

A photograph of a savanna landscape. In the foreground, a large, gnarled tree with thick branches and sparse green leaves stands prominently. The ground is covered in tall, vibrant green grass. In the background, several smaller, similar trees are scattered across a flat, grassy plain. The sky is a clear, bright blue with a few wispy white clouds. The overall scene is bright and sunny.

Savanna **East of Nakum**

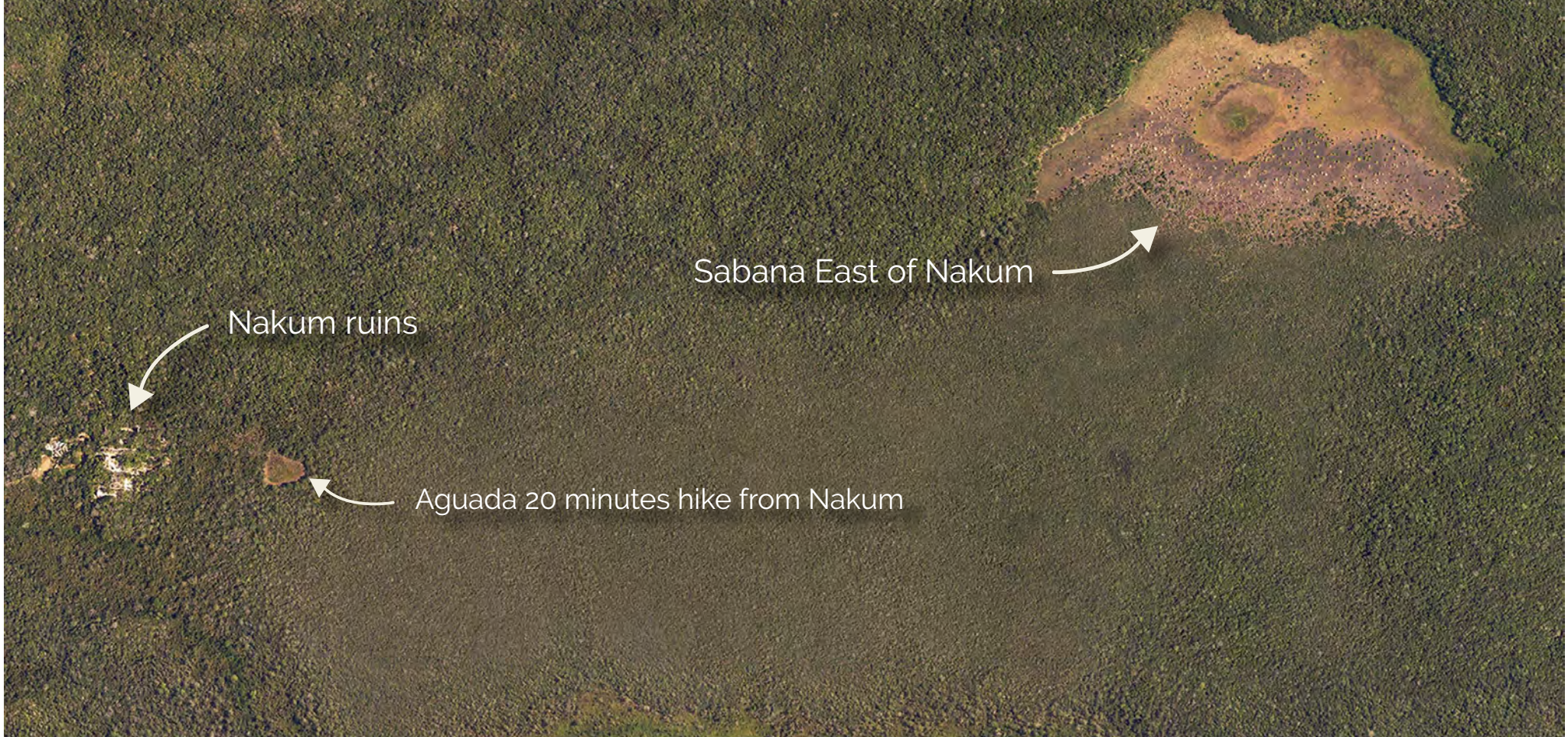
Savanna of Multiple & Biodiverse Micro-Ecosystems

Parque Nacional Yaxha, Nakum y Naranjo (PNYNN)

Nicholas Hellmuth

Savanna of Multiple & Biodiverse Micro-Ecosystems

Parque Nacional Yaxha, Nakum y Naranjo (PNYNN) Reserva de la Biosfera Maya (RBM)



Nakum ruins

Sabana East of Nakum

Aguada 20 minutes hike from Nakum

Nicholas Hellmuth

FLAAR (USA) and FLAAR Mesoamerica (Guatemala)

September 2021



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Photo from: Satellites.pro
Nakum ruins with park facilities
to left and aguada area to the
right. The Savanna East of Nakum
is over a dozen times larger than
the entire city of Nakum!

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We thank the helpful team of Guardarecursos who helped clear the trail and help us reach the savanna in 2019.

Catalina López for cooking for the team at Nakum during our year 2019 visits.

ON MARCH 28 IT WAS VERY PLEASANT TO HAVE THE PRESENCE OF

Sergio Alejandro Balan González (from the CONAP offices, in front of Lake Petén Itzá) who accompanied us to experience this vast biodiversity savannah east of Nakum. He is very knowledgeable in the use of satellite photos and GPS systems. In addition, he discussed the value of the use, in the future when there is special permission, of drones, high quality for scientific research.

FOR HOSPITALITY IN NAKUM CAMP

We appreciate the hospitality of the IDAEH and CONAP park rangers at their Nakum camp.

FOR HOSPITALITY IN YAXHA

We appreciate the hospitality, lodging, and meals provided by Gabriela Moretti at Ecolodge El Sombrero, near entrance to Yaxha part of PNYNN

This report can be cited in your preferred style. Here is the basic information:

HELLMUTH, N. (2021)

Savanna East of Nakum. Savanna of Multiple & Biodiverse Micro-Ecosystems Parque Nacional Yaxha, Nakum y Naranjo (PNYNN). FLAAR Mesoamerica and FLAAR



We appreciate

a donation during November 2021 and a subsequent donation in early June 2022 to help cover the costs of FLAAR research projects specifically to assist and support the current FLAAR project of flora and fauna in the Reserva de la Biosfera Maya (RBM). This continuing donation is also assisting the FLAAR (USA) and FLAAR Mesoamerica (Guatemala) research project searching for wild edible plants in the wetlands of the Municipio de Livingston area of the departamento of Izabal, Guatemala.

These donations are from a family in Chicago in honor of the decades of botanical field work of botanist Dr John D. Dwyer, who worked in many areas of Mesoamerica,

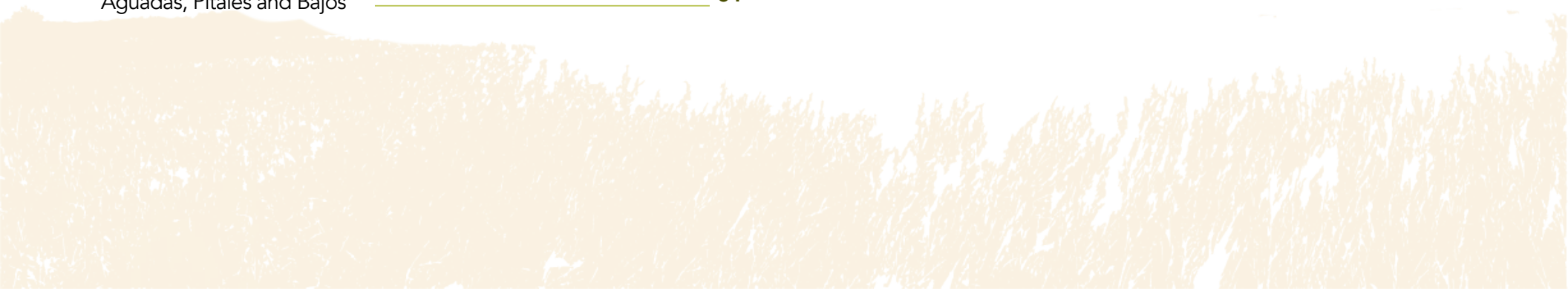
including in the Yaxha area in the 1970's while the site was being mapped by FLAAR.

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), Parque Nacional Laguna de Tigre (PNLT) and the wetlands of Municipio San Jose are three parts of the over 5 million acres of the RBM.

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Introduction to the Savanna East of Nakum

I first noticed the savanna to the east of Nakum from satellite photographs of IGN (Instituto Geográfico de Guatemala) of Guatemala. It was rather obvious from these photographs that this area was a bio-diverse savanna. Thus, with the cooperation and coordination of the co-administrators of Parque Nacional Yaxha, Nakum and Naranjo the team of FLAAR Mesoamerica drove to Nakum accompanied by guardarecursos of the park. Nakum has camping space, rudimentary shower area, and some cooking facilities

We first reached the Savanna East of Nakum on February 18, 2019.

Later, we made a second field trip to the Savanna East of Nakum on March 28, 2019, to reach some of the humedales further to the east.

We also made an additional field trips to the Savanna East of Nakum on May 4th and 5th.

This savanna is known to local people and to archaeologists

The archaeologists of the nearby Naranjo sector of PNYNN know this savanna. Many of them have hiked through or near this savanna while studying house mound areas on the hills. I estimate that biologists and ecologists have also visited this savanna while studying the nearby bajo that is at the south of the savanna. This (and lots of other savannas) are surrounded by bajos. Some areas are tinal bajos, others are bajos that are not filled with palo de tinto. There is usually an area of transitional species between the bajo and the savanna.

So the team of FLAAR Mesoamerica did not discover this savanna; what we did was to study it, and hike through it, note its bio-diverse aspects, note the “islands” of different plants in different areas of the savanna, and undertake panorama photography with iPhone and Google Pixel phone cameras. To our knowledge, there are no published panorama photos of this savanna. Also, I estimate that 90 to 99% of the reports on this part of Petén do not either mention or show photos of this savanna. The majority of studies in Petén in past decades focus on:

- Hilltop and hillside forests (searching for ramon by Puleston following suggestions by Lundell)
- bajos of Petén (by dozens of projects, by T. Patrick Culbert, and capable Guatemalan scholars)

You see the Bright Sun Reflecting off the open Savanna from the Hill above (north side, near west end)

There are many ways to enter the savanna:

- From the bajo at the west end
- From Naranjo at the east end
- From Nakum along the trail over the hills

From Nakum you are up on a steep karstic hill and since you are high up you can see the savanna through the trees. This is the view that literally caused me to break into tears: a totally open sunlit grass savanna stretching for kilometers and miles to the horizon.



We are now halfway down the steep hill. Through the branches and leaves you can see the bright yellow-orange of the flat grassland Savanna East of Nakum. It's one of the largest savannas in PNYNN; nothing this large anywhere around unless you get farther north or west (obviously lots of savannas have been destroyed by cattle ranches and other commercial farming).

