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Re-finding and conservation status of the threatened fern *Maxonia apiifolia* (Dryopteridaceae) in Southern Havana wetland, Cuba

Re-localización y estado de conservación del helecho amenazado *Maxonia apiifolia* (Dryopteridaceae) en el humedal sur de La Habana, Cuba

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Key words: conservation status, Cuban ferns, endangered species, phorophyte species, swamp forest
Palabras clave: bosque de ciénaga, especie amenazada, especies forófito, estado de conservación, helechos de Cuba

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ABSTRACT

The re-finding and conservation status of the endangered fern *Maxonia apiifolia* in Southern Havana are reported. We estimated the extent of occurrence of *M. apiifolia* by GPS marking. We registered the number of mature individuals, their reproductive status and phorophyte species. *Maxonia apiifolia* was found in two swamp forest fragments located in La Luisa, Melena del Sur (Mayabeque), named Embarcadero and Los Patos. Together these areas represent 4.30 km^2 for the species' extent of occurrence, comprising a single location and a single subpopulation distributed between the two forest fragments. We counted a number of 64 mature individuals (23% with fertile fronds) of *M. apiifolia*. *Roystonea regia*, *Callophyllum antillanum* and *Calyptronoma occidentalis* were the most frequent phorophytes. La Luisa constitutes a significant site for *M. apiifolia* conservation, because it contains one of the biggest subpopulations compared with the ones recently found. Its abundance, high number of mature individuals observed and estimated and its generalist condition in terms of phorophyte preference suggest that this subpopulation has a good conservation status.

RESUMEN

Se reportó la re-localización y estado de conservación del helecho amenazado *Maxonia apiifolia* en el sur de La Habana. Se estimó la extensión de presencia de la especie a través del marcaje con GPS. Se registró el número de individuos maduros, su estado reproductivo y la especie forófito. *Maxonia apiifolia* fue encontrada en dos fragmentos de bosque de ciénaga localizados en el poblado La Luisa, Melena del Sur (Mayabeque) nombrados Embarcadero y Los Patos. Ambas áreas representan 4.30 km² para la extensión de presencia de la especie, y constituyen una sola localidad y una sola subpoblación distribuida entre los dos fragmentos de bosque. Se contaron 64 individuos maduros de *M. apiifolia* (23% con frondes fértiles). *Roystonea regia*, *Callophyllum antillanum* y *Calyptronoma occidentalis* fueron las especies de forófitos más frecuentes. La Luisa constituye un sitio importante para la conservación de *M. apiifolia*, porque contiene una de las subpoblaciones más grandes hasta ahora reportadas. Su abundancia, alto número de individuos maduros observados y su condición de generalista en cuanto a la preferencia de forófito, sugieren que esta subpoblación tiene un buen estado de conservación.

INTRODUCTION

Maxonia apiifolia (Sw.) C. Chr. is a hemiepiphyte fern native from Cuba and Jamaica. Its reproductive cycle and life traits are still unknown. As many ferns, it requires high levels of humidity and shade. In Cuba, this fern is typical of swamp forests (Sánchez and Regalado, 2015). Although the range of its distribution covered several localities from Western and Central Cuba, it has not been re-found since the 20th century in most of these localities. Therefore, it was considered as Critically Endangered in 2005 (Berazaín *et al*., 2005) and possibly extinct in Cuba in 2007 (Sánchez, 2007).

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During 2008 and 2012, *M. apiifolia* was found in two protected areas: Santo Tomás, Ciénaga de Zapata, Matanzas (Sánchez and García-Lahera, 2013) and in Real Campiña, Yaguajay, Sancti Spíritus (García-Lahera *et al*., 2013a). Even so, this species was considered as one of the 50 most threatened plant species in Cuba, because of the drastic decrease in its extent of occurrence and area of occupancy, mainly due to habitat destruction (Sánchez and García-Lahera, 2013). In 2013, it was found in the gallery forest of San Juan de Dios farm in Camajuaní, Villa Clara (collector A. Orozco, herbarium number 10715 ULV) (I. Castañeda and R. A. Pérez, pers. comun.). In 2015, three new localities were reported for this species in Yaguajay, Sancti Spíritus: Arroyo Los Chícharos (near the limits of "Jobo Rosado" Protected Area), Río Bamburanao and Río La Media Legua (Falcón *et al*., 2016). All these findings increase the original distribution range of *M. apiifolia* because they constitute new localities but, until now, there has been no re-localization in areas where this species used to occur. Therefore, *M. apiifolia* is still considered a threatened species, categorized by Sánchez and Regalado (2015) as Endangered.

The earliest report of *M. apiifolia* in Southern Havana was by Ekman in 1920 (GBIF, 2018a). Then Brother León made another two reports in 1928 and 1930 (GBIF, 2018b, c). These findings were in Batabanó (Mayabeque, Southern Havana), where the species has not been sighted again. This work aims to document the re-localization and conservation status of *M. apiifolia* in Southern Havana. We estimated the number of individuals in the region, the area of occupancy and the extent of occurrence, evaluated the habitat preference and characterized the habitat where the species occurs.

MATERIAL AND METHODS

Species

Maxonia apiifolia is a climber terrestrial fern (**Fig. 1A**). The climbing rhizome is thick and woody with a dense cover of ferruginous scales (**Fig. 1B**). Fronds (**Fig.1C**) are dimorphic and not articulated to the rhizome. Fertile fronds are smaller, skeletal (**Fig. 1D**), 4-pinnate with tissue reduced to wings on both sides of the axes of the last divisions. Sometimes the sterile fronds have one or more fertile pinnae (Sánchez and García-Lahera, 2013). This fern is typical of swamp and gallery forests where it is

