



FLAAR
MESOAMÉRICA

WETLANDS #5

CACAO SUBSTITUTE

— ZAPOTÓN SEEDS —

Pachira aquatica

Swamp and Marshes,
at the caribbean Sea

NICHOLAS HELLMUTH

WETLANDS #5

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— ZAPOTÓN SEEDS —

Pachira aquatica



Municipio de Livingston,
Izabal, Guatemala

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CREDITS

The helpful individuals listed below are all part of the FLAAR Mesoamerica research and field work team. The office research team, webmaster, and web designers are additional individuals in the main office in Guatemala City. Since each report is a different plant or animal, the individuals who assist in preparing the bibliography, species identification and botanical information category are not the same for each report.

Author

Nicholas Hellmuth

Compilation of Basic Data From Earlier Botanist

Vivian Hurtado

Bibliography Team

Nicholas Hellmuth
Vivian Hurtado

Photographers

Nicholas Hellmuth
Victor Mendoza
David Arrivillaga

Editors

Alejandra Valenzuela

Manager of Design and Layout

Andrea Sánchez Díaz

Layout of this English Edition

Heidy Galindo

APPRECIATION

Assistance for local Access, Municipio de Livingston

Daniel Esaú Pinto Peña, Alcalde of Livingston (Izabal, Guatemala).

Initiation of the Project of Cooperation, February and March 2020

Edwin Mármol Quiñonez, Coordinación de Cooperación de Livingston (Izabal, Guatemala).

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This donation is from a family in Chicago in honor and memory of botanist Dr John D. Dwyer, who worked in many areas of Mesoamerica, including in the Yaxha area in the 1970's while the site was being mapped by FLAAR.

This donation is also in recognition of the urgency and need for conservation of both wildlife and rare plants in the bio-diverse ecosystems of the Reserva de la Biosfera Maya (RBM) of Guatemala. Parque Nacional Yaxha, Nakum and Naranjo (PNYNN) is one part of the over 5 million acres of the RBM.

Pachira aquatica.

Photo by: David Arrivillaga, FLAAR Mesoamerica, Dec. 14, 2021, 11:05 a.m.
Lagunita Creek reserve, Livingston. Camera: iPhone 13 Pro Max.

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Edible Wetlands Plants of Municipio de Livingston, Izabal

Wetland Series 1: from Swamps, Marshes and Seasonally Inundated Flatlands of Izabal



Wetland Series 2: plants that grow along the beach shore of Amatique Bay



Wetland Series 3: plants that grow alongside water: rivers, lagoons, swamps, or ocean





Pachira aquatica.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Dec. 14, 2021, 1:23 p.m. Lagunita Creek reserve, Livingston, Izabal.
Camera: iPhone 13 Pro Max.

INTRODUCTION TO *PACHIRA AQUATICA*

This *Pachira aquatica* tree is a close relative of *Ceiba pentandra*: you notice this when you see a young trunk of each: they are the same color and vertical color striations. This tree is not a relative of zapote but its fruit is same color on the outside.

The fruit is one of the largest, and heaviest, for a wild native fruit tree of all Mesoamerica. No one today in Guatemala eats the seeds, but the gigantic seeds are not only edible but also can make "chocolate" (substitute).

Pachira aquatica grows along the edge of rivers, lakes, lagoons and in swamps and marches.

Thousands of *Pachira aquatica* trees were available in the Maya Lowlands, the coastal area (facing Amatique Bay (a bay of the Caribbean Sea), and along the Costa Sur (facing the Pacific Ocean).

So let's document and explain the potential of this tree both for wildlife conservation (lots of creatures love to eat what's inside the giant fruits). Also for wildlife conservation is that the large showy flowers of *Pachira aquatica* provide nutrients for lots of pollinators.



Many flowers, like this from *Pachira aquatica*, outstanding from its tree leaves.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Dec. 14, 2021, 1:30 p.m. El Golfete Rio Caliz, Livingston.

Camera: Canon EOS-1D X Mark II. Lens: Canon EOS-1D X Mark II C. Settings: 1/250 sec; f/20; ISO 8,000.

MY PERSONAL EXPERIENCE WITH *PACHIRA AQUATICA*: FLOWERS AND FRUITS, **NICHOLAS HELLMUTH**

One of the first times that I paid attention to *Pachira aquatica* was over a decade ago while visiting the town of Naranjo, along the Rio San Pedro, in western Peten, Guatemala. There were *Pachira aquatica* trees along the edge of the river with the giant zapoton fruits so clearly visible. I was with botanist Mirtha Cano; we were studying water plants, especially *Nymphaea ampla*.

Also a decade ago, while staying at the guest house of Richard Bronson and his son Juan Bronson, a hundred meters north of the highway bridge over Rio Dulce, there was *Pachira aquatica* sprouting up from the 20 cm deep water, documenting for me that this tree can also sprout up from low standing water area (in addition to shores of seasonally inundated swamp areas). Some of us stayed in the boat of Scott Forsyth which was anchored there in those years.

Then also a decade ago, while staying in the comfortable Las Guacamayas facility of Nini Berger, I noticed young and mature *Pachira aquatica* along most of the edges of the Rio San Pedro, especially where there were marshes along one side of the river.

I also saw lots of *Pachira aquatica* driving to Auto Safari Chapin, in the Costa Sur. Plus there were *Pachira aquatica* trees with their beautiful flowers and giant fruits along the edge of the lagoons of Auto Safari Chapin.

Plus while doing botanical research at Tikal while biologist Mirtha Cano was there, I photographed the *Pachira aquatica* tree adjacent to the aguada. So during our August 2018-July 2019 project at nearby Parque Nacional Yaxha, Nakum and Naranjo I looked for *Pachira aquatica* trees along the edge of Lake Yaxha and Rio Ixtinto and along Rio Holmul. I never saw one single solitary *Pachira aquatica* in the entire park. Is the chemistry of the water here not what *Pachira aquatica* prefers?

But when doing field work for our Municipio de Livingston project, February and March 2020 and then autumn 2020 through all twelve months of 2021, I saw and photographed *Pachira aquatica* along the swampy edges of many of the rivers that flow into Rio Dulce or El Golfete. *Pachira aquatica* is very common in these areas. Keep in mind that many of these rivers and inland areas have brackish water.

MY PERSONAL EXPERIENCE WITH *PACHIRA AQUATICA*, VIVIAN HURTADO

In the Municipio of Livingston I have observed this tree on the shore of Quehueche Beach and I have been fortunate enough to find it blooming (in December), since its flowers seem spectacular to me. They are very similar to the amapola flowers (*Pseudobombax ellipticum*), but differ by their larger size (18-30 cm) and having bicolor stamens, the tips are pinkish-red, while the rest is white, their petals are presented in cream or yellowish color.

My first encounter with *Pachira aquatica* was also with the FLAAR team. We were documenting flora in Senahu, Alta Verapaz and we saw it on the road back to Tamahu. Fortunately, on that occasion it was also blooming (January) and we achieved capturing good photographs of its flowers and fruits. Both of them really impressed me because of their singularity and size. Later I learned about its edible, medicinal and dyeing uses, in addition to the fact that its flowers are very representative in Mayan art, so to this day I can say that it is one of my favorite trees.

***Pachira aquatica*.**

Photo by: María Alejandra Gutiérrez, FLAAR
Mesoamerica, Dec. 14, 2021, 2:19 p.m. Río Chocón
Machacas, Guatemala. Camera: iPhone 13 Pro Max.



FULL BOTANICAL NAME

Pachira aquatica Aubl. is the accepted name according to tropicos.org

Originally this tree was in family Bombacaceae; then it was moved to Bombacoideae; and now is in family Malvaceae.

HERE ARE SYNONYMS FOR **PACHIRA AQUATICA**

This plant has variety of synonyms, according to tropicos.org and theplantlist.com

- *Bombax aquaticum* (Aubl.) K.Schum.
- *Bombax insigne* Wall.
- *Bombax macrocarpum* (Schltdl. & Cham.) K.Schum.
- *Bombax rigidifolium* Ducke
- *Carolinea grandiflora* (Tussac) Spach
- *Carolinea macrocarpa* Schltdl. & Cham.
- *Carolinea princeps* L.f. [Illegitimate]
- *Pachira aquatica* var. *occidentalis* Cuatrec.
- *Pachira aquatica* var. *surinamensis* Decne.
- *Pachira carolinea* Dum.Cours. [Illegitimate]
- *Pachira grandiflora* Tussac
- *Pachira longifolia* Hook. [Illegitimate]
- *Pachira macrocarpa* (Schltdl. & Cham.) Walp.
- *Pachira pustulifera* Pittier
- *Pachira spruceana* Decne.
- *Pachira villosula* Pittier
- *Pachira villulosa* Pittier
- *Sophia carolina* L.



