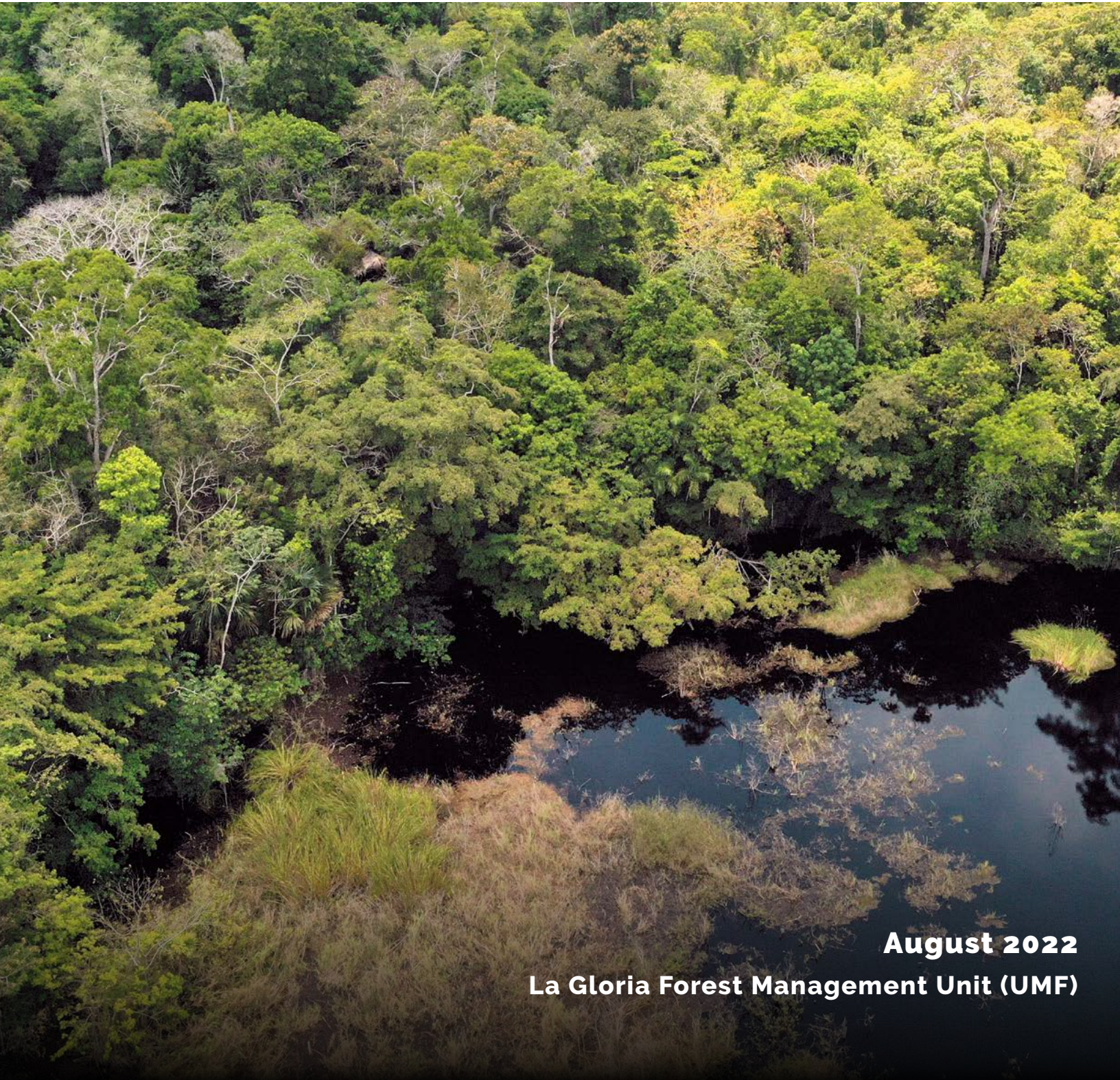




# Documenting our Remote Field Work and Savanna Exploration in the Maya Biosphere Reserve (RBM) through GPS Technologies



**August 2022**

**La Gloria Forest Management Unit (UMF)**

**SERGIO D'ANGELO JEREZ**  
FLAAR MESOAMERICA

# APPRECIATION

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CONAP administrator of the multiple use zone (ZUM) of the Maya Biosphere Reserve (RBM).

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CONAP forest ranger at base camp Los Pescaditos.

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Abel Castro, infantry lieutenant

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Rubencin Recinos Orellana

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We appreciate a donation during November 2021 and a subsequent donation in early June 2022 to help cover the costs of the FLAAR research projects; specifically, to assist and support the current FLAAR project of flora and fauna in the Maya Biosphere Reserve (RBM). These continuing donations are also assisting the FLAAR (USA) and FLAAR Mesoamérica (Guatemala) research project that aims to search for wild edible plants in the wetlands of the Municipio de Livingston area, in 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 Mesoamérica, including the Yaxhá area in the 1970's while the site was being mapped by FLAAR.

These donations are also in recognition of the urgency and need for conservation of both wildlife and rare plants in the biodiverse ecosystems of the Maya Biosphere Reserve (RBM) of Guatemala. Parque Nacional Yaxhá, Nakum and Naranjo (PNYNN), Parque Nacional Laguna de Tigre (PNLT) and the wetlands of Municipio San José are three particular zones of the over 5 million acres of the RBM.

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### **PHOTO FROM FRONT COVER Aguada and floodable ecosystem at campamento El Barranco, La Gloria Forest Management Unit.**

Photo by: Emanuel Chocooj, FLAAR Mesoamerica.  
May 9th, 2022. Maya Biosphere Reserve (RBM).

Camera: drone Mavic Pro 2, 28 mm.

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# What's our aim through our exploration of the unexplored wetland and savanna ecosystems in remote areas of Petén?

The Maya Biosphere Reserve (RBM) constitutes an area which contains diverse ecosystems. Among them, the National Council for Protected Areas (CONAP, by its acronym in Spanish) of Guatemala has categorized the tropical and subtropical forests of the area as low, medium-high, and montane medium-high as some of the most common. Likewise, it distinguishes pine patches, jimbales (associations of *Guadua longifolia*), and tintaales (associations with *Haematoxylum campechianum*) as some of the common plant communities that are well known locally.

However, there are other types of ecosystems, which include wetlands and savannas, that are less known. Even when CONAP recognizes floodable savannas in the Reserve's master plan as one of four main terrestrial systems, this type of ecosystem has not yet been studied in depth. In fact, there are no

publications that describe savannas' ecology, plant associations, or the conditions that should be followed to preserve them. Therefore, and even when such types of ecosystems have been well documented in Belize and the rest of the Yucatán peninsula, the studies in Guatemala have been scarce or even non-existent for some of them.

Also, there appears to be a difference among the conception that local people of the area, professionals, technicians, and the scientific community have of these ecosystems. This is due to the fact that technicians, professionals and local people that live or work in the Reserve do recognize these ecosystems, but on the other hand, many Guatemalan scientists don't. Either they ignore that these ecosystems exist, or they consider that they aren't natural and therefore, they shouldn't be categorized as a particular type of system.



**Savanna ecosystems beside Campamento El Tazistal.**

Photo by: Emanuel Chocooj, FLAAR Mesoamérica. May 7th, 2022. Savanna ecosystems en route to the main tazistal ecosystem and besides Campamento El Tazistal. La Gloria Forest Management Unit. Camera: drone Mavic Pro 2, 28 mm.

## **Introduction to the cooperation project with the National Council for Protected Areas (CONAP)**

Currently, we are working in cooperation with CONAP to document the biodiversity of ecosystems, and wild species of the Maya Biosphere Reserve (RBM). Our main approach to do so, is through professional high-resolution photography and aerial photography with drone. So we take photos with great quality that later can be used by researchers or technicians in the areas we visit.

