



FLAAR
MESOAMÉRICA

LEAF-LITTER TRAP

PALMA DE COROZO

Attalea cohune

Tapón Creek Natural Reserve,
FUNDAECO, Livingston, Izabal

NICHOLAS **HELLMUTH**

A photograph of a dense tropical forest. The central focus is a large tree trunk covered in numerous thick, brown, fibrous vines. The tree is surrounded by lush green foliage, including large, deeply lobed leaves and smaller, more rounded leaves. The background shows a clear blue sky through the canopy.

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MARCH 2021



CREDITS

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

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***Attalea cohune*.**

Photo by: David Arrivillaga, FLAAR Mesoamerica, Dec. 16, 2020. Aldea Plan Grande Tatín, Livingston, Izabal. Camera: Sony Alpha A7R IV. Lens: Sony FE 50mm Macro. Settings: 1/1,250 sec; f/5; ISO 640.

PHOTO FROM TITLE PAGE

***Attalea cohune*.**

Photo by: David Arrivillaga, FLAAR Mesoamerica, Dec. 16, 2020. Aldea Plan Grande Tatín, Livingston. Camera: Sony Alpha A7R IV. Lens: Sony FE 50mm Macro. Settings: 1/640 sec; f/5; ISO 800.

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Attalea cohune palm stems trunks with *Nephrolepis sp.* fern, growing in leaf litter traps.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Dec. 4, 2020.
Tapón Creek Natural Reserve, Livingston, Izabal, Guatemala.
Camera: iPhone 12 Pro Max.

INTRODUCTION TO LEAF-LITTER AND HOW SOME PLANTS “CAPTURE LEAF-LITTER”

While hiking through the thickly forested areas of Municipio de Livingston, Departamento de Izabal, Guatemala, you see millions of fallen leaves on the ground. Often you see little or no soil: only craggy karst geology (limestone all the way to the surface but fissured and cracked). Even if you have never studied soil science or ecology, you realize that leaves falling over thousands of years are one source of the little soil that is not washed away in the torrential Neotropical rainstorms (especially when hurricanes hit; two hit in November 2020, Eta and then Iota).



Attalea cohune, cohune palm, “palma de corozo” trunk with ferns and *Philodendron radiatum* (*Araceae*, born in leaf litter traps), Tapón Creek Nature Reserve.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Dec. 4, 2020. Tapón Creek Natural Reserve, Municipio de Livingston, Izabal.

Camera: iPhone 12 Pro Max.



Attalea cohune, corozo palm stem (trunk) has so many leaves caught over recent decades that *Nephrolepis* sp. ferns and bromeliads love to grow up and down the trunk.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Nov. 5, 2020. Mirador del Cañón, FUNDAECO, Río Dulce, Livingston.
Camera: iPhone 11 Pro Max.

Something else you notice in moist areas of Guatemala such as Alta Verapaz, Petén, and Izabal (and elsewhere in Mesoamerica) is that tree trunks and palm stems of certain species provide places for lots of plants and relatives to grow:

- Ferns
- Mosses
- Bromeliads
- Orchid
- Aroids (Araceae)
- Other vines
- Lichens
- Mushrooms
- Liverworts
- Etc