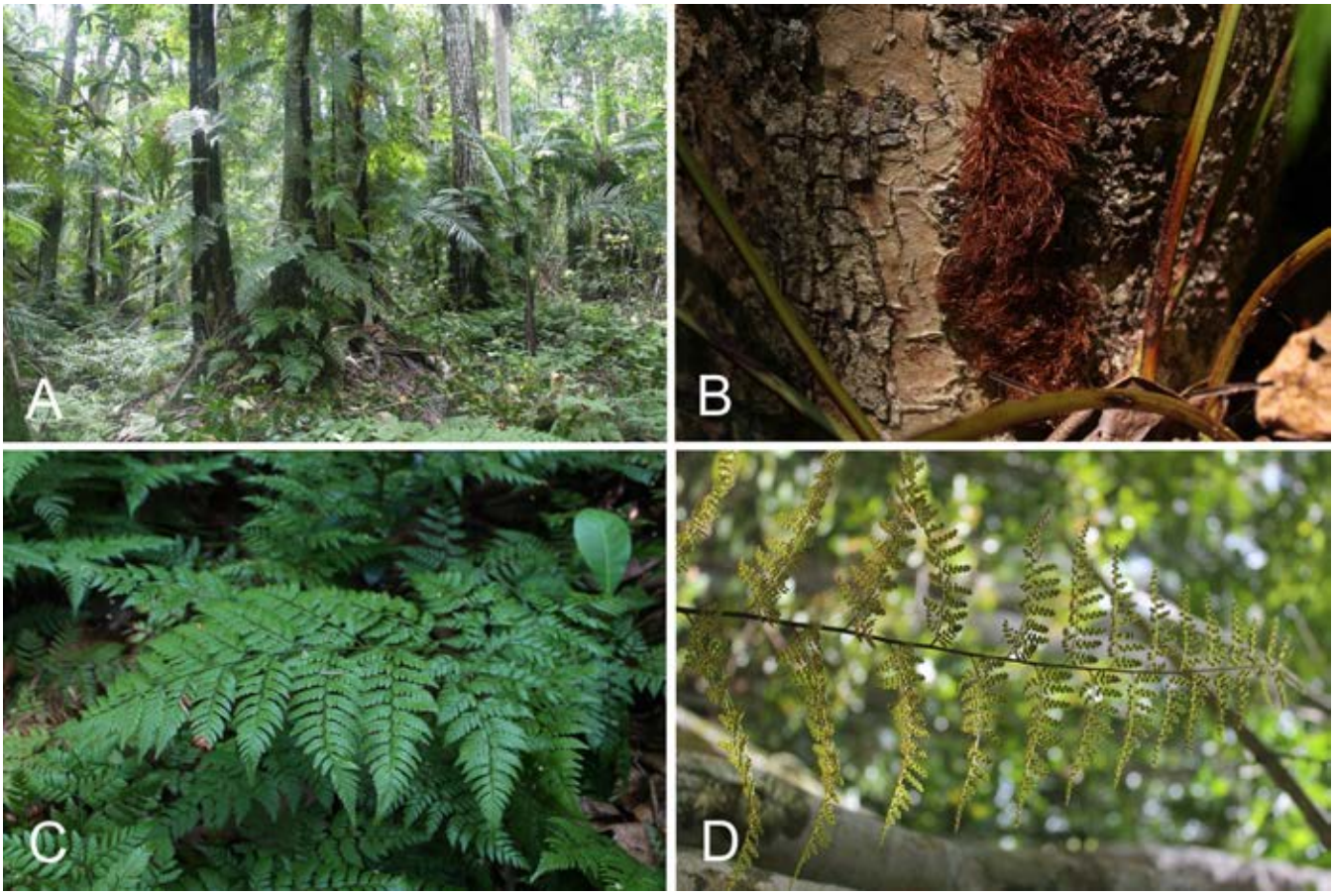

Figure 1. *Maxonia apiifolia.* A, habitat and habit. B, rhizome. C, infertile frond. D, fertile frond.
Figura 1. *Maxonia apiifolia*. A, hábitat y hábito. B, rizoma. C, fronde estéril. D, fronde fértil.

shaded and the humidity is high (García-Lahera, 2013a, 2016).

Methods

A search for *M. apiifolia* was carried out in several swamp forest fragments that cover the Southern region of Artemisa and Mayabeque between April 2016 and June 2018. Sites where *M. apiifolia* was found were marked with GPS (Garmin GPSMAP® 62st) to estimate its extent of occurrence in the region, following IUCN guidelines (IUCN, 2001). In addition, we identified the potential threats for *M. apiifolia* wherever it was found. One witness sample of the *M. apiifolia* was collected and deposited in the Cuban National Herbarium (HAC) with the number SV 43205. Using the tool "Random points" in *QGis* 2.18 "Las Palmas", we selected two sites (named EM1 and EM2) in the biggest forest fragment where *M. apiifolia* was found (**Fig. 2**). The number of climbing rhizomes of *M. apiifolia* and the phorophyte species were recorded in those sites, to estimate the population size. The percentage cover of the fern within three plots of 80 m^2 (2 x 40 m) in each site, was calculated, in order to estimate the total area of occupancy by the rule of proportion and previously knowing the area of the forest fragment. Each climbing rhizome was considered a mature individual according to Falcón *et al.* (2016) because those rhizomes produce the fertile fronds. We considered individuals to be distinct when a separation between rhizomes was noticeable and they were climbing different trunks. This helped us to diminish the risk of overestimating the number of mature individuals, due to the clonal growth of this fern, which makes individual identification very difficult. Nevertheless, a high level of this risk is assumed.

For IUCN categorization purpose, we defined location as a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present (IUCN, 2001). Therefore, the size of the location depends on the area covered by the threatening event and may include part of one or many subpopulations. We followed Regalado *et al*. (2015) criterion that Cuban ferns have a single population in the archipelago, composed by a given number of subpopulations. Subpopulation was defined following IUCN (2001) criterion as well: geographically or otherwise distinct groups in the population between which there is little demographic or genetic exchange (typically one successful migrant individual or gamete per year or less).