Pachira aquatica.

Photo by: David Arrivillaga, FLAAR Mesoamerica, Dec. 11, 2021, 1:48 p.m. Lago Lagartos, Izabal.
Camera: Sony A7R (ILCE-7RM4). Lens: Sony FE 90mm Macro G OSS. Settings: 1/400 sec; f/8; ISO 1,600.



Pachira aquatica.

Photo by: David Arrivillaga, FLAAR Mesoamerica, Dec. 11, 2021, 1:52 p.m. Lago Lagartos, Izabal.
Camera: Sony A7R (ILCE-7RM4). Lens: Sony FE 90mm Macro G OSS. Settings: 1/400 sec; f/8; ISO 1,600.

LOCAL NAMES FOR **PACHIRA AQUATICA**

Zapotón, Zapote bobo (Guatemala); Zapote de agua, Zapote de santo domingo, Amapola, Cuyche, Shila blanca, Zapote de agua (México)

HOW MANY OTHER PLANTS OF GUATEMALA HAVE THE SAME SPANISH NAME?

Zapotón can be confused with the common Zapote, but despite their similarity in name and appearance of the fruit, they are very different species. Zapoton belongs to the Bombacaceae family and the common Zapote, or also called Mamey, belongs to the Sapotaceae family. There are also other fruits of different species and families that are known as Zapote, such as *Diospyros nigra* (Ebenaceae), which is commonly called "Black Zapote". There's also the "White Zapote" (*Casimiroa edulis*: Rutaceae) and "Chicozapote" (*Manikara zapota*: Sapotaceae).

Due to the fact that there are more fruits related to the name "Zapote", it is important to differentiate the species of each one, since it is very likely that most of them are not taxonomically related.

MAYAN NAMES FOR **PACHIRA AQUATICA**

According to the Yucatan Scientific Research Center (CICY in Spanish) the Mayan Yucatec name for *Pachira aquatica* is *k'uuy che'*, but surely there must be more names in different Mayan languages for this plant.

HABIT FOR ***PACHIRA AQUATICA***

Tree, can reach up to 20 meters high. The color of the trunk, when young, has parallel color patterns comparable to its relative *Ceiba pentandra*. But I do not see spines on the trunk of *Pachira aquatica*. And although *Pachira aquatica* can grow many decades, it never reaches the extreme height of a century-old *Ceiba pentandra* tree.

HABITAT FOR ***PACHIRA AQUATICA***

Pachira aquatica, in its native range, commonly grows in freshwater wetlands and seasonally flooded forests, along river banks, lake shores, and on the edge of mangroves and woods, always on moist ground (Robyns, 1963, 1964; Infante-Mata et al., 2011, 2014). It has been reported to 1,300 masl (Duarte and Paull, 2008).

WHAT OTHER TREES OR PLANTS ARE **OFTEN FOUND IN THE SAME HABITAT?**

In Livingston you see *Pachira aquatica* along the edges of rivers and swamps. In both areas it obviously prefers sun but you often see it “deep into a swamp” where there are so many trees growing out of the shallow water that not much sun hits the ground level.



Pachira aquatica.

Photo by: David Arrivillaga, FLAAR Mesoamerica, Dec. 11, 2021, 12:18 p.m. Lago Lagartos, Izabal.
Camera: Sony A7R (ILCE-7RM4). Lens: Sony FE 90mm Macro G OSS. Settings: 1/1000 sec; f/10; ISO 2,500.



Pachira aquatica.

Photo by: David Arrivillaga, FLAAR Mesoamerica, Dec. 12, 2021, 12:43 p.m. Lago Lagartos, Izabal.
Camera: Sony A7R (ILCE-7RM4). Lens: Sony FE 90mm Macro G OSS. Settings: 1/640 sec; f/6.3; ISO 2,000.

BOTANICAL DESCRIPTION OF *PACHIRA AQUATICA* IN STANDLEY AND CO-AUTHORS CHICAGO BOTANICAL MONOGRAPHS

Pachira aquatica Aubl. Pl. Guian. 725. pis. 291, 292. 1775. *Carolinea princeps* L. f. Suppl. 314. 1781. *C. macrocarpa* Schlecht. & Cham. Linnaea 6: 423. 1831. *P. macrocarpa* Walp. Repert. Bot. 1: 329. 1842. Zapoton; Pumpunjuche; Uacoot (Petén, Maya); Zapote bobo (Petén). Densely forested or more usually rather open swamps, sometimes in or at the edge of brackish water, chiefly at or near sea level, at higher elevations growing along stream banks, at 300 meters or less; Peten; Izabal; Santa Rosa; Escuintla; Suchitepéquez; Retalhuleu; San Marcos. Southern Mexico to British Honduras and Panama; South America. A large or small tree, sometimes flowering when only a shrub, commonly 12-20 meters high, seldom more than 60 cm. in diameter, supported by usually narrow and tall buttresses, the bark light brown or grayish, smooth, the crown usually small but sometimes depressed and spreading; branchlets glabrous or nearly so, thick; leaves long-petiolate, the leaflets 5-8, rather thick and somewhat coriaceous, elliptic-oblong to oblanceolate-oblong, 8-20 cm. long, acute or obtuse, attenuate to the base, glabrous above, beneath glabrous to rather densely velutinous-pubescent; calyx 1.5-2 cm. long, densely yellowish-tomentulose, truncate; petals 18-30 cm. long, about 1 cm. wide, often involute, tomentulose outside, white or pale greenish yellow; stamens very long, the stout tube 4.5-12 cm. long, the slender filaments purple or reddish; fruit subglobose or ovoid, mostly 20-30 cm. long, light brown, smooth or nearly so. Known in British Honduras as "provision tree" and "Santo Domingo"; called "zapote de agua" in Chiapas; "shila blanca" in Salvador; "amapola" in Yucatan; "apompo" in Veracruz and Oaxaca. The Maya name in Yucatan is recorded as "cuyche." The tree is particularly abundant along or near the North Coast, often dominant in shallow open swamps where it forms dense groves. It is conspicuous because of the light-colored smooth bark, and especially on account of the huge, very hard and heavy fruits which occur in such abundance that one wonders how the trees can support such a load. Fruits are found sometimes on trees no more than 2 meters high. The fruits often weigh six pounds or more, and are filled with solid white flesh in which the many large seeds are imbedded. Sometimes or perhaps usually they remain upon the trees until ripe, when they open, and the brown seeds, often as large as a hen's egg, fall into the water. There they soon germinate and float about with expanded cotyledons until they land on some shoal or bank, where they root. The seeds, called "saba nuts" in Atlantic Nicaragua, are cooked and eaten in some parts of Central America. The young leaves are said to be cooked and eaten in South America. Probably the highest region in which the tree grows in Guatemala is in the vicinity of San Felipe and Retalhuleu, where it is frequent along streams. The exceedingly large flowers are handsome and rather showy, but the petals, of course, are very narrow.

(Standley and Steyermark 1949: 400).

PACHIRA AQUATICA MENTIONED IN TREES AND SHRUBS OF MÉXICO, STANDLEY

In this year *Pachira macrocarpa* was still thought to be a separate species. But *Pachira aquatica* was now recognized as another species. Later botanists realized they were all the same so merged *Pachira macrocarpa* in with *Pachira aquatica*. From the description of *Pachira macrocarpa* you can see they are the same:

1. **Pachira macrocarpa** (Schlecht. & Cham.) Walp. Repert. Bot. 1: 329. 1842. *Carolinea macrocarpa* Schlecht. & Cham. Linnaea 6: 423, 1831. *Pachira longifolia* Hook, in Curtl's Bot. Mag. 76: pi. 1850. Veracruz and Oaxaca; reported from Tabasco; type from Papantla and Tecolutla, Veracruz. Central America. Large tree with rounded crown; leaflets 6 to 8, elliptic-oblong or obovate-oblong, 8 to 10 cm. long, obtuse or acutish, coriaceous, glabrous; calyx 1.5 cm. long, minutely tomentulose; petals 7 to 11 mm. wide, minutely tomentulose outside; stamens purplish; fruit subglobose. "Apompo," "zapote reventador" (Veracruz); "sapot6u" or "zapotfin" (Guatemala, El Salvador); "pumpum-Juche" (El Salvador). The fruit is said to be as large as a coconut. The tree usually grows along river banks. The seeds fall into the water, where they germinate and float about with expanded cotyledons until they reach the bank and take root. The leaves and flowers are said to be employed to relieve inflammation of the eyes, and the seeds to be employed as a substitute for cacao. *Pachira longifolia* appears to be intended as a new name for *P. macrocarpa*, but the plant illustrated is probably *P. aquatica*. For Illustrations of *P. macrocarpa* see Contr. U. S. Nat. Herb. 18: pi, 68, 69.

