




# Conservation assessment using the IUCN criterion B: A case study on palms of the Mexican portion of the Yucatán Peninsula Biotic Province

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**Summary.** Arecaceae is one of the most morphologically diverse plant families in the world, represented by over 185 genera and 2600 species. The Mayan communities in the Mexican portion of the Yucatán Peninsula (YP) have made extensive use of these palm species as food, construction materials, handicrafts and medicine. Deforestation, intensive use of native palms and their products, lack of management strategies, global warming, and climate change, are negatively impacting wild palm populations in this region. We assessed the conservation status of palm species that grow in the region following the IUCN criterion B: geographic range in the form of either B1 (extent of occurrence) or B2 (area of occupancy) or both. Twenty palm species were evaluated and considered not threatened (with the exception of *Sabal gretherae*, designated as an endangered species). In some particular cases, we consider that these evaluations are too optimistic. Previous evaluations carried out by the Mexican legislation are supported, with the exception of *Attalea guacuyule*, *Cryosophila stauracantha*, *Gaussia maya* and *Thrinax radiata*. We propose that the distribution and population density of *Roystonea dunlapiana* and *R. regia* in Mexico must be assessed to confirm their conservation status at national level. In the case of *S. gretherae*, a systematic evaluation of its taxonomic status must be implemented.

**Key Words.** Arecaceae, biodiversity, Campeche, Global Strategy for Plant Conservation, Quintana Roo.

## Introduction

The conservation status of plants and animals is one of the essential indicators used to assess the status of local ecosystems and biodiversity as well as an important tool for setting necessary conservation priorities (Bilz *et al.* 2011; Peters *et al.* 2016). One of the most ambitious and critical goals for the Global Strategy for Plant Conservation is a preliminary assessment of the conservation status of all known plant species, at national, regional and international levels (target 2) (GSPC 2002). So far, a complete inventory of world-wide plants has not yet been assembled, but it is estimated that the total number of vascular plants is around 383,670 (Nic Lughadha *et al.* 2016). The percentage of plant species in a threatened category according to the current IUCN Red List is an underestimate and the actual figure could be higher within the range 22 to 47 % (Pitman & Jorgensen 2002).

On a global scale, the IUCN Red List of Threatened Species ([www.iucnredlist.org](http://www.iucnredlist.org); IUCN 2014) is the leading authority in setting criteria and evaluating species. Among twenty-five systems for assessing extinction risk categories in 20 neotropical countries, the IUCN criteria were considered the most appropriate and objective (Grammont & Cuarón 2006). The Red List classifies the risk of extinction of species using five criteria: a) Declining population (past, present and/or projected); b) Geographic range size, and fragmentation, decline or fluctuations; c) Small population size and fragmentation, decline, or fluctuations; d) Very small population or very restricted distribution; e) Quantitative analysis of extinction risk (e.g., Population Viability Analysis). This Red List takes into account nine categories: Extinct (EX), Extinct in the wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD), and Not Evaluat-

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ed (NE). Species classified as CR, EN and VU are collectively designated as threatened species (IUCN 2001).

For the assessment of the conservation status of a particular species, herbarium specimens are often the only source of information available (Rivers *et al.* 2011). There is also a consensus regarding the role of herbaria for the assessment of extinction risk using criterion B, as a main source of information (Wilkin *et al.* 2012; Nic Lughadha *et al.* 2018). For example, Rivers *et al.* (2011) demonstrated that using 15 georeferenced specimens, a robust estimation can be performed on the conservation status based on species distribution.

Herbarium specimens provide spatial data, which are relevant for supporting assessments made under IUCN Red List Criterion B and D2 (Red List Technical Working Group 2018). There are three main reasons for creating a distribution map for taxa being assessed for the IUCN Red List: 1) Informing Red List assessments: supporting calculations of some parameters used in the assessment process, such as the extent of occurrence (EOO); 2) helping to identify conservation priorities; and 3) visual representation.

The Arecaceae are one of the most morphologically diverse and well-known plant families in the world, represented by over 185 genera including 2600 species (Dransfield *et al.* 2008). Since ancient times, people have harvested palms, in the tropics and subtropics, for multiple purposes as building materials, source of food, handicrafts, and medicine (Dransfield *et al.* 2008). Twenty native palm species grow in the Yucatán Peninsula (YP) of Mexico where the Mayan communities use palms extensively as food (*e.g.* *Acrocomia aculeata* (Fig. 3A) and *Attalea guacuyule*), roofing houses (*e.g.* *Sabal mexicana* (Fig. 4F) and *S. yapa* (Fig. 2C)), construction (*e.g.* *Coccothrinax readii* and *Thrinax radiata*), and even in handicrafts and ornaments (*e.g.* *Pseudophoenix sargentii* and *T. radiata*) (de la Torre *et al.* 2009). Deforestation, overharvesting of populations and their products, lack of management strategies, global warming, and climate change are supposed to be negatively impacting wild palm populations (Alvarado Segura *et al.* 2015).