In addition, the plant diversity of these sites was characterized by a check-list using our skills in rapid plant identification together with the collection of plant material for the posterior identification in the herbarium. The taxonomy of the identified species was updated following Greuter and Rankin (2017). In order to make the checklist more complete, for each species we added the IUCN categories (González-Torres *et al*., 2016), the biogeographical status and invasiveness (Oviedo and González-Oliva, 2015; González-Torres *et al*., 2016; Greuter and Rankin, 2017), the forest fragment where it was found, the biological type classified as tree, shrub, herb, vine and epiphyte (García-Beltrán *et al*., 2017) and the common name (Roig, 2014) (**Appendix 1**). Moreover, we recorded the understory species abundance in six plots of 80 m^2 (2 x 40 m) evenly divided between EM1 and EM2. Plots inside each site were randomly distributed. This survey was conducted in Embarcadero because it was the biggest forest fragment (1.89 km^2). The measure used for estimating abundance was direct counting in the case of tree saplings, and percentage of covered area in the case of clonal species and very abundant and small herbs and/or tree seedlings. In order to rank the species abundance, these measures were standardized dividing them by the total area of the plots and converting the densities to percentage. Though the focus was the understory species, we also recorded the dominant species at canopy level.

RESULTS

In total, 19 locations were visited. Of them, six in Melena del Sur:

1. Campechal (22.70681,-82.17761)
2. La Teresa (22.71158,-82.10967)
3. Los Patos (22.71044,-82.14836)
4. Embarcadero (22.70531,-82.12953)

Four in Alquízar:

5. Arca de Noé (22.72252,-82.62352)
6. La Aurora (22.728,-82.59208)
7. Ojo de agua de Guanímar (22.72269,-82.64077)
8. Playa Guanímar (22.68679,-82.65507)

Six in Güira de Melena:

9. Finca San Miguel (22.72161,-82.47831)
10. Finca Los Cabrera (22.71758,-82.45678)
11. Finca Santa Ana (22.71646,-82.45891)
12. Herradura de Peñalver (22.7279,-82.53407)
13. Ojo de agua de Gavilán (22.72377,-82.50522)
14. Barnet (22.73033,-82.55778)

One in Quivicán:

15. Finca Piedra-Medeiros (22.72283,-82.42699)

Two in Batabanó:

16. Golfo de Batabanó (22.69555,-82.31139)
17. Camacho (22.71511,-82.36813)

One in Nueva Paz:
18. Punta del Inglés (22.71117,-81.72136)

One in Artemisa:
19. Playa Majana (22.69709,-82.7725).

Maxonia apiifolia was only found in Embarcadero and Los Patos (**Fig. 2**). These patches are located in a town named La Luisa (Melena del Sur, Mayabeque). These areas represent 4.30 km^2 for the species' extent of occurrence in the region, constituting a single location and a single subpopulation.

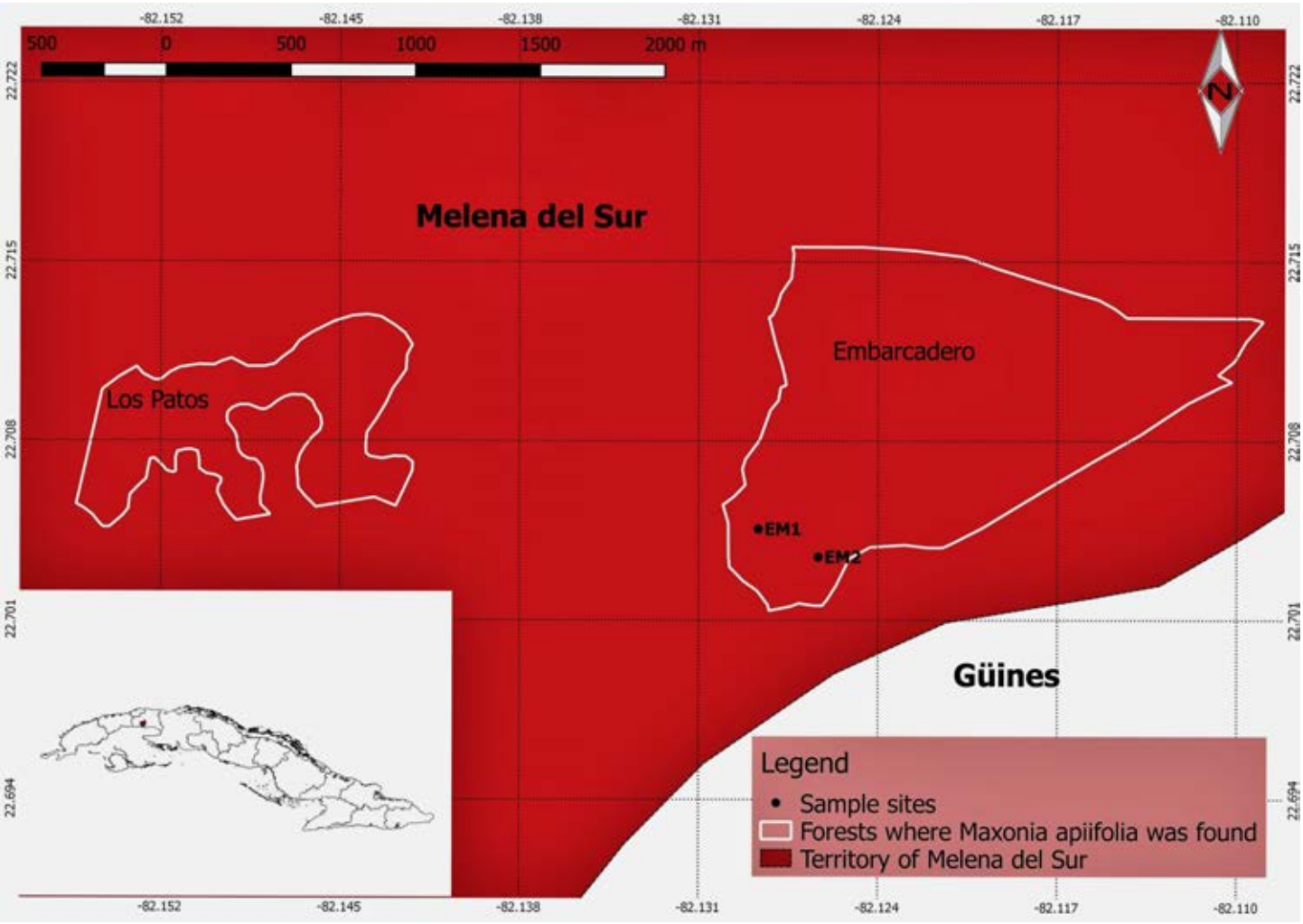

Figure 2. Current distribution of *Maxonia apiifolia* in La Luisa, Melena del Sur, Mayabeque, Cuba.
Figura 2. Distribución actual de *Maxonia apiifolia* en La Luisa, Melena del Sur, Mayabeque, Cuba.