2. **Pachira aquatica** Aubl. Pl. Gulan. 725. pi, 291, 292. 1775. *Carolinea princeps* L. f. Suppl. Pl. 314. 1781. Veracruz and probably elsewhere; reported from Tabasco and Chiapas, Central and South America; type from French Guiana. Large or small tree; leaflets 5 to 7, oblong, elliptic, or oblanceolate, 8 to 20 cm. long, acute to rounded at apex, coriaceous, glabrous or nearly so; calyx. 1.5 to 2 cm. long; petals 10 to 15 mm. wide, greenish and tomentulose outside, yellowish within; fruit ovoid, 10 to 30 cm. long. " Zapote bobo" (Tabasco, Ramirez); " zapote de agua " (Chiapas, Rovirosa); " ceibdn de agua " " ceibfin de arroyo," " castafio silvestre" (Cuba). The tree is said to be known in British Honduras as " provision-tree." The large seeds are often eaten, usually after having been roasted, and it is said that in the Guianas the young leaves are sometimes cooked and eaten. Here is to be referred Hemsley's report of *P. imignis* Savigny, a Brazilian plant. Hemsley also reports *P. minor* (Sims) Hemsl. from Mexico, but the original illustration¹ of that species is unlike any Mexican plant of which the writer has seen specimens. For illustrations of *P. aquatica* see Contr. U- S. Nat. Herb. 18: pi. 70, 71.

PACHIRA AQUATICA IN BELIZE **(BALICK, NEE AND ATHA 2000)**

Pachira aquatica Aubl. — **Syn:** *Pachira macrocarpa* Walp. —

Loc Use: MED, FOOD, CNST. — **Reg Use:** MED, FOOD, DYE.

— Nv: provision bark, provision tree, santo domingo, sapote bobo, uacut, zapote bobo, zapoton. — **Habit:** Tree.

(Balick, Nee and Atha 2000: 68)

BOTANICAL DESCRIPTION OF THE *PACHIRA* ***AQUATICA* BY STANDLEY FOR YUCATÁN**

Pachira macrocarpa (Schlecht. & Cham.) Walp. *Carolinea macrocarpa* Schlecht. & Cham. Kuyche (Gaumer). Sp. Amapola (Gaumer), Zapote reventon (Maler), Santo Domingo (B. H.), Zapotdn (B. H.). Provision-tree (B. H.). No Yucatan specimens seen, but the species is reported from Quintana Roo and occurs in British Honduras. A large or small tree, the trunk unarmed; leaflets 6-8, oblong to obovate, obtuse or acutish, entire, glabrous; flowers about 20 cm. long, the stamens purplish; fruit as large as a coconut, hard, the large seeds (1.5 cm. or more in diameter) imbedded in solid flesh. The tree grows usually in swamps. The large seeds are edible.

Standley 1930: 353-354)



Pachira aquatica.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Dec. 14, 2021, 1:30 p.m. El Golfete Rio Caliz, Livingston.
Camera: iPhone 13 Pro Max.



Pachira aquatica.

Photo by: María Alejandra Gutiérrez, FLAAR Mesoamerica, Dec. 14, 2021, 2:19 p.m. Río Chocón Machacas, Guatemala.
Camera: iPhone 13 Pro Max.

CLOSE RELATIVE(S) OF **PACHIRA AQUATICA**

According to Berazain (2018), *Pachira aquatica* is most closely related to *Pachira insignis* and *Pachira glabra*, but the three species can be distinguished by the colour of the flower.

- *Pachira insignis* has orange, dark red or brownish petals
- *Pachira glabra* has whitish or greenish petals and entirely white stamens
- *Pachira aquatica* has bicoloured petals.

P. aquatica might also be confused with *Pseudobombax ellipticum* (the 'shaving brush tree' or 'Carolina'), another commonly cultivated bombacoid with brush-type flowers of numerous stamens, but *P. ellipticum* differs in being a deciduous tree, with smaller, entirely pink or white flowers that have distinctly coiled, reflexed petals and many more (>300) stamens.

Levy Tacher et al (2006) has mentioned the following species as related trees because the similarity of their flowers:

- *Ceiba pentandra*
- *Ochroma pyramidale*
- *Pseudobombax ellipticum*
- *Quararibea funebris*
- *Quararibea yunckeri*

WHERE HAS *PACHIRA AQUATICA* BEEN FOUND IN THE MUNICIPIO OF LIVINGSTON?

The FLAAR team has documented the tree along the edge of every river and lake in Livingston. It is very common to find *Pachira aquatica* at Playa Quehueche. Here is a tabulation of where we have stopped to photograph *Pachira aquatica*. It is so common that we don't tend to stop unless there are fresh flowers or giant fruits or a curious root

| DATES | LOCATION | FRUIT OR FLOWER ROOT (OR BOTH OR ALL) | POTOGRAPHER AND/OR FOLDER |
|-------------------|---------------------|---------------------------------------|--|
| July 29, 2021 | Playa Quehueche | Flowers | Nicholas Hellmuth / Pachira-aquatica-withstands-salt-water-beach-above-Playa-Quehueche-Livingston-NikonD10-200mm-1113am-Jul-29-2021-NH |
| January 24, 2021 | Río Chocón Machacas | Roots | Nicholas Hellmuth / Pachira-aquatica-zapoton-root-starts-Rio-Chocon-Machacas-iPhone-12Pro-Max-Jan-24-2021-NH |
| October 11, 2020 | Taponcito Creek | Trunk and tree | Boris Llamas / Pachira-aquatica-zapoton-2-Tapon-Creek-Taponcito-Livingston-Oct-11-2020-BL |
| November 7, 2020 | Río Chocón Machas | Flowers | Roxana Leal / Pachira-aquatica-zapoton-flowers-Google-Pixel-3xl-Rio-Chocon-Machacas-El-Golfete-Livingston-Nov-7-2020-RL |
| January 26, 2021 | Río Cáliz | Roots | Nicholas Hellmuth / Pachira-aquatica-roots-swamp-edge-trees-along-Rio-Caliz-Municipio-de-Livingston-Izabal-iPhone-12pro-Max-Jan-26-2021-NH |
| February 25, 2021 | Río Sarstún | Fruit and tree | David Arrivillaga / Pachira-aquatica-zapoton-fruit-Rio-Sarstun-Livingston-Feb-25-2021-DA |
| March 25, 2021 | Río Higuerito | Fruit | David Arrivillaga / Pachira-aquatica-fruits-on-tree-brown-fruits-Rio-Higuerito-El-Golfete-Livingston-Mar-25-2021-DA |

Edible Plants of Municipio de Livingston

From Swamps, Marshes, and Seasonally Inundated Flatlands of Izabal

| DATES | LOCATION | FRUIT OR FLOWER ROOT (OR BOTH OR ALL) | POTOGRAPHER AND/OR FOLDER |
|-------------------|--------------------|---------------------------------------|---|
| April 31, 2021 | La Buga Livingston | Fruit and Seeds | Nicholas Hellmuth / Pachira-aquatica-zapoton-fruit-pods-seeds-Municipio-de-Livingston-FLAAR-studio-Apr-31-2021-NH |
| June 19, 2021 | Río Dulce | Fruit | Nicholas Hellmuth / Pachira-aquatica-zapoton-fruits-perfectly-lit-Mansion-Rio-Dulce-Livingston-NikonD810-933am-Jun-19-2021-NH |
| July 29, 2021 | Playa Quehueche | Flowers | Victor Mendoza / Pachira-aquatica-zapoton-red-flower-Playa-Quehueche-Livingston-SonyRX10-600mm-114am-Jul-29-2021-VM |
| September 7, 2021 | Río Lámpara | Tree and Fruits | Nicholas Hellmuth / Pachira-aquatica-zapoton-fruits-Rio-Lampara-Muni-Livingston-Sony7c-202pm-Sep-7-2021-NH |
| October 4, 2021 | Playa Quehueche | Fruit | Victor Mendoza / Pachira-aquatica-zapoton-brown-fruit-Playa-Quehueche-Livingston-SonyRX10-600mm-212pm-Oct-4-2021-VM |
| November 12, 2021 | Lago de Izabal | Button | David Arrivillaga / Pachira-aquatica-flowers-fruit-Lagartos-Lago-de-Izabal-Livingston-Sony-A1-151pm-Nov-12-2021-DA |
| December 14, 2021 | Sarstún Creek | Flowers | David Arrivillaga / Pachira-aquatica-flowers-Sarstun-Creek-Livingston-Sony-A1-120pm-Dec-14-2021-DA |

