Preliminary Observations on the Stem Enlargement of *Colpothrinax wrightii*, the Cuban Belly Palm

Katiuska Izquierdo Medero
Estación de Monitoreo y Análisis Ambiental Sandino, ECOVIDA,
Km 4½ Carretera a La Fe, Sandino, Pinar del Río, Cuba
kizquierdomedero@gmail.com

The results of an analysis of stem diameter and height in mature individuals of *Colpothrinax wrightii* are presented. The study was carried out in the localities of Sabanalamar, Santa Teresa and San Ubaldo, which are part of the San Ubaldo-Sabanalamar Floristic Management Reserve in Cuba. Reproductive adults were found to possess larger bellies than non-reproductive adults.

A characteristic of some palms is to form extensive colonies, which are well known in Latin America as *palmares* (Capote & Berazaín 1984). The Cuban Belly Palm, *Colpothrinax wrightii* Griseb. & H. Wendl. ex Voss., is an endemic species from Pinar del Río and Isla de la Juventud, Cuba, that grows on white sands and slates (Borhidi 1981).This species is classified as endangered (EN: B2abc) by IUCN, in light of the drastic decrease in population size as a result of over-exploitation and indiscriminate use (Peña et al. 1998).

A significant feature of this species is the conspicuous belly that characterizes the mature individuals. Controversy exists regarding the cause and function of the belly. Many botanists have tried to give an explanation to these questions and much speculation exists. This paper presents a hypothesis to explain the appearance of the belly in the life of this palm.

Materials and Methods

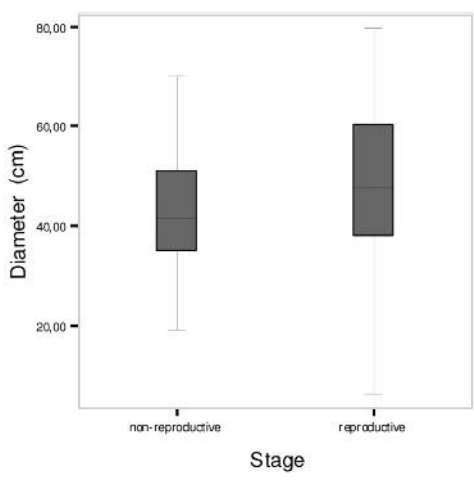
The study localities are Sabanalamar, Santa Teresa and San Ubaldo that are part of the San Ubaldo-Sabanalamar Floristic Management Reserve, Pinar del Río, Cuba. The vegetation forms three well-defined communities: sandy savanna with *Pinus*, herbaceous marsh and fresh water aquatic communities. The tree

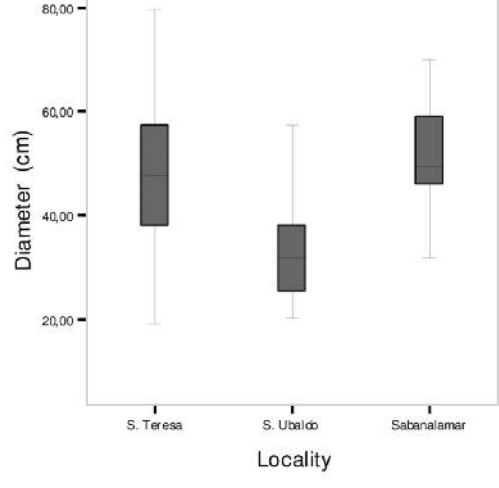
1 (left). *Colpothrinax wrightii*, reproductive adult. 2 (right). Non-reproductive adult.