The Mexican regulation aims to identify species or populations of wild flora and fauna at extinction risk in Mexico (DOF 2010). There are nine native palm species in the YP included in the Mexican regulation (DOF 2010), five of them with a category of endangered (*Coccothrinax readii*, *Cryosophila stauracantha*, *Gaussia maya*, *Pseudophoenix sargentii*, and *Thrinax radiata*) and the remaining four species under the special protection category (*Attalea guacuyule*, *Roystonea dunlapiana*, *R. regia*, and *Sabal gretherae*). This means that 45% of the regional palm species are either endangered or under the special protection category in accordance with Mexican legislation.

The objective of this study was to assess the current regional conservation status of palm species in the Mexican portion of the YP based on the criterion B of the IUCN in comparison to earlier evaluation (DOF 2010; IUCN 2014). Another objective was to promote the implementation of target 2 of the Global Strategy for Plant Conservation, assessing the extinction risk category of the native palm species to the YP, Mexico.

## Materials & Methods

### Study area

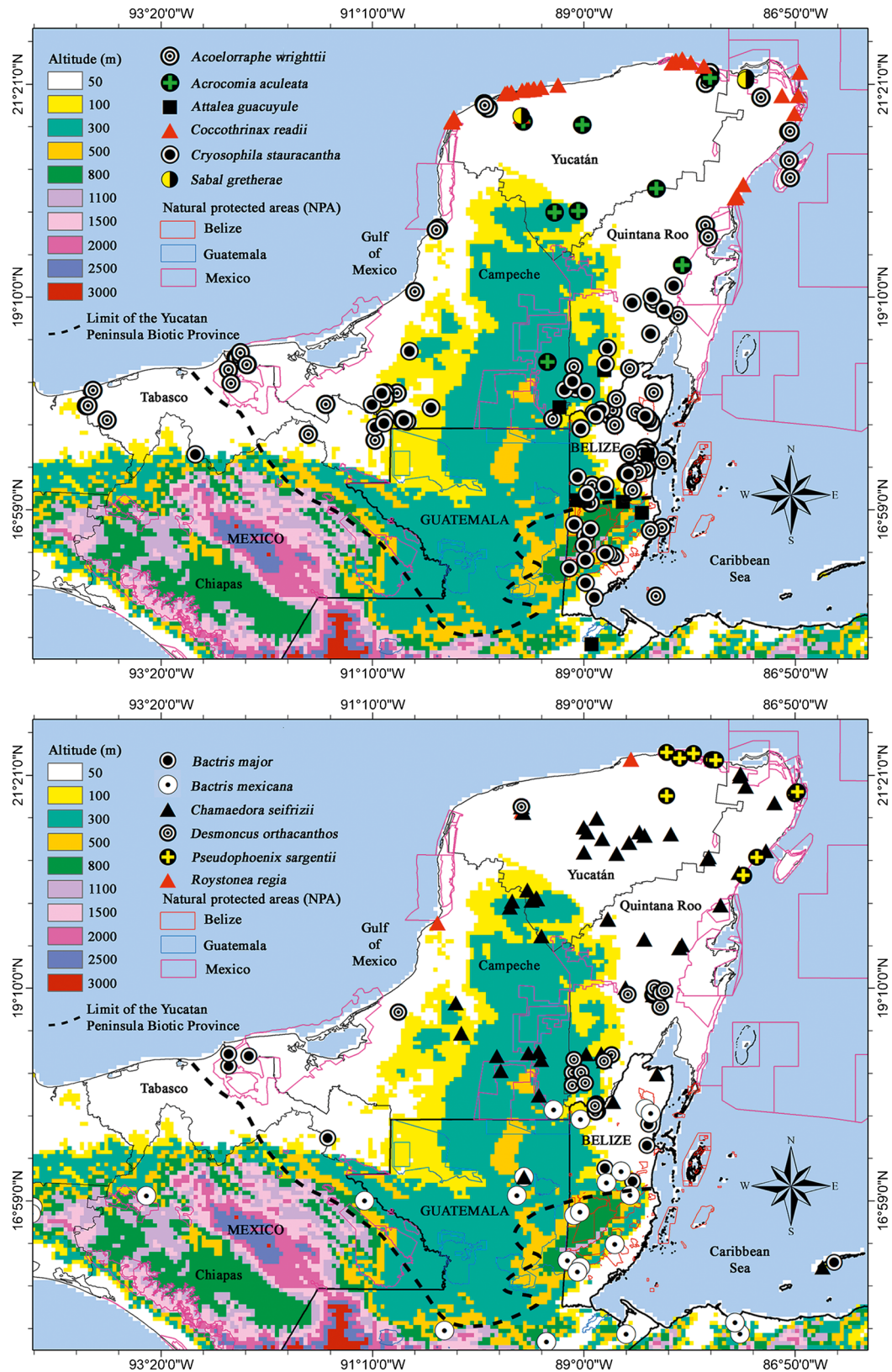
The Mexican portion of the YP includes the states of Campeche, Quintana Roo and Yucatán (Maps 1, 2). The YP is characterised mainly by calcareous rocks (and the soils derived from them), with elevations below 350 m, low surface hydrography, with annual average temperatures between 25 – 28°C with precipitation not exceeding 2200 mm per year; the karst geology, associated with calcareous substrate determines underground drainage systems, with typical formations of caves and cenotes. The area originated as a result of the tectonic movements during the Miocene and Plio-Pleistocene and has a large marine limestone platform. These rocks are older and more exposed in the south (Cretaceous) than the recent ones in the north (Pleistocene-Holocene) (Lugo-Hubp *et al.* 1992).