> **Is *Pachira aquatica* listed for Biotopo Protegido Chocón Machacas, CECON/USAC?**

CECON elaborated a very useful report “Especies de flora endémica y amenazada de la Reserva Protectora de Manantiales Cerro San Gil y Biotopo Chocón Machacas para la conservación del Manatí, Izabal, Guatemala”. The report lists the species collected in Chocón Machacas and Cerro San Gil, and which ones are endemic or threatened. *Pachira aquatica* appears in the collection as a common plant in these places.

Pachira aquatica is also mentioned in “Perfil de Parque – Guatemala Biotopo Protegido Chocón Machacas” by Parks Watch. The document describes the different types of forests that exist in Chocón Machacas. Zapotón predominates in the low flood forest, high forest and mangrove forest.

> **Is *Pachira aquatica* listed for Tapón Creek Nature Reserve (including Taponcito Creek), FUNDAECO?**

There is little information on Tapón Creek Nature Reserve, but FUNDAECO through its proposal for the conservation of the Multiple-Use Reserve Río Sarstún has researched the whole area, including Tapón Creek and Taponcito Creek. *Pachira aquatica* has been registered in their flora list.

> **Is *Pachira aquatica* listed for Buena Vista Tapón Creek Nature Reserve?**

No records.

> **Is *Pachira aquatica* listed for Cerro San Gil (south side of Río Dulce)?**

Zapotón has been registered in Cerro San Gil by CECON.

> **Is *Pachira aquatica* listed for El Refugio de Vida Silvestre Punta de Manabique?**

FUNDAECO has registered *Pachira aquatica* as a predominant species in this place.

The forest cover of the Punta de Manabique wetland is characteristic of a subtropical floodplain forest. For the area, a total of 453 species of flora distributed in 103 families are reported, the main ones being: Fabaceae (6.4%), Melastomataceae (5.3%), Mimosaceae (4.4%) and Verbenaceae (4.4%). Tropical forests subject to flooding represent more than 50% of the land section. They are dominated by the confra palm (*Manicaria saccifera*) and accompanied by species such as palo blood or cáhue (*Pterocarpus officinalis*), barillo (*Symphonia globulifera*), Zapote bobo (*Pachira aquatica*) and santa maría (*Calophyllum brasiliense* var *Rekoj*).

(FUNDAECO, n.d.)

> **Is *Pachira aquatica* listed for Ecoalbergue Lagunita Creek (Área de Usos Múltiples Río Sarstún)?**

There is not a specific list of flora for Ecoalbergue Lagunita Creek, but *Pachira aquatica* is registered in Multiple-Use Reserve Río Sarstún.

> **Is *Pachira aquatica* listed for Sarstoon-Temash National Park (northern side of Río Sarstún)?**

It is registered in the Sarstoon Temash National Park Management Plan, also in Rapid Ecological Assessment Sarstoon Temash National Park Toledo District, Belize.

> **Is *Pachira aquatica* listed for Bocas de Polochic?**

Fundación Defensores de la Naturaleza registered *Pachira aquatica* in Bocas del Polochic (Refugio de Vida Silvestre). It appears in an Informative file of RAMSAR Wetlands (1996).

> **Is *Pachira aquatica* from the Highlands or from the Lowlands (or both)?**

According to Standley and Steyermark (1949), *Pachira aquatica* is sometimes found in or at the edge of brackish water, but chiefly at or near sea level and also at higher elevations growing along stream banks, at 300 meters or less. So, this tree inhabits primarily lowlands. But in a garden can be raised in the Maya Highlands.

ROOT SIZE AND SHAPE OF *PACHIRA AQUATICA* INSIDE SWAMPS

It is notable that Standley and Steyermark make no mention whatsoever of the size, shape, or classification of the trunk. Yet they do comment on the fruit size. So the question is, did these botanists explore the riversides, swamps, and lakeside ecosystems where these trees grow? Inside a swamp, going up and down the rivers (which is the only way to get into the swamps parallel to Rio Dulce, El Golfete, and Amatique Bay) you see hundreds of these trees and quickly notice their remarkable roots.

We have plenty of photographs of the roots from our almost two years of field work in these wetlands of eastern half of Izabal, Guatemala, Central America.



Roots of *Pachira aquatica*.

Photo by: David Arrivillaga, FLAAR Mesoamerica, Jan. 26, 2021, 12:11 p.m. El Golfete Rio Caliz, Livingston.
Camera: Sony A7R (ILCE-7RM4). Lens: Sony FE 90mm Macro G OSS. Settings: 1/250 sec; f/7.1; ISO 800.



Roots of *Pachira aquatica*.

Photo by: David Arrivillaga, FLAAR Mesoamerica, Jan. 26, 2021, 11:45 a.m. El Golfete Rio Caliz, Livingston.
Camera: Sony A7R (ILCE-7RM4). Lens: Sony FE 90mm Macro G OSS. Settings: 1/500 sec; f/6.3; ISO 2,500.

FRUIT SIZE, SHAPE AND CONTENTS

Fortunately botanists do mention the fruits (even though these fruits are unlikely in drawers of a herbaria in a botanical garden).

It is conspicuous because of the light-colored smooth bark, and especially on account of the huge, very hard and heavy fruits which occur in such abundance that one wonders how the trees can support such a load. Fruits are found sometimes on trees no more than 2 meters high. The fruits often weigh six pounds or more, and are filled with solid white flesh in which the many large seeds are imbedded. Sometimes or perhaps usually they remain upon the trees until ripe, when they open, and the brown seeds, often as large as a hen's egg, fall into the water. There they soon germinate and float about with expanded cotyledons until they land on some shoal or bank, where they root.

(Standley y Steyermark 1949: 400).

***Pachira aquatica*.**

Photo by: Victor Mendoza, FLAAR Mesoamerica, Apr. 10, 2021, 2:13 p.m. Playa Quehueche, Livingston, Izabal. Camera: Sony DSC-RX10M4. Lens: Sony FE 200-600mm G OSS. Settings: 1/200 sec; f/4.0; ISO 400.





Pachira aquatica.

Photo by: Nicolas Hellmuth, FLAAR Mesoamerica,
Jul. 9, 2021, 2:00 p.m. Río Lámpara, Izabal. Camera: Google Pixel x4.



Pachira aquatica.

Photo by: Nicolas Hellmuth, FLAAR Mesoamerica,
Jul. 9, 2021, 2:00 p.m. Río Lámpara, Izabal. Camera: Google Pixel x4.

DOES *PACHIRA AQUATICA* ALSO GROW IN HOME GARDENS?

It is mentioned to grow in home gardens and is very common near the lagoons at Auto Safari Chapin. In our FLAAR Ethnobotanical Research Garden around our office we grow *Pachira aquatica*. Starting 2 years ago it began to flower but not many fruits (since we are at 1,500 meters above sea level, a bit higher than the usual sea-level to 300 meter elevation out in the wild. Plus there is no river or lake adjacent (in its native habitat *Pachira aquatica* likes to be near a river or lake).

USES OF *PACHIRA AQUATICA*

This tree has multiple uses. It is cultivated as a shade tree, for its dense canopy, and for its large flowers (Robyns 1963), but also as an indoor foliage plant, since it can work as a biofilter (Li et al. 2009). It is a good option for landscape improvement and revegetation. It is very effective in reducing the concentrations of benzene, ethylbenzene, toluene and xylene, especially when placed in a sunny area (Song et al. 2007).

