Dominican Discoveries

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Two recent expeditions to the Dominican Republic revealed numerous exciting novelties in palms.

Our new international collaboration has set its goal to create a better understanding of *Coccothrinax*. The genus is in tribe Cryosophileae of subfamily Coryphoideae (Dransfield et al. 2008). Relatedness amongst the genera in Cryosophileae is not well known (Baker et al. 2009, Cano et al. 2018), and much remains to be discovered about the genera of the Cryosophileae. Despite this, it has been shown that *Coccothrinax* is strongly supported as closely related to *Zombia* (they are sister genera; Cano et al. 2018), a monotypic genus endemic to the island of Hispaniola (Dominican Republic and Haiti) in the Caribbean.

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Coccothrinax is a genus of mostly medium-sized palms with palmate leaves that are usually silvery-white on the lower surface. The stems are initially covered by fibrous leaf sheaths that break down into fibrous nets, eventually leaving a bare trunk covered with leaf scars. The leaf sheaths are not split at the base, as they are in other Caribbean genera such as *Hemithrinax*, *Leucothrinax* and *Thrinax*, for example, and this is an important characteristic for field identification of sterile *Coccothrinax* individuals. Flowers are hermaphrodite and fruits are small and fleshy, with seeds that are deeply grooved and resemble a brain (Henderson et al. 1995).

Coccothrinax is the most diverse genus of Caribbean palms (Roncal et al. 2008), and the majority of species are endemic to Cuba. The genus is widely distributed throughout the islands of the Caribbean and in adjacent mainland areas, primarily on limestone or serpentine substrates, sometimes in dry and often exposed highlands, sometimes in valleys and on coasts (Dransfield et al. 2008). A lack of study has led to large variation in the number of species recognized; for example, Henderson et al. (1995) included 14 species in the genus and Govaerts et al. (2020) accepted 56 names. On Hispaniola there are 10 recognized species of *Coccothrinax*, although they remain poorly known (Fernández & Gottschalk 2017).

This lack of understanding of the number of species in *Coccothrinax* has implications beyond taxonomy. Biodiversity conservation

1. A population of *Coccothrinax boschiana*, with its curved stems arching over the Caribbean waters. It is an endangered species according to the local Red List for the Dominican Republic. Photo by E. Fernández.

regulations often require names on taxa before they can be protected. Without accurate understanding of what species are and what populations are included within these species, they cannot be protected by law or interested stakeholders. We cannot protect what we do not know. Currently, the International Union for the Conservation of Species (IUCN) has 11 entries in the Red List of Threatened Species for *Coccothrinax*. *Coccothrinax concolor* and *C. ekmanii* are both data deficient, *C. argentata*, *C. alta* and *C. gundlachii* are categorized as least concern, *C. inaguensis* is near-threatened, and *C. pauciramosa* is vulnerable. *Coccothrinax proctorii* and *C. spritiuana* are endangered and both *C. borhidiana* and *C. jimenezii* are critically endangered. Many more species urgently need information and IUCN categorization. The global Red List can be compared to the local Red List for the Dominican Republic (2011), for example, to see how taxonomy and threatened status may differ. There, we find the data for *C. ekmanii*, an endemic species to Hispaniola, is categorized as vulnerable to extinction, contrasting with the global list, which rates it as data deficient. If the species exists only on the island, then the local conservation assessment should be sufficient to warrant its protection. *Coccothrinax barbadensis* is also categorized as vulnerable to extinction. *Coccothrinax boschiana* (Fig. 1) and *C. gracilis* are both endangered, and *C. montana*, *C. scoparia*, and *C. spissa* (Back Cover) are all critically endangered. Most of these data are non-overlapping, and a comprehensive global Red List assessment is lacking. Clearly, a revision of *Coccothrinax* is urgently needed to understand and conserve these beautiful palms.