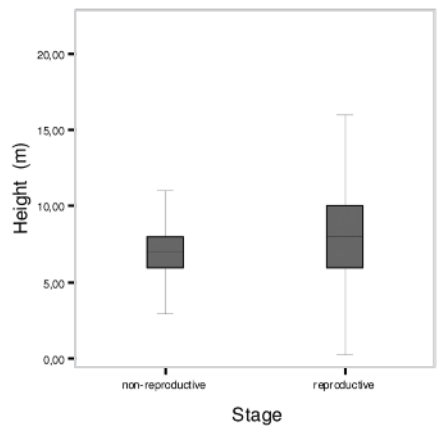
stratum is composed of pines and palms (*Pinus tropicalis* and *P. caribaea*), oak (*Quercus oleoides*) and *Colpothrinax wrightii*, among other species of palms. The shrub stratum is richer in species. Representative genera are: *Byrsonima*, *Lyonia*, *Ouratea* and *Hypericum*. The herbaceous understory is the richest, with numerous characteristic species and endemics. Typical families include Xyridaceae, Eriocaulaceae, Haemodoraceae, Cistaceae, as well as the insectivorous Lentibulariaceae and Droseraceae.

Within each area, palms were sampled along transects every 400 m. Each transect was traced starting from the border of each locality and extended until no more palms were present. Twenty linear transects were made (5 in Sabanalamar, 9 in Santa Teresa and 6 in San Ubaldo), and all palms within 5 m of each side

3 (left). Statistical analysis of the stem diameter and reproductive status. 4 (right). Statistical analysis of the stem diameter and locality. Means are statistically different to the 0.05 level in both diagrams.







5. Analysis of plant height by growth stages.

of the line were examined. The diameter of the stem of *Colpothrinax wrightii* was measured in adults, which were assigned to one of two classes – reproductive adults (belly stems, with inflorescences; Fig. 1), non-reproductive adults (belly stems, without inflorescences; Fig. 2). Juveniles (no belly stems, no inflorescences) were ignored. No palms were found having inflorescences but not bellies. The diameter was measured with a metric tape, at the level of the widest part of the belly. The height of the individuals was measured with a metric tape or with a 10 m graduated rod.

Statistical analysis: The analyses were carried out using SPSS vers. 15.0. Height and diameter data for both of the reproductive stages were tested for normality using a Kolmogorov-Smirnov test and a Lilliefors correction.

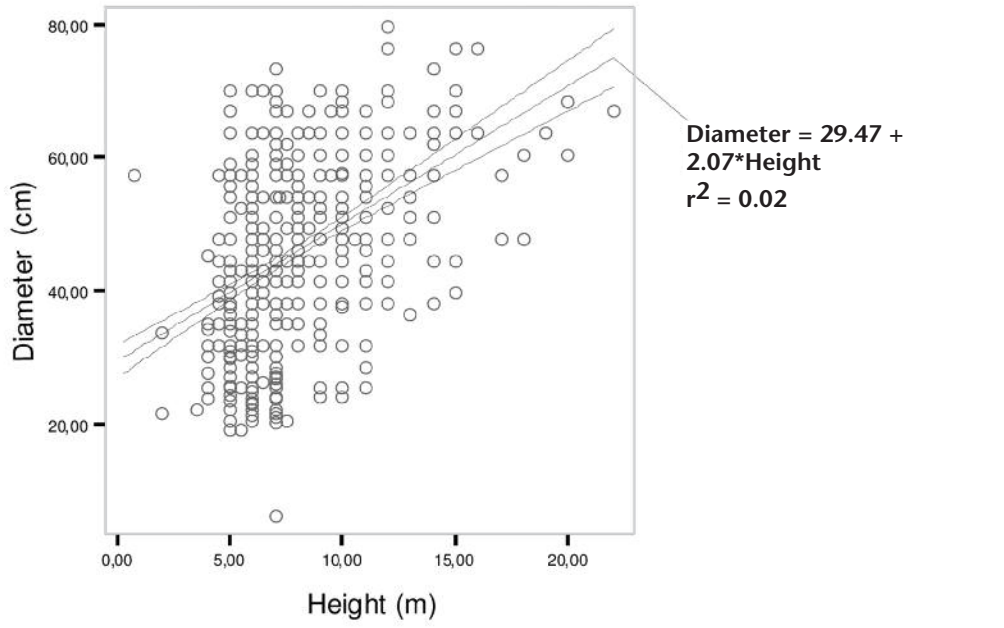
A Mann-Whitney was applied to determine if the median height differed significantly among growth stages in all localities and to determine if the diameter among growth stages differed too. To determine if a significant difference in mean diameter occurred among localities, I carried out an analysis of variance (ANOVA), followed by a Dunnett C post-hoc test because equal variances could not be assumed. The relationship between height and diameter of the stem was evaluated using a Spearman's Rank correlation.