The seeds are edible and can be eaten raw, roasted, fried or boiled. When roasted, they can be ground into a flour to make bread or a hot drink similar to hot chocolate. Oliveira et al. (2000) mention that on their nutritional composition reveal a high content of protein and oil. The crude protein content is 129 g kg¹ dry matter, which is comparable to that of wheat and corn. The oil content is 539 g kg¹ dry matter, higher than soybean and comparable to peanut, castor bean and sunflower. They also have a higher content of the essential amino acids tryptophan, threonine and phenylalanine + tyrosine than that reported for chicken eggs, human milk and cow's milk. Nonetheless, several toxic compounds have also been found in the seeds including lectins and trypsin inhibitors. The leaves can also be cooked and eaten as a vegetable.

Other parts of the tree can be used. A red dye is extracted from the bark and pulp to create paper from the soft wood and it is also timber (Lorenzi 1992; Duarte and Paull 2008).

IS THERE POTENTIAL MEDICINAL USAGE OF ***PACHIRA AQUATICA*** BY LOCAL PEOPLE?

If you Google *Pachira aquatica* medicinal you will find enough articles and reports to keep you busy for a long time. I mention just one: that the boiled leaves are used for fever and headaches and the fruits for respiratory diseases. Castro et al. (2014) also mention this tree as antidiabetic.

ARE ANY PARTS OF *PACHIRA AQUATICA* EATEN BY MAMMALS?

Not yet found mention but there is lots of edible material inside the pods.

WHAT ARE THE PRIMARY POLLINATORS OF ***PACHIRA AQUATICA*** FLOWERS?

According to Fleming et al. (2009), the flowers of *Pachira aquatica* are pollinated by bats, but subsequent research by Pale Esquivel in 2014, determined that moths are the true pollinators that are attracted by the essence of this plant and not bats, as ecologists have long thought, although it is not ruled out that they are pollinating it but are not attracted to its essence. A more recent report on pollinators of *Pachira aquatica* is Pale et al. 2018.

CREDITS FOR PHOTO ON PAGE 36.

Pachira aquatica.

Photo by: María Alejandra Gutiérrez, FLAAR Mesoamerica, Dec. 14, 2021, 2:19 p.m.
Río Chocón Machacas, Guatemala. Camera: iPhone 13 Pro Max.

CONCLUDING DISCUSSION AND SUMMARY **ON *PACHIRA AQUATICA***

The objective of this report is to provide general information about *Pachira aquatica*, where it is possible to find it in the Municipio of Livingston and highlight its importance due to its variety of potential uses. Probably most people don't know that its seeds are not only edible but also highly nutritious, or that its leaves can be cooked and consumed as a vegetable. On the other hand, it is also possible to extract natural dyes from its bark, make paper with its pulp and take advantage of the wood.

Knowing this information is of great value because it shows us the potential use that we can give to this wild native species, which in turn can contribute to generate monetary income for the families of the communities.

We are also working on all cacao substitutes that are native and wild in the Mayan areas. Lots of Mayan people wanted to have cacao but either could not grow it in the climate or soil of their home gardens or could not afford to import it. When I google cacao substitutes zilch Mesoamerica plants are mentioned, yet I have already found two cacao substitutes that both grow in the Municipio de Livingston areas of Izabal, Guatemala:

- *Amphitecna latifolia*, morro de playa, beach calabash
- *Pachira aquatica*, zapoton

As we accomplish our final month(s) of field work in the wetlands of the Municipio de Livingston and as we continue our 5-year project of flora, fauna, and ecology field work in the entire 5-million acres of the Reserva de la Biosfera Maya, we will have additional information.





Pachira aquatica.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Jul. 11, 2020, 10:59 a.m. Río Chocón Machacas, Guatemala.
Camera: Nikon D810. Lens: Nikon AF-Micro-NIKKOR 200mm IF-ED Macro. Settings: 1/250 sec; f/11; ISO 1,000.



Pachira aquatica.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Jul. 11, 2020, 11:46 a.m. Río Chocón Machacas, Guatemala.
Camera: Nikon D810. Lens: Nikon AF-Micro-NIKKOR 200mm IF-ED Macro. Settings: 1/250 sec; f/11; ISO 1,000.

REFERENCES CITED ON *PACHIRA AQUATICA* **AND SUGGESTED ADDITIONAL READING**

Most helpful mention of this plant (because this book lists the most uses):

Balick, Nee and Atha 2000: 63.

Most helpful website on this plant:

<https://www.cabi.org/isc/datasheet/39234>

AGUIRRE de Riojas, Regina and **Elfriede de PÖLL**

2007 Trees in the Life of the Maya World. BRIT PRESS, Botanical Research Institute of Texas. 206 pages.

Note: Regina de Riojas has dedicated much of her life to trees of the Maya and trees of Guatemala. Elfriede de Pöll has likewise dedicated her life, to biology of Guatemala, at Universidad del Valle de Guatemala.

ATRAN, Scott, LOIS, Mimena and **Edilberto UCAN Ek'**

2004 Plants of the Peten Itza' Maya. Museum of Anthropology, Memoirs, Number 38, University of Michigan. 248 pages.

Note: Very helpful and nice collaboration with local Itza' Maya people. But would help in the future to have a single index that has all Latin, Spanish, and English plant names so that you can find plants more easily.

Not available as a download.

BALICK, Michael J., NEE, Michael H. and **Daniel E. ATHA**

2000 Checklist of the Vascular Plants of Belize: With Common Names and Uses. Memoirs of the New York Botanical Garden Vol. 85. 246 pages.

BALICK, Michael J. and Rosita ARVIGO

2015 Messages from the Gods: A Guide to the Useful Plants of Belize. The New York Botanical Garden, Oxford University Press.

BUENO, Joaquín, ALVAREZ, Fernando and Silvia SANTIAGO (editors)

2005 Biodiversidad del Estado de Tabasco. CONABIO, UNAM, Mexico. 370 pages.

CASTRO-Juárez, Carlos Jonnathan, VILLA-Ruano, C. Nemesio, RAMÍREZ-García, C. Sergio Alberto and C. Clemente MOSSO-González

2014 Uso medicinal de plantas antidiabéticas en el legado etnobotánico oaxaqueño. Revista Cubana de Plantas Medicinales 2014;19(1):101-120

CHIZMAR, Carla

2009 Plantas Comestibles de Centroamérica. Instituto Nacional de Biodiversidad (INBio). Santo Domingo de Heredia. Costa Rica. 360 pages.

Available online:

www.academia.edu/5891130/Plantas_Comestibles_de_Centroame_rica

Note: Information in page 123.

COOK, Suzanne

2016 The forest of the Lacandon Maya: an ethnobotanical guide. Springer. 334 pages.

Sold online: www.springer.com/la/book/9781461491101

ESTRADA-BELLI, Francisco and David B. WAHL

2010 Prehistoric Human-Environment Interactions in the Southern Maya Lowlands: The Holmul Region Case Final Report to the National Science Foundation.

Note: Figure 21 is a wonderful photograph; first, it is large enough (half page size). Second, it is adequately exposed, but most important of all, this helpful photo shows lots of *Acoelorrhaphe wrightii* around what I estimate is a single *Crescentia cujete* tree.

ESTRADA Loreto, Feliciano

2010 Indicadores ecológicos de la zona riparia del Río San Pedro, Tabasco, México. MS Thesis, El Colegio de la Frontera Sur. 131 pages.

Available online: https://ecosur.repositorioinstitucional.mx/jspui/bitstream/1017/1656/1/100000050585_documento.pdf

GARCIA de Miguel, Jesus

2000 Etnobotánica Maya: Origen y evolución de los Huertos Familiares de la Península de Yucatán, México.

GRANDTNER, M.

2005 Elsevier's Dictionary of Trees: North America. Elsevier Science; 1er edición. 1529 pages.

GUERRA-Centeno, Dennis, VALDEZ-Sandoval, Carlos, OROZCO-Acevedo, Dennis
and **Héctor FUENTES-Rousselin**

2016 Guía para la identificación de especies de árboles y arbustos comunes en el agropaisaje de Guatemala. 206 pages.

HELLMUTH, Nicholas

nd Flowers of the Maya Art Visible at Tikal: *Pachira aquatica*, Zapotón. Parque Nacional Tikal Petén. FLAAR Reports.

Available online: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.734.2609&rep=rep1&type=pdf>

HERNÁNDEZ-Montero, Jesús and **Vinicio J. SOSA**

2016 Reproductive biology of *Pachira aquatic* Aubl. (Malvaceae: Bombacoideae): a tropical tree pollinated by bats, sphingid moths and honey bees. Plant Species Biology 31, 125-134.