### Palm species and herbarium collections

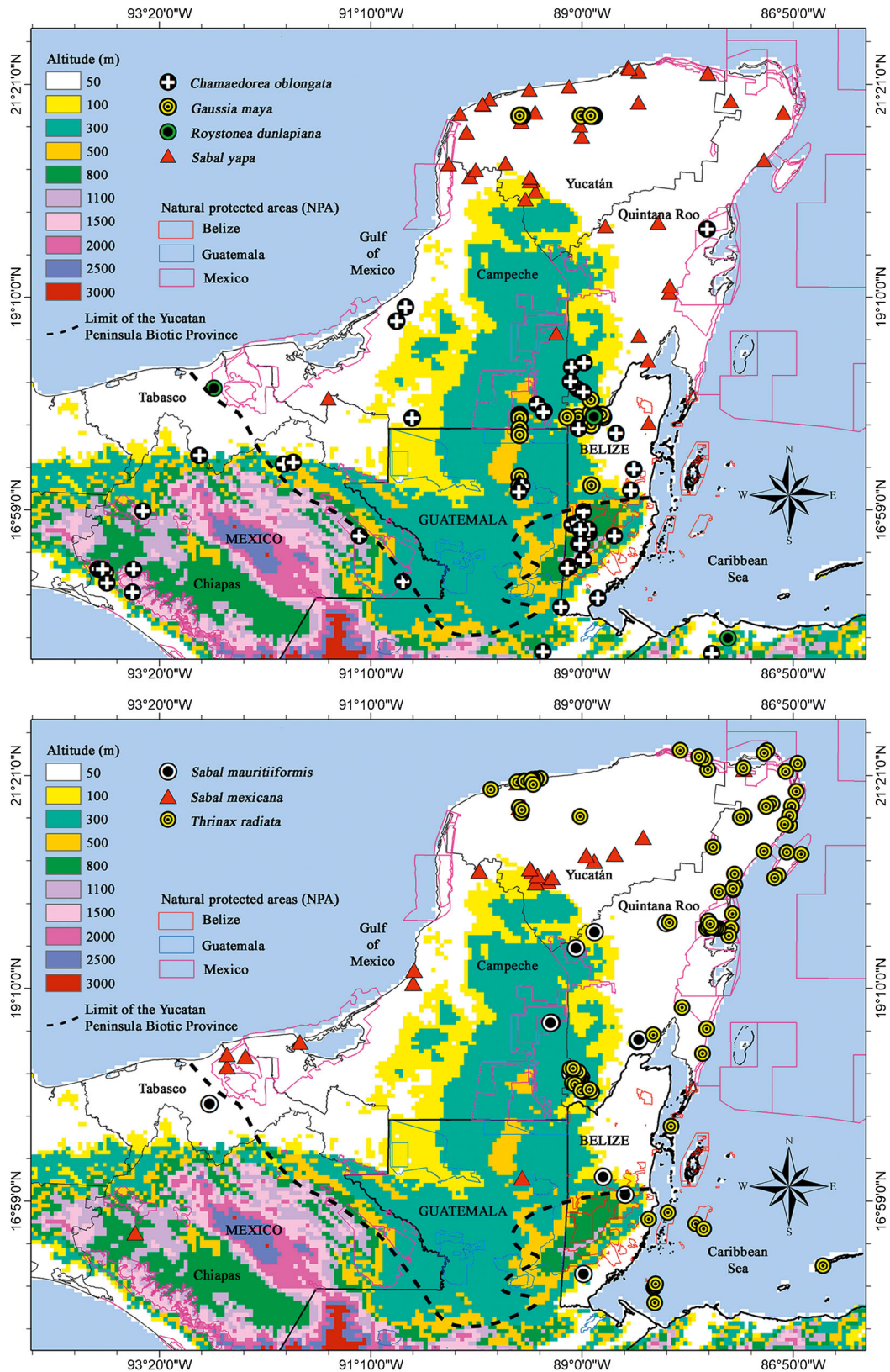
We reviewed 3191 herbarium specimens stored at the Universidad Autónoma de Campeche (UCAM), the Centro de Investigación Científica de Yucatán, A.C. (CICY), and the Missouri Botanical Garden (MO) (Fig. 1A). The fact that some species that grow in the YP are widely distributed outside it, especially in Central America, suggests the need for consulting several national and regional herbaria for comprehensive information regarding those species. However, in our analyses the online database of the Missouri Botanical Garden, <http://www.tropicos.org> (Tropicos 2015), was a successful tool for a preliminary conservation assessment of these species. Complementary information was obtained through taxonomic literature when less than 10 specimens were obtained for *Roystonea* (Zona 1996) and *Pseudophoenix* (Zona 2002).

