemannii* seeds appear to be able to survive and germinate even beneath the crown of the maternal parent (see below and Table 1). Nonetheless, seeds have been observed to be dispersed by agoutis, *Dasyprocta punctata*, (N. Smythe, pers. comm.) and by paca, *Agouti paca* (Zona and Henderson 1989). Furthermore, seedlings can be found up to 20 m from the nearest adult (JWD, KEH, and JRE, unpublished data).

Table 1. Demographic data for P. seemannii *along two, 10-m wide, 0.8-km long transects. Transect I follows the Río Perresénico upstream from Estación Pirre. Transect II follows the Cerro Pirre ridge trail, beginning c. 100 m up the trail, at the point where it joins the ridge crest. Seedling, Sapling, Trunked, and Trunkless categories are defined in the text. Under and Away refer to whether or not an individual seedling or sapling was found beneath or beyond, respectively, the crown of a trunked individual.*

	Seedling Under	Sapling Under	Seedling Away	Sapling Away	Trunkless with fruit	Trunked with fruit	Trunkless w/o fruit	Trunked w/o fruit
Transect I	9	16	9	77	1	7	24	23
Transect II	0	1	0	27	0	0	10	3

Although seeds of *P. seemannii* do not float in water, moving water for riverine individuals, and gravity for individuals found on slopes are also likely agents of seed dispersal.

Distribution of P. seemannii in Panamá

P. seemannii appears to be widely distributed along the Atlantic coast of Panamá. It has been reported from Bocas del Toro, the Santa Rita Ridge (eastern side of the Panamá Canal), Kuna Yala and Darién Province (see Barfod 1991a for further information). Within its range in central Darién, however, *P. seemannii* appears to be restricted to sub-montane sites around the fringes of the cordillera, and is most abundant along stream margins and flood terraces. The absence of *P. seemannii* from the low-lying "bajos" of central Darién appears to be due to habitat requirements rather than historical over-exploitation. Barfod (1991a) also suggests that *P. seemannii* does not extend beyond 1,000 m in elevation.

P. seemannii is also found in the Chocó region of Colombia where it is currently under investigation by Rodrigo Bernal of La Universidad Nacional in Bogotá (pers. comm.)

Demographic Data for Estación Pirre, Darién

In July of 1994 we censused all *P. seemannii* within two, 10-m wide, 0.8-km long transects near the Estación Pirre at the edge of the Darién National Park. One transect was located along the flood terrace of the Río Perresénico, and the other transect ran along lower elevations of the ridge-top trail to Cerro Pirre. Individual palms were classified as seedlings (<0.5 m height), saplings (>0.5 m, but <2 m height), trunkless (>2 m height, but without a trunk), and trunked (>2 m with trunks). In the case of reproductive females, we recorded the number of infructescences and fruits per infructescence.

Demographic data for these populations is summarized in Table 1. A total of 166 individuals were found along the river transect, and 41 individuals within the ridge-top transect. Approximately one-third of the individuals were potentially reproductive (>2 m height); this apparently high proportion of reproductive individuals could indicate either low levels of recruitment and/or high survivorship of mature individuals, assuming a stable population. Of reproductive-sized individuals, 11% bore fruit, though we have no information on the proportion of female trees that were reproductive. No male trees were in flower at the time of the census. Nineteen percent of seedlings and saplings were found directly beneath the crown of adults (i.e., within 3 m of the base of the trunk).

Exploitation of P. seemannii in Panamá

Barfod (1991a) briefly described the uses of *P. seemannii* to be: seed exports of Panamá and Colombia before WWII and, currently, handicrafts from the hard endosperm from a few factories located in Colombia. The current uses of *P. seemannii* in Panamá are summarized below.

There are three principal uses of *P. seemannii* in Panamá: food, thatch, and seeds for carving. The liquid endosperm of the immature seeds is consumed as a beverage by Wounaan and Emberá peoples. Duke (1986) reports that, "the thin crust around the ivory is occasionally brought into the market in San Blas as a food." This "thin crust" is the inner mesocarp, which is also consumed from South American species of *Phytelephas* (Barfod 1991b). Leaves of *P. seemannii* are cut for roofing thatch by rural and indigenous (Wounaan and Emberá) Panamanians (Fig. 3). Mature seeds are carved primarily by Wounaan craftsmen. Carving of seeds ("tagua") appears to have developed recently in Panamá, and was stimulated by the suggestion of Dr. John Cubit while at the Smithsonian Tropical Research Institute (J. Cubit, pers. comm.; G. Membache, pers. comm.). Adoption of tagua as a carving material, primarily by the Wounaan, apparently is derived from a historic tradition of carving the wood of Balsa (*Ochroma spp.*), "Caoba" (Mahogany, *Swietenia macrophylla*), and "Cedro" (*Cedrela spp.*) (Torres de Araúz 1975), and more recently "Cocobolo" (Rosewood, a species of *Dalbergia*).