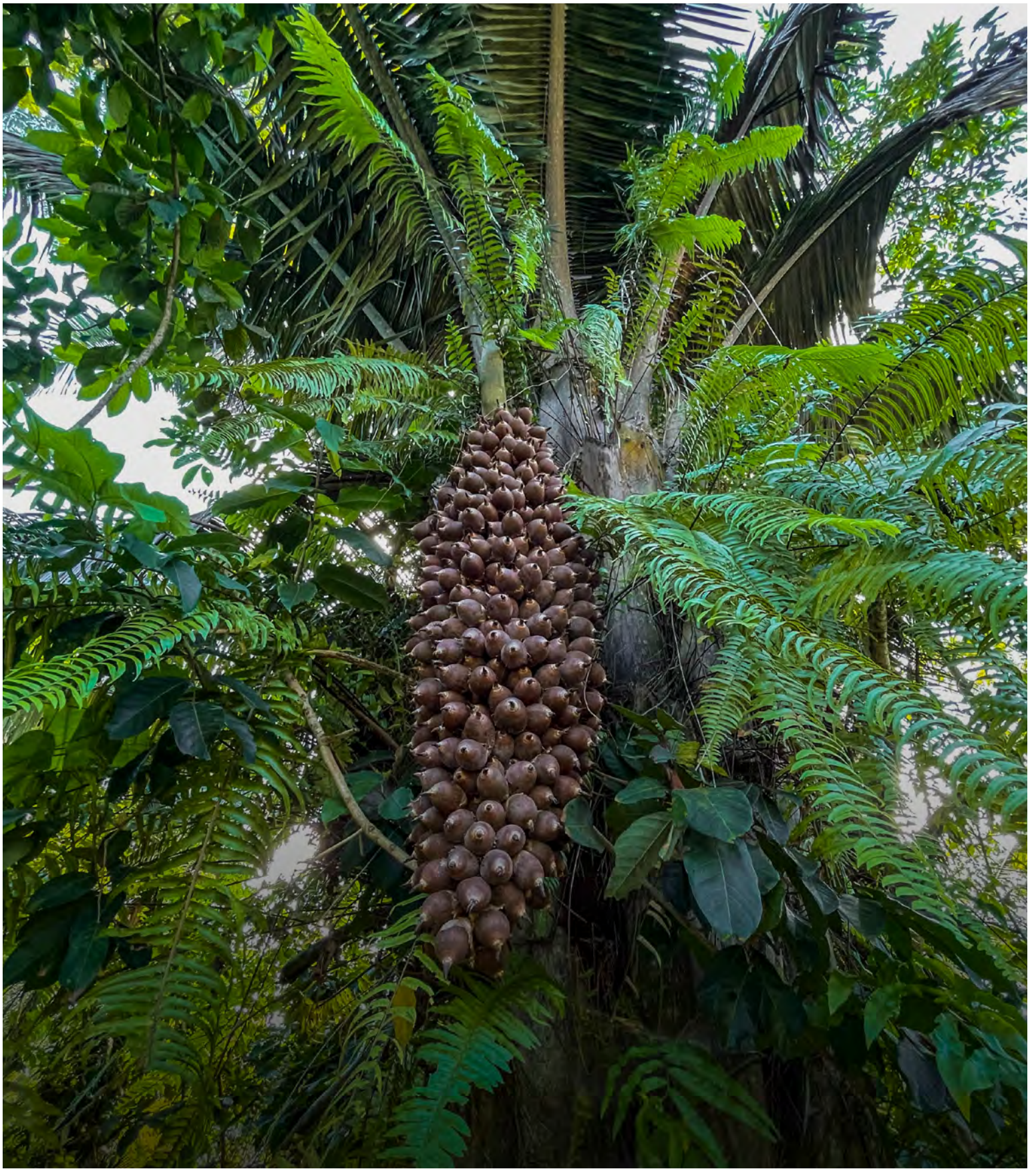
The palms of the Municipio de Livingston that have the most Araceae and ferns growing on their stems are the **cohune palm**, palma de corozo, *Attalea cohune* Mart. Since these palms have stems as big around and as tall as tree trunks, I prefer to use the generic term “trunks”. They are also hard as a tree trunk (actually harder than many soft tree trunk species).

***Nephrolepis* sp.** fern that grows in Corozo leaf little traps.

Photo by: David Arrivillaga, FLAAR Mesoamerica, Dec. 16, 2020. Aldea Plan Grande, Tatin, Livingston.

Camera: Sony Alpha A7R IV. Lens: Sony FE 50mm Macro. Settings: 1/640 sec; f/5; ISO 320.





Corozo palms are a complete botanical garden and definitely deserving of further botanical research. Our goal is to document where you can find these easily so you don't have to do the month-after-month exploratory field trips that we do (so you can study them in detail since you can go directly to each palm).

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Dec. 15, 2020. Aldea Plan Grande Tatin, Livingston.
Camera: iPhone 12 Pro Max.



Attalea cohune, corozo palm with trunk spaces filled with leaf litter which act as "soil" to allow *Syngonium podophyllum* (Araceae vines) and *Nephrolepis* sp. ferns to happily grow in this leaf litter.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Dec. 15, 2020. Cascada Lámpara, at head of a river flowing into El Golfete (Río Dulce), Municipio de Livingston.
Camera: iPhone 12 Pro Max



Attalea cohune. Corozo palms with trunks filled with *Nephrolepis sp.* ferns and Aroids, Plan Grande Tatin, between Livingston and Cueva del Tigre. There are dozens of these corozo palms surrounding the aldea of Plan Grande Tatin. Be sure to come with local guides and if you wish to study the palms, the leaf litter, and all the plants growing up and down, be sure to register yourself and your project with the village COCODES. It also helps to hire local guides from Plan Grande Tatin itself. We will be returning to study these palms in mid-December.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Dec. 15, 2020. Aldea Plan Grande Tatin, Livingston.
Camera: iPhone 12 Pro Max.