In addition, we are looking to explore savannas and wetland ecosystems, in order to attract people's attention to such scarcely studied habitats. By doing so, we want to improve any future or current research that could be or is being done in the Reserve.

We also look forward to enrich any species inventory of the area through the photographs, videos, lists of species and other materials (maps, bibliographic compilation, etc.) that we are generating. We will later show everything we find with students, scientists, explorers, tourists, photographers and nature conservationists in general.

At the end of this five year project, we will have shared all the materials that we create with the administrators of each of the protected areas that we visit. By doing so, these resources could be helpful in the update of any master plan, as well as in the edition of any activities report that is currently being made.

## **Savanna exploration in Laguna del Tigre National Park (PNLT)**

Starting in August of last year, we have been able to explore some of the savanna ecosystems of both Yaxhá, Nakum and Naranjo (PNYNN) and Laguna del Tigre (PNLT) National Parks. In fact, we have identified more than 30 of these ecosystems in the latter.





**Reference map of savannas 1 to 14 at Parque Nacional Laguna del Tigre (PNLT).** This is an old numeration that we are currently updating based on the new savannas and open areas that we have found through our visits. Photographic background from Instituto Geográfico Nacional (IGN) of Guatemala. Numeration and coordinates put on the map by David Arrivillaga.



**Reference map of savannas 12 to 33 at Parque Nacional Laguna del Tigre (PNLT).** Photographic background from Instituto Geográfico Nacional (IGN) of Guatemala. Numeration and coordinates put on the map by David Arrivillaga.

Additionally, we have been able to document some of the plant species that are known in Mesoamérica to characterize such ecosystems. Some of them are *Crescentia cujete*, *Byrsonima crassifolia*, *Acoelorrhaphe wrightii*, *Quercus spp.*, as well as various other grasses, sedges and rush species.



**Jicaro trees and tasiste palms at Spider Lily Savanna.** Photo by: Nicholas Hellmuth, FLAAR Mesoamérica. Jan. 9th, 2022. Camera: iPhone 13 Pro Max.

One of the savannas that has impressed us the most is the one that we've called Spider Lily Savanna. In this 1 km<sup>2</sup> grassland savanna, we have found tasiste palms (*A. wrightii*), morro trees (*C. cujete*) and nance trees (*B. crassifolia*). We have also found one oak tree (*Quercus sp.*).

However, the one species that has caught our attention is *Hymenocallis littoralis*, also called spider lily. So far, we have seen it bloom here in different months of the year. Despite the solar radiation, the prevalent dry conditions, and the high temperatures in this savanna, these plants do not only develop well, but they also exhibit their delicate flowers.

Another characteristic that has caught our attention is the fact that many of the savannas in PNLT are extremely vulnerable to fires. During one of our last expeditions, we hiked through one savanna that had been recently burned. All the vegetation was incinerated and we found several burned turtle shells. Unfortunately, this happened because inhabitants of near areas tend to fire these savannas to corner wild deers and hunt them. In that sense, these fires generally have important consequences and can greatly impact the biodiversity. By continuing to explore these areas we expect them to be better studied by other people, which would better promote their conservation.



**Spider Lily flowers on the Spider Lily Savanna at Parque Nacional Laguna del Tigre (PNLT).**

Photo by: Boris Llamas. August 5th, 2021. Spider Lily Savanna, Parque Nacional Laguna del Tigre (PNLT).  
Camera: Canon EOS R5.



**Burnt trunk of jicaro tree (*Crescentia cujete*).**

Photo by: Nicholas Hellmuth, FLAAR Mesoamérica. Jan. 9th, 2022. Spider Lily Savanna, at Parque Nacional Laguna del Tigre (PNLT).  
Camera: iPhone 13Pro Max.

## **Recent savanna and wetland exploration in La Gloria**

In the last few months, we have focused our work inside the RBM in exploring the Forest Management Unit La Gloria and the surrounding area. Approximately, since the beginning of April we started analyzing satellite

images of this area to identify how many savannas we could find. So far, we have defined more than 140 and our goal for this and the next year is to visit and explore them.




**Burnt tasiste (*Acoelorrhaphes wrightii*) landscape at savannas 30 and 31 from Parque Nacional Laguna del Tigre (PNLT).**

Photo by: Haniel López, FLAAR Mesoamérica. April 2nd, 2022. Savannas 30 and 31, Parque Nacional Laguna del Tigre (PNLT). Camera: drone Mavic Pro 2, 28 mm.



**Bromeliads and other epiphytes (as the *Peperomia* species left and center in this photograph) tend to love aguadas, due to the high humidity. This aguada looked like a biodiverse, exuberant and natural garden.**  
Photo by: Sergio D'angelo Jerez, FLAAR Mesoamérica, May 6th, 2022. Aguada La Paylona, La Gloria Forest Management Unit.  
Camera: Google Pixel 6Pro.



In fact, we went to some of the ecosystems in this Unit in May. The Unit is located North to the Protected Biotope San Miguel La Palotada El Zotz, in the Multiple Use Zone of the RBM. On such occasion, we were surprised by the plant diversity that we documented in some of the wetland ecosystems, and previous to that, we were also impressed by the large number of savannas that we could find through satellite images.

Even when we haven't been able to return to this area because of the heavy rains and the fact that many roads in the area become impassable, our May exploration was very productive. We visited aguadas, lagoons, floodable savannas and other wetlands which showcased a very interesting and diverse amount of plant species. In general, we left with the impression that the majority of the ecosystems in the Unit were healthy and well conserved.

## **How are we continually discovering new savannas and wetland ecosystems through satellite imagery?**

As it has been stated before in this report, using satellite images has been vital in our exploration work. Only through these images, have we been able to identify the wetlands and savannas in the RBM and later plan our expeditions to visit them.

When we look at these ecosystems through aerial images, it's relatively easy to identify the open areas (which generally are savannas or wetlands). Anyhow, the only way to determine what kind of ecosystem these areas are is by visiting them. Species as *C. kujete* and *A. wrightii* have helped us

categorize some of these locations as savannas, but in general others may constitute different types of wetlands.

Some of the main resources and platforms that we have used during this process include Google Earth, Google Earth Pro, Satellites.pro, Caltopo and Google Maps.

We have also used orthophotos from the National Geographic Institute (IGN) of Guatemala. Additionally, we have used other online platforms which enable you to explore different collections of satellite imagery.

Locally, the National Geographic Institute (IGN) is the main entity that has scanned and documented Guatemala's land surface using both aerial images and maps. However, the last photographs that were taken by the institute correspond to 2006. For that reason,

the other resources that we have used have been so helpful. Even when the institute's orthophotos have great quality, they don't show how the land and ecosystems have evolved through the last sixteen years, particularly, through any human intervention.

## Satellite image collections available online

Today, the amount of satellite images that can be found online is abundant. Some of the most popular and used collections, such as those of the Landsat and Sentinel projects, can be easily accessed and visualized through various online platforms.



