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Photo by: Andrea Bracamonte, FLAAR Mesoamerica, Aug. 5, 2021, Spider Lily Savanna, Petén. Camera: Canon T6. Lens: Canon EF-S 18-55mm. Settings: 1/160 sec; f/11; ISO 100.

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Introduction to the Grassland Savanna SE of Parque Nacional Laguna del Tigre

Some months ago, while studying satellite photographs of the Reserva de la Biosfera Maya (RBM), I noticed several savannalike areas on the far southeast corner of Parque Nacional Laguna del Tigre. We use satellite photos to identify which areas of the RBM have wetlands, and specifically which have virgin savannas (savannas not destroyed for cattle ranches or similar). Savannas are wetlands because they are seasonally inundated during the rainy season. You can identify a savanna in satellite photos because the savannas do not have solid tree cover: if the photo is taken during the dry season you can often see the open ground.

When I noticed that southeast of Paso Caballos there were between five and ten open areas (areas not covered by trees), I decided that we should visit it to learn more about the open areas: to learn which were grasslands (low grass savannas), which were cibals (high cutting grass savannas), which small open areas were aguadas, etc. Aerial photos from Google Earth and Satellites. Pro are usually not high enough resolution to tell whether an open area is a low grassland savanna (with occasional tasiste, nance, and jicara trees) and which area is a cibal (with up to 2 meter high sawgrass). So it is helpful to hike to each open area and check the vegetation.

Previous Experiencewith Río San Pedro area

Since I have been staying at the comfortable and spacious Estación Biológica Las Guacamayas. About once a year for the recent 12 years, I was aware of all the marshes and swamps parallel to the Rio San Pedro. I have hiked through the hills on the north side of Río San Pedro. During these visits we were assisted by Jeovany Tut and Cornelio Chablé. However, all these areas are several kilometers north of where the savannas are (and none of the savannas is parallel to any river or creek).

Over a decade ago I also did research with biologist Mirtha Cano on *Nymphaea ampla* in marshes parallel to Río San Pedro near the town of Naranjo (far downstream from Las Guacamayas).

Once we realized that the savanna-like open areas had not previously been studied, we notified the CONAP administrator for this area, Ing. Edvin Ramírez Villalobos. We asked permission to camp in our tents adjacent to the CONAP station. At the entrance to the park. To explore and document the flora and fauna of this area. With the hospitality of Ing. Villalobos and Cornelio Chablé we made contact with local guides.

Experience with Savannas

I first learned about savannas when doing ethnobistorical research in the Archivo General de Centro America, in Zona 1. The archive was about 3 blocks from where I lived in the 1970's. Based on what I found there, I was awarded a grant for a one month visit to the Archivo General de las Indias, in Sevilla, Spain. In both these archives I found the Spanish conquistadores mentioning grassland savannas in Petén.

In the 1970's, the savannas around Poptún and between San Benito and Sayaxché (around La Libertad) were not as destroyed by cattle ranches as they are today. Thus, when driving through these areas you learned about the pine savannas of these areas. The karst geology in these areas is very different than the karst hills around Tikal, Yaxha, Naranjo (Nakum is in a lower area; not built on top of high hills, but there are plenty of hills nearby).

The first impressive savannas that I hiked through and studied were in PNYNN:

- Savanna East of Nakum
- Savanna of 3 Fern Species
- Rectangular Savanna
- Savanna that changes from Bajo La Pita into a traditional grassland savanna and then turns into a cibal, then jimbal

I found the ecology, geology, flora and fauna of these savannas so amazing that I developed an interest to find more savannas in Reserva de la Biosfera Maya, because most research in recent decades has been on

- Hilltop and hillside areas
- Bajos (that occupy a significant percent of the area of Peten)
- Aguadas (especially ones near ancient Maya cities where the aguadas were modified).

Savanna of Nakum



Savanna East of Nakum, May. 4, 2019, 3:44 pm. Parque Nacional Yaxha, Nakum and Naranjo, RBM, Petén, Guatemala.

Access to study these Savannas

During the week that we planned to visit Petén in early August 2021. there were political manifestations and road blocks on all highways of the country so we were stuck several on our way to Petén for two days (literally). Finally, we got to the park area (about midnight on August 3rd).

On August 4th, we explored the seasonally inundated bajo between the road to Paso Caballos and a savanna-cibal that I had found on Satellites.pro several months earlier. What looked like a savanna on the website turned out to be 90% a cibal (cutting grass, often 2 meters high). Only the final 50 meters or more on the southeast end was a savanna (lower open grassland with tasiste palms and jicaro trees). So after exploring we hiked back to the road (that leads from the park entrance to Paso Caballos) and then drove back to the base camp for the night.

The next morning the helpful local guides and support team led us to the southern wetland area that I had found via Satellites. Pro. It takes hours to hike through the bajo because the ground is not flat; much of the ground here is ridged: ridges about 30-45 cm wide; then a hollow about the same width (perhaps 20 to 30cm deep). Kilometer after kilometer of this ridged area. I am curious whether all this was agricultural land for the Classic Maya thousands of years ago, but our goal is to collect data of flora, fauna, and ecology, so we encourage other scholars to study the "many kilometers of ridged bajo." The local guides said the furrows were when the bajos were full of water and

runoff gouged out the drainage. But since most of the bajo was all approximately the same elevation, I doubt the water runs off fast enough to create the drainage areas. Also, why were all the drainage areas parallel to each other; and all the ridges were the same size. Geologists, soil scientists, and archaeologists now have an interesting area to study. Our project is exclusively on flora, fauna, and ecosystems.

Hiking also involves passing through entangled vines, fallen trees, and thorns everywhere. I fully understand why no intelligent professor has dared traverse an area as exhausting (and painful) to transit. Two of our team wore out after the first few kilometers and asked permission to return to the base camp to recuperate; naturally this was allowed and Haniel led them back to the base camp.

I kept hiking with the rest of the team, hour after hour after hour. Tripping on vines, tripping in holes in the ground (from trees that had fallen and torn up soil, leaving a home). After many hours we reached the savanna: you could see its bright open sunlit area through the trees of the bajo. I decided to sit and have lunch before we explored the savanna as I knew that once I saw the full savanna, I would never stop and eat lunch; so we rested and had lunch.

Then, I walked into the savanna and when I saw it was a total complete kilometer-long traditional Petén pine-less savanna, I cried and cried with joy and emotion. This is all recorded in a video.

We then hiked to photograph the tasiste groves: most of the tasiste inside the savanna had been incinerated by fires in a recent year. In fact, the soil of the savanna was covered with black charcoal powder. However, since we were in the middle of the rainy season, the grass was knee high and plants were growing everywhere.

Crescentia cujete was easy to see; the jicaro pods were all over the ground. These are cut in half to make drinking bowls for cacao.

I was really surprised to find *Hymenocallis littoralis*, white spider lilies, some flowering and lots with bunches of bright green seeds. The seeds are "nowhere" described in 90% of the botanical reports I have found, so we photographed them. They are the size and shape (approximately) of an oval lima bean (but more oval). I spent three days researching, back in my office, on these white spider lilies. We will be issuing a full FLAAR report on *Hymenocallis littoralis* in September. These lilies grow along the edge of rivers feeding into El Golfete, so; they really like water. They can survive submerged during the height of the rainy season.

Sagittaria lancifolia is common along edges of creeks, marshes, and swamps in the Municipio de Livingston. We have found Sagittaria in wetlands of Parque Nacional Yaxha, Nakum, and Naranjo (including in the Savanna East of Nakum if my memory serves me). It is easy to recognize this plant when flowering but when not flowering it's often not noticeable because of the thick grass and other plants. Parts of this plant are edible (as are lots of plants found in savannas).



The Selenicereus cactus grows anywhere and everywhere when a bird poops out the seed. To identify the species it would help to be able to see the flowers. The bright red parts of the inflorescence of the bromeliad Aechmea bracteata makes it easy to spot. This plant grows all over Petén; we have found hundreds in Parque Nacional Yaxha, Nakum and Naranjo. This is the kind of bright colors that tourists also like to see and photograph.

I could not find any sandpaper leaf bushes or small trees; these are found in most savannas of Belize and in the dry savanna near Rabinal, Baja Verapaz that is ringed with pine trees. Lots and lots of nance there, but here in here in Parque Nacional Laguna del Tigre, PNLDT only a few nance trees around the edge.

On the other hand, Boris Llamas found oak leaves on a tree; I am frankly impressed at his ability. The next day he found acorns on an oak on the edge of Río Sacluc, a tributary of Río San Pedro. But so far, no pine trees anywhere. Oak trees are known in the frequently visited parts of Parque Nacional Laguna del Tigre that are to the west and north; the south eastern portion, in wich we focused on, has not yet been studied by any botanical or ecological project that we know of (the north and west are easier to reach). There is an Las Guacamayas with great food and welcoming hospitality. Jeovany Tut is the manager of this remarkable facility.

In the transition zone of vegetation, between the edge of the savanna and the edge of the bajo that encircles the savanna, we found lots of bushes with pretty pink flowers. We are working on identifying them. Victor Mendoza, of another project team, identified the genus as *Parathesis*; after research, some considered the species may be

cubana (but more research is needed).