### Species Distribution and Assessment of Conservation Status

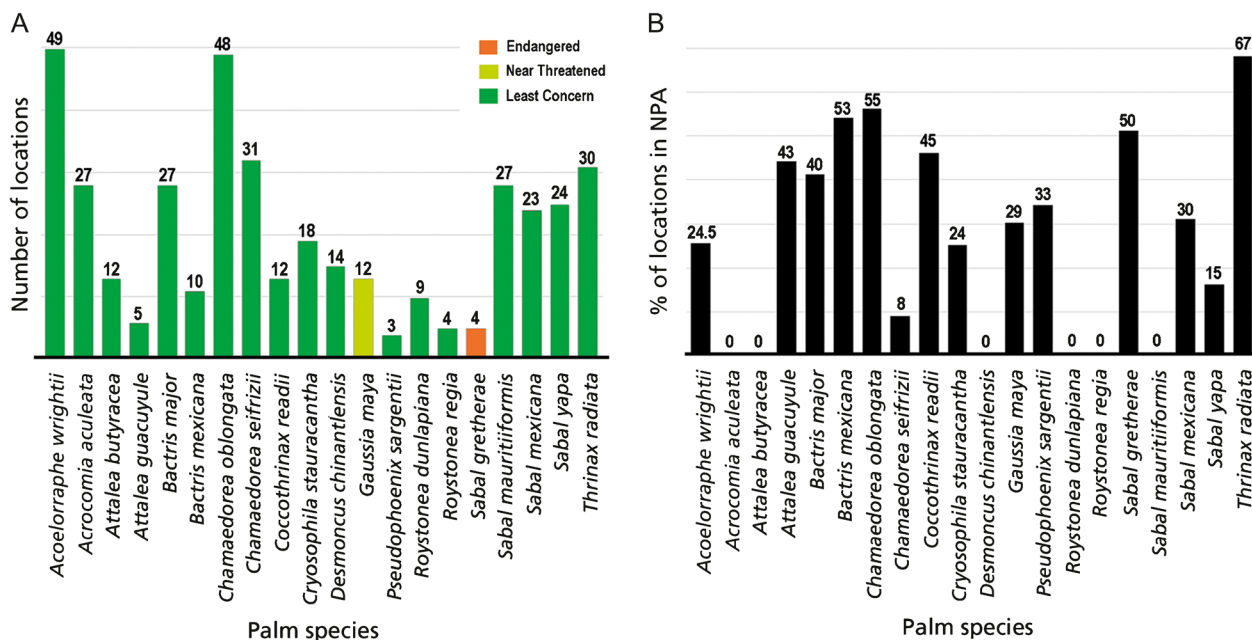
Georeferenced data were obtained from the herbarium databases consulted (CICY, MO, UCAM). In general, botanical samples in these herbaria have geographic coordinates. If any sample did not have such information, it was estimated. Using the



**Map 1.** Distribution of several native and endemic palms in natural protected areas in the Yucatán Peninsula Biotic Province.



**Map 2.** Distribution of several native and endemic palms in natural protected areas in the Yucatán Peninsula Biotic Province.