**This is how the savanna P131 looks like through the satellite imagery platform Satellites.pro. Generally, most of the images that are available online need edition to correct the color.**

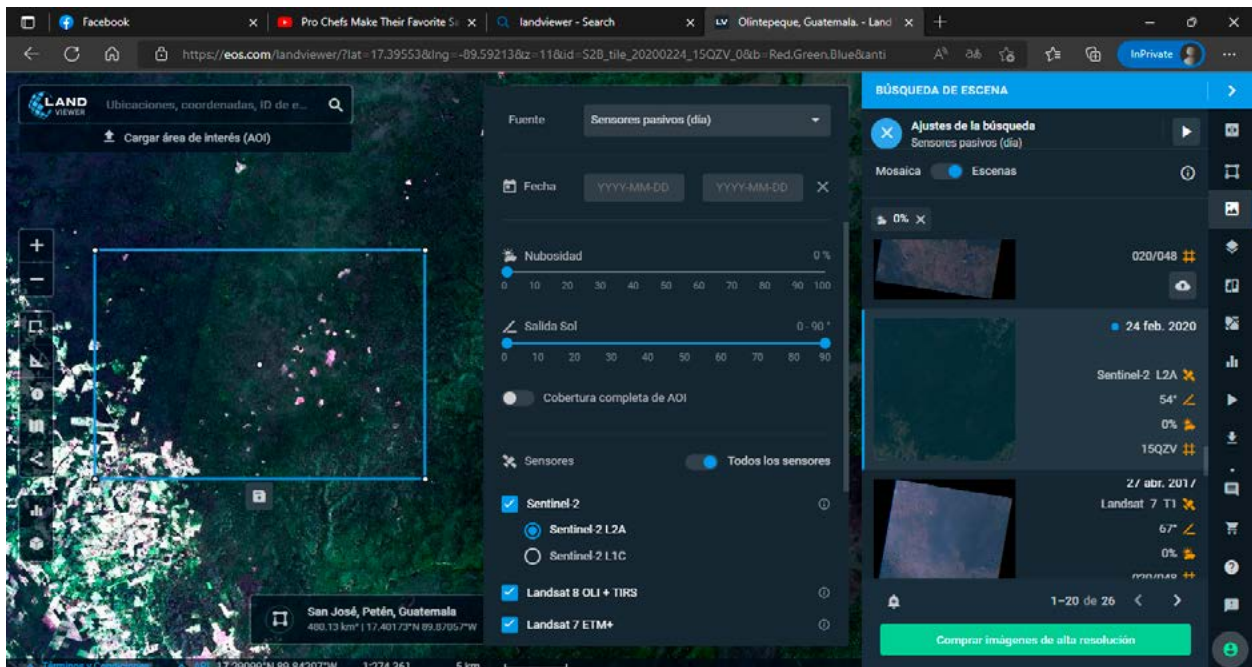
Protected Biotope San Miguel La Palotada El Zotz (Satellites.pro, 2022).



At the same time, there are different sites which not only contain these images, but have also improved them through various processing methods. In these sites, the images can be visualized, processed and downloaded, which is really helpful.

In that sense, we usually use Google Earth to identify the ecosystems that we are focused on. Then, we look through each platform to decide which one has the best quality images. In fact, sometimes some platforms exhibit areas that others don't. Once we found the best images, we download them.

Besides using all of the above platforms and the IGN orthophotos, one of the most useful resources to explore La Gloria has been Caltopo. This online platform has a visualizer which contains various layers from Caltopo itself, as well as from other agencies such as Mapbox, Maxar, the Farm Service Agency of the USDA, EOX IT and modified Copernicus data. As a result, the images appear very clear and have great quality. For instance, they let us identify 100% more ecosystems while we were studying La Gloria area, as it is described in the following section.



**This is LandViewer's visualizer platform, where one can look through different satellite image collections and download individual files. In the blue rectangle, at the left, the main group of savannas from La Gloria can be easily spotted.**

San José Municipality (LandViewer, Earth Observing System [EOS], 2022).

## More than 140 savannas and wetland ecosystems in La Gloria and the surrounding area

In the last 6 months, we have identified more than 140 savannas and wetland ecosystems in the area which encompasses La Gloria, a forest management unit adjoined to the north border of the Protected Biotope San Miguel La Palotada El Zotz. Initially, while only using IGN imagery, Satellites.pro and Google Maps, we had identified 70 of these ecosystems. However, by exploring the same areas in Caltopo.com we were able to identify 100% more. This group of savannas and wetlands is located in the region that goes from the Protected Biotope San Miguel La Palotada El Zotz, through the Forest Management Unit, and the Southwest end of Río Azul National Park.

Whilst it has been relatively easy to find the majority of these ecosystems in the satellital images, a significant percentage has smaller dimensions

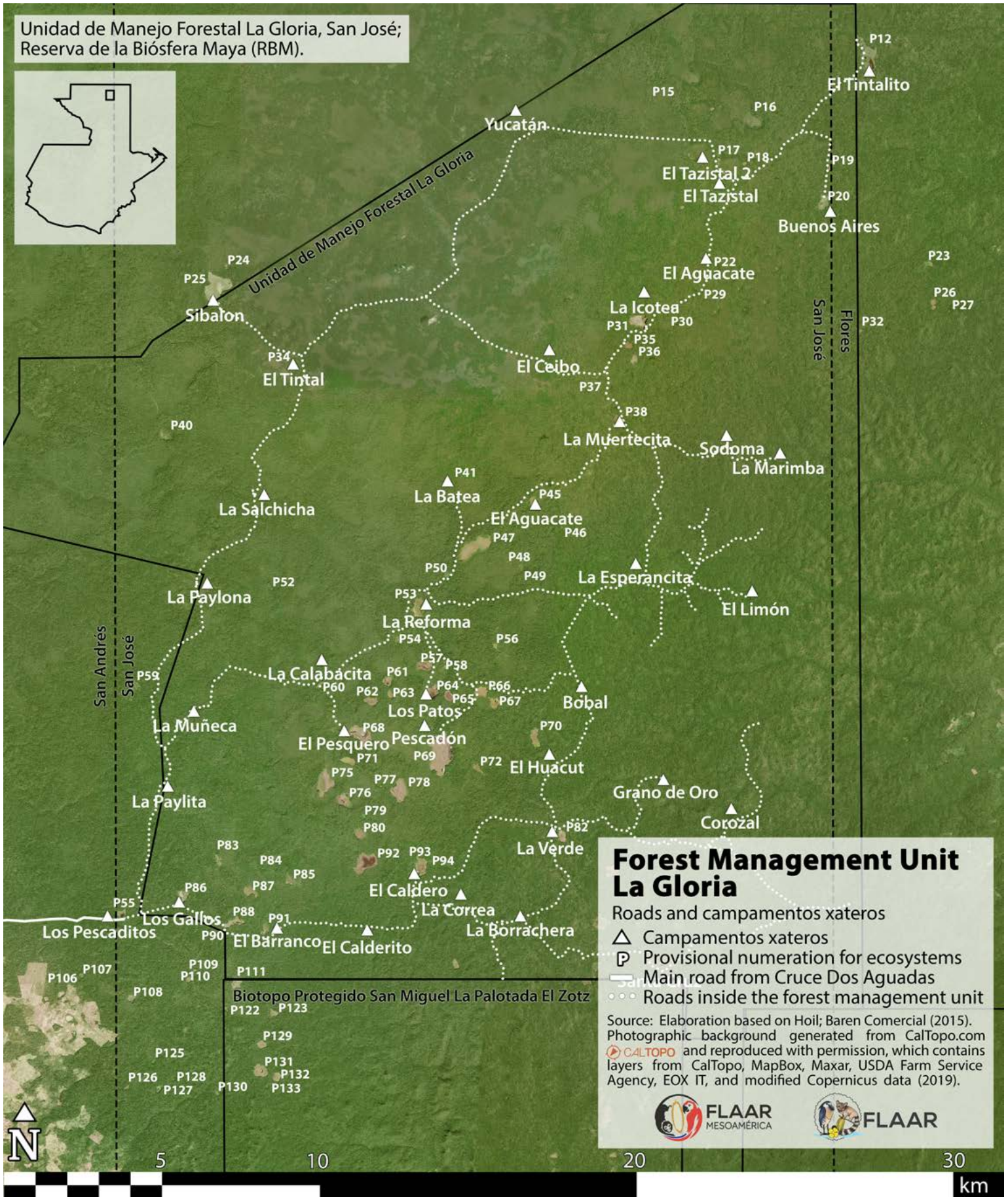
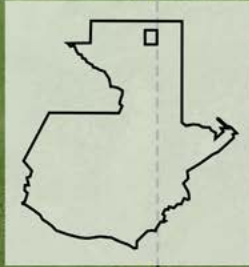
and therefore, has required more of our attention. The larger savannas stand out and can be easily spotted, however, the smaller ecosystems can be overlooked. In fact, the way in which we have located such ecosystems is by spotting any area, as small as it may seem, that exhibits a height difference in the vegetation.