I first noticed the sheer mass of *Philodendron* vines and ferns growing up and down these corozo palm trunks near Plan Grande Tatin (en route to Cueva del Tigre), a few kilometers from the town of Livingston. Then there were even more as you hike along the trail parallel to Río Lámpara to reach the Cascada Lámpara (where the river cascades down the limestone to start the river that you can navigate with a lancha (a boat for six to ten people)).



***Attalea cohune* Mart.**

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Nov. 5, 2020. Mirador del Cañón, FUNDAECO, Río Dulce, Livingston.

Camera: iPhone 11 Pro Max.

You notice the sheer number of ferns or Aroids on trunks of corozo palms in these two areas because there is open space around them (so you can easily see the entire palm, from the ground up to the fronds starting a dozen meters or more above). Once you notice these, you begin to notice the same situation deep in the rain forests (where vegetation and entangled vines are so thick you can't see most trees in their entirety).



***Attalea cohune*.** The Corozo Palm produces this kind of fruits that resemble dates or little coconuts. The Scarlet Macaw prefers this kind of fruits, because his long beak makes them easy to reach.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Nov. 5, 2020. Mirador del Cañón, FUNDAECO, Río Dulce, Livingston.

Camera: iPhone 11 Pro Max.

Once I realized, from visiting Plan Grande Tatín, how many ferns, aroids and LOTS of other plants often grow on the palm trunks, I naturally was curious about how they survived. Plus, clearly these plants were totally happy on the corozo palm trunks. The rather obvious answer is that when the palm leaves (fronds) are cut off for making thatch of the Q'eqchi' Mayan houses, or when the palm leaves are old and wilt, turn brown, and fall off, their bases are often still on the tree (especially when cut off with a machete). This is because every intelligent local Maya person knows not to chop into the trunk; for two reasons:

- You don't need the base of the rachis
- And if you cut into the palm trunk itself this damages the entire palm.



Attalea cohune, cohune corozo palm.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Nov. 8, 2020. Río Lámpara, Livingston.
Camera: iPhone 11 Pro Max.

Most corozo palms have a leaf base (base of the petiole) that has a relatively large area to collect leaf-litter, and any and all parts of the upper palm that fall down (the inflorescences, spathe, etc.), dead arboreal insects. In other words, almost every single leaf base acts as a “flower pot” of healthy bio-degrading materials that serve as a soil-like material for ferns, Aroids, and other vines to grow from (and occasional mata-palo, strangler figs as well).

So during our December 4, 2020 fieldtrip hike through Tapón Creek Nature Reserve, I did close-up photography of the early stages of leaf-litter trapping by these leaf bases. The leaf bases have to collect the leaf-litter and then it has to decompose to help other plants grow. So when the corozo palms are young and the leaf bases are at eye-level, they don't yet have ferns and *Philodendron* vines growing out of the leaf bases.

I am now trying to find articles by botanists and ecologists who have previously documented leaf-litter capture by the leaf bases of *Attalea cohune* palms.

Philodendron radiatum. (Araceae born in leaf litter traps)

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Nov. 8, 2020. Río Lámpara, Livingston, Izabal, Guatemala.

Camera: iPhone 11 Pro Max.



NEXT TO LEARN: WHAT ENCOURAGES **ONE PLANT OVER THE OTHER?**



Attalea cohune Mart. and *Nephrolepis* sp.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Nov. 5, 2020.
Mirador del Cañón, FUNDAECO, Río Dulce, Livingston.
Camera: iPhone 11 Pro Max.



Nephrolepis sp. ferns in corozo palm.

Photo by: Víctor Mendoza, FLAAR Mesoamerica, Feb. 24, 2021. Finca Laguna Grande, Sarstun, Livingston.

Camera: Sony RX10 IV. Lens: Sony FE Macro.
Settings: 1/640 sec; f/4; ISO 400.

The palm that traps the most leaf litter is the giant mature *Attalea cohune* Mart., the corozo palm. Anything and everything that falls down from above is caught by the broken off frond bases. This anything and everything is leaf litter; it rots and forms a soil-like mulch that other plants love to grow in.



***Attalea cohune* Mart.**

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Dec. 4, 2020. Tapón Creek Natural Reserve, Municipio de Livingston, Izabal.
Camera: iPhone 12 Pro Max.

