

PITAL ECOSYSTEMS OF PNYNN

Biodiverse Ecosystems of Edible
& Useable *Aechmea magdalenae*

Part 2: Pital Aguada La Sardina

July 2022

Parque Nacional Yaxha, Nakum and Naranjo (PNYNN)
Reserva de la Biosfera Maya (RBM)
Peten, Guatemala



FLAAR
MESOAMÉRICA

NICHOLAS HELLMUTH

FLAAR (USA) AND FLAAR MESOAMÉRICA (GUATEMALA)

APPRECIATION FOR FACILITATING THE RESEARCH PROJECTS

For cooperation, hospitality, and assistance at Parque Nacional Yaxha, Nakum and Naranjo project (August 2018 through July 2019)

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(CONAP, Santa Elena, Peten)

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For cooperation, hospitality, and assistance at Parque Nacional Yaxha, we thank

all the helpful and knowledgeable guides of IDAEH CONAP at PNYNN who accompanied us each day. It is essential to have either an IDAEH and/or CONAP guardabosque or comparable when doing flora and fauna research in a national park.

Guides and equipment porters from La Maquina and nearby during november, 2021

Ricardo de Jesus Herrera Marroquin, guide and helped carry digital camera equipment

Equipment porters from La Maquina and nearby during november, 2021

Dennis Dennilson Diaz Duarte

Enrique Rodas

6WD Pickup truck driver and guide

Sebastial de la Hoz

4WD Pickup truck drivers

Edwin Pérez- Suzuki Samurái

Edwin Rodriguez- Toyota 22R

Assistance for knowledge of plants and animals of PNYNN

Teco, Moises Daniel Pérez Díaz, park ranger, PNYNN

Tents and cooking equipment at Nakum Camp, PNYNN

Manola Margot Lima Diaz owner of Restaurante El Portal de Yaxha, La Maquina

Storage facilities before and after year 2022 field trips

Sergio Balam

Place to overnight, charge camera & computer batteries & healthy meals & storage

Gabriela Moretti, Ecolodge El Sombrero, before entrance to Yaxha area of PNYNN

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

These donations are from a family in Chicago in honor of the decades of botanical field work of botanist Dr John D. Dwyer, who worked in many areas of Mesoamerica, including in the Yaxha area in the 1970's while the site was being mapped by FLAAR.

This donation is also in recognition of the urgency and need for conservation of both wildlife and rare plants in the bio-diverse ecosystems of the Reserva de la Biosfera Maya (RBM) of Guatemala. Parque Nacional Yaxha, Nakum and Naranjo (PNYNN), Parque Nacional Laguna de Tigre (PNLT) and the wetlands of Municipio San Jose are three parts of the over 5 million acres of the RBM.



CREDITS

The helpful individuals listed below are part of the FLAAR Mesoamerica research and field work team together with report preparation team.

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Aechmea magdalenae. View of the inflorescence from the top looking straight down.

Photograph by: Nicholas Hellmuth.

FLAAR Mesoamerica, Aug. 24, 2018.

Camera: Sony RX10 IV. Settings: 1/125 sec; f/4; ISO 800.

FLAAR was formed in 1969 to map Yaxha (and nearby Topoxte Island and Nakum) and we worked with the president of Guatemala and the head of FYDEP to initiate protection of this area as a national park. Recently we were asked to return for flora, fauna, and biosphere field work from August 2018 to July 2019. This project was successful and as a result we were asked by CONAP to return for five years, 2021-2025 of coordination and cooperation with them, both in the Yaxha, Nakum and Naranjo national park plus all the rest of the Reserva de la Biosfera Maya.

The aerial photographs of IGN, Instituto Geográfico Nacional de Guatemala, are the best aerial photographs that we have found so far. If you are a professor or student studying ecosystems of Guatemala these photographs are essential.