In addition, these smaller habitats constitute the majority of the 140 we've found, and the only way in which they can be categorized into a particular type of ecosystem is by visiting them. Namely, they could be floodable areas, cibales (saw-grass associations), aguadas, or jimbales (*G. longifolia* associations). Categorizing what type of ecosystem they are encourages us to go to such a remote area, and explore each one of them.

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The following map, as well as most of the maps presented in this report were created with satellite photographic background that was retrieved from Caltopo.com and is used with permission. The photographs have multiple layers and the attribution of the sources and agencies that created or modified each layer is included in this report following the reference section.

Unidad de Manejo Forestal La Gloria, San José;  
Reserva de la Biosfera Maya (RBM).



### Forest Management Unit La Gloria

- Roads and campamentos xateros
- △ Campamentos xateros
- P Provisional numeration for ecosystems
- Main road from Cruce Dos Aguadas
- ⋯ Roads inside the forest management unit

Source: Elaboration based on Hoil; Baren Comercial (2015).  
Photographic background generated from CalTopo.com  
CALTOPO and reproduced with permission, which contains layers from CalTopo, MapBox, Maxar, USDA Farm Service Agency, EOX IT, and modified Copernicus data (2019).



Map of the main group of savannas at La Gloria Forest Management Unit.

Photographic background from Caltopo.com and elements put on the map by Sergio D. Jerez. The attributions for each layer of the Caltopo images are included in this report following the reference section.



**Jimbal, association of *Guadua longifolia* (a native bamboo).**

Photo by: Nicholas Hellmuth, FLAAR Mesoamérica. Jan. 9th, 2022. Río Sacluc.  
Camera: iPhone 13 Pro Max.



**Cibal, association of *Cladium mariscus* (sawgrass).**

Photo by: Nicholas Hellmuth, FLAAR Mesoamérica. Aug. 5th, 2021. Cibal savanna at  
Parque Nacional Laguna del Tigre (PNLT).  
Camera: iPhone 12 Pro.



**Lagoon and floodable surrounding areas at Los Gallos, La Gloria Forest Management Unit.**

Photo by: Nicholas Hellmuth, FLAAR Mesoamérica. May 9th, 2022.  
Camera: iPhone 13 Pro Max.



**Bajo (low) forest. Generally bajo forests are noticeable in satellite images.**

Photo by: Sergio D'angelo Jerez, FLAAR Mesoamérica. May 7th, 2022. En route to tasistal ecosystem, from campamento El Tazistal.  
Camera: Google Pixel 6Pro.

## Documenting our expeditions and routes with GPS technologies

To register the routes we travel and later create maps that can be used as reference by other students, scientists and professionals, we use a GPS device. During our May expedition in La Gloria we used a 66sr Garmin. Yet, even when this is one of the most recent models, it lost the satellite connection several times. Nevertheless, we had an alternative track recording method.



**GPS coordinates are recorded for each of the ecosystems we visit during the field expeditions.**

Photo by: Nicholas Hellmuth, FLAAR Mesoamérica. May 6th, 2022. Entrance to campamento La Paylita, La Gloria Forest Management Unit.  
Camera: iPhone 13Pro Max.

In August from last year, the rangers at PNLT showed us the Avenza Maps mobile app. Without needing internet connection, which actually is not available often in some areas of the Maya Biosphere Reserve, they showed us how they get to record their tracks and visualize the terrain. This free application works by uploading georeferenced maps. Also, by selecting the adequate settings, you can see your location, record your hikes and do marks for specific points.

For that reason, we decided to explore this tool and to install the application to document our work. We got georeferenced maps of La Gloria through Caltopo and later, we documented our tracks using the app. in a Google Pixel 6Pro. Additionally, this tool let us know the coordinates for every ecosystem we visited, the location of the species we photographed, and mark other locations of our interest.

**Moisés Daniel Pérez “Teco” sharing with us the maps he has generated through Avenza Maps.**

Photo by: Nicholas Hellmuth, FLAAR Mesoamérica. May 5th, 2022. Campamento Los Pescaditos, La Gloria Forest Management Unit. Camera: iPhone 13Pro Max.



## The map creation process

When we got back to the office, we started processing the satellital information and creating the maps.

In first place, we looked for satellite images that we could use as backgrounds for our maps. To do so, some of the platforms we used include:

- **Land Viewer, from the Earth Observation System (EOS):** it contains images from the satellital programs Sentinel-2, Landsat 8, Landsat 7, Landsat 4-5, the China-Brazil Earth Resources Satellite Program (CBERS) and the National Agriculture Imagery Program (NAIP) from the USDA.
- **The Earth Observation Browser, from Sentinel Hub:** contains images from the satellite programs Sentinel-1, Sentinel-2, Sentinel-3, Landsat 1-5, Landsat 4-5, Landsat 7, Landsat 8-9, and the NASA Moderate Resolution Imaging Spectroradiometer (MODIS), among others.
- **Caltopo:** contains processing layers from Caltopo, Mapbox, Maxar, the Farm Service Agency of the USDA, EOX IT, and modified Copernicus (2019) data, among others.

In addition to the imagery that is available online, we have also acquired orthophotos from the IGN which have been very useful. One of the greatest features in these images is that they have good quality. Because of this, you can even clearly see some species with distinctive features, such as corozo palms (*Attalea cohune*) for example.

Along this process, one of the greatest challenges is to find images that cover the whole area, while having good enough quality. For instance, many of the areas tend to be covered by clouds because of the region's tropical climate. The sun reflection in the water bodies can reduce the quality of the images as well. Another common defect is the coloration throughout different sectors, which is due to the fact that these pictures are taken at different moments of the day, or even different seasons. Nevertheless, sometimes this can be corrected through edition programs, such as Photoshop.





**Savannas P131, 132 and 133 at La Gloria Forest Management Unit, in original orthophoto from the National Geographic Institute (IGN) of Guatemala.**

Protected Biotope San Miguel La Palotada El Zotz (Instituto Geográfico Nacional [IGN], 2006).



**The same savannas after editing the color of the same IGN orthophoto. Most of the times, by correcting the color appropriately, all the savanna ecosystems become more visible.**

Protected Biotope San Miguel La Palotada El Zotz (Instituto Geográfico Nacional [IGN], 2006).

It is worth mentioning that the maps that we create have been differentiated from the ones that other scientists and institutions in the region have published because of the graphic quality we look for. Our maps showcase high resolution aerial photographs that can be zoomed in to visualize each of the ecosystems. That way, we can share what we have discovered and other researchers can get interested in better studying this area. Although aerial images have been created for a few decades now, the processing and visualization technologies are relatively new. Additionally, very few researchers in the region include these kind of materials in their publications.

For that reason, we encourage students and other professionals to

explore available satellite imagery. This is definitely a helpful tool that is worth exploring.