MY PERSONAL EXPERIENCE **WITH LEAF-LITTER**



When the corozo palms are decades old, their lower trunk no longer has any leaf-stems remaining (when are all many meters above). Lots of older corozo palms have moss covering their bases. Others have vines or thin lianas covering their base. We show here an example with moss coverage.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Dec. 4, 2020. Tapón Creek Natural Reserve, Municipio de Livingston, Izabal.

Camera: iPhone 12 Pro Max.

LEAF-LITTER STARTS COLLECTING BEFORE THE **LONG FRONDS BREAK OFF OR ARE CUT OFF**



***Attalea cohune* Mart.** Cohune palm, palma de corozo. A great view of leaves caught in the bases of the palm leaves.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Dec. 4, 2020. Tapón Creek Natural Reserve, Municipio de Livingston, Izabal. Camera: iPhone 12 Pro Max.



***Attalea cohune* Mart.** Entire trunk (this corozo palm is not yet decades old, so the fronds are still rising from ground level). The previous page shows a close-up of the same part of the trunk. The next page shows another side of this same cohune palm.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Dec. 4, 2020. Tapón Creek Natural Reserve, Municipio de Livingston, Izabal.
Camera: iPhone 12 Pro Max.



Corozo palm a bit older than the previous one; so the fronds are not any more at ground level. The fronds at ground level are mostly already broken off, leaving the base of the rachis (leaf base).

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Dec. 4, 2020. Tapón Creek Natural Reserve, Municipio de Livingston, Izabal.
Camera: iPhone 12 Pro Max.



Leaf-litter that you can find in hundreds of corozo palms as you hike through the rain forests of the Municipio de Livingston. This is a close-up of another side of the same palm as on previous pages.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Dec. 4, 2020. Tapón Creek Natural Reserve, Municipio de Livingston, Izabal.
Camera: iPhone 12 Pro Max.



Another side of the same palm.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Dec. 4, 2020. Tapón Creek Natural Reserve, Municipio de Livingston, Izabal.
Camera: iPhone 12 Pro Max.



Some leaves have fallen here recently (they still have a bit of green). Others are aging; the leaves below are rotting (which is perfect to create a material that vines and ferns like to grow in).

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Dec. 4, 2020. Tapón Creek Natural Reserve, Municipio de Livingston, Izabal.
Camera: iPhone 12 Pro Max.



There are actually several different species of giant corozo palms. But everyone names 90% of these as *Attalea cohune*. We would need to see the inflorescences to be more precise.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Nov. 5, 2020. Mirador del Cañón, FUNDAECO, Río Dulce, Livingston.
Camera: iPhone 11 Pro Max.

SUMMARY ON THE BEGINNING OF OUR RESEARCH ON PALMS AS LEAF LITTER TRAPS

Surely, somewhere a botanist or ecologist or soil scientist has written on cohune palm stem bases capturing leaf litter. This is why we have prepared this initial report to find these articles since it is highly unlikely that the FLAAR Mesoamerica team is the first to photograph leaf litter collecting between the stem and the rachis base of the leaves.



Corozo palm that is actually only half way up to being mature height. The ferns are so thick that the “trunk” is “many meters in diameter”. Of course the trunk is normal size; it’s the tons of ferns that make a cascade of ferns up and down the trunk. Mirador del Cañón, FUNDAECO nature reserve uphill from CESIDES headquarters, west end of Río-Dulce Canyon, less than a kilometer from where El Golfete starts, Municipio de Livingston, Izabal.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Nov. 5, 2020. Mirador del Cañón, FUNDAECO, Río Dulce, Livingston.
Camera: iPhone 11 Pro Max.

APPENDIX A

Photographic equipment that we recommend for botanical, ethnobotanical and ecological field trips

We use Apple iPhones to do photography while hiking long distances. We also have Google Pixel 3XL and Google Pixel 4a (the Google Pixel 5 series was curiously only lower-priced and thus with no added improved features over the previous two models; so we didn't acquire any of the Pixel 5 series).

Huawei phone cameras are excellent, but the recent two years of new models have terrible color balance: like Fujichrome did decades ago, the Huawei photos try to pump up the color to make the results more bright and more colorful than an Apple iPhone. Fujichrome did that in the 1970's-1990's to combat the success of Kodak Kodachrome 35mm slide film.