In August of 1994, we visited the Wounnaan village of Vista Alegre, approximately one and a half hours by motorized "piragua" (dug-out canoe) upstream of El Real on the Río Tuira (Fig. 4). Within this community of 100 people, the income from agriculture, fishing, and hunting is supplemented by basket weaving and carving. In 1989 craftsmen switched from carving rosewood to predominantly carving tagua.

The village of Vista Alegre appears to lie outside the natural range of *P. seemannii*. Although the

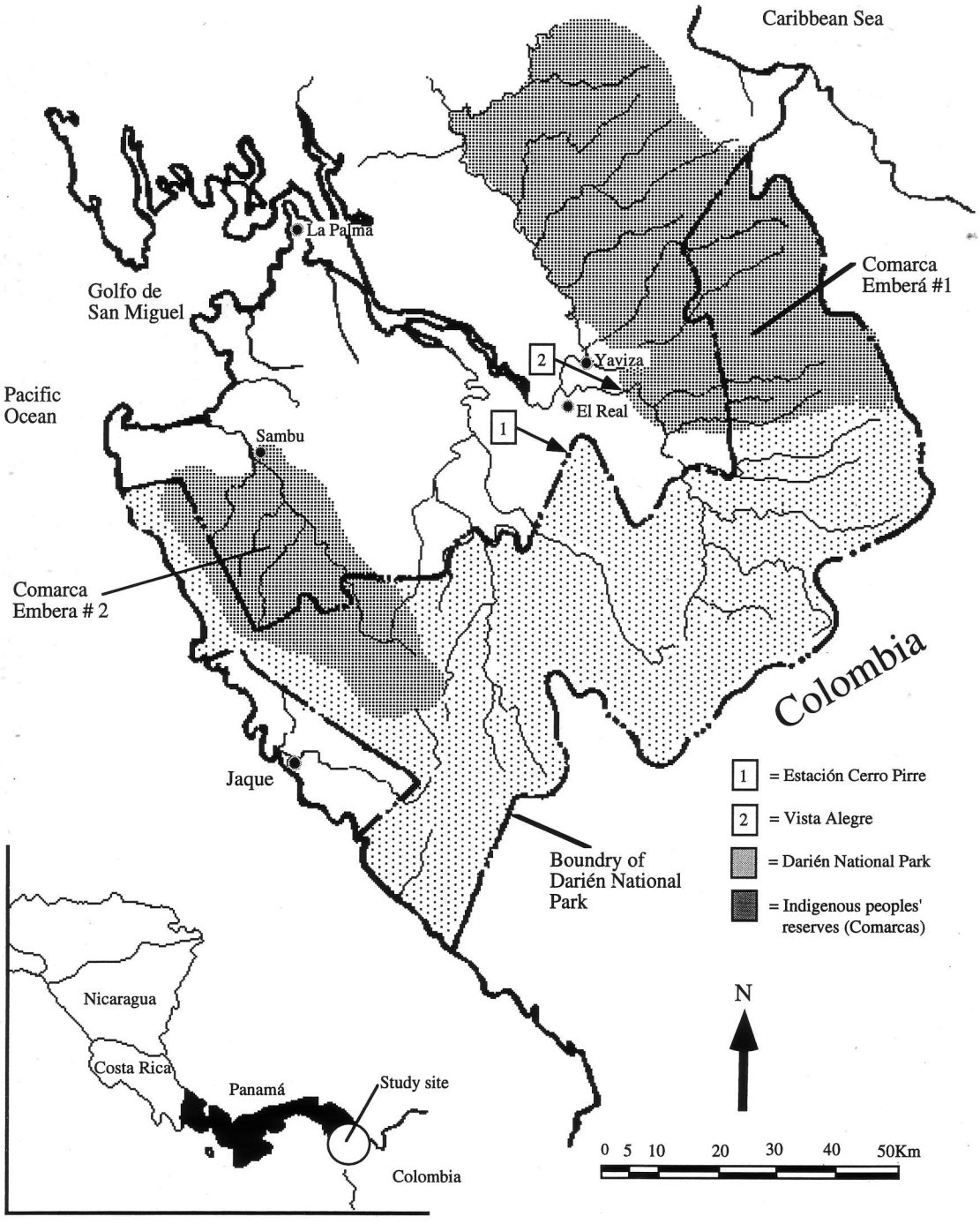
3. *Phytelephas seemannii* from which leaves have been harvested for thatch; found just inside the boundary of the Darién National Park, Panamá. Photo by Kyle E. Harms.