Results

Stem diameter of non-reproductive adults ranged from 19.11 to 70.06 cm (n = 419; mean = 43.02; standard error = 0.57); that of reproductive adults ranged from 6.37 to 79.62 cm (n = 307; mean = 48.96; standard error = 0.75) (Fig. 3). Median stem diameter differed significantly among reproductive and non-reproductive adults (U = 47, 075.50; df = 1 and $p < 0.05$).

Stem diameter also varied among the three localities, Sabanalamar, Santa Teresa and San Ubaldo (Fig. 4). In the analysis of diameter by

6. Relationship between height and diameter in adults of *Colpothrinax wrightii*.



locality, the values can be ranked: San Ubaldo < Santa Teresa < Sabanalamar (F = 56.476; between groups df = 2, within-group df = 723 and p < 0. 05). The post-hoc tests confirm that the differences are high among all the localities: San Ubaldo and Santa Teresa (differences in medians = 9.88 and p = 0), San Ubaldo and Sabanalamar (differences in medians = 13.99 and p = 0) and Santa Teresa and Sabanalamar (differences in medians = 4.12 and p = 0.008).

Reproductive individuals were taller than non-reproductive individuals (U = 47, 202.5, p < 0.05) (Fig. 5). A greater variation in height was found in reproductive adults (2.0–22.0 m) than in non-reproductive adults (1.5–15.0 m). Height and belly diameter were positively correlated (R_S = 0.45, p< 0.05) (Fig. 6).

Discussion

The analysis shows that reproductive adults tend to have trunks with bigger belly diameter than do non-reproductive adults. Moreover, the relationship between stem height and belly diameter suggests that larger (taller) palms have larger bellies, although the correlation is weak. These results suggest that a small-bellied, non-reproductive palm acquires a larger belly before reproducing and that the belly size continues to increase as the palm grows in height.

Because palms have no vascular cambium and produce no secondary xylem, palm stems do not usually increase in diameter with growth; however, increase in stem parenchyma tissue, cell enlargement and cell wall deposition can result in gains in stem diameter (Tomlinson et al. 2011). The belly of *Colpothrinax wrightii* has a higher proportion of parenchyma tissue than the unswollen parts of the stem. As a consequence, the capacity of the belly to enlarge over time may be much greater than that of an ordinary stem.

The function of the belly is still imperfectly known, although these results suggest that there is a relationship with reproduction. The reproductive process is very expensive for the plant from the energy point of view, and given that this species occurs on nutrient-poor soils, it is very probable that *Colpothrinax wrightii* develops the belly for the accumulation of starch prior to flowering and fruiting. Fisher et al. (1996), dissecting an individual of *Acrocomia crispa*, noted very little starch content in the belly and instead found structures that they believed might be lipid droplets. Lipids have higher energy content than starches. The stem of *C. wrightii* has not be studied at the anatomical level and its storage products are unknown.

Zona et al. (2000) concluded that the enlargement of the stem in *C. wrightii* was an adaptation for the storage of water, a conclusion based on cultivated individuals, in which the bellies were less conspicuous and for which water was available year around. They noted that the bellies of cultivated individuals were less conspicuous because the non-swollen parts of the stem were larger in diameter than in wild palms. In our areas of study, water is unlimited because the species grows near bodies of water, and yet individuals still produce conspicuous bellies. Although the belly may store water, it does not form in response to water stress or a surfeit of water.

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