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Introduction to pita, piñuela *Aechmea magdalenae* of Guatemala

All botanical references and ecological information on *Aechmea magdalenae* are in our Part 1 (2022) and in our earlier FLAAR Report on *Aechmea magdalenae* (Hellmuth 2022). The present FLAAR Report is to show the photographs of the plants and the ecosystem of Pital La Sardina, south of Nakum, PNYNN. *Aechmea magdalenae* is a helpful healthy wild native plant that can be planted around aguadas to restore lost vegetation when a cattle ranch is rescued and turned into a nature reserve for flora and fauna.

My Personal Experience with *Aechmea magdalenae*

We have photographs of the pital areas of Parque Nacional Yaxha, Nakum and Naranjo (PNYNN) from:

- August 24, 2018
- September 4, 2018
- January 20, 2019
- January 21, 2019
- January 23, 2019, El Tigre, not far from campamento
- March 29, 2019
- November 15, 2021 (only photos by Norma Cho)
- May 11, 2022 (almost no flowers whatsoever; only one or two fruits).

Entering a pital is an adventure. First you need to hike from the nearest 4-wheel drive dirt or mud road. Then you reach the aguada and the team begins to search to learn in what parts of the circumference the *Aechmea magdalenae* are located. It is a challenge to get close enough to take photos; there are vines everywhere, fallen trees that you trip over (because your eyes are focused on the bright red *Aechmea magdalenae* inflorescence several meters in front of you).

Then you have to figure out how to get your camera so you can take a close-up of the red inflorescence. The hooked spines on both edges of the thick leaves grab your shirt and your skin. Plus many of the vines have solid 4 cm long spines waiting for you.



***Aechmea magdalenae*.** These common vines have straight spines up to 5 cm long; they are “hard as wood” because these are lianas, woody vines.

Photograph by: Norma Estefany Cho Cu. FLAAR Mesoamerica, Nov. 15, 2021.
Camera: Google Pixel 3



Aechmea magdalenae. Spines keep you from getting close, but with patience you can do it.

Photograph by: Norma Estefany Cho Cu. FLAAR Mesoamerica, Nov. 15, 2021.

Arroyo La Sardina, between Yaxha and Nakum, PNYNN.

Camera: Google Pixel 3

The Seasonally Dry, Seasonally Inundated Aguadas that are surrounded by *Aechmea magdalenae*



Most of these aguadas in RMB area of Peten have Acacia and other bushes that can survive season inundation as well as seasonal lack of water.

Photograph by: Nicholas Hellmuth. FLAAR Mesoamerica, May. 22, 2022.
Camera: iPhone 13 Pro Max.



Photograph by: Nicholas Hellmuth. FLAAR Mesoamerica, May. 22, 2022.
Camera: iPhone 13 Pro Max.

An aguada in Peten can also be called a poza, though in my Spanglish a poza means a well. Yes, the Classic Maya re-engineered many aguadas but these far-away aguadas have never been visited or studied by archaeologists to my knowledge (though best to ask archaeologist Vilma Fialko, since she knows the PNYNN bajo areas quite well).



Photograph by: Nicholas Hellmuth. FLAAR Mesoamerica, May. 22, 2022.
Camera: iPhone 13 Pro Max.

The forest starts only on the higher ground. The pital grows around parts of the aguada in this higher ground.



Photograph by: Emanuel Chocooj. FLAAR Mesoamerica, Feb. 16, 2022.
Camera: Drone DJI Mavic 2 Pro.

Since much of the aguada is covered with bushes you don't notice very much of the aguada in the dry season. The *Aechmea magdalenae* bromeliads are not visible from the air because they grow under the tree cover.

Tall botan palm visible on top and right side. The giant tree with maroon-red bromeliads on the branches is at top left.



Photograph by: Emanuel Chocooj. FLAAR Mesoamerica, Feb. 16, 2022.
Camera: Drone DJI Mavic 2 Pro

Slightly closer aerial view of the aguada surrounded by forest.