With the goals to understand and conserve, we began this project by consulting botanical collections in the herbaria of the New York Botanical Garden, Smithsonian Museum of Natural History and Jardín Botánico Nacional Dr. Rafael M. Moscoso. From this, we noted various issues with the current taxonomy as defined in Govaerts et al. (2020) and identified sites and species to target for more sampling. In December 2021, we traveled to Santo Domingo in the Dominican Republic to meet our local collaborators from the Jardín Botánico Nacional and begin multiple field expeditions with the goals of using morphology and genetics to define species in *Coccothrinax*, write a monograph of the genus with Red List assessments for each species, and produce a new version of the palms of Hispaniola book (Fernández & Gottschalk 2017).

2. *Coccothrinax argentea* with multiple stems collected in Guzmancito, Dominican Republic. Note the cleared pasture field surrounding the plants, highlighting human impact. Photo by E. Fernández.

We started in the Parque de la Biodiversidad, north of Santo Domingo. There we encountered *Calyptronoma rivalis*, *Coccothrinax argentea* and *Roystonea borinquena*. *Coccothrinax argentea* is endemic and widespread in Hispaniola and occurs in a variety of habitats at 0–1,000 m elevation, including dry forest, broad leaf forest, secondary forest or pine forest, and persists in disturbed areas. Indeed, disturbance from human impacts is

3. Christine Bacon and Oscar Montero in Cabrera, standing in pasture with *Coccothrinax* individuals. Photo by E. Fernández.

unavoidable for native species on Hispaniola; for example, Haiti is one of the most deforested places on Earth (Hedges et al. 2018). The impact of humans is likely a confounding factor in most island systems where the legacy of humans has been so strong, since the area is relatively small and geographic isolation is high.

4. The non-split leaf bases of the palms in the population on Morro de Montecristi. Photo by E. Fernández

Another population of *Coccothrinax argentea* was observed by the team in Guzmancito, near the northern coast. This population was distinct because of its clustered stems (Fig. 2), which we had not seen before in the genus. Other palms in the habitats in and around this

5. *Coccothrinax argentea* collections from the Falcondo mine. Photo by E. Fernández.

area are *Bactris plumeriana*, *Coccothrinax fragans*, *Copernicia berteroana*, *Coccothrinax gracilis*, *Pseudophoenix* sp., *Roystonea hispaniolana*, *Sabal causarium* and *Sabal domingensis*.

We then continued north to Cabrera, where we found a few palm individuals distributed in cow pastures along the side of the road (Fig. 3). The hot day drove out the wasps, whose stings left our legs swollen for days. The population appears quite like *Coccothrinax fragrans*, due to the stout stems and large leaves. After further examination of the population, we found it has smaller inflorescences then expected, white fruits, and a small costa at the abaxial base of the leaf, meaning it is slightly costapalmate, leaving us uncertain as to the specific identity of these palms. *Bactris plumeriana*, *Roystonea hispaniola* and *Sabal domingensis* were also seen at the site, forming a lovely assemblage of classic Caribbean species.

We continued to the area of Gaspar Hernandez, where on a small private farm we found a population of *Coccothrinax* with distinct morphological characters in terms of the shape of its leaf segments that had no indumentum abaxially and its erect inflorescences that scarcely projected beyond the leaves. This was a site of an interesting serpentine soil outcrop and unique plant community. In the area we found other palm species such as *Bactris plumeriana*, *Coccothrinax argentea*, *Copernicia berteroana*, *Roystonea hispaniolana* and *Sabal domingensis*.

We also visited the Morro de Montecristi, a fantastic sandstone table-mountain that ends in the bluest of seas. The mountain is extremely arid and harbors endemic species, two species that are found on the mountain and nowhere else in the world – *Salvia montecristina* and *Mosiera urbaniana* (Veloz & Peguero, 2002). What we found, corroborated by specimens in the herbarium in New York, were palms without split leaf bases (Fig. 4) or transverse veins on the leaves, immediately ruling out *Thrinax radiata*. We think this population may be a form of *Coccothrinax fragrans*, or a possible new species, but more work is required to delimit it; particularly genetic data will be important to test its identity with other populations on the island.