I estimate the species based on what Lundell found in the 1930's in other areas of Petén. This species has edible fruits; for every edible plant of every wetland of RBM I am preparing a FLAAR report on.

Another plant in the transition zone is *Tillandsia brachycaulos*. We have found a lot of these in transition zones and bajos of Parque Nacional Yaxha, Nakum and Naranjo.

About an hour after we entered the savanna, thunder, lightning and rain began, so we only had time to investigate about 15% of the savanna. However, I estimate the entire area is a traditional Petén savanna (NOT a Belize type savanna which tends to include pine and sandpaper leaf plants).

As we were leaving we followed a narrow trail cleared by the helpful team from Paso Caballos but after a few kilometers we all got lost; totally lost. We ended up not being able to reach the road (where our 4WD vehicle was parked and waiting for us). Since the guides had GSP apps, they were able to rescue us and take us to another trail to reach the base camp by foot. The total distance I hiked the entire day, round trip (stumbling across the rise and fall of the grooved ground of the bajo) was estimated to be 13 kilometers. Not bad for 76 years of age.

We arrived back at the base camp after dark (the last kilometer we hiked parallel to the crocodile-beloved Arroyo Sacluc). Quite a botanical and ecological adventure. We are now preparing a full report on this initial visit to the savanna and a separate report on the white spider lilies plus a separate report on *Parathesis* species.

The bajo surrounding the savanna had trees of all sizes, some quite large; but did not have much *Haematoxylum campechianum*, so I would not call this a tintal. However, *Haematoxylum campechianum* is present all along Arroyo Sacluc surroundings and surely there were a few in the bajo also.

Nance: one of three trees found in 90% of Savannas of PNYNN and PNLT, RBM

Nance is an icon of savannas of Petén. I can still remember reading documents written by Spanish conquistadores which described when they went through savannas and noticed all the nance. The Spaniards commented that the leaves of the nance were used to wrap tobacco to make cigars. I learned this while doing research at the 1970's in the Archivo General de las Indias, Sevilla, Spain, and in the Archivo General de Centro America (Zona 1, Guatemala City).

While doing research on savannas in a library, you find that nance, tasiste palm and *Crescentia cujete* are in almost every savanna. In most savannas, including hillside savannas, you also find *Curatella americana*, sandpaper leaf tree. However so far, it has not been found in PNYNN or PNLT. As it is so common in other savannas of Guatemala, Belize and elsewhere, we will continue to look for it in Reserva de la Biosfera Maya.

Tasiste palms are easy to recognize (they are the only palms within savannas of PNYNN and PNLT) because they frequently grow in clusters.

Crescentia cujete trees are also easy to recognize. While nance trees do not "stand out" thus i cannot identify it easily when they don't have the flowers or fruits. However, Andrea Rocio Bracamonte took photographs of some flowers that have been identified as nance.



Nance tree (*Byrsonima crassifolia*) behind tasiste palm (*Acoelorrhaphe wrightii*) on the south edge of the Spider Lily Savanna. Photo by Nicholas Hellmuth, iPhone 12 Pro Max, 3:20 pm, August 5, 2021.





Photos of tree flowers in the Spider Lily Savanna by Andrea Bracamonte, FLAAR Mesoamerica, Aug. 5, 2021, PNLT, RBM. Camera: Canon T6. Lens: Canon EF-S 18-55mm. Settings: 1/125 sec; f/4.5; ISO 100.

Tasiste: one of three trees found in over 90% of Savannas of PNYNN and PNLT, RBM

Tasiste palm is an icon of grassland savannas in the top half of Petén and adjacent areas of Belize. When you find

- Tasiste palm, Acoelorrhaphe wrightii
- Nance, Byrsonima crassifolia
- Calabash tree, jícara, Crescentia cujete

Then you know you are in a traditional grassland savanna.

Grassland flatland savannas in Belize also have other plants, especially *Curatella americana*, sandpaper leaf tree (or large shrub). However, so far we have not found any sandpaper leaf trees anywhere in Reserva de la Biosfera (the entire northern half of Petén). Also, so far we had not found no pine trees anywhere in PNYNN or in the southeast savannas and cibal-savanna of PNLT.

We have hundreds of photos of the tasiste palm: panoramas, cluster by cluster, and close-ups. We now show a sample of photos from the August 5th, 2021 field trip by Andrea, Boris, and Nicholas.



Photo by: Boris Llamas, FLAAR Mesoamerica. Tasiste and jicara trees occupy areas within all savannas that we have explored so far in PNYNN and PNLT areas of RBM.



Tasiste Palms are burned every several years

Many of these palm stems are incinerated because throughout the Maya Lowlands the savannas are burned every year (usually by illegal bunters).

The palms at the left (near the edge of the savanna) have been burned to a crisp, but they survived. Thus, they are still at full height

when the leaves sprout back from the top of the stem (top of the trunk).

On the contrary, the calabash trees have just their leaves burned off; the tree is the same height when it begins to rain and the leaves return.







The fire incinerates the palms because their "bark" burns rapidly. The fronts also probably burn rapidly (especially the dry ones).

However, the forest of the surrounding bajo rarely catches on fire.





You also get

Tasiste Palms on the edge of the savanna

The vegetation around the edge of the savanna includes transitional habitat. Tasiste palms also occur in these transitional areas.







Calabash trees, Crescentia cujete, are the logo trees of savannas throughout Mesoamérica

The calabash trees do not lose their height when they are burned while many of the thin-stem (thin trunk) tasiste palms are "burned to the ground." Tasiste often regrows from the ground up when the rains begin.

Other tasiste palms in the same savanna got just their "bark" burned off and leaves; so they keep their height. These we see in other photos in the tasiste palm section of this report.









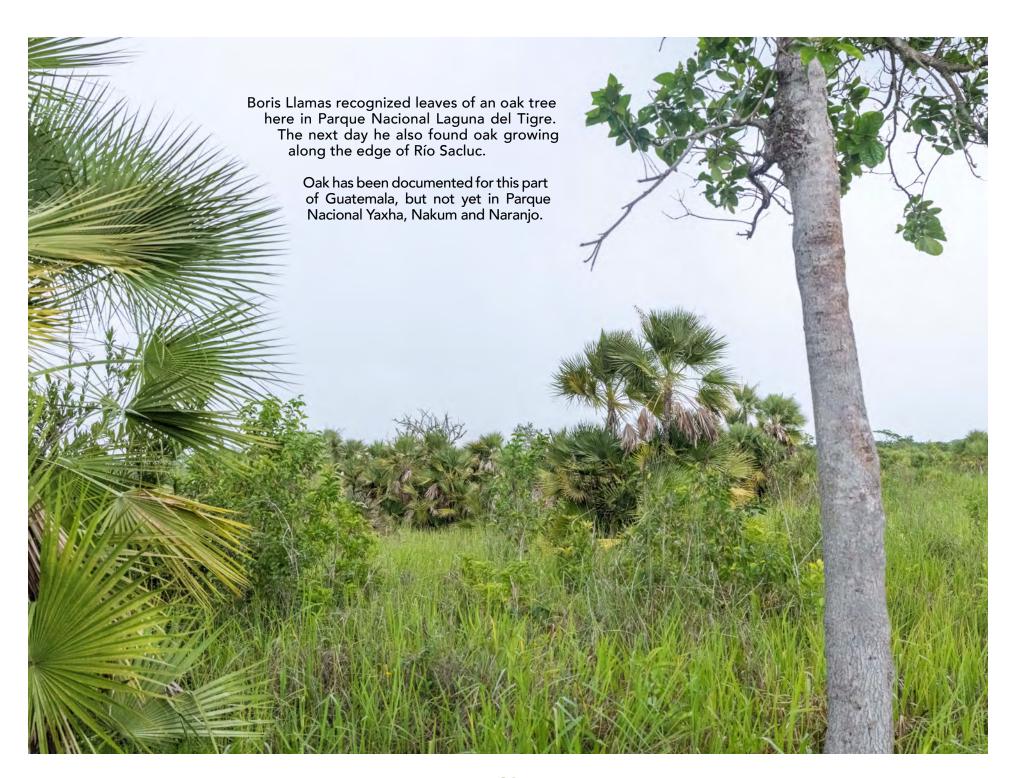




Oak trees are present in many savannas (but so far not in PNYNN savannas)