We found potential threats to *M. apiifolia* in the surroundings of both forest fragments: livestock and agriculture in Los Patos and agriculture in Embarcadero. In addition, both fragments are being used and managed by the Regional Forestry Company, which might be another threat. Tourism in Mayabeque beach can also constitute a potential threat. This fern occupied almost 20% of the sampled area, which was extrapolated to 0.37 km^2 as the total area of occupancy. In total, 64 climbing rhizomes (mature individuals) were counted in Embarcadero at both sample sites, of which 23% had fertile fronds. We observed climbing rhizomes on living trunks as well as dead trunks and stumps. *Roystonea regia* (Kunth) O.F. Cook, *Calophyllum antillanum* Britton and *Calyptronoma occidentalis* (Sw.) H.E. Moore were the most frequent phorophytes. Nevertheless, we found some differences between sample sites. In EM1, 34 climbing rhizomes were counted, of which 38% had fertile fronds. From the seven phorophyte species identified, *R. regia* was the most frequent, followed by *C. antillanum* and *Terminalia catappa* L. (**Table 1**). In EM2 we counted 30 climbing rhizomes, of which only two had fertile fronds. In that case, eight phorophyte species were identified. *Calyptronoma occidentalis* and *Calophyllum antillanum* were the most frequent, followed by *R. regia* and *Ficus maxima* Mill. (**Table 1**).

Table 1. Total number of climbing rhizomes by phorophyte species per sample site (EM1 and EM2) in Embarcadero, La Luisa, Mayabeque, Cuba. In parenthesis, the number of rizhomes with fertile fronds out of the number by site and phorophyte species.
Tabla 1. Número total de rizomas por especie forófito y sitio de muestreo (EM1 y EM2) en Embarcadero, La Luisa, Mayabeque, Cuba. En paréntesis el número de rizomas fértiles del número de rizomas trepadores por sitio y especie.

Phorophyte species	EM1	EM2	Total
Calophyllum antillanum	8 (3)	7	15
Terminalia catappa	5 (2)	0	5
Roystonea regia	14 (5)	5	19
Cojoba arborea	1 (1)	0	1
Talipariti elatum	4 (1)	1	5
Tabernaemontana sp.	1 (1)	0	1
Calyptronoma occidentalis	1	9	10
Ficus maxima	0	4 (2)	4
Tabebuia sp.	0	1	1
Amphitecna latifolia	0	2	2
Wallenia laurifolia	0	1	1

We identified 98 plant species for both areas (89 in Embarcadero and 56 in Los Patos) (**Appendix 1**). Approximately 50% of the plant species found in both forest fragments are either Less Concern (LC) or have been not yet evaluated (NE) in Cuba according to IUCN criteria. Only one threatened species was identified: *Crinum oliganthum* Urb.

We recorded 24 understory plant species in EM1, of which 22 are native species and typical of Cuban swamp forests. Only two exotic and invasive species were found: *T. catappa* and *Oeceoclades maculata* (Lindl.) Lindl. Trees were the dominant growth form comprising 50% of the total of species. The canopy was dominated by the invader *T. catappa*, followed by the typical trees *C. antillanum*, *R. regia* and *Talipariti elatum* (Sw.) Fryxell. The understory was dominated by trees as well, with *C. antillanum* saplings, followed by *T. catappa* seedlings and saplings, *R. regia* seedlings and *T. elatum* seedlings (**Fig. 3A**). In EM2, 21 plant species were recorded, of which 19 are native and typical of Cuban swamp forests. Trees were predominant, being 48% of the total of species found. In this case, the same invasive species were found: *T. catappa* and *O. maculata*. The canopy was dominated by *Calophyllum antillanum*, *Calyptronoma occidentalis*, *F. maxima* and *R. regia*. The understory was dominated by *Wallenia laurifolia* (Jacq.) Sw. and *C. antillanum* saplings, followed by the fern *Acrostichum aureum* L., *F. maxima* seedlings, the vine *Cissus trifoliata* (L.) L. and the herb *C. oliganthum*. In addition, *C. occidentalis*, *T. elatum* and *Amphitecna latifolia* (Mill.) A.H. Gentry seedlings were relatively abundant (**Fig. 3B**).

DISCUSSION

Maxonia apiifolia re-finding in Melena del Sur increases by one this species' current subpopulation number, bringing the number of known sites or subpopulations of this fern in Cuba (García-Lahera *et al*., 2013a, b; Sánchez and Regalado, 2015; Falcón *et al*., 2016; I. Castañeda, comun. pers.) to seven. In addition, it enlarges its current distribution range to seven localities and consequently, its extent of occurrence. This finding opens the way to search for this species at the historical localities, and therefore, to evaluate again its conservation status in Cuba according to IUCN criteria. Regalado *et al.* (2015) state that in general, ferns are a poorly studied plant group and not taken into account when plant inventories are conducted in Cuba. Consequently, some fern species such as *M. apiifolia* had been considered as possibly extinct (Sánchez, 2007).

We consider that both fragments belong to the same location for the species and shelter only one subpopulation, according to IUCN (2001) criteria. In fact, both fragments constituted a single unit in the past and are currently threatened by the same activities. The genetic exchange between fragments should be enough to consider a single subpopulation if we consider the high dispersal capacity of ferns, whose spores are capable of traveling hundreds of kilometers (Wolf *et al*., 2001).