Available online: www.academia.edu/31681233/Reproductive_biology_of_Pachira_aquatica_Aubl._Malvaceae_Bombacoideae_a_tropical_tree_pollinated_by_bats_sphingid_moths_and_honey_bees

INFANTE-Mata, Dulce, MORENO-Casasola, Patricia and Carolina MADERO-Vega

2014 ¿*Pachira aquatica*, un indicador del límite del manglar? Revista Mexicana de Biodiversidad 85: 143-160.

Available online: <https://reader.elsevier.com/reader/sd/pii/S1870345314707407?token=D2A595D63BCEFD8C75820EA0AD163B0BF23A917BDB3DAA5468FF5E76C437AE36E889F8F70461AB397F093A3CE81DDF29>

JANICK, Jules and Robert E. PAULL

2008 The Encyclopedia of Fruits & Nuts. CABI; First edition. 800 pages.

Note: Even if compiled from other sources it is an excellent compilation on the Zapotón tree and fruit

LÓPEZ-Pérez, Diana, CASTILLO-Acosta, Ofelia, ZAVLA-Cruz, Joel and Humberto HERNÁNDEZ-Trejo

2014 Estructura y composición florística de la vegetación secundaria en tres regiones de la Sierra Norte de Chiapas, México. Polibotánica, No. 37, pp 1-23.

Available online: www.scielo.org.mx/pdf/polib/n37/n37a1.pdf

LESUR, Luis

2011 Árboles de México. Editorial Trillas. 368 pages.

LUNDELL, Cyrus L.

1937 The Vegetation of Peten. Carnegie Institution of Washington, Publ. 478. Washington. 244 pages.

LUNDELL, Cyrus L.

1938 Plants Probably Utilized by the Old Empire Maya of Peten and Adjacent Lowlands. *Papers of the Michigan Academy of Sciences, Arts and Letters* 24, Part I:37-59.

MacVEAN, Lucrecia

2003 Plantas útiles de Petén, Guatemala. Herbario UVAL, Instituto de Investigaciones, Universidad del Valle de Guatemala.

MORTON, Julia F.

1987 Fruits of warm climates. Julia F. Morton, Miami, FL. 550 pages.

OCHOA-Gaona, Susana, RUÍZ-González, Hugo, ÁLVAREZ-Montejo, Demetrio, CHAN-Coba, Gabriel and Bernardus H. J. DE JONG

2018 Árboles de Calakmul. ECCOSUR, Chiapas. 245 pages.

Note: It is amazing that there is no such book for Parque Nacional Tikal, nor El Mirador. Even though it includes only half the estimated number of “trees,” it has more tree species than Schulze and Whitacre for Tikal (they estimated about 200 but list only about 156 (their lists of species and list by plant family are not identical)).

The entire book is a totally free download; however, you can't copy and paste so is difficult to add to your discussion.

http://aleph.ecosur.mx:8991/exlibris/aleph/a22_1/apache_media/74R92GMRSJSEPFDEE5NJY4SJI2I8AK.pdf

OSPINA, J. A.

and Pachira aquatica Aubl. Centro Internacional de Agricultura Tropical (CIAT), Colombia. Manual de Semillas de Árboles Tropicales.

Available online:

<https://rngr.net/publications/manual-de-semillas-de-arboles-tropicales/..ii/.../>

file

PALE-Ezquivela, Ivan V.

2014 Caracterización química de los compuestos volátiles emitidos por *Pachira aquatica* mediante headspace dinámica—GC—MS thesis, Facultad de Química Farmacéutica Biológica. Universidad Veracruzana, Xalapa, Veracruz, Mexico

PEÑA-Chocarro, María and **Sandra KNAPP**

2011 Árboles del mundo maya. Natural History Museum Publications. 263 pages.

Note: Helpful book; contributing authors are experienced botanists. They cover 220 species of trees, more than virtually all other “Books on Trees of the Maya.” Even include tasiste (which is missing from all other books on “Trees of the Maya” except for the recent book on Árboles de Calakmul).

But if all this effort is going into a book, it would help if there were more photos, larger photos, and not so much blank space at the bottom of each page. Plus, it would help if the text could include personal firsthand experience with these trees out in the Mundo Maya. But even as is, it is a helpful book.

If you are doing field work you need this, plus Árboles de Calakmul, plus Árboles tropicales de México. Parker’s book you need back in your office, since out in the field it’s not much help due to lack of photographs. Back in your office the books by Regina Aguirre de Riojas are also helpful.

PENNINGTON, Terence D. and **José SARUKHAN**

2005 Árboles tropicales de México. Manual para la identificación de las principales especies. 3rd edition. UNAM, Fondo de Cultura Económica. 523 pages.

Note: This book is a serious botanical monograph. 1968 was the first edition (I still have this), 1998 was second edition. The 3rd edition is a “must have” book. Each tree has an excellent line drawing of leaves and often flowers and fruits (though to understand flowers you need them in photographs, in full color). Each tree has a map showing where found in Mexico (such maps are lacking in most books on Trees of Guatemala or plants of Belize). But trying to fit a description of a tree on one single page means that a lot of potential information on flowering time is not present. Unfortunately, this is definitely not a book on ethnobotany: not one single solitary “use” for *Pachira aquatica*: for that you need Suzanne Cook.

SÁNCHEZ-Sánchez, Odilon and **Cecilia HERNÁNDEZ-Zepeda**

2004 Estudio morfológico de plántulas de la familia Bombacaceae en Quintana Roo, México. *Foresta Veracruzana* 6(2):1-6.

Available online: www.redalyc.org/pdf/497/49760201.pdf

SELVIN Pérez, Edgar and **Miriam Lorena CASTILLO Villeda**

2000 A rapid assessment of avifaunal diversity in aquatic habitats of Laguna del Tigre National Park, Petén, Guatemala. In: Bestelmeyer, B.T. and Alonso, L.E. (eds.). *A Biological Assessment of Laguna del Tigre National Park, Petén, Guatemala*, pp. 56-60. Conservation International.

STANDLEY, Paul C.

1923 *Trees and Shrubs of Mexico*. Contributions from the United States National Herbarium, Volume 23, Part 3. Smithsonian Institution, United States National Museum.

STANDLEY, Paul C. and **Julian A. STEYERMARK**

1949 *Flora of Guatemala*. *Fieldiana, Botany*, Volume 24, Part VI. Chicago Natural History Museum.

VILLEGAS, Pedro. BUROGOS, Claudia, and **Harim CRUZ**

2011 *Plantas medicinales y comestibles de la Reserva Natural de Usos Múltiples Monterrico-RNUMM-, Taxisco, Santa Rosa*. Programa Universitario de Investigación en Recursos Naturales y Ambiente- PUIRNA-. Universidad de San Carlos de Guatemala. Guatemala.

Free download:

<http://digi.usac.edu.gt/bvirtual/informes/puirna/INF-2011-024.pdf>

ZIDAR, Charles and **Wayne ELISENS**

2009 *Sacred Giants: Depiction of Bombacoideae on Maya Ceramics in Mexico, Guatemala, and Belize*. *Economic Botany*, Vol. 63, No. 2, pp. 119-129.

Available online: www.researchgate.net/publication/227268745_Sacred_Giants_Depiction_of_Bombacoideae_n_Maya_Ceramics_in_Mexico_Guatemala_and_Belize

HELPFUL WEB SITES FOR **ANY AND ALL PLANTS**

There are several web sites that are helpful even though not of a university or botanical garden or government institute.

However, most popular web sites are copy-and-paste (a polite way of saying that their authors do not work out in the field, or even in a botanical garden). Many of these web sites are click bait (they make money when you buy stuff in the advertisements that are all along the sides and in wide banners also). Therefore, we prefer to focus on web sites that have reliable information.

<https://serv.biokic.asu.edu/neotrop/plantae/>

Neotropical Flora data base. To start your search, click on this page:

<https://serv.biokic.asu.edu/neotrop/plantae/collections/harvestparams.php>

<http://legacy.tropicos.org/NameSearch.aspx?projectid=3>

This is the main SEARCH page.

<https://plantidtools.fieldmuseum.org/pt/rrc/5582>

SEARCH page, but only for collection of the Field Museum herbarium, Chicago.