A grassland savanna obviously has lots of sedges, reeds or grasses

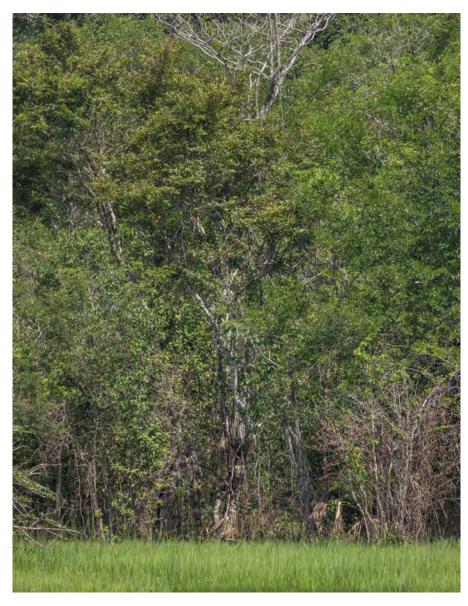




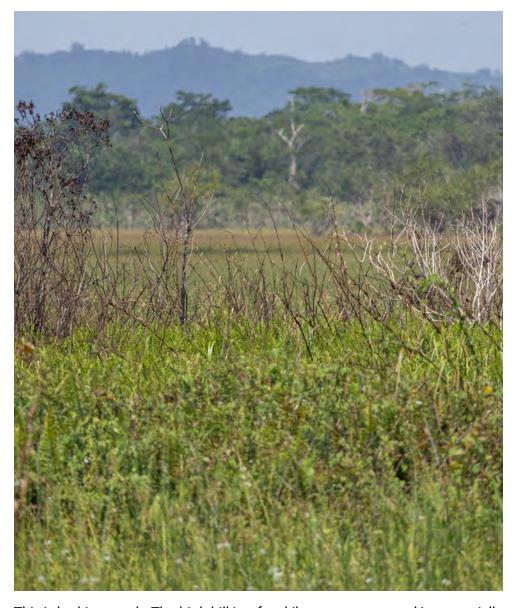








Here you can see the height of the trees in the bajo surrounding the savanna on the south side (west half, since we did not reach the east half due to thunder storm).



This is looking north. The high hill is a few kilometers away and is potentially the Peñon de Buena Vista. I estimate Boris was standing at the south transition zone (hence the mish-mash of vegetation before the grassland savanna begins). Note that the grass of one height ends in a line when another height of grasses, reeds, or sedges begins. Height difference can be caused by different soil, more humidity, or different species of plants.

Since savannas are seasonally inundated you also find *Sagittaria lancifolia*











Bushes of genus Parathesis are along the edge of most savannas

Often you see just the flower buds of this plant but since this plant is relatively common in the transition zone from the edge of the savanna to the bajo around the savanna, you can learn to recognize it.

We have identified the genus as Parathesis, but identifying the species is a challenge.





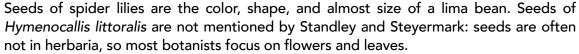


Spider Lilies are

the namesake of this Savanna in Parque Nacional Laguna del Tigre

We have found spider lilies along the Caribbean beach of Municipio de Livingston, Izabal Guatemala. Plus along the edges of rivers feeding into El Golfete area of Río Dulce. These plants like to be near water or at least in areas that are seasonally inundated.





In other words, most botanical descriptions are incomplete for *Hymenocallis littoralis*. Surely there are botanical descriptions somewhere that describe and show the seeds. However, in the meantime, the FLAAR Photo Archive of Plants of Guatemala may have the best records worldwide for these seeds.











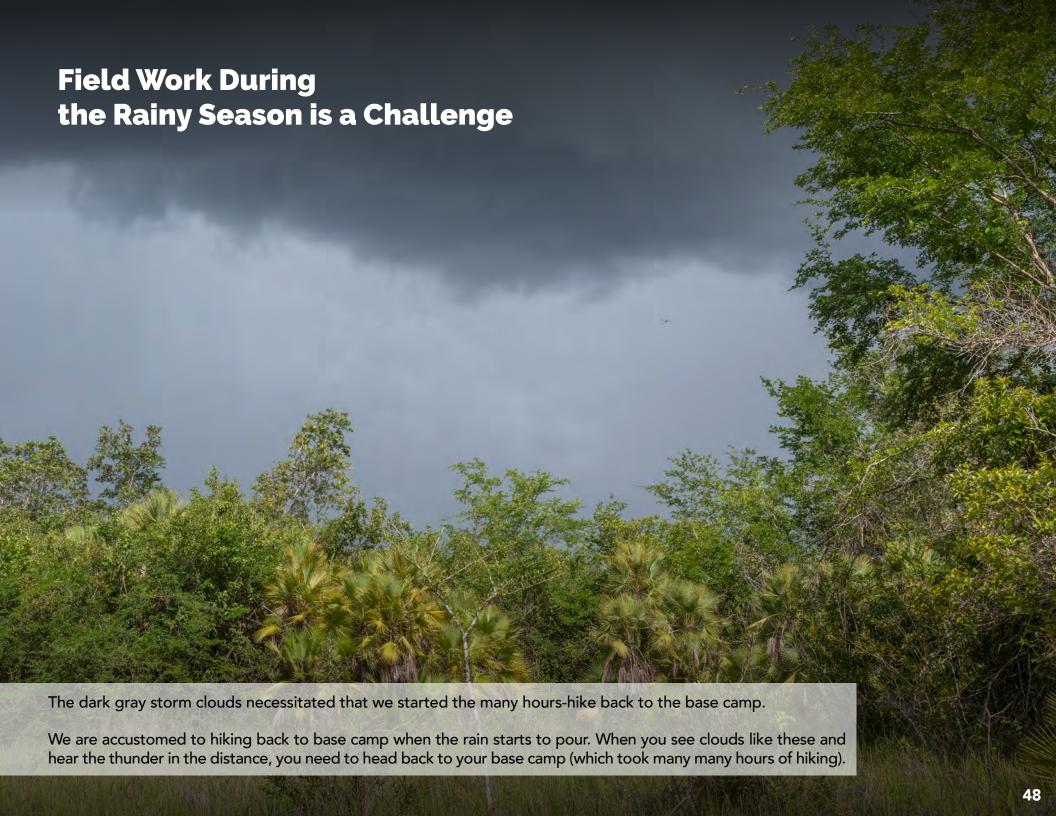


Photo by: Nicholas Helmuth, FLAAR Mesoamerica. Jicara trees at left and across the middle. Clusters of tasiste palm visible. At right is the bajo forest. The species of trees in the bajo forest do not intrude into the savanna because they can't survive the annual fires.









Dedication to Accomplishing Total Coverage of these Savannas

1st, it is essential to return to this savanna and hike to all areas

- To see if there are different "islands of plants" (as in Savanna of 3 Fern Species and Savanna East of Nakum).
 So far, the Spider Lily Savanna appears to be relatively consistent (meaning that we have not yet found many islands of any particular plant).
- It is important to identify where the nance is and learn why it is mostly around the edges.
- To learn how many oak trees are present, their species, and whether they are mostly around the edges.
- It is crucial to learn whether Curatella americana (sandpaper leaf shrub) is present or not.
- See whether there are any pine hidden around the edges.
- To identify what other plants are common inside the savanna.
- 2nd, tabulate and document the similarities and differences between this savanna in Parque Nacional Laguna del Tigre, the Savanna of 3 Fern Species, Savanna East of Nakum (PNYNN) and savannas of Belize.
- **3rd**, visit the savanna adjacent to the south; we estimate it is similar or possibly even identical. But to visit this savanna it would be necessary to be able to hike from that savanna straight out to the road (otherwise too much time is wasted hiking north or south).

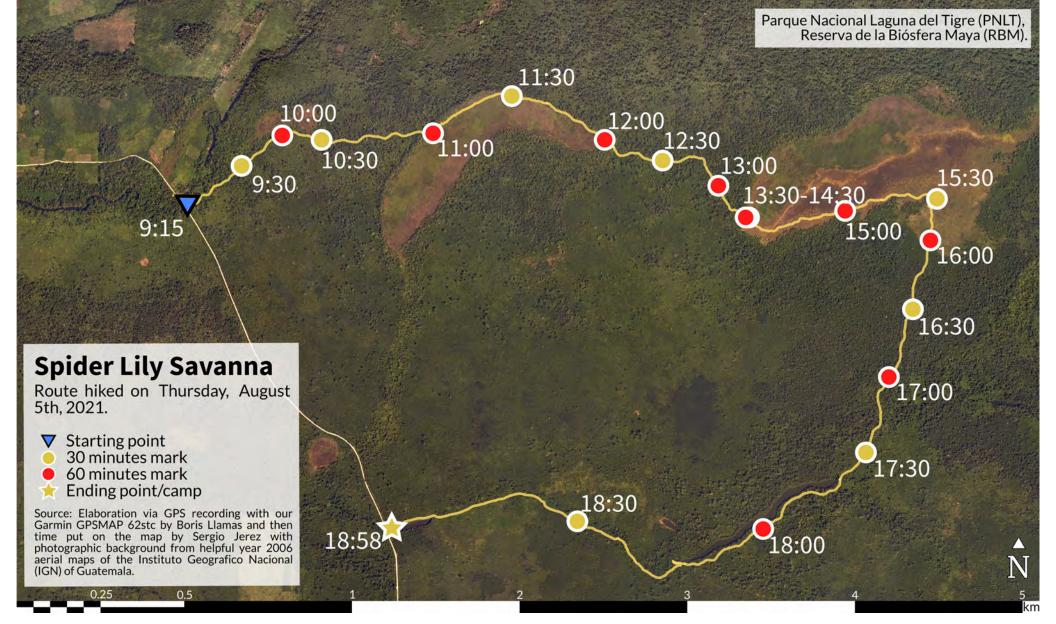
4th, visit, study and photograph other nearby wetlands on the east side of the road.