The minimal number of 64 climbing rhizomes in Embarcadero forest suggests that La Luisa shelters the second biggest subpopulation compared to the ones recently found by García-Lahera *et al*. (2013b) and Falcón *et al.* (2016). The subpopulation in Real Campiña (Yaguajay, Sancti Spíritus) is so far the biggest with 74 rhizomes in 100 m^2 (García-Lahera *et al*., 2013b). Taking into account the high density of *M. apiifolia* in the forest understory, we think that there might be many more than the number reported in this manuscript (64) in less than 5 km^2. The relatively low number of climbing rhizomes with fertile fronds could be related to two non-self-excluding phenomena: 1) we sampled in the first half of the wet season in Cuba when this species is perhaps starting or finishing its reproductive period, and 2) this fern simply produces fertile fronds asynchronously. These assumptions, as well as the method for mature individual counting, should be verified. Detailed research about *M. apiifolia*'s life cycle must be carried out in order to adequately define a mature individual and identify its phenological features for conservation purposes.

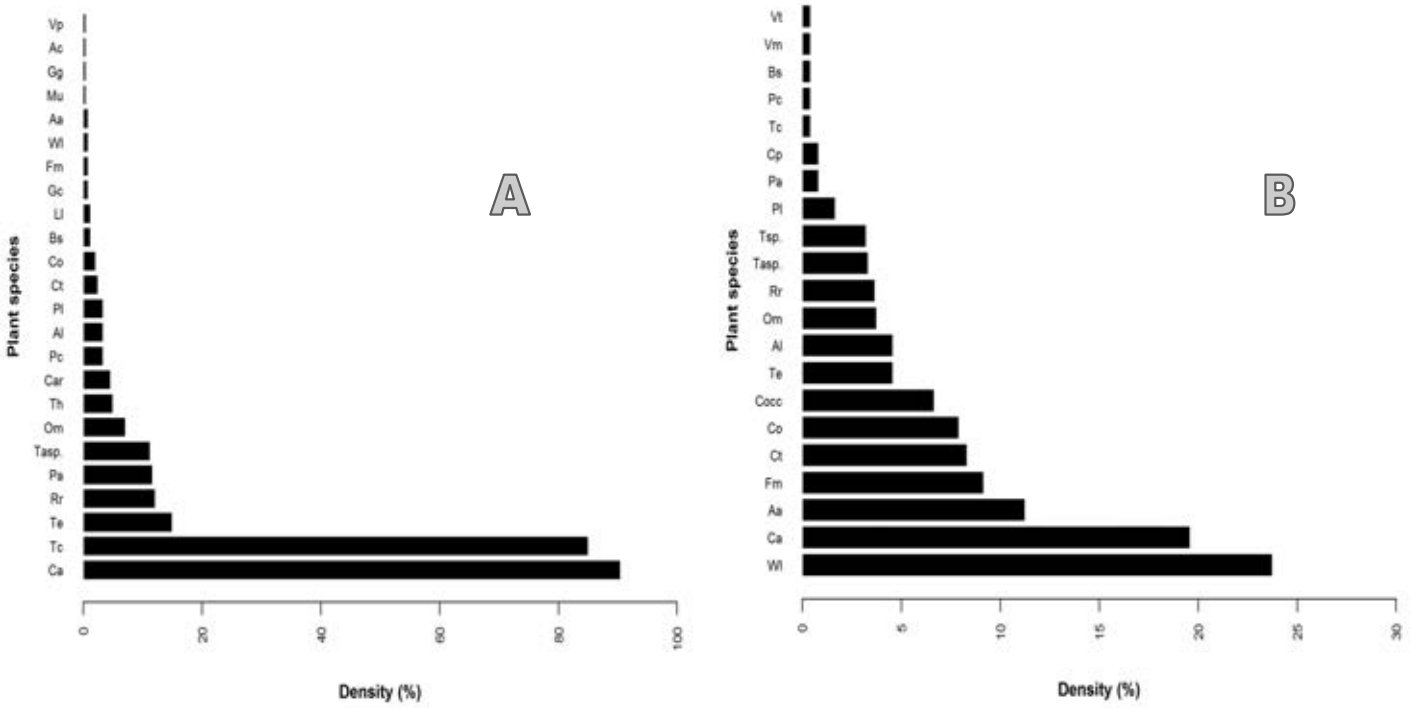

Figure 3. Plant species density in the understory of Embarcadero forest, La Luisa, Mayabeque, Cuba. A, EM1. B, EM2. Aa: *Acrostichum aureum*, Ac: *Allophylus cominia*, Al: *Amphitecna latifolia*, Bs: *Bursera simaruba*, Ca: *Calophyllun antillanum*, Car: *Cojoba arborea*, Co: *Crinum oliganthum*, Cocc: *Calyptronoma occidentalis*, Cp: *Cecropia peltata*, Ct: *Cissus trifoliata*, Fm: *Ficus maxima*, Gc: *Guettarda combsii*, Gg: *Guarea guidonia*, Ll: *Hippobroma longiflora*, Mu: *Mucuna urens*, Om: *Oeceoclades maculata*, Pa: *Pisonia aculeata*, Pc: *Philodendron consanguineum*, Pl: *Philodendron lacerum*, Rr: *Roystonea regia*, Tasp.: *Tabernaemontana* sp., Tc: *Terminalia catappa*, Te: *Taliparitі elatum*, Th: *Trichilia havanensis*, Tsp.: *Tectaria* sp., Vm: *Vanilla mexicana*, Vp: *Vanilla phaeantha*, Vt: *Vitis tiliifolia,* Wl: *Wallenia laurifolia*.
Figura 3. Densidad de especies vegetales en el sotobosque del Embarcadero, La Luisa, Mayabeque. A, EM1. B, EM2. Aa: *Acrostichum aureum*, Ac: *Allophylus cominia*, Al: *Amphitecna latifolia*, Bs: *Bursera simaruba*, Ca: *Calophyllum antillanum*, Car: *Cojoba arborea*, Co: *Crinum oliganthum*, Cocc: *Calyptronoma occidentalis*, Cp: *Cecropia peltata*, Ct: *Cissus trifoliata*, Fm: *Ficus maxima*, Gc: *Guettarda combsii*, Gg: *Guarea guidonia*, Ll: *Laurentia longiflora*, Mu: *Mucuna urens*, Om: *Oeceoclades maculata*, Pa: *Pisonia aculeata*, Pc: *Philodendron consanguineum*, Pl: *Philodendron lacerum*, Rr: *Roystonea regia*, Tasp.: *Tabernaemontana* sp., Tc: *Terminalia catappa*, Te: *Taliparitі elatum*, Th: *Trichilia havanensis*, Tsp.: *Tectaria* sp., Vm: *Vanilla mexicana*, Vp: *Vanilla phaeantha*, Vt: *Vitis tiliifolia,* Wl: *Wallenia laurifolia*.