<https://fieldguides.fieldmuseum.org/guides?category=37>

These field guides are very helpful. Put in the Country (Guatemala) and you get eight photo albums.

<http://enciclovida.mx>

CONABIO. The video they show on their home page shows a wide range of flowers pollinators, a snake and animals. The videos of the insects are great.

www.kew.org/science/tropamerica/imagetdatabase/index.html

Kew gardens in the UK is one of several botanical gardens that I have visited (also New York Botanical Gardens and Missouri Botanical Gardens (MOBOT), in St Louis, the botanical garden in Singapore, and El Jardín Botánico, the open forest botanical garden in Guatemala City).

www.ThePlantList.org

This is the most reliable botanical web site to find synonyms. In the recent year, only one plant had more synonyms on another botanical web site.

ACKNOWLEDGEMENTS TO FLAAR MESOAMÉRICA

The reports are a joint production between the field trip team and the in-house office team. So here we wish to cite the full team:

Flor de María Setina is the office manager, overseeing all the diverse projects around the world (including FLAAR-REPORTS research on advanced wide-format digital inkjet printers, a worldwide project for over 20 years). We also utilize the inkjet prints to produce educational banners to donate to schools.

Vivian Díaz environmental engineer, is project manager for flora, fauna projects (field work and resulting reports at a level helpful for botanists, zoologists and ecologists, and for university students). Also coordinates activities at MayanToons, division where educational material for kids is prepared.

Victor Mendoza identifies plants, mushrooms, lichen, insects, and arachnids. When his university schedule allows, he also likes to participate in field trips on flora and fauna research.

Vivian Hurtado prepares the bibliography for each subject and downloads pertinent research material for our e-library on flora and fauna. All of us use both these downloads plus our in-house library on flora and fauna of Mesoamerica (Mexico through Guatemala into Costa Rica).

Sergio Jerez prepares the bibliography of each topic and download the pertinent research material for our electronic library on flora and fauna. We all use these two downloads plus our internal library on Mesoamerican flora and fauna (México through Guatemala to Costa Rica).

Andrea de la Paz is a designer who helps prepare the master-plan for aspects of our publications. She is our editorial art director

Norma Estefany Cho Cu helps with preparing the camera equipment for each field trip and helps in the office (and on field trips) as cook.

Jaqueline González is a designer who puts together the text and photographs to create the actual report (we have several designers at work since we have multiple reports to produce).

Roxana Leal is Social Media Manager for flora and fauna research and publications, and MayanToons educational book projects

María Alejandra Gutiérrez is an experienced photographer, especially with the Canon EOS 1D X Mark II camera and 5x macro lens for photographing tiny insects, tiny flowers, and tiny mushrooms. Work during and after a field trip also includes sorting, naming, and processing. And then preparing reports in PDF format.

David Arrivillaga is an experienced photographer and is able to handle both Nikon and the newest Sony digital cameras. Work during and after a field trip also includes sorting, naming, and processing.

Juan Carlos Hernández takes the material that we write and places it into the pertinent modern Internet software to produce our web pages (total network is read by over half a million people around the world).

Paulo Núñez is a webmaster, overlooking the multitude of web sites. Internet SEO changes every year, so we work together to evolve the format of our web sites.

Valeria Áviles is an illustrator for MayanToons, the division in charge of educational materials for schools, especially the Q'eqchi' Mayan schools in Alta Verapaz, Q'eqchi' and Petén Itzá Maya in Petén, and the Q'eqchi' Mayan and Garifuna schools in the municipality of Livingston, Izabal.

Josefina Sequén is illustrator for MayanToons and also helps prepare illustrations for Social Media posts and for animated videos.

Rosa Sequén is also an illustrator for MayanToons and also helps prepare illustrations for Social Media posts and for animated videos.

Laura Morales is preparing animated videos in MayanToons style since animated videos are the best way to help school children how to protect the fragile ecosystems and endangered species

Heidy Alejandra Galindo Setina joined our design team in August 2020. She likes photography, drawing, painting, and design.

María José Rabanales she is part of the team for editing photographic reports and educational material of Flora and Fauna since September 2020. She works together with others of the team to prepare the finished pdf editions of the material of the Yaxha, Nakum and Naranjo Project.

Alejandra Valenzuela biology student is now part of Flora y Fauna's photographic report and educational material editing team since September 2020.

Alexander Gudiel designer who join the editorial design team on December 2020. He will combine the text, pictures and maps into the FLAAR Mesoamerica editorial criteria.

Cristina Ríos designer student who join the editorial design team on December 2020. He will combine the text, pictures and maps into the FLAAR Mesoamerica editorial criteria.

Byron Pacay handles GPS mapping of where we hike or go in the lancha (boat) each field trip day. He also lists where we stop to take photos and what each one of us is photographing and then has that tabulation ready each night.

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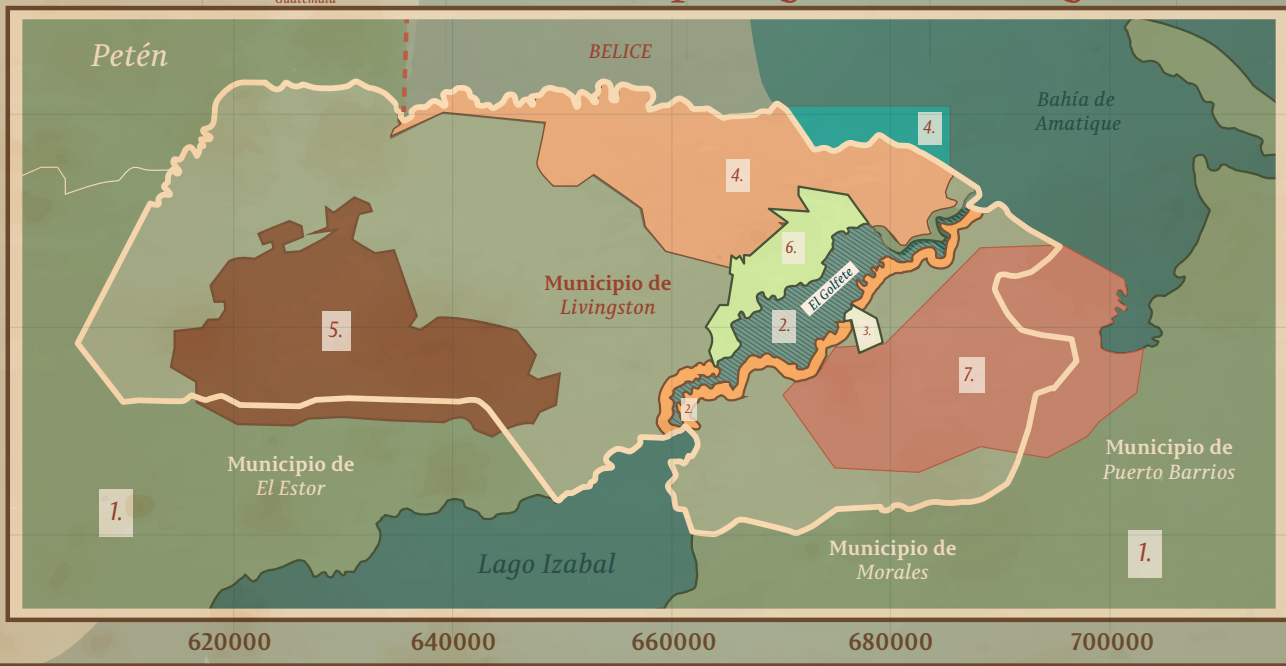
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Áreas naturales protegidas de Livingston



Izabal

- 1. Área sin protección
- 2. Parque Nacional Río Dulce
- 3. El Higuerito
- 4. Área de Usos Múltiples Río Sarstún
- 5. Sierra de Santa Cruz
- 6. Biotopo Protegido Chocón Machacas
- 7. Reserva Protectora de Manantiales Cerro San Gil

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Reserva Natural Tapón Creek, Livingston

Bahía de Amatique

Área de Usos Múltiples
Río Sarstún

Punta
Cocolí

Aldea Buena
Vista Tapon Creek

San Juan

Reserva Natural Tapón Creek
Municipio de Livingston

Siete
Altares

Finca
Gangadiwali

Sarstún Creek

Taponcito
Creek

El Rosario

San
Martin

La Desmembración

Plan Grande
Tatin

Área de Usos Múltiples
Río Sarstún

Biotopo
Chocón Machacas

El Golfete

Parque Nacional
Río Dulce

Izabal



Información de referencia:

- Límites departamentales de Guatemala. (IGN)
- Instituto Geográfico Nacional (IGN) (Hojas 2463 IV y 2463 III)
- Google Map data 2020. Shapes: Sistema Guatemalteco de Áreas Protegidas 2017.
- Cuerpos de agua. Ministerio de Agricultura Ganadería y Alimentación (MAGA)
- Dirección de Análisis Geoespacial del (CONAP), Marzo/2017.