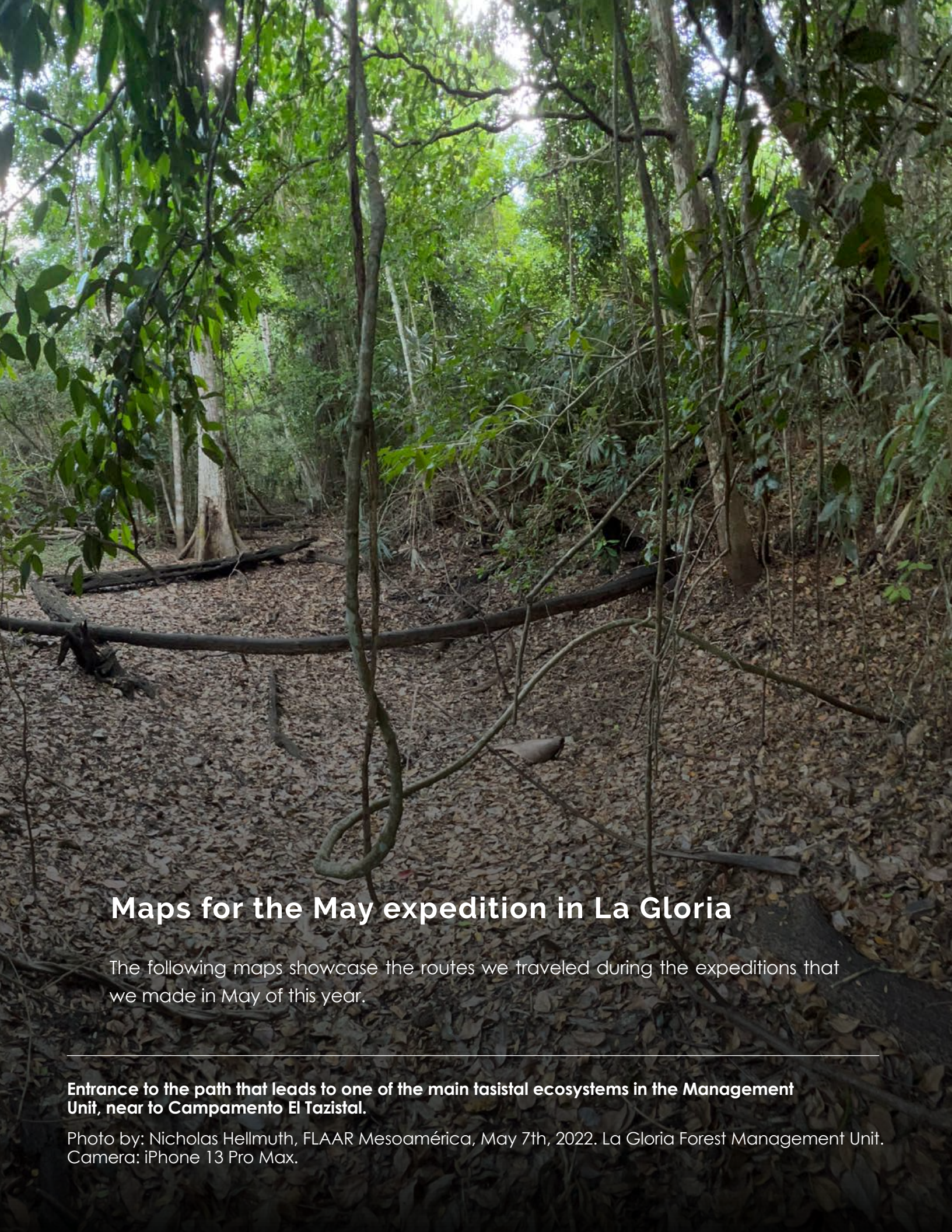
Following up on the process to create the maps, the next step after acquiring the images is to create mosaics that cover the whole zone that we study. Put another way, after we find the images, we generally have to join many of them to create a single image in which the whole area can be visualized. These images can cover hundreds of square kilometers, because the areas are vast.

Finally, the color is corrected and the graphic elements are added, such as the routes, the symbology, and the legend, etc.



**Savanna complex at Laguna del Tigre National Park (PNLT). This is a mosaic conformed by at least three different orthophotos from the IGN and it encloses more than 15 linear kilometers lengthwise.**

Parque Nacional Laguna del Tigre (PNLT) (IGN, 2006).



## Maps for the May expedition in La Gloria

The following maps showcase the routes we traveled during the expeditions that we made in May of this year.

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**Entrance to the path that leads to one of the main tasistal ecosystems in the Management Unit, near to Campamento El Tazistal.**

Photo by: Nicholas Hellmuth, FLAAR Mesoamérica, May 7th, 2022. La Gloria Forest Management Unit.  
Camera: iPhone 13 Pro Max.

Unidad de Manejo Forestal La Gloria, San José;  
Reserva de la Biosfera Maya (RBM).



Map with the route traveled on May 6th.

The attributions for each layer of the Caltopo photographic background are included in this report following the reference section.

During our first day of expedition, we were able to visit one of the furthest North ecosystems. In general, the road was passable, but the local people told us, and we figured out that it would certainly not remain that way when the rainy season started. In fact, we decided to visit some of the most remote areas this time given that it had not started raining, so that we could explore these places first and later, in following months, focus on the ecosystems that are near to Campamento Los Pescaditos. Once the rains start, we won't be able to transit the road in the management unit anymore, but we decided that we could perhaps hike to those ecosystems near Los Pescaditos.

The campamentos xateros inside the unit are base camps that the xateros build to remain there while they do the harvest. Xate is the local name for various species of palms in the *Chamaedorea* genus, and xateros is the local name for people that harvest the leaves of these palms. Because there are wild populations of these species, xate is one the resources that local communities can sustainably harvest as a non-timber forest product. Xate leaves are mostly used in floriculture.

These campamentos usually have few thatch roof small structures

that the xateros use to sleep and rest throughout the day. These are generally made out of branches and guano (various *Sabal* species) leaves.

Since Moisés Pérez "Teco" went with us this day he was able to show us the "chupamiel" vine, which is probably an *Aristolochia* species. According to him, the sap of the vine is locally used to reduce the effects of venomous snake bites. He also let us try this sap, and it turned out to be extremely bitter. Even after an hour or so, the bitter taste remained.

We do not recommend anyone to eat any unknown plant until a medical doctor personally approves it. Also it should be taken into account that each part of most plants has different chemicals. So even if one part is edible, that does not mean that all parts should be eaten. Biologist Eduardo Sacayon has also pointed out to us that many resins and potentially latex of trees have crystals that can be damaging to humans. We have known Teco for many years, and we know that he has a lot of knowledge on which plants are locally used, but you should keep in mind to always be careful and do not ingest plants that you don't know or that you have not previously tasted in the wild.



**Aguada at Campamento La Paylita.**

Photo by: Emanuel Chocooj, FLAAR Mesoamérica. May 6th, 2022. La Paylita, La Gloria Forest Management Unit.

Camera: drone Mavic Pro 2, 28 mm.

***Malpighia lundellii* flowers. The fruits of this species have been reported to be edible.**

Photo by: Edwin Solares, FLAAR Mesoamérica. May 6th, 2022. Campamento La Paylona,  
La Gloria Forest Management Unit.  
Camera: Sony A1 , 200-600 mm.



Unidad de Manejo Forestal La Gloria, San José;  
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Map with the route traveled on May 7th.

The attributions for each layer of the Caltopo photographic background are included in this report following the reference section.



While we were approaching the furthest North ecosystems that we had visited on the previous day, Teco was extremely perceptive to find a wild vanilla flower. He was in the copilot seat, when he asked us to stop. A few meters along the road, there was an open flower. It has turned out that in Peten, this is something that one could rarely see in a lifetime due to the fact that vanilla flowers open for a few hours and that they can bloom in different seasons throughout the year. Teco himself has tried to keep track of vanilla orchids to see the flowers, but so far he has not seen any. The open flower that he found with us was the last remaining in the vine. All the others appeared to have already opened or fallen from the plant.

Later that day, when we were returning from the furthest North ecosystem that

we had visited the previous day, near to the campamento El Tazistal, a twig got stuck under the car and broke a tiny portion of the diesel tank, where the diesel hose is connected. So we had to tow the Volkswagen pickup for almost 35 km inside the jungle on a dirt road, while it was darkening.