Maxonia apiifolia seems not to have a preference for a particular phorophyte species. Probably, this fern is a generalist species that takes advantage of the relative abundance of tree species in each site. In fact, like in Embarcadero, Falcón *et al.* (2016) showed that this fern makes use of the available space on invasive trees where they are dominant. In Embarcadero, *M. apiifolia* was found climbing on *T. catappa* where this tree was highly abundant, whereas Falcón *et al*. (2016) stated that this fern was found climbing the invasive tree *Syzygium jambos* (L.) Alston in Arroyo Los Chícharos and Río La Media Legua. Likewise, it is noticeable how the differences between sample sites in Embarcadero in regard to phorophyte species correspond with the presence/absence and relative abundance of common trees in this swamp forest fragment.

On the other hand, the number of phorophyte species found in Embarcadero forest was higher than the number reported by Falcón *et al*. (2016). Comparing our study to the report of Falcón *et al*. (2016), only *S. jambos* was not found as a phorophyte in our case, probably because it is not present in La Luisa. *Roystonea regia*, *Calyptronoma occidentalis*, and *Calophyllum antillanum* are common phorophyte species for all the analyzed locations. This is probably because they are very common trees in swamp and gallery forests all over Cuba.

The analysis of species composition and abundance in the sampled sites shows that *T. catappa* is transforming certain parts whereas in other it is almost absent. This species was highly abundant at all forest strata in EM1, the sample site nearest to the ancient Mayabeque river's

bed and hence, the most accessible zone for people and floating propagules such as the *T. catappa*'s nut. However, in EM2 we only found a *T. catappa* seedling. Maybe this is related to the fact that EM2 is less accessible and further away to the riverbank. In general, this entire forest fragment belongs to the Forestry Company and they once introduced *T. catappa* in the region for wood production. Now, this species covers a large extent all over the Southern Havana wetland.

Nonetheless, we found typical native species at different stages: from seedlings to adults at both sample sites. In particular, EM2 is a highlight because there we found higher native tree diversity in both the overstory and understory. This suggests that this forest retains its original attributes and resilience to some extent. Furthermore, it can act as a source of propagules for other degraded areas.

In general, the species found in these two forest fragments agree with the definition of swamp forest given by Capote and Berazaín (1984). Moreover, this forest is highly similar to those where *M. apiifolia* was found recently (García-Lahera *et al.,* 2013a; Falcón *et al.,* 2016). In contrast, there is no livestock that could threaten *M. apiifolia* population in this swamp forest in Embarcadero, as it was reported by García-Lahera *et al.* (2013a) and Falcón *et al.* (2016) for the recent new localities. However, the agriculture and forestry that have been developed in the surroundings of Embarcadero could threaten *M. apiifolia* and in general, biodiversity conservation, as it has been suggested by Falcón *et al.* (2016) in Río Bamburanao and Río La Media Legua. On the other hand, in Los Patos, where this fern was also found, livestock, agriculture and forestry development are current threats to the forest including *M. apiifolia*. In addition, tourism in Mayabeque beach may threaten the conservation of this entire ecosystem, due to the increasing and accelerated demand for many resources such as water.

To sum up, the past deforestation for agriculture, the current and future effects of climate change such as increased drought, the inappropriate management of swamps (forestry, intensive farming, fires, etc.), and the inadequate management and use of water sources, have had and will have a negative impact on the structure and dynamics of these swamp forest fragments (information gathered during the execution of the project "Manglar Vivo"). Nevertheless, the actions that are taking place in the region by the project "Reduction of the vulnerability to coastal flooding through ecosystem-based adaptation in the Southern Artemisa and Mayabeque" ("Manglar Vivo"), whose main goal is to recover the resilience of this wetland, could mitigate the effects of these threats.

CONCLUSIONS

La Luisa, Melena del Sur, constitutes a significant site for *M. apiifolia* conservation because one of its biggest subpopulations is found there. In addition, the fact that this fern is dominant in the understory of the swamp forest fragments in La Luisa, together with its condition of generalist in terms of phorophyte preference, could suggest that this subpopulation has a good conservation status. Nevertheless, detailed work that estimates subpopulation size again and studies reproductive features is needed to obtain more accurate conclusions about *M. apiifolia* in the region. Though *M. apiifolia* has more than five known sites today, it is not enough to change the current IUCN category and criteria (EN B2ab (ii, iii, iv)) because its area of occupancy still weigh less than 500 km^2 and eight historical locations remain without a current report of presence. Consequently, *M. apiifolia* conservation is still a priority for Cuban conservation practitioners. This subpopulation is not included in the Cuban System of Protected Areas and is threatened by several activities such as agriculture, forestry, and tourism that can increase the habitat degradation and lastly, the habitat loss. However, this habitat is being monitored and managed to restore and protect the Southern Havana wetland. A periodical assessment must be carried out in order to evaluate the effects of these actions on *M. apiifolia* subpopulation.