Edible Wetlands Plants of Municipio de Livingston, Izabal

Wetland Series 1: from Swamps, Marshes and Seasonally Inundated Flatlands of Izabal

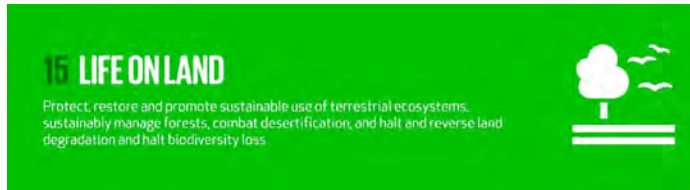
| | | | |
|---|---|--|--|
| <p>Cyperus esculentus</p> <p>Chufa, Yellow Nutsedge, Earth Almond</p> <p>MLW#1</p> | <p>Eleocharis geniculata Eleocharis caribaea</p> <p>Caribbean Spike-Rush</p> <p>MLW#2</p> | <p>Montrichardia arborescens</p> <p>Camotillo Water Chestnut</p> <p>MLW#3</p> | <p>Nymphoides indica</p> <p>Floating Heart Water Snowflake</p> <p>MLW#4</p> |
| <p>Pachira aquatica</p> <p>Zapoton</p> <p>MLW#5</p> | <p>Pontederia cordata</p> <p>Pickereel Weed</p> <p>MLW#6</p> | <p>Sagittaria latifolia</p> <p>Water Potatoes</p> <p>MLW#7</p> | <p>Typha domingensis</p> <p>Cattail</p> <p>MLW#8</p> |

Wetland Series 2: plants that grow along the beach shore of Amatique Bay

| | | | | | |
|---|--|---|--|---|---|
| <p>Amphitecna latifolia</p> <p>Black calabash</p> <p>MLW#9</p> | <p>Coccoloba uvifera</p> <p>Uva del mar</p> <p>MLW#10</p> | <p>Manicaria saccifera</p> <p>Confra, Manaca</p> <p>MLW#11</p> | <p>Chrysobalanus icaco</p> <p>Coco Plum</p> <p>MLW#12</p> | <p>Avicennia germinans</p> <p>Black Mangrove</p> <p>MLW#13</p> | <p>Rhizophora mangle</p> <p>Red Mangrove</p> <p>MLW#14</p> |
|---|--|---|--|---|---|

Wetland Series 3: plants that grow alongside water: rivers, lagoons, swamps, or ocean

| | | | | | |
|---|---|--|---|---|--|
| <p>Glossary of Wetland Terms</p> <p>Bibliography of Wetlands Habitat Names</p> <p>MLW#15</p> | <p>Acoelorrhaphe wrightii</p> <p>Pimientillo, Tasiste, Palmetto Palm</p> <p>MLW#16</p> | <p>Acrostichum aureum</p> <p>Mangrove Fern</p> <p>MLW#17</p> | <p>Annona glabra</p> <p>Alligator Apple</p> <p>MLW#18</p> | <p>Bactris major</p> <p>Huiscoyol Palm</p> <p>MLW#19</p> | <p>Diospyros nigra</p> <p>Zapote negro</p> <p>MLW#20</p> |
| <p>Grias cauliflora</p> <p>Palo de Jawuilla</p> <p>MLW#21</p> | <p>Inga vera Inga multijuga Inga thibaudiana</p> <p>River Koko</p> <p>MLW#22</p> | <p>Pithecellobium lanceolatum</p> <p>Bastard Bully Tree Chucum Red Fowl</p> <p>MLW#23</p> | <p>Coccoloba belizensis</p> <p>Papaturro</p> <p>MLW#24</p> | <p>Symphonia globulifera</p> <p>Barillo</p> <p>MLW#25</p> | <p>Crataeva tapia</p> <p>Matasanillo, Granadillo, Tortugo</p> <p>MLW#26</p> |



The current Alcalde of Livingston, Mr. Daniel Pinto, together with his team of International Cooperation division, have set the goal of achieving the municipality development in the years 2020-2024 based on the goals and indicators proposed by the 2030 Agenda for Sustainable Development. From this agenda, FLAAR (USA) and FLAAR Mesoamerica (Guatemala) will collaborate to achieve Sustainable Development Goal (SDG), number 15 "Life on Land".

Throughout this cooperation project, different materials have been prepared, like this Photo Essay, that helps to collect information on species, different ecosystems: terrestrial, wetlands and fresh water biodiversity. This information would also be useful as part of a strategy to protect threatened species and prevent their extinction. The municipality's goals include to promote the sustainable use, conservation and research of the species of flora and fauna of the terrestrial, wetlands and aquatic shore and coastal ecosystems of the Guatemalan Caribbean. Learn more about this project and the SDG indicators at:

<https://flaar-mesoamerica.org/rain-forests-rivers-lakes-bays-ocean-caves-canyons-livingston-the-caribbean-biodiversity-wonderland-of-guatemala/>

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HELLMUTH, N. (2022)
Cacao Substitute, Zapotón Seeds, *Pachira aquatica*. Wetlands of Municipio de Livingston, Izabal, Guatemala. Wetlands Report #5, Edible Plants of Municipio de Livingston that grow along the beach shore of Amatique Bay MLW5, Number 1. FLAAR Mesoamerica.

BACK COVER PHOTO
Pachira aquatica

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica,
Dec. 14, 2021, 1:23 p.m. Río Petexbatún,
Petén, Guatemala. Camera: iPhone 13 Pro Max.

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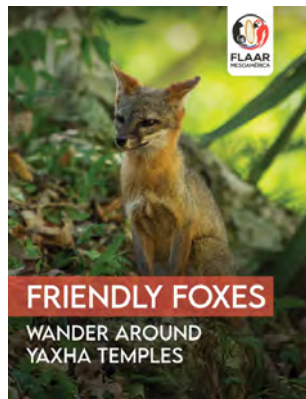
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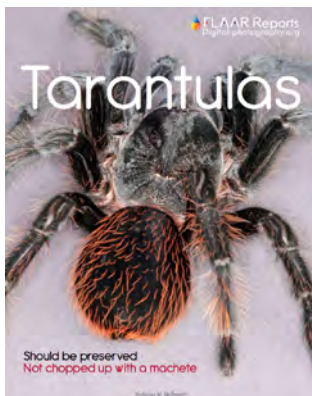
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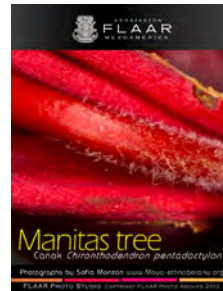
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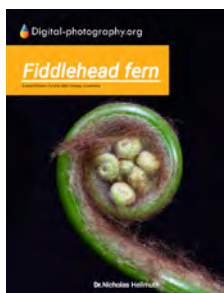
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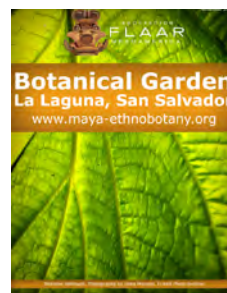
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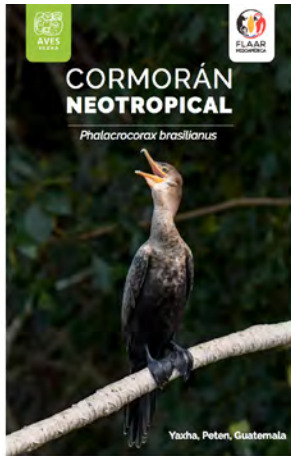
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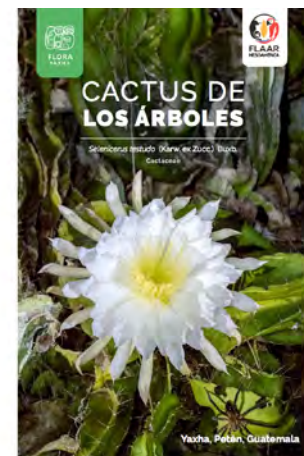
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