If you are a botanist, ecologist, or ethnobotanist you don't want fake colors. So we stick with Apple iPhone. That said, ideally you also need a MacBeth ColorChecker at least once in each series of photos or a gray balance color balance sheet. But when hiking through the forest this means stopping, removing your backpack, opening the zipper, pulling out the MacBeth or rebranded X-Rite ColorChecker, having an assistant place it behind the flower or plant. Then put it back into your backpack, close the zipper, put it back on your back, and hike to the next plant. Unfortunately, this is not realistic when hiking to explore a nature reserve: you want to get to the end of the trail and see everything: each eco-system, each different habitat. Yes, if we had funding for a larger team and more days in each part of the remote rain forests, we would do better color balance, but in the meantime we do the best we can. The X-Rite ColorChecker is the world standard for digital photography. Kodak had color charts that we used half a century ago for 35mm and medium format film; they are obsolete since MacBeth ColorChecker came out.

Since there are several photographers on each team, we need different kinds of cameras:

- Nikon D810
- Nikon D5 (can freeze a bird's wings and feathers in flight with high ISO)
- Canon EOS 1D X Mark II (has 5x macro lens, not available for any other brand)
- And three of the most recent models of Sony cameras
- Sony a9 II
- Sony a7C, smallest (so most portable), but full frame
- Sony a7R IV, 61MP (high resolution so you can enlarge details)

But when hiking through a rain forest there are vines at foot level waiting to trip you; then you reach out to grab a nearby tree for support to keep you from falling... but in the rush to avoid falling you did not notice it was a bayal palm vine or a Bactris palm or *Astrocaryum mexicanum*, lancetillo palm or "palma de escoba" that your hand was wrapping itself around. Look at their needle-long thorns on the Internet.



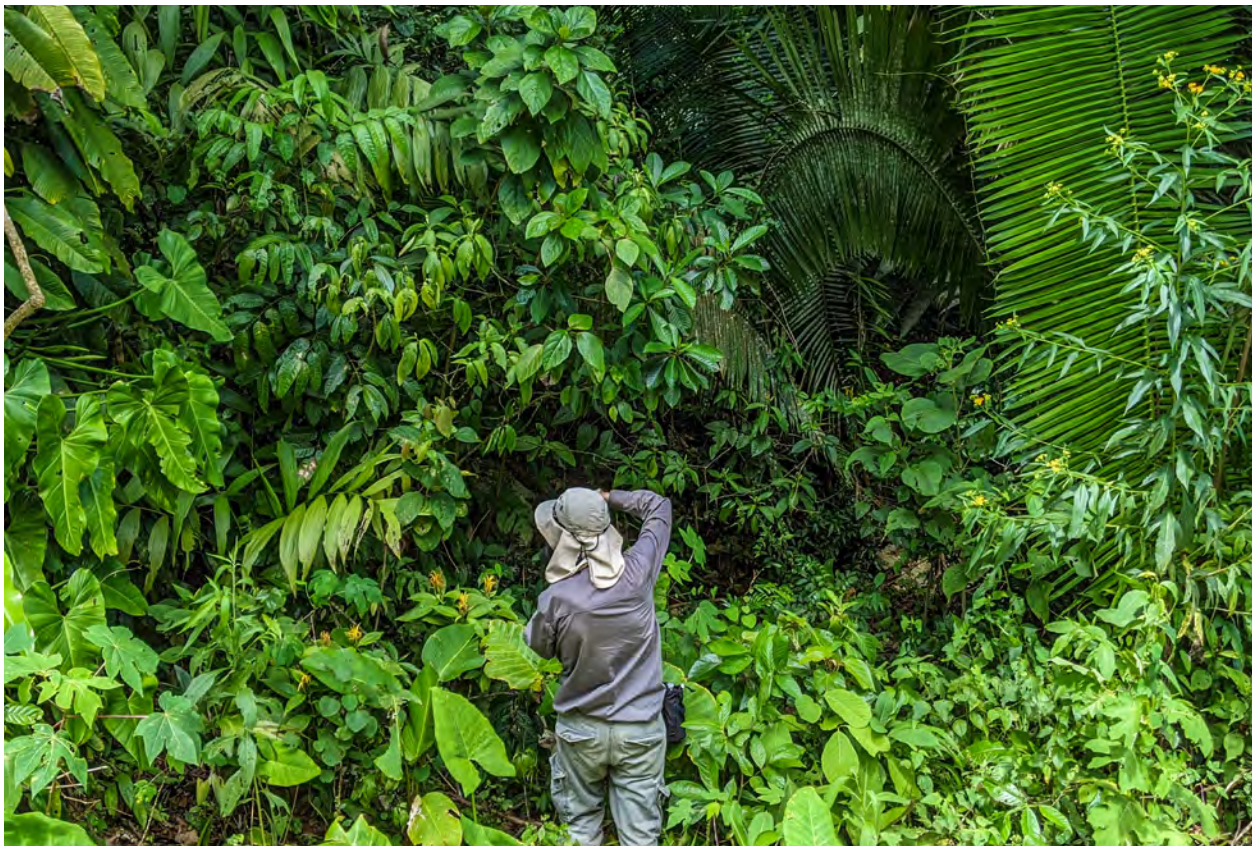
Photo by: María Alejandra Gutiérrez, FLAAR Mesoamerica, Aug. 18, 2020. Mirador del Cañón, Aldea Tatín, FUNDAECO, Livingston.