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Appendix 1. List of plant species observed in Embarcadero (E) and Los Patos (LP), La Luisa, Mayabeque, Cuba. The IUCN categories mentioned below are: Less Concern (LC), Deficient Data (DD), Near Threatened (NT), and Endangered (EN). NE means "not evaluated".
Anexo 1. Lista de especies de plantas observadas en Embarcadero (E) y Los Patos (LP), La Luisa, Mayabeque, Cuba. Categorías de la UICN mencionadas: Preocupación Menor (LC), Datos Deficientes (DD), Casi Amenazada (NT), y En Peligro (EN). NE significa "no evaluada".

Species	Family	Biogeographical status and invasiveness	Biological type	IUCN category	Common name	E	LP
Abarema glaucum (Urb.) Barneby & J. W. Grimes	Fabaceae	native	tree	VU	abey, argelino	x	x
Acoelorrhaphe wrightii (Griseb. & H. Wendl.) H. Wendl. ex Becc.	Arecacae	native	tree	LC	guano prieto	x	x
Acrostichum aureum L.	Pteridaceae	native	herb	NE	palmita de río	x	
Acrostichum danaeifolium (Fée) C.Presl	Pteridaceae	native	herb	NE	penquita	x	x
Allophylus cominia (L.) Sw.	Sapindaceae	native	tree	NE	palo caja	x	x
Amphitecna latifolia (Mill.) A.H. Gentry	Bignoniaceae	native	tree	LC	magüira	x	x
Andira inermis (W. Wright) DC.	Fabaceae	native	tree	NE	yaba	x	
Annona glabra L.	Annonaceae		shrub	NE	bagá	x	
Bacopa monnieri (L.) Pennell	Scrophulariaceae	native	herb	NE	verdolaga de costa	x	
Bambusa vulgaris Schrad. ex H.L. Wendl.	Poaceae	alien invasive	tree	-	bambú	x	
Bursera simaruba (L.) Sarg.	Burseraceae	native	tree	NE	almácigo	x	x
Calophyllum antillanum Britton	Calophyllaceae	native	tree	LC	ocuje	x	x
Calyptranthes cf. *zuzygium* (L.) Sw.	Myrtaceae	native	shrub	NE	guairajón	x	
Calyptronoma occidentalis (Sw.) H. E. Moore	Arecaceae	native	tree	LC	palma manaca	x	x
Campyloneurum phyllitidis (L.) C. Presl	Polypodiaceae	native	epiphyte	LC	pasa de negro	x	
Casearia guianensis (Aubl.) Urb.	Samydaceae	native	shrub	LC	jía blanca		x
Cecropia peltata L.	Cecropiaceae	native	tree	LC	yagruma	x	x
Chiococca alba (L.) Hitchc.	Rubiaceae	native	shrub	LC	bejuco de verraco	x	x
Cissus cf. *gossypiifolia* Standl.	Vitaceae	native	vine	A		x	x
Cissus cf. *obovata* Vahl	Vitaceae	native	vine	LC	bejuco ubí	x	
Cissus trifoliata (L.) L.	Vitaceae	native	vine	LC	bejucoubí	x	
Citharexylum spinosum L.	Verbenaceae	native	tree	NE	canilla de venado	x	
Coccoloba diversifolia Jacq.	Polygonaceae	native	tree	LC	uvilla	x	
Cojoba arborea (L.) Britton & Rose	Fabaceae	native	tree	LC	moruro rojo	x	x
Cordia collococca L.	Boraginaceae	native	tree	LC	ateje común		x
Crescentia cujete L.	Bignoniaceae	native	tree	NE	güira cimarrona	x	x
Crinum oliganthum Urb.	Amaryllidiaceae	endemic	herb	EN	lirio	x	x
Cyperus sp.	Cyperaceae		herb			x	
Dalbergia ecastaphyllum (L.) Taub.	Euphorbiaceae	native	shrub	NE	péndola	x	

Appendix 1. List of plant species observed in Embarcadero (E) and Los Patos (LP), ...Cont.
Anexo 1. Lista de especies de plantas observadas en Embarcadero (E) y Los Patos (LP), ...Cont.

Species	Family	Biogeographical status and invasiveness	Biological type	IUCN category	Common name	E	LP
Eleocharis interstincta (Vahl) Roem. & Schult.	Cyperaceae	native	herb	LC	junco	x	
Erythroxylum confusum Britton	Erythroxylaceae	native	shrub	LC	arabo colorado	x	x
Eugenia axillaris (Sw.) Willd.	Myrtaceae	native	tree	LC	guairaje		x
Ficus maxima Mill.	Moraceae	native	tree	LC	jagüey	x	x
Genipa americana L.	Rubiaceae	native	tree	LC	jagua	x	
Guarea guidonia (L.) Sleumer	Meliaceae	native	tree	LC	yamagua	x	
Guazuma ulmifolia Lam.	Malvaceae	native	tree	LC	guásima		x
Guettarda combsii Urb.	Rubiaceae	native	tree	LC	hueso	x	x
Heteropterys laurifolia (L.) A. Juss.	Malpighiaceae	native	vine	LC	bejuco tortuga	x	x
Heterosavia bahamensis (Britton)	Phyllantaceae	native	shrub	LC	hicaquillo	x	
Hydrocotile umbellata L.	Araliaceae	native	herb	NE	galletica	x	x
Hydrocotyle bonariensis Lam.	Araliaceae	native	herb	DD		x	
Hymenocallis sp.	Amaryllidaceae	alien	herb			x	x
Ilex cassine L.	Aquifoliaceae	native	shrub	LC	yanilla	x	x
Lasiacis divaricata (L.) Hitchc.	Poaceae	native	herb	NE	tibisí	x	x
Lasiacis sp.	Poaceae		herb			x	
Laurentia longiflora (L.) Peterm.	Campanulaceae	native	herb	NE	revienta caballos	x	x
Piper umbellatum L.	Piperaceae	native	herb	LC	caisimón		x
Limnocharis flava (L.) Buchenau	Alismataceae	native	herb	LC	malanga de río	x	
Lonchocarpus sericeus (Poir.) Kunth ex DC.	Fabaceae	native	tree	NT	guamá	x	x
Ludwigia sp.	Onagraceae		herb			x	
Maclura tinctoria (L.) D. Don ex Steud. subsp. *tinctoria*	Moraceae	native	tree	LC	mora del país	x	
Mikania oopetala Urb. & Nied.	Asteraceae	native	vine	LC		x	
Mimosa pigra L.	Fabaceae	alien invasive	shrub	-	weyler	x	x
Morinda royoc L.	Rubiaceae	native	shrub		piñipiñí	x	x
Mucuna urens (L.) Medik.	Fabaceae	native	vine	NE	ojo de buey	x	x
Nectandra hihua (Ruiz & Pav.) Rohwer	Lauraceae	native	tree	LC	aguacatillo	x	
Nephrolepis sp.	Lomariopsidaceae		herb			x	x
Neurolaena lobata (L.) R. Br. ex Cass.	Asteraceae	native	herb	LC	victoriana	x	x
Nymphaea ampla (Salisb.) DC.	Nymphaeaceae	native	herb	LC	flor de agua	x	
Oeceoclades maculata (Lindl.) Lindl.	Orchidaceae	alien invasive	herb	-	lengua de vaca	x	
Panicum cf. *polygonatum* Schrad.	Poaceae	native	herb	NE	cañamazo cimarrón	x	x
Partenocissus cf. *quinquefolia* (L.) Planch.	Vitaceae	native	vine	LC	parrita cimarrona	x	x
Passiflora suberosa L.	Passifloraceae	native	vine	LC	meloncillo	x	