Photo by: Nicholas Helmuth, FLAAR Mesoamerica, May. 31, 2019. Camera: iPhone XS



Here you can see the savanna even better. It's like looking at another world. After 50 years experiencing hillside and hilltop forests, and steep karst hills, when I saw "treeless grassland savanna stretching for kilometers in front of me" brought tears. I literally cried emotionally all the way down the hill.



Photo by: Maria Alejandra Gutierrez, FLAAR Mesoamerica, Feb. 18, 2019. Camera: Canon 1D X Mark II.

At the left you can see the steep limestone hill ending totally at the edge of the savanna. This hill is so steep much of the time I simply slid down on my behind (was safer than slipping trying to hike down). Note that 100% of the trees stop at the edge of the hill. The only trees in the core area of savanna are *Crescentia cujete*, nance, and tasiste palm. Realize that when the *Ceiba pentandra* tree (the white trunk at the left) flowers, its kapok seeds will float in the breeze up to many many meters away from the tree. Yet nowhere in the savanna is there any *Ceiba* seedling (because the fire burns

out every tree that is not evolved to withstand fire: jicara, nance, and especially tasiste palm survive fire).

Savanna East of Nakum, PNYNN, RBM, Petén, Guatemala. This photo was taken from the "outside" of the savanna, in one of many different peripheral transition areas. Each side, each edge of the savanna has a different transition area. The transition at the base of the steep karstic hill is remarkable: the hill ends the savanna begins; the trees STOP; the grass begins.



Here is a closeup of the steep hill plunging down and the flat savanna clearly visible. About 80 meters to the left is where the geological fault "enters this lower elevation." But the geological fault is visible only on the hilltop and hillside; nowhere in the savanna itself (though a geologist could document all this much better).

Photo by: Maria Alejandra Gutierrez, FLAAR Mesoamerica, Feb. 18, 2019. Camera: Canon 1D X Mark II.



Here you can see the trees on the limestone hill at the northwest edge; then the hill gets lower and the rest of the north edge is not a steep hill.

In a few areas there is indeed a transition zone between trees of a hill and grass of the savanna. This may depend on soil, on whether the edge is more humid than either the hill or the savanna, or other factors.

Photo by: Nicholas Helmuth, FLAAR Mesoamerica, May. 31, 2019. Camera: iPhone XS



Looking north at the karst hill that borders a few hundred meters of the savanna.

The only trees out in this part of the savanna are *Crescentia cujete*, calabash tree, jicara.

Photo by: Nicholas Helmuth, FLAAR Mesoamerica, May. 31, 2019. Camera: iPhone XS

Short Grass savannas compared with Giant Cutting Grass Cibal areas

The flat lowland area west of the west side of the ruins of Naranjo is a great place to study the difference between a cibal, a jimbal, a savanna, and a bajo. We have gigabytes of photographs of each of these habitats; but what is lacking are drone photos; only with drone photos can you see the transition in a clear and understandable manner. We have a licensed registered drone with a good resolution camera; we have an experienced drone pilot. So we hope to cooperate and coordinate in the future with permission to do a few quick minutes of drone photography. These photographs can help the Plan Maestro of the park considerably.



Photo from: Satellite.pro

Savanna West of Naranjo-Sa'al, PNYNN. This savanna is a bajo transition at southwest; then traditional grassland savanna (morro and tasiste), then cibal (sawgrass) then jimbal (spiny wild native bamboo). We have explored this savanna several times. It is very different (much much smaller) than the Savanna East of Nakum.



Here you see the flat grassland aspect. No two - meter high cibal cutting grass (at least not in this month). You can see a *Crescentia cujete* tree at the far right. At the left is the edge; here there is no more steep hill; it's more a kind of bajo (but not pure Bajo la Justa which is far behind us, on the southwest transition area).

In the present photo you can see a different ecosystem at the far left (before the trees start). Probably Alligator Flag plants. This is why this savanna needs to be mapped with a drone so we can name and show the location of every different eco-system within the savanna.

Photo by: Nicholas Helmuth, FLAAR Mesoamerica, May. 31, 2019. Camera: iPhone XS

The **Cibal Savanna** southeast of Paso Caballos (that FLAAR Mesoamerica visited in August 2021) is another good example of transition between pure Cibal of cutting grass several meters high at the western half; and a traditional savanna of low grass at 10% of the east end. We will have a separate introduction to this Cibal Savanna; it is about a kilometer or so northwest from the **Spider Lily Savanna** (that is mostly low grassland; we have not yet found areas of tall cutting grass but due to lightning,

thunder, and heavy rain, we had only one hour to be inside this savanna (it took hour after hour after hour to reach here; and even more hours to hike back to camp). We did not arrive back to the base camp until after dark (we are checking GPS but our telephone meter's walked app suggested we hiked almost 16 kilometers that day; not bad considering there was only a 45 to 60 cm wide trail available to hike most of the distance).



Notice that in late March the savanna grass is very dry.

Photo by Maria Alejandra Gutierrez, FLAAR Mesoamerica. March 28, 2019. Camera: Canon EOS-1D X Mark II



Photo by Maria Alejandra Gutierrez, FLAAR Mesoamerica. March 28, 2019. Camera: Canon EOS-1D X Mark II



It is rare to find a *Crescentia cujete* tree this large. The fires every year or at least every two years stunts them. Most of the tasiste palms are not very tall here because the tasiste palms are often “burned to the ground;” but they sprout up quickly when it rains.

Transitional Zones at the edge of a Savanna, a Cibal, a Bajo, etc.

The hilltop vegetation ends abruptly. Around the north side of the Savanna East of Nakum there is only occasionally transition vegetation of the karstic hillside and the savanna: it's almost like the savanna has a barbed wire fence and a sign saying "Hey, you trees of the hillside, you are not allowed here (because you will not survive the fires every year or so and may not survive the seasonal inundations)."

That said, there is a transitional zone in the sense that, so far, 80% of the savannas that I have studied has a ring of wet or standing water around it (a narrow transition zone). Even the Aguada Maya (Poza Maya), which is partially Maya-made thousands of years ago, has

- standing water around the eastern corner at the south, around most of the eastern end, and a bit of water elsewhere around it.
- The Savanna of 3 Fern Species has a permanent circle of water around most of the circular circumference
- There are moist areas and a bit of standing water around the edge of the Cibal Savanna of Parque Nacional Laguna del Tigre.

The Savanna East of Nakum definitely has a "ring of transition zone" along the western 75% of the north edge, but no standing water in the western 25% in November 2021 (a wet month).

Often the water around the edge is permanent (Poza Maya and Savanna of 3 Fern Species). Other areas the water visible around the edge is mostly in the wet season. But no matter, it is needed to study "did the Classic Maya dig out the area around savannas or their partially constructed Aguada Maya" or is there a natural, geological reason for water around the edges.

There are dozens, scores of savannas surrounded by the rain forests of the Reserva de la Biosfera Maya. So worth a student doing a PhD dissertation on the "ring around the savanna" aspect. Plus compare this with the dozens of savannas documented by Cyrus Lundell around La Libertad. We are not studying these because cattle ranches and commercial plantations have destroyed most of this area. But they still deserve modern field work by other scholars.

What is the Relationship between a Savanna and an adjacent Bajo?

The savanna adjacent to the west side of Naranjo ruins evolves out of Bajo la Pita. This bajo turns into the grassland-tasiste-jicara-savanna which turns into a cibal (cutting grass) and then a jimbol (bamboo).

The Savanna East of Nakum is at the north of Bajo la Justa.

I estimate that the area around the Rectangular Savanna adjacent to the Savanna of 3 Fern Species (west end of PNYNN) is a bajo. One difference is that the Rectangular Savanna which extends east from

the oval Savanna of 3 Fern Species is across the top of hills at much higher elevation than the series of lagoons and small lakes west of Lake Yaxha.

But the point is that the largest savanna in Parque Nacional Yaxha, Nakum and Naranjo has a bajo around much of the southern and southwestern edge. The entire southern part of the savanna west of Naranjo evolves into Bajo La Pita.

And the Cibal Savanna and Spider Lily Savanna in the southeastern part of Parque Nacional Laguna del Tigre are surrounded 100% by a bajo (so no hills at the edge of any of these savannas). Much of the forested bajo is ridged, so much so that I estimate these areas (outside the savannas) were agricultural areas modified by the ancient Maya (but soil scientists, geologists, and ecologists will need to undertake LiDAR and excavation; our goal is to find, photograph, study, and publish the flora, fauna, and basic nomenclature of the biodiverse ecosystems of the Reserva de la Biosfera Maya.

Bajos have been studied for the recent half century. The project of Culbert et al. is one of many capable international projects. The publications by Culbert and team and the year 2009 slide lecture at UFM by archaeologist Liwy Grazioso are good places to start learning about bajo projects of past decades.

Edible Wild Native Plants of the Savanna East of Nakum

Acoelorrhaphe wrightii (Griseb. & H.Wendl.) H.Wendl. ex Becc. is locally called tasiste in Petén. Since plant names with all the botanical authorities stuck on are too long, we prefer to use the Genus species name. The full name, all the synonyms, are all readily available on ThePlantList.org website. Tasiste seeds are medicinal (I take two tablets every day). As with many palms, the seeds are edible (Balick, Nee and Atha 2000: 194).

We are doing research and field work to have a list of all edible plants that are inside a savanna: *Crescentia cujete* and nance are obvious. Lots more to come.



***Acoelorrhaphe wrightii*,
Tasiste Palm**

Photo by: Nicholas Helmuth, FLAAR Mesoamerica, May. 4, 2019. Camera: iPhone XS



Photo by: Nicholas Helmuth, FLAAR Mesoamerica, May. 4, 2019. Camera: iPhone XS



Photo by: Nicholas Helmuth, FLAAR Mesoamerica, May. 4, 2019. Camera: iPhone XS



***Aechmea bracteata*,**
gallito, bromeliad

This bromeliad is common on trees throughout Petén and nearby areas. It is listed as food by Balick, Nee and Atha (2000: 174). This bromeliad is not specialized for growing in a savanna; these bromeliads are “all over the trees” in Mesoamerica.

Photo by: Maria Alejandra Gutierrez, FLAAR Mesoamerica,
Mar. 28, 2019. Camera: Canon EOS-1D X Mark II

Byrsonima crassifolia
Nance

This is the nance tree we are estimating is in these PNYNN savannas. But there are several species of nance, some more edible than sour ones.

Photo by: Nicholas Helmuth, FLAAR Mesoamerica, May. 4, 2019.
Camera: iPhone XS





***Byrsonima crassifolia*,**
Nance

Photo by: Maria Alejandra Gutierrez, FLAAR Mesoamerica, Mar. 28, 2019. Camera: Canon EOS-1D X Mark II



Photo by: Maria Alejandra Gutierrez, FLAAR Mesoamerica, Mar. 28, 2019. Camera: Canon EOS-1D X Mark II



***Byrsonima crassifolia*,**
Nance

Photo by: Nicholas Helmuth, FLAAR Mesoamerica, May. 4, 2019. Camera: Nikon D5

***Canna indica*,**
canna lily

Edible and medicinal; leaves used as tamale wrap

Photo by: Nicholas Helmuth, FLAAR Mesoamerica,
May. 4, 2019. Camera: Nikon D810





Crescentia cujete, **jícara, jícaro**

Seeds are edible (Fresh seeds are ground and mixed with water to make a refreshing drink. The drink has a sweet and pleasant taste. Niembro 2004: 426), but mainly the dry pods are cut in half and each half is used as a bowl or cup (to drink chocolate).