Camera: Sony RX10 IV. Lens: Sony 28-60mm.
Settings: 1/1,250 sec; f/9; ISO 1000.

And, if you do fall, you can't have your multi-thousand dollar camera loose around your neck. It should be packed into a protective carrying case. Most of the "ground" in most parts of Peten, Izabal, and Alta Verapaz is limestone: so you are tripping and falling on rock outcrops.

Since we have six different cameras and a dozen different lenses, plus portable lighting equipment, all these items are in large backpacks which local porters help bring along the trails. These helpful local people are also the guides to get us safely to our distant destination, and then safely back to the base camp.

So using an iPhone or Google Pixel phone camera is the most realistic option. Plus, they process the photos so you don't have to waste days having your team back in the office process each photograph manually. We have a full team in the office (about 20 people) but it is more productive not to have to use software manually to compose every photo for the report.



Nicholas Hellmuth photographing in the vibrant green rain forests between the Q'eqchi' Mayan village of aldea Plan Grande Tatin and the town of Livingston, Izabal, Guatemala.

Photo by: Juan Pablo Fumagalli, FLAAR Mesoamerica, Mar. 13, 2020. From Aldea Plan Grande Tatin to town of Livingston. Camera: Google Pixel 3 XL.

To photograph the leaves of a tree (to help identify it) you need at least 400mm or 600mm telephoto lenses. We have all of these but on initial exploration field trips it is not realistic to stop and set up either of our cameras that have these lenses (we have 180mm, 200mm, 300mm, 400mm, 600mm, and 800mm prime lenses plus zoom lens for Canon, for Nikon, and for Sony). Besides, normally there are so many other species of trees surrounding the tree whose leaves you need to photograph, that you can't even see the leaves of the tall tree because the lower branches of all the other trees block the view. And you can't launch a drone from the floor of the **rain forest**.

Prime lenses provide better results but a zoom lens is more realistic for using on a long hike. Our project has all of these lenses, plus of course wide-angle, macro, etc. Alejandra Gutiérrez uses a special 5X super-macro of Canon to photograph ants, termites, tiny mushrooms, etc. (Canon MP-E 65mm f/2.8 1-5x Macro lens). Neither Sony nor Nikon have even a 2x; they have only 1:1 macro. All the Chinese macro lenses vary between low bid to total junk.

Photo by: María Alejandra Gutiérrez, FLAAR Mesoamerica, Feb. 14, 2020. Biotopo Chocón Machacas, Livingston, Izabal.

Camera: Sony RX10 IV. Lens: Sony FE 28-60mm. Settings: 1/40 sec; f/5.6; ISO 800.



We also have ring flash, macro flash, and telephoto flash (but setting these up takes time so on initial hikes we don't use them). Canon is the only company with a true ring flash; Nikon has only "ringed" flash (four independent flash units hooked to a ring). This is very heavy and you can't carry the camera with this on it. The same thing happens with Metz and other ring flash units (for the camera brands that don't offer a ring flash of their own); these flash units are too heavy to have permanently on the lens (and if you leave it on the lens when you put the camera into a bag it gets pressured at an angle and eventually breaks off).

Plus, all this equipment requires multiple porters; but as soon as outside funding comes our way, we have porters available who would like to assist us on future field trips.



Carrying the equipment and keeping it safe from falling and rain is a everyday activity for the FLAAR Mesoamerica field trip team.

Photo by: Senaida Ba, FLAAR Mesoamerica, Mar. 9, 2020. Tatin, Livingston, Izabal.
Camera: Google Pixel 3 XL.

LEAF-LITTER TRAPS

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SUGGESTED WEBPAGES WITH PHOTOS AND INFORMATION ON *ATTALEA COHUNE*

<https://blog.aspb.org/meet-the-litter-trappers/>

Information on litter trappers

<https://floridata.com/Plants/Arecacea/Attalea%20cohune/755>

Information.

<https://medium.com/@scottmeadowschowdhry/the-coroza-palm-attalea-cohune-and-its-habitat-d82d1cba674d>

Information and photos.

www.plantasyhongos.es/herbarium/htm/Orbignya_cohune.htm

Photos.