Fruits (Inflorescence) and Flowers of *Aechmea magdalenae* bromeliads



Photograph by: Nicholas Hellmuth. FLAAR Mesoamerica, Sep. 4, 2018.
Camera: Nikon D5. Settings: 1/250 sec; f/13; ISO 2,500.

Finally you can get close enough to photograph the actual “pineapple” sized inflorescence. When it finishes growing it is almost the size and shape of a pineapple. But the outside is totally different (definitely not smooth). And there is no mass of “fruit” because these *Aechmea magdalenae* bromeliads have not been domesticated (and thus improved) as has the pineapple. For the *Aechmea magdalenae* you pull out one seed mass at a time and suck the pulp off each seed.

This inflorescence does not yet have any flowers or seeds. Note that the red “leaf-like” parts of the inflorescence have even more spines than the green leaves (but shorter and not as curved).



Aechmea magdalenae. If you crop down you can see the spines on the green leaves better and the photogenic red inflorescence.

Photograph by: Nicholas Hellmuth. FLAAR Mesoamerica, Sep. 4, 2018.
Camera: Nikon D5. Settings: 1/250 sec; f/13; ISO 2,500.



Aechmea magdalenae. Finally you can get close enough to see the actual inflorescence. It is fresh so does not yet have any flowers or edible parts.

Photograph by: Nicholas Hellmuth. FLAAR Mesoamerica, Sep. 4, 2018.
Camera: Nikon D5. Settings: 1/250 sec; f/13; ISO 2,500.



Two inflorescences; one is dull red with dull green around lower edge. Front inflorescence is yellow-orange and light green.

Photograph by: Nicholas Hellmuth. FLAAR Mesoamerica, Aug. 24, 2018.

Camera: Nikon D810. Settings: 1/125 sec; f/7,1; ISO 320.



Photograph by: Nicholas Hellmuth. FLAAR Mesoamerica, Aug. 24, 2018.
Camera: Nikon D810. Settings: 1/125 sec; f/11; ISO 6,400



Photograph by: Nicholas Hellmuth. FLAAR Mesoamerica, Aug. 24, 2018.
Camera: Nikon D810. Settings: 1/6 sec; f/11; ISO 250.



Mature inflorescence of *Aechmea magdalenae*, Pital La Sardina,

Photograph by: Nicholas Hellmuth. FLAAR Mesoamerica, Jan. 20, 2019.
Camera: Nikon D810. Settings: 1/6 sec; f/14; ISO 3,200.



Mature inflorescence of *Aechmea magdalenae*. This is one of the best illuminated inflorescences; doubly beautiful because of the contrast between the bright red at top and dull yellow-green around the bottom. Norma began as a photography assistant and worked her way up the ladder and now is an independent photographer.

Photograph by: Norma Estefany Cho Cu. FLAAR Mesoamerica, Nov. 15, 2021.
Camera: Google Pixel 3.



Here the base is same green as the nearby leaves; then yellowish, with only a few yellow areas.

Photograph by: Norma Estefany Cho Cu. FLAAR Mesoamerica, Nov. 15, 2021.

Camera: Google Pixel 3.



Flowers in various stages rise out of the inflorescence.

Photograph by: Norma Estefany Cho Cu. FLAAR Mesoamerica, Nov. 15, 2021.
Camera: Google Pixel 3.



Pretty amazing engineering by Mother Nature.

Photograph by: Norma Estefany Cho Cu. FLAAR Mesoamerica, Nov. 15, 2021.
Camera: Google Pixel 3.

Other Plants near the Pital of La Sardina



We have usually found 4-petalled yellow flowers (*Ludwigia octavilis*) around wet areas. Close the Pital area we have found 5-petalled yellow flowers of the species *Pavonia spinifex*.

Photograph by: Nicholas Hellmuth. FLAAR Mesoamerica, Aug. 8, 2018.
Camera: Nikon D5. Settings: 1/250 sec; f/13; ISO 3,200.



Giant trees grow around the aguada of pital La Sardina.