5th, visit, study and photograph the wetlands on the west side of the road.

It would take one or two full days to accomplish the needed research inside this savanna. Also, it would be essential to visit it throughout different months of the year, since in each month different flowers will bloom (making it possible to identify more of the plants).

If it takes 3 hours to hike in and 3 hours to hike out, most of the day is wasted, so it will be helpful to have a trail straight from the road 90 degrees directly to the middle of this northern savanna.

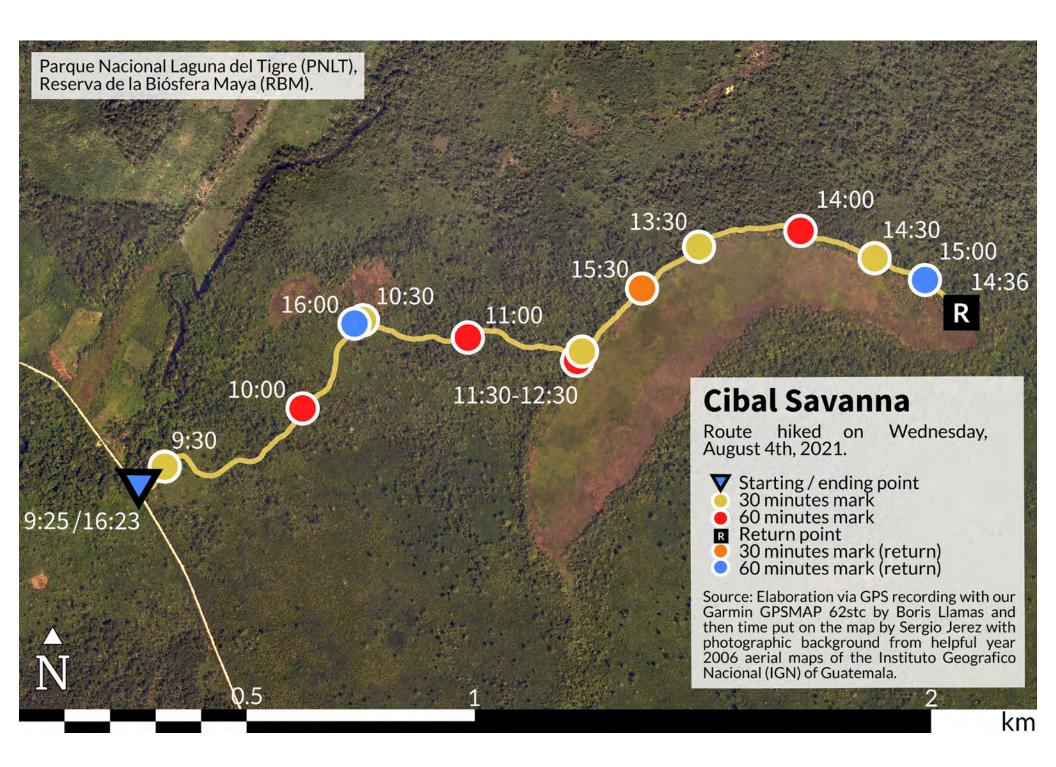
All photographs will be donated to CONAP in Guatemala City and to CONAP in Santa Elena so that the office of Parque Nacional Laguna del Tigre has access to the photographs as well as other entities of CONAP. These photos will be used for the Plan Maestro, to make training presentations for ZOOM lectures, etc.



This is a GPS map to show where the parked the 4WD pickup (9:15 am), where we hiked around the Cibal Savanna (that we had explored the day before) and then arrived for lunch at the west edge of the true grassland savanna (12:45 pm). After lunch we entered the savanna but in an hour the storm clouds covered us and the rain started so we hiked back to the base camp (getting lost several times). For

our next trip we need a trail straight from the road northeast to the juncture of the Water Lily Savanna at the top and the much larger longer savanna to the immediate east (that goes southeast).

We had an antiquated Garmin GPSMAP 62stc; we have now acquired a significantly better Garmin GPSMAP 66sr.





If you look out into the middle of the savanna (we were at the edge, leaving because of the storm clouds approaching) you see the endless grassland of the previous two photos.

But if you turn 180 degrees and look at the edge of the savanna you see lots of tasiste palms, Acoelorraphe wrightii and a tall healthy Crescentia cujete, calabash tree, jicara.

In a close-up photo of the tasiste you see their trunks (stems) are totally charcoal black. These we show in the vertical oriented FLAAR report; the present report is horizontal in order to show the panorama views at a nice size.

The bajo forest starts about 40 meters off the photo to the left).

Photo by Boris Llamas, 2:21 pm, August 5, 2021.



This is a closer view and you can notice the black charcoal color of the trunks of the tasiste palms.

These palm stems grow a thick layer of blanket-like coverings around their trunk. This is what catches fire and burns off. Usually the tree itself survives (so only the leaves and covering (wrapping) of the trunk burns off. Then when rains come fresh leaves sprout out.

Photograph by Boris Llamas, 2:22 pm, August 5, 2021.



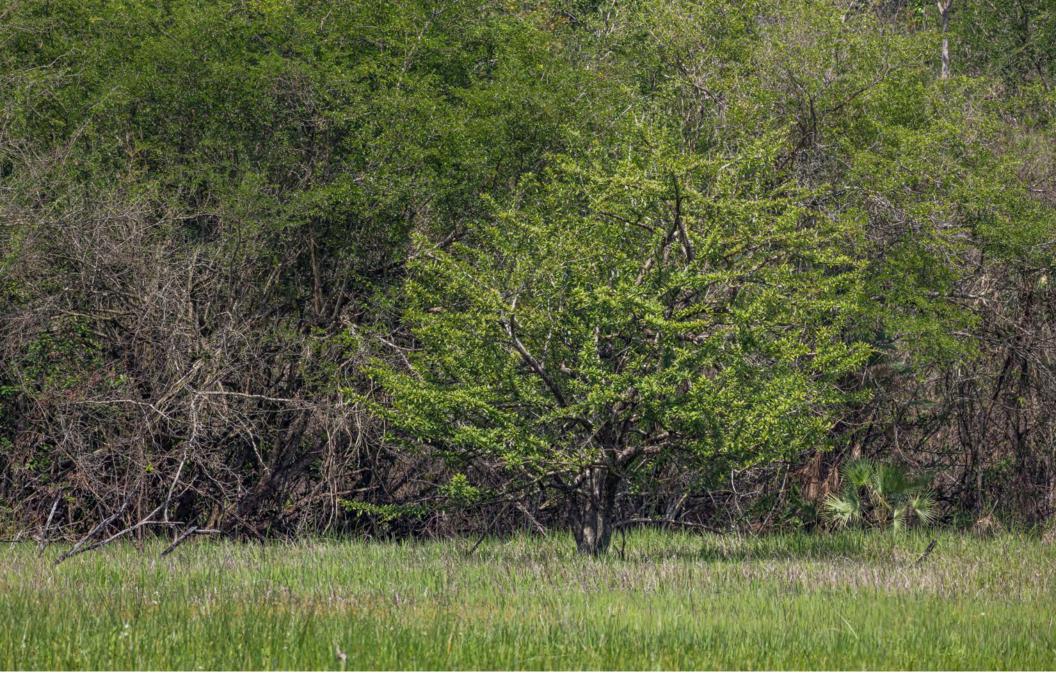
I estimate this is the same tasiste area but from a different position. You can see the dark trunks.

Photograph by Boris Llamas, 2:22 pm, August 5, 2021.



If you look out into the savanna (the previous photos were on the south edge) you see the grassland.

Photograph by Boris Llamas, 2:28 pm, August 5, 2021.



Now you are looking at the south edge of the savanna. Healthy jícara tree is visible. At the left is a stunted tasiste palm; this suggests it was totally burned down and had to resprout from its "fire proof" tuber-like roots.

Photograph by Boris Llamas, 2:33 pm, August 5, 2021.



Tall Crescentia cujete, jícara trees since these trees (usually) do not burn down; they only lose their leaves to the annual figures.

But all the tasiste here are only a meter high, with the leaves sprouting from only a bit above the ground. This is because the previous generation were "burned to the ground" by the last fire. And now that it's been raining for several months, the fresh leaves are growing and gradually the stem will rise up and form a 3-meter high palm "tree."

Nice panorama with Canon RAW setting. But for a PDF publication, or for a web page, it's better nowadays to use an iPhone 13 Pro Max (new as of mid-September 2021; available in October). Or to use the new Google Pixel 6 Pro (available circa late October, 2021). Photos from these do not require any Photoshop or Lightroom whatsoever; the photos come out of the phone camera perfectly balanced in every aspect.

Photograph by Boris Llamas, 2:54 pm, August 5, 2021.



Closer view of the fresh growth of the tasiste palms.

Photograph by Boris Llamas, 2:54 pm, August 5, 2021.