<https://palmerastomasfont.com/project/cryosophila-stauracantha/>

Photos

www.theplantlist.org/tpl1.1/record/kew-17777

Synonyms.

<http://tropical.theferns.info/viewtropical.php?id=Attalea+cohune>

Information and photos.

<https://enciclovida.mx/especies/193249>

Photos, general information and map distribution

<https://palms.org/litter-trapping-palms/>

www.flickrriver.com/photos/tags/littertrapping/

Two photos of same *Cryosophila stauracantha* palm with root spines going almost straight up and nicely trapping leaves in the areas between the base of the root spines.

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680000

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1760000
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Izabal



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

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684000

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Bahía de Amatique

Aldea Plan Grande Tatin, Livingston

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1756000
1744000
1742000



Izabal

- 1. Reserva Protectora de Manantiales Cerro San Gil
- 2. Biotopo Protegido Chocón Machacas
- 3. Área sin protección
- 4. Parque Nacional Río Dulce
- 5. Área de Usos Múltiples Río Sarstún
- Acceso terrestre
- Acceso de tierra

Información de referencia:

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

ACKNOWLEDGEMENTS TO FLAAR MESOAMÉRICA

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

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

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

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

Senaida Ba has been photography assistant for many years. She knows the Canon, Nikon and is learning the two new Sony mirrorless cameras. She prepares, packs, sets-up, and helps the photographers before, during, and after each day's field trip.

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, plus MayanToons educational book projects

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

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

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

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

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

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

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.

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

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.

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

LIVINGSTON: THE CARIBBEAN BIODIVERSITY WONDERLAND OF GUATEMALA

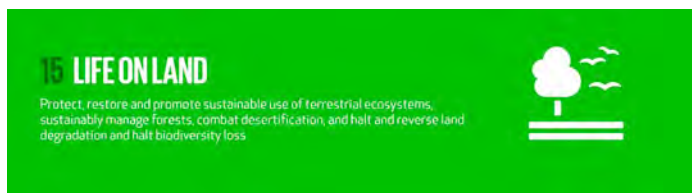
Izabal, one of the regional departments of Guatemala that offers a variety of recreational activities, is home to numerous nature parks and diverse natural landscapes. There are white sandy beaches a short boat trip away, with tall jungle-covered mountains in the background, and the Mesoamerican Reef System in the Caribbean Sea on the horizon in front of you. Mangrove swamps, seagrass, islands, cenotes, caves, karst geology canyons and streams of crystal clear water abound along the Rio Dulce and Lake Izabal coast or inland. All this together makes Livingston one of the destinations for tourists wanting to do bird-watching, explore caves, and get healthy exercise hiking through trails in the rainforest. In addition to the incredible flora and fauna that the municipality offers, three different cultures coexist in the ecosystem (Mayan Q'eqchi', Garifuna and Ladinos).

In order to conserve the biodiversity found in the municipality and that continues to be of benefit to the ecosystem, it is necessary to have an updated record of the species that inhabit it, and thus be able to detect changes in the species population. Thanks to the efforts of different institutions focused on environmental improvement projects at various sites in Livingston (FUNDAECO working in Río Sarstun, CONAP covering Río Dulce, CECON-USAC in Chocón-Machacas, and ARNPG with more than ten private reserves, among many others) are records of species of flora, fauna and ecosystems of this municipality of Izabal.

Using this information in the most efficient way and using the potential of digital technology, the database for the municipality can be supplemented with photographic records of flora, fauna, and ecosystems. The FLAAR Mesoamerica team, in cooperation with the municipal authorities, have begun to produce this educational material using the photographic records generated during the cooperation project to account for the flora, fauna and ecosystems that can be seen in Livingston. This will be accomplished in order to provide information to schools, families and institutions already working to protect the environment.

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 Mesoamerica finds during each field trip each month.





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

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

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

SERIES OF MUNICIPIO OF LIVINGSTON



Any school, college, university, botanical garden, zoological garden, botanical or zoological association (or club) may post this report on their web sites, (at no cost) as long as they link back to one of our web sites:

www.maya-ethnobotany.org
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Hellmuth, N. (2020) Leaf-Litter Trap, Palma de Corozo, *Attalea cohune*. Tapon Creek Natural Reserve, FUNDAECO, Livingston, Izabal, Guatemala: FLAAR (USA) and FLAAR Mesoamerica (Guatemala).

BACK COVER PHOTO
Attalea cohune Mart.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Nov. 8, 2020. Río Lámpara, Livingston.
 Camera: iPhone 11 Pro Max.