Photograph by: Nicholas Hellmuth. FLAAR Mesoamerica, Sep. 4, 2018.
Camera: Nikon D5. Settings: 1/125 sec; f/13; ISO 2,500.



Would need to check whether these trees prefer to grow near a seasonally inundated aguada or whether they grow throughout PNYNN and adjacent areas.

Photograph by: Nicholas Hellmuth. FLAAR Mesoamerica, Sep. 4, 2018.
Camera: Nikon D5. Settings: 1/125 sec; f/13; ISO 2,500.



Photograph by: Emanuel Chocooj. FLAAR Mesoamerica, May. 11, 2022.
Camera: Drone DJI Mavic 2 Pro.

Guano or botan palm (guano when not very high), lots of shorter palms visible if you have a 32" 4K monitor to see ground level plants. This is a bajo area but definitely not a tinal.



Photograph by: Emanuel Chocooj. FLAAR Mesoamerica, May. 11, 2022.
Camera: Drone DJI Mavic 2 Pro.

I would need a 5K monitor and higher resolution drone to see whether the radial leaves of ground plants that I see around the edge of this open area are the *Aechmea* bromeliads. We will be acquiring a DJI Mavic 3 drone for our next visit (since we do not have funds for a 100-megapixel Phase One iXM UAV aerial camera with its special lenses).

Concluding Discussion and Summary on *Aechmea magdalenae* Additional Research

It helps to visit each ecosystem several times a year since the flowers and fruits are in different stages of development each month. In May 2022, not many inflorescences whatsoever.

There is a lot more field work and library research needed:

- Tabulate how many pitah areas exist elsewhere in the Reserva de la Biosfera Maya.
- Tabulate how many pitah areas exist in areas surrounding Peten:
 - Belize, Quintana Roo, etc.
- Find whether pita really grows wild in Izabal; Standley and Steyermark seem to believe so, but we did not find any during 17 field trips during 2020-2021.



Photograph by: Emanuel Chocooj. FLAAR Mesoamerica, May. 11, 2022.
Camera: Drone DJI Mavic 2 Pro.

The research and results are the combined teamwork of the field work team plus the staff back in the home office (Guatemala City). Here is the field work team. From left to right: Teco, Byron, Vivi, Edwin, Nicholas, Isabel, Norma, Emanuel, Sergio.

References Cited and Suggested Reading on *Aechmea magdalenae*

Note: since the present edition is a work-in-progress this bibliography also is a work-in-progress. A lot more field work needs to be accomplished to estimate how many cattle ranches have watering holes that were aguadas a century ago. Most watering holes for cattle have been dredged out by ranchers but many others were aguadas in previous decades.

The list of suggested reading also needs to find monographs and articles on pital areas of Belize, Quintana Roo, etc. (the areas surrounding Peten). For example, is Campeche too dry for pital areas?

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

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

Very helpful and nice collaboration with local Itza' Maya people. But would help in the future to have a single index that has all Latin, Spanish, and English plant names so that you can find plants more easily. Suzanne Cook's Lacandon ethnobotany index is significantly easier to use.

Not available as a download. To help the world learn about the Itza Maya culture and ethnobotany, would be a courtesy of the author and publisher to make as an open searchable PDF as a helpful download.

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

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

BALICK, Michael J. and Rosita ARVIGO

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

BESTELMEYER, Brandon T. and Leeanne E. ALONSO (editors)

2000 A Biological Assessment of Laguna del Tigre National Park, Petén, Guatemala. RAP Bulletin of Biological Assessment 16, Conservation International, Washington, DC. 221 pages.

ESTRADA Loreto, Feliciano

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

Helpful download:

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

GOODWIN, Z. A., LÓPEZ, G. N., STUART, N., BRIDGEWATER, G. M., HANSTON, E. M., CAMERON, I. D., MICHELAKIS, D., RATTER, J. A., FURLEY, P. A., KAY, E., WHITEFOORD, C., SOLOMON, J. LLOYD, A. J. and D. J. HARRIS

- 2013 A checklist of the vascular plants of the lowland savannas of Belize, Central America. *Phytotaxa* 101 (1): 1–119.