Photo by: Nicholas Helmuth, FLAAR Mesoamerica, May. 4, 2019. Camera: iPhone XS

Epiphyllum phyllanthus, Galán de noche

Fruits of *Epiphyllum phyllanthus* are edible and medicinal (Balick, Nee and Atha 2000: 61).

Photo by: María Alejandra Gutierrez, FLAAR Mesoamerica, Mar. 28, 2019. Camera: Canon EOS-1D X Mark II



***Haematoxylum campechianum*,**
Palo de tinto, logwood

This gnarled tree is best known as a major source of natural dye colorants. But this tree has other potential uses such as the ceiling beams for the Tomb of the Jade Jaguar that I discovered at Tikal under Str. 5D-73 in 1965.

Photo by: Elena Siekavizza, FLAAR Mesoamerica, Mar. 28, 2019. Camera: Google Pixel 3 XL



***Lantana camara*, family Vebenaceae**

cinco negritos, wild sage

This common weed grows in open areas throughout Guatemala where sun is available. It is also a common garden plant. I had no idea it had edible parts until I checked Balick, Nee and Atha (2000: 131).

Photo by: Juan Pablo, FLAAR Mesoamerica, May. 8, 2019. Camera: Google Pixel 3 XL



***Passiflora foetida*,**
granadilla del monte, sa-yèp (Balick, Nee and Atha 2000: 74)

We estimate this is *Passiflora foetida*, but there is another (different) species that looks very similar. *Passiflora foetida* is edible. This photogenic also encases the red fruits. These vines are found all along the inundated edges of Rio Ixtinto, Río San Pedro and lots of other wetlands. There are other species of edible *Passiflora* in PNYNN but the species *foetida* is the easiest to identify. *Passiflora sublanceolata* is also in the Savanna East of Nakum but has no published edible uses (and has no net around the bud or the fruit).

Photo by: Nicholas Helmuth, FLAAR Mesoamerica, May. 4, 2019. Camera: Nikon D810





***Selenicereus testudo*,**
Pitaya de Tortuga, Devil's Guts (Belize)

Although this is not listed as food in Belize by Balick, Nee and Atha (2000: 61) it is considered edible elsewhere.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Mar. 28, 2019. Camera: Canon EOS-1D X Mark II



Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Mar. 28, 2019. Camera: Canon EOS-1D X Mark II

This epiphytic cactus is common throughout the Reserva de la Biosfera Maya. It grows on trees in hilltop forests, bajos, and here in the savanna.

***Thalia geniculata*,**
popal, bent alligator-flag, family Marantaceae

<http://tropical.theferns.info/viewtropical.php?id=Thalia+geniculata>

<http://www.conabio.gob.mx/malezasdemexico/marantaceae/thalia-geniculata/fichas/ficha.htm#1.%20Nombres>



Photo by: Maria Alejandra Gutierrez, FLAAR Mesoamerica, Mar. 28, 2019. Camera: Canon EOS-1D X Mark II



Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Mar. 28, 2019. Camera: Nikon D810



This aquatic herb thrives where there is seasonal inundation. It helps if there is still moisture in the soil in the dry season, though the rizome can survive

(www.conabio.gob.mx/malezasdemexico/marantaceae/thalia-geniculata/fichas/ficha.htm#1.%20Nombres).

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Mar. 28, 2019. Camera: Nikon D810



Ximena americana

Ximena americana is a relative of nance (but not as well known or documented). Many parts of are edible (if properly cooked: <https://tropical.theferns.info/viewtropical.php?id=Ximena+americana>).

Photo by: Maria Alejandra Gutierrez, FLAAR Mesoamerica, Mar. 28, 2019. Camera: Canon EOS-1D X Mark II



Photo by: Maria Alejandra Gutierrez, FLAAR Mesoamerica, Mar. 28, 2019. Camera: Canon EOS-1D X Mark II

4-Petalled and/or 4-Sepalled Flowers or 4-Valve Seed Pods

The most common flowers pictured in Classic Maya art (on vases, bowls, and plates of Tikal, Uaxactun, Nakum, etc.) are:

- Fleur de lis (name used before Charles Zidar and Nicholas Hellmuth each realized was a *Pseudobombax ellipticum* or *Pachira aquatica* or relative).
- Flowers featuring four petals and/or for sepals (I have identified over 30 species native to Guatemala).

4-petalled flowers are of interest to me since two ceramic bowls that I found in Burial 196, Tikal Str. 5D-73 had flowers with 4-petals.

In March 2019 we found lots of flowers with seed pods with “four dried petals” (the petals had dropped off in a previous month so what you now see is the 4-valvate seed capsule). Each valve looks like a solidified petal. *Merremia tuberosa* has a dried seed pod that looks exactly and precisely like a petalled flower cut out of cardboard or super thin wood.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Mar. 28, 2019.
Camera: Nikon D810





Aniseia ***martinicensis***

This bright white flowered vine is not listed as edible in reports on Mesoamerica but is frequently listed as edible in other parts of the world (Siemonsma and Aarls-van den Bergh 1986: 150, Annex 1, tentative list of primary use vegetables). In other words, the Maya 2000 years ago in Petén, Campeche, Quintana Roo, Belize, etc. could have eaten this wetlands plant. Although eaten primarily in Asia and around the world outside Mesoamerica, *Aniseia martinicensis* is native and wild in Guatemala and surrounding areas of Mesoamerica. *Aniseia martinicensis* is also included in the edible plants of the indigenous people of the Andes of Perú, South America

(<https://whowaswhowari.sdsu.edu/WWWPlantIDICON.html>).

Convolvulaceae family. It is notable that *Aniseia martinicensis* is widely considered an “aquatic plant” so it may prefer to grow around the edges of the savanna which have more water than out in the middle.

Photo by: María Alejandra Gutierrez, FLAAR Mesoamerica,
Mar. 28, 2019. Camera: Canon EOS-1D X Mark II



Aniseia martinicensis

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Mar. 28, 2019. Camera: Nikon D810



Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Mar. 28, 2019. Camera: Nikon D810



Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Mar. 28, 2019. Camera: Nikon D810

Passiflora foetida immature fruits right next to *Aniseia martinicensis*



Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Mar. 28, 2019. Camera: Nikon D810

Vines whose Juice is used to Coagulate Latex to make Rubber Bounce

The latex of the Maya rubber tree (as also the latex of the Brazil rubber tree used for making tires today) the latex does not bounce or have usable properties until it is chemically treated. Goodyear and chemists in the UK and Germany vulcanized latex with sulfur. But the Olmec, Maya, Aztec and everyone else in Mesoamerica coagulated the latex of *Castilla elastica* trees with the juice of any one of several plants:

- *Ipomoea alba*
- *Merremia tuberosa*
- *Merremia umbellata*

FLAAR Mesoamerica has found all three of these vines can be found in PNYNN. Ironic that not many wild *Castilla elastica* trees are present. Other plants can also produce material to make rubber; and other plants can produce chemicals to make the rubber functional. But the ones we mention here are the most used.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Mar. 28, 2019.
Camera: Nikon D810





Ipomoea alba grows in both the Maya Lowlands and the Maya Highlands (especially around Senahu, Alta Verapaz). *Merremia tuberosa* grows by the thousands between the river and the highway before the turnoff north to Senahu (Senahu is high in the mountains; the river is much lower altitude).

Ipomoea alba grows in many areas along the shore of Lake Yaxha. Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Mar. 28, 2019.
Camera: Nikon D810

Parasitic Vines

One of my many favorite parasitic vines is genus *Cuscuta*. You see these especially in the Maya Highlands. When I began to find them en masse along the south edge of Lake Yaxha, and along the east side of Río Ixtinto, when I did research I learned that the parasitic yellow-orange spaghetti-like thin vines of Petén were often a totally different genus, family, and species (but 99% identical in size, color, shape and growth habit of *Cuscuta*). So now we estimate the parasitic spaghetti in PNYNN and elsewhere in the RBM is *Cassytha filiformis*. Photo by: Elena Siekavizza, FLAAR Mesoamerica, Mar. 28, 2019. Camera: Google Pixel 3 XL





Logo Trees of a Seasonally Humid Savanna of Petén

Photo by: Nicholas Helmuth, FLAAR Mesoamerica, May. 4, 2019. Camera: iPhone XS



Logo Trees of a Seasonally Humid Savanna of Petén: *Crescentia cujete*

Two large healthy *Crescentia cujete* trees. Most of these are in the western third of the savanna (keeping in mind we have not yet explored the southeastern third of the savanna).

The leaves at the base are in front of the camera at the edge (outside) the savanna.

Photo by: Nicholas Helmuth, FLAAR Mesoamerica, May. 4, 2019. Camera: iPhone XS



You can judge the height of these two *Crescentia cujete* trees by the height of Nicholas (at the left, about 6 feet tall).

Photo by: Nicholas Helmuth, FLAAR Mesoamerica, May. 31, 2019. Camera: iPhone XS



Logo Trees of a Seasonally Humid Savanna of Petén: Tasiste

Photo by Nicholas Helmuth, FLAAR Mesoamerica. Jul. 29, 2019. Camera: iPhone XS



Here you can see how burned the tasiste palm trunks are. These palms have a literal "thick wrapping" around the trunk. This gets burned off during the fires set by illegal hunters (to drive out animals so the hunters can get them). Sometimes the palms are burned so thoroughly the entire stem (trunk) dies off, but then they sprout from the root mass. Or, the palm trunk wrapping and the palm leaves are burned off but the stem survives and the leaves resprout when it begins to rain.

I estimate that in 2019 this savanna was not burned down; that the burning was from an earlier year. We would like to rescue the fragile endangered eco-system here by having the savannas become as much beloved as the sunset over Lake Yaxha.



These savannas deserve to be saved. Eco-tourism has saved much of the entire country of Costa Rica. Let's make the Reserva de la Biosfera Maya as popular, as well known, and as conserved as Costa Rica.

Here you see that tasiste often grows literally embraced by a jícara tree.

Photo by Nicholas Hellmuth, FLAAR Mesoamerica. May 4, 2019.

Camera: iPhone XS



Logo Trees of a Seasonally Humid Savanna of Petén: Nance

Young nance tree sprouting up (probably after a fire estimated 2 years ago).

Photo by Nicholas Hellmuth, FLAAR Mesoamerica.
May 4, 2019. Camera: iPhone XS

Nance sprouting from the caked dry soil.

2019 was a dry year. Fortunately this savanna was not burned this year (of if so, was when we were not visiting there; invasores do not happen when park rangers or tour groups or research teams are present).

Photo by Maria Alejandra Gutierrez, FLAAR Mesoamerica. Mar, 28, 2019. Camera: Canon EOS-1D X Mark II



Plants that have not yet been found in the Savanna East of Nakum

Lundell has made lists of plants of savannas near La Libertad, in central Petén. In the 1930's La Libertad was a base camp for research as it was also for archaeological explorer Teobert Maler in the 1890's. Today there are highways much deeper into Petén and dirt roads even deeper.