Appendix 1. List of plant species observed in Embarcadero (E) and Los Patos (LP), ...Cont.
Anexo 1. Lista de especies de plantas observadas en Embarcadero (E) y Los Patos (LP), ...Cont.

Species	Family	Biogeographical status and invasiveness	Biological type	IUCN category	Common name	E	LP
Pavonia fructicosa (Mill.) Fawc. & Rendle	Malvaceae	native	herb	NE	guizazo de tres puyas	x	
Pentalinon luteum (L.) B.F. Hansen & Wunderlin	Apocynaceae	native	vine	NE	clavelitos	x	
Philodendron consanguineum Schott	Araceae	native	epiphyte	NE	macusey hembra	x	x
Philodendron lacerum (Jacq.) Schott	Araceae	native	epiphyte	NE	macusey macho	x	x
Piscidia piscipula (L.) Sarg.	Fabaceae	native	tree	A	guamá candelón	x	
Pisonia aculeata L.	Nyctaginaceae	native	shrub	NE	zarza, uña de gato	x	x
Pisonia macranthocarpa (Donn. Sm.) Donn. Sm.	Nyctaginaceae	native	shrub	NE	zarza mansa	x	x
Pistia stratiotes L.	Araceae	alien invasive	herb	-	lechuga cimarrona	x	
Pluchea carolinensis (Jacq.) G. Don	Asteraceae	native	shrub	LC	salvia de playa	x	
Psilotum nudum (L.) P. Beauv.	Psilotaceae	native	herb	LC		x	
Roystonea regia (Kunth) O.F. Cook	Arecaceae	native	tree	LC	palma real	x	x
Sagittaria lancifolia L.	Alismataceae	native	herb	LC	flecha de agua	x	x
Salix caroliniana Michx.	Salicaceae	native	shrub	NE	clavellina	x	
Salvinia auriculata Aubl.	Salviniaceae	native	herb	LC		x	
Samanea saman (Jacq.) Merr.	Mimosaceae	potentially invasive	tree	-	algarrobo del país	x	x
Securidaca elliptica Turcz.	Polygalaceae	endemic	vine	LC	maravedí	x	
Tabebuia angustata Britton	Bignoniaceae	native	tree	LC	roble blanco	x	x
Tabebuia shaferi Britton	Bignoniaceae	endemic	tree	LC	roble blanco de montaña		x
Tabernaemontana alba Mill.	Apocynaceae	native	shrub	NE	lechoso, huevo de gallo	x	
Tabernaemontana citrifolia L.	Apocynaceae	native	shrub	NE	pegojo, huevo de gallo	x	x
Talipariti elatum (Sw.) Fryxell	Malvaceae	native	tree	LC	majagua	x	x
Tapura cubensis (Poepp.) Griseb. subsp. *cubensis*	Dichapetalaceae	endemic	tree	NE	aura	x	
Tectaria sp.	Tectariaceae		herb			x	
Terminalia catappa L.	Combretaceae	alien invasive	tree	-	almendro de la India	x	x
Thelypteris cf. *interrupta* (Willd.) K. Iwats.	Thelypteridaceae	native	herb	LC		x	
Thelypteris sp.	Thelypteridaceae		herb			x	x
Tournefortia bicolor Sw.	Boraginaceae	native	vine	LC	nigua	x	x

Appendix 1. List of plant species observed in Embarcadero (E) and Los Patos (LP), ...Cont.
Anexo 1. Lista de especies de plantas observadas en Embarcadero (E) y Los Patos (LP), ...Cont.

Species	Family	Biogeographical status and invasiveness	Biological type	IUCN category	Common name	E	LP
Trichilia havanensis Jacq.	Meliaceae	native	tree	LC	siguaraya	x	x
Trichostigma octandrum (L.) H. Walter	Petiveriaceae	native	vine	LC	bejuco canasta		x
Turbina corymbosa (L.) Raf.	Convolvulaceae	alien invasive	vine	-	aguinaldo		x
Vanilla mexicana Mill.	Orchidaceae	native	vine	NE	vainilla	x	
Vanilla phaeantha Rchb. f.	Orchidaceae	native	vine	DD	vainilla	x	
Varronia bullata subsp. *globosa* (Jacq.) Greuter & R. Rankin	Boraginaceae	native	shrub	LC	hierba de la sangre		x
Vitis tiliifolia Humb. & Bonpl. ex Roem. & Schult.	Vitaceae	native	vine	LC	parra cimarrona	x	x
Wallenia laurifolia (Jacq.) Sw.	Primulaceae	native	tree	LC	camagua	x	x