We were also not able to better explore this furthest North ecosystem at El Tazistal that day, but we were extremely lucky to find the open vanilla flower. In addition, we were extremely lucky that a twig broke the diesel tank. We got back to the camp base 6 hours after the tank broke. Nicholas had to almost blindly drive the Volkswagen due to the dark, the narrowness of the road, as well as other conditions of this jungle road.



**Vanilla insignis flower.** Photo by: Edwin Solares, FLAAR Mesoamérica. May 7th, 2022. Camera: Sony A1, 90 mm.



***Vanilla insignis* flower beside the road 2 kilometers past Campamento El Ceibo.**

Photo by: Edwin Solares, FLAAR Mesoamérica. May 7th, 2022. La Gloria Forest Management Unit.  
Camera: Sony A1, 90 mm.



**Cauliflorous inflorescence of *Bignonia binata*, 2.5 km before Campamento El Aguacate.**

Photo by: Edwin Solares, FLAAR Mesoamérica. May 7th, 2022. La Gloria Forest Management Unit.  
Camera: Sony A1, 90 mm.



**Cauliflorous inflorescence of *Bignonia binata*, 2.5 km before Campamento El Aguacate.**

Photo by: Edwin Solares, FLAAR Mesoamérica. May 7th, 2022. La Gloria Forest Management Unit.  
Camera: Sony A1, 90 mm.



**We couldn't find a trail to the main tasistal ecosystem but we got to this tintal-tasistal area. We will find a route during 2023 field trips.**

Photos by: Nicholas Hellmuth, FLAAR Mesoamérica. May 7th, 2022. Tintal-tasistal near campamento El Tazistal, en route to the main tasistal ecosystem.

*Salvinia minima* at Aguada near Campamento La Muertecita.

Photo by: Edwin Solares, FLAAR Mesoamérica. May 8th, 2022. Campamento La Muertecita, La Gloria Forest Management Unit. Camera: Sony A1, 90 mm.



Unidad de Manejo Forestal La Gloria, San José;  
Reserva de la Biosfera Maya (RBM).



Map with the route traveled on May 8th.

The attributions for each layer of the Caltopo photographic background are included in this report following the reference section.

We were able to visit some of the larger wetland and savanna ecosystems during our third expedition day. We have not yet concluded what the ecosystem at the Savanna Emanuel, one of these larger ecosystems, could be, given that it has portions with characteristics of both a floodable area and a pure savanna. Also, we found several tall trees in the “savanna area” while exploring it through the drone. Although we temporarily called this area as Savanna Emanuel, we later found out that this place is locally known as Valle del Keh.

Campamento La Reforma also has one of the most interesting and larger ecosystems. Primarily, it appears to be a permanently flooded area, with floodable savanna portions.

We did not enter these ecosystems this time because we wanted to find as many of them as possible and have insight on what types of wetlands they enclose by documenting them through aerial photography. We also wanted to see how many of these areas were the same areas that we had previously identified through satellite images. When we get enough funding, it would be extremely helpful to hike inside these ecosystems, check if there are more microhabitats inside, and check what other plants grow in here as well.

#### **Savanna and floodable area at Campamento La Reforma.**

Photo by: Emanuel Chocooj, FLAAR Mesoamérica. May 8th, 2022.  
Camera: drone Mavic Pro 2, 28 mm.





**Amapola, *Pseudobombax* species, fruits at aguada near La Icotea, or Las Isabelas as we temporarily called it.**

Photo by: Edwin Solares, FLAAR Mesoamérica. May 8th, 2022. La Gloria Forest Management Unit.  
Camera: Sony A1, 200-600 mm.



**Ecotone at the end of the Valle del Keh savanna.**

Photo by: Emanuel Chocooj, FLAAR Mesoamérica. May 8th, 2022. Valle del Keh,  
La Gloria Forest Management Unit.  
Camera: drone Phantom 4, 28 mm.



**Savanna ecosystem Las Isabelas, as we temporarily called it.**

Photo by: Emanuel Chocooj, FLAAR Mesoamérica. May 8th, 2022. La Gloria Forest Management Unit.  
Camera: drone Phantom 4, 28 mm.





***Pachira aquatica*, zapotón, fruit at Campamento La Reforma.**

Photo by: Edwin Solares, FLAAR Mesoamérica. May 8th, 2022. Campamento La Reforma, La Gloria Forest Management Unit. Camera: Sony A1, 200-600 mm.

***Myrmecophila christinae* flower at Campamento La Reforma.**

Photo by: Edwin Solares, FLAAR Mesoamérica. May 8th, 2022. Campamento La Reforma, La Gloria Forest Management Unit.  
Camera: Sony A1, 90 mm.

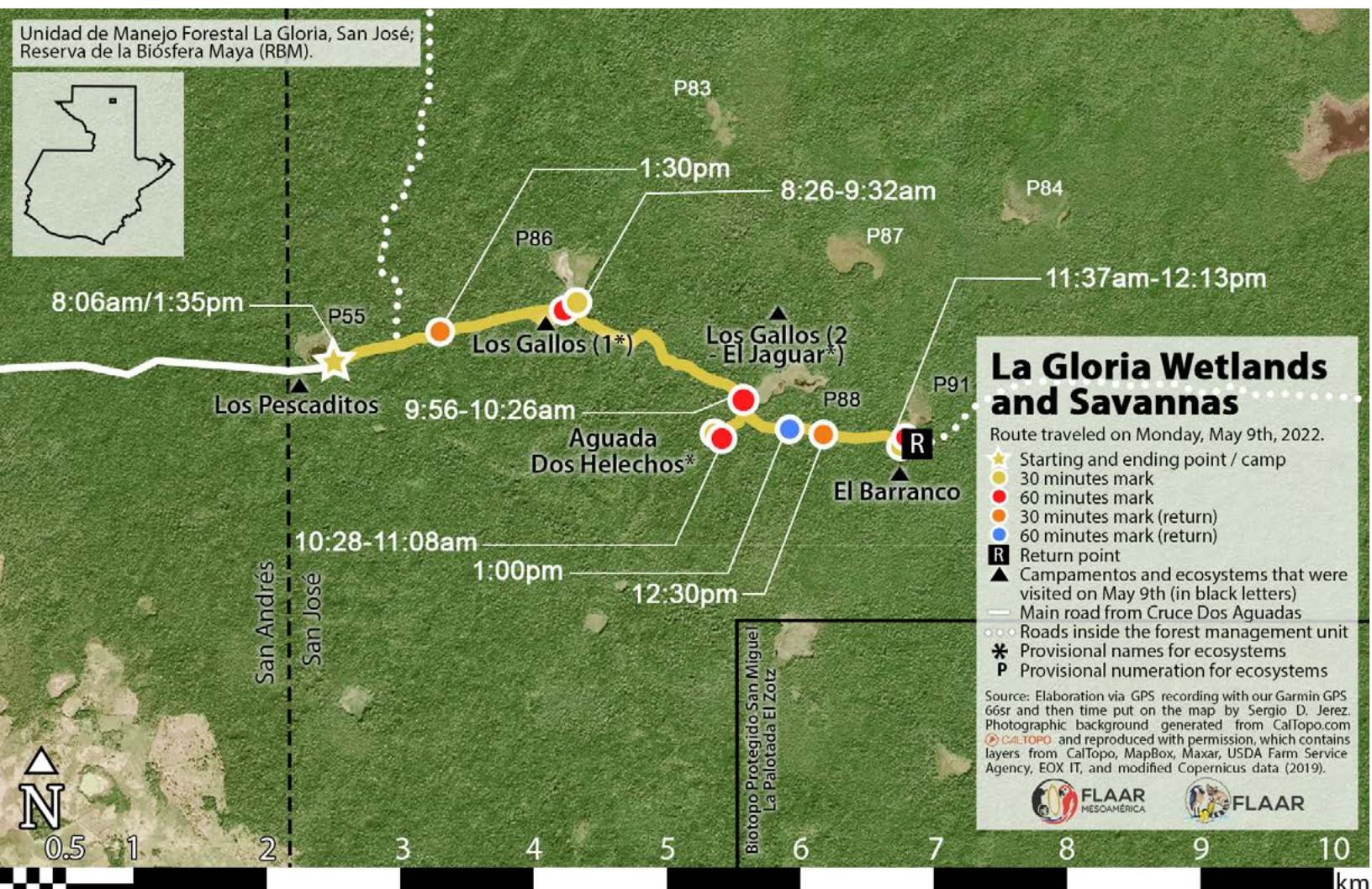


On our last day of expedition in La Gloria, we were able to visit one of the most striking and apparently biodiverse wetland ecosystems. There is a small lagoon near to Campamento Los Gallos where we were able to find several macrophytes. We also were very fortunate to photograph the inflorescences of what we think to be an *Helosis cayenensis* individual. As well, we got to photograph some pollinators visiting the flowers, which was quite impressive.