**Fig. 1.** Locations of native and endemic palms in the Yucatán Peninsula Biotic Province. **A** number of locations; **B** percentage of locations in natural protected areas.

georeferenced-species list, we generated a distribution map and assigned the risk categories based on the IUCN criteria (IUCN 2017) and using the GeoCAT tools (Bachman *et al.* 2011). The variable extent of occurrence (EOO), and area of occupancy (AOO) were estimated with GeoCAT (Bachman *et al.* 2011). Although GeoCAT does not directly calculate the number of locations in the sense of the IUCN, it can be calculated if the AOO value is divided by four. The GeoCAT is an open source, browser-based tool that performs geospatial analysis to ease the process of Red Listing taxa. It has been developed to utilise spatially referenced primary occurrence data. The analysis focuses on two aspects of the geographic range of a taxon: the EOO and the AOO. Estimates of AOO are highly sensitive to the spatial scale at which AOO is measured. To ensure valid use of the criteria and maintain consistency of Red List assessments across taxa, it is essential to scale estimates of AOO using  $2 \times 2$  km grid cells. The number of populations in natural protected areas was estimated in the YP and also in all distribution areas for each species. This information was obtained from The Protect Planet Online Platform (UNEP-WCMC 2019a, b, c) (Maps 1, 2).

## Results

All 20 native palm species were evaluated (Maps 1, 2, Figs 2 – 4), with four species for the first time: *Attalea guacuyule*, *Bactris mexicana*, *Cryosophila stauracantha*, and *Desmoncus chinantlensis* (Fig. 3E). For a species to

be a candidate for a risk category, it should have an EOO less than 20,000 km<sup>2</sup> or an AOO less than 2000 km<sup>2</sup>. It also needs to meet at least two of the three following conditions: 1) severely fragmented or low number of locations (<10), 2) continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals, and 3) extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals.

Eighteen species have an EOO greater than 20,000 km<sup>2</sup> (Table 1). These species have an AOO between 10 and 500 km<sup>2</sup>, values suited for Endangered category, but none of them meets at least two of the additional sub-criteria to be considered Endangered or Vulnerable. All these eighteen species are considered Least Concern (LC) due to their large EOO, large number of localities, and some of them growing in protected areas (Fig. 1B). However, *Gaussia maya* has an EOO less than 10,000 km<sup>2</sup> and an AOO less than 500 km<sup>2</sup>; but does not meet at least two of the three additional sub-criteria to be considered as Vulnerable, but as Near Threatened (NT). All these 19 species were considered non-threatened supporting previous evaluations (Table 1). Only *Sabal gretherae* meets the criteria of threatened category as Endangered (E) due to its small EOO (12 km<sup>2</sup>), small AOO (12 km<sup>2</sup>), few localities (<5), and continuing decline based on EOO and AOO.



**Fig. 2.** Conserved habitats where palms grow in the Yucatán peninsula, Mexico. **A** *Acoelorrhaphe wrightii* (The Hondo River in Quintana Roo); **B** *Attalea guacuyule* (Archaeological zone Kohunlich in Quintana Roo); **C** *Sabal yapa* (Archaeological Zone Xcambó in Yucatán); **D** *Thrinax radiata* (Sian Ka'an Biosphere Reserve). PHOTOS: W. CETZAL-IX.



**Fig. 3.** Some native palms in the Yucatán Peninsula, Mexico. A *Acrocomia aculeata*; B *Chamaedorea seifrizii*; C *Coccothrinax readii*; D *Cryosophila stauracantha*; E *Desmoncus chinantlensis*; F *Gaussia maya*. PHOTOS: A, B, E D. PEDERSEN; C, D, F W. CETZAL-IX.

**Table 1.** Category assignment for palm species, including distribution, uses, extent of occurrence (EOO), area of occupancy (AOO), and conservation status of native palms in the Mexican portion of the Yucatan Peninsula (PC: previous category, AC: assigned category).