lands surrounding this community have now been converted to agriculture it was the impression of the older villagers that tagua had never grown in the immediate area. Instead, tagua is collected approximately 30 km away within the Darién National Park and within the cordillera of Cerro Pirre. Collection trips by villagers take five days and are made at intervals of approximately three months; each craftsman collects about 80 seeds per trip. There are currently six craftsmen and several apprentices carving tagua in Vista Alegre; the annual production of tagua carvings for this community is therefore approximately 2,000 finished pieces, each made from a single seed.

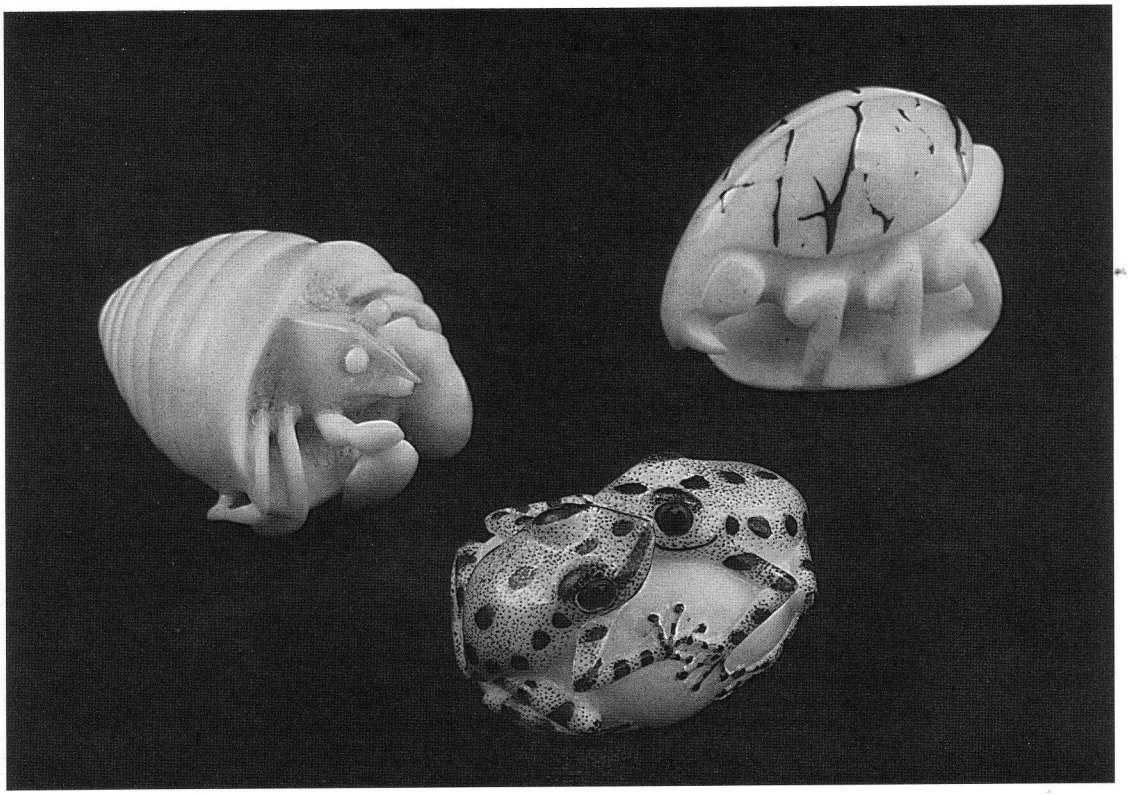
Tagua is generally carved into animal forms (Fig. 5), with each piece taking between one and three days to complete. The initial carving is made with scalpels and small chisels, and is subsequently smoothed using sandpaper and dentists' silicone powder. Seeds are often soaked in water prior to carving, which softens the endosperm. Some nuts are painted on or drawn on using India ink ("tinta china"). Individual pieces of tagua carvings sell in Panamá City for between $10 and $40 U.S.