This parasitic plant has no leaves, and grows completely underground. The mushroom looking inflorescences are the only parts that emerge from the ground and can be easily seen. One could indeed easily mistake the inflorescences as mushrooms.

### Map with the route traveled on May 9th.

The attributions for each layer of the Caltopo photographic background are included in this report, following the reference section.





***Helosis cayennensis* inflorescences being pollinated by a bee (*Trigona fulviventris*). In this series, the different development stages of the flowers can be seen.**

Photos by: Edwin Solares, FLAAR Mesoamérica. May 9th, 2022. Lagoon at Campamento Los Gallos, La Gloria Forest Management Unit.  
Camera: Sony A1, 90 mm.



***Helosis cayennensis* inflorescence and vegetative body.**

Photo by: Edwin Solares, FLAAR Mesoamérica. May 9th, 2022. Lagoon at Campamento Los Gallos, La Gloria Forest Management Unit.  
Camera: Sony A1, 90 mm.





**Different macrophyte species seen from above at small Lagoon beside Campamento Los Gallos.**

Photo by: Emanuel Chocooj, FLAAR Mesoamérica. May 9th, 2022. Campamento Los Gallos, La Gloria Forest Management Unit. Camera: drone Mavic Pro 2, 28 mm.



**Floodable areas surrounding the Lagoon beside Campamento Los Gallos.**

Photo by: Emanuel Chocoj, FLAAR Mesoamérica. May 9th, 2022. Campamento Los Gallos, La Gloria Forest Management Unit.  
Camera: drone Mavic Pro 2, 28 mm.

Other ecosystems we visited on May 9th were an inundated area near Los Gallos, which we called Los Gallos 2, and another small lagoon near Campamento El Barranco. We couldn't get inside, but we were able to find floodable areas and dry areas through the drone photos that we took. Revisiting such places would be very important in the future but

there are so many ecosystems in La Gloria that we will have to do that in several months. We will also need more funding in order to accomplish that. Visiting each area could help us identify what kind of ecosystem they are, and what kind of diverse habitats and microhabitats they enclose.

## **Interesting topics for future research in La Gloria and concluding discussion**

One of our main goals is to make an inventory of all the wetland and savanna ecosystems in the Forest Management Unit. It will be important as well to define whether the ecosystems that we find are the same that we have already identified through satellite images or not. Additionally, it is important to establish what kind of habitats they enclose, given that we have found ciberales, tintales, lagoons, floodable savannas, among others types of wetlands (each of them with a unique ecology and biotic implications in the global ecosystem).

This will only be fully achieved when other scientists better study these

areas, but we hope that our work can introduce them to the area and constitute helpful reference.

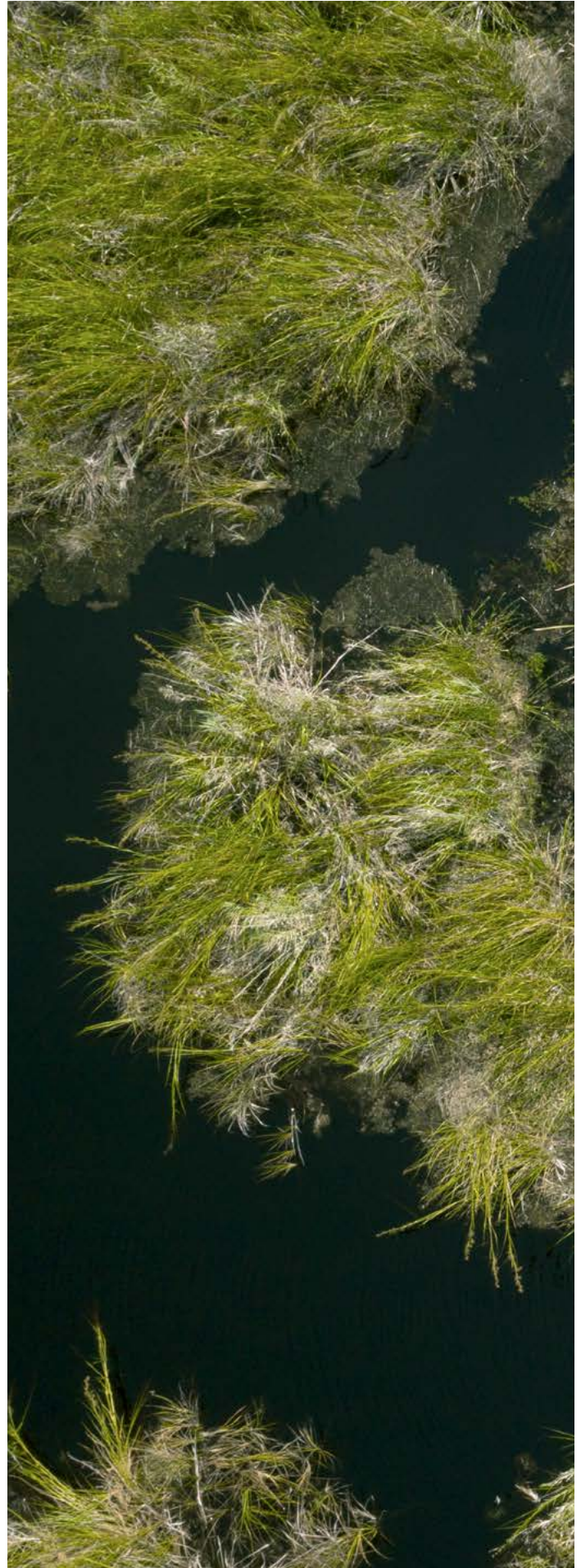
By doing that, we encourage scientists and students to better study these ecosystems. No publication has been made so far on the ecology of these individual ecosystems, and many of them are still unknown or not taken into account when considering the richness of these areas and their conservation. In that sense, it is worth considering that, savannas included, many of the wetlands in the area have a vital role in the health and development of the global ecosystem and the species populations that live here.

Finally, it would be extremely important to define how the anthropogenic activity of the Maya influenced the emergence of these ecosystems. To answer if the savannas, aguadas, lagoons and other habitats have naturally evolved because of the impact of the Maya could give impactful insight not only on how they changed the land that they inhabited, but also on how modern civilization could be defining the ecosystems of the future in this and other similar areas.

By documenting these locations, we are helping to achieve all of the above plus every other activity or research project that could promote the conservation and sustainable use of the abundant natural resources in the RBM.

**Aerial view of a floodable area surrounding the Lagoon besides Campamento Los Gallos.**

Photo by: Emanuel Chocooj,  
FLAAR Mesoamérica. May 9th, 2022.  
Campamento Los Gallos, La Gloria  
Forest Management Unit.  
Camera: drone Mavic Pro 2, 28 mm.