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Any website in or related to the Municipio of Livingston, is also welcome to post this PDF on their web site (no fee). This permission includes travel agencies, hotels, guide services, etc. And you do not need to write and ask permission; but we do appreciate it when you include a link back to one of our web sites. CECON-USAC, CONAP, FUNDAECO, Plantemos, AIESEC, are welcome to publish our reports, at no cost.

All national parks, nature reserves, and comparable are welcome to have and use our reports at no cost. USAC, UVG, URL, Universidad Rural, INTECAP and other Guatemalan universities, and high schools, and schools, are welcome to post our reports, at no cost.

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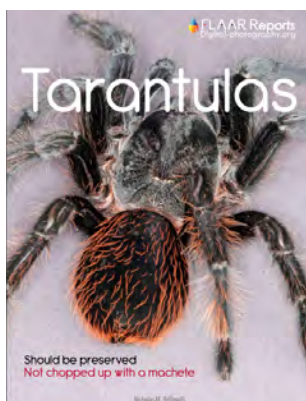
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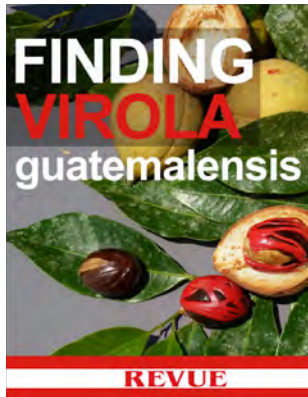
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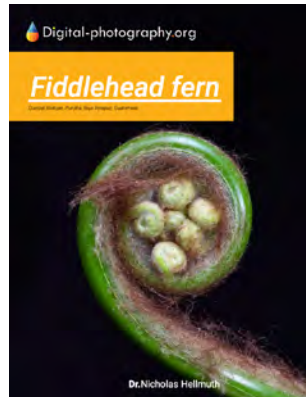
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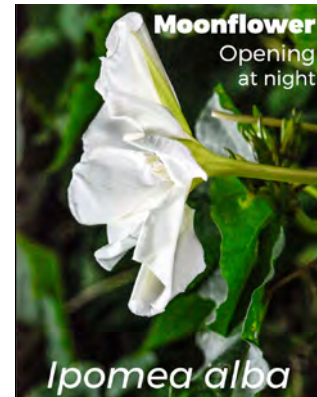
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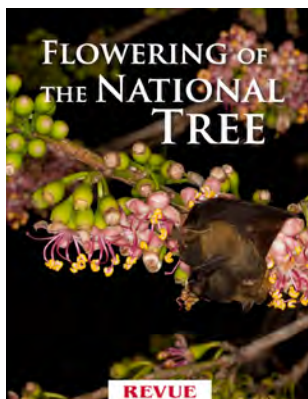
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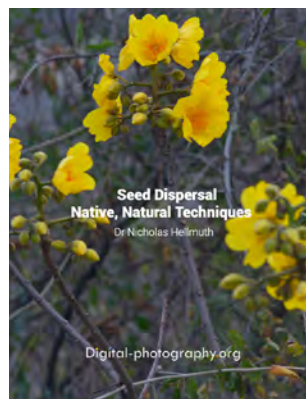
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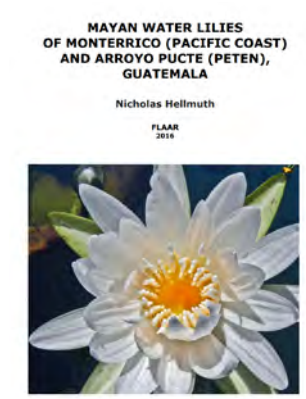
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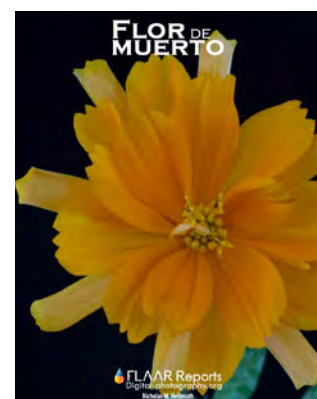
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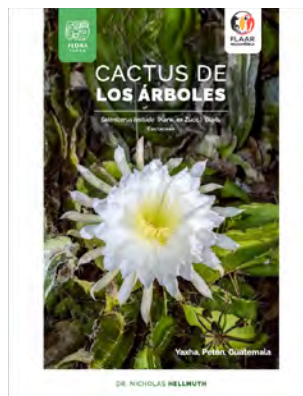
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