On our second expedition to the Dominican Republic in March 2022, we visited a higher elevation area called Resolí. Based on a single specimen (*T. Zanoni, M. Mejía & C. Ramirez 14979*, 24 June 1981, JBSD), we were curious to see this population since it had very thick leaf sheath fibers, distinct from other

6. *Coccothrinax gracilis* from the Los Haiteses National Park, growing on karst surfaces. Photo by Christine Bacon.

Coccothrinax material we had seen. The specimen label said it grew on a "cliff face," but after three independent visits to the locality, we could not find any individuals in the original location based on the coordinates on the label. Not only does the top of the mountain cliff area have an old stone fort on it, but it also has a large antenna and there is a large reservoir at the base of the area, indicating a long and diverse history of human disturbance. We assume the population was eradicated by human activities and is now extinct. Because there is only a single specimen as a guide, it is difficult to say for certain the identity of the plant.

Human impact was also highly evident when we were looking for palms in the pine forests at 300m in the Falcondo nickel mine near Bonao. After donning protective equipment and preparing with a training video for permission to enter and collect in the mine, we headed first to the top of the mountain to work our way down. It is always wonderful to see these mixed forests of temperate and tropical elements, pines and palms mixed, and we were excited to find healthy populations of *Coccothrinax argentea* (Fig. 5). The plants were in full fruit, and we made herbarium collections as well as collected seeds for ex situ conservation in the Jardín Botánico Nacional Dr. Rafael M. Moscoso and the Montgomery Botanical Center.

The big adventure of our second trip was to visit the Los Haiteses National Park, found on the northeast coast of the island. The park harbors habitats varying from dense mangrove stands full of bird diversity to magnificent landscapes of rock formations formed from limestone karst. The park has a diversity of tree species including endemics such as *Tabebuia maxonii* and *Cinnamodendron eckmanii*, as well as large variety of native orchid species. Los Haiteses boasts a wonderful diversity of palms including *Bactris plumeriana*, *Calyptronoma plumeriana*, *Calyptronoma rivalis* and *Prestoea montana* (Mejía et al. 2017). We went to Los Haiteses in search of *Coccothrinax gracilis* (Fig. 6), an appropriate name because of its very graceful appearence. Interestingly we found this population varied between erect stems, rising straight from the rock to the sky with their elegant tuft of fine leaves, to curvy,

7. The group involved in an outreach event at the Jardín Botánico Nacional Dr. Rafael M. Moscoso in Santo Domingo, Dominican Republic in March of 2022.

bending stems, arching out over the water and above the other vegetation. What causes this variation? This same stem variation is noted in another fantastic Dominican species (Fernández and Gottschalk, 2017), of serious conservation concern, *Coccothrinax boschiana* (Fig. 1). This species occurs on the Sierra Martín García in dry forest on similar limestone formations as Los Haiteses, at 30–200 m elevation.

On our second trip we also focused on outreach activities with the Ministry of the Environment, the botanical garden, and the local university. We held a seminar series and workshop focused on palm evolution, cultivation, and identification (Fig. 7). Students and professionals alike were very interested, and we were able to easily use the dichotomous key in Spanish from the Field Guide to the Palms of Colombia (Galeano & Bernal 2010) to identify genera in the botanical garden. Our collaboration between the University of Gothenburg, the New York Botanical Garden, the Montgomery Botanical Center, the Jardín Botánico Nacional Dr. Rafael M. Moscoso and the Ministerio de Medio Ambiente is just beginning, and we are excited about these and future discoveries to be had.

Acknowledgments

We acknowledge the Plant Exploration Fund of the Montgomery Botanical Center for their generous support of our collaborative research. This research was also supported by the Biodiversity in a Changing Climate Strategic (BECC) Research Area at the University of Gothenburg and the Swedish Research Council (2017-04980). We thank the Ministerio de Medio Ambiente, and in particular the Vice-Ministerio de Áreas Protegidas y Biodiversidad, for their support and permission for collection and exportation (permits #119-2022).

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