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## Base Camp Assistance in Parque Nacional Tikal

While doing field work in the Tikal national park about a decade ago we appreciate the house provided to us by the park administration. We also thank the Solis family, owners of the Jaguar Inn, for providing a place to stay when park facilities had other occupants, and for food in their Jaguar Inn restaurant.

## Base Camp Assistance in PNYNN

We thank Biologist Lorena Lobos and both co-administrators of PNYNN (Arq. Jose Leonel Ziese (IDAEH) and Ing. Jorge Mario Vázquez (CONAP) for providing a place to stay for the photographers, biologists, and assistants of the FLAAR Mesoamérica team of flora and fauna.

## Ecolodge El Sombrero

We thank Gabriella Moretti, owner of Ecolodge El Sombrero, for providing hotel room and meals while we have been doing field work at Parque Nacional Yaxhá, Nakum and 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 our teams' 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 Yaxhá, Nakum and Naranjo.

Equally crucial is having a place to charge the batteries of the computers, or all the cameras, and 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, or WhatsApp.

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

JEREZ, Sergio (2022). Documenting our Remote Expeditions and Savanna Exploration in the Maya Biosphere Reserve (RBM) through GPS Technologies. FLAAR Mesoamérica and FLAAR.



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## To publish

Hellmuth's photographs have been published by National Geographic, by Hasselblad Magazine, and used as front covers on books on Mayan topics around the world. His photos of cacao (cocoa) are in books on chocolate of the Maya and Aztec both by Dr Michael Coe (all three of editions) and another book on chocolate by Japanese specialist in Mayan languages and culture, Dr Yasugi. We naturally appreciate a contribution to help cover the costs our office expenses for all the cataloging, processing, and organization of the photos and the field trip data.

## For your social media

You can post any of the FLAAR Mesoamérica PDFs about the Municipio of Livingston on your Social Media sites; you can send any of these PDFs to your friends and colleagues and family: no cost, no permission needed.

We hope to attract the attention of professors, botanical garden clubs, orchid and bromeliad societies, students, tourists, experts, explorers, photographers and nature lovers who want to get closer, to marvel at the species of flowering plants, mushrooms and lichen that FLAAR Mesoamérica finds during each field trip each month.

### PHOTO FROM BACK COVER

Photo by: Edwin Solares, FLAAR  
Mesoamérica. May 9th, 2022. Lagoon at  
Campamento  
Los Gallos, La Gloria Forest  
Management Unit.  
Camera: Sony A1, 90 mm.

## 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).

**Vivian Hurtado** is the actual project manager for FLAAR's divisions: Flora & Fauna and MayanToons. She is also an environmental engineer and passionate researcher.

**Victor Mendoza** environmental engineer who is in charge of the photographic database of species of FLAAR Mesoamerica and taxonomic identification. He is also a research assistant.

**Sergio Jerez** he is involved with plant identification, bibliographic research and map design for the trails explored on each expedition.

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

**Senaida Ba** has been our photography assistant for several years. Now, she puts together PowerPoint presentations for students and teachers to learn about Flora, Fauna and Mayan Iconography.

**Jaqueline González** is a designer who puts together the text and photographs to create the actual reports.

**Roxana Leal** major in Communication who manages all our social media and digital community. She's sometimes part of our fieldwork trips, since she has a special interest for adventure and Guatemala's diverse nature.

**María Alejandra Gutiérrez** is an experienced photographer who now prepares all the Photography Catalogs for the project we're currently working on the RBM. She also contributed to the coordination of several trips we made during our Livingston, Izabal research project.

**David Arrivillaga** is an experienced photographer 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 webs.

**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.

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

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

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

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

**Paula García** is part of our MayanToons Animation team. Her job is to bring our favorite jungle, wetland and savanna characters to life.

**Heidy A. 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. She helps prepare the finished pdf editions.

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

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

**Edwin Solares** environmental engineering. He is a photographer and videographer during our expeditions and later edits this content to create new content.

**Belén Chacón** her job includes organizing and tabulating data on useful and edible flora, which is listed in FLAAR's bibliography and many other references, in order to keep a complete list of plant species that are useful, along with updated taxonomic information.

**Diana Sandoval** her work consists of the recopilation of scientific information, which later is included in the FLAAR reports that are published on our websites.

**María José Toralla** she gathers information and bibliographies that are added to our Flora & Fauna electronic library and also make part of the information found in research, reports and websites.

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

**Niza Franco** is part of our MayanToons Animation team. Her job brings our favorite jungle, wetland and savanna characters to life.

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

**Isabel Rodríguez Paiz** is in charge of the fundrasing. She is experienced in networking, social media, and organizing meetings to experience what FLAAR does out in the remote rain forest ecosystems



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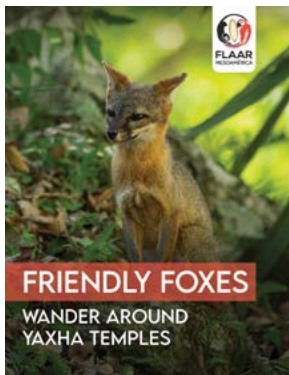
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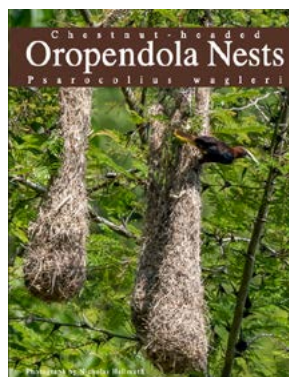
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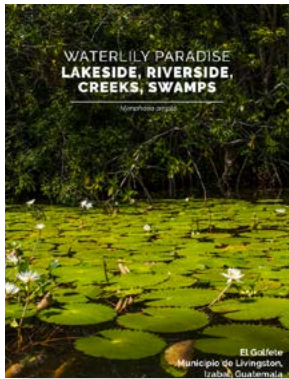
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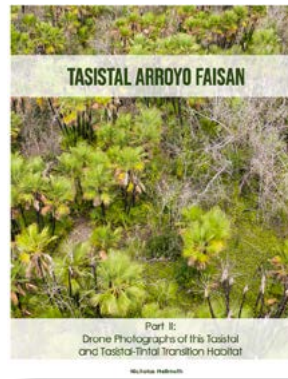
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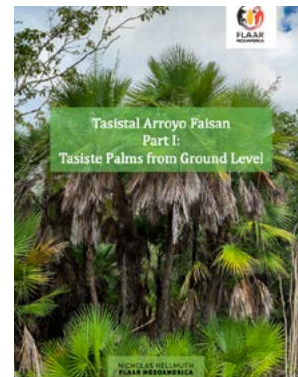
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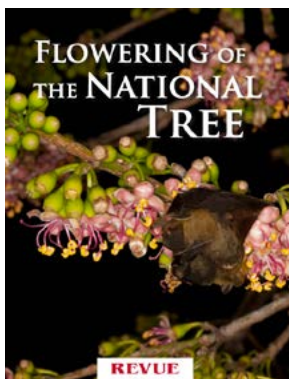
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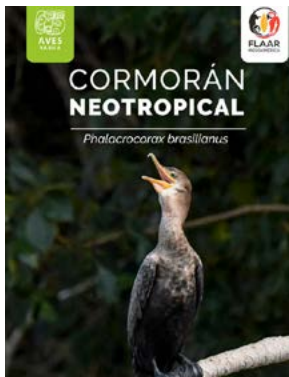
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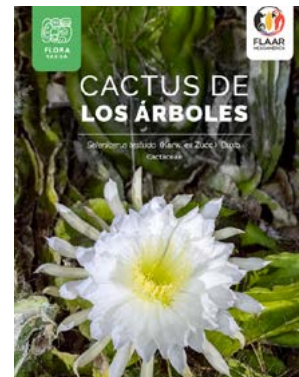
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