There are lots of savannas around Poptun, an hour or more drive south of Lake Petén Itza. But the regional variation of karst geology of Poptún results in pine forests and pine savannas. It would be helpful for a student to initiate a comparative tabulated thesis or PhD dissertation on what plants are in each savanna of Petén and then compare these with plants in the savannas of Belize. But the plants that immediately stand out as well documented for many savannas but 100% either missing (pine trees) or not yet noticed (*Curatella americana*)

Curatella americana, family Dilleniaceae, Sandpaper (leaf) Tree present in the dry hillside savanna near Rabinal, Baja Verapaz (that FLAAR has visited and photographed several times several years ago). Lundell notes *Curatella americana* in a savanna on the Tayasal peninsula (1937). *Curatella americana* is present in most savannas of Belize but so far we have not yet found *Curatella americana* anywhere in PNYNN.

Pine trees

Present in most (but not all) savannas of Poptún area of Petén and dozens of savannas in Belize. Most of the savannas around La Libertad are destroyed for commercial plantations or for cattle ranches (need to check Cyrus Lundell to see what trees were in all the savannas around La Libertad). No pine trees in any savanna west of Yaxha, east of Nakum or parallel to west side of Naranjo. We found no pine trees in the two savannas we explored

in Parque Nacional Laguna del Tigre, southeast of Paso Caballos in August 2021. Pine is mentioned frequently for 3 km northeast of the corner of Parque Nacional Tikal but not inside the park.

Oak trees

Present in most (but not all) savannas of other parts of the Maya Lowlands. So far we have not noticed oak in any savanna of PNYNN. Yet Boris Llamas found oak trees in the Spider Lily Savanna that I noticed on aerial photos in early 2021 and we finally visited there in August 2021. Boris Llamas also found oak along Rio Sacluc, tributary of Río San Pedro in same PNLTL as the Spider Lily Savanna. Oak is mentioned in lists for PNLTL by earlier botanists (but they worked in the western area; we focused on the southeastern area of the park).

The savannas of Yaxha, Nakum, and Naranjo have the "logo trees" of a seasonally inundated and frequently incinerated savanna:

- Tasiste palm, *Acoelorrhapha wrightii*, resistant to fire; sprouts immediately when first rains come.
- *Byrsonima crassifolia* is the nance tree we estimate is here (but there are several different "nance" trees in Guatemala. Nance survives fire.
- *Crescentia cujete*, called jícara, jícaro; the word morro is best focused on *Crescentia alata* of dry areas of Guatemala. *Crescentia cujete* must also survive fires since in the Spider Lily Savanna southeast of Paso Caballos, the trunks of the nearby tasiste palms were literally charcoal color from being incinerated.

What makes this Savanna different than many others?

This savanna is larger than any other savanna or cibal in the entire Parque Nacional Yaxha, Nakum, and Naranjo. Note: there are no large savannas in Parque Nacional Tikal, but there are dozens of savannas, cibal grasslands in the Reserva de la Biosfera Maya, especially west of Uaxactun. We have also found on aerial maps and satellite photos almost a dozen savannas, cibal grasslands, or aguadas (which are relatively open areas surrounded by forest or bajo vegetation) in the southern part of Parque Nacional Laguna del Tigre. Plus obviously there are savannas in other parts of the RBM that we have not yet initiated research (since the scores of savannas we have listed already are enough to keep us busy during 2022; our project is 2021-2025 so we will be exploring lots more wetlands in the coming years: swamps in addition to savannas).

Most savannas are “seasonally inundated.” In a dry month of a dry year the surface is bone dry. In a rainy season of a dry year there may not be much water on the surface. But in a wet month of a relatively wet year we found between 4 and 16 cm of water in many areas of the Savanna East of Nakum and in December 2021 found comparable amounts of water on about 50% of the surface of the Savanna West of Naranjo. But in a really wet month of a really wet year we estimate there is deeper water and over 90% to 100% of a savanna.

The Savanna East of Peten has “hundreds” of *Crescentia cujete* trees. The Spider Lily Savanna (SE part of PNLT) also has lots of *Crescentia cujete* trees. The Savanna West of Naranjo has only about three jicaro trees.

The Savanna East of Nakum has “hundreds” of tasiste palm clusters. The Spider Lily Savanna has lots of areas of tasiste palm clusters. The Savanna West of Naranjo has only one clump (because the fires set here every year or so burn so intensely that even the tasiste palms are “burnt to the ground”). The Savanna of 3 Fern Species and adjacent Rectangular Savanna have only a few tasiste palms (because these savannas are being gradually taken over by bajo forest trees from the surrounding bajos).

The Savanna of 3 Fern Species (west of Yaxha) has thousands of several fern species. Almost no fern species are in the savannas near Nakum or near Naranjo (other than around the moist edges if at all).

The Savanna of 3 Fern Species and the adjacent Rectangular Savanna (PNYNN) are both being overgrown by trees from the adjacent bajo. This is because these areas are rarely burned since they are not as large as the savannas near Nakum and Naranjo. The savanna near Naranjo-Sa'al ruins is incinerated frequently as is the Savanna East of Nakum).

The Savanna of 3 Fern Species has more diversity of plants than any of the other savannas. The Savanna West of Naranjo has more diversity of plants than the Savanna East of Nakum.

All savannas have tasiste, jicaro, and nance. No savanna or other wetland in PNYNN has any oak trees. Spider Lily Savanna and rivers of Parque Nacional Laguna del Tigre (PNLT) have oak trees (but no pine). Savannas of Belize, Peten around Poptun, Peten around La Libertad and before Sayaxche have pine trees. Pine trees a few kilometers outside of the northeast corner of Tikal but no documentation that there is a large open grassland savanna there.

Will take more weeks, months, years of field work, and then in the future we can tabulate what each savanna of the Reserva de la Biosfera Maya has, so you can more clearly see the differences. Our goal is to find (on aerial photos and satellite photos), visit (to photograph in high resolution), to research what flora and fauna are in each savanna, cibal, or pital aguada or similar flat wetland, and to make this documentation available to students, professors, all the conservation agencies, and to the general public to help conservation of these biodiverse but fragile wetlands ecosystems of the Reserva de la Biosfera Maya, Peten, Guatemala. Our photographs, notes, lists of flowering plants, snail shells, etc. are also intended to assist the personnel and administrators of each park or nature reserve for their Plan Maestro reports.



Photo by Nicholas Helmuth, FLAAR Mesoamerica. May. 4, 2019. Camera: iPhone XS

To Assist Field Research in Savannas, Cibales, Aguadas, Pitales and Bajos

It takes at least 3 hours to reach the savanna from the Nakum base camp, tripping on vines, tripping on stubs of saplings that were cut but not flat down to the ground. All of us have experience hiking these areas but still we are bruised and wounded by being tripped by the vines that wander around the ground and have not been cleared on the foot path.

The other hazard is being stuck in the eye by a branch or vine that was cut but not high enough or not removed completely.

Then it takes 3 to 4 hours to return to base camp (because we are all worn out from hiking to the savanna and exploring kilometers across the savanna). So between 6 and 7 hours of every day are totally lost hiking back and forth. It would definitely help if we could be driven at least half way (or driven to near the geological fault line). From there we can hike downhill to the savanna in less than 20 minutes. There are trukke-passes (truck passes) the entire distance (from illegal lumber cutting of past decades). But these trucks simply should not be allowed on the access roads. These access trails should be for park rangers on quadrimotos, for Maya Trek groups (eco-turism), and for research teams documenting this area to assist in its conservation.

Xateros, Chicleros, illegal hunters, people stealing copal pom, and other people who are not supposed to be damaging the park areas don't need a pickup truck to get here; they don't even need to use a motorcycle (and most of them do not have a quadrimoto). All the illegal people get here on foot from the eastern edge of the park. We need to reach the savanna from the central part of the park.

Let's make the savanna of PNYNN better documented, better photographed, and more published than the impressive savannas of Belize.

Plus, if there is a trail for a quadrimoto or a Suzuki Mula, then park guards can patrol all the areas. And if registered guides have access for trek tours, avi-turismo, eco-turismo then the invasores will not longer be able to sneak in. The Maya Trek from El Zotz to Tikal is an inspiring model for trek tours (tourists provide jobs for local people; tourists ticket entry money provides income; and trek tours can make PNYNN as famous for eco-turism as it is already for Maya ruins and sunset photo ops).

If ecologists, botanists, zoologists, geologists, biologists can reach the Savanna East of Nakum by vehicle (with just a 20 minute hike down the geological karst fault area) then this savanna can become as famous as other remarkably biodiverse areas of Petén. I consider the Savanna East of Nakum as potentially more biodiverse than most savannas of Belize. Yet dozens, scores of savannas of Belize are documented every year because the Belize savannas can be easily and comfortably reached by scientists.

Due to the size and bio-diversity of this PNYNN savanna it deserves a dedicated research focus. Plus every two months there will be different plants flowering. So it helps to visit every two months over a minimum one year period to find and photograph the majority of the flowering plants of this remarkable habitat. Our team is inspired to accomplish these goals.



Giant almost leafless *Ceiba pentandra* tree is at the literal base of the limestone hill.

Crescentia cujete, jícara trees widely scattered in this western portion of the savanna.

Photo by Nicholas Hellmuth, FLAAR Mesoamerica. Mar 28, 2019. Camera: iPhone XS

Appendix A

SAVANNA EAST OF NAKUM BIODIVERSITY, PNYNN, PETÉN

Trees and palms within the Savanna

| No. | Scientific name | Family | Common name |
|-----|-------------------------------|---------------|----------------------|
| 1 | <i>Byrsonima crassifolia</i> | MALPIGHIACEAE | Nance |
| 3 | <i>Crescentia cujete</i> | BIGNONIACEAE | Jícara |
| 6 | <i>Myrcianthes storkii</i> | MYRTACEAE | Guayabillo |
| 7 | <i>Ximena americana</i> | OLACACEAE | Pepe Nance |
| 8 | <i>Acoelorrhaphe wrightii</i> | ARECACEAE | Tasiste Palma |

En nuestras próximas visitas de viaje de campo, esperamos encontrar más de tres especies de árboles que se encuentran dentro de la sabana.

By Elena Siekavizza and forest rangers, PNYNN. March 28, 2019

Herbaceous within the savanna

| No. | Scientific name | Family | Common name |
|-----|--|------------------------------------|-------------|
| 9 | <i>Androlepis skinneri</i> | BROMELIACEAE | |
| 10 | <i>Aniseia martinicensis</i> | CONVOLVULACEAE | |
| 11 | <i>Canna indica</i> | CANNACEAE | Canna |
| 12 | <i>Cuscuta</i> sp or <i>Cassytha filiformis</i> | CONVOLVULACEAE or LAURACEAE | Spaguetti |
| 13 | <i>Eleocharis</i> species | CYPERACEAE | |
| 14 | <i>Epiphyllum phyllanthus</i> | CACTACEAE | Pitaya |
| 15 | <i>Mimosa pigra</i> | FABACEAE | Dormilona |

En nuestras próximas visitas de viaje de campo, se realizará una definición de los micro-ecosistemas que se encuentran en la sabana, donde se realizará un listado completo de acuerdo a dichos ecosistemas de todas las herbáceas encontradas dentro de la sabana.