Future of P. seemannii exploitation in Panamá

One primary objective of this paper is to highlight the scarcity of information on the natural history, regeneration, and exploitation of *P. seemannii*, and its implications for the sustainable management of this species. As yet, no estimate exists for current tagua production in Panamá; however, at any one time approximately 1,000–2,000 pieces are on sale in Panama City; an additional, unknown number may be directly exported from Panamá. The sustainability of tagua exploitation in Panamá is a matter of concern for several reasons. First, *P. seemannii* appears to have a restricted range within the Darién, and many communities in that part of the country are dependent on seeds extracted from populations within the Darién National Park. Second, tagua



4. Map of the Darién, Panamá.



5. Figures carved from tagua. Photo by Marcos A. Guerra.

nuts of the related species, *P. aequatorialis*, take between four and seven years to mature (Borgtoft Pedersen 1993). It seems unlikely that seed maturation times for *P. seemannii* would be much different, and actual per annum fruit production from the population we investigated would therefore be quite low. Finally, if the market for carved tagua continues to increase, e.g., as Barfod et al. (1990) predicted for Ecuadorian tagua, the pressure on existing exploited *P. seemannii* populations will increase.

At present, populations of *P. seemannii* that we have observed at the edge of the Darién National Park do not appear to be suffering from overexploitation (seedlings were abundant, and mature seeds were found scattered around several trees); this may in part be due to a responsible ethic by the tagua craftsmen towards their resource, and in part due to the short number of years during which tagua has been carved in Panamá.

P. seemannii is not yet cultivated or actively managed in Panamá, in contrast to the Ecuador situation, where *P. aequatorialis* once was, and may be still, found as part of small-scale agroforestry plots (Barfod et al. 1990). *Aphandra natalia* (also a phytelephantoid palm) has been planted successfully in plantations in Ecuador (Barfod 1991b). The time is ripe for agroforesty projects in the Darién to incorporate *P. seemannii*.

At this stage we strongly advocate detailed, long-term field studies of the production and demographic parameters of *P. seemannii* (e.g., population densities, growth rates, sex-ratios, seed maturation times, and duration of seed dormancy[1]). Such work will complement recent investigations by R. Bernal on *P. seemannii* in Colombia. These studies will also be of value in allowing comparisons to be made with *P. aequatorialis* in Ecuador, recently under investigation by Borgtoft Pedersen (1993) and currently under investigation by Julie Velásquez in collaboration with the Tagua Initiative of the Ecuadorian Foundation for Socio-Environmental Training, Research, and Development

[1] We would especially appreciate information from readers with *P. seemannii* in cultivation, and who might have information on some of these parameters.

(CIDESA) and Conservation International (C.I.) (J. Velásquez, pers. comm.). Without this information, the sustainability of harvesting regimes from wild populations cannot be assessed. Furthermore, *P. seemannii* should probably be brought into cultivation sooner rather than later. The short stature of this palm, and the consequent ease with which both fruits and thatch can be harvested make it suitable for establishment as the understory component of a small-scale, multi-purpose plantation or agroforesty system, perhaps incorporating an overstory of the hardwood tree species also utilized by craftsmen (e.g., *Dalbergia*). Borgtoft Pedersen (1993) has shown that a heavy overstory reduces growth and fruit yield and that leaf harvest reduces seed production in *P. aequatorialis*. If the same is true for *P. seemannii*, care must be taken to insure sufficient light levels in an understory overtopped by *Dalbergia*. Once the palms have reached reproductive size, females could be retained for fruit production, while the majority of male palms could provide the principal source of thatch, taking care not to overharvest leaves on female or male individuals.

Acknowledgments

We thank George Angehr and Stanley Heckadon for advice and encouragement during the early stages of this investigation, and Oxford Scientific Films for financial support. Gómez Membache and the community of Vista Alegre, Agustín Zuñiga and Meyo Dogiramá kindly provided information on the natural history and uses of tagua. We also thank Anders Barfod, Rodrigo Bernal, John Cubit, Dan Johnson, Enrique Ortíz, Julie Velásquez, and Stephen Wood for providing further information and suggestions. Finally, thanks to the staff of INRENARE for logistic support and access to the Darién National Park.

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