Taxa	Distribution	NPA	Uses	EOO (Km <sup>2</sup> )	AOO (Km <sup>2</sup> )	PC	AC
<i>Acoelorrhaphe wrightii</i> (Griseb. & H.Wendl.) H.Wendl. ex Becc.	ANT, CA, SA	B, E, F, J, K	4, 5, 6, 10	869,974.750	376	NRT <sup>b</sup>	LC
<i>Acrocomia aculeata</i> (Jacq.) Lodd. ex Mart.	NA, CA, SA		1, 3, 4, 6, 7, 9, 10	8,087,223.226	140	NRT <sup>b</sup>	LC
<i>Attalea butyracea</i> (Mutis ex L.f.) Wess.Boer	CA, SA		1, 3, 4, 6, 7, 8, 10	4,302.544 (40% water)	128	VU <sup>b</sup>	LC
<i>Attalea guacuyule</i> (Liebm. ex Mart.) Zona	ME		6	903,096.238	48		LC
<i>Bactris major</i> Jacq.	CA, SA	L, M	1, 2, 3, 6, 10	4,754.358 (20% water)	348	NRT <sup>b</sup>	LC
<i>Bactris mexicana</i> Mart.	NA, CA		3, 6, 10	204,613 (10% water)	104		LC
<i>Chamaedorea oblongata</i> Mart.	CA, SA	F, J, K	6, 7, 10	722,350 (20% water)	392	VU <sup>a</sup>	LC
<i>Chamaedorea seifrizii</i> Burret	CA	B, C, D, E, F, I, L, M	1, 7, 9, 10	221,891 (30% water)	224		LC
<i>Coccothrinax readii</i> H.J.Quero	PY	F, J, K, M	6, 7, 10	34,264.557	104	EN <sup>b</sup>	LC
<i>Cryosophila stauracantha</i> (Heynh.) R.Evans	CA	A, B, C	3, 4, 6, 10	63,530.000	160	VU <sup>b</sup> , T <sup>c</sup>	LC
<i>Desmoncus chinantlensis</i> Liebm. ex Mart.	CA, SA		3, 4, 6, 10	11,066,942.62	148		LC
<i>Gaussia maya</i> (O.F.Cook) H.J.Quero	PY, CA	C	3, 4, 6, 10	9,704.701	108	VU <sup>c</sup>	NT
<i>Pseudophoenix sargentii</i> H.Wendl. ex Sarg.	ANT, CA	F, J, K	3, 4, 10	884,438.523 (90% water)	96	VU <sup>bd</sup> , T <sup>b</sup>	LC
<i>Roystonea dunlapiana</i> P.H.Allen	ANT, CA	E	3, 4, 6, 10	32,095.375 (50% water)	12	NRT <sup>b</sup> , T <sup>c</sup> , EN <sup>g</sup>	LC
<i>Roystonea regia</i> (Kunth) O.F.Cook.	ANT, CA	D, F, K	3, 4, 6, 10	464,563.016 (60% water)	20	EN <sup>d</sup>	LC
<i>Sabal gretherae</i> H.J.Quero	PY		1, 6, 10	12	12	NRT <sup>b</sup> , SP <sup>c</sup> , VU <sup>f</sup>	EN
<i>Sabal mauritiiformis</i> (H.Karst.) Griseb. & H.Wendl.	NA, CA, SA		1, 3, 5, 6, 7, 9, 10	3,637.102 (50% water)	124	VU <sup>d</sup>	LC
<i>Sabal mexicana</i> Mart.	NA, CA	E, H, I, K, L	1, 3, 4, 5, 6, 7, 9, 10	901,873,903	132	NRT <sup>b</sup>	LC
<i>Sabal yapa</i> C. Wright ex Becc.	NA, CA	B, E, F, G, I, J, K, L	1, 3, 4, 5, 6, 7, 9, 10	131,062.312	148	NRT <sup>b</sup>	LC
<i>Thrinax radiata</i> Lodd. ex Schult. & Schult.f.	ANT, CA	B, D, E, F, I, J, M	1, 3, 4, 5, 6, 7, 9, 10	959,909.967	368	NRT <sup>b</sup>	LC

Distribution areas: ANT = Antilles, CA = Central America, NA = North America, SA = South America, PY = Yucatan Peninsula. Occurrence in Mexican's Natural protected areas (NPA): A = Balam-kú, B = Bala'an Uk'aax Flora and Fauna Protected Area, C = Calakmul Biosphere Reserve, D = Cuxtal Reserve, E = Dzilam State Reserve, F = El Palmar State Reserve, G = Kabah state park, H = Lagunas de Yalahau State Park, I = Punta Laguna Flora and Fauna Protected Area, J = Ría Celestún Biosphere Reserve, K = Ría Lagartos Biosphere Reserve, L = San Juan Bautista Tabi Protected Natural Area of Scenic, Historical and Cultural Value, Sacnicé Annex, M = Sian Ka'an Biosphere Reserve. Uses: 1 = Food, 2 = Food additives, 3 = Vertebrate food, 4 = Melliferous, 5 = Firewood, 6 = Construction, 7 = Social, 8 = Toxic, 9 = Medicinal, 10 = Environmental. Distribution data (based on Alvarado-Segura *et al.* 2014) and uses (de la Torre *et al.* 2009). Conservation status (Alvarado Segura *et al.* 2015<sup>a</sup>, Dransfield *et al.* 1988<sup>b</sup>, DOF 2010<sup>c</sup>, IUCN 2014<sup>d</sup>, Quero 1998<sup>ae</sup>, Quero 1998<sup>bf</sup>, World Conservation Monitoring Centre 1998<sup>g</sup>). EN = Endangered, LC = Least Concern, NRT = Neither rare nor threatened, NT = Near Threatened, SP = Special Protection, T = Threatened, and VU = Vulnerable.

## Discussion

Nine species were included in the Mexican legislation (DOF 2010) under the Threatened (A, Amenazada, in Spanish) category or subjected to special protection (Pr, Sujeta a protección especial, in Spanish). This result is not necessarily contradictory or incompatible. First, the Risk Assessment Method of the Mexican Government only refers to Mexican populations;

secondly, the categories are not the same (Sánchez-Salas *et al.* 2013). Each of these nine species is discussed below.