Eleocharis intrinseca is a name not present in ThePlantList, so I change it to *Eleocharis* species.

There are also lots of other plants that are not linked or focused on growing only in savannas. This list is added to this Appendix by Nicholas Hellmuth. We estimate we have found only a fraction of the flowering plants of this savanna. But here is a start (in addition to the eight above that tend to prefer to grow in savannas).

- *Aechmea bracteata*
- *Cameraria latifolia*, Chechén blanco
- *Ficus* species, amate
- *Ipomoea alba*, moon flower
- *Ipomoea pandurata*

- *Lantana camara*
- *Merremia umbellata*
- *Passiflora foetida*
- *Passiflora sublanceolata*
- *Selenicereus testudo*
- *Thalia geniculata*

And reeds, sedges and/or grasses that have still to be identified

TREES ON THE BAJO (LA JUSTA) SURROUNDING THE SAVANNA SOUTH SIDE

| No. | Scientific name | Family | Common name |
|-----|--|---------------|--------------------|
| 16 | <i>Carica</i> sp. | CARICACEAE | Papaya Silvestre |
| 17 | <i>Cecropia</i> sp. | URTICACEAE | Guarumo |
| 18 | <i>Ceiba pentandra</i> | MALVACEAE | Ceiba |
| 19 | <i>Ficus</i> sp. | MORACEAE | Amate |
| 20 | <i>Haematoxylum campechianum</i> | MORACEAE | Palo Tinto |
| 21 | <i>Metopium brownei</i> | ANACARDIACEAE | Chechén |
| 22 | <i>Tallisia olivaeformis</i> <i>Talisia oliviformis</i> | SAPINDACEAE | Coloc |
| 23 | <i>Trichilia minutiflora</i> | MELIACEAE | Cedrillo hoja fina |

In the next field trip visits, we will note all the tree species that are found on the lowlands that surround the savanna, we hope find more than 12 species of trees that are not on this list.

TREES ON HILLSIDE THAT SURROUNDS THE SAVANNA NORTH SIDE

| No. | Scientific name | Family | Common name |
|-----|----------------------------------|-------------|----------------|
| 24 | <i>Aspidosperma megalocarpon</i> | APOCYNACEAE | Malerio Blanco |
| 25 | <i>Brosimum alicastrum</i> | MORACEAE | Ramón |
| 26 | <i>Ceiba pentandra</i> | MALVACEAE | Ceiba |
| 27 | <i>Melicoccus bijugatus</i> | SAPINDACEAE | Guaya |
| 28 | <i>Protium copal</i> | BURSERACEAE | Copal |
| 29 | <i>Pseudobombax ellipticum</i> | BOMBACACEAE | Mapola roja |
| 30 | <i>Schizolobium parahyba</i> | FABACEAE | Plumajillo |

In the next field trip visits, we will note all the tree species that are found on the lowlands that surround the savanna, we hope find more than 12 species of trees that are not on this list.

Appendix B

Comments on Petén Savannas by Cyrus Lundell

Savannas-In Northern Petén near Lake Petén exist several well-drained upland areas which are characterized by savanna vegetation (Plates 20 and 21). The *rendzina* soils without exception are reddish calcareous clays of no greater depth than in the climax forest. Through continued occupation as inhabited sites, or by milpa rotation and subsequent fire destruction, the retrogression of the vegetation to the present state has resulted. I am convinced that the savanna vegetation in the Northern Petén savannas is maintained in the present condition by fire, and that forest would completely reclaim them if fires were controlled. Even in spite of fires, it is evident that forest growth of fire-resistant species is encroaching on the areas. At Kantetul scrub growth has almost completely over-run the savanna (Plate 21).

I investigated the savanna growth on the Tayasal peninsula, and north of Lake Petén in Sabana Zis, Sabana Tzimintun, and at Kantetul. At the first three localities fire-resistant scrubby trees, scattered through the open grasslands (Plate 20), include the *zakuche*, *Hippocratea subintegra* (Lundell 3193), the *zitzya*, *Dipholis salicifolia* (3197), the *chique*, *Ternstroemia tepezapote* (3204), the *saha*, *Curatella americana*, and the *nanze*, *Byrsonima crassifolia*. The last two are commonest.

I visited the areas in May after they had been swept by fires, so that little remained of the herbaceous growth (Plate 20). The species that had survived and were in flower included the perennials *Brickellia oliganthes* (Lundell 4013), *Orthopappus angustifolius* (4014), *Anemia adiantifolia* (3891, 4706), *Stenorrhynchus orchioides* (3134, 3897), *Asclepias longicornu* (4060), and two grasses, *Bouteloua triaena* (3860), and *Pentarrhaphis scabra* (3196). Most of the herbaceous species in the

savannas have fleshy roots, corms, or woody underground stems which enable them to survive fire and drought. (Lundell 1937: 43-44).

To trace the succession in such an area from the savanna stage through all phases to the climax forest will be most important. Succession in the uplands apparently varies in its initial phases according to the state of the area. In other words, different species appear to characterize successional stages in savannas, abandoned inhabited clearings, abandoned milpas of recently cleared climax forest, abandoned milpas of cleared *acahual*, etc. By noting the state to which an area has retrogressed floristically and edaphically, it may be possible to predict what successional stages will ensue if the area is left undisturbed. Other botanists visiting Kantetul are urged to collect through the ruins and record dominant species so that at least some of the stages of the sere in such a savanna area will be known.

The prominent trees in the savanna at Kantetul were the *abalche*, *Ximenia americana* (Lundell 3183), the *tah*, *Lippia myriocephala* (3171), the *zupte*, *Lysiloma desmostachys* (3172), the *saha*, *Curatella americana*, the *nanze*, *Byrsonima crassifolia*, and *Acacia angustissima*. Two large shrubs, *Piper kantetulense* (3173) and *Piper multitermum* (3168), were common.

Of the herbaceous growth I collected two tall grasses, the *ac*, *Imperata contracta* (Lundell 3167), and the *chachihuhe*, *Andropogon condensatus* (3169), a leguminous vine called *ixbeho*, *Rhynchosia longeracemosa* (3166), and the composite, *Calea urticifolia* (3174).

There are other small savannas in the uplands around Lake Petén. The existence of these savannas on the *rendzina* soils of the

region is very interesting, for their presence indicates that long-continued human occupation of the land, coupled probably with fire destruction, results in savanna conditions even in humid limy areas which naturally support forest vegetation.

In the following systematic list are given the plants found in the grasslands and around the margins of the Northern Petén savannas. A detailed survey would greatly increase the number of species. The collection numbers are those of the writer, unless otherwise indicated.

TREES:

- Olacaceae *Ximenia americana* L. Abalche. 3183.
Lauraceae *Ocotea lundellii* Standl. Yaaxhochoc, Laurel. 3195.
Leguminosae *Acacia angustissima* Mill. Kuntze.
Lysiloma desmostachys Benth. Zupte. 3172.
Swartzia lundellii Standl. Cataox, Lloro sangre. 3189.
Malpighiaceae *Byrsonima crassifolia* L. HBK. Nanze.
Hippocrateaceae *Hippocratea subintegra* Blake. Zackuche.
3193 Dilleniaceae *Curatella americana* L. Saha.
Ternstroemiaceae *Ternstroemia tepezapote* Schl. & Cham.
Chique. 3204. Clusiaceae *Clusia flava* Jacq. Hubuche. 3238.
Araliaceae *Oreopanax guatemalense* Lem. Dcne. & Planch.
3135. Sapotaceae *Dipholis salicifolia* L. A. DC. Zitzya. 3197.
Verbenaceae *Lippia myriocephala* Schl. & Cham. Tah- 3171.

SHRUBS: *Piper kantetulense* Trel. 3173.

- Piperaceae *Piper multineraium* Mart. & Gal. 316
Polygalaceae *Polygala jamaicense* Chodat. Limonaria Cimarron.
3187.
Ebenaceae *Diospyros yucatanensis* Lundell Jaboncillo 3194.
Rubiaceae *Rondeletia belizensis* Standl. Bakke 3188.

LIANAS:

Smilacaceae *Smilax lundellii* Killip & Morton. 3190.

HERBACEOUS VINES:

Leguminosae *Rhynchosia longeracemosa* Mart. & Gal.
Ixbeho. 3166.

HERBS:

- Schizeaceae *Anemia adiantifolia* (L.) Sw. 3891, 4706.
Gramineae *Androposon condensatus* HBK. Chachihuhe. 3169.
Bouteloua triaena (Spreng) Scribn 3860.
Imperata contracta (HBK) Hitchc Ac 3167.
Pentarrhaphis scabra HBK 3196.
Orchidaceae *Stenorrhynchus orchioides* (Sw) L. C. Rich 3134,
3897.
Asclepiadaceae *Asclepias longicornu* Benth. 4060.
Compositae *Brickellia oligantes* (Less.) Gray. 4013.
Calea urticifolia (Mill.) DC.
Orthopappus angustifolius (Sw.) Gleason 4014.

PARASITES:

Loranthaceae *Phoradendron aurantiacum* Trel. Kimiche,
Mata palo. 3191

Lundell provides literally endless discussions of the soils of savannas and then lists of plants (pages 94 to 104). It will be necessary to tabulate them and update the old names used in the 1930's to the accepted names used today.

I am surprised to note that nowhere is tasiste palm mentioned for savannas of his area of central

Petén. Tasiste palms, *Acoelorrhaphe wrightii*, are a clearly significant indicator of a savanna in Parque Nacional Yaxha, Nakum and Naranjo and Parque Nacional Laguna del Tigre.

Appendix C

GEOLOGICAL FAULT LINE CUTTING THROUGH KARST HILL OVERLOOKING THE SAVANNA EAST OF NAKUM

This is the largest and most obvious geological fault line I have seen while hiking through Petén.

There is also a geological fault line running through the plaza in front of Yaxha Stela 11 (but the crack is filled not open to view). The fault line is very impressive. Down below to the west it is awesome.

I will be preparing a set of photographs of this fault line for the future. For the savanna report we simply wanted to mention to geologists that this fault line is waiting for them to map it.



This is a geological fault; this is not because Maya quarried stone here. This part of the hill is literally "split" with the south part "falling downhill."

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Bibliography on *Tasiste palm, Acoelorrhaphe wrightii*, a logo tree of Savannas of the Maya Lowlands

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.

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.

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1940 Several palm problems. 33. *Acoelorrhaphe* vs. *Paurotis*. Silver Saw Palms. *Gentes Herbarum* 4: 361-365.

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1994 The Conservation Status of *Schippia concolor* in Belize. *Principes*, 38(3), 1994, pp. 124-128.

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

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

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Download failed: <https://idoc.pub/download/guia-ilustrada-de-las-plantas-del-peten-yucatan-8x4eok88m3n3>

Carrillo-Bastos, A.

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CHAN, Rosa Maria

2003 Plan Maestro del Parque Nacional Tikal 2003-2008. Ministerio de Cultura y Deportes-Dirección del Patrimonio Cultural y Natural-Parque Nacional Tikal. The Nature Conservancy, RARE, WCS, UNESCO and USAID. 135 pages.