Helpful download:

www.eeo.ed.ac.uk/sea-belize/outputs/Papers/goodwin.pdf

HELLMUTH, Nicholas

- 2022 Major Source of Fiber for rope, baskets, mats, etc. *Aechmea magdalenae*. Another impressive but underutilized plant of the Maya. FLAAR Reports, FLAAR (USA) and FLAAR Mesoamerica (Guatemala). 37 pages.

LUNDELL, Cyrus L.

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

We scanned the entire book so have it as a super-helpful in-house PDF

LUNDELL, Cyrus L.

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

SCHULZE, Mark D. and David F. WHITACRE

- 1999 A Classification and Ordination of the Tree Community of Tikal National Park, Peten, Guatemala. *Bulletin Florida Museum of Natural History* 41(3): 169-297

SCHULZE, Mark D. and David F. WHITACRE

- 1999 A Classification and Ordination of the Tree Community of Tikal National Park, Peten, Guatemala. *Bulletin Florida Museum of Natural History* 41(3): 169-297.

STANDLEY, Paul C. and Samuel J. RECORD

- 1936 The Forests and Flora of British Honduras. Field Museum of Natural History, Botany Series 12. 432 pages.

QUATTROCCHI, Umberto

- 2016 CRC World dictionary of medicinal and poisonous plants: common names, scientific names, eponyms, synonyms, and etymology. Vol. 5. 3960 pages.

VÁSQUEZ Mejía, Héctor Mizael

- 2002 Evaluacion Tecnica, Economica y Social de Pita Floja (*Aechmea magdalenae*) en la Zona de Amortiguamiento del Parque Nacional Sierra del Lacandon, La Libertad, Peten, Guatemala.

Helpful Powerpoint that shows where farmed in Parque Nacional Sierra del Lacandon.

We include lots of other helpful reports by Vásquez Mejía in our year 2019 FLAAR Report on *Aechmea magdalenae* of PNYNN.

VILLASEÑOR, José Luis

- 2016 Checklist of the native vascular plants of Mexico. Catálogo de las plantas vasculares nativas de México. *Revista Mexicana de Biodiversidad* 87 (2016) 559–902.

<http://revista.ib.unam.mx/index.php/bio/article/view/1638/1296>

Helpful web sites for any and all plants

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

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

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

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

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

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

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

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

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

<http://enciclovida.mx>

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

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

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

www.ThePlantList.org

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

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

This is the main SEARCH page.

Web pages specifically on *Aechmea magdalenae*

<http://tropical.theferns.info/viewtropical.php?id=Aechmea+magdalenae>

Helpful because it cites information in an academic manner. Has several photos

Videos on *Aechmea magdalenae*

90% of returns when you Google "*Aechmea magdalenae*" video are commercial junk (or on bromeliads in general with just a few seconds on pita). Surely more videos must exist but for now we show one:

<https://twitter.com/frutascolombia/status/1350076454026031109?lang=en>

Shows how to pull out the fruity seed areas (this is what you can eat, the pulp around each seed).

Permissions

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: either

www.maya-ethnobotany.org or www.maya-ethnozoology.org or
www.maya-archaeology.org or www.digital-photography.org or
www.FLAAR-Mesoamerica.org.

FLAAR (in USA) and FLAAR Mesoamerica (in Guatemala) are both non-profit research and educational institutes, so there is no fee. And you do not need to write and ask permission; but we do appreciate when you include a link back to one of our sites.

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Any web site 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 when you include a link back to one of our web sites.

CECON, CONAP, FUNDAECO, INGUAT, ARCAS, IDAEH, Municipio de Livingston, etc. 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.

To publish photographs

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 Mesoamerica 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 Mesoamerica finds during each field trip each month.

BACKCOVER PHOTOGRAPH

Photograph by: Nicholas Hellmuth.
FLAAR Mesoamerica, Aug. 24, 2018.
Camera: Nikon D5. Settings: 1/200 sec; f/6,3;
ISO 4,000.