You can see how thick the limbs and branches are of this *Crescentia cujete*, calabash tree.

In the middle of the savanna is an entire row of these same jícara trees.

In the background is the mature bajo forest.

Photograph by Boris Llamas, 3:06 pm, August 5, 2021.



True grassland savanna; kilometer after kilometer of open grassland. Around the edge you see the seasonally inundated bajo forest (that we had to hike through for many hours to get here to be able to take these photographs).

Note again the row of different looking grass across the middle.

The stunted tree is *Crescentia cujete*, calabash trees, jícara. It is stunted most likely because most savannas are burned every year or at least every several years by invasive local hunters.



Low grass (not quite up to your knee). Note the row of different looking grass across the middle. This is why fresh drone photos are needed: to show the different areas.

The trees are *Crescentia cujete*, calabash trees, jícara. These are found in most savannas of Parque Nacional Laguna del Tigre and Parque Nacional Yaxha, Nakum y Naranjo.

Storm clouds everywhere.



Many more Savannas to Explore and to Conserve

There are many more savannas and cibal sawgrass flatlands to find, hike to, explore, photograph, and publish at the far south end of Parque Nacional Laguna del Tigre (PNLT) in the west part of the Reserva de la Biosfera Maya (RBM) of Petén, Guatemala, Central America.



This is the savanna where we found lots of white spider lily flowers and seeds on August 4, 2021. Since it takes so many hours to get here (since the trail is not yet made to get straight here) and since it takes hours to hike back, and since it began to thunder, lightning, and rain, we had only an hour in the southwestern part.

So we have hiked through only about 18%; we have 82% more to delve into on our next exploration field trip. That said, the photographs of this report of only 18% of the biodiverse habitats reveal tempting views of what we can see, explore, photograph, and document when we return.

Notice at the far right, above, a narrow arm of the savanna goes east (to the right). This leads to another GIANT savanna that we really want to explore on our next trip (it's heavy rainy season now, so not good time to slip, slide, trying to get there through the seasonal bajo swamp surrounding it).



At the top left is the Cibal Savanna (shaped like a boomerang). On August 4th, 2021, we hiked around its entire top side and only entered the far east end (since the other 90% was cutting grass (sawgrass) cibal).

In the middle of this satellite photo is the White Spider Lily Savanna; at its immediate right is the unexplored much longer savanna. Below is a triangular-shaped cibal-savanna-lagoon-marsh area. You can see the water inside the open area (better visible in the view on the next page).

The second day, August 5th, we hiked the same trail but continued all the way east/southeast to reach the far west end of the savanna with white spider lilies.



This photograph from Satellites.pro gives hints of the paradise of biodiversity of ecosystems that we can explore and document in 2022:

- Grassland (low grass) savanna
- Cibal savanna (2 to 3 meter high sawgrass savanna)
- Possibly bamboo swamp (Guadua longifolia, native to Guatemala and surrounding countries)
- River side ecosystem (lots of trees prefer to grow along side of a creek)
- Lagoon side biodiversity (reeds, sedges, grasses)

To achieve our dream to being able to explore this biological and ecological treasure of flora and fauna we are making a list of the 4WD vehicle, digital cameras, and super-high resolution aerial camera that can make a difference.

Our team works most efficiently with a minimum of 8 people (plus the local guides):

- 1. Project manager (planning manager)
- 2. Equipment manager (who also packs the ton of equipment in the pickup and unpacks every day; charges all the batteries at night, does GPS mapping during the hike, etc.)
- 3. Photographer with Sony Alpha 1 (50 megapixels and "bird eye focus" option)
- 4. Photography assistant (the photographer should concentrate on taking excellent photos)
- 5. Photographer with Nikon D810 and D5
- 6. Photographer for the Canon camera equipment (EOS 1D X Mark II and EOS R5)
- 7. Nicholas Hellmuth with the Sony a7C and macro-camera equipment
- 8. Photography assistant (so the photographer can focus on taking excellent photos)

We already have pretty good equipment but need higher resolution to record the endangered species in these biodiverse savannas surrounded by rain forest (that is being encroached and destroyed). A first step to protect these areas is to show the world what's here that deserves conservation. Our research has found which new equipment would help us the most. Here is one item on our list

- Phase One 100 MP medium format metric camera (iXM)
- That is carried by a DJI M600 (DJI Matrice 600 Pro) hexacopter
- RSM 80mm auto-focus lens specially made to use on a drone with the Phase One
- RSM 150mm auto-focus lens specially made to use on a drone with Phase One
- XQD storage for camera (Sony is good brand, need 256 GB due to RAW file size)
- XQD memory card reader (also from Sony, MRWE90/BC2 XQD USB 3.0)

The purpose of this 100 megapixel aerial camera would be to donate the photos to CONAP.



This is the Cibal Savanna that I found on satellite photos and the local guides helped us hike here. Upon arrival the sawgrass was so thick and several meters high so we did not try to hike through it; instead we walked around the outside (in the bajo around it).

As I hiked outside each several dozen meters parallel, I kept noticing that the sawgrass was getting shorter and shorter. By the time we got to the end of the cibal area I walked into the now open grassland and found tasiste—an indicator that the cibal had transitioned into a savanna. We have a separate FLAAR report on this Cibal Savanna, on vegetation and "ring of water" in the transition zone between bajo and savanna, and the vegetation of the bajo itself.



The empty far right area is the tasiste savanna area of the boomerang-shaped Cibal Savanna. The ground vegetation varies each month due to whether a dry month in the dry season or a wet month in the wet season. Once we get permission to use our nice resolution drone camera we can show you the transition from tall sawgrass to progressively shorter sawgrass to the transition to the low grass area with tasiste palm.

Now you can see why we need drone photos; Satellites.pro (the source of this photo) is not adequate resolution for a close-up view. We need crisp precise good resolution coverage the whole savanna plus of each individual tree so we can make all these photos available to CONAP and university ecology research programs so that they can study these remote areas from their offices.



Several kilometers away (so not that far) are three more savannas or cibal savannas in another remote seasonally inundated bajo area. This photograph shows the small one at the top middle; and the larger two at left and right.

To really explore this area would be best to have a full day for each of the two smaller ones and two days for the larger one. Again, a drone is essential to show what we find to professors, students, and conservation agencies.



Here is a fourth open area that is not yet studied. Ironically this is the smallest of the seasonally inundated wetlands in this area.

Satellites.pro is totally inadequate to facilitate study of what's on the ground. With a drone and high-resolution camera, we can map the savanna and help the world see the transition from one part of this wetland to another.

As typical or most cibals, cibal savannas, and savannas, there is a ring of bright green grasses, reeds or sedges around the edge. Rings of water or soil with lots of moisture around the edge of a savanna or cibal is a characteristic we have found at the Savanna of 3 Fern Species and several other savannas or cibal savannas.

We look forward to exploring this wetland to find, study, photograph, and research each part of the biodiverse vegetation habitats here.



In summary, this satellite view shows the key areas that we will continue to explore first.

At the bottom (south) is a triangular seasonally flooded open area that I estimate is half cibal, 30% savanna, 10% lagoon and the rest marsh (swamp without many trees).

This will be an amazing adventure to explore here. A drone is essential to begin to map each individual open wetland area.

At the top right is the giant unexplored savanna. This giant savanna has lots of different "micro-environments", like islands of different plants because the moisture in the soil is different in each part.



While we were in the Spider Lily Savanna the helpful local guides told us about the Peñón de Buena Vista. You could see this high hill in the distance when standing in the savanna. In front of this range of cliffs are swamps, rivers, lagoons, and seasonally inundated savannas.

The Peñón de Buena Vista is perhaps five kilometers north of the Spider Lily Savanna. Photos on the Internet show that if you reach the back of this cliff you can see (and photograph) an amazing area. We will explore this area as soon as funding makes this possible



Satellites.Pro names the water at the left: Arroyo Peje Lagarto. Once it gets wider it's named Laguneta Yala.

CONRED map labels this all as Laguneta Yala.



Several kilometers south of the triangular savanna-cibal-lagoonmarsh area is a string of what are most likely cibal savannas. To determine which classification, it is essential to have high resolution drone photography.

We have a capable experienced drone pilot and a good drone camera (Hasselblad L1D-20c aerial camera on a DJI Mavic 2 Pro). But the open grassland areas available here deserve higher resolution (than the 20MP in our current system) so we can prepare maps before we hike here (we can fly the drone from nearby).

Phase One Industrial (in Denmark) has developed a 100 MP medium format metric camera (iXM) with XQD storage that is carried by a DJI M600 (DJI Matrice 600 Pro) hexacopter. There are a dozen mapping software options.

Capture One image processing software (made by Phase One) is noticeably better than Adobe Photoshop or Adobe Lightroom because Capture One is made to process RAW files of huge size (from 100 megapixel medium format cameras).

Most computers can't handle file sizes this large without hiccupping a bit. Capture One has a special software to handle the RAW conversion for the Phase One aerial camera systems. The Phase One aerial system and processing software can also accomplish 3D mapping (so comparable to 3D scanning, but with a camera and special software).