CONAP, et al.

2006 Plan Maestro del Parque Nacional Yaxha – Nakum – Naranja 2006-2010. 168 pages.

Free download (from several web sites, here is one): https://issuu.com/informaticapatrimonio/docs/plan_maestro_yaxha_nakun-naranja

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2015 Plan Maestro del Parque Nacional Yaxha, Nakum, Naranja, primera actualización. CONAP, Ministerio de Cultura y Deportes, et al. 335 pages.

Free download: <https://conapgt.com/wp-content/uploads/2019/09/Documento-Final-Plan-Maestro-PNYNN.pdf>

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.

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.

FIALKO, Vilma

2001 Investigaciones arqueológicas en el Bajo Santa Fe y la Cuenca del Río Holmul, Petén: Parte 2. Región Noreste del Parque Nacional Tikal y Periferia de Nakum. Temporada 2001. Proyecto Nacional Tikal. Sub-Proyecto Triángulo Yaxhá-Nakum-Naranjo. Instituto de Antropología e Historia. Guatemala.

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

Henderson, Andrew, Galeano, Gloria and **Rodrigo BERNAL**

1997 Field Guide to the Palms of the Americas, Princeton University Press. 363 pages.

Some web sites list the date as 1995; most list the date as 2019.

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.

Neither *Acoelorrhaphe wrightii* nor synonym *Paurotis wrightii* nor any other *Paurotis* is in his index.

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.

LUNDELL, Cyrus L.

1961 Plantae Mayanae II. Collections from Peten and Belice. *Wrightia* 2(3): 111- 126.

MARTÍNEZ, J. N.

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2019 A Review of the Nomenclature and Types of the Genus *Acoelorrhaphe* (Arecaceae). *PalmArbor* 2019-3: 1-30.

Free download: <file:///Users/new/Downloads/Moya2019NomenclatureAcoelorrhaphePalmArbor.pdf>

PARKER, Tracey

2008 *Trees of Guatemala*. The Tree Press. 1033 pages.

If you are doing research on trees of Mesoamerica every month the way we do, this book by Tracey Parker is helpful because it has all of Standley, Williams, and colleagues all combined in one single thousand-page volume.

But if you need fresh finds, if you need high-res photographs, if you need documentation from a botanist, ethnobotanist, or student who has stood in front of the tree you want to study, in its true habitat in Mesoamerica, then you also need dozens of other resources.

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

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

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, would help if there were more photos, larger photos, and not so much blank space at the bottom of each page. Plus would help if the text could include personal first hand 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 (though tasiste is conspicuously missing). 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 very 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.

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. And, this is definitely not a book on ethnobotany: for that you need Suzanne Cook.

PULESTON, Dennis

1973 Ancient Maya Settlement Patterns and Environment at Tikal, Guatemala. PhD dissertation, Anthropology, University of Pennsylvania.

Free download: www.puleston.org/writings-dissertation.html

But no pagination, and no copy-and-paste facility.

PULESTON, Dennis

2015 Settlement and Subsistence in Tikal The assembled work of Dennis E. Puleston (Field research 1961-1972). Paris Monographs in American Archaeology 43, BAR International Series 2757. 187 pages.

This is his wife's reorganization of his 1973 PhD. No *tasiste*, no *nance* could I find. *Crescentia cujete* is only mentioned as a usable plant, seemingly based on Lundell's 1938 list rather than Puleston finding it in a savanna. In other words, there is no list in this Puleston opus that suggests he studied or made lists of savanna habitats. And there are no photographs of any savanna. Indeed the word savanna is not in his index. This is because the focus of all 1960's-1970's Maya field work was in traditional archaeology and in hilltop settlement areas. There were no house mounds in savannas so no interest (in those decades) in studying a savanna.

QUERO, H, and J. SALVADOR

2004 Arecaceae de la Península de Yucatán. Etnoflora Yucateca, Fas. 23. Universidad Autónoma de Yucatán.

SCHULZE, Mark D. and David F. WHITACRE

1999 A Classification and Ordination of the Tree Community of Tikal National Park, Peten, Guatemala. Bulletin of the Florida Museum of Natural History. Vol. 41, No. 3, pp. 169-297.

Even though 20 years ago, it's the best list of trees of Tikal that I have found. There is a web site with plants of Tikal but they are not separated into trees, vines, shrubs, etc., so harder to use. The new monograph on *Arboles de Calakmul* is better than anything available so far on Tikal (and the nice albeit short book by Felipe Lanza of decades back on trees of Tikal is neither available as a scanned PDF nor as a book on Amazon or ebay).

Free download on the Internet.

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.

Free download.

SMALL, J. K.

1922 The saw-cabbage palm. The history and distribution of *Paurotis wrightii*. J. New York Bot. Gard. 23: 61-70.

STANDLEY, Paul C. and Samuel J. RECORD

1936 The Forests and Flora of British Honduras. Field Museum of Natural History. Publication 350, Botanical Series Volume XII. 432 pages plus photographs.

STANDLEY, Paul C. and Julian A. STEYERMARK

1958 Flora of Guatemala. Fieldiana: Botany, Volume 24, art I. Chicago Natural History Museum.

Free download from various web sites. But some versions are easier to copy-and-paste than other versions. All have spelling errors when any Spanish or Mayan word has an accent.

Bibliography on Nance, a logo tree of Savannas of the Maya Lowlands

There is "nance dulce", "nance agrio" and other kinds of nance in Guatemala and adjacent parts of the Maya Lowlands (Chiapas, Tabasco, Campeche, Quintana Roo, Belize, etc.)

AGUIRRE DE RIOJAS, REGINA and ELFRIEDE DE PÖLL

2007 Trees in the Life of the Maya World. BRIT Press, Botanical Research Institute of Texas.

Has only one terrible photo of a nance tree (p. 65). This photo is a good example of a snapshot that should not have been enlarged to attempt to decorate a page in a coffee-table book. This image was probably not good at a smaller size either.

AVILES-Peraza, Gabriela C.

2015 Rico y popular: Importancia y usos tradicionales del nance (*Byrsonima crassifolia* (L.) Kunth). Herbario CICY 7: 157–160 (15/Octubre/2015). Centro de Investigación Científica de Yucatán, A.C.

Nice summary of multiple uses noted by earlier botanists and ecologists. However does not mention use as leaf to wrap tobacco cigars, probably because not many people make their own cigars any more.

Free download: www.cicy.mx/Documentos/CICY/Desde_Herbario/2015/2015-10-15-Aviles-Peraza-Importancia_y_usos_tradicionales_del_nance.pdf

BREEDLOVE, D. E. and R. M. LAUGHLIN

1993 Page 151 mentions nance is used to treat tooth pain.

BRIDGEWATER, S., IBÁÑEZ, A., RATTER, J. and P. FURLEY

2002 Vegetation Classification and Floristics of the Savannas and associated Wetlands of the Rio Bravo Conservation and Management Area, Belize. Edinburgh Journal of Botany 59(3): 421-442. November 2002.

The pagination in the download is different since the pagination is before it was published by the journal.

BROWN, M. Kathryn and Travis W. STANDON

2003 Ancient Mesoamerican Warfare. AltaMira Press, 384 pages.

CASTAÑEDA, C.

2006 Estudios botánicos en Cuenca Mirador: Estudio y desarrollo de vegetación y su significado cultural. Informe Proyecto Qrqueológico cuenta Mirador Temporada 2006. Mexico.

CHRISTENSON, Allen J.

2007 Popol Vuh: The sacred book of the Maya. University of Oklahoma Press. 328 pages.

CONANP

2016 Estudio Previo Justificativo para la declaratoria de la Reserva de la Biosfera Caribe Mexicano, Quintana Roo. Comisión Nacional de Áreas Naturales Protegidas. 305 pages.

Free download: file:///Users/new/Downloads/20161108170003_41447_EPJ%20RB%20CM%2022abril2016_Aviso.pdf

COOK, Suzanne

2016 The Forest of the Lacandon Maya, an Ethnobotanical Guide. Springer. 334 pages.

Discusses nance on her pages 132 and 172-173. Her information is helpful but she correctly points out that if someone hands you the fruit it is not realistic to identify it as to which of the two "nance" trees it is from. So without the flower, from the fruit or leaf alone, that does not guarantee identification.

We need to study nance in all savannas of Parque Nacional Yaxha Nakum Naranjo to figure out whether only B. is present; and we need to find how many other kinds of nance are present (and hence potentially which other species, or potentially other genera grow in the park and are also named nance (or nanche). Che or te means tree in most Mayan languages.

FEDDEMA, VICKI LYNN

1993 Early Cormative Subsistence and Agriculture in Southeastern Mesoamerica. MA Thesis, University of British Columbia, Dept of Anthropology and Sociology.

FLORES J. S. and I. ESPEJEL

1994 Tipos de Vegetación de la Península de Yucatán. Etnoflora yucatanense, Fasc. 3. Ed. Universidad Autónoma de Yucatán. 135 pages.

FLORESCANO, ENRIQUE; translated by Lysa HOCHROTH

2002 The Myth of Quetzalcoatl, JHU Press. 312 pages.

Suggests the tree on Izapa Stela is a nance tree. But unfortunately the fruits on this Izapa tree are of the size, shape, and location that would be typical of a morro or jicara tree, and not a nance at all. The misidentification as a nance tree is because the Popol Vuh has always been translated as the bird deity being on a nance tree. But most of the trees on which the bird is pictured as perched are really Crescentia trees, calabash trees.

HOGAN, C. Michael and World Wildlife Fund

2012 Belizean pine forests. ed. M. McGinley. Encyclopedia of Earth. Washington DC

JANICK, Jules and Robert E. PAULI

2008 The Encyclopedia of Fruits and Nuts. CABI. 800 pages.

KAUFMAN, TERRENCE and JOHN JUSTESON

2003 A Preliminary Mayan Etymological Dictionary. On-line. Over 1500 pages.

KRICHER, J.

1997 A Neotropical Companion: An Introduction to the Animals, Plants, and Ecosystems of the New World Tropics (2nd ed - 1999), Princeton University Press, 451 pp.

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1937 The Vegetation of Peten. Carnegie Institution of Washington. Publication No. 478. 244 pages.

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1938 Plants probably utilized by the Old Empire Maya of Peten and adjacent Lowlands. Papers of the Michigan Academy of Sciences, Arts, and Letters; vol. 24, pp: 37-56. University of Michigan, Ann Arbor.

MacVEAN, Lucrecia

2003 Plantas utiles de Peten, Guatemala. Herbario UVAL, Instituto de Investigaciones Universidad del Valle de Guatemala.

MARTINEZ Muriel, A.

1978 Don Martin Chiapas: Inferencias economico-sociales. Tesis de Licenciatura en Arqueologia, ENAH, Mexico.

MARTINEZ, E. and C. GALINDO-Leal

2007 La Vegetacion de *Calakmul*, Campeche, Mexico: clasificacion, descripcion y distribucion. Bol. Soc. Bot. Mexico 71:7-32.