Several of these species need an additional comment. EOO is calculated by applying a Minimum Convex Polygon (MCP). There are three exceptions to estimate EOO using the MCP: 1) Doughnut distributions (e.g., aquatic species confined to the margins of



a lake); 2) small and highly disjunct subpopulations (e.g., majority of the population occurs on a mainland with an additional subpopulation on a small and distant island); 3) curved linear distributions that are shaped in an arc. In all these cases, the MCP would considerably increase the EOO estimate (see Table 1). The second exception applies to several species with populations in the YP and the Caribbean islands (e.g. *Acoelorrhaphe wrightii* Fig. 2A, *Pseudophoenix sargentii*, and *Roystonea regia*). The third exception applies to *Coccothrinax readii* and *Thrinax radiata*. However, even if AOO is used alone, all species would not be considered at any risk category.

### Conservation status of palm species: special cases

#### *Attalea guacuyule*

This palm has a large distribution in Mexico (Villaseñor 2016); and its conservation status as LC seems to be appropriate. This large species with stems up to 25 m in height and more than 40 cm wide was scarcely found in the evergreen forest of the Southern Quintana Roo. It has a population density of 130 individuals per hectare in the two populations sampled in the evergreen tropical forest (Map 1, Fig. 2B) (Alvarado-Segura *et al.* 2014).

#### *Cryosophila stauracantha*

We found this endemic palm of the YP is not threatened (NT), but it is considered as threatened (A) in the Mexican legislation (DOF 2010). Its global distribution encompasses southern Mexico (Villaseñor 2016), Belize, Guatemala and Honduras (Map 1, Fig. 3D) (Henderson *et al.* 1995). In Mexico, this is the most abundant palm species in the evergreen forest of southern Quintana Roo with population density of 5524 individuals per hectare. It is a species with several 10 cm long spines in the stem and reaches up to 10 m in the forest canopy (Alvarado-Segura *et al.* 2014). In the state of Campeche, important populations are distributed in the Calakmul Biosphere Reserve, where this species is legally protected. It also occurs in the neighbouring areas like Caobas, where the forest has been managed for timber and firewood since 1960. We consider that the present evaluation is more realistic than that carried out by Mexican law (DOF 2010).

#### *Coccothrinax readii*

We found this endemic species of the YP (Map 1, Fig. 3C) as not threatened (LC) but it is included in the Mexican legislation (DOF 2010) under a category subject to special protection (Pr). It grows in the coastal matorral dune and in the medium subdeciduous forest (DOF 2010), including some

important protected areas as Sian Kaan and Ría Lagartos. There are important natural populations occurring in protected areas with a population density of 722 – 760 individuals per hectare (Alvarado-Segura *et al.* 2014). The main threat to this species is the deforestation around the coastal areas through a massive tourist development. Also, the stem of this solitary medium sized palm is used to build traditional Mayan houses. A small house (8 × 4 m<sup>2</sup>) can be constructed using up ~480 adult trunks and ~600 palms (Olmsted & Álvarez-Buylla 1995). It is our opinion that the present evaluation is very optimistic and that the Mexican legislation (DOF 2010) took the correct step in considering this species in the category of special protection; and that it must be maintained. Also, previous evaluation as VU is more realistic (Dransfield *et al.* 1988; IUCN 2014).

#### *Gaussia maya*

*Gaussia maya* is also an endemic palm from the Yucatán Peninsula Biotic Province. It has a southern distribution, in a small triangle including the south of Mexico, Belize, and Guatemala (Map 2, Fig. 3F). *Gaussia maya* occurs in the Calakmul Biosphere Reserve where the species is legally protected. It is also occurs in neighbouring areas including Caobas, where the forest is managed for wood extraction; in this last locality, the species has a density of 39 individuals per hectare (Alvarado-Segura *et al.* 2014). Nevertheless, this palm is included in the NOM-059-SEMARNAT-2010 (DOF 2010) as a threatened species. *Gaussia maya* has an EOO less than 10,000 km<sup>2</sup> and an AOO less than 500 km<sup>2</sup>; but, there are many localities (>10), where the species is abundant and some in protected areas (Fig. 1). This species is therefore considered as Near Threatened (NT).