Motorized-focus 80mm and motorized-focus 150mm lenses are the two crucial high-resolution lenses that are essential. Exposure speed can be up to 1/2500th of a second. The Phase One iX Controller MK4 supports up to 3 monitors (so the drone pilot can have two photographers helping make decision where to take each individual photograph. We do not yet have this system but as soon as funds come in, we are prepared to use the latest technology to study areas of remote parts of Central America that deserve this technology.

To 3D "scan" a giant *Ceiba pentandra* tree is one of my many dreams of digital possibilities to achieve. The trunk, limbs and branches of this giant rain forest tree can support over a hundred different plant species (lichens, ferns, bromeliads, orchids).

But mainly we need the high resolution to show where each different species of plant is located within a savanna or marsh. We then need to print these detailed aerial photographs and take them with us to wright notes directly onto the map which species we saw and photographed from the air.

We are especially interested in learning which wetlands plants are edible (so were available to eat for the Classic Maya thousands of years ago).

PS, we have also found 38 additional savannas in another single area covered by our flora/fauna/ecosystem research permit. Our goal is to document that Guatemala has biodiverse ecosystems not available in Costa Rica. And most comparable savanna and wetlands ecosystems in Chiapas and Tabasco are long ago destroyed by cattle ranches. I estimate half of the comparable ecosystems of Campeche and Quintana Roo also no longer are available for study (unless you want to see the bulldozed, chainsaw felled, commercialized residue).

PSS: with helpful funding our initiative, inspiration, and dedication is to find, hike to explore, do high-resolution photography of, and provide these photographs to the local conservation entities and to show the world our goal of 100 different savannas, cibales, or other seasonally-dry/seasonally inundated biodiverse ecosystems within the Reserva de la Biosfera Maya. The Petén has more to offer ecologists, biologists, soil scientists, botanists, zoologists, and archaeologists. Our goal is to find all the previously unstudied areas and with GPSMAPS to show where these areas are waiting to have conservation projects initiated.



In closing I would like to show samples "of the 100 savannas we aspire to hike to, photograph, study, and provide this information to CONAP and conservation organizations.

This is the longest reed/sedge/grass "savanna" that I have yet found on satellite photos (of the Reserva de la Biosfera Maya).

To the left is a normal shaped savanna.

At the bottom is an interesting cibal with an island of tall trees within it (and two miniature seasonally inundated wetlands at the right.

These "are only the beginning."

This project also assists Guatemalan university students learn where they can accomplish theses or dissertations in the future.



The savanna-cibal at the left is same as the bottom of the other satellite photo. Then there is a row of additional seasonally inundated open savanna-like areas.

Lots and lots to explore.



When I was a student intern at Tikal in 1965, for an entire year taking a year-off from Harvard, I saw primarily hilltop and hillside forests.

When I began an educational program to help interested people visit Calakmul and El Mirador in the mid-1970's, a decade before regular tourism began, I learned about endless bajos (tintal, logwood bajos).

During our year August 2018-July 2019 project of cooperation and coordination with Parque Nacional Yaxha, Nakum and Naranjo I learned about cibal, jimbal, and open savannas. I expanded this knowledge during three field trips to visit and photograph two amazing tasistal savanna ecosystems upstream from Sayaxché (a tasistal is a seasonally inundated flatland area of up to one million tasistal palms in a small area).

During our 15 month research project (2020-through December 2021) in the wetlands of the remote areas of the eastern half of Izabal I learned about swamps, marshes, riverside tree preferences, and lagoon edge plants. Learned that tasiste palm here grow in totally different biodiverse ecosystems than the same identical *Acoelorraphe wrightii* palm species in Petén (in Petén 99% are in a grassland savanna).

Now we have been asked to assist for 5 years (2021-2025) with a project of coordination and cooperation with CONAP for the Reserva de la Biosfera Maya. We will focus on PNYNN, Biotopo San Miguel la Palotada el Zotz, Bio Itzá and nearby members of associated parks and natural reserves, but "there is a lot out there" to study also in adjacent areas from the Petén-Chiapas border at the west (Parque Nacional Laguna del Tigre and Parque Nacional Sierra de Lacandón) and the Petén-Campeche border across the entire northern part of Guatemala and over to the Petén-Belize border at the east.

Bajos have been capably researched, visited, studied, and published by experienced geographers, ecologists, archaeologists from the 1970's through present day. So, our focus and experience and ability in digital photography is optimized on savannas, cibales, pitales, jimbales and other biodiverse ecosystems.

Appendix A

PHOTO FOLDERS FOR AUGUST 5, 2021

When hiking long distances I take most of my photos with an iPhone 12Pro Max because it takes too long to take a camera out of its carrying case, decide which lens to use, arrange the camera settings. It is more efficient to take a photograph with an iPhone or a Google Pixel telephone so you don't have to waste time back in the office preparing your photos.

Needs: iPhone in **Green**

Photos by Andrea Google Pixel 4a in **brown**

Photos taken in the Bajo while hiking from the road through the bajo towards the savanna

Genus species	Family	Common Names	Folder Name(s)
			Laguna-del-Tigre-NEEDS-ID-hike-past-cibal- en-route-to-Savanna-PNLDT-iPhone-12pro- 1009am-Aug-5-2021-NH
Acoelorrhaphe wrightii , Tasiste palm	ARECACEAE		Cibal-Savanna-while-hiking-to-true-Savanna- Acoelorrhaphe-wrightii-tasiste-palm-iPhone- 12pro-Aug-5-2021-NH
Tillandsia brachycaulos	BROMELIACEAE		Cibal-Savanna-while-hiking-to-true-Savanna- Tillandsia-brachycaulos-red-bromeliad- lavender-flowers-iPhone-12pro-12pm-Aug-5- 2021-NH
			Savanna-Petenense-Norte-getting-there-from- Cibal-Savanna-iPhone-12Pro-Aug-5-2021-NH
			NEEDS-ID-peeling-bark-hike-to-aguada-en- route-to-cibal-PNLT-iPhone-12pro-948am-Aug- 5-2021-NH

Photos taken in the Savanna of White Spider Lilies (Spider Lily Savanna)

Genus species	Family	Common Names	Folder Name(s)
Tasiste, jicaro,	ARECACEAE, BIGNONIACEAE		Savanna-Petenense-Norte-PNLDT-panoramas- iPhone-12pro-Aug-5-2021-NH
Accelerate and a state Total	ADECACEAE		Spider-Lily-Savanna-Laguna-del-Tigre-RMB- Cuscuta-or-Cassytha-filiformis-in-Spider-Lily- Google-Pixel-4a-213pm-Ago-5-2021-NH
Acoelorrhaphe wrightii , Tasiste palm	ARECACEAE		Laguna-del-Tigre-Spider-Lily-Savanna-RBM- Cuscuta-or-Cassytha-filiformis-iPhone-12Pro- 318pm-Ago-5-2021
	ARECACEAE		Savanna-Petenense-Norte-Acoelorrhaphe- wrightii-burned-iPhone-12pro-221pm-Aug-5- 2021-NH
			Laguna-del-Tigre-true-Savanna-Hymenocallis- littoralis-Spider-Lily-RMB-Google-Pixel-4a- 1427pm-Ago-5-2021-NH
	AMARYLLIACEAE		Savanna-Petenense-Norte-NEEDS-ID- Hymenocallis-littoralis-spider-lily-flowers-and- seeds-PNLT-iPhone-12pro-249pm-Aug-5-2021- NH
Grass, reed, or sedge	AMARYLLIDACEAE		Laguna-del-Tigre-Spider-Lily-Savanna-NEEDS-ID-Google-Pixel-4a-227pm-Aug-5-2021-NH

Sagittaria lancifolia (estimated, double-check species)	ALISMATACEAE and AMARYLLIDACEAE	Common in marshes and edge of swamps; edible Two folders may have same photos	Sagittaria-lancifolia-Spider-Lily-Savanna-Paso- de-Caballos-RMB-Google-Pixel-4a-1435pm- Ago-5-2021-NH Laguna-del-Tigre-Spider-Lily-Savanna- Sagittaria- lancifolia-Google-Pixel-4a-235pm-Aug-5-2021- NH
Crescentia cujete, jicaro	BIGNONIACEAE		Savanna-Petenense-Norte-Crescentia-cujete-PNLDT-iPhone-12pro-248pm-Aug-5-2021
	BIGNONIACEAE		Savanna-Petenense-Norte-Crescentia-cujete-PNLDT-iPhone-12pro-248pm-Aug-5-2021-NH
	MALPIGHIACEAE and ARECACEAE		Savanna-Petenense-Norte-NEEDS-ID-nance- behind-Acoelorrhaphe-wrightii-tasiste-palm- PNLT-iPhone-12pro-320pm-Aug-5-2021-N
	PRIMULACEAE		Savanna-Petenense-Norte-transition-zone- Parathesis-NEEDS-ID-species-lavender-flowers- PNLT-iPhone-12pro-347pm-Aug-5-2021-NH
			Laguna-del-Tigre-true-Savanna-Parathesis- NEEDS-ID-species-pink-flowers-RMB-Google- Pixel-4a-214pm-Ago-5-2021-NH-214006873. jpg
	AMARYLLIDACEAE		Laguna-del-Tigre-Spider-Lily-Savanna-NEEDS-ID-Google-Pixel-4a-227pm-Aug-5-2021-NH
	AMARYLLIDACEAE		Savanna-Petenense-Norte-NEEDS-ID- Hymenocallis-littoralis-spider-lily-flowers-and- seeds-PNLT-iPhone-12pro-249pm-Aug-5-2021- NH

Cassytha filiformis	LAURACEAE		Laguna-del-Tigre-Spider-Lily-Savanna-RBM- Cuscuta-or-Cassytha-filiformis-iPhone-12Pro- 318pm-Ago-5-2021-NH
		Edible	Laguna-del-Tigre-Spider-Lily-Savanna-Cuscuta- or-Cassytha-filiformis-Google-Pixel-4a-337pm- Aug-5-2021-NH
	AMARYLLIDACEAE		Laguna-del-Tigre-Spider-Lily-Savanna- Parathesis-NEEDS-ID-for-species-Google-Pixel- 4a-340pm-Aug-5-2021-NH

Not yet sorted:

Savanna-Petenense-Norte-PNLT-iPhone-12pro-Aug-5-2021-NH Savanna-Petenense-Norte-NEEDS-ID-misc-PNLT-iPhone-12pro-Aug-5-2021-NH Parque-Nacional-Laguna-del-Tigre-savanna-Aug-5-2021-NH-NEEDS-sorting

Laguna-del-Tigre-Spider-Lily-Savanna-Parathesis-NEEDS-ID-for-species-Google-Pixel-4a-340pm-Aug-5-2021-NH

NEED-ID before can be listed

Genus species	Family	Common Names	Folder Name(s)
	LAURACEAE, CYPERACEAE and		Cuscuta-or-faux-Cuscuta-Cyperaceae-Spider- Lily-Savanna-Paso-de-Caballos-RMB-Google- Pixel-4a-1427pm-Ago-5-2021-NH
	AMARYLLIDACEAE		Savanna-Petenense-Norte-NEEDS-ID-parasitic- Cuscuta-like-vine-PNLT-iPhone-12pro-318pm- Aug-5-2021-NH
	CYPERACEAE and AMARYLLIDACEAE		Cyperaceae-Spider-Lily-Savanna-Paso-de- Caballos-RMB-Google-Pixel-4a-1427pm-Ago- 5-2021-NH
	AMARYLLIDACEAE		Savanna-Petenense-Norte-NEEDS-ID-spider-lily- flowers-and-seeds-PNLT-iPhone-12pro-249pm- Aug-5-2021-NH
Parathesis, species unknown	PRIMULACEAE		NEEDS-ID-pink-flowers-Spider-Lily-Savanna- Paso-de-Caballos-RMB-Google-Pixel-4a- 214pm-Ago-5-2021-NH-214006873.jpg
	CACTACEAE and BIGNONIACEAE		Savanna-Petenense-Norte-NEEDS-ID- Selenicereus-cactus-climbing-Crescentia-cujete- PNLT-iPhone-12pro-305pm-Aug-5-2021-NH
	BROMELIACEAE		Savanna-Petenense-Norte-Aechmea-bracteata- bromeliad-bright-inflorescence-PNLT-iPhone- 12pro-307pm-Aug-5-2021-NH

MALPIGHIACEAE	Savanna-Petenense-Norte-NEEDS-ID-nance- behind-Acoelorrhaphe-wrightii-tasiste-palm- PNLDT-iPhone-12pro-320pm-Aug-5-2021-NH
FAGACEAE	Savanna-Petenense-Norte-NEEDS-ID-encino- oak-near-transition-zone-PNLDT-iPhone-12pro- 324pm-Aug-5-2021-NH-8658.JPG
	Parque-Nacional-Laguna-del-Tigre-hiking-from- Savanna-Petenense-Norte-to-CONAP-camp- iPhone-12pro-pm-Aug-5-2021-NH

Note: while in the camp I named the savanna "Savanna Petenense Norte" because it was the north of two associated savannas. I named it Petenense to remind us that these are different than savannas in Belize. However, there are "Belize type savannas" in the karst mound savanna area around Poptún and around La Libertad (not always identical, but these savannas, especially around Poptún, have pine and the karst limestone forms small domed hills throughout the area).

However, for now, I think it is better to name it Spider Lily Savanna.

Fauna

Genus species	Family	Common Names	Folder Name(s)

Folders not in savanna

NEEDS-ID-pepitorio-seeds-to-dry-Paso-Caballos-iPhone-12pro-732am-Aug-5-2021-NH

Parque-Nacional-Laguna-del-Tigre-CONAP-base-camp-Paso-Caballos-misc-Aug-5-2021-NH-NEEDS-sorting

Laguna-del-Tigre-NEEDS-ID-palms-west-of-concrete-bridge-between-CONAP- and -Paso-Caballos-iPhone-12 pro-650 am- Aug-5-2021-NH- and -Paso-Cab

Laguna-del-Tigre-NEEDS-ID-zapote-fruits-nearing-Paso-Caballos-iPhone-12pro-652am-Aug-5-2021-NH

Parque-Nacional-Laguna-del-Tigre-CONAP-entrance-area-Inga-seed-pods-608am-Aug-5-2021-NH

Photo folders not on plants or animals

FLAAR TEAM-Savana 2-Petén-Ago-05-2021-BL

Photos by Boris Llamas (are missing hour): Plants

Crescentia cujete-PN Laguna del Tigre-Savana 2-Petén-Ago-05-2021-BL Hymenocallis sp.-Spider Lili-PN Laguna del Tigre-Savana 2-Petén-Ago-05-2021-BL Nichola's Video-PN Laguna del Tigre-Savana 2-Petén-Ago-05-2021-BL Quercus sp.-Encino-Savana 2-PN Laguna del Tigre-Petén-Ago-05-2021-BL Sagitaria lancifolia-PN Laguna del Tigre-Savana 2-Petén-Ago-05-2021-BL Savana 2 landscape-PN Laguna del Tigre-Petén-Ago-05-2021-BL Selenicerus grandiflorus-PN Laguna del Tigre-Savana 2-Petén-Ago-05-2021-BL

Appendix B

August 5, 2021

REPORTE DE FOTOGRAFIA EN VIAJE DE CAMPO DE PETÉN PASO CABALLOS

Segunda Sabana (Spider Lily Savanna)

Hour by Hour Notes by Byron Pacay

FOTOGRAFO: NICHOLAS HELLMUTH

- iPhone 12pro in **Green**
- Google Pixel 4a in **brown**

Nikon 200 mm

Hora en que se tomó la fotografía	Nombre Local del Lugar de donde se tomó la fotografía	Notes by Byron	Folder Name(s)
6:45 am	Segunda Sabana, Paso Caballos	Palma	Laguna-del-Tigre-Arecaceae-family-west-of-concrete-bridge-between-CONAP-and-Paso-Caballos-iPhone-12pro-650am-Aug-5-2021-NH
6:55 am	Segunda Sabana, Paso Caballos	Sapote	Laguna-del-Tigre-Malvaceae-family-zapote-fruits-nearing-Paso-Caballos-iPhone-12pro-652am-Aug-5-2021-NH
9:15 am	Segunda Sabana, Paso Caballos	Ingreso al bosque	
9:50 am	Segunda Sabana, Paso Caballos	Árbol con corteza similar a la pimienta	Laguna-del-tigre-Myrtaceae-family-hike-to-aguada-en-route-to-cibal-PNLT-iPhone-12pro-948am-Aug-5-2021-NH
9:52 am	Segunda Sabana, Paso Caballos	Árbol con corteza similar a la pimienta	Laguna-del-tigre-Myrtaceae-family-hike-to-aguada-en-route-to-cibal-PNLT-iPhone-12pro-948am-Aug-5-2021-NH
10:00 am	Segunda Sabana, Paso Caballos	Ubicación de un Suampo pequeño	Laguna-del-tigre-Landscape-Pano-little-swamp-hike-to-cibal-savanna-iPhone- 12pro-1000am-Aug-5-2021-NH
10:30 am	Segunda Sabana, Paso Caballos	Bejuco con espina	
10:55 am	Segunda Sabana, Paso Caballos	Llegada a la primera Sabana	
11:28 am	Segunda Sabana, Paso Caballos	Tasiste	Cibal-Savanna-while-hiking-to-true-Savanna-Acoelorrhaphe-wrightii-tasiste-palm-iPhone-12pro-Aug-5-2021-NH
12:00 pm	Segunda Sabana, Paso Caballos	Bromelia roja	Cibal-Savanna-while-hiking-to-true-Savanna-Tillandsia-brachycaulos-red-bromeliad-lavender-flowers-iPhone-12pro-12pm-Aug-5-2021-NH

12:01 pm	Segunda Sabana, Paso Caballos	Panorama parte de la sabana	Laguna-del-Tigre-NEEDS-ID-hike-past-cibal-en-route-to-Savanna-PNLDT-iPhone-12pro-1009am-Aug-5-2021-NH
12:03 pm	Segunda Sabana, Paso Caballos	Tasiste	Cibal-Savanna-while-hiking-to-true-Savanna-Acoelorrhaphe-wrightii-tasiste-palm-iPhone-12pro-Aug-5-2021-NH
12:05 pm	Segunda Sabana, Paso Caballos	Tasiste	Cibal-Savanna-while-hiking-to-true-Savanna-Acoelorrhaphe-wrightii-tasiste-palm-iPhone-12pro-Aug-5-2021-NH
12:10 pm	Segunda Sabana, Paso Caballos	Panorama de otro ángulo de la sabana	Cibal-Savanna-landscape-pano-Acoelorrhaphe-wrightii-tasiste-palm-Crescentia-cujete-PNLT-iPhone-12pro-1210pm-Aug-5-2021-NH-8607
12:40 pm	Segunda Sabana, Paso Caballos	Palo de Jiote	Bursera-simaruba-jiote-peeling-bark-Cibal-Savanna-to-main-savanna-PNLT-iPhone-12pro-1240pm-Aug-5-2021-NH-8612
1:08 pm	Segunda Sabana, Paso Caballos	Bejuco blanco	
2:15 pm	Segunda Sabana, Paso Caballos	Llegada a la segunda sabana	
2:20 pm	Segunda Sabana, Paso Caballos	Panorama de la sabana	Spider-lily-savanna-Norte-PNLDT-panoramas-iPhone-12pro-Aug-5-2021-NH
2:30 am	Segunda Sabana, Paso Caballos	Gramínea. Flor amarilla	Spider-lily-savanna-Rynchospora-species-Paso-de-caballo-BRM-Peten- Google-Pixel-4a-1427pm-Ago-5-2021-NH
2:32 pm	Segunda Sabana, Paso Caballos	Tasiste	Spider-lily-savanna-Norte-PNLDT-panoramas-iPhone-12pro-Aug-5-2021-NH
2:34 pm	Segunda Sabana, Paso Caballos	Árbol de Jícaro	Spider-lily-savanna-Norte-Crescentia-cujete-PNLDT-iPhone-12pro-248pm- Aug-5-2021-NH
2:35 pm	Segunda Sabana, Paso Caballos	Panorama Tasiste	Spider-lily-savanna-Norte-Acoelorrhaphe-wrightii-burned-iPhone-12pro- 221pm-Aug-5-2021-NH

2:38 pm	Segunda Sabana, Paso Caballos	Sagittaria	Laguna-del-Tigre-Spider-Lily-Savanna-Sagittaria-lancifolia-Google-Pixel-4a-235pm-Aug-5-2021-NH
2:45 pm	Segunda Sabana, Paso Caballos	Gramínea, Flor Amarilla	Laguna-del-Tigre-Spider-Lily-Savanna-Rynchospora-species-Google-Pixel-4a- 227pm-Aug-5-2021-NH
2:50 pm	Segunda Sabana, Paso Caballos	Panorama Jícara	Spider-lily-savanna-Norte-Crescentia-cujete-PNLDT-iPhone-12pro-248pm- Aug-5-2021-NH
2:52 pm	Segunda Sabana, Paso Caballos	Flor blanca/ imenocales	Spider-lily-savanna-Norte-Hymenocallis-littoralis-spider-lily-flowers-and- seeds-PNLT-iPhone-12pro-249pm-Aug-5-2021-NH
2:55 pm	Segunda Sabana, Paso Caballos	Semilla de imenocales	Spider-lily-savanna-Norte-Hymenocallis-littoralis-spider-lily-flowers-and-seeds-PNLT-iPhone-12pro-249pm-Aug-5-2021-NH
2:56 pm	Segunda Sabana, Paso Caballos	Panorama de Jícara y tasiste	Spider-lily-savanna-Norte-Acoelorrhaphe-wrightii-burned-iPhone-12pro- 221pm-Aug-5-2021-NH
3:05 pm	Segunda Sabana, Paso Caballos	Cactus en árbol de Jícara	Spider-lily-savanna-Norte-Selenicereus-grandiflorus-subspecies-donkelaarii- Crescentia-cujete-PNLT-iPhone-12pro-305pm-Aug-5-2021-NH
3:08 pm	Segunda Sabana, Paso Caballos	Bromelia en jícara	Spider-lily-savanna-Norte-Aechmea-bracteata-bromeliad-bright-inflorescence-PNLDT-iPhone-12pro-307pm-Aug-5-2021-NH
3:11 pm	Segunda Sabana, Paso Caballos	Flor y semilla de imenocales	Spider-lily-savanna-Norte-Hymenocallis-littoralis-spider-lily-flowers-and- seeds-PNLT-iPhone-12pro-249pm-Aug-5-2021-NH
3:18 pm	Segunda Sabana, Paso Caballos	Panorama de tasistal	
3:21 pm	Segunda Sabana, Paso Caballos	Cuscuta Falsa	Laguna-del-Tigre-Spider-Lily-Savanna-RBM-Cassytha-filiformis-iPhone-12Pro- 318pm-Ago-5-2021-NH
3:25 pm	Segunda Sabana, Paso Caballos	Árbol de Nance	Spider-lily-savanna-Norte-Byrsonima-crassifolia-nance-behind-Acoelorrhaphe-wrightii-tasiste-PNLT-iPhone-12pro-320pm-Aug-5-2021-NH

5:30 pm	Segunda Sabana, Paso Caballos	Orquídea de Flor amarilla	Maxillaria-species-hike-return-from-spider-lily-savanna-PNLT-iPhone-12-pro-541pm-Aug-5-2021-NH
5:45 pm	Segunda Sabana, Paso Caballos	Jimba	Guadua-longifolia-hike-returning-from-spider-lily-savanna-PNLT-iPhone- 12pro-534pm-Aug-5-2021-NH
5:48 pm	Segunda Sabana, Paso Caballos	Panorama del Arroyo Sacluc	Parque-Nacional-Laguna-del-Tigre-hiking-from-Savanna-Petenense-Norte- to-CONAP-camp-iPhone-12pro-pm-Aug-5-2021-NH

Appendix C

AGOSTO 3, 2021

REPORTE DE KILOMETRAJE DE SALIDA DE SAN BENITO A PASO CABALLOS, PETÉN

Gravel road from km. 9.4; 4WD helps in the rainy season but in dry season any vehicle should make it (unless if it is too low where could scrape the bottom of vehicle as you maneuver a few ruts).

Hora	Kilometraje	Notes By Byron
9:06 pm	Km 0.0	Salida de San Benito redondel hacia Paso Caballos
9:37 pm	Km 9.4	Cruzar Puente, despues, girar a la Izquierda
9:45 pm	Km 16.7	Barrio el Plantel
9:48 pm	Km 16.9	Laguneta Sacpuy

9:55 pm	Km 18.7	Barrio el Centro
9:57 pm	Km 18.8	Barrio el Corazal
10:02 pm	Km 21.5	Cementerio
10:07 pm	Km 23.9	Finca Yoly, sigue por la derecha en la calle principal
10:12 pm	Km 26.9	Cruce a la izquierda, seguir directo
10:16 pm	Km 30.0	Rancho Mariales
10: 19 pm	Km 31.7	El Batalito
10:26 pm	Km 35.7	Caserío San José
10:29 pm	Km 37.3	Desvió a la derecha
10:37 pm	Km 41.1	Se encuentra un camino tipo Y, cruzar a la izquierda
10:39 pm	Km 41.3	(Ceiba pentandra), Girar a la derecha
11:02 pm	Km 60.0	Finca el Mecate
11:05 pm	Km 60.1	Llegada al campamento de CONAP, al sur de Paso Caballos
15 minutes to Reach Río San Pedro	Km 63.9	Comunidad Paso Caballos

Our base camp, where we slept in tents, was about 4 kilometers south of Paso Caballos (which is where you find the Río San Pedro).

Our base camp was at CONAP's entrance gate for the Parque Nacional Laguna del Tigre. 99% of all field work and biological, geological, and other research by professors and students is always carried out based at the luxurious Las Guacamayas (half hour or so boat ride along Río San Pedro west from Paso Caballos). Due to the cost of this impressive luxury facility, we stayed in tents and ate in the house of local Q'eqchi' Mayan people.





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 is part of our bibliography team. In addition, she also prepares blogs and articles for our websites with helpful information about the flora and fauna we document in our field trips and other topics we interested in.

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 helsp 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

Maria 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 Avilés 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 Sequen is illustrator for MayanToons and also helps prepare illustrations for Social Media posts and for animated videos.

Rosa Sequen 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.

Maria 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. She will combine the text, pictures and maps into the FLAAR Mesoamerica editorial criteria.

Carlos Marroquín is a USAC graphic design student who volunteered to do his professional practice with the Editorial Design Team. We are very grateful with people like him who join our team and bring his knowledge and work.

Sergio Jerez 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 inhouse library on flora and fauna of Mesoamerica (Mexico through Guatemala into Costa Rica).

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