MEDINA-TORRES, RAUL, SALAZAR-GARCIA, SAMUEL, and JOSE ROBERTO GOMEZ-AGUILAR

2004 Fruit Quality Indices in eight Nance [*Brysonima crassifolia* (L.) H.B.K.] Selections. HortScience, vol. 39, no. 5, pp, 1070-1073. American Society for Horticultural Science.

MORTON, Julia F.

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

Free download for Nance pages: <https://hort.purdue.edu/newcrop/morton/nance.html>

OFI-CATI

2003 Arboles de Centroamerica: un Manual para Extensionistas (Trees of Central America: a Manual for Extensionists). Cordero, J. and Boshier, D. H. (eds). OFI (Oxford Forestry Institute) and CATIE (Centro Agronómico Tropical de Investigación y Enseñanza). About 1083 pages.

Available at no cost on the Internet; usually tree by tree.

ORELLANA Polanco, Albaro Dionel

2014 Catálogo de frutales nativos de Guatemala. ICTA, Guatemala. 87 pages.

PENN, Malcolm G., SUTTON, David A. and Alex MONRO

2004 Vegetation of the Greater Maya Mountains, Belize. Systematics and Biodiversity 2 (1): 21–44.

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.

QUEZADA Aguilar, Maura Liseth, RODAS Duarte, Lourdes del Rosario and Andrea Azucena MARROQUIN Tinti

2016 Diversidad de encinos en Guatemala; una alternativa para bosques energéticos, seguridad alimentaria y mitigación al cambio climático. Fase I. Las Verapaces y Petén. Universidad de San Carlos de Guatemala. 143 pages.

REYGADAS Prado, Fabiola, coordinator

2006 DIAGNOSTICO AMBIENTAL Y FORESTAL DEL ESTADO DE QUINTANA ROO. Inifap, CONAFOR. 182 pages.

SABIDO Zetina, Rafael Antonio

2004 ANÁLISIS ESPACIO-TEMPORAL DE LA EXPLOTACIÓN FORESTAL EN LA PENÍNSULA DE YUCATÁN. Lic. Thesis, UNAM, Mexico.

Free download: <http://132.248.9.34/pd2005/0601792/0601792.pdf>

The download ends on p. 96 and lacks the rest of the thesis; so lacks the bibliography.

SEA Belize (Southern Environmental Association)

2015 Placencia Lagoon Management Plan, Management Plan 2015-2020. SEA Belize, Wildtracks, Belize.

SHARER, Robert J. and David W. SEDAT

1987 Archaeological investigations in the northern Maya Highlands, Guatemala. University of Pennsylvania Press. 487 pages.

Mentions nance tree with no further comment on page 19. This book covers archaeological research in the Salama Valley.

SMITH, Cameron

1977 Ethnobotany in the Puuc, Yucatan. Economic Botany 31:93-110.

SOBRINO Gomez, Martin

2012 El dulce sabor del nance: préstamos lingüísticos del cholano al Yucatecano. V. Coloquio Leonardo Manrique (2012) Instituto Nacional de Antropología e Historia. Mexico.

Very impressive to see a study using botany, ethnobotany, iconography, and linguistics to study a plant.

STANDLEY, Paul C. and Samuel J. RECORD

1936 The Forests and Flora of British Honduras. Publication 350, Botanical series Volume XII, Field Museum of Natural History.

STANDLEY, Paul and Julian STEYERMARK

1946 Flora of Guatemala. Fieldiana: Botany Volume 24, Part V. Chicago Natural History Museum.

STANZIONE, Vincent James, HARBAUGH, Paul and Angelika BAUER

2003 Rituals of Sacrifice: walking the Face of the Earth on the sacred Path of the Sun. University of New Mexico Press. 360 pages

Page 190 discusses the nance tree. This book is on the Tz'utujil Maya people of Santiago Atitlán.

Hardcover and softcover dates are list as different by Amazon, so "p 190" may be another page in the other edition. Frankly very confusing listings for this book.

TRABANINO, Felipe

2010 Evidencias paleoetnobotánicas del uso del nance *Byrsonima crassifolia* (L.) Kunth. (Malpighiaceae) en la reserva de la Biosfera Maya, México. SISTEMAS BIOCOGNITIVOS TRADICIONALES Paradigmas en la conservación biológica y el fortalecimiento cultural, pages 476-480. Asociación Etnobiológica Mexicana, A. C.

VILLAR Anleu, Luis

2005 Guatemala Arboles mágicos y notables. Artemis Edinter Editores, Guatemala.

WILLIAMS, L. O.

1981 The useful Plants of Central America. Ceiba 24 (1-2): 1-390.

Helpful websites

with either photos and/or information on *Byrsonima crassifolia*

www.backyardnature.net/yucatan/nance.html

Among the best photos of these flowers of any web site on the Internet.

www.backyardnature.net/mexnat/spondias.html

General comments by botanist Jim Conrad and has many good-sized nice photographs of the flowers and initiation of the fruit from the flowers of Spanish plum (which is not nance, but the photos of fruits in his hand, the outside color, size, and shape might remind you of a nance). In fact Sobrino uses this photo in his 2012 article on *Byrsonima crassifolia*.

www.forestgeneration.com/nance-tree.html

One page general description of nance tree, but with no particular orientation to its habitat specifically in Guatemala. Has a few small photographs.

<http://ntsavanna.com/nance-in-bloom>

<http://ntsavanna.com/nance-macho/> (but in November 2019 both these web pages had either been hacked or who knows what; all that appears is Chinese script).

Nice photographs of nance tree flowers and general information. Includes an excellent close-up of a single flower. This is (or was) a web site by Mary F. Farmer.

www.mayacodices.org/searchWiz.asp

Search engine for Madrid Codex.

www.hort.purdue.edu/newcrop/morton/Nance.html

Basic scientific information; minimal photos; not updated since 1999. But since it has a sentence on every aspect, the report is nonetheless worthwhile (though it lacks a bibliography other than Morton 1987). In effect, there is a need for more modern information.

<http://usaid.fiu.edu/Marketresearch/4/group5.pdf>

A market survey of summer 2008 by US AID on whether it is worthwhile trying to export Nance fruit to the US. Main use is its bibliography of a dozen web sites.

Articles specifically on *Byrsonima bucidifolia* Standl.

Websites on *Byrsonima bucidifolia* Standl.

www.cicy.mx/sitios/flora%20digital/ficha_virtual.php?especie=1710

FLORA DE LA PENÍNSULA DE YUCATÁN web site.

PDF, Articles, Books on *Crescentia cujete*, a logo tree of Savannas of the Maya Lowlands

AGARWAL, M. and S. CHAUHAN

2015 Anti-mycobacterial potential of *Crescentia cujete* (Bignoniaceae). International Journal of Advanced Research in Botany. Vol. 1, No. 1. Pages 1-9.

Available online: www.arcjournals.org/pdfs/ijarb/v1-i1/1.pdf

EJELONU, B. C., LASISI, A. A., OLAREMU, A. G. and O. C. EJELONU

2011 The chemical constituents of calabash (*Crescentia cujete*). African Journal of Biotechnology. Vol. 10, No. 84. Pages 19631-19636.

Available online: www.academicjournals.org/article/article1380972423_Ejelonu%20et%20al.pdf

ESPITIA, J. E., DURÁN, H., FANDIÑO, J., DÍAZ, F. and H. A. GÓMEZ

2011 Química y biología del extracto etanólico del epicarpio de *Crescentia cujete* L. (totumo). Rev. Cubana Plant Med. Vol. 16, No. 4. Pages 337-346.

Available online: http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1028-479620110004000

KNUDSEN, J. T. and L. TOLLSTEN

1995 Floral scent in bat-pollinated plants: a case of convergent evolution. Botanical Journal of the Linnean Society. No. 199. Pages 45-47.

NIEMBRO, A.

2004 *Crescentia cujete* L. Instituto de Ecología, Xalapa, Veracruz México. Pages 426-428.

Suggested webpages with photos and information on *Crescentia kujete*

<http://orton.catie.ac.cr/repdoc/A0009s/A0009s145.pdf>

Information.

www.arbolesornamentales.es/Crescentiacujete.htm

Information.

www.medicinatradicionalmexicana.unam.mx/monografia.php?l=3&t=Crescentia%20cujete&id=7659

Information.

<http://eol.org/pages/578228/overview>

Photos and map location.

<http://tropical.theferns.info/viewtropical.php?id=Crescentia+cujete>

Information and photos.

<https://www.gbif.org/species/5415081>

Map location.

www.tropicaldesigns.com/tta6.html

Photos and information.



Ecolodge **El Sombrero**

I thank Gabriella Moretti, owner of Ecolodge El Sombrero, for providing hotel room and meals while we have been doing field work at Parque Nacional Yaxha, Nakum y Naranjo. We also appreciate the hospitality of her sons Sebastian de la Hoz and Juan Carlo de la Hoz.

Every workday is exhausting because we are carrying and then using very heavy cameras, super-telephoto lenses, sturdy tripods, large gimbals or ball tripod heads. Thus it is crucial for my health to be able to rest and totally recuperate every night in order to be ready for the following day of botanical and zoological adventures in Parque Nacional Yaxha, Nakum y Naranjo.

Equally crucial is having a place to charge the batteries of the computers, or all the cameras, and of the cell phones. Solar power is great, but it lasts only an hour, or less, if you plug in multiple computers and cameras and flash batteries to charge. So a place with enough electricity to charge the entire mass of essential field work equipment is essential and thus very much appreciated.

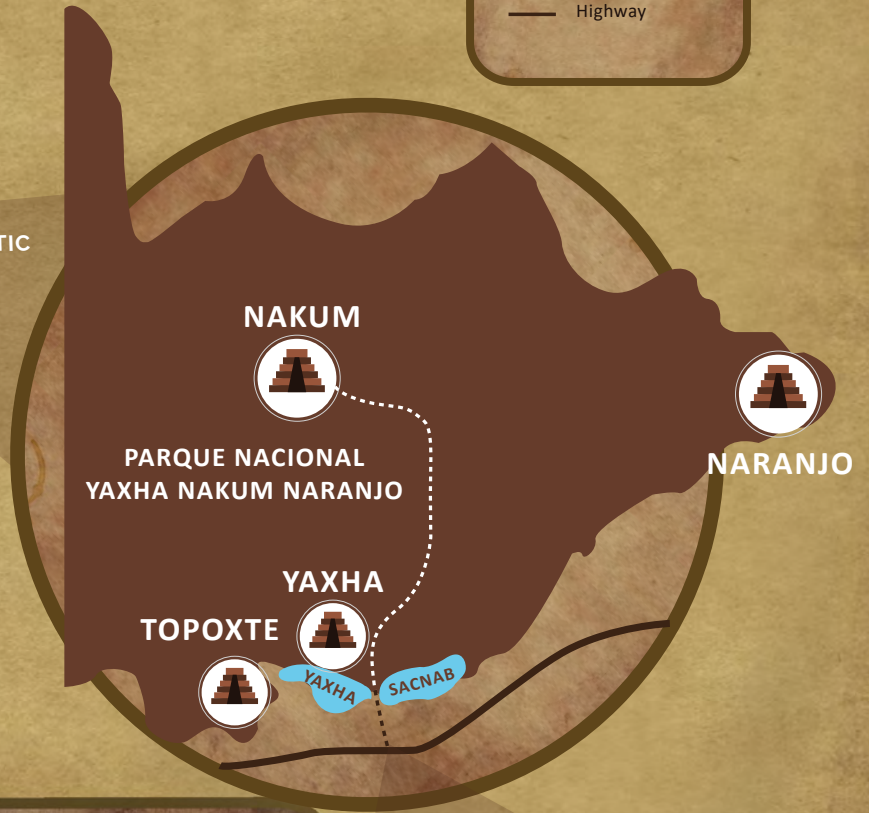
Contact Info: +502 5460 2934, ventaselsombrero@gmail.com or WhatsApp.
www.elsombreroecolodge.com/en-us



HOW TO GET TO YAXHA?