ACKNOWLEDGEMENTS TO FLAAR MESOAMÉRICA

Flor de María Setina is the office manager, overseeing all the diverse projects around the world. We also utilize the inkjet prints to produce educational banners to donate to schools.

Vivian Díaz is coordinator of Flora & Fauna and MayanToons projects. She's an environmental engineer and for more than six years she has helped with organizing and coordinating each team for the Yaxha and RBM research projects, from 2018 to 2022.

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 At first, she helped us by preparing bibliographies on different subjects. Now, her job consists of coordinating our fieldtrips for the RBM project of 2022 and helps us manage other Flora & Fauna activities.

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

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 our photography assistant for several years. Now, she puts together PowerPoint presentations for students and teachers to learn about several subjects like Flora, Fauna and Mayan Iconography.

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

Roxana Leal is a 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 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.

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.

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.

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

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

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

Edwin Solares is an environmental engineering student. He is a photographer and videographer during our expeditions and later edits this content to be able to use it in the materials we generate.

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 taxonomical information.

Diana Sandoval her work consists of the recompilation of scientific information, which later is transformed into 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.

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

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

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

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

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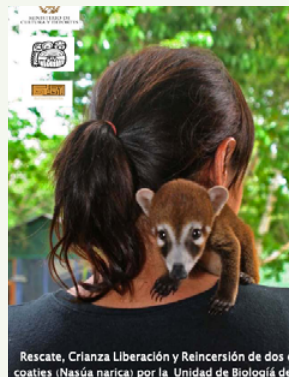
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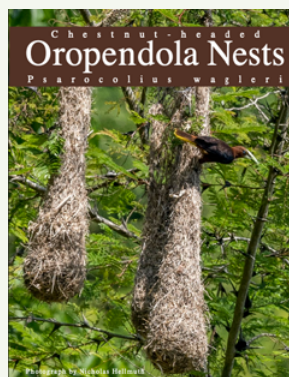
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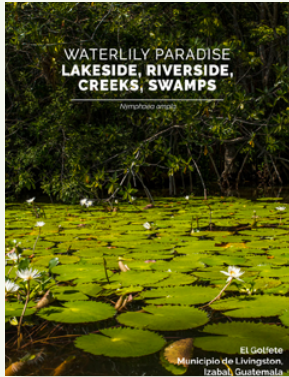
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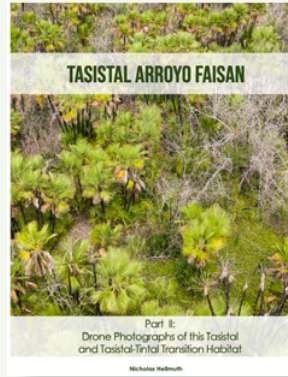
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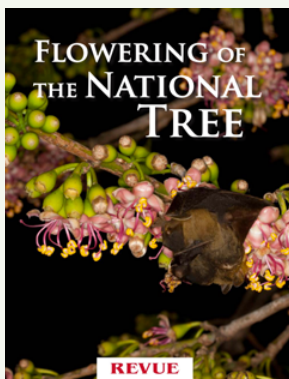
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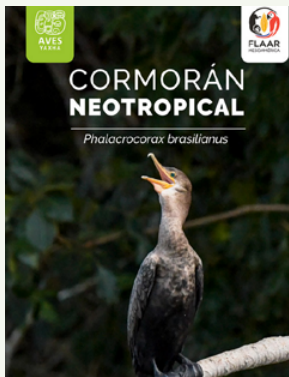
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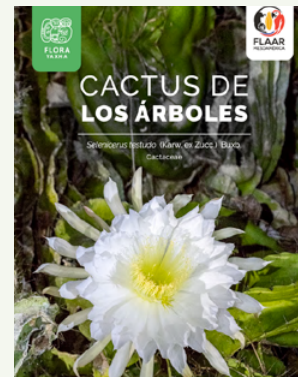
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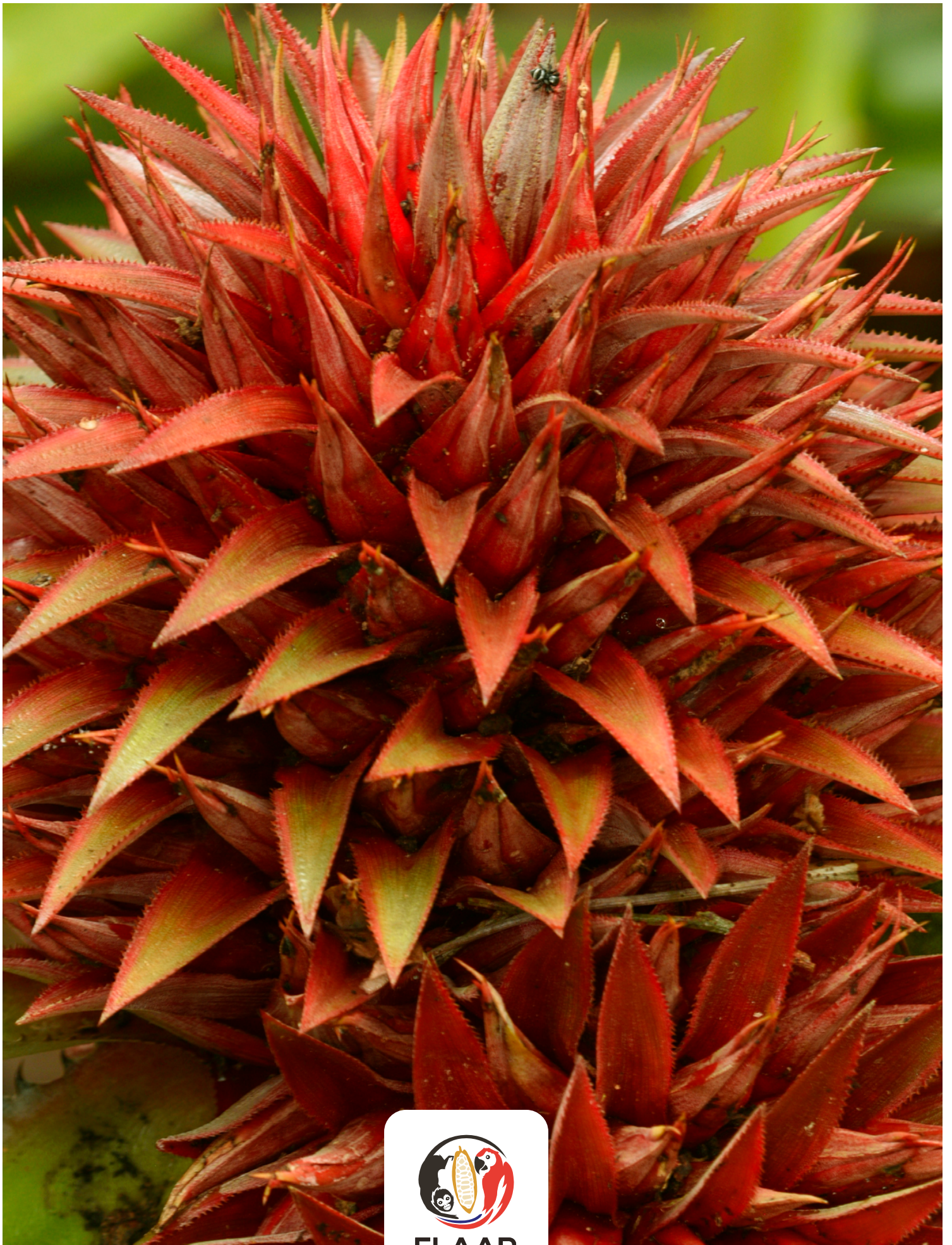


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