#### *Pseudophoenix sargentii*

We found this species as not threatened (LC). This palm has a wide distribution in the Caribbean basin including Mexico (Map 1, Fig. 4A), Belize, Bahamas, Dominica, Dominican Republic, Puerto Rico, and the Turkos & Caicos Islands (Henderson *et al.* 1995). In Mexico, it occurs only in the northeast portion of Yucatán State and the eastern portion of Quintana Roo State. It is found in the coastal areas including coastal dune, scrub coastal dune, low deciduous forest and medium sub-deciduous forest. This species has been found in the Riviera Maya, which is currently under massive tourist development (Quero 1981, 1998a). The populations are restricted and isolated but the population density can be very high, between 3200 – 15,000 individuals per hectare; but the population is asymmetrical with 70 – 90% of individuals being seedlings. The palm is easy to extract and resistant to transplantation. The harvest of leaves from palms of wild populations has been recorded because



**Fig. 4.** Some native palms in the Yucatán Peninsula, Mexico. A *Pseudophoenix sargentii*; B *Roystonea dunlapiana*; C *R. regia*; D *Sabal gretherae*; E *S. mauritiiiformis*; F *S. mexicana*. PHOTOS: A – C, F W. CETZAL-IX; D – E D. PEDERSEN.

it has a high ornamental value (Quero 1981). The present evaluation is very optimistic at the national level and, thus, the Mexican legislation (DOF 2010) took a correct step in considering this species in the category of special protection and it must be maintained.

#### Roystonea dunlapiana

We found this species as not threatened (LC) but it is included in the Mexican legislation under the category subject to special protection (DOF 2010) or Endangered by the IUCN (World Conservation Monitoring Centre 1998). It occurs dispersed in several estuarine areas from Veracruz (Gómez-Pompa *et al.* 2010), Tabasco (Magaña-Alejandro & González-Hernández 2017), Campeche and Quintana Roo in Mexico (Map 2, Fig. 4B) to Honduras, and Nicaragua (Zona 1996). This last author mentioned that the information on this species is based on only few specimens; and that there is no information regarding the staminate flowers. It is therefore necessary to develop a programme to evaluate the distribution and population density of this species in Mexico to reconsider a final decision about its conservation status at both the national and international level.

#### Roystonea regia

We found this species categorised as Least Concern (LC) but it is included in the Mexican legislation under the category subject to special protection (DOF 2010). It occurs in the southeast of the USA (Florida), Mexico (Campeche, Tabasco, Veracruz, and Yucatán) (Map 1, Fig. 4C), Belize, Honduras and the Greater Antilles (Cuba). The species is abundant in Florida and Cuba (Zona 1996) and is widely cultivated as an ornamental palm in some cattle farms of Campeche, Tabasco, and Veracruz.

#### Thrinax radiata

We found this species is not threatened (LC). However, this palm is officially considered in Mexico in the category subject to special protection (DOF 2010). It is one of the most common species of the coastal scrub dune as well as the low deciduous forest. It occurs along a narrow band in the north of Campeche, Yucatán and Quintana Roo in Mexico as well as in Belize, from Corozal to Stann Creek districts (Map 2, Fig. 2D). This species is found in many natural protected areas, including the Sian Ka'an Biosphere Reserve. The population density varies between 1116 – 1173 individuals per hectare in the tropical deciduous and semi-deciduous forest of Quintana Roo (Alvarado-Segura *et al.* 2014). Despite the fact that many coastal areas have been destroyed by aggressive tourism development, there are huge populations in the region. Also, the species is widely cultivated as an orna-

mental palm. It is our opinion that the present evaluation is more realistic than that carried out by the Mexican law (DOF 2010).

#### Sabal gretherae

*Sabal gretherae* is an endemic palm species occurring from the Mexican portion of the YP (Map 1, 4D), and all information suggests it is an Endangered species (EN). We find that *S. gretherae* is better suited to the category of Endangered (EN). This species has an EOO and an AOO of 12 km<sup>2</sup>, it has four known localities and fits some of the conditions of subcriterion B. The IUCN alphanumeric summary of our evaluation of criteria and subcriteria is: B1 ab(i,ii,iii) + B2 ab(i,ii,iii). *Sabal gretherae* is included in the Mexican legislation under the category subject to special protection (DOF 2010) or Vulnerable by the IUCN (Quero 1998b). However, it is necessary to evaluate the taxonomic status of the species before any formal conclusion. Palm specialists considered it a synonym of *S. mexicana* or a natural hybrid (*S. yapa* × *S. mexicana*) (H. Balslev, pers. comm., 9 Jan. 2016). In this sense, the conservation status of this species is pending its final taxonomic status: hybrid or real biological species.

#### Conclusion

We assign the LC category to six species without prior evaluation (*Attalea guacuyule*, *Bactris mexicana*, *Chamaedorea oblongata*, *C. seifrizii* (Fig. 3B), *Desmoncus chinantlensis*, and *Gaussia maya*). Also, seven species are assigned a lower category than their previous evaluation and seven of them, a higher category. *Sabal gretherae* needs a taxonomic evaluation before a definitive conservation status can be assigned.

#### Compliance with ethical standards

**Conflict of Interest.** The authors declare that they have no conflict of interest.

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