MAP LEGEND

- Archaeological sites
- Airports
- Earthworks
- Highway



PROTECTED AREA



Go to the Mundo Maya airport in Santa Elena and then you will find a services of tourist vehicles to go to the archaeological site. If you want to go by car from Guatemala City, take the following route: Río Dulce - Poptún-Flores. At the junction further on you will find on the left the route to Tikal. Go straight on to the right towards Yaxha (towards Melchor de Mencos). In km. 521 at the village La Maquina, turn left to the site. Ecolodge El Sombrero is 50 meters before the entrance to National Park Yaxha - Nakum - Naranjo.

Photo Folders List

east-of-Nakum-savanna-returning-from-cival-sibal-UNKNOWN-tree-trunks-iPhone-Xs-Mar-28-2019-NH EMPTY

Nakum-savanna-before-reaching-savanna-view-of-savanna-iPhone-Xs-Mar-28-2019-NH

Nakum-savanna-from-far-hill-view-landscape-iPhone-Xs-May-4-2019-NH

Nakum-savanna-exploration-FLAAR-team-Google-Pixel-3XL-May-4-2019-JuanPablo

Nakum-savanna-east-side-panorama-view-landscape-Google-Pixel-3XL-May-4-2019-JuanPablo

Nakum-savanna-grass-Google-Pixel-3XL-Mar-28-2019-Elena

Nakum-Savanna-iPhone-Xs-May-4-2019-Nicholas

Nakum-east-of-savanna-Vitex-gaumeri-yaxnic-purple-tree-trunk-flowers-Google-Pixel-3XL-May-4-2019-JuanPablo

Nakum-east-savanna-Ceiba-tree-Feb-18-2019-NH

Nakum-savanna-Ceiba-pentandra-panorama-landscape-view-Google-Pixel-3XL-May-4-2019-JuanPablo

Nakum-east-savanna-Ceiba-tree-Feb-18-2019-NH

Nakum-eastern-savanna-north-edge-maybe-Ceiba-Feb-18-2019-NH

Nakum-eastern-savanna-north-edge-maybe-Ceiba-Feb-18-2019-NH

Nakum-cival-east-of-Nakum-Savannah-panoramas-sibal-Mar-28-2019-iPHONE-Xs-Nicholas

Nakum-east-of-savanna-bajo-Bromelia-pinguin-flowering-iPhone-Xs-May-4-2019-Nicholas

Nakum-east-of-savanna-bajo-Bromelia-pinguin-flowering-Nicholas-taking-photographs-Google-Pixel-3XL-May-4-2019-JuanPablo

Nakum-Savanna-Aechmea-bracteata-bromeliad-on-Crescentia-cujete-jicara-Mar-28-2019-MAG

Nakum-east-savanna-maybe-white-lichened-UNKNOWN-tree-Feb-18-2019-NH

Nakum-east-savanna-maybe-white-lichened-Crescentia-tree-Feb-18-2019-NH

Nakum-hiking-to-Savanna-East-of-Nakum-maybe-UNSORTED-May-2019

Nakum-savanna-Acoelorrhaphe-wrightii-tasiste-palm-tree-Crescentia-cujete-jicaro-tree-iPhone-XS-May-4-2019-NH

Nakum-savanna-Acoelorrhaphe-wrightii-tasiste-palm-tree-iPhone-Xs-May-4-2019-NH

Nakum-Savanna-Acoelorrhaphe-wrightii-tasiste-palmetto-palm-Mar-28-2019-MAG

Nakum-Savanna-Crescentia-cujete-Jicara-Acoelorrhaphe-wrightii-tasiste-palm-view-Mar-28-2019-MAG

Nakum-savanna-Crescentia-cujete-Tasiste-FLAAR-team-taking-photographs-Google-Pixel-3XL-Mar-28-2019-Elena

Nakum-Savanna-ecosystem-Crescentia-trees-grass-palms-lphone-Xs-Feb-18-2019-NH

Nakum-Savanna-area-6km-far-Crescentia-ecosystem-grass-Feb-18-2019-MAG

Nakum-savanna-Crescentia-cujete-flower-fruit-tree-trunk-iPhone-Xs-May-4-2019-NH

Nakum-Savanna-Crescentia-cujete-Jicara-Acoelorrhaphe-wrightii-tasiste-palm-view-Mar-28-2019-MAG

Nakum-savanna-Crescentia-cujete-Tasiste-FLAAR-team-taking-photographs-Google-Pixel-3XL-Mar-28-2019-Elena

Nakum-savanna-Crescentia-cujete-tree-leaf-Google-Pixel-3XL-Mar-28-2019-Elena

Nakum-savanna-Crescentia-cujete-view-Google-Pixel-3XL-Mar-28-2019-Elena

Nakum-savanna-Crescentia-cujete-flower-fruit-tree-trunk-iPhone-Xs-May-4-2019-NH

Nakum-savanna-east-side-Crescentia-cujete-jicaro-tree-flower-fruit-trunk-Nicholas-taking-photographs-Google-Pixel-3XL-May-4-2019-JuanPablo

Nakum-Savanna-ecosystem-Crescentia-trees-grass-palms-lphone-Xs-Feb-18-2019-NH

Nakum-Savanna-Ficus-amate-on-Crescentia-cujete-jicara-Mar-28-2019-MAG

Nakum-savanna-Aniseia-martinicensis-4-sepal-4-lobed-seeds-Mar-28-2019-MAG

Nakum-savanna-Aniseia-martinicensis-4-sepal-4-lobed-seeds-Mar-28-2019-NH

Nakum-savanna-Aniseia-martinicensis-white-flower-Google-Pixel-3XL-Mar-28-2019-Elena

Nakum-savanna-Aniseia-martinicensis-white-flower-Mar-28-2019-MAG

Nakum-savanna-Aniseia-martinicensis-white-morning-glory-flowers-Mar-28-2019-NH

Nakum-savanna-arboreal-ant-nest-Mar-28-2019-MAG

Nakum-Savanna-Epiphyllum-phyllanthus-pitaya-on-Crescentia-cujete-Mar-28-2019-MAG

Nakum-savanna-Byrsonima-crassifolia-nance-growing-up-iPhone-XS-May-4-2019-NH

Nakum-Savanna-Byrsonima-crassifolia-nance-young-leaves-Mar-28-2019-MAG

Nakum-savanna-east-side-Byrsonima-crassifolia-nance-yellow-flowers-tree-May-5-2019-NH

Nakum-savanna-Canna-indica-near-Thalia-geniculata-Marantaceae-Mar-28-2019-NH

Nakum-Savanna-ecosystem-Crescentia-trees-grass-palms-lphone-Xs-Feb-18-2019-NH

Nakum-Savanna-area-6km-far-Crescentia-ecosystem-grass-Feb-18-2019-MAG

Nakum-savanna-Carica-papaya-wild-tree-leaf-Google-Pixel-3XL-Mar-28-2019-Elena

Nakum-Savanna-Cecrocopia-guarumo-Mar-28-2019-MAG

Nakum-Savanna-Cecropia-sp-guarumo-Mar-28-2019-MAG

Nakum-savanna-Cuscuta-spaguetti-Google-Pixel-3XL-Mar-28-2019-Elena

Nakum-Savanna-Cuscuta-sp-spaguetti-orange-Mar-28-2019-MAG

Nakum-savanna-Dioscorea-turtle-shell-root-Google-Pixel-3XL-Mar-28-2019-Elena

Nakum-Savanna-East-of-Nakum-2nd-visit-2019-iPhone-from-dump

Nakum-Savanna-East-of-Nakum-dump-needs-sorting

Nakum-savanna-east-of-Nakum-Cameraria-latifolia-Chechen-blanco-de-sabana-white-flower-bush-tree-May-5-2019-NH

Nakum-savanna-east-side-Cameraria-latifolia-chechen-blanco-white-flower-Google-Pixel-3XL-May-5-2019-JuanPablo

akum-savanna-east-of-Nakum-Passiflora-passionflower-May-5-2019-NH

Nakum-savanna-east-side-Passiflora-sublanceolata-pink-passiflora-May-5-2019-NH

Nakum-savanna-east-side-Lantana-camara-cinco-negritos-orange-flower-Google-Pixel-3XL-May-4-2019-JuanPablo

Nakum-savanna-Haematoxylum-campechianum-tinto-tree-leaf-Google-Pixel-3XL-Mar-28-2019-Elena

Satellite Photos; CONRED maps

Yaxha-aerial-photos-2006-IGN-Instituto-Geográfico-Nacional-cropped-areas-only-Savanna-Cibal-etc

Hiking from Nakum to the Fractured Karst hilltop Geological Fault Line

Nakum-savanna-before-guano-palm-for-string-cordage-iPhone-Xs-Mar-28-2019-NH

Nakum-savanna-before-reaching-savanna-Aspidosperma-megalocarpon-malerio-tree-seed-pod-iPhone-Xs-Mar-28-2019-NH

Nakum-savanna-before-reaching-savanna-common-UNIDENTIFIED-tree-seed-pod-iPhone-Xs-Mar-28-2019-NH

Nakum-savanna-before-reaching-savanna-park-team-and-FLAAR-Mesoamerica-team-iPhone-Xs-Mar-28-2019-NH

Nakum-savanna-before-reaching-savanna-Pseudobombax-ellipticum-flowers-tree-trunk-iPhone-Xs-Mar-28-2019-NH

Nakum-savanna-before-reaching-savanna-UNIDENTIFIED-skull-of-illegally-shot-animal-iPhone-Xs-Mar-28-2019-NH

Nakum-towards-Savanna-Nicholas-taking-photographs-Tabebuia-donnellsmithii-cortez-yellow-flower-tree-Google-Pixel-3XL-May-4-2019-JuanPablo

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Nakum-savanna-east-geological-fault-iPhone-Xs-Mar-28-2019-NH

Nakum-savanna-geological-fault-karst-Google-Pixel-3XL-Mar-28-2019-Elena

Nakum-towards-Savanna-Nicholas-taking-photographs-Tabebuia-donnellsmithii-cortez-yellow-flower-tree-Google-Pixel-3XL-May-4-2019-JuanPablo

Nakum-towards-savanna-maybe-Dioscorea-turtle-shell-roots-Nicholas-taking-photographs-Google-Pixel-3XL-May-4-2